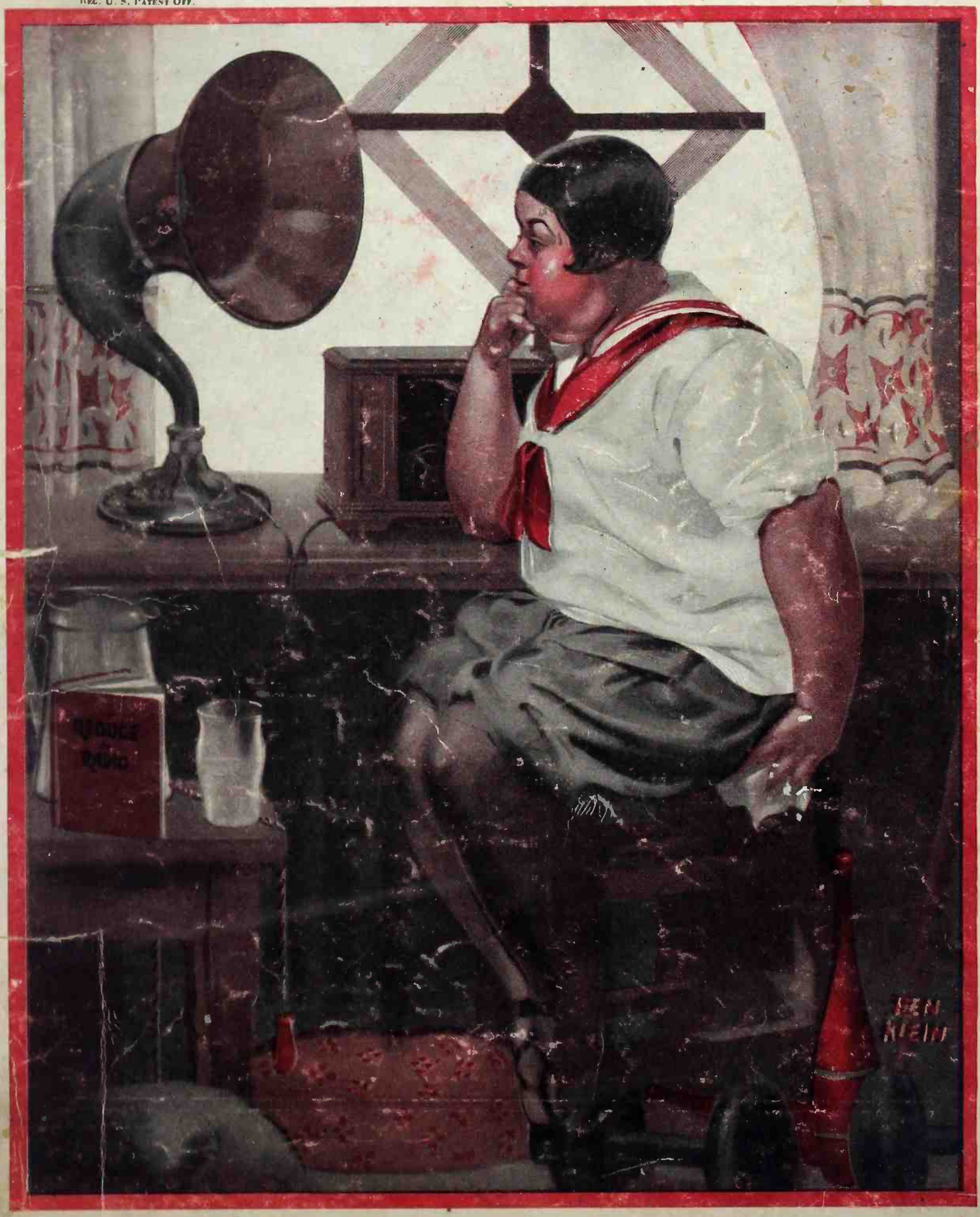
SEPTEMBER, 1926 25 CENTS

RADIO

Reg. U. S. Patent Off.



Cunningham RADIO TUBES

Since 1915—
Standard for all Sets

Dogged Determination

to approach perfection within the narrow confines of these delicate glass enclosures has led up to the present high stage in the development of Cunningham Radio Tubes.

The Cunningham appeal to the radio public always has been, and ever will be, a quality appeal. Performance claims are backed consistently day after day, year after year, by the steady, efficient service these tubes render in millions of American receivers.

All Types C-&CX---

In the Orange and Blue Carton

E. T. Cunningham Inc.

New York Chicago San Francisco

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The new Tower cone

—majestically sweet

$9.50

LIKE the grand cathedral organ—mighty monarch of all musical instruments—the new Tower Cone runs the entire gamut of tone, bringing to you each note, majestically sweet and clear—with the variety of color and shading demanded by the real musical critic.

Due to the exclusive direct-drive unit with its eight points of contact from unit to cone, the new Tower Cone gives not only a complete range of tone, but a beauty of "voicing", and a *responsiveness* to changes of tempo, long sought but never until now achieved.

Your Dealer Will Be Glad to Demonstrate

TOWER MFG. CORP. ~ BOSTON MASS.

RADIO

With Which Is Incorporated "Radio Journal"
Established 1917
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VOLUME VIII SEPTEMBER, 1926 NUMBER 9

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Forecast of Contributions for October Issue

Continuing his series of articles on the infradyne receiver, E. M. Sargent tells how almost any tuned r. f. set, including the various neutrodynes, may be easily converted into an infradyne by adding an infradyne amplifier unit and oscillator. Marvellous success with this type of receiver has been secured by many readers who report having constructed it in accordance with the directions given in August RADIO.

G. M. Best is working on a real *A* battery eliminator which is hoped to be ready for description in the October number. This gives full wave rectification with two Tungar bulbs and will deliver a minimum of two amperes of direct current at 6 volts, using the 110 volt a. c. supply as the source.

Raymond B. Thorpe has an unusually helpful article on "Detection Without Distortion." The high standard set by his various contributions in the past are fully met in this new analysis of detector tube operation.

H. W. Armstrong gives full instructional details regarding the improvements he has embodied in a shielded model of the Best's superheterodyne with one stage of r. f. amplification.

The novice constructor will be interested in the minute directions given for the easy assembly of a new five-tube set using tuned and untuned radio frequency amplification.

C. A. Kulmann has designed an unusually simple and complete nomograph for the quick determination of the inductance of single layer solenoids.

Arthur Hobart has some excellent practical suggestions on impedance and transformer coupling of loudspeakers for safe use with the new power tubes.

W. H. Stirling has devised an oscillator-wavemeter which may be readily made and operated for use in checking receivers and transmitters. He outlines the methods to be used in balancing condensers and inductances, determining the antenna fundamental, and in adjusting receiver constants.

Major R. Raven-Hart of Chile writes of the successful means which he has employed for audio frequency amplification of short-wave signals.

Don C. Wallace describes the practical and inexpensive mercury arc rectifier which he is using at 9ZT-9XAX.

Lester I. Wiltze tells how to analyze various circuits from diagrams in an article intended to assist the radio novice.

The fiction feature is a humorous story by Earl Ennis, "The Fatal L-Ray."

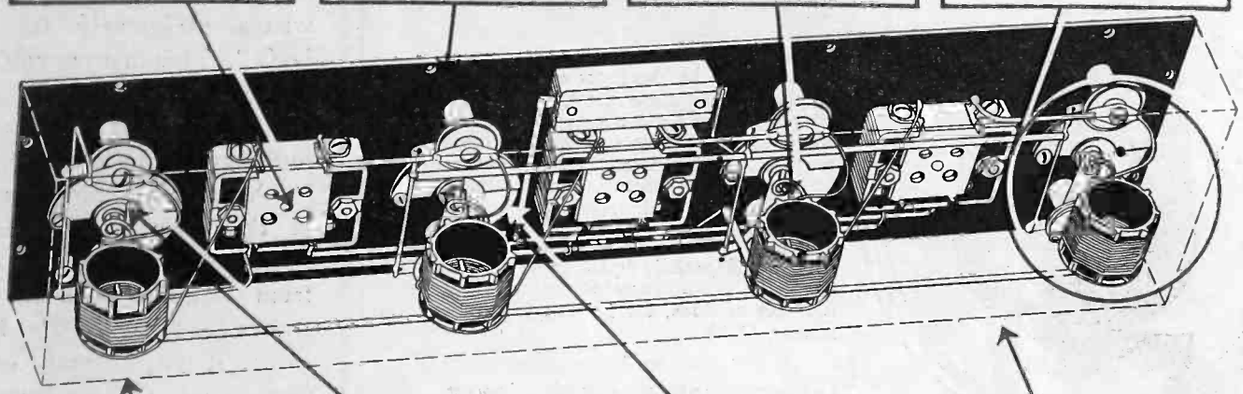
REMLER Assures Infradyne Success

Remler Sockets insure smooth action. Permanent pressure on contact levers provided by steel springs which do not lose their "life."

Genuine Bakelite Panel. Controls of Bakelite and nickelplated brass.

Pigtail connection to rotor plate for positive contact and quiet operation.

Each tuned stage is compact and well isolated to prevent interstage coupling.



Moulded Bakelite coil forms ribbed to minimize dielectric losses. Coils designed for maximum efficiency and sharp tuning.

Mica dielectric fixed condensers specially constructed to meet the requirements of the circuit.

Rigidly constructed vernier condensers well separated from dielectric material. Require no further adjustment after having been set on installation of unit.

Polished and lacquered copper box which acts as an effective shield to prevent undesirable coupling between unit and balance of receiver.

REMLER INFRA-DYNE AMPLIFIER

Sargent's Infradyne Circuit is every day proving its preeminent superiority in 1926 RADIO RECEPTION.

REMLER quality and accuracy are illustrated in the drawing above.

The new No. 700 Amplifier gives all the advantages of multitube amplification at short wavelengths.

It is the most important unit in the Sargent Infradyne Circuit which is already a phenomenal success.

The Remler Infradyne Amplifier can be readily adapted to many receivers of the usual tuned radio frequency type. Write for a reprint of the Sargent Infradyne article from the August Issue of "Radio" and for complete descriptive folder.

Price $25.00

REMLER Twin-Rotor Condenser $5.00

REMLER

DIVISION OF

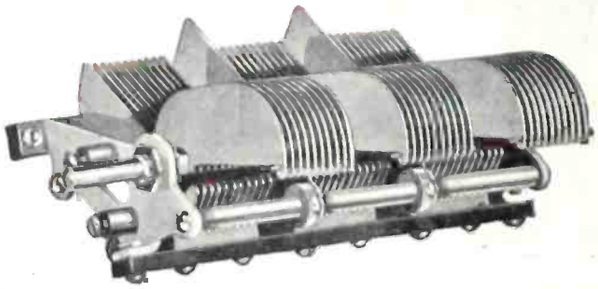
GRAY and DANIELSON Manufacturing Company

Chicago — 260 First Street, San Francisco — New York

IMPROVED Remler Socket .50

CONTINENTAL LO LOSS

Specified and Recommended for the INFRA+DYNE CIRCUIT



THIS Continental special triple condenser was designed by Mr. E. M. Sargent for use in the Infra-Dyne Circuit.

The low dielectric losses, exact capacities and mechanical perfection of these condensers make them the logical choice wherever fine reception is desired.

You will find Continental Condensers in the stores of most reliable dealers.

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611 Widener Building, Philadelphia, Pa.

After giving the Continental special triple condenser every conceivable test for weakness and performance Mr. E. M. Sargent chose it over all others for the Infradyne Circuit.

It is a straight line wave length and frequency condenser with special compensating plates.

Licensed under the Hogan Patent No. 1014002.

Capacity .00035.

List Price Only $9.50

INFRA+DYNE
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1 No. 700 Remler Infradyne Amplifier	$25.00
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1 No. 630 Remler Condenser .00035 mfd.	5.00
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1 General Radio No. 301 30-ohm Rheostat	1.25
1 Set No. 33 Thorola Doughnut coils	6.00
2 National Type B CCW Dials	5.00
2 Benjamin UX Sockets	5.25
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1 Amperite 6V 199	1.10
2 Amperites 1-A	2.20
1 Electrad Grid Leak Mounting	.35
1 Electrad Series Condenser Mounting	.35
1 30-ohm USL Rheostat	.90
1 10-ohm USL Rheostat	.90
1 Centralab 50,000-ohm variable resistance	2.00
3 2-inch Rheostat Dials	1.20
1 Yaxley Filament Switch	.50
1 Electrad Single Closed Jack	.35
1 Electrad Single Open Jack	.35
1 Jewell No. 135 0-5 D C Voltmeter	7.00
1 1-megohm Electrad Fused Metallic Leak or Arthur H. Lynch Fixed Resistor	.60
1 2-megohm Electrad Fused Metallic Leak or Arthur H. Lynch Fixed Resistor	.60
1 Electrad .0001 mfd. Condenser	.30
2 Sangamo .0005 mfd. Condensers	.80
1 Electrad .00025 mfd. Condenser	.30
2 Electrad 1 mfd. Condensers	2.50
2 AmerTran De Luxe Transformers	20.00
1 Bakelite Panel, Drilled and Engraved	6.85
1 Poplar Baseboard, cut to size and varnished	2.85
1 Complete Set Binding Posts and Engraved Strips	1.75
Price for Complete Kit of Parts	$113.10

New Remler Infradyne

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We have earned a most enviable reputation for honest square dealing. Thousands all over the country consider our monthly catalogue their "buy" book and invaluable. Our trade discounts are generous, our service and shipments unexcelled (24 hour service is the rule) and our stocks varied and complete. We carry over 40 nationally advertised lines. If you are not already on our mailing list, you're losing money. Don't delay—write today for our FREE CATALOGUE.

Complete KITS in stock for all leading circuits—Improved Browning-Drake, Hammarlund Roberts, Silver-Marshall Shield Six, Raytheon and the *NEW* LC-27 RECEIVER.

DEALERS: Our usual liberal trade discounts apply on the INFRADYNE KIT or individual parts. Remember, we ship within 24 hours.

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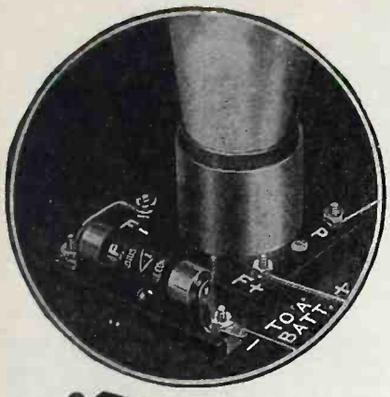
WHOLESALE RADIO SERVICE CO., 6 Church St., New York City

In Every Popular Construction Set



Amperite controls perfectly and automatically the current flow from battery to tubes. No rheostat knobs on panel to turn. Simplifies wiring and operation of the set. Any type of tube or combination of tubes can be used with Amperite, which insures filament regulation to meet each tube's individual requirement.

Be sure the set you buy or build is equipped with Amperite.

Used in E. M. Sargent's

INFRA-DYNE
TRADE MARK

as described in this issue

Radiall Company
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PACIFIC COAST OFFICE

of

ELECTRAD, Inc.

Located in the NEW CHRONICLE Building, San Francisco.

Write us for list of parts used in building the INFRADYNE.

INFRA-DYNE

ELECTRAD Inc

Your Set Is As Good As Your Parts

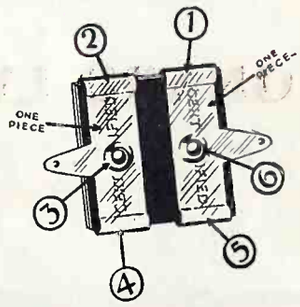
NO DOUBT about that. If you know radio you know how important your Grid Leaks are. Use Electrad Fused Metallic Leaks. New—totally different. No carbon, paper, varnish, fiber. The metallic resistance element is fused to the inside of a glass tube. Capped with the exclusive Electrad ferrule. Paraffined under high vacuum.

Six points of superiority: Noiseless, Constant, Accurate, Non-Hydroscopic Non-inductive, Unvarying under any weather or working condition. Greater current-carrying capacity without overheating or change of resistance.

Make this test—try these leaks in your own set. Hear the improvement in reception. Sizes 5000 ohms to 10 megohms. Price U. S. 60c. Canada 85c.

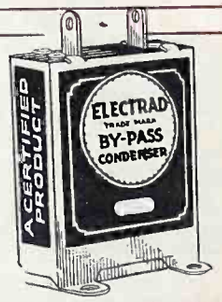
Use ELECTRAD Certified Condensers

Without hesitancy we claim the Electrad Certified Six-Point Fixed Condenser to be without equal. Here is why: Uniform pressure insured by rigid binding at six points. Sheet copper, not tinfoil. Soldering iron can't hurt it. Certified electrically and mechanically. Guaranteed to remain within 10% of calibration. Standard capacities. All types. Prices U. S. 30c to 75c, Canada 45c to $1.50, in sealed packages at all good radio stores.



ELECTRAD Certified By-Pass Condensers

Prevents B-voltage fluctuation. Gives undistorted amplification. Each condenser certified electrically and mechanically, tested at 1000 volts. Maximum working voltage 250 A. C. Has lower power factor, low radio-frequency resistance and negligible D. C. leakage. Don't take substitutes. Get the Electrad Certified. If your dealer can't supply you, let us know. Prices U. S. 60c to $3.75. In Canada 85c to $5.25.



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Copied and imitated but the quality never approached. Triple-ply insulation full 10 inches long, covered with waterproof webbing. Fahnestock clips, all connections riveted and soldered. Fits under locked windows and doors. Bend to any shape. Saves walls and window and door trim. Price U. S. 40c, Canada 60c, at all good radio stores.

For perfect control of tone and volume use the Electrad 500,000 ohm compensator. For free hook-up write 428 Broadway, N. Y. City.

ELECTRAD

Infradyne Blue Prints for Illinois

The INFRADYNE is a wonder for long distance reception, simplicity and ease of tuning. Already thousands are being made since its announcement last month. The radio public is enthusiastic about the circuit. The interest is greater than on any other set in the past.

DEALERS and JOBBERS

Cash in on the big "Parts" business created by the INFRADYNE. A large national advertising campaign is behind this only new circuit since Armstrong—entirely revolutionary. Send in your order now for one package of ten blue prints and instructions—copies in separate containers. Selling the blue prints means sales in parts. There will be a tremendous business for those pushing the INFRADYNE. Attractive discounts to dealers and jobbers. Write us for information.

We are Midwest Distributors for these Blue Prints.
Jobbers and Dealers write us.

LEONARD LYNN RADIO CO., Inc.

302 S. Wells St., Chicago, Ill.

E. M. SARGENT
Specifies

TRADE MARK
UNITED SCIEN. LAB
INC.

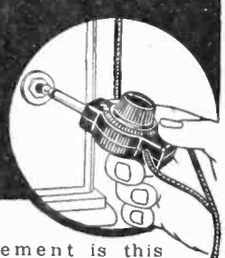
RHEOSTATS
FOR THE

INFRA-DYNE
TRADE MARK

Because of their known superiority and efficiency Mr. Sargent has specified one 30 ohm and one 10 ohm United Scientific Lab. rheostat for the Infradyne.

United Scientific Lab., Inc.
80 Fourth Ave., New York

Modernize Your Set for $2.50



TONE improvement is this year's only real radio advance. Just one change will modernize your present set. Replace your loud speaker plug with the Centralab Modu-Plug and your set will equal the tone performance of the latest high-priced receivers. Gives any degree of tone volume. No other control but the small knob on the plug. Interfering noises are reduced.

$2.50 at your dealer's, or mailed direct on receipt of price.

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Centralab variable resistances are used by 69 makers of leading standard sets.

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We are distributors for INFRADYNE Blue Print Packages.

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161 Tehama Street, San Francisco, Calif.

Order By Mail

All Parts for the Infradyne

Everything needed for building this receiver exactly as specified by E. M. Sargent in August "RADIO"

$113.10

This price includes all parts listed on page 11 of last month's "RADIO."

PROMPT DELIVERY

C.O.D. Orders accepted when accompanied by $56.55.

International Radio Sales Co.
133 First Street, San Francisco

REMLER
INFRA+DYNE

All Parts in Stock,
DEALERS, write today for discounts.
Big free catalog upon request, showing 79 other lines.

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FLEXIBLE CELATSITE

Flexible, stranded wire for point-to-point and sub-panel wiring. Non-inflammable "spaghetti" covering. In black, yellow, green, red and brown; a color for each circuit. Put up in 25-foot coils.

The Original Celatsite
—a tinned, copper bus bar wire with non-inflammable "spaghetti" covering, for hook-ups. 5 colors; 30-inch lengths.

Celatsite Battery Cable
—a silk-covered cable of vari-colored Flexible Celatsite wires, for connecting batteries to set. Prevents "blowing" of tubes; gives your set an orderly appearance.

We also offer the highest grade of "spaghetti" tubing for Nos. 10 to 18 wires. 5 colors; 30-inch lengths.

Stranded Enameled Antenna

Best outdoor antenna you can buy. 7 strands of enameled copper wire; maximum surface for reception. Prevents corrosion and consequent weak signals.

Send for folder

THE ACME WIRE CO., DEPT. R
NEW HAVEN, CONN.

ACME WIRE
MAKES BETTER RADIO

THE IMPROVED *Thorola* LOW LOSS DOUGHNUT

TRADE MARK REGISTERED

COILS

IN Mr. Sargent's new ten tube circuit, employing three stages of intermediate frequency amplification, the proper coils to use are the Thorola Low Loss Doughnuts. A set of No. 33 Doughnut Coils work *perfectly* in this remarkable circuit. "Doughnut" coils are a radical departure from the type of coil heretofore used. The magnetic fields from radio frequency circuits generally surrounding and spreading from other types of coils are completely *within* the Doughnut Coil, eliminating all possibility of inter-action from stray magnetic forces. Through an entirely different method of winding self capacity is reduced to a minimum, affecting lower loss, and consequently greater selectivity with true reproduction. Selectivity, control, sure results will be assured if you select Thorola Low Loss Doughnut Coils.

Prices---

The set of Three Coils for use with .00035 Condenser

$6.00

REICHMAN COMPANY

1725 W. 74th St. CHICAGO, U. S. A.

SAN FRANCISCO BRANCH - - - 171 SECOND STREET

A Friendly Tip to the Builder of the Infradyne

OUR INFRADYNE deserves the best. Use only the highest grade of panels, baseboards, meters and binding post strips. We are manufacturing a panel especially for the Infradyne. Genuine Bakelite is used. The holes are drilled exactly as specified by E. M. Sargent. Each panel is beautifully engraved. Black, walnut or mahogany finishes are optional. We also manufacture Poplar Baseboards for the Infradyne. They are finished in Egyptian lacquer and provided with end pieces to prevent warping. Another of our products is the Bakelite binding post strip for the Infradyne. Get "Heintz and Kohlmoos' products from your dealer. If he cannot supply you, send your order direct to the factory

PANELS

These panels are of the exact size as specified for building the Infradyne. They are 3/16" thick. We have a large stock ready for delivery.

$8.00

BASEBOARDS

Only the best baseboard will satisfy. Due to its large size it is reinforced with tongue and groove end pieces. It will not warp. Beautifully finished in clear Egyptian lacquer.

$2.85

METERS

We recommend the Jewell 0-5 DC voltmeter for the Infradyne. This meter is the accepted standard. We sell these meters to dealers. Write for prices to the trade.

$7.50

SPECIALTIES

Bakelite strips cut to exact size and assembled with high grade binding posts, spacers and lugs. Built to specifications and made expressly for the Infradyne.

$2.25

Use "Solderdipt" Lugs for wiring the Infradyne. Get a package from your dealer. Standard packages sell for 25 cents. They save time and trouble.

Attractive Discounts to Jobbers and Dealers

Immediate Deliveries

HEIKOH PRODUCTS

HEINTZ AND KOHLMOOS

SCIENTIFIC APPARATUS INC.

219-221-223 Natoma St. San Francisco, Calif.

MANUFACTURERS FOR MANUFACTURERS

What happened to your motorcar in 1914 is now happening to your radio

—*take a look at it*

THIS year radio has taken probably its last big jump ahead---just as the motor car did in 1914. Radio's pleasures and comforts have been immensely increased---its nuisances eliminated.

Out goes the horn speaker

YOUR old horn type loud speaker is today as inefficient and out of date as a bulb horn on your car. After 6 years and nearly 400 experimental models, Acme has made a "free edge cone loud speaker" that makes you think you are sitting in the "bald-headed" row---gives you living, thrilling, *human,* voices.

Showing the Acme K-1 "double free edge cone" loud speaker, round model, 14" cone diameter, handsome tan casing. **$25.00.**

The "train announcer mumble" need never overwork your ears again. Bury its gurgle along with your horn---in the attic with all the other family relics.

Make your set a light socket receiver

A, B & C BATTERIES have always been a nuisance---as troublesome as a car without a self-starter. Now trouble from them is eliminated---and with it has gone those famous "fading" concerts (the kind that die a slow and painful death due to aged, starved or emaciated batteries).

Your set can now be turned into a light-socket receiver---over-night. No change, merely add Acme A, B & C power supply units. They give you permanent, unfailing power that keeps your set operating at its highest degree of efficiency---maintaining clarity, distance, volume . . . truthfully, "not for just a day, not for just a year---but *always.*"

Showing Acme E-3 Power Supply Unit ("B"-eliminator) with non-filament tube for one to six tube sets, 110 volts, 60 cycles. **$30.50.**

Send for the 12th edition of this famous Acme book

11 editions, 500,000 copies of the famous Acme book, "Amplification Without Distortion" have been sent to Acme friends. Now the 12th and greatest edition is ready. It is written by a prominent radio engineer in a non-technical and interesting manner. It gives you a clear picture of radio reception, and shows exactly how you can eliminate distortion and improve the operation of your set. It also describes fully these wonderful new Acme loud speaker and power supply units---and includes details of the complete Acme line of transformers, impedances, condensers, pot-rehos, choke coils, kitsets, etc. Use the coupon for convenience.

Showing the Acme K-3 "single free edge cone" loud speaker. 11" cone diameter. Finished in handsome green bronze. **$18.50.**

ACME APPARATUS COMPANY
Pioneer Radio and Transformer Engineers and Manufacturers
Cambridge, Mass.

ACME APPARATUS CO.,
Dept. D19, Cambridge, Mass.

Enclosed find 10c (stamps or coin) to cover costs of sending me one copy of "Amplification Without Distortion," 12th edition.

Name.....

Street.....

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

ACME *~for amplification*

RADIO
WITH WHICH IS INCORPORATED "RADIO JOURNAL"
VOLUME VIII SEPTEMBER, 1926 No. 9

Radiotorial Comment

THE dire predictions of utter chaos that would ensue when the bars of governmental control of radio broadcasting were let down, have not come true. Nor does there appear to be much likelihood of any serious confusion before Congress can again meet to enact suitable legislation. The good sense of the great majority of present broadcasters saved the day.

This good sense has been shown in several ways. It was first exhibited by a group of Pacific Coast broadcasters who agreed to voluntarily confer with their Radio Supervisor before making any changes in wavelength, power, or time of operation, and to abide by his decision as to what change would create a minimum of interference. As soon as this plan, which is being sponsored by the Pacific Radio Trade Association, is unanimously subscribed to by the stations in the sixth and seventh radio districts the supervisors have the consent of the Department of Commerce to thus act, unofficially, as arbitrators.

Nearly half the stations throughout the country have responded to the appeal from the National Association of Broadcasters to continue to operate under the assignments made by the Department of Commerce prior to the failure of Congress to pass the laws needed to legalize governmental control of the situation. Several stations have returned to their original wavelengths after having made a change. This was done in recognition of the possible loss of the right of priority when legal allocations are finally made by the government and also because they were in accord with the real spirit of regulation as administered by Secretary Hoover.

Most of the changes have been made by relatively powerful stations who had been interfering with reception from less powerful stations between 200 and 250 meters. Some of them had previously applied to the Department for such change, which would have been normally granted if the Dill bill or the White bill had passed. While their legal right cannot be questioned, there is grave doubt, in several cases, regarding the wisdom of their own choice of new wavelengths which interfere with those of established stations. If the change had been made after conference with a radio supervisor he would possibly have suggested some wavelength which would not interfere with any other station within a radius of 1500 miles.

It remains to be seen whether an injured station or some aggrieved listener will bring civil suit to enjoin operation on interfering wavelengths. At best, with the usual delays of the law, little practical good could thus be accomplished during the short time before Congress acts.

Another weapon proposed against offending stations is the boycott. While this method has sometimes been effective in accomplishing desired results since it was first employed by Irish tenants against Captain Boycott in 1880, it has never been in very high repute. It has frequently reacted against those who started it and gained public sympathy for those against whom it was directed. It is usually mean-spirited, contemptible, and not in accord with the modern ideals of fair play and ethics which should exist in the transmission and reception of broadcasting.

There is little likelihood of an influx of new stations into a field that is so evidently over-crowded. Not only is there the great expense of installation and operation of a station sufficient to command a public hearing, but also is there the knowledge that the administrators of whatever law may be passed will necessarily give due consideration to the priority of the pioneer stations. The risk is too great to justify any sane business investment.

PROFITING from the experience gained in the automobile and music trades as regards trading-in second hand radio sets as part payment on the purchase of a new set, the Pacific Radio Trade Association is the first trade organization in the country to suggest a definite policy to dealers. As this policy is of interest to the consumer as well as to the trade, a brief review of its salient features seems justified in these columns.

It has as its basis the answer to a series of questions which were asked a large number of radio dealers. These answers show that perhaps one-fourth of the radio owners would like to turn in their present sets for better ones. Most of the dealers plan to re-sell the old sets thus taken in after they have been put in first class condition and tested under operating conditions.

The main point of divergence in the answers was the amount of the allowance to be made. It was recognized that the original list price could have no bearing on the decision, due to the decrease in prices of many sets during the past year or so. The recommendation of the committee which handled the matter is that the dealer allow half what he estimates to be its probable re-sale value. This is believed to allow sufficient margin to cover the expense of testing, repairing and putting in condition for re-sale as well as reasonable protection against the possibility of not selling the set, together with a legitimate profit.

It is of interest to note that the committee discourages any allowance on home-made sets, not alone because they are more difficult to sell than a standard factory-built set, but also because their re-sale may be illegal because of patent infringements. This is in line with the intent of parts manufacturers and magazine publishers that directions for building home-assembled sets are for the builders' personal use.

Should these suggestions be generally followed there is a possibility of avoiding the second-hand problem that has been such a trouble-maker in the automobile trade. The association is to be congratulated on its foresight in trying to meet the problem before it becomes a problem. As time goes on and as sets are improved there will be a constantly increasing desire on the part of set owners to get the best that they can afford. This plan gives them a fair means for salvaging a part of their original investment without disrupting a growing industry.

Static, Inc.

An Interview by Keith LaBar

Staff Artist, Louis McManus

IN THE past few years the general public has awakened to the fact that we have a monopoly in our midst, a monopoly the government seems powerless to control. We refer, of course, to the firm of Static, Inc. This firm, headed by George J. Jupiter, has grown from the modest establishment it occupied prior to the war to the present large factory, covering many acres. As it is due entirely to the efforts of George J. Jupiter that this marvelous growth has taken place, the public has been awaiting the story of his rise. Mr. Jupiter has kindly consented to give the readers of this magazine the first real inside story of his successful career.

"Yes, it was force of circumstances rather than personal initiative that caused my success."

Mr. Jupiter was speaking. During the past hour we had been led through the vast factory and now we sat in his office, a restful place, with the rush and roar of the factory reduced to a gentle murmur. This remark of Mr. Jupiter's startled us out of our calm.

"Really, Mr. Jupiter," we said as we gazed incredulously at this mild mannered, yet dynamic man. The blue eyes of Mr. Jupiter expressed affectionate approval of our defense of the tradition the public has built up about him.

"Nevertheless, it is true," said Mr. Jupiter. "And in order to dispel many illusions I will tell you of the growth of the business and some of the trade secrets."

"Back in the days known as 'before the war' the static business was barely paying expenses. Being mostly a natural product our output of static was large. But our customers were few, mostly radio amateurs and commercial operators.

"With the growth of radio as a household utility came, logically, the growth of our business. Natural static cannot now fill all requirements and so we have various assorted statics, all artificially prepared.

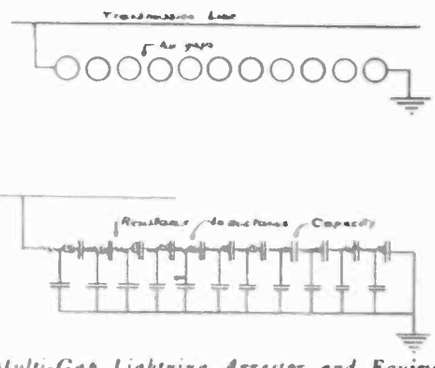
"To most people static means atmospheric disturbances. Yet both atmospheric disturbances and man-made disturbances come electrically under the heading of transient phenomena. That is, it is a momentary disturbance bringing back to balance an electrical system that has gradually gotten out of balance.

"The air in the atmosphere is in a continually changing state. It is alternately hot or cold, moist or dry, and is always in motion. What is more natural, therefore, than by friction or other means, that its electric potential is continually changing, producing through silent electrical discharge the familiar static.

Mr. George J. Jupiter.

"In a storm these conditions are accentuated. Due to condensation of moisture in a cloud, and to the lack of uniformity of the condensation by reason of air currents, the rain drops in the cloud have a non-uniform distribution of potential. When the potential somewhere between two points in a cloud exceeds that potential at which the air breaks down, an oscillatory discharge is set up. Once started, the discharge goes to other points in a row and we have the complete lightning flash.

"The circuit is equivalent to that of the multi-gap lightning arrester. It is



Multi-Gap Lightning Arrester and Equivalent Electrical Circuit.

curious that in such circuits, if we have a difference of potential between the two ends, the voltage across any two gaps is not the same. It is curious also that the total voltage necessary to break down the air is less with a high frequency discharge, due to the fact that with higher frequency the potential gradient is steep, the voltage between the first gap being a large proportion of the total voltage across the series of gaps.

"A lightning discharge is of radio frequency, therefore, simply because it is easier for it to be high frequency than low. The electrical laws are more lax, the circuits kinder.

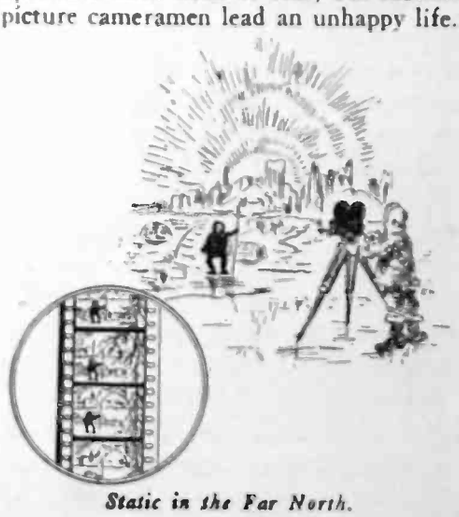
"Static is directly proportional to the relative humidity," continued Mr. Jupiter, with an expansive wave of his hand. "With a moist, muggy atmosphere we have much more static than with the air crisp and clear. For this reason it is being used as a forecaster of storms, for with an increase in one, we can reasonably expect an increase in the other.

"The dancing girls of the tropics are famous, and are carefully stored away in miles of celluloid. But known only to the few is the static. Sitting in a hot

Under Tropical Skies.

radio room the operator, after the twentieth repeat of a message, with the loss of vital parts even then, will lose his reason.

"In the north, static is not idle. Radio operators have little to fear, but motion picture cameramen lead an unhappy life.



Static in the Far North.

Owing to friction in the camera in the dry, cold atmosphere, electrical discharges take place, which are registered on the film in the form of trees and various odd patterns. This has been one of the deciding reasons in favor of photographing many of the dramas of the far north in some Hollywood studio lot.

"Static, Inc. has many competitors," continued Mr. Jupiter sorrowfully. "Every modern youth either tries to write a scenario or invent a static eliminator. One pet eliminator has been invented a good many times now. It consists of attaching a non-inductive variable resistance between the antenna and ground, bridging the primary of the receiving set. The static is supposed to run through the resistance to the ground, while the signals are attracted by the pretty wire circles inside the set. To some of the signals the green spirals have no sales appeal and so this eliminator weakens signals, although the ratio between static and signals is slightly improved.

"But it is a case of locking the door and opening all the windows," said Mr. Jupiter happily. "Even if we had a perfect eliminator, it would be of little use without thoroughly shielding the set by completely enclosing it in a metal box. The coils, the wiring—all pick up any static that the aerial misses.

"As our branch factories are so widely scattered," said Mr. Jupiter, "static is extremely directive. For this reason the most practical of all plans to give us competition, with the exception of raising the power of stations, is to use a loop antenna with a thoroughly shielded set. With the great competition between those who desire to pour us full of advertising, this plan reduces many funny noises besides static.

"A radio set receives signals by tuning it to one particular frequency. It then vibrates when a transmitting station of the same frequency is going. Some forms of electric discharge, when they hit the antenna, act as a hammer, and start the receiving antenna vibrating electrically no matter to what wavelength it is tuned. It is like the good old spark transmitters that gave the antenna system a terrific swat. The antenna then did the shimmy on the easiest wavelength of wavelengths.

"The anti-static devices described in *QST* for February and March of 1925 are the best to study for those who want to make an eliminator with lots of coils and tubes and trick circuits," continued Mr. Jupiter. "For those who spend in radio that time that in the old days would have been spent in arguing about politics, the problem of anti-static devices is recommended."

Mr. Jupiter, after making this remark, lit another cigar and leaned back in his chair.

"What can you predict for the future?" we asked.

Mr. Jupiter grew thoughtful.

"With the passage of time, many of the sources causing artificial static will be investigated and stopped. My factories may some day be closed down. The various electrical devices that have sparking generators, obsolete systems of street lighting, with especial mention of the famous arc lights doing an imitation of a circus caliope at its best—or worst, trick heating pads, leaky insulators—all these may some day be gone.

"But the most interesting development which I predict for the future," said Mr. Jupiter reflectively," is this. Compact static eliminators will be invented which will put me out of business. It is the trend of the times. These eliminators will operate on the principle that the wave form of static is very steep, irregular, and uncertain. The wave form of continuous waves and the modulated continuous waves of music is smooth sinsoidual.

"Now by research and experimentation it will perhaps be possible to produce a filter that is not selective as to frequency, but is selective as to wave form. This will produce curious results when applied in practice.

"When one of those—er—unfortunate

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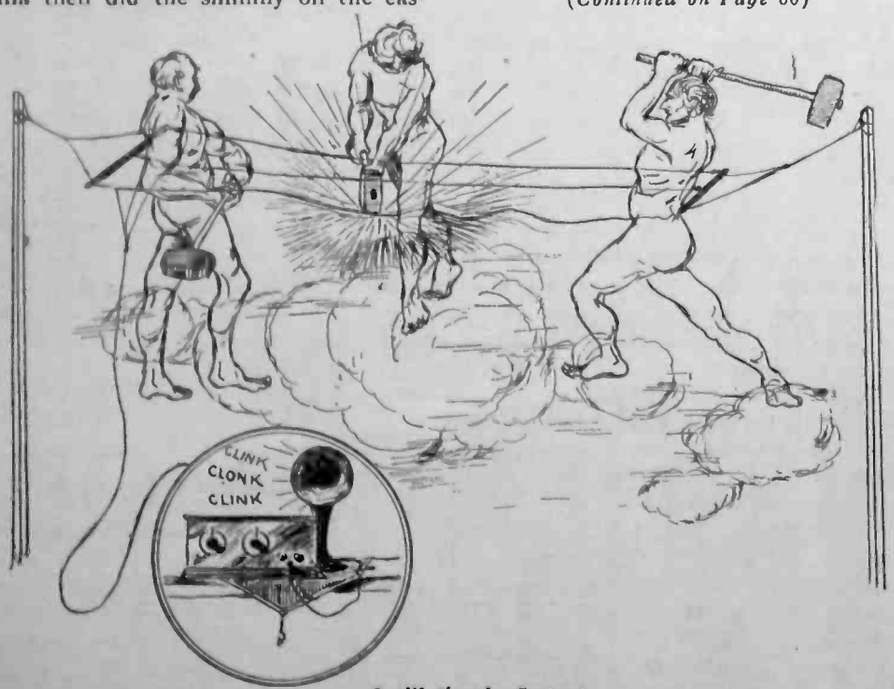

Oscillation by Impact.

LO-LOSS' DREAM

By E. S. SULLIVAN

THE FIRST red rays of the sun illumined the rugged, Neolithic landscape. Somewhere in the depths of the antediluvian forest the stillness was broken by the plaintive call of a dinosaur to his mate, and silhouetted against the dark sky, a mere speck in the distance, floated the figure of a homing pterodactyl. A shaggy elk, grazing on the mountain-side, sniffed the air suspiciously as a thin wisp of smoke borne on the morning breeze proclaimed the presence of his arch-enemy, man.

Loloss, the cave man, squatted before the dark cave-mouth on the shore of the deep glacial lake. Before him was a rude stone box, a curious plaything for a man of his time, and in it was a still more curious mass of tangled copper, mined laboriously from the lake shore, and bits of carefully scrapped hide. From a smouldering fire at his side, he drew a rudely fashioned chunk of iron, which he applied to the interior of the box. A smell of fusing copper, a cloud of smoke, and a crude but effectual connection was made. The primitive man produced from his girdle a glittering crystal of virgin rock, fondled it in his hand for a moment, and placed it in the box. Rising, he surveyed his handiwork and with a guttural cry summoned his fellows.

Scores of hairy men poured from the dark caves on the hillside, to cluster in awe about the genius. With a sign to wait, he disappeared into his cave, to emerge a moment later bearing a similar stone box. He placed it a short distance from the first and squatted down beside it.

An awed silence fell upon the assembled brutes as he slowly began to rotate a circular stone protruding from the top. A woman shrieked in terror and a low murmur ran through the assembly as a shower of sparks leapt into the air. Loloss paid no heed, indeed, he did not seem to be conscious of the interruption, for his close-set, piglike eyes gazed into space with the look of a dreamer far ahead of his time. Slowly, with trembling hand, he placed his finger upon a bent copper strip at his side, and still more slowly he pressed it down, down, until, with a sharp crackling noise and a shower of sparks, it came into contact with a similar strip beneath it. Instantly a deep-toned "Dah!" issued from a circular orifice in the other box. With screams of mortal terror, the simple brutes scurried like rats to their burrows, leaving the dreamer alone on the dark sands.

He stood for a moment as if in a trance, then, with a wild cry, he broke into a dance of joy.

"I shall name it Radio!" he cried, "and in the ages to come the name of

(*Continued on Page* 58)

More About the Infradyne

Reasons for Selection of Intermediate Frequency, Necessary Precautions in Construction of Amplifier and Suggestions for Antenna Size

By E. M. Sargent

IN designing the infradyne, as described in August RADIO, a great many problems were encountered for which we had no precedent to help in determining the solution, one of the first being the selection of the best frequency on which to operate the intermediate amplifier. Theoretically, any frequency that is higher than the highest to be received can be used. The infradyne is designed to receive wavelengths from 200 to 550 meters, (frequencies 1500 to 545 kilocycles) and therefore any frequency above 1500 kc could be used were it not for other practical limitations.

Suppose a frequency of 1600 kc were selected. To receive a 200 meter signal (1500 kc) the oscillator would have to be adjusted to 100 kc, while to receive a 550 meter signal (545 kc), the oscillator would have to be set at 1055 kc. Thus the oscillator would not only travel through the broadcast wave band, but would have to cover a wave band of 280 to 3000 meters. It is not practicable to handle so large a wave band with an oscillating tube controlled by a single variable condenser.

In some earlier experiments, we used an intermediate frequency of 2000 kc (150 meters). This made it necessary for the oscillator to run from 200 to 600 meters, and we found that in the vicinity of 300 meters the oscillator was set on nearly the same wavelength as the incoming signal, and that the two actually crossed at exactly 300 meters. The result was that near this wavelength the oscillator fed so much energy directly into the antenna system that the radio frequency amplifier tubes were partially paralyzed and the set had a dead spot between 285 and 320 meters. The most perfect shielding of the oscillator would be necessary to overcome this trouble, and even then it is doubtful if a station exactly on 300 meters could be received.

To eliminate this type of trouble the intermediate wavelength had to be dropped to less than one-half of the lowest wavelength that was to be received. In this case it meant going well below 100 meters. As it is increasingly more difficult to amplify as the wavelength is shortened, the intermediate wave should not be dropped any further below 100 meters than is necessary. A wavelength of 95 meters was first adopted, and later this was changed to 86 meters. This is the wavelength which we are now using.

With the amplifier set at 86 meters, the oscillator has only to run from 100 to 151 meters. The advantages of confining it to this waveband are numerous. For one thing it will never radiate from the antenna so as to bother the neighbors, because it is far de-tuned from the antenna system and is not on a wavelength that anyone is normally trying to receive. Also, it is not constantly set at only 30 or 45 kilocycles from the incoming signal, as is the case with a superheterodyne, and thus it does not "wave trap" out the weak signals before they reach the first detector. In a 45,000 cycle superheterodyne half of the energy from a weak signal can be lost through the "wave trapping" effect of the oscillator, and in a 30,000 cycle super it is even worse. In the infradyne the oscillator wavelength is so far removed from that of the incoming signal that the wave trap effect is nil, and the net result is that weak signals have a better chance to be amplified and heard. Another advantage of confining the oscillator to this waveband is that strong local broadcasters will not modulate it and cause freak dial settings for strong stations.

It was stated in the previous article that the infradyne had only one setting of the dials per station. This is strictly true only when the dials are rotated together in the right direction. If both dials are set at 200 meters, and are turned together over the waveband up to 550 meters, no station will be encountered more than once. However, if the antenna tuning condenser is adjusted to a powerful local station and the oscillator dial turned alone throughout the scale, other freak settings can be found. These are all weaker than the sum frequency (infradyne) setting, but sometimes they are encountered when the set is first put into operation before the operator has had time to familiarize himself with it, and in that case they might cause a little confusion. That is the reason they are mentioned here. If the instructions given in August RADIO for putting the set into operation are carefully followed, these settings will not be encountered.

The writer has said a great deal from time to time about the arrangement of parts on a baseboard and the important role that it plays in the operation of any radio set employing radio frequency amplification. Fig 1 has been drawn with a view to explaining this more in detail.

A casual glance at the diagram will convince anyone that the circuit is anything but selective,—yet if the true circuits of a great many sets were drawn out they would look a good deal like this. A_1 is the intended antenna and is the pickup through which distant or weak signals enter the receiver. Powerful local signals enter the set through this antenna, and also through A_2, A_3, A_4, A_5, and A_6. These are shown as antennas on the diagram but in reality are merely long grid and plate leads which look innocent enough if you do not know too much about them. Distant signals, of course, are also picked up by these leads but not with sufficient strength to operate the tubes and be amplified.

Hence all distant signals enter through the real antenna and are amplified through the most selective path between the antenna and the detector tube, and as a result the selectivity of the set on distant signals will be "knife-edged." For a powerful local station, the net result of the several other pick-ups is to cause broad tuning over a band two or three times as wide as it should rightfully cover. There is only one cure for the evil,—eliminate these small energy collectors. This can best be done by so arranging the apparatus so that the grid and plate leads are as short as possible and run directly to their destinations, not around fancy square corners.

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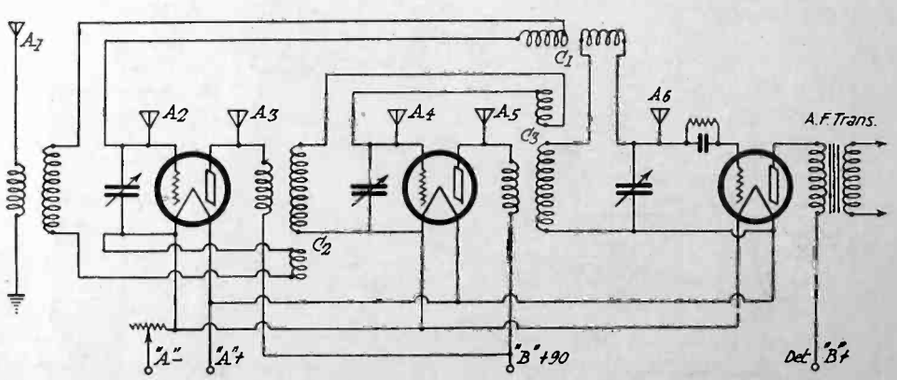


Fig. 1. Possible Places for Energy Pick-up and By-passing in Infradyne Circuit.

An Accurate Direction Finder

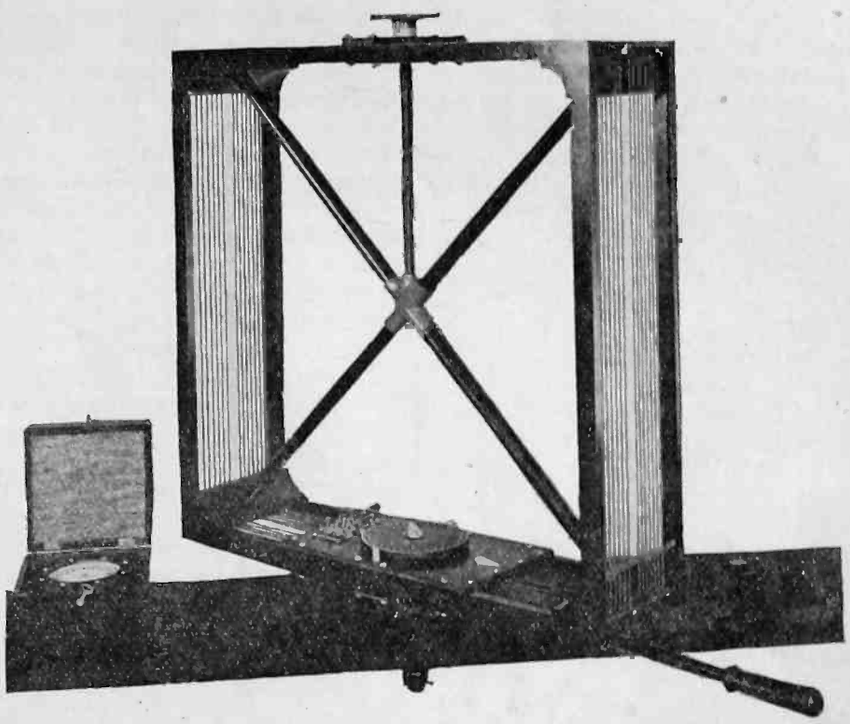
Constructional Details for Uni-Directional Loop and Receiver for Locating Interference to Radiocast Reception

By W. H. Stirling

THE FIRST essential in clearing up interference to radio reception is to find the cause. This, with the equipment usually available, is a tiresome, tedious, and often fruitless task. The results secured by taking bearings are usually greatly in error, the degree of which cannot be predicted. The area of "minimum" signal as obtained with most types of sets used for radiocast reception is very broad, usually several degrees, which disqualifies them for the accurate performance required. Many superheterodynes used with a loop may be caused to radiate energy which bends or distorts the advancing signal wave front.

Another factor which causes uncertainty is that a loop shows two positions for maximum signal and two positions for minimum signal,—each maximum and each minimum separated by 180 degrees. Thus a single bearing is ambiguous and may result in an entirely misleading result. This was illustrated in the case of the inexperienced operator who took the last compass bearing on the plane of Commander Rodgers on his Hawaiian flight, and caused all associated vessels to search for the plane to the south, when the plane was to the north of the ship taking the bearing.

Another and most important factor is the absence of any device or arrangement whereby the operator of the equipment may definitely in terms of degrees or cardinal bearings orient a transmitter. Any one of the three faults mentioned, viz;—doubtful minimum bearing, 180 degree ambiguity, or lack of definite indication of bearing militate against effective results and when these three faults are all embodied in the same equipment, consistent performance is impossible.



Kolster Loop Developed as Direction Finder for Radio Supervisor's Truck.

It follows, then, that a dependable device permitting the taking of accurate bearings should assume the characteristics of a radio compass, such as that developed by the Federal Telegraph Company under the supervision of F. A. Kolster, and which has been characterized by George R. Putnam, U. S. Commissioner of Lighthouses as "equivalent to giving the navigator another pair of eyes."

The Chief Supervisor of Radio, Department of Commerce, early this year authorized the Federal Telegraph Company to develop, for his department, a direction finder, embodying those principles of accuracy and dependability existent in the Kolster Radio Compass, but capable of covering a different range of wavelengths. This range was specified as from 90 to 750 meters, with certain other physical dimensions to make it suitable to be installed in a specially built motor truck, together with other instruments used in the work of his department.

A great deal of research work was done in connection with the development of this instrument, the accompanying picture showing the completed direction finder ready for installation.

Owing to the ratio of maximum to minimum wavelength range it was necessary to sectionalize the loop. This sectionalization is controlled by means of the switch shown on the shelf inside the loop frame. The "dumb compass" or

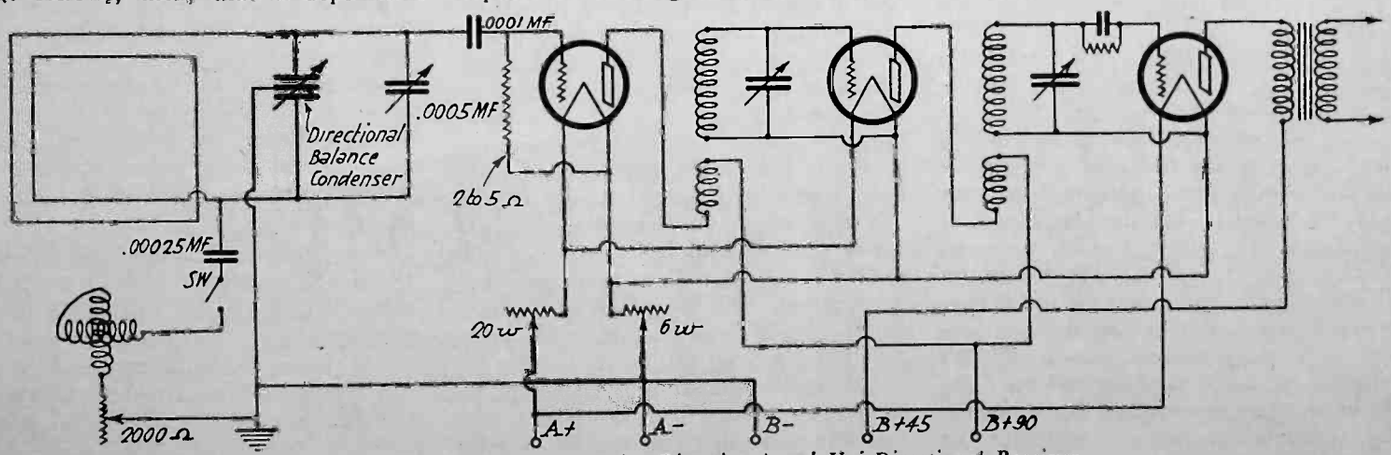


Fig. 1. Circuit Arrangement for Directional and Uni-Directional Receiver.

azimuth circle, shown in the center of this shelf, rotates with it. The pointer is semi-fixed,—that is, it may be placed in any position with respect to the magnetic compass or the fore and aft line of the motor truck when taking a bearing, and as the loop is rotated the degrees of the azimuth circle travel under it. The pointer on the right indicates the "direction" of reception when using the uni-directional adjustment. The two leads from the loop are taken to the two collector rings shown beneath the shelf, and the leads to the receiver are attached to the brushes making contact with the collector rings.

The receiver used with the loop consists essentially of two stages of tuned radio frequency, detector, and two audio stages. In addition, there is a variable capacitance for tuning the loop, apparatus for effecting sharp directional bearings, and the uni-directional apparatus. These last named will come in for discussion in succeeding paragraphs, in which will be given suggestions for modifying existing equipment to conform with the requirements of directional operation as well as information leading to the construction of such apparatus, covering the broadcast range. Fig. 1 shows the circuit arrangement for this directional and uni-directional receiver, that portion shown in heavy lines embracing the special equipment used.

Any of the existing types of loops now on the market may be used, as all are designed for use in the broadcast range. Or if it is desired to construct a loop, use a frame 24 in. square and approximately 4 in. wide. Wind with 12 turns of No. 18 stranded fixture wire spaced approximately 5/16 in. apart. This loop should be attached to a shaft or stem and any method desired may be used in bringing out the leads, care being taken that these leads are short as possible. A supporting base should be provided and upon it should be mounted the azimuth circle, which may be 5 or 6 in. in diameter, and divided accurately into 360 degrees, around its circumference. A pointer of the proper length, to travel over these divisions as the loop is rotated, should be secured to the loop shaft or stem, preferably, but not necessarily, so that its position on the stem in relation to the plane of the loop may be changed at will. A collar carrying the pointer and fitting snugly but capable of turning on the stem, is suggested.

The variable capacitance for tuning the loop is of the order of 500 micro-microfarads. The directional balance consists of a variable condenser with a rotor and two sets of stators, the plan being shown in Fig. 2. The plates are of the semi-circular type and if it is proposed to use plates having a 2-inch radius, two rotary plates are used, and two plates in each section of the stators. The stator sections are evolved from the usual semi-circular plates, which are cut and drilled and mounted as shown in Fig. 2. If smaller condenser plates are to be used in the construction of this piece of equipment, use three rotors, and three plates in each section of the stators. All constructional details are left to the option of the builder, there being no departure from standard practice other

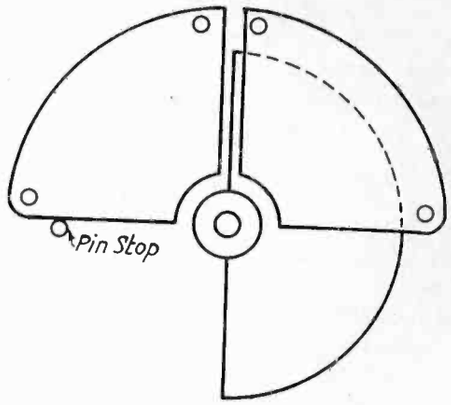


Fig. 2. Sectionalized Stator Plate of Directional Balance Condenser.

than the sectionalization of the stator plates. The rotor plates should be arranged to travel through 180 degrees, and a pin stop or other method as may occur to the constructor may be used.

The variometer used for obtaining uni-directional bearings or "sense of direction" may be any type of well constructed variometer having a relatively high ratio of maximum to minimum inductance. There are several types manufactured, of moulded bakelite, which will serve nicely. As a suggestion, and to conserve space, Gilfillan makes a small variometer of excellent construction which is admirably suited to this purpose.

The potentiometer shown in Fig. 1 may be any type available, either of the non-inductive type, or wire wound. Perhaps the latter type is preferable, for usually smoother changes of resistance are possible with this type.

The switch, as will be noted, is merely a type of "on and off" switch and may be any type that suggests itself to the builder. It is used to disconnect the uni-directional apparatus when taking a directional bearing.

It will be noted in Fig. 1 that no grid return is used from the loop to filament of the tube, and connection to grid is effected through a small capacitance. Much sharper minimum bearings are thus obtained, with a very slight reduction of signal strength. The remainder of the circuit is the conventional tuned radio frequency type. However, if using this equipment with any standard receiver of this kind it is suggested that the first stage of radio in the receiver be disregarded, and the plate and plus *B* battery leads from the direction finder tube be connected to their respective terminals in the second tube circuit of the receiver. This will make for greater flexibility, as otherwise too much selectivity is achieved and adjustments are too numerous and too critical.

Any of the single control tuned radio frequency receivers would be preferable for use in connection with this equipment for the reason that the logging of the wavelengths would be a simple matter. Most such receivers are calibrated directly in wavelength and all that would remain would be to log or calibrate the loop tuning control. However, inasmuch as the adjustments of the usual three-dial receiver are not disturbed by the addition of this equipment, the use of such a receiver is permissible.

All of this equipment may be incorporated as a complete unit and include the receiving circuits, or the direction finder circuits may be developed as a separate unit and mounted in a separate cabinet. In the latter case it would be only necessary to provide two leads to the receiver, and the *A* and *B* battery leads to the direction finder tube. All battery leads can be common.

Let it be suggested here that results with equipment of this nature are almost directly proportional to the quality of the material and the general excellence of the workmanship involved, as well as care in arrangement design. The element of makeshift in such apparatus leads inevitably to makeshift results, and will assuredly defeat the purpose of the constructor.

When tuning in a station, the switch should be in "Directional" position with "Direction Balance" condenser in center. Then set the receiver dial or dials for the station desired, after which adjust loop tuning condenser for maximum signal. If the direction of the transmitter is unknown, rotate the loop slowly until loudest signal results. After tuning in the signal for maximum, rotate the loop approximately 90 degrees, when the signal will be found to approach a minimum. Locate this minimum as definitely as possible, slowly swinging the loop across this point, and simultaneously adjusting the Directional Balance. It will be found that this minimum can be made extremely sharp,—within one to two degrees. If the loop is now rotated 180 degrees or half way around, minimum will again appear.

Let us assume that this minimum appears on one side at 90 degrees, and at 270 degrees on the other side. The transmitting station will lie at some point along a line drawn between these two points and extended indefinitely on either side. It may be on either side, however, which illustrates the feature of ambiguity or doubt.

Now throwing the switch to uni-directional and rotating the loop so that its plane lies along this imaginary line or bearing, and adjusting the uni-directional tuning and uni-directional balance, it will be found that when the loop points towards one direction the signal is quite

(*Continued on Page* 46)

Converting Your Set to use the "ABC" Power Plant

By G. M. Best

THE complete *ABC* power plant designed to furnish all the power needed to operate a Browning-Drake receiver from the 110-volt a.c. mains described in August RADIO can be used to operate any other receiver using '99 type of tubes by making a few changes in the set wiring, without the addition of new apparatus. The principal change in any of the standard circuits is to wire the filaments of all tubes but the power stage in series and to connect the grid returns of the various tubes so that the voltage drop across some other tube in the circuit will provide the required *C* voltage.

The new Yaxley 1200 ohm resistance is ideal for this purpose.

To indicate conditions in the filament circuit, a 0-5 volt voltmeter is placed across the detector tube filament, and as was explained in the previous article, this voltage is adjusted to 3 volts. If the type 112 power tube is used in the power stage, the connections shown in Fig. 2 will be satisfactory, but if the type 371 power tube is installed, an output transformer will have to be connected between the tube and the loudspeaker as the plate current of this tube is too high to permit its passing through the speaker windings. The manner of connecting the 371 tube is shown in Fig. 3, which is the suggested rewiring arrangement for the well known S-C circuit, described in April RADIO.

The S-C circuit presents a different problem from that of Fig. 1, in that it is a single control set, and the rotor plates of both tuning condensers are mounted on one shaft, and are common to each other. Fortunately, no *C* voltage is required for the r.f. tube, and so the condenser shaft is connected to the common terminal between the r.f and detector tubes. But if the set had two stages of tuned r.f. with single control, it would be necessary to apply *C* voltage to at least one of the r.f. tubes. The filament and grid return connections for the Hammarlund-Roberts, and others of the same type are wired as in Fig. 3, the only real difference being in the arrangement of the radio frequency transformer and the neutralizing of the r.f. amplifier tube.

The re-wiring of a superheterodyne receiver is more complicated, principally because of the number of tubes. In Fig. 4 is shown the circuit of an 8-tube Best superheterodyne, in which there are 7 type 99 tubes, and one power tube. The series filament circuit is so arranged that not only do the amplifier tubes obtain 3 volts negative grid due to the voltage drop across one of the tube's filaments, but the 1st detector grid is 6 volts negative with respect to its filament due to the drop across two consecutive tube filaments. Volume control is obtained by a shunt potentiometer across the primary of the second intermediate frequency transformer, and the voltmeter is shunted across the second detector filament, as is customary. With 7 tubes in series, the second detector filament, which is nearest the negative end of the circuit, will carry the plate current of the other six tubes, so that the current at the posi-

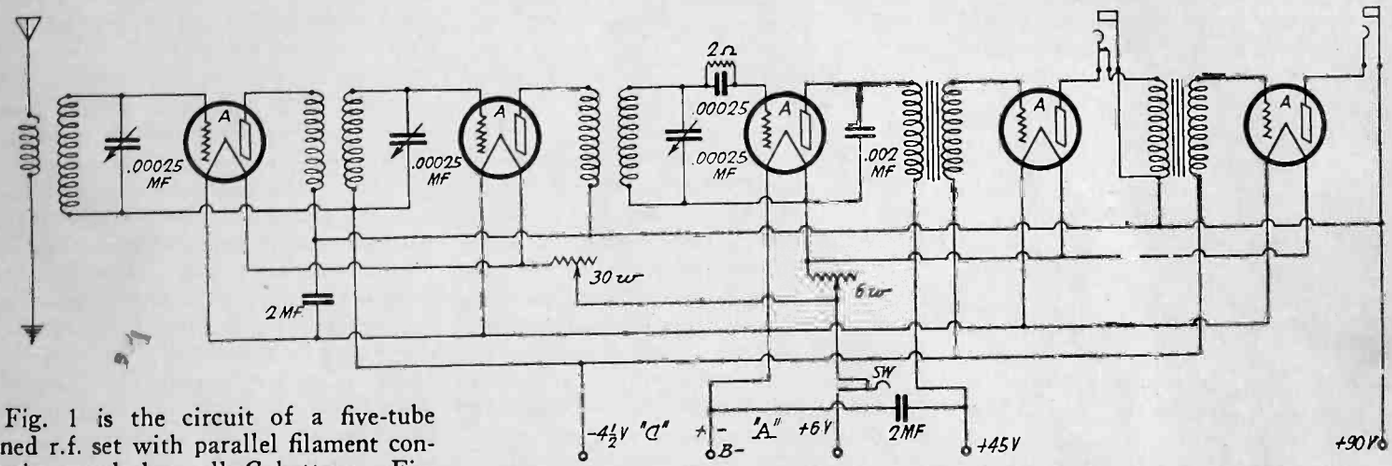


Fig. 1. Schematic Wiring Diagram of Five Tube Receiver for Battery Operation.

Fig. 1 is the circuit of a five-tube tuned r.f. set with parallel filament connections and dry cell *C* battery. Fig. 2 shows the same circuit with connections changed for series filament operation. The grid returns of the various tubes are connected so that a *C* battery is not necessary. The filament connections for the power tube are made to the power plant through a small length of twisted lamp cord.

As the volume control rheostat used in the r.f. tube filament circuit is necessarily omitted in the rewired circuit, a shunt resistance having a maximum value of not over 1500 ohms is placed across the first r.f. tube filament, so that the filament current of this tube can be reduced to whatever amount is desired.

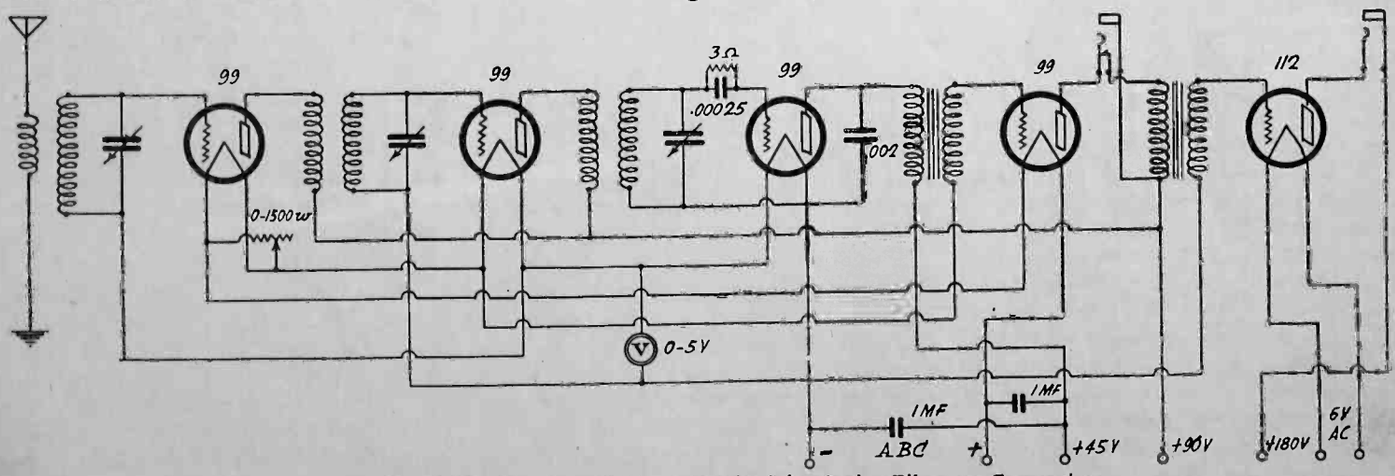


Fig. 2. Five Tube Receiver of Fig. 1 Rewired for Series Filament Connection.

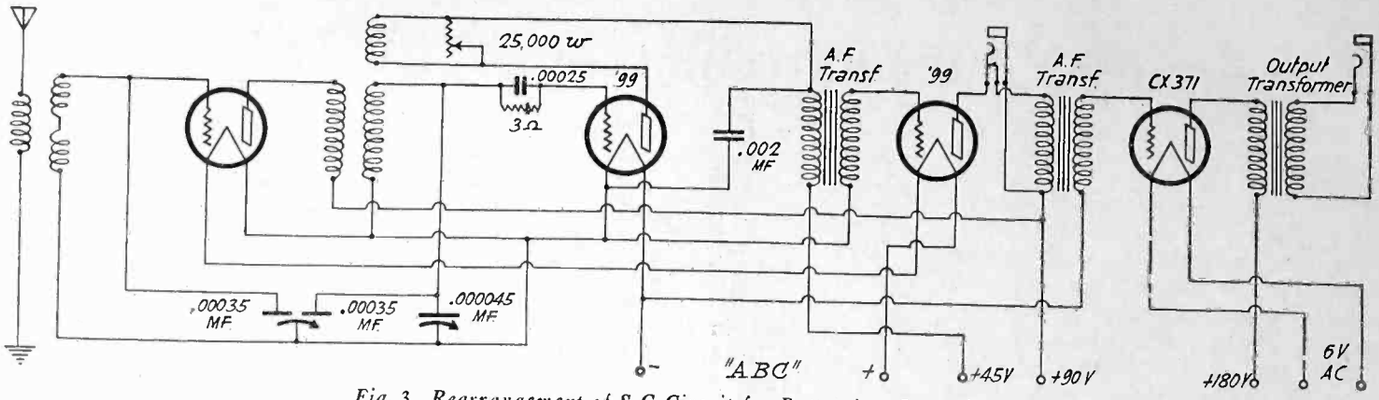


Fig. 3. Rearrangement of S-C Circuit for Batteryless Operation.

tive end of the series filament connection will be about 55 milliamperes, which, added to the 8 to 10 milliamperes plate current will make about 63 to 65 milliamperes in the second detector filament circuit. The 99 tube will operate satisfactorily with only 55 milliamperes filament current, so that the receiver should function normally as with battery supply.

If a receiver whose circuit is not shown in any of the diagrams is to be rewired, a special diagram for the particular set involved can be drawn. Remember to start the positive filament connection with the last 99 tube audio amplifier, and after wiring the audio stages in series (in case there were two 99 tube audio amplifiers as in resistance or impedance coupling), connect the r.f. tubes next in line, starting with the 1st r.f. and working back so as to end up with the detector tube, which is connected to the negative of the *A* current supply. With these connections made the grids of the various tubes can be connected in the manner shown in the diagrams, and the proper *C* voltage obtained.

In the picture is shown the power plant assembled in its cabinet, with the necessary ventilating holes in the top and back. The box can be constructed with a hinged lid, so as to be more accessible, or the back can fold down, as was done in the experimental model. The importance of ventilation cannot be overemphasized, as several watts of power are dissipated in the filament of each rectifier tube, and in the mazda lamp bank, so that with no ventilation, the box would soon be sprung out of shape, and some of the apparatus might possibly be damaged if the plant were operated for a long period of time.

It has been suggested that the main snap switch in the 110-volt line be located on the panel of the receiver itself. This can be done if twisted lamp cord is used to bring the a.c. into the receiver, and then over to the power plant. If obtainable, shielded lamp cord should be used, the shield being grounded to prevent a.c. disturbances from being picked up by the detector tube. Another handy method would be to place a Cutler-Hammer feed-through switch in series with the flexible cord extending from the power plant to the convenience outlet on the baseboard, making the cord long enough so that the switch can be laid on the table near the receiver.

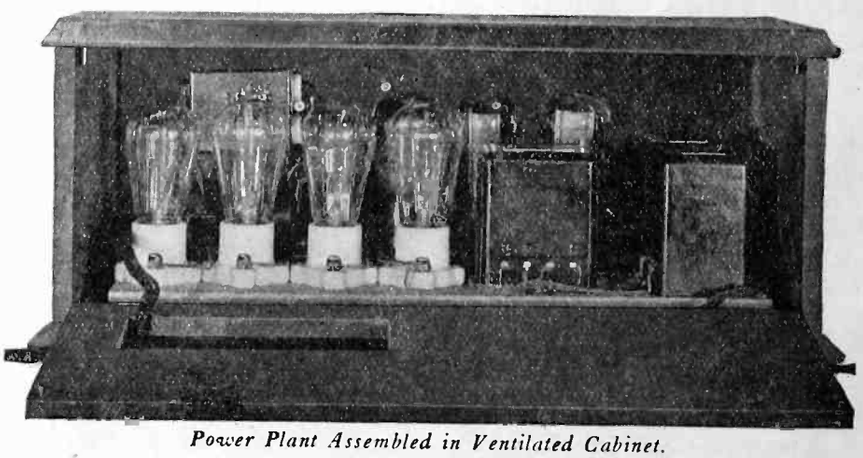
HANDY HINTS

By D. E. McGown

WHEN working around storage batteries a rubber sponge will be found to be handy in absorbing spilled acid or water Such a sponge can be washed out in water, and used many times, not being damaged if saturated with acid.

In shielding a receiving set a very good metal is common sheet roofing "tin," which is actually sheet iron tin plated. This is cheap and readily obtainable, and is quite easily worked; besides this, it provides electro-magnetic, as well as electro-static shielding, which is quite important in some cases.

Adhesive tape, such as used for medical purposes, will serve quite well to cover up wire connections, in the absence of the usual electrician's tape; it is not moisture-proof, however, so should be used carefully.



Power Plant Assembled in Ventilated Cabinet.

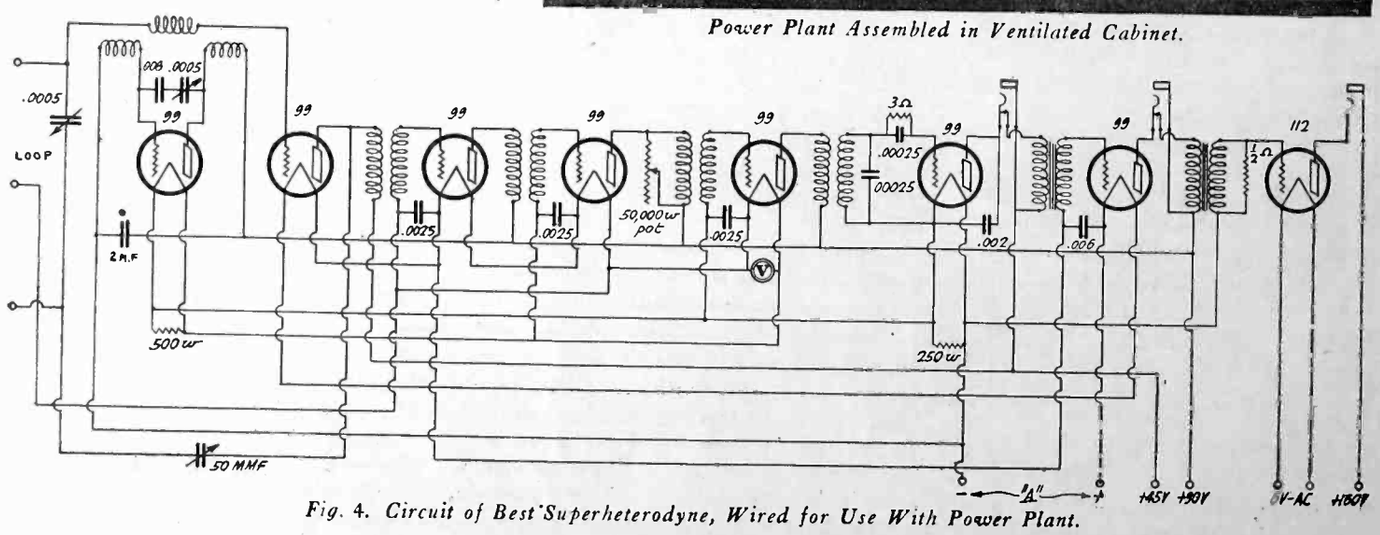


Fig. 4. Circuit of Best Superheterodyne, Wired for Use With Power Plant.

"I think there'll be a little entertainment on the air which you'll find interesting."

Tuning in on Elwood Glover

By John Eugene Hasty

THE CHAP who came out with the remark about a man's being innocent until he's been proved guilty ought to have his name emblazoned on the shining roll of fame, along with the fellows who invented the expressions, "What'll you have?" and "Enclosed find check." I mean to say that he put enough stuff in that one saying to make his mark in the world, even if he didn't utter another peep for the rest of his life. I know; because I've jolly well been through the well known mill.

It all started with this fellow Elwood Glover, the big clothing manufacturer. You know, Glover's Gaudy Garments for Goofy Guys, the gent who made so much money selling tissue paper uniforms to Uncle Sam during the war. I used to see him around the club quite a bit—a beefy, red-faced individual with a pair of cold, gray eyes that had a look in them like the far-away gaze of a dead fish. Somehow, when he turned them on me, I felt like parking my watch in a well guarded safety deposit vault, and calling a cop just for personal comfort. I never had much to do with him, except for passing the time of day and what not; so I was a bit surprised when he surged into the grill room one morning and whacked me on the shoulder.

"Hullo, Freddie," he said, with what passed for a jovial grin, "I thought I'd find you here. I just dropped in to give you a little tip."

"You could have used the mails, and saved yourself a lot of trouble," I answered, not looking up from my grapefruit, which is a good starter for the day because it combines a shower-bath with nourishment.

"Oh, no trouble, at all," he went on, missing my neat, little sarcastic thrust, "No trouble at all. You see, I'm throwing a swell party at my country place over the week end, and you're on the guest list."

"I'm simply dumbfounded," I chortled, viciously attacking a grilled chop.

"Then I can count on you, eh?"

"U-huh," I replied, "you can count me out."

"You mean that you won't come?" he said, gawping at me as if I'd just turned down an opportunity to grab off the ice water concession in Hades. "Er—why not?"

"Well, one reason," I told him, "is that I have a date on Saturday afternoon to play golf with Bill Curtiss."

"Curtiss!" he snorted. "Never heard of him. What did *he* ever do?"

"He wore one of your uniforms in a rain storm," I replied, "and managed to get back to camp without being arrested for indecent exposure. They gave him a medal for it. In addition to that, he's a radio expert."

"Ha, ha!" Glover roared, "I always thought you blue-blooded aristocrats didn't have a sense of humor; but I see you enjoy a joke as well as the next man. I don't know this guy, Curtiss; but if he's a friend of yours, he must be okay. So bring him along with you. If he knows anything about radio, he'll get a big kick out of my outfits. I've got two sets—one in the drawing room and one in my bedroom. They cost me twelve thousand dollars apiece. I had 'em made to order. Well, so long Freddie, I'll see you and your friend Curtiss next Saturday, then."

"Hold on there——," I began; but Glover was absolutely too fast for me.

"Remember, we dine at eight," he shouted, "and I'm expecting you." And with that he stalked off, leaving me about in the same position as the chap in the book who gets a telegram which reads, "I have learned the truth; and all is over between us—signed, Bertha."

I mean to say it was a bit mouldy to have to go around to Bill Curtiss and explain the situation. Bill knows a lot about radio; but as a social lion he's a dismal flop. It's just about as hard to get him into a dinner jacket as it is to get a fellow named Francis X. Kelly into the Ku Klux Klan. However, as the poet said, if you can't lie in your bed, lie out of it; so gulping down my coffee, I set boldly out for Bill's laboratory to

fix things up. Well, the old bean happened to be clicking perfectly that morning, and before I arrived there, I had the whole scheme worked out."

"See here, Bill," I said, draping myself in a nearby chair, "I've just been talking to a chap who has a radio that will pick up sounds right out of the air —you know, without their having been shot through a broadcasting station. I mean to say, he can go into another part of the house and whisper something, and his receiving set will pick it up and amplify it so that it sounds as if he were talking to you in a natural voice, right there in the same room."

"What's that?" Bill said, laying aside a thingumajig he was working with, and pricking up his ears like a pet bull pup that's just remembered where he buried a juicy bone. "You mean to say that his set will pick up sounds which haven't first been converted into electrical energy by——?"

"Absolutely," I cut in. "He had the set made to order. I guess he must have invented it himself."

"Nonsense!" Bill came back. "He's been kidding you. The thing is impossible, entirely contrary to the whole theory of radio."

"I don't know anything about the theory of radio," I said, giving him the old stoney stare, "but I do know that this chap has such a radio set; and I'm willing to lay you twenty-five dollars on it."

"Is this a joke?" he asked.

"It's no joke," I answered, thinking of the twenty-five berries I was going to part with. "And if you don't believe it, we'll take a run down to this chap's place over the week end, and you can see the set for yourself."

"I hate to take your money, Freddie," he said with a grin, "but you're on. I pay you twenty-five dollars if the set works as you have described it; you pay me twenty-five if it doesn't."

"Righto!" I sang out. "And may the best chappie win."

Even if the scheme did stand to cost me a piece of change, I still claim it was a stroke of genius—you know, working on Bill's weakness, the old heel of Achilles and all that sort of thing. I mean to say he was so positively pepped up about seeing the imaginary radio set that he overlooked the fact that he was booked for the soup and fish act. Saturday when I called for him in the car, he was as anxious to get to Glover's place as a woman is to get to a bargain counter.

"Do you suppose that Glover will let me inspect the hook-up of his set?" he asked, as innocent as a child.

"I don't know about that," I replied, giving my deep-dyed plot another deft touch. "The old fellow is a bit reticent, doesn't like to confide in strangers. If I were you, I'd sort of get chummy with him before mentioning the set at all. I mean to say, don't rush him. Kid him along a little. Then about Sunday evening, you can drop a gentle hint that you'd like to look at the set."

It was amazing how well my little strategy was working out—so perfectly that I should have known that things couldn't go on like that. We arrived at the Glover domicile about five-thirty; and what with dressing and gossiping a bit with some of the other guests, I didn't see Curtiss again until we went in to dinner. He was sitting next to a frivolous, young blood of some forty odd summers, and trying to look interested in what she was saying. But it wasn't hard to see that beneath his happy and carefree mask, the poor egg was suffering terribly. There was a sort of half-scared, half-apologetic expression on his face that positively went to my heart. After the ladies had gone into the drawing room for coffee, he came over and dropped limply into the chair beside me.

"Say, Freddie," he whispered in a hushed, bedside sort of voice, "I'm not cut out for this society game. I'm going to beat it."

"Oh, come now, you can't do that kind of thing, you know," I answered, trying to rally around the fellow and buck him up, as it were. "I really isn't done. Besides, you haven't inspected the radio set yet."

"Damn the radio set," he muttered savagely. "I want you to drive me back to town tonight."

"But, my dear chap," I objected, "that's impossible. I'm willing to do anything in reason, but as for——."

"You mean you're turning me down?" he came in hoarsely, crushing a napkin in his hand and breathing hard like the hero in the movies, just before he smacks the villain for a goal.

I saw right away that things had passed the point where I could humor him along. He was outright panicky. The situation required a firm hand; and while we Rockford-Peebles are usually amiability itself, we can be stern as steel when the occasion demands it.

"Now see here, old friend," I answered, with a touch of austerity, "you're forgetting that this business isn't a passing lark which you can drop out of whenever you please. It's an affair of honor, a matter of winning or losing a bet. I expect you to stay with it."

He gave a groan; and before he could think up a reply, Glover pounced into the conversation and sort of eased Curtiss into the background.

"Say, Freddie," he asked, "know anything about art? I just bought a painting that I'd like you to look at. It cost me a cool seven thousand smacks."

I must say that art has never bulked large in my young life, but as Glover insisted I followed him into his study to have a squint at the picture. While I was giving it the old up and down, he reached over and swung it to one side. Behind it was a wall safe.

"You'd never guess it," he said slyly, tapping the safe with his finger, "but that picture hides enough money to clean up the Allies' war debt. I've got bonds in this safe worth about a quarter of a million dollars."

Then he went on to tell he how smart he was at making money, and how he had invested some odd sums for his nephew and had run them into six figures in less than two years. After he had gone on in that vein for fifteen or twenty minutes, I must say I got somewhat fed up. It's all very well for a chap to be proud of his success, but this fellow Glover overdid it. I mean to say that when it comes to showing off the family bank book like a trick pup, it's a bit of rather low taste, don't you think? Finally, I managed to tear away and join the group in the drawing room where I spent the remainder of the evening dodging a conversation with Curtiss. Taking it all by and large, I can't say that I was having a particularly glorious time. But it wasn't anything to what happened the next morning.

I had passed up the breakfast gong and was lingering peacefully in the well known lap of Morpheus, when someone began pounding on my door.

"Hullo!" I shouted, sitting up in bed. "What's all the row?"

"It's Higgins, sir, the butler," came a voice from the other side of the door. "Mr. Glover is especially anxious for you to come down to his study at once. It's very important, sir."

Thinking that maybe the jolly old house was afire, I hopped into my clothes and scrambled downstairs. There was a medley of mixed voices in progress in Glover's study; and as nobody paid any attention when I knocked, I turned the knob and trickled in. The whole crowd was there, including Glover, who was surging back and forth, ruffling his hair, and wearing an expression of one who, having a-Maying gone, sits down upon a hornet's nest. I mean to say he seemed rather put out about something. In fact, the only person who wasn't buzzing with excitement was a little, dark-complexioned, rat-faced chap who apparently was a newcomer in our midst. He was sitting at Glover's desk, but got up as I came in.

"Uh—I think we are all here now"; he began, "so I—uh—may as well explain the purpose of this—uh—this conference. As Mr. Glover has already explained to some of you, the wall safe in this room was broken open last night, and two hundred thousand dollars' worth of securities taken. In the capacity of Mr. Glover's attorney, I have advised him not to notify the police as yet; because—uh—because we have very substantial evidence that the securities were taken by one of Mr. Glover's house guests."

Everyone gasped as if he or she were

(*Continued on Page* 48)

Distortion in Resistance Coupled Amplifiers

How Minimized by Proper Choice of Stopping and By-Pass Condensers and of Grid-Leak Resistance

By J. E. Anderson

IT IS usually said of resistance coupled amplifiers that they amplify all audio frequencies to the same degree; and consequently it is generally held that they do not introduce any distortion into the signal. Unfortunately, they do not perform according to their reputation, for all of them introduce some distortion and some of them introduce a great deal. It all depends on how they have been designed and built. But still they are the best amplifiers that we have, or may easily be made so by a judicious choice of parts. Let us see how the distortion is introduced and how it may be minimized.

The conclusion that resistance coupled amplifiers are non-distorting is reached by assuming that the coupling device between two tubes is purely resistive, or wholly non-reactive. That is, the assumption is made that there is neither inductance nor capacity in the coupling device. But this assumption is rarely allowable, for in all practical amplifiers there is at least the capacity of the stopping condenser and sometimes that of a by-pass condenser across the first coupling resistance. As soon as these condensers are introduced the circuit becomes reactive and it no longer amplifies all frequencies to the same degree.

Let us first consider the case in which there is only one condenser, namely, the stopping condenser. The equivalent circuit for this case is shown in Fig. 1. In this E represents the input voltage to the first tube, μ the amplification constant of that tube, R_0 the a.c. plate resistance of the tube, R_1 the coupling resistance through which the plate voltage is supplied the tube, C the stopping condenser which prevents the high positive voltage from reaching the grid of the second tube, and R_2 represents the effective grid leak resistance of the second tube. If E_g is the effective input voltage to the second tube, then the voltage amplification of first tube and associated coupling device is $M=E_g/E$. The value of M in terms of the various coupling impedances and the amplification constant of the tube is found from the formula

$$M=\frac{\mu R_1R_2}{R_0R_1+R_0R_2+R_1R_2+(R_0+R_1)Z} \quad \text{.....(1)}$$

in which Z, the reactance of the condenser C is equal to $1/j\,C\,\omega$.....(1a). When C is infinite, i.e. when the reactance is zero, equation (1) reduces to

$$M=\frac{\mu R_1}{R_0+R_1} \quad \text{.....(2)}$$

which is the equation usually given in connection with resistance coupled amplification, and from which the conclusion is drawn that resistance coupling is absolutely non-distorting. The conclusion, of course, is true when equation (2) applies, which it never does for any practical circuit. We must consider (1).

Equation (2) was obtained by letting Z in (1) be zero. By making the capacity C of the stopping condenser large enough we may approach the condition $Z=0$ as closely as we wish, and therefore we may eliminate the distorting effect of this condenser to any degree we desire. The amount of distortion for different sizes of stopping condensers at various frequencies will be shown later by means of curves.

If we let R_2 be infinite in value in equation (1), that is, if we assume that there is no leakage from the second grid to the filament whatsoever, then (1) will again reduce to equation (2). Then making R_2 infinitely large is another condition for obtaining, theoretically, distortionless amplification. But as soon as R_2 is removed, the amplifier becomes inoperative, so that method is not available in practice. But the amplifier will work for widely different values of R_2, and we may, therefore, get different degrees of distortion for any given size of stopping condenser according to the magnitude of the grid leak. It is plain that to minimize distortion, the grid leak resistance should be as large as possible in practice. The size depends on the value of E_g.

In the graph of Fig. 3 is shown the distorting effect of various sizes of stopping condensers for certain assumed conditions. These are that $\mu=8$, $R_0=20{,}000$ ohms, $R_1=100{,}000$ ohms, and $R_2=500{,}000$ ohms. The straight line AA^1 parallel to the axis or frequency represents the amplification when the size of the stopping condenser is infinite, i.e. it is the value of M obtained from equation (2). The curve for a 1 mfd. stopping condenser practically coincides with this curve for all audible frequencies. For a frequency as low as 16 cycles per second it does not deviate from this line by as much as 1 per cent. Hence we may conclude that if a 1mfd. condenser is used for stopping there will be no suppression of any audio frequencies to any appreciable degree, at least not when the resistance values assumed in this case are used.

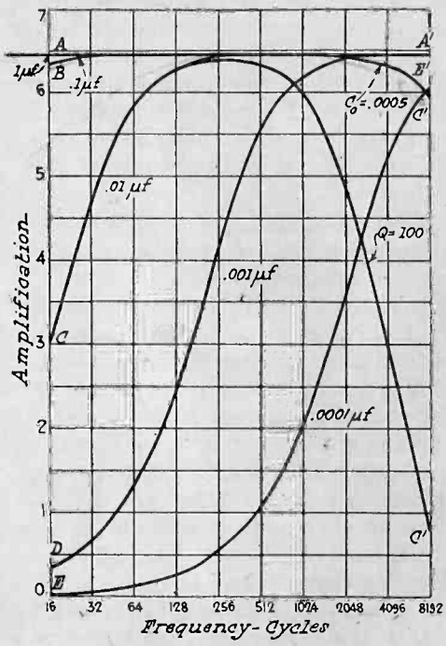


Fig. 3. Distorting Effect of Various Stopping Condensers.

The line BA^1 represents the amplification curve when the stopping condenser is .1 mfd., with the other conditions remaining unchanged. At 16 cycles per second this shows an amplification of 6.33 as against a possible maximum of 6.45 for an infinite condenser. At 37 cycles per second the BA^1 line joins the AA^1 line. Thus with a .1 mfd. condenser there is only a slight suppression

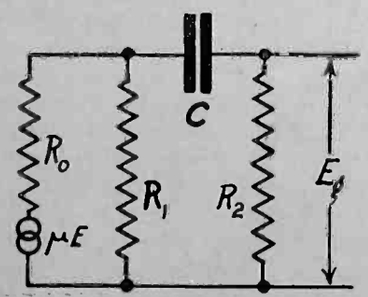


Fig. 1. Circuit Equivalent to Resistance Coupled Amplifier with Stopping Condenser.

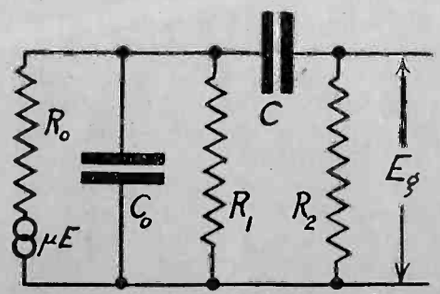


Fig. 2 Circuit Equivalent to Resistance Coupled Amplifier with By-Pass and Stopping Condensers.

of the notes in the 16-32 octave, and the amount of distortion is negligible.

The next curve, CA^1, is the result when the stopping condenser has a value of .01 mfd. This presents considerable distortion on the lower audible octaves. Thus at 16 cycles the transmission is only 46 per cent of the maximum. At 32 it is 72 per cent, at 64, 90 per cent, at 128, 97 per cent, and at 256 cycles it is 98.5 per cent. This line joins AA^1 at 316 cycles per second. With this size of condenser there is appreciable distortion for all frequencies below middle C, and for the lowest audible octaves it is quite serious. This is the smallest condenser that should ever be used in an audio frequency, resistance coupled amplifier, and it should only be used where first cost and space must be kept down to a minimum. It would, however, be better to set .1 mfd. as the minimum.

Condensers as small as .001 mfd. have been recommended for stopping in a resistance coupled amplifier. Curve DA^1 on the graph shows what reproduction may be expected with such a small condenser. At 16 cycles the transmission is only 5.1 per cent of the maximum, at 64 cycles it is 20.8 per cent, at 256, 64.4 per cent, and at 1024, 96 per cent. Two octaves higher, or at 4096, the curve coincides with the AA^1 line, and for frequencies higher than that the amplification is the same as if the capacity of the condensers were infinite. In view of the fact that Curve DA^1 shows considerable suppression for all of the most important frequencies, it is obvious that a .001 mfd. condenser should never be used for stopping in a resistance coupled amplifier. When it is used the boasted amplification of the low notes is mainly a function of the imagination.

Although a smaller condenser than .001 mfd. is never used in a resistance coupler amplifier, for stopping purposes, it is interesting to see what kind of reproduction is possible with a smaller value, say a .0001 mfd. The curve for this value is given by EE^1 The course of the curve at the upper end shows that there should be appreciable suppression for all audible frequencies.

It may be well to point out that if it were possible to use no leakage resistance whatever, i. e. if it were possible to make R_2 infinite, the smallest stopping condenser would have no distorting effect on the signal. The distortion enters because there is a current through the condenser, and there could be no current if the leakage were absent. This neglects the capacity between the grid and filament of the second tube, however.

The curves from AA^1 to EE^1 correspond to the case where there is no by-pass condenser across the coupling resistance R_1. If the detector tube and the first audio tube are connected by a resistance coupler, then a small by-pass condenser is usually connected across R_1. This alters the amplification and the distortion. Fig. 2 illustrates the equivalent circuit for this case. Fig. 2 is the same as Fig. 1 with the exception of the addition of the by-pass condenser C_0.

When this is taken into account in deriving the expression for amplification we get formula

$$M=\frac{\mu R_1R_2}{R_0R_1+R_0R_2+R_1R_2+R_0R_1\frac{C_0}{C}+j\left[R_0R_1R_2C_0\omega-\frac{(R_0+R_1)}{C\omega}\right]} \qquad (3)$$

as the value of M. The reactive part of this formula is composed of two parts, one positive which is directly proportional to the frequency, and one negative which is inversely proportional to the frequency. It is plain, therefore, that there is one frequency for which the reactive part is zero, and for which the amplification is a maximum. The frequency where this occurs is given by

$$f=\frac{1}{2\pi\sqrt{C_0C\,R_0R_1R_2}}\sqrt{R_0+R_1} \qquad (4).$$

By suitable choice of the various impedances entering into the coupler this maximum may be placed at any point in the frequency scale.

If the amplification is calculated with the aid of formula (3), using the same values of resistance and of μ as before and the values C_0=.0005 mfd. and C=.01 mfd., we get Curve CC^1. This curve coincides, practically, with CA^1 up to and slightly above the point where M is maximum. For higher values of frequency the amplification decreases due to the by-passing effect of the condenser. The distortion caused by this .0005 mfd. condenser is negligible, but it would increase rapidly with an increase in the value of the capacity of the by-pass. It is obvious that the smallest by-pass condenser that will give satisfactory regeneration should be used if the quality of the signal is to be retained.

If instead of applying formula (3) to curve CA^1 it had been applied to AA^1 or BA^1, the resulting curve would still have coincided with these curves below the maximum, and the deviation at the upper end would have been the same as it is for the CC^1 curve. That is, for C=.1 mfd. and C_0=.0005 mfd. the distortion would have been negligible for both high and low frequencies, and it would have been still smaller at the lower end if C=1 had been used.

The distortion introduced into the signal by the various amplifying stages is cumulative, not by simple addition but by multiplication. For example, if the suppression at 16 cycles is 3% for one stage, then the suppression by three similar stages will be about 8.7%. Again, if the suppression at a certain frequency by one stage is 50%, the suppression at the same frequency by three similar stages will be 87.5%. Hence if the distortion for one stage is considerable, the distortion by several stages will be very serious. For example, the distortion caused by a stopping condenser of .01 mfd., as shown by *Curve* CA^1, may be tolerable in one stage, but that caused by three stages of the same characteristics would be more than even the imagination could compensate.

Since, usually, there is only one by-pass condenser to cut down the amplification at the higher frequencies, if we choose as small a value as possible for this, there will be no cumulative or appreciable suppression of the higher essential frequencies. But suppression of these frequencies by the by-pass is not the only way in which they are cut down. The distortion by the tuner is much more serious in highly selective receivers.

To show the magnitude of this one case has been determined, which is a modification of the Curve CC''. It has been assumed that the overall effective selectivity of the tuner is 100. This means that if there is a single tuner which has the same selectivity as the total system, then the reactance of the inductance coil divided by the resistance of the coil is equal to 100. This value is not nearly high enough for regenerative circuits, super-heterodynes, or well designed radio frequency tuners comprising two or more circuits; and since the distortion increases rapidly with an increase in the selectivity, Q, the distortion obtained by letting Q=*100* will not be nearly as great as that which may be obtained in actual circuits commonly used. Curve CC'' is the transmission characteristic obtained from Curve CC' when Q=*100*. For low frequencies CC'' follows CC' very closely but begins to drop down at about 128 cycles. The curve reaches a maximum at about 280 cycles, and beyond that point it drops very rapidly, reaching a low of .8 at a frequency of 8192 cycles. In view of the great distorting effect of a sharp tuner, it is evident that for quality the selectivity should be no greater than is absolutely necessary to separate interfering stations from the desired.

Summing up the conclusions in this article, the stopping condenser in the grid circuit of an audio frequency, resistance coupled amplifier should be as large as practicable in order to prevent the suppression of the lower octaves in the audible scale; the by-pass condenser across the first coupling resistance should be as small as possible in order to prevent the by-passing of the higher octaves in the audible scale; the tuner system should be no more selective than necessary if the higher notes in the audible scale are to be brought out; the grid leak resistance in any stage should not be any smaller than necessary in order that the distortion caused by any given stopping condenser used shall be as small as possible. The size of the latter is determined by blocking tendency of the grid when the leakage is insufficient.

A Portable All-Purpose Testing Instrument

A Specially Constructed Testing Outfit for the Radio Shop Service-man and Home Laboratory

By E. E. Griffin

TO fill the needs of an inexpensive, all-purpose testing instrument, a single meter may be made to serve as a milliammeter, an ammeter, a multi-range voltmeter, a tube tester for all styles of receiving tubes; and most important of all a set and circuit tester. As a set or circuit tester it indicates the most common causes of receiver troubles, such as burnt out or open transformers and loudspeakers, open or shorted wiring, run-down batteries, reversed connections, etc. This is all accomplished with a Weston 0 to 5 milliammeter in conjunction with a Weston bi-polar switch, arranged in a circuit of shunts and multipliers, the switch serving to place the meter in the circuit at the points of test and to indicate its function at that position.

The panel view of the completed instrument is given in Fig. 1, and the diagram of connections is shown in Fig. 2. At first glance the instrument appears to be somewhat complicated, but becomes quite simplified when each function is considered separately. As a voltmeter, the meter gives full scale readings of 0 to 5, 0 to 25, 0 to 50 and 0 to 250 volts, each individual range being obtained by turning the bi-polar switch to the desired position, the two lower binding posts serving to connect the instrument to any external circuit. As an ammeter the ranges are 0 to 50 and 0 to 500 milliamperes, 0 to 5 and 0 to 25 amperes, the individual ranges being obtained by shifting the negative test lead to the post of desired range, the bi-polar switch remaining on the *Amps* position for all ranges.

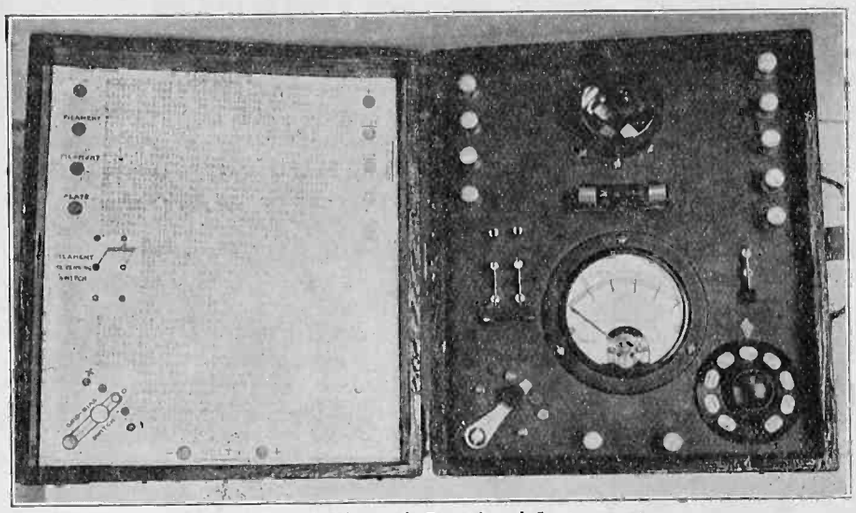


Fig. 1. Panel View of Completed Instrument.

As a tube tester, *A* and *B* current is supplied from a receiver through a plug and four wire flexible cord, *C* voltage being furnished by two small flashlight batteries contained within the case of the instrument and varied by a five point switch. When used as a tube tester, the meter indicates the voltage across the tube filament in a range of 0 to 5 volts, and the plate current in milliamperes from 0 to 5, the two positions being indicated on the bi-polar switch as *"Fil. Volts"* and *"Plate Mills."* For use in testing power tubes a small single pole single throw switch above the bi-polar dial gives the meter a range of 0 to 50 milliamperes.

Used as a set and circuit tester, the same plug and cord serves to connect the instrument into the various tube sockets of a receiver, the positions of *"Grid Volts," "Fil. Volts,"* and *"Plate Volts"* on the bi-polar switch then serving to denote circuit continuity for the grid, filament and plate circuits of that particular tube socket. The actual calibrations of the meter for the three positions are 0 to 5, 0 to 5 and 0 to 250 volts respectively, but actual voltage values are disregarded except on r. f. sockets where full battery voltages will be had on the average set. What is required is current indication of correct polarity, failure of which indicates reversed or wrongly connected or run-down batteries, open circuit, etc., as the case may be. Since it takes only a few seconds to plug into all tube sockets of a set and apply the three positions of the bi-polar switch to each socket, complete circuit test of a receiver can be quickly accomplished. The double pole double throw switch to the left of the meter serves to reverse the filament connections to the instrument should the meter read backwards on *"Fil. Volts."* This switch is necessary on account of the fact that many sets on the market have their detector and oscillator filaments connected, the reverse of amplifiers. Above the meter is a protective fuse mounted in a holder, and a standard tube socket.

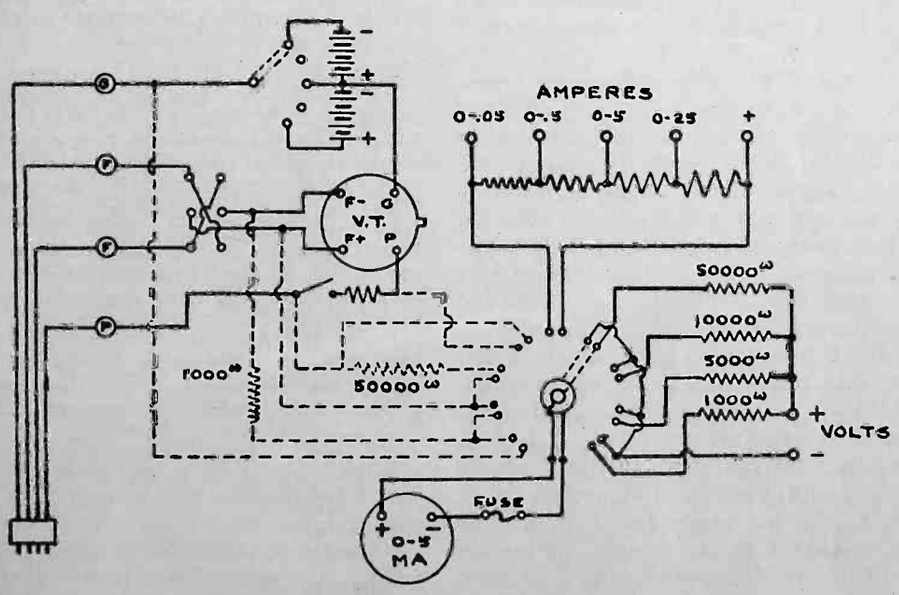


Fig. 2. Circuit Diagram of Testing Instrument.

The accessories to be used with the instrument consist of four adaptors, the cord and plug and a two-conductor flexible lead for use with the voltmeter and ammeter connections. Sufficient space is provided between the cover and panel when the instrument box is closed to contain these items, which are illustrated in Fig. 3. The cord and plug used to connect the instrument to a receiver is

made up from the base of a 199 type of tube, the grid, plate and filament terminals leading out through a wood handle and connecting to the respective grid, plate and filament terminals of the tester by stranded lamp cord. One standard adaptor used in the socket of the tester arranges the instrument for testing 199 type tubes, while the same adaptor placed on the end of the cord plug arranges the instrument for testing the large base tubes. This new adaptor is also suitable for plugging into the UX and CX sockets, while a UX adaptor is used for placing the X base tubes in the socket of the tester. For the WD-11 type tube, one adaptor from WD-11 to standard base is used in the tester socket, and one adapting the 199 plug to the WD-11 sockets of a receiver is necessary. All of these adaptors are on the market and readily obtainable. Thus the instrument may be used to test all types of receiving tubes and may be plugged into any receiver.

Fig. 3. Accessories for Test Instrument.

For those who desire to construct such an instrument the following points will be of interest and result in considerable saving of time. The most important point is in the selection of a suitable switch. Various types and arrangements have been tried with various results, the ones of suitable small size generally giving trouble in variation of contact resistance, which introduces error in the meter calibration. Others were satisfactory in this respect, but were considered too bulky and cumbersome. The one used on the instrument illustrated is both small in size and easily wired, having soldering lugs extending from each contact. The contacts are of the self-cleaning wipe type, and introduce no error in calibration as noted above. The milliammeter may be captioned with an 0 to 25 scale as illustrated, any draughtsman will do this for a nominal charge. Here it is pointed out that instead of using any 0 to 25 or 0 to 250 scale, all readings could be made in scales of 10, thus requiring no special work on the meter dial.

For the protective fuse of the milliammeter, most any instrument or *B* battery fuse will suffice, there being many available. The main requirement is that when the fuse blows, it must be replaceable with one of like resistance in order not to affect the meter calibration. Experience has shown that 4v-199 amperite will blow before serious damage is done to the meter, and since amperites are always readily obtainable, they are quite suitable.

The multipliers for the voltmeter ranges may be obtained from the makers of the meter, the resistances required for the various readings being given in the diagram. Good resistors such as the Allen-Bradley may be used, however, mounting them in their holders. In either case, accurate calibration must be done by checking with a standard voltmeter. Multipliers obtained from the instrument makers are of slightly higher resistance than their rated values, so that final accuracy may be obtained by removing a few turns of wire to suit the individual meter and circuit. If the Allen-Bradley are used the reverse method must be applied, selecting resistors whose value is slightly lower than the rated value, calibrating accurately by filing away slight portions of the resistor material until the meter reads the correct voltage. We can increase the resistance of the Allen-Bradley type by removing some of the material, but we cannot decrease it, as is the case with the wire-wound types. For the 1000 ohm resistances, number 40 enameled wire such as is used for rewinding phones or speakers may be used, 1040 feet being required to make 1000 ohms. A single 1000 ohm resistance from the negative filament connection serves as a multiplier for both the *"Fil Volts"* and *"Grid Volts"* positions of the bi-polar switch, this connection being common to both positions, as shown by the diagram.

Shunts for the ammeter ranges can be made from commonly available wire, calibration being made by checking with an accurate ammeter. Two shunts of 0 to 50 milliamperes will be required, one for the tube tester and one for the external ampere terminals. Each of these will require approximately 90 in. of No. 34 copper wire. For the 0 to 500 milliampere reading, 56 in. of No. 26 wire will suffice and for the 0 to 5 ampere range, 36 in. of No. 18. For the 0 to 25 ampere shunt, approximately 22 in. of ordinary square bus wire will be found suitable. These sizes and lengths were used in the instrument illustrated, but if other fuse or switch is used than the ones designated the proper lengths must be found by trial. Calibration is fairly simple, starting with the smaller shunt and working up to the 25 ampere. As each shunt is approximately determined it is left in circuit, final calibration being made by rechecking from the 50 milliampere range up, as before. All connections in this shunt circuit must be firm, preferably sweat-soldered, but each length of wire may be coiled into a small space by doubling back in non-inductive form.

The tube tester circular is similar in form to portable testers on the market. Variation in grid bias voltage is obtained by using two small 4½ volt flashlight batteries in conjunction with a five point switch, the switch increasing and diminishing the normal set bias by 4½ volts. The second and fourth switch taps are left open so as to prevent short-circuiting of the battery by the switch lever. The remainder of the circuit is explained by the diagram. Power tubes, must be tested with the instrument plugged into their own special socket, since they require higher *B* and bias voltages; the tester then adds or subtracts from the normal bias as above. Thus in the case of the UX-120 the grid voltages would be 18 minimum and 27 maximum, considering 22½ volts as normal. In all cases the difference between the maximum and minimum readings is taken as the indication of the tube's effectiveness.

Simplified instructions for the use of the completed instrument are contained in the cover and read as follows:

"AMMETER-Place Rotary Switch *RS* on *AMPS*. Connect positive lead to upper post marked +. Connect negative lead to post marked 0-25. Meter then reads 25 amperes full scale. If reading is less than 5 amperes, connect negative lead to post 0-5, and then read scale as 0 to 5 amperes. Following two posts give full scale reading of 0 to 500 and 0 to 50 mills. To protect meter always work from the 0-25 post down.

VOLTMETER: Place *RS* on 0-250 volt position. Connect leads to posts marked *Volts*. Meter then reads 0 to 250 volts full scale. If reading is less than 50 volts, turn *RS* to 0-50, etc., as above, working down to required range.

TUBE TESTER: Place four wire plug into amplifier socket of a receiver. Place tube in socket of tester. Turn *RS* to *Fil. Volts* and adjust rheostat of receiver to correct tube voltage. If meter reads backwards, shift position of *reversing switch*. Turn *RS* to *Plate Mills*, then move *Grid Bias Switch* from negative to positive position, note readings of meter for each position. Difference between these two readings denotes tube condition. If readings are over 5 mills, close *Multiplying Switch*. Meter then reads 0 to 50 milliamperes.

CIRCUIT TESTER: Plug into each socket of receiver in turn, moving *RS* through positions of *Grid Volts, Fil. Volts* and *Plate Volts*. Current indication of correct polarity should show on each socket for grid and plate volts, except detectors, where grid volts should read backwards when grid condenser of set is shorted. Failure of *Plate Volts* to indicate denotes open primary circuit; failure of *Grid Volts* denotes open secondary circuit. *Fil. Volts* should read total battery voltage, full scale reading being 0-5. Full scale for *Grid Volts* is 0-5, and for *Plate Volts* 0-250, but should be disregarded except on r. f. sockets, where full values should indicate. On audio and detector sockets current indication of correct polarity is only requirement. The instrument may be used to measure voltage or amperage while being used as a circuit or tube tester without injury."

These instructions are necessarily condensed and in no wise are intended to supplant experience or knowledge on the part of the operator.

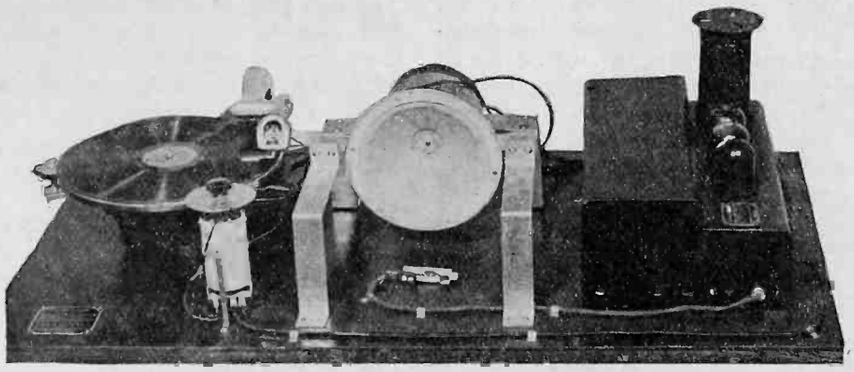
The Electrical Phonograph

A Description and Explanation of the Radio Principles Employed in Its Operation

By Clinton Osborne

AS THE recent improvements in phonographs represent an application of the principles developed in radio, it is deemed that those interested in radio will likewise be interested in the means whereby music from the electrical phonograph has greater volume than of old and a quality equal to the best obtainable from a first class radio receiver. The entire process of making and reproducing the records follows radio precedent. The selections to be recorded are picked up by a microphone similar to that used in broadcasting stations, amplified to the required degree by means of vacuum tubes, and then placed on a master record by an electro-mechanical recorder. Likewise the reproducing apparatus is entirely electrical, the sound being amplified in an audio-frequency amplifier like that used in a radio set and being transmitted to the listener by means of a loudspeaker identical with those used for radio.

These principles are illustrated in the Panatrope, whose parts are illustrated herewith. These are normally concealed in a cabinet together with a turn-table, reproducer and loudspeaker. Referring to Fig. 1, which is the schematic wiring diagram, it can be seen that the turntable on which the phonograph record



Dis-Assembled Parts of Panatrope.

is mounted is a unit in itself, operated by means of an electric motor which receives its power from the 110-volt lighting supply. The turn-table and motor are shown at the left of the board, in the picture, the motor being underneath the turntable.

The pickup device, which consists of an armature on which is wound a number of turns of fine wire, enclosed within a strong magnetic field, is shown attached to the tone arm, which instead of being used to convey sound to a horn, is merely used to support the pickup mechanism. Referring again to Fig. 1, when the needle is placed in the groove of the record and vibrates the armature back and forth, the pickup produces very weak electric currents, which are conducted through a pair of wires to the volume control, a tapped resistance coil, the taps being brought out to a five-point switch mounted near the turn-table in the top of the instrument. Across the volume control is connected a filter which cuts out the noise from the scratching of the needle, so that the music is remarkably free from the hissing noise which usually accompanies the sound from a mechanically operated phonograph.

From the volume control, the currents are conducted to the rectifier-amplifier unit at the right of the board, to a type 99 amplifier tube, thence through a step-

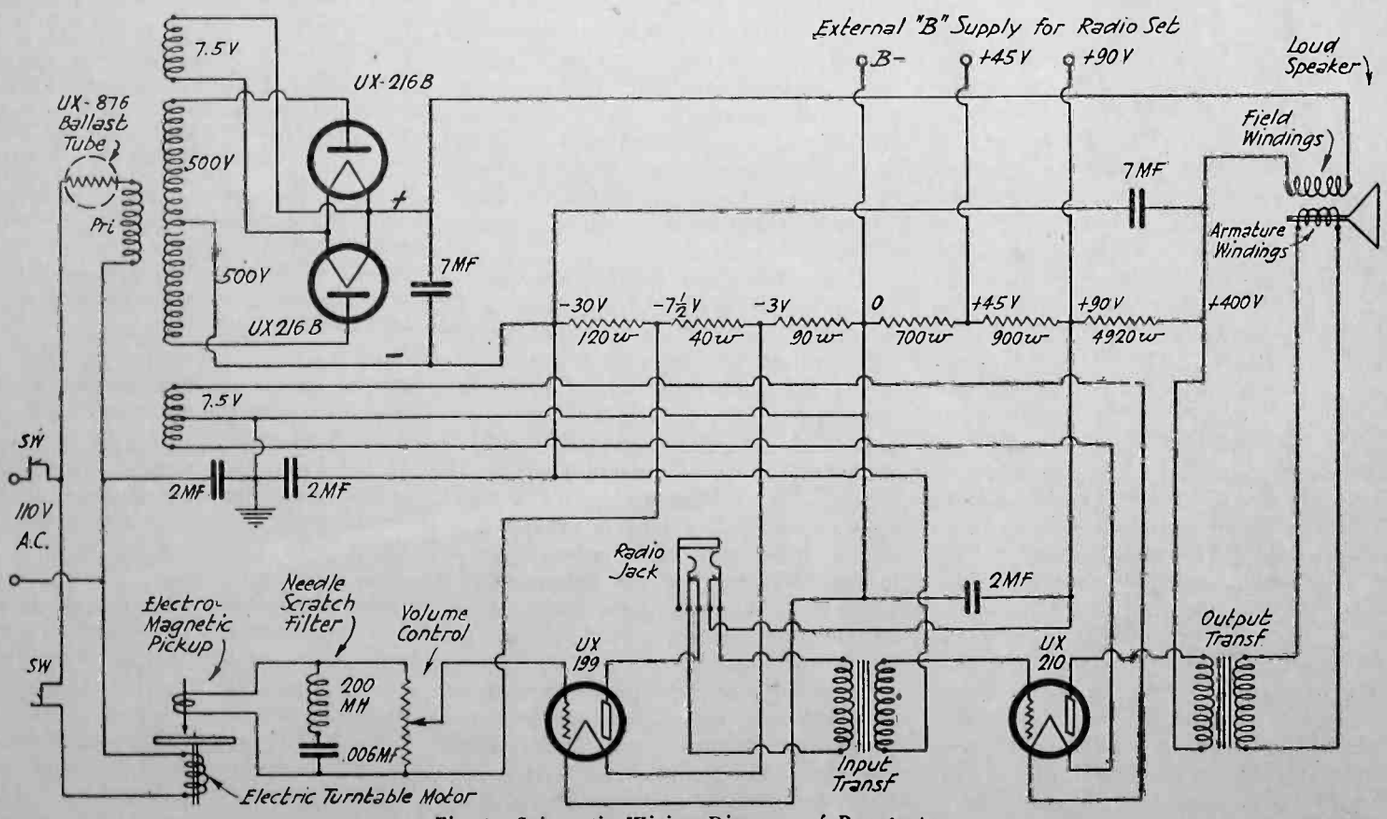


Fig. 1. Schematic Wiring Diagram of Panatrope.

up transformer into a type UX-210 power tube, through an output transformer and into the windings of a cone type loudspeaker, which is shown in the center of the picture. This speaker is of the Rice-Kellogg type, has a set of field windings through which an energizing current of 120 milliamperes flows, and is similar to the Radiola 104 speaker, which is customarily used in radio work.

The most interesting part of the phonograph, to the radio fan, is the power supply. The complete rectifier-amplifier

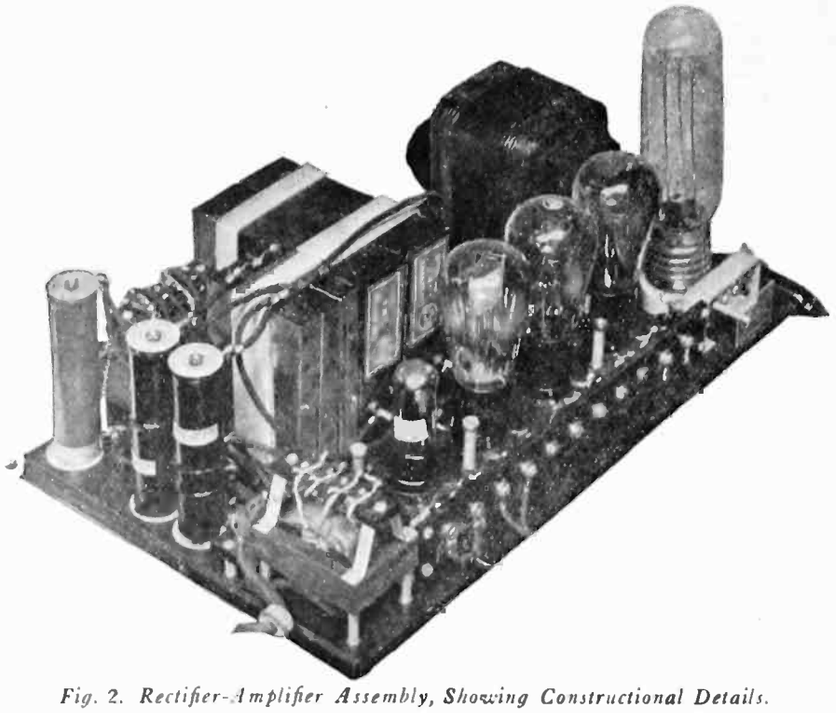


Fig. 2. Rectifier-Amplifier Assembly, Showing Constructional Details.

is shown in Fig. 2, with the metal cover removed to show all the parts. The five tubes, looking from left to right, are the 99 first stage amplifier, the 210 power tube, two UX-216-B rectifier tubes, and a type UV-876 ballast tube. In Fig. 1 is shown the wiring of the power unit, which consists of a transformer having two 500 volt secondaries in series, for the plate supply, and two 7½-volt filament lighting secondaries, one being for the rectifier tube filaments which are in parallel, and the other for the power amplifier tube filament. The latter winding has a center tap, for connection to the negative *B* and grid return circuits. Two UX-216-B tubes rectify both halves of the alternating current wave, a total of 120 milliamperes of pulsating direct current at approximately 500 volts being drawn from these two tubes to supply the amplifier.

The loudspeaker field windings have a very high inductance, and hence make an excellent filter choke to smooth out the pulsating d.c. from the rectifier. Two sets of 7 mfd. fixed condensers are shunted across the d.c. output on each side of the choke, to form a brute force filter similar to that used in most *B* supply units. As 120 milliamperes at 100 volts is required for the field coils of the speaker, the entire load on the rectifier is passed through the field, causing a voltage drop of 100 volts, and leaving a total of 400 volts, 120 milliamperes, available for the amplifier. A set of resistances having a total of 6770 ohms is connected between the output of the filter and the negative of the rectifier, and the various voltage taps are taken off at points along the resistances. The 210 power tube requires the entire 400 volts as plate potential, and so its plate tap is connected directly to the filter output. The filament of the 99 tube requires 3 volts, 60 milliamperes, so the filament is shunted across a pair of the taps between a 90 ohm resistance, as is shown in the diagram. Another tap provides 90 volts plate for the 99 tube, and still another taken out a point 700 ohms from the zero, or ground terminal provides a voltage of 45 for the *B* supply of a radio set, when the latter is used in connection with the phonograph loudspeaker.

Bias voltage for the 99 tube is obtained by the voltage drop across a 40 ohm resistance, and the 30 volt *C* potential required for the power tube is obtained from the drop across 250 ohms, the sum of 120, 40 and 90 ohm resistances shown in the diagram. Should it be desired to connect a radio set to the phonograph, and use its loudspeaker and power amplifier, a jack is provided, as shown in the picture underneath the loudspeaker, so that the output of the radio set is plugged in the jack, cutting off the 99 phonograph amplifier and the pickup mechanism.

Some of the new phonographs are equipped with a built-in radio receiver, of the superheterodyne type, in which case the receiver obtains its current supply from the same rectifier supplying the phonograph amplifier, and the 99 tube shown in the diagram is omitted, having been included in the receiving set circuit. By means of a switch, the radio set or phonograph can be connected at will, without changes in the wiring or adjustment.

As the voltage from the power line may vary with changes in the load, a voltage regulator tube is placed in series with the primary circuit, so that if the voltage rises suddenly while the instrument is in operation, the tube compensates for this rise, and keeps the output of the rectifier absolutely constant. As the tube becomes quite hot during operation, it is completely enclosed in a metal can, which gives adequate protection. The 99 tube amplifier is mounted on a cushioned base, and is also enclosed in a can, so as to prevent coupling between this tube and the loudspeaker, which is mounted directly above it in the assembled phonograph.

The actual operation of the phonograph is extremely simple. A main switch turns on the rectifier-amplifier, and the only indication that the machine is ready for operation is a small red pilot lamp mounted at the base of the cabinet. An auxiliary switch mounted at the edge of the turntable controls the turntable motor, and it is simply necessary to place a record on the disk, close the motor switch, and place the needle in the record groove. The volume is then adjusted to the required proportions by means of the volume control switch.

If you have troublesome interference in your receiving set, such as humming, crackling, crashing, or other noises, the source of the noise can be found most easily by a process of elimination. The first thing to do is to discover whether the noise originates in the set itself, or if it comes from some outside source. To do this, disconnect the aerial and ground from the receiving set; and tune the set over its entire range. If the noise is still present and as loud as before, it is in the set, and proper steps to eliminate it can be taken. In most cases where the noise is in the set, a worn-out *A* or *B* battery will be found to be the source of the trouble. You can get your batteries tested free of charge at any radio store. If the noise is not in the batteries, a poor or a dirty connection may be the cause of it. If the interfering noise stops when the aerial is disconnected, it comes from an outside source; and will have to be traced down with a portable set using a loop aerial. The interference can be found by trying the portable set in several different locations, getting the direction of the noise with the loop aerial in each place, and then plotting the whole thing out on a map of the neighborhood. Where the lines drawn through the plane of the loop in each location cross is the point where the interference will be found. This is the same method as used for finding the location of ships at sea.

Tuned Radio Frequency

An Analysis of Various Methods Employed to Control Oscillations

By L. W. Hatry

BY TUNED radio frequency is meant the use of vacuum tubes as radio frequency amplifiers, the inter-tube coupling circuits being tuned to resonance at the frequency which is desired to be received, and being inefficient for any other frequency. Such a circuit is generally that of Fig. 1, a five-tube receiver with two stages of r.f., detector, and two stages of audio amplification. There are many variations of this circuit in commercial practice, but they all originate from this basic circuit, which has now been in use for about four years.

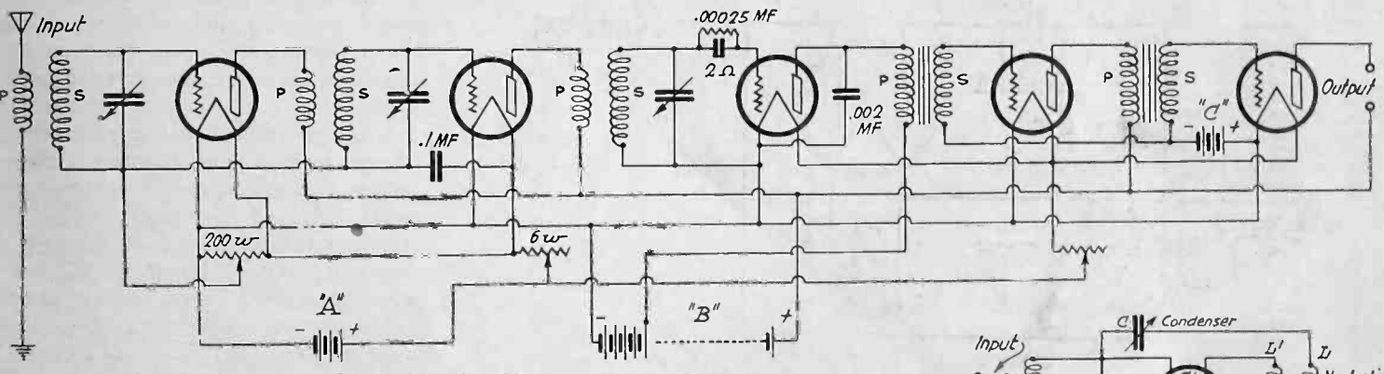


Fig. 1. Basic Tuned R.F. Circuit with Potentiometer Control.

Almost every type of r.f. amplifier has a tendency towards regeneration and oscillation which should be halted before oscillation occurs. The methods of controlling oscillation are numerous, Fig. 1 showing the "potentiometer control." When the slider of the potentiometer is adjusted so that the grid is sufficiently positive, the grid attracts enough electrons so that oscillation cannot take place. This method wastes *B* current as well as signal energy, and so has been properly dubbed a "losser." It was used in the earlier forms of r.f. amplification, both with transformers whose secondaries were untuned, and with those designed for tuning controls.

If we disconnect the potentiometer shown in Fig. 1, and connect the grid return of each r.f tube directly to its negative filament, using the filament rheostat as a volume control, we have an arrangement which is more economical of tubes and batteries. It is being used on a number of the lower-priced receivers, as it requires fewer parts. This method is also a "losser," since it requires lowering the filament current of the r.f. tubes to a point where their amplification is not sufficient to produce oscillation.

An elaboration of Fig. 1, to prevent oscillation troubles, was the Neutrodyne, which prevented oscillation by getting at the cause, and neutralizing certain parasitic capacities. The conventional neutrodyne circuit is shown in Fig. 2, the audio amplifier being omitted, as it is not necessary to the discussion. If no inductive coupling exists between the grid circuit of one of the r.f tubes and its plate circuit load, oscillation will not occur through inductive coupling. There remains but one coupling possible, the capacity of the tube. So that in the neutrodyne, by balancing out the feedback voltage with another voltage equal and opposite to it, oscillation is prevented.

Professor Hazeltine is credited with the best known neutralizing scheme, which is primarily a double coil affair, one coil serving to oppose the other, as shown in Fig. 3a. With two coils of the same size, the voltage at the ends will be equal though opposite. By feeding the grid side through capacity of the same size as the tube electrode capacity, the necessary cancelling voltage is applied. The device resolves itself into a bridge, wherein one path is equal to the other, but the forces traveling them are opposite in nature, so that their meeting cancels them both.

A variation of the Hazeltine method is shown in Fig. 3b, which uses a single tapped coil, half of it being the plate coupling coil and the other half the neutralizing coil. While this is obviously the same as Fig. 3a, some manufacturers have claimed that it is not. Another bridge neutralizing arrangement is shown in Fig. 3c, and is credited to Rice. This method differs from Hazeltine's only in that it provides control from the grid coil instead of the plate coil. Still another method is shown in Fig. 3d, in which the neutralizing tap is taken out from the secondary winding.

The Rice method of neutralizing is bothersome unless shielding is employed between the variable condensers, for there is a tendency for coupling between

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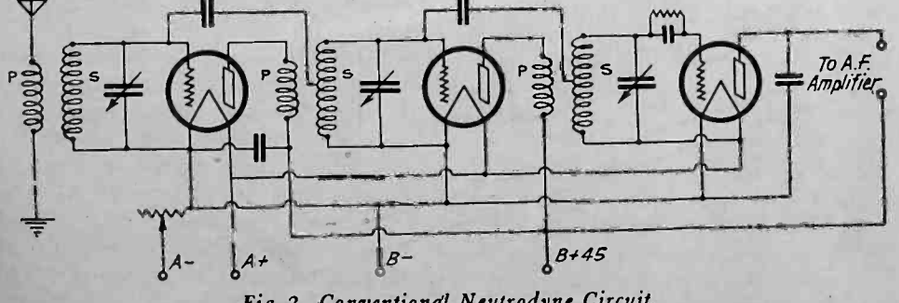


Fig. 2. Conventional Neutrodyne Circuit.

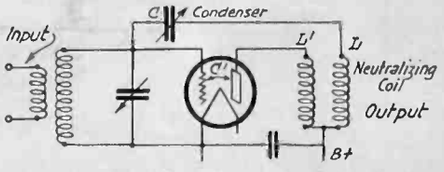


Fig. 3a. Hazeltine Method of Control.

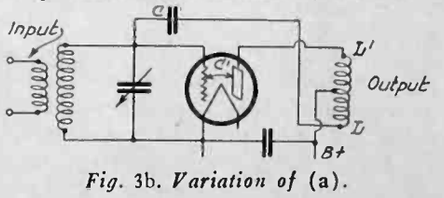


Fig. 3b. Variation of (a).

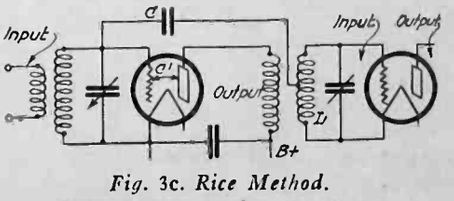


Fig. 3c. Rice Method.

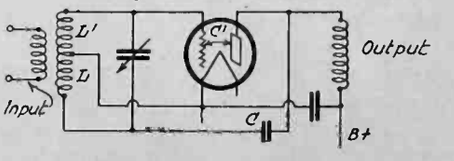


Fig. 3d. Tapped Secondary.

Interchangeable Radio-Frequency Choke Coils

By Charles F. Felstead, 6CU

SINCE the popular wavelength range has been broadened by the amateur going down on the low waves, a receiving set, to be really useful on both the amateur and broadcast bands, must have a tuning range of from about 15 to 600 meters. The best way of accomplishing this is by using interchangeable, plug-in coils, as is employed by most of the modern amateur receivers. Capacity feed-back is generally used in these sets to produce regeneration; and that makes necessary a radio-frequency choke in the plate circuit. A hook-up using capacity feedback, which is the sort used in most amateur receivers, is

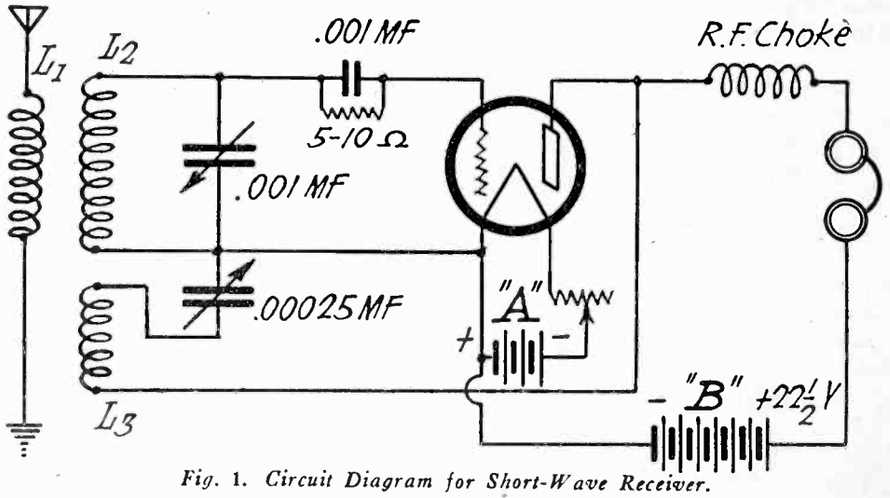


Fig. 1. Circuit Diagram for Short-Wave Receiver.

shown in Fig. 1. The sizes of the coils and condensers for the 40-meter amateur band are as follows: L_1 5 turns No. 16 enamel spaced ⅛ in. on 3-in. diameter form, L_2 10 turns ditto, L_3 4 turns No. 22 enamel close-wound on 2¼-in. form. Condensers should be straight line frequency. Different coils will have to be used if other bands of wavelengths are to be covered. This circuit makes an excellent receiver for the broadcast wavelengths, also, by using larger variable condensers and coils.

The radio-frequency choke coil in the plate circuit must be of the proper size for the waveband to be received, or regeneration and oscillation will not take place. This choke coil is not nearly so critical in size as the secondary and tickler coils; as one choke will do for the wavelengths below 100 meters, and another one will cover the broadcast band of wavelengths—200 to 550 meters—and down to 100 meters. If one receiving set is to be used for both bands, some simple method for changing radio-frequency choke coils will have to be employed. Such an arrangement is shown in Fig. 2.

An ordinary spool is used for the winding form; and small wire jumble-wound on it. By jumble-winding or scramble-winding, is meant that the turns are just jumbled on the spool—wound over each other without order. The wire can be wound on neatly, if desired; though jumble-winding is preferable because it keeps the distributed capacity low. The wire must be insulated; and can be between No. 24 and No. 40, the exact size not being important electrically. Probably a smaller size wire will have to be used, though, to get all the turns on the spool. Two choke coils will be needed: one of about 150 turns for the wavelengths below 100 meters, and another of about 250 or 300 turns for the broadcast wavelengths. The number of turns given is about the least that can be used on the wavelength bands designated.

The plug-in mounting for the chokes is made up of two switch jaws; and two switch blades, which are bent and fastened to the ends of the spool. Regular switch blades can be used, and bent and drilled as in Fig. 2; or two pieces of ⅛-inch thick copper or brass strip, ⅜ to ¼-inch wide and 1½ inches long, may be used. The switch blades are fastened to the ends of the spool by two small wood-screws, and the ends of the winding soldered to the screws. The switch jaws can be mounted about two inches apart on the baseboard or on the panel. The blades and jaws from an old switch can be used, and, being almost exactly the right size, will save labor.

A winding like this on a thread spool is a far more compact and easily-made R.F. choke than the usual, bulky, single-layer winding. This thread-spool choke coil can be used in any receiving circuit employing a radio-frequency choke, such as the Reinartz, or any similar receiver using inductive-capacity-feedback or throttle-control. If the receiving set in which this choke is used is built for only one band of wavelengths, the brass blades can be left off and the ends of the winding soldered to brass tacks or escutcheon pins driven into one end of the spool. The choke can be fastened by running a wood-screw up through the baseboard to the other end of the spool.

A choke coil of this type with this form of mounting should be excellent to use on a small transmitter. A larger spool—the kind that basting thread and linen thread are wound on—and heavier wire can be used for the more powerful transmitting sets, which draw a higher plate current.

If a paper cone on a loud-speaking receiver becomes crumpled through handling or falling remove the whole paper cone unit from the stand, and detach all reproducing mechanism. Take a quantity of soft rags, moisten them thoroughly, and wring them out so they are just damp. Now pack them into the cone, in such a way that it is held in its normal shape, and let the whole affair dry. The paper will then assume its normal shape, and will be almost as good as new.

Torn paper cones on loud-speakers can be mended in some cases by cementing strips of paper under the torn portion, inside of the cone, with shellac, and pressing the outer paper into place with the fingers.

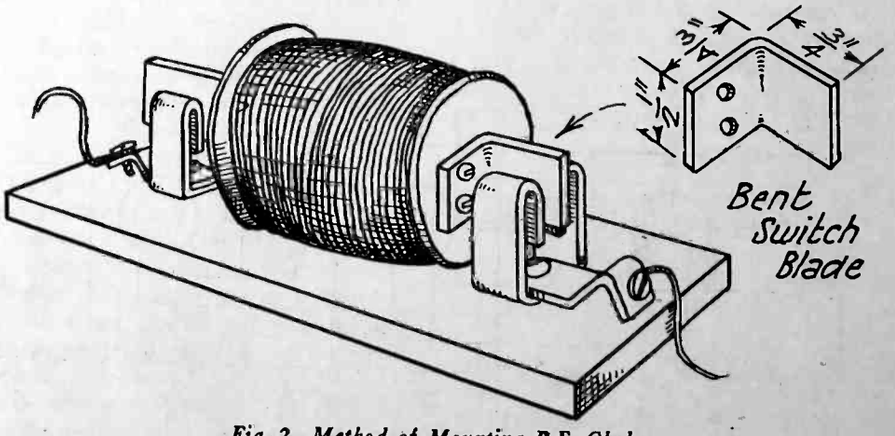


Fig. 2. Method of Mounting R.F. Choke.

Superheterodyne Oscillators

A Discussion of the Differences in Various Circuits and of the Comparative Results to be Expected from Them

By G. M. Best

THE PURPOSE of the oscillator tube in the superheterodyne receiver is to provide a source of local high frequency energy differing in value from the incoming signal frequency by the frequency to which the intermediate amplifier is tuned. It is required to produce a reasonably uniform output throughout the broadcast frequency band from 545,000 to 1,500,000 cycles, to be free from harmonics, and to have an oscillator condenser which can be controlled without trouble from body capacity effects.

If the oscillator output is not uniform, the receiver will be more sensitive at one end of the frequency scale, and a condition may then exist where too much oscillator energy is being fed into the frequency changer, or first detector tube, and a large amount of hissing or rushing noise will be heard along with the speech or music. If the oscillator emits bad harmonics, a station at the high frequency end of the broadcast band will be picked up at four or more points on the oscillator condenser dial, thus interfering with the selectivity of the set and making it necessary to increase the selectivity of the tuned circuits. The latter is usually accomplished by adding stages of tuned r.f. amplification ahead of the first detector, or by the installation of band pass filters in the intermediate amplifier. If placing the hand near the oscillator condenser dial causes the frequency of the oscillator to change, tuning will be difficult, especially on distant stations, and often it is impossible to tune the station at the higher frequencies.

Having the above requirements in mind, diagrams of the four most popular types of oscillator circuits are shown and the advantages or faults of each are discussed. With the exception of the second harmonic superheterodyne developed by Armstrong, in which the oscillator tube acts also as the first detector, the oscillator is a single purpose tube, and is most commonly connected as in Fig. 1.

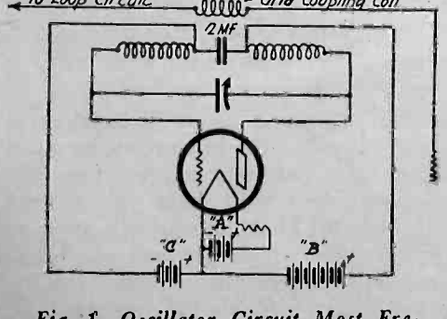


Fig. 1. Oscillator Circuit Most Frequently Used.

Energy from the oscillator is transferred to the first detector circuit by means of a low inductance coupling coil placed in the field of the oscillator coil. The coupling coil is generally placed in the grid circuit of the first detector, next to the grid, although it can also be placed in the plate circuit, or in the grid return to the filament. The coupling may be either fixed or variable, the latter being preferable, so that adjustments for individual tubes may be obtained. Superheterodynes designed for all-wave use generally feed the oscillator energy to the first detector by connecting the grids of the two tubes together through a condenser or resistance, but in the diagrams used here for discussion, we will assume that the inductive coupling method is employed.

In Fig. 1, the oscillator coil is of the split winding type, of two equal sections, the tuning condenser being connected to the outside terminals of the coil, in parallel with the grid and plate of the oscillator tube. A fixed condenser of high capacity is connected across the low potential ends of the coil, where the batteries are connected, so as to by-pass all high frequencies around the battery circuits.

This circuit, in common with many others, is susceptible to body capacity effects, and emits harmonics of the fundamental frequency to a considerable amount, making the tuning of the receiver difficult when many local stations are on the air. If the rotor plates of the oscillator variable condenser are connected to the plate of the tube, the trouble from body capacity will be lessened, but not eliminated. If a variable condenser in which the shaft is not a part of the circuit is used, the body capacity effect can be entirely eliminated. Shielding the panel back of the oscillator dial will not entirely remove body capacity effects if the shaft is connected to the rotor plates electrically.

This circuit has the advantage of having a fairly uniform output throughout the broadcast frequency range, and with the proper adjustment of the grid coupling coil, the sensitivity of the set will be uniform. Should the oscillator condenser develop a short circuit, the oscillator coil will probably burn out, and if the negative *B* battery is by any chance connected to the positive *A* battery, all the tubes in the set will burn out at the same time. This trouble is usually obviated by placing a fixed mica condenser of .006 mfd. or more in series with the variable condenser, the former having no effect on the tuning, and acting as a blocking medium for direct current.

In Fig. 2, the oscillator circuit has been changed so that the grid coil only of the oscillator is tuned. In this case,

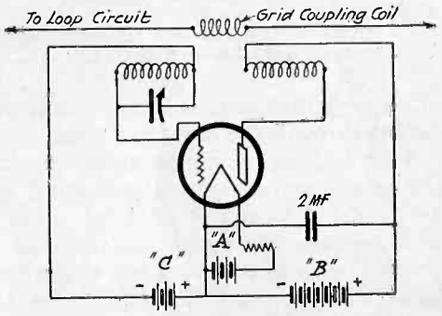


Fig. 2. Tuned Grid Oscillator, With Fixed Plate Coil.

the grid coil is about equal in inductance to the combined grid and plate coils of Fig. 1, and the plate coil is a separate winding, placed at the filament end of the grid coil. The principle of the circuit is the same as that of the average regenerative detector tube, except that the tickler or plate coil is fixed, and is of such high inductance, and is coupled so closely to the grid coil that the tube oscillates through the entire frequency range. If the rotor plates of the tuning condenser are connected to the filament end of the coil, no trouble from body capacity will be experienced, and any type of variable condenser may be used. The oscillator output, however, will not be uniform throughout the frequency range, being greater at the higher frequencies. But if the coil constants are chosen for an average frequency, no appreciable difference in output at the minimum and maximum frequencies will be noted. Harmonics are produced by this oscillator in about the same amount as the circuit of Fig. 1.

Owners of superheterodynes having the oscillator circuit of Fig. 1, and who are troubled from body capacity, may convert their circuit into that of Fig. 2 by connecting the two stator windings together and using the entire coil as the grid coil of Fig. 2, and by winding 25 turns of No. 28 or 30 silk covered wire at the filament end of the grid coil. It may be placed on the coil form in a haphazard manner, so that it will occupy only 1/8-in. of space.

Fig. 3 shows the oscillator circuit used in the various Best superheterodyne receivers, and differs from Fig. 1 in that the tuning condenser is placed in series between the grid and plate, and between the center terminals of the split-winding

oscillator coil. It requires a variable condenser having an insulated shaft and the same precautions against short circuit as recommended for Fig. 1. It has about the same proportion of harmonics as the

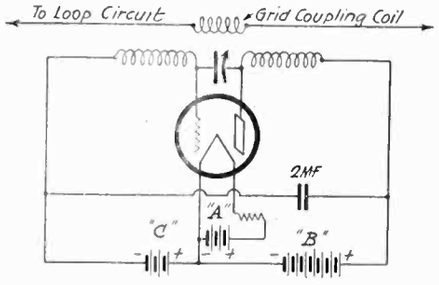


Fig. 3. Oscillator Used in Best Superheterodyne, with Series Condenser.

other oscillators, and is of quite uniform output through the broadcast band.

Fig. 4 is an arrangement for tuning the plate circuit only, there being no grid coil. This circuit is useful where a wide frequency range is desired, and a set of plug-in coils having but two windings, with no variable inductances, is used. It has the same body capacity troubles of Figs. 1 and 3, and is a particularly bad harmonic producer, especially if no *C* battery is used.

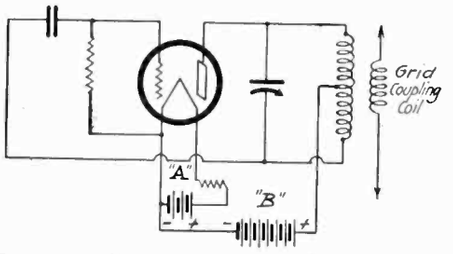


Fig. 4. Oscillator with Tuned Plate Circuit.

An oscillator circuit which has great possibilities for use in superheterodyne circuits, and which is relatively unknown to the radio fraternity, is shown in Fig. 5. It is known as the stabilized oscil-

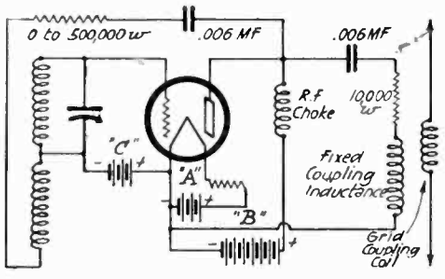


Fig. 5. Stabilized Oscillator, Using Tuned Grid Circuit.

lator, and was developed in the Bell Telephone Laboratories for measurements where the requirements are a constant frequency, independent of the load impedance or slight *A* and *B* battery changes, and no harmonics. It has been described in detail in various technical papers, and is now available commercially for testing purposes.

It consists of a vacuum tube, supplied with filament current in the usual manner, and with plate voltage through a choke coil designed to have a high impedance to all frequencies within the range of the oscillator. Thus no alternating current disturbances can take place in the *B* battery circuit, and the *B* battery may be used in common with other tubes. The oscillator coil consists of a split winding of two equal sections, connected together, and with the grid coil tuned with a variable condenser. Feedback from the plate of the tube is accomplished through the blocking condenser, stabilizing resistance and plate inductance, to the grid coil. The output circuit is taken through another blocking condenser, 10,000 ohm resistance, and the coupling inductance, back to the filament, so that there are in reality three separate plate circuits, one for the direct current path through the choke, another for the feedback path, and a third for the output path. The purpose of the blocking condenser in the feedback circuit is to keep the plate battery out of the oscillator coil circuit, and the stabilizing resistance is to aid in eliminating harmonics.

In any oscillating vacuum tube circuit, energy from the plate is fed back into the grid circuit, this energy being amplified by the tube, and re-amplified until a certain maximum depending on the circuit constants is reached, beyond which the energy transfer from the plate to the grid remains constant, the output limit of the tube having been reached. The plate current of an oscillating tube varies through its entire limits as indicated by the tube's grid voltage-plate current curve, and as this curve is not a straight line at the upper and lower ends, the tube emits a distorted sine wave, in which harmonics are present.

The only practical way the harmonics can be eliminated is to limit the grid voltage variation to such an extent that the tube operates only on the straight line portion of its grid voltage-plate current curve. While this is not actually possible, it can be approached in practice by the introduction of sufficient resistance in the feedback circuit to limit the effective voltage applied to the grid.

Assuming, for example, that the amplification constant of the tube is 6, and that we apply 1 volt to the grid circuit. This will produce an output of 6 volts in the plate circuit, and, with a direct path from the plate back to the grid, this will place an effective 6 volts on the grid, which will in turn produce 36 volts in the plate, and so on until the limits of the tube are reached. If, however, we introduce a resistance in the plate circuit of such value that it produces a voltage drop of say 4.99 volts, the grid receives only a small amount in excess of 1 volt, the tube will just barely oscillate, and as the extreme upper and lower limits of the grid voltage-plate current curve are not reached, the output will be a relatively pure sine wave free from harmonics.

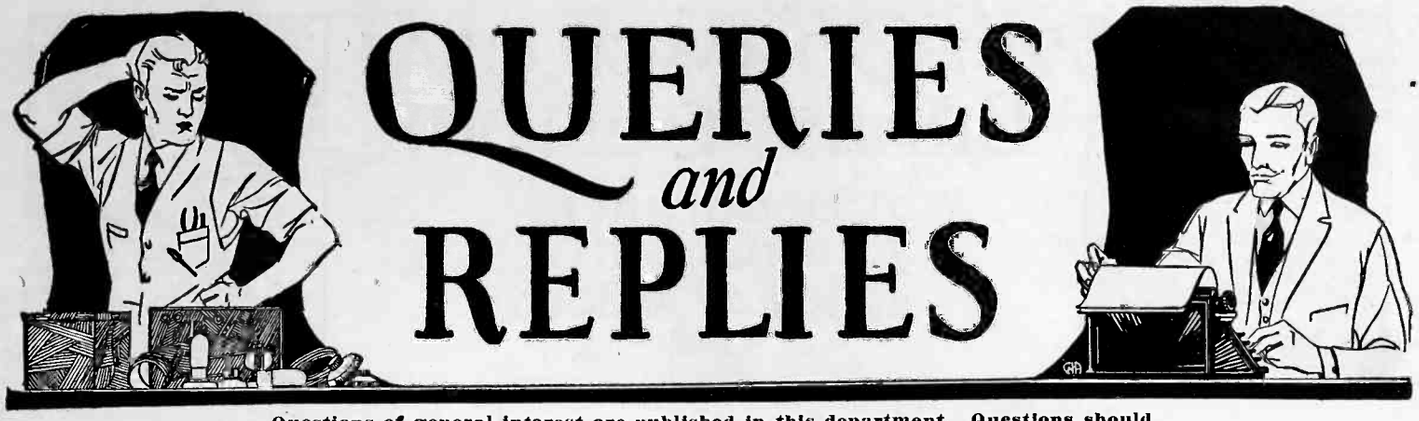
By placing a non-inductive resistance which is several times larger than the resistance of the load alone, as is indicated in Fig. 5, changes in the load will have little or no effect on the frequency of the oscillator. By connecting the rotor plates of the tuning condenser to the negative *C* battery, body capacity effects are eliminated.

The actual construction of the oscillator is not difficult, although there are certain inconveniences in the way of additional controls. The oscillator coil may be an ordinary two winding coil, such as is used in the oscillator of Fig. 2. The stabilizing resistance should be non-inductive, and continuously variable without steps so that the best resistance value for the circuit can be selected. The coil, stabilizer, choke and blocking condensers, together with the tube and tuning condenser should be mounted in a shielded compartment, and the output circuit, consisting of 10,000 ohm resistance and coupling coils should be mounted in another compartment, so that no energy from the main oscillator coil will be picked up by the output inductances. The fixed coupling inductance should be of such value that it is not resonant at any frequency in the broadcast band, so that half the stator winding of a conventional oscillator coupler will do. The grid coupling coil is of the usual pattern, placed inside the coupling inductance, and variable with respect to it. The r.f choke may be the primary of an intermediate frequency transformer, or one of the new r.f. chokes now available.

In operating the oscillator, the stabilizing resistance should be adjusted so that the tube just barely oscillates, as can easily be determined by tuning in a local station, and cutting in stabilizer resistance until the station disappears. Unfortunately, any one setting of the stabilizer is good only over a limited part of the broadcast band, and it must be re-adjusted by a small amount to obtain minimum output of harmonics at any given point on the condenser dial. If the resistance is adjusted for the best condition for the upper half of the broadcast wavelength band, however, the oscillator will be very satisfactory, as the trouble from harmonics is most apparent at the upper end of the wavelength band.

If no stabilizer is employed, this oscillator will be little if any better than the other circuits shown. But if properly connected, it will greatly improve the operation of any superheterodyne using the other forms of oscillator circuits, and will especially improve the selectivity.

Small fuses, of about 1 ampere capacity, placed in the box or on the panel of current supply sets running from the lighting circuit will hold the normal load, but will blow immediately if there is any trouble, which may save tube burnouts. Fused "attachment plugs" may be obtained, also, which will serve the same purpose.



Questions of general interest are published in this department. Questions should be brief, typewritten, or in ink, written on one side of the paper, and should state whether the answer is to be published or personally acknowledged. Where personal answer is desired, a fee of 25c per question, including diagrams, should be sent. If questions require special work, or diagrams, particularly those of factory-built receivers, an extra charge will be made, and correspondents will be notified of the amount of this charge before answer is made.

Can you tell me how to make a bulb type battery charger for a six-volt A battery?—F. R., Healdsburg, Calif.

The circuit diagram for a two ampere charger using a tungar bulb is shown in Fig.

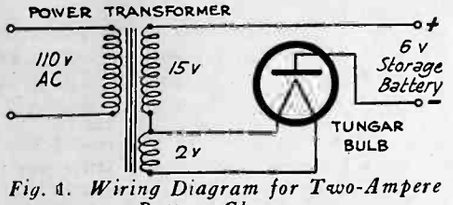


Fig. 1. Wiring Diagram for Two-Ampere Battery Charger.

1. The equipment consists of a transformer, porcelain lamp socket, and bulb, mounted on a metal plate or other suitable base. The transformer should be constructed on a rectangular core, a convenient design being

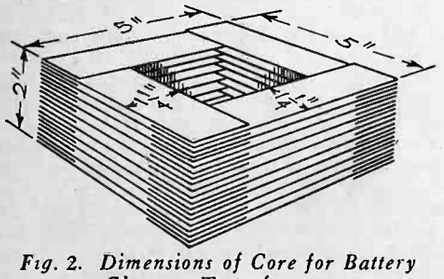


Fig. 2. Dimensions of Core for Battery Charger Transformer.

shown in Fig. 2. The data for the turns are based on the assumption that common sheet iron is available for core material. If high grade silicon steel can be obtained, the height of the core may be reduced by one-half, with the same number of turns on the windings.

The primary consists of 605 turns of No. 20 D.C.C. wire, wound on one leg of the core. The charging secondary consists of 85 turns of No. 18 D.C.C. wire, wound on the other leg of the core, and over this winding is placed the filament lighting secondary, which should consist of 12 turns of No. 14 D.C.C. wire, with the last four turns tapped so as to provide an adjustment of filament voltage to take care of variation in tubes. Ordinarily the entire 12-turn winding will be required. If a lower charging rate is required, a resistance may be inserted in the positive charging lead, and the current reduced to the proper amount. The tungar bulb is screwed into the lamp socket in the manner of an ordinary incandescent lamp, and the plate terminal connection is made to a steel pin in the top of the bulb, by means of a fahnestock clip.

An easy way to check the operation of the charger is to turn on the supply current, when the battery to be charged is disconnected. When the battery is cut in the circuit, the brilliancy of the filament in the bulb will be considerably lessened, due to the additional load on the transformer. If no difference in filament brilliancy is noted, there is probably an open circuit, and the battery is not being charged.

Have a five-tube tuned r.f. set which brings in any station from 200 to 400 meters satisfactorily, but above 400 meters the volume is not sufficient to operate a loudspeaker. How can I make the set work on all wavelengths alike?—A. W., Hamakuapoko, Hawaii.

A number of methods of increasing the sensitivity of your set at the longer waves are available, but one of the most efficient schemes is to rewire the detector circuit as in Fig. 3. Over the filament end of the secondary of the last r.f. transformer is wound an extra coil consisting of 15 turns of No. 24 silk or cotton covered wire. One side of this coil is connected to the filament terminal of the r.f., transformer, and the other side is connected to the plate of the detector tube through a small feedback condenser of 50 m.m.f. capacity. The phone by-pass condenser, which is usually .002 mfd., should be omitted, for otherwise it would short circuit the feedback condenser. On the short waves, the regeneration control will not be needed, and a switch should be used to open circuit the condenser, as marked with an *X* on the diagram, unless the presence of the condenser, set at minimum capacity, does not interfere with the operation of the set below 400 meters.

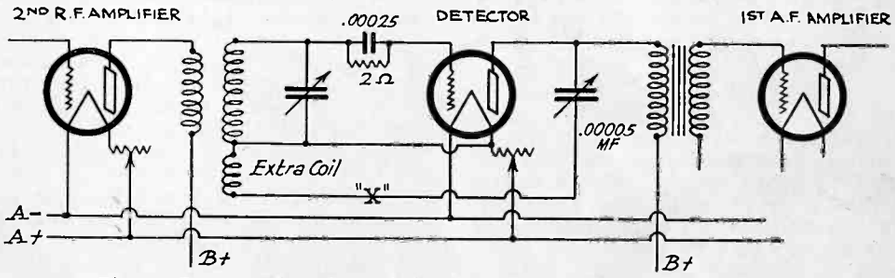


Fig. 3. Regeneration Control for Detector in Tuned R. F. Circuit.

I want to build a 50-watt power amplifier to operate a number of cone speakers in series-parallel. The speakers being located in various parts of a building. I have tried a 5-watt power amplifier circuit, and it does not give sufficient volume.—T. S. W., Joliet, Ill.

The circuit for a 50-watt amplifier is shown in Fig. 4. It is assumed that the input to the amplifier is from a type CX-112 power tube or its equivalent, with at least 157½ volts plate and 10½ volts negative grid, and that a high grade input transformer is used. The voltage of the power transformer secondary should be 900 for the plate winding, and two filament lighting secondaries of 10 volts each, one with center tap. A 50-watt tube can be used as a rectifier, with the grid and plate connected together as is shown in the diagram. The chokes must be capable of carrying 50 milliamperes, so that heavy duty chokes, such as the Amertran, should be used. The output transformer must be capable of carrying a plate current of 50 milliamperes, so that Silver-Marshall type 221 is recommended. The filter condensers must all be rated at 1750 volts.

(*Continued on Page 59*)

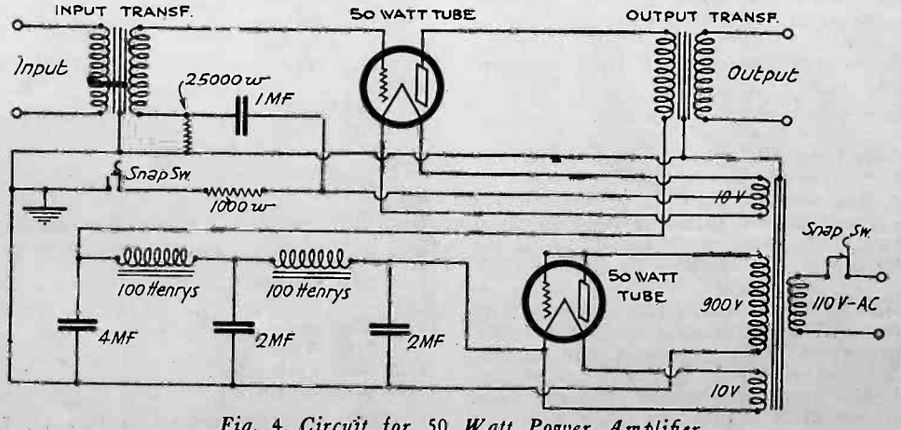
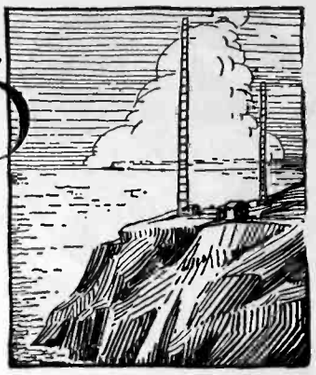


Fig. 4. Circuit for 50 Watt Power Amplifier.

The COMMERCIAL BRASSPOUNDER

A Department for the Operator at Sea and Ashore



Edited by P. S. LUCAS

R. O. KOCH, *Great Lakes Correspondent* C. W. RADOS, *Boston Correspondent*

QLZ-Z-Z?

Singling out our friend Bob Koch, who wrote us an article on Q signals in a recent issue of this magazine, as an authority on the subject, we asked him what a good one would be for "Are you too lazy?" "I am too lazy." His answer was very fitting: QLZ, with a couple extra Zs added on for emphasis. (Note: Now's a good time for all those with guilty consciences to turn the page.)

If QLZ were to be put into use we'll bet it would be popular; especially for those of you who have some dope in your heads that would help us out in this department but hesitate to get down to work and write it up for us. Why not help out with your knowledge Some of you say you are not writers. Well, we're not masters in that line ourselves; not by a long shot; but if you will jot down the story any old way you want to we shall be glad to edit it for you to the best of our capacity. Never mind our English, just so it IS English.

Others of you don't realize that material which has become commonplace to you will be full of interest to the majority of the rest of the readers of this department. And most of you think that, because we seem to keep the department pretty full, we are not in need of your particular contribution. Well, you're wrong again, for we *do* need it and need it badly. So far, the contributors have numbered, in all, less than a dozen. Do you think that such a small number can long hold the interest of a gang of men who continually rove the seven seas, all the lakes, and then get out and walk Not much.

Alright: now that we've convinced you that you owe us a contribution, and have you in the writing mood, here are a few suggestions for you to start in on: Px, Wx and Time schedules as mentioned last month; ship and shore station descriptions with pictures, history etc. (KOK, WFK and KSE have appeared in the past.) Interesting experiences that you have had or know about: crabby letters clearing your chest of any grievance you may have; in short, anything you should like to read if some other operator wrote it. 'Nuff sed. We'll expect the mails to be jammed solid from now on. QLZ? No!!!

Hong Kong Notice to Mariners—With reference to government notification No. 686 of 21st November, 1925, it is hereby notified that from July 1, 1926, the Meteorological Observations from various stations in the Far East will be broadcast by Cape d'Aguilar, VPS, on a 600 meter spark wave at 0400 and 1200 GMT and repeated on a 2800 meter CW wave at 0500 and 1300 GMT respectively. These messages will be followed immediately by the weather reports and forecasts which have hitherto been broadcast at 0500 and 1200 GMT.

GREAT LAKES TROUBLES

As Seen by a Coastal Operator

Here is the 1926 navigation season on the Lakes going in full swing! Omigosh, what a mess! On the whole, the tendency for radio conditions seems to be in the wrong direction. Of course, the increasing number of radio-equipped ships has something to do with that, but—SUCH OPERATING!

Probably the worst evil is the pest that insists on testing by the hour without a break or a sign, and then finally ends with an SK only to start all over again in about five minutes. The law requires that testers break frequently, sign and ask QRM? The tester either never saw a law book, or else doesn't believe in superfluous readable signals. Ask him to sign and he either doesn't hear you, or doesn't want to. Some of these stations seem to be transmitting only. Nothing seems to make much difference as long as the HWA needle is jumping. If he must see that needle move, why not do it with a key and dry-cell? It will jump to his heart's content without jamming anyone. If he must practice code, why do it on the air? A cheap little buzzer will take care of his key-itch without making all the ops crave to chew iron rings for 100 miles around.

Then there is the bozo who must give a nice, pretty CQ every few minutes. He doesn't even rate a good amateur! Yet he is trying to hold down a commercial job. Any op who will stand his watch, will get all that's coming to him. If he doesn't want to stand his watch, he doesn't belong on the job. As for finding out where his friends are, that's a job for the Post Office Department.

The TR fiend is disgusting to say the least. He must know the position of every ship he hears, whether near or far. He doesn't care about malicious interference or anything else —he must have that TR! He should get it —between the eyes.

There are times, of course, when TRs are of considerable value and in such cases an operator is justified in asking for them but when he does it just for curiosity—well, he is something else. The genuine TR fiend doesn't even quit with a TR but has to ask QRA? and everything else that he happens to think of down to a personal sine. He sines his own personal sine after every call and every other place that he shouldn't. He is usually on a ONE OPERATOR ship Yeh, it's a wise stunt.

QRM from DX hounds stays about the same. At times it is awful! In many cases, however, it is not the fault of the operator so much as the company for whom he works. He has explicit instructions to work some one specific station regardless of where he is and it is his choice to obey his employer or obey the law. In practically all cases his job will last longer if he chooses the former. Thus we can hear ships calling and working WLC and other stations from any lake at any time even although there may be five coast stations that are much closer and are entitled to the traffic unless the ship chooses to work his DX on 875 on schedule and not use 715 for either calling or working. We will hear ships calling one station for hours without response. And then they wonder

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SCHEDULES FOR ATLANTIC COAST AND GULF OF MEXICO

Time 75th Meridian.

A.M.				
9:00	New York	WSC WCC	600, 2200	WX Sandy Hook
10:00	New Orleans	NAT	2600	WX Hydro
:30	New York	NAH	1538	WX Hydro
:45	Norfolk	NAM	600, 1363	WX
:50	Washington	NAA	2650	Pressure, WX
11:00	Boston	NAD	1363	WX Hydro
:30	New Orleans	WNU	3331	WX Private PX
:55	New Orleans	NAT	2600	Time Tick
:55	Washington	NAA	2650	Time Tick QST
12:00	Key West	NAR	1600 (approx.)	WX Ship calls
P.M.				
4:00	Norfolk	NAM	600, 1363	WX
5:00	New York	WSC WCC	600, 2200	WX Sandy Hook
		NAH	1538	WX Hydro
8:15	New York	WSA WSH	600, 2200	Baseball, PX
		WCG	700	Baseball, PX
9:55	Washington	NAA	2650	Time Tick QST
10:00	Canada	VBT	2660	Private PX
:55	Washington	NAA	2650	Pressure, WX
11:30	New Orleans	WNU	3331	WX, Pressure
A.M.				Private PX
12:15	Chatham	WCC	2200	Private PX
	New York	WCG	11,000	Private (?) PX
1:30	New York	WSA	(?)	PX
2:30	Washington	NAA	2650	PX to QST

These schedules correct to July 15, 1926. —C. William Rados.

why a coastal station just a few miles away will tell them QRT! This is something that really should be straightened out. Working a more distant coast station is justified under some conditions with due consideration of the convenience and the nature of the service. It would seem to me that the remedy would be to permit ships to work any coastal station within a radius of 100 miles and use either 715 or 875 to effect the communication. Beyond this limit they should be permitted to work ONLY on 875 on schedule and some attempt be made to enforce the law. Over the range of 100 miles, a ship can work one station with about the same ease as he can another under normal conditions, and thus the resulting interference would not be great and at the same time he could give the message to the station giving the best service or the station belonging to his own line. It isn't reasonable to expect a ship to work WMW when going up the Manitowoc river when he belongs to the Reiss Line which owns and operates a station but 28 miles away. It IS reasonable though to expect him to keep off 715 with his calling and working when he wants to work WSK from Lake Erie and but a few miles from other coastal stations.

Much useless calling could be avoided if all ops knew the hours of the various coastal stations. Unfortunately many do not have continuous service. There are also some who do not adhere to the hours specified in their licenses and there is at least one which is licensed for continuous service whose license would more appropriately read "No regular hours." Operators can help things a lot nevertheless, if they will keep a copy of the latest call book and RSBs on hand. These publications contain much valuable information if the op will only use it.

Now OMs, let's pull together on this. It isn't always the beginner that is the ham. If the brand new op will use his head for something besides a can-spreader, we will have patience with him. The one way to meet the demand for operators is to start new men out and all of us must remember that we started from the bottom. In the meantime Mr. Old-Timer, let's set an example for the new fellow and show him that the man who is the real operator is the man with real sense.

VPS, Cape d'Aguilar Radio, Hong Kong, listens for ships CW on 2200 to 2400, answering on 2800 CW between 35 and 45 minutes past each hour.

WHO'S WHO AND WHERE

Francis E. Beaulieu, who brought the *Point Sur* around from New Orleans, got off in Los Angeles to take the *Santa Maria,* vice C. R. Ferguson, who has had trouble with his leg and will have to undergo an operation.

* * *

Karl E. Zint, who has just come back from England on the *Yorba Linda,* says he's not so strong for that London fog they rave about. The Yorba made five British ports this trip, which is rather unusual for a gasoline tanker.

* * *

H. D. Watson, Chief at KOK, has been bucking some rough seas lately. His wife has been very critically ill at the White Memorial Hospital for several weeks, but is at last showing signs of regaining her health. It seems as if HD has had more than any one man's share of fog in the last few years; but the skies are bound to clear sometime. We hope it will be soon, OM.

* * *

J. R. Foran is enjoying the sights of Los Angeles during the blowdown period of the *La Purisima.*

* * *

George Rang, of the *Utacarbon,* is spending his vacation in Chicago. He lit there on a day when the thermo-coupled thermometer radiated 100 degrees, and now he is wishing he were back in sunny Southern California where it's cool. (?|'!*?)

* * *

B. Wentworth, ex-6XAM, the Stanford University calibration station, is now on the *H. F. Alexander,* vice S. B. Capelle.

* * *

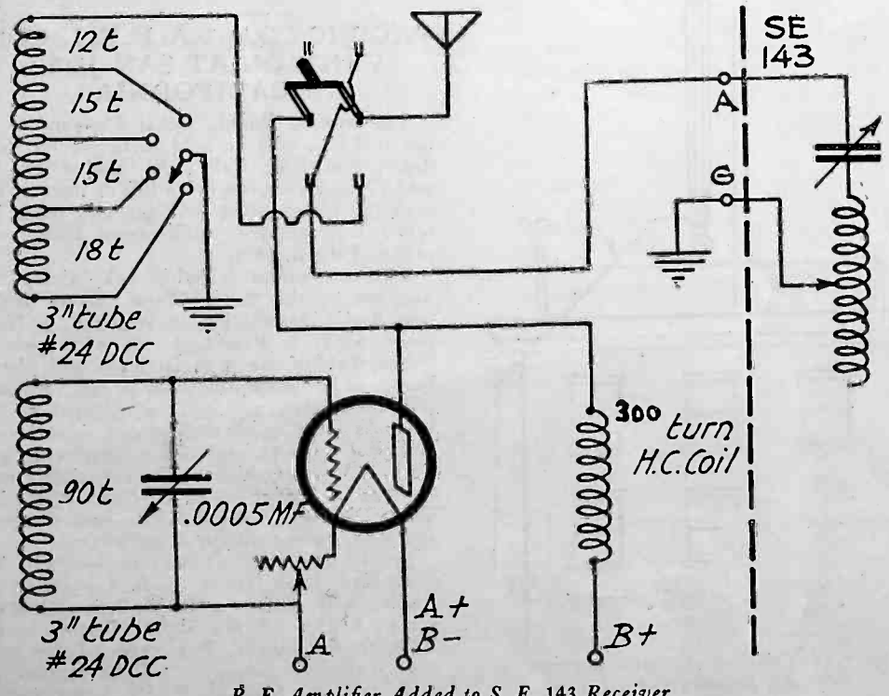
Lindley E. Windsor, Second at KOK, is on his vacation. He is being relieved by J. E. Delaney, who is taking a teacher's course in radio.

* * *

John P. Matthews, an old-time amateur operator and pioneer experimenter, is now pounding brass on the *S.S. Saucon,* W.L.H., a 600 ft. ore freighter on the Lakes.

* * *

Harry W. Money was recently assigned to *M. S. Bidwell* at Philadelphia. A new Type E T 3630 I C W Tube transmitter and Type I P 501 receiver was installed, replacing the old Federal arc transmitter and SE 143 Navy Standard Receiver. Everything's ready now for some real work on 600.



R. F. Amplifier Added to S. E. 143 Receiver

AN R. F. AMPLIFIER FOR THE SE 143

By FRANK FREIMANN, *2nd Operator S. S. President Van Buren*

It behooves me to do my bit towards the growth of the "Commercial Brasspounders" section. No doubt, this department will be much appreciated by all who are interested in the radio field as a whole, as well as the brasspounder himself. May Allah put blessings on it, for it is much needed.

I am about to harp on the betterment of receivers, in view of more efficiency and less QRM. Logically, a given station cannot have a range greater than that of the receiver. Why not pay a little attention to the receiver, increase the range and put less power into the ether? Reduced interference will ensue. Also if receivers were more selective, reduced interference, less repetitions and more traffic handled in a given length of time would be the result. This fact is most pronounced along the coast, where compass stations on 800 meters, stations on and around 700 meters, and often broadcasting stations, are all heard on 600 meters, in fact, this group comes in simultaneously on that whole range in many cases, prompting intolerant "op" to throw the cans on the deck, his hands into the air, and fluently express his inner feelings in terms known only to seafaring men.

Many of the SE 143's are very broad—some more so than othes; often due to deteriorated soldered connections, and to broken strands of litz in the inductors. In the latter case it is usually impossible to clear up the trouble without tearing apart the whole heap. At any rate, all of them, whether at their best or not, are too broad in tuning. The solution, as I have found it, is an effective radio frequency amplifier ahead of the receiver. One stage will suffice—even do wonders to it. Such an amplifier can be built up with a little trouble and some of the junk found in the drawers of the battery room. With the amplifier herein described, it is unnecessary to make any changes in the receiver whatever merely connect the output to the aerial and ground posts, and away she'll go.

To cover the wavelength range from about 230 to 1000 meters, the secondary should have an inductance of 565 microhenries, to be tuned with a condenser of .0005 mfd. The coil may be made up of about 90 turns of No. 24 DCC or DSC wire, wound on a 3 in. tube, having a length of 3 in. The primary consists of about 60 turns of wire wound on a tube of the same dimensions, either multilayer wound, or single layer. My amplifier is wound in four multi-layer groups, each spaced about the width of the winding, so that the coupling will increase with each switch contact, in the same proportion. The coupling between the secondary and primary should be about 1½ in. It is well to dope the coils—contrary to some belief—for when the coils are damp, as in high humidity, the resistance rises greatly, while the actual increase in total circuit resistance is slight with a doped coil of this type, when good dope is carefully used.

Four taps on the primary are sufficient to tune the aerial circuit. The first twelve turns will cover the broadcast range—of course commercial operators *never* listen to broadcasting, so this may be omitted; the next tap of fifteen turns will cover 600; then 700 and 800, and the last tap, including all the wire on the coil, is for 1000 meters. The diagram is self-explanatory. No tricks are claimed to this circuit. It is a common amplifier circuit, with perhaps the exception of the plate circuit, comprising the tapped primary and variable condenser in series, in the receiver. The plate voltage for the tube is applied through a 300 turn honeycomb coil, a radio frequency choke; any similar coil may be used for this purpose; the value is not critical. Care should be taken so that no coupling will be effective

(*Continued on Page* 60)

Reactance Coupling For Short Wave Transmitters

By L. J. N. du Treil

Vacuum tube transmitters when inductively coupled can be made to emit a very sharp wave, but unfortunately this type of coupling does not always eliminate the radiation of harmonics of the fundamental wave. A new type of coupling has been devised which not only causes the emission of an extremely sharp wave, but also suppresses harmonics to a great extent. In crowded communities this is greatly to be desired in order to permit a number of radio services to be carried on without interference with each other, and, from the standpoint of the broadcast listener, to permit reception without interference from amateur transmitters in the immediate vicinity.

A type of coupling meeting the above requirements and suitable for short waves is known as reactance coupling. The essential circuit is shown in Fig. 1. This oscillator employs the conventional Hartley circuit, but the writer believes that almost any oscillatory circuit may be employed with this type of coupling. It is therefore assumed that the experimenter is in possession of a suitable transmitter or oscillator.

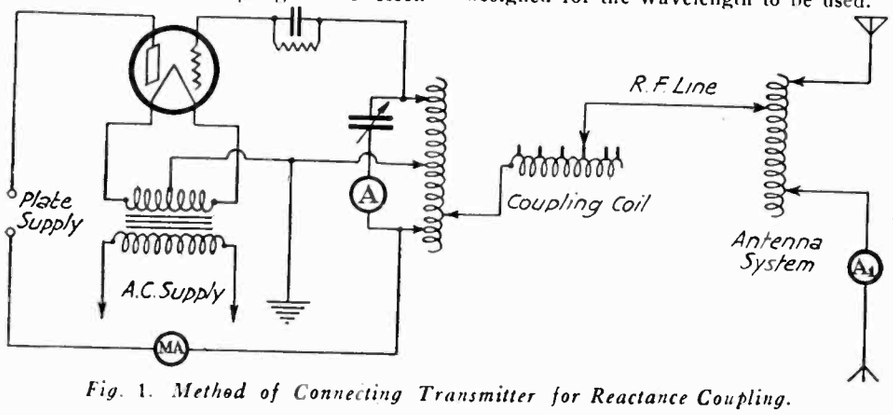


Fig. 1. Method of Connecting Transmitter for Reactance Coupling.

If the transmiter has a two-coil oscillation transformer the secondary coil may be used for the antenna inductance. It should, however, be removed from the transmitter and connected to the antenna and counterpoise at the point where these enter the operating room. If the leads from the antenna and counterpoise are very long the antenna coil may be placed outside the operating room at a point near the terminals of the antenna and counterpoise. For instance, the antenna system including the antenna inductance could be erected on the roof of a building and could be energized by a single radio frequency feed line from the transmitter which could be located on one of the lower floors of the building, or in a separate building nearby. Inasmuch as the length of the radio frequency feed line has no effect on the emitted wavelength, this system is particularly adapted to installations where it is desirable to have the transmitter at some distance from the antenna system. Fig. 2 illustrates the foregoing.

Some experimenters prefer to house the antenna inductance in a box when used outside. It occurs to the writer that if the antenna inductance is supported on pyrex or similar insulating material it could be left in the open. Thus lead-in insulators could be dispensed with, but there would probably be some loss of energy during damp weather.

The coupling coil consists of a winding on a 3 in. tube of bakelite or other insulating material. Double cotton covered wire of any size at hand between No. 20 and No. 26 may be used. About 80 turns of wire are wound in a single layer, with taps taken every five turns. This coil may be mounted near the transmitter but care should be taken that it is not placed in inductive relation with the oscillator inductance.

To facilitate tuning, it is advisable to have two radiation ammeters, one in the oscillator circuit at *A* and one in the antenna circuit at *A*-1, *Fig.* 1. One end of the coupling coil is connected by a flexible connector and clip to some point on the oscillator inductance near the plate tap. A clip on the end of the radio frequency feed line is placed on one of the taps of the coupling clip and the other end of the feed line clips on to the antenna coil at the nodal point. Coupling is determined by the number of turns used in the coupling coil; reducing the number of turns increases the coupling and vice versa.

The antenna system should preferably be designed for the wavelength to be used. An efficient system has been used wherein the wavelength of the antenna and counterpoise including a few turns of antenna inductance is the normal wavelength to be employed.

To tune the transmitter the following procedure should be followed. The radio feed line is disconnected, the oscillator placed in operation and tuned to a wavelength near that to be used. The readings of the ammeter *A*, Fig. 1, and of the plate milliammeter *MA* are noted. The feed line is now clipped on the oscillator inductance near the plate tap, and the variable condenser rotated until a point is reached where the reading of the ammeter *A* drops, the ammeter *A*-1 rises to maximum with a corresponding increase in the reading of the plate milliammeter *MA*. If maximum antenna current is obtained with two settings of the variable condenser it is an indication that the coupling is too close and more turns should be inserted in the coupling coil. When the correct number of turns are employed in the coupling coil there will be only one point on the variable condenser where maximum antenna current is obtained.

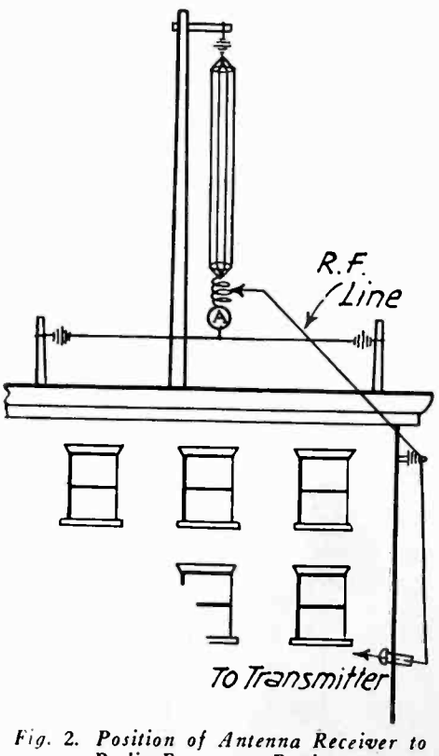


Fig. 2. Position of Antenna Receiver to Radio Frequency Feeder.

After becoming familiar with the operation of this type of transmitter the experimenter will be able to tell from the readings of the ammeter *A* and milliammeter *MA* whether the antenna is radiating, thus eliminating the use of ammeter *A*-1, which in some cases could be read with difficulty if placed at some distance from the transmitter.

Should the feed line be quite long it may not be necessary to include more than five or ten turns of the coupling coil in this circuit, whereas if the feed line is short a greater number of turns will be required The feed line may be a single wire and it is not necessary to take particular pains to have it mounted on low loss insulators as in the case of the antenna lead-in.

To find the nodal point of the antenna system it is merely necessary to move the feed line clip back and forth on the antenna inductance until ammeter *A*-1 indicates maximum radiation. In some cases where the antenna or counterpoise is too long the nodal point may be found off the antenna inductance, in which case the antenna or counterpoise may be shortened until the nodal point falls on the antenna inductance.

The writer has observed noticeable increase of efficiency in the case of both broadcast and amateur stations which have been rebuilt to use this type of coupling. There are many possible modifications and improvements of this system and experimenters should be encouraged to make further investigations in such a promising field.

PACIFIC COAST A. R. R. L. CONVENTION AT SAN JOSE, CALIFORNIA

The annual Pacific Coast Convention of the A.R.R.L. will be held at the Hotel Vendome, San Jose, Calif., on October 15, 16, and 17, and promises to be full of interest for both the transmitting amateur and those interested in amateur radio from among the ranks of the B.C.L.s.

The convention is being held under the auspices of the Santa Clara County Amateur Radio Association, of which F. J. Quement, 6NX, is President. It will open at 9 a.m. Friday, when registration and distribution of badges in the lobby of the Vendome will take place, and will be followed by the business meeting of the League, a series of technical sessions, and will end with a banquet on Saturday night. The convention will be called to order by A. H. Babcock, Pacific Coast Director of the A.R.R.L., and a representative of the parent organization.

Speakers at the technical session will include Col. J. F. Dillon, U. S. Supervisor of Radio, D. B. McGown, G. M. Best, Col. Robert F. Loghry of the Signal Corps, A. H. Babcock, and others. It is expected that several Hawaiian amateurs will be present, as well as many from all Pacific Coast States.

A Good Ham Receiver

By L. W. Hatry

Some sort of set with changeable coils is necessary for satisfactory reception on all short wavelength bands and there are now several manufacturers who make plug-in coils or coil forms adaptable to short wave work. To the writer's mind, the coil form should be such that all three coils, primary, secondary and feedback, can be mounted on it so that a single change of form settles the whole business. The coil form shown in the picture has six contact buttons and all three coils can be wound upon the single form.

For simplicity in appearance, the panel front has but the two dials and the rheostat knob, the usual jack being left off because the phone cord is annoying if left to run across the table top where one must write, and because a two stage amplifier already made was used with the set.

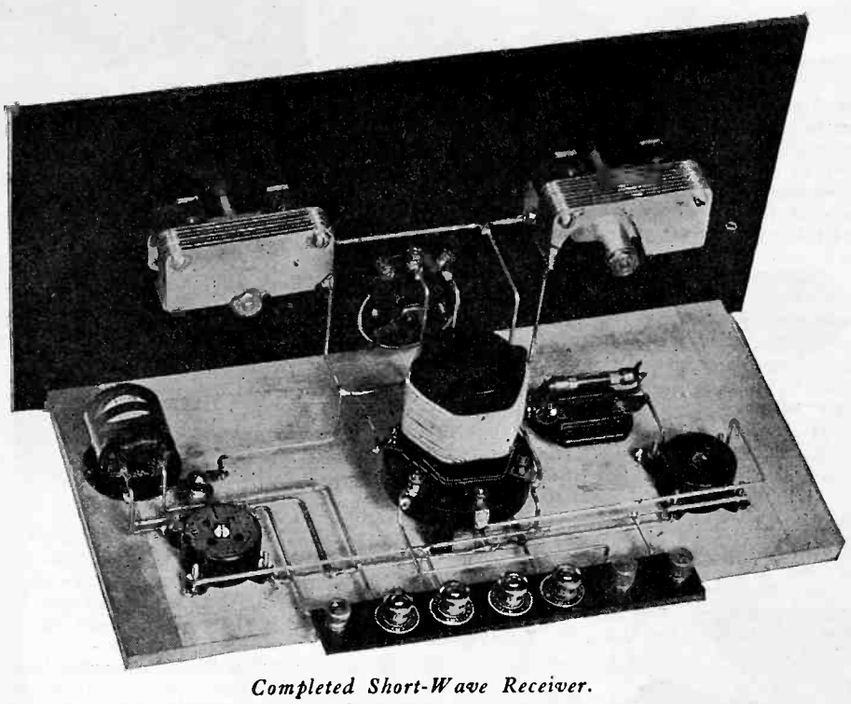
In general, short wave receivers are not designed to give ease of tuning. In designing receivers for the broadcast band, where the tuning range is 3 to 1, 500 to 1500 kilocycles (200 to 600 meters), a 6 to 1 reduction gear is satisfastory and tuning fairly critical, with condensers ranging from .00025 to .0005 mfd. and about 10 kc. to the scale division on the dial. For the so-called 80 meter band, the average coil covers a wavelength range of 70 to 210 meters, with .00025 mfd. condenser and we have a frequency range of 1400 to 4250 kc. which is about 28 kc per scale division. This increase in frequency range will require a slow motion dial of 18 to 1 to have the same ease of tuning as for the broadcast band and as it is difficult to handle a dial whose ratio is much greater than 6 to 1, tuning is at a disadvantage.

Considering the 40 meter band, and still retaining the 3 to 1 wavelength range, the minimum is 30 and the maximum 90 meters, or 3450 to 10,000 kc., which is 65 kc. to the dial division and requires a 36 to 1 vernier dial. As c.w. stations can be allowed at separations of 1 kc. each, 65 stations to the scale division would result from the figures above.

With the .00015 mfd. tuning condenser comomnly used by most writers in describing short wave sets, the 20 meter band is located between about 36 and 57 on a 100 division dial. 18.725 meters to 21.4 does not sound so much, but when we speak in terms of frequency, we find that the reach is 2000 kc. wide. It is bad enough to stretch that over 100 divisions, let alone 20, with 100 kc. to the division.

The regeneration control is approximate and never critcal, in this case affecting the tuning but slightly.

We figure the secondary tuning capacity needed by the wavelength range we cover. Let's say for the 80 meter band a stretch of 73 to 88 meters. That gives a minimum to maximum ratio of 1 to 1.2, and a required capacity range of 1 to 1.5. The average condenser minimum, cut down, is 10 mmfs. and



Completed Short-Wave Receiver.

the average circuit capacity might be assumed to be the same. The total minimum is then 20 mfs. (.00002), and the maximum required is about 30 mmfs. That means that our condenser maximum ought to be on the order of 20 mmf., for the circuit capacity was allowed at 10 and that is a fixed figure.

Condensers with this low a maximum and minimum are not usual so it is best to use slightly more capacity than necessary. The little midget condenser that the "BCL" fan uses for neutralizing is a first class tuning condenser for the amateur. Marco, for instance, makes one in 30 mmf. maximum capacity, whose minimum is probably less than 10 mmfs., or you can cut a large condenser.

The circuit is the Weagant or converted Hartley or revised Reinartz or Gawdnosewot. It is shown in Fig. 1. The antenna and grid coils are located on the stator for, and the plate coil on the rotor form, a Silver-Marshall plug-in unit. I have since come to think that the rotor might better have been the antenna coil, but that is after all a matter of opinion. After winding some of the coils required, there is hardly room for much winding on the stator, a small diameter plate coil gives less tuning effect to regeneration control, the antenna coil gives sufficient coupling with a single turn or two, and the adjustable angle of the rotor coil makes it particularly convenient to use to get the best regeneration control. Suit yourself in that matter and in the matter of contact allocation; the writer is not stating the numbers he used since they departed from standard practice anyhow.

The wire used on the secondary is No. 18 bell-wire, the idea being merely to space the wire well and at the same time have the insulation moisture proof (the cotton on the bell-wire is paraffine impregnated). It was necessary to depart from the bell-wire to achieve some of the coils in their correct sizes for the tuning range desired and in these cases the wire was invariably soaked in paraffine, kept warm afterward to remove the surplus by drainage and then wound into the coil spaced with string or shoemaker's waxed thread, according to the number of turns needed. The 200 meter coil is wound with turns touching of the size of wire specified.

The primary coils are all one or two turns wound on the same form with the secondary and spaced as far from it as possible. The drawings in Fig. 2 show the idea. The

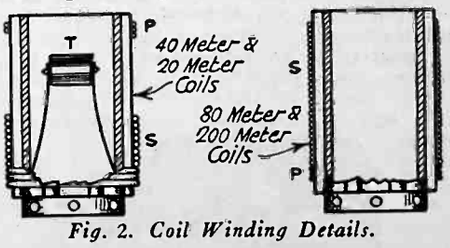


Fig. 2. Coil Winding Details.

tickler was wound with No. 34 wire with about the same number of turns as the secondary. This made an overlarge tickler that could be adjusted for best performance by adjusting the coupling. The tickler can be wound with a third more turns than the secondary and coupled through a midget variable condenser and in this event the regeneration control will generally prove to be fixed and tuning will be done with one hand. This the writer does not like since interference or static makes it often useful to dive deeply into oscillation to muffle the externals, a handy trick in traffic handling or long periods of communication. Suit yourself in this matter and remember that the regenera-

(*Continued on Page 62*)

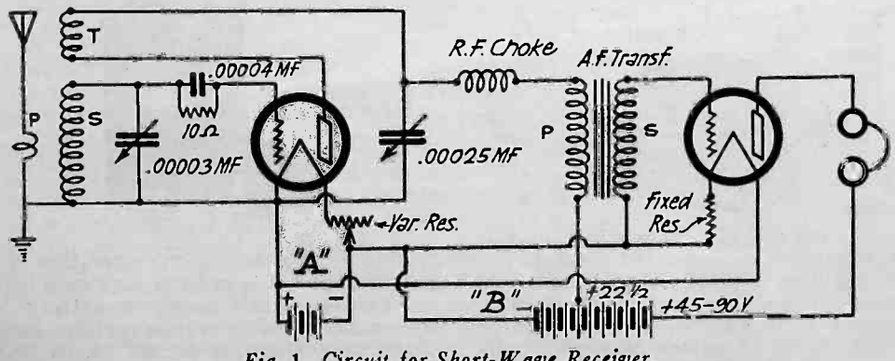


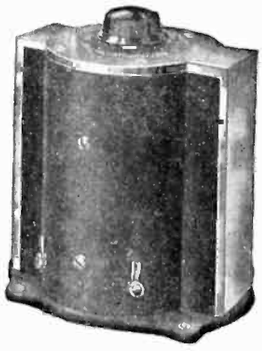
Fig. 1. Circuit for Short-Wave Receiver.

FROM THE RADIO MANUFACTURERS

The Tobe Veritas Hi-Current Resistor is designed to continuously carry from 4 to 5 watts without change or deterioration. It is furnished in sizes 1, ¾, ½, and ¼ megohm, 100,000, 50,000 and 10,000 ohms and under. It is said to be well-adapted for use in B eliminators, for grid

leaks on transmitting tubes and for use with De Forest H tubes. The resistance material is coated directly on the inside of a glass tube large enough to dissipate the heat. It fits any standard holder.

The G. I. variable audio transformer is equipped with a small knob which may be turned until the input impedance of the transformer primary matches the output impedance of the tube, this design



being intended to improve the quality and volume of tone delivered through an audio amplifier. In use, this adjustment is simply made by turning the knob until reception is best.

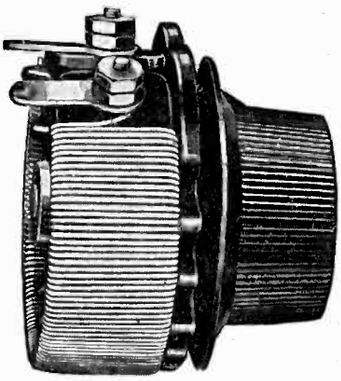
The Westinghouse "A" Autopower is a combination of a storage battery and trickle charger. The charger unit is claimed to be noiseless and of long life, test models having been in use for three

years without deterioration. The charging rate can be varied from 1/10 to ½ ampere, with two intermediate steps, by simply changing the position of a connecting link between the four contacts. The unit is made in four models, 4 volt 60 cycle, and 6 volt 65, 50 and 25 cycle.

The Burns "B" eliminator uses a Raytheon rectifier tube to deliver up to 135 volts for plate supply of detector and amplifier tubes, being provided with taps

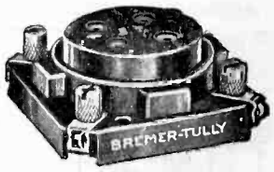
and rheostats for various intermediate requirements. Its capacity is sufficient to meet the full voltage requirements of an eight-tube set. It is conveniently housed in a case 7 in. in each dimension.

The new Frost Radio rheostat has been designed to meet the increased current consumption required for some of the new tubes without exceeding a safe operating temperature. It is made with either a metal or a bakelite frame for single hole mounting. It operates smoothly and



quietly, the contact spring maintaining a constant pressure of 4 ounces. This rheostat comes in 12 sizes from 2½ to 75 ohms so as to give the required filament current for a specified type and number of tubes. It is also supplied as a 200 and 400 ohm potentiometer for volume control. All sizes are uniformly 1⅝ in. in diameter over the windings.

The Bremer-Tulley UX absorber socket is designed to protect tube elements against vibrations which may cause microphonic noises. It is intended only for

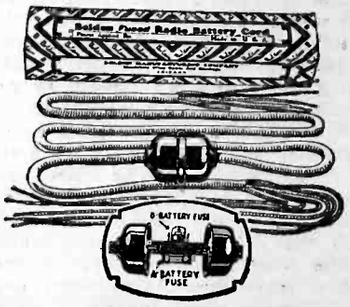


the new UX and CX tubes which may be easily inserted and removed from its positive contacts without sudden release. A special socket for detector tubes is equipped with additional side mufflers which prevent vibrations from even starting.

The Jefferson new tube charger is intended for use in re-activating all the tubes in a set without the necessity of removing them from their sockets. The A

battery wires from the set are merely connected to the charger and the tubes given a 45 second flash and ten minute bake.

Belden fused battery cord is either a five or a seven conductor cable, color coded and equipped with fuses in the A and B battery circuits. The fuses are held in position by special clips mounted



on the cord and are protected by a bakelite shield which may be opened for inspection or replacement. This cord protects tubes and batteries against accidental over-voltage and does away with the unsightly mass of wires frequently used to connect the batteries to a set.

The Handy trickle-booster charger, by means of a convenient toggle switch, charges a storage battery at either a ½ or a 2 ampere rate, the low rate giving a

trickle charge during the operation of a set without noise and the high rate being used to restore a run-down battery. It uses a 2-amp. vacuum tube rectifier and is made in models for 25, 30, 40, 50 or 60 cycles, 110 volts.

You hear *all* the tones

with an

Lorel Model

ALL-AMERICAN
TRADE MARK
Reproducer

An All-American Quality Product

A *good* speaker is the only kind worth having. A poor one will ruin otherwise good reception.

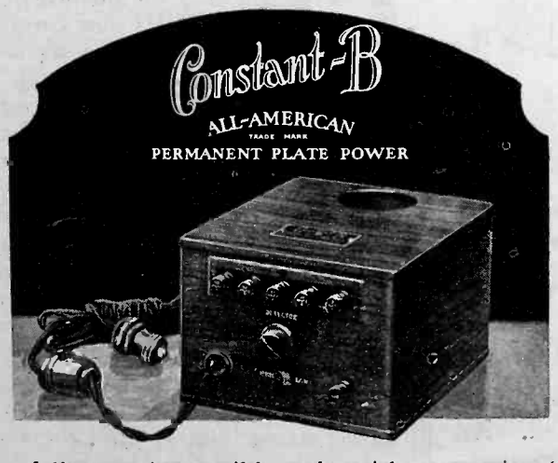
We're making a good one for you—the *Lorel* Reproducer; a cone type correctly balanced with sounding-board and sounding-chamber, to give you that purity of *all* tones, which you desire.

This remarkable unit combines the good features of both cone and sounding-chamber types of speaker; and eliminates their inherent weaknesses. You can hear *all* the high and low tones with the *Lorel*; clear and full.

Ask your dealer for a demonstration of the Lorel. You'll find it a real improvement in radio reception.

Price $25 *Slightly higher west of the Rockies*

ALL-AMERICAN RADIO CORPORATION
0000 Belmont Avenue , Chicago

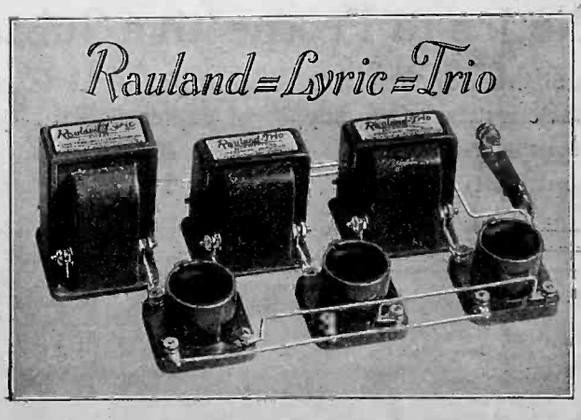


Pure full tone is possible only with unvarying "B" power. With All-American "Constant B" you get a permanent, constant plate power. There's nothing to take care of; no annoying hum, and no acid. Permanently sealed. "Constant B" has a 10 to 60 volt tap, varied in output by a "detector" control; a 67½ volt and a 90 volt tap; a variable voltage "power-tube" tap uniformly controlled by a "High-Low" switch.

Price $37.50 *Complete with Raytheon tube Slightly higher west of the Rockies*

A Remarkable Improvement in Audio Amplification

A development by All-American laboratories—the Rauland-Lyric-Trio. You know the Rauland Lyric Transformer, famous among music critics for its exceptional tone perfection. It is now combined with two Rauland Trio impedance units; retaining the advantages and eliminating the weaknesses of the two leading systems of audio amplification. The result is the last word in audio amplification. *Free book, "Modern Audio Amplification," tells more about this interesting development. Write for handbook "B-90."*



Notice to Prospective Subscribers

The publishers of "RADIO" cannot guarantee to start subscriptions with back issues. Our supply of copies is entirely exhausted. All subscriptions received this month must be started with the October Issue, out Sept. 25th.

MORE ABOUT THE INFRADYNE

(*Continued from Page 18*)

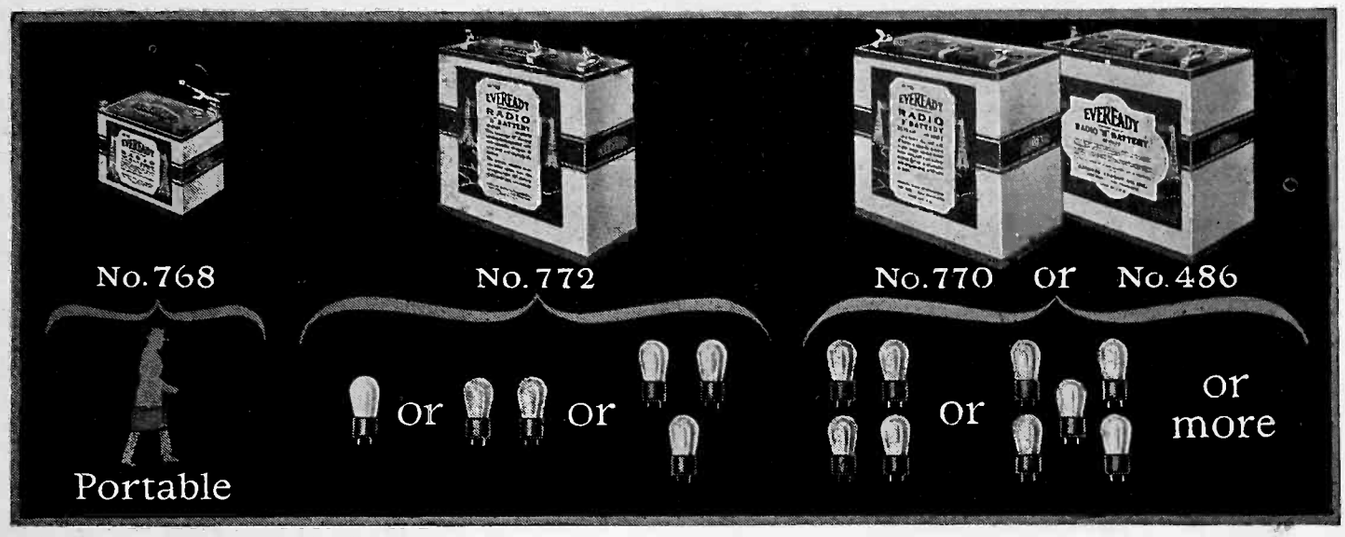
Even the energy that enters the antenna does not necessarily travel to the detector in its appointed path. Some of it is bypassed around both radio frequency tubes and fed right into the detector through inductive coupling between the first and third coils. This is represented by C_1 in Fig 1; C_2 and C_3 are other places where this coupling is likely to occur. The more compact a set is made, the greater the part played by these undesired inductive bypasses. Putting the coils at an angle or using toroids tends to cut down this effect but does not eliminate it. About the only practical solution is plenty of space between coils. In the infradyne the spacing and wiring are such that these undesirable features have been minimized.

The selectivity of the infradyne depends upon the size of the antenna used, the proper size to use being determined only after a study of local conditions. If a number of different sizes are tried, be sure and line up the three gang condenser for each one. The selection of the proper antenna brings up the old question of selectivity vs. sensitivity, and a suitable compromise must be made. Perhaps an illustration will help to make clear why the maximum selectivity and maximum sensitivity of any set cannot be had at the same time.

Suppose a man in Chicago about 5 miles from WEBH, 370 meters wants to receive WTAM in Cleveland, 389 meters. He starts out with a single circuit regenerative receiver and a 50 ft. antenna and finds that WEBH is "all over" the dial, covering from 285 to 500 meters and he cannot hear WTAM. He reduces the length of his antenna to 20 ft. and finds that WEBH now covers from 320 to 420 meters but is weaker and WTAM still cannot be found. The next step is to add a stage of tuned radio frequency amplification ahead of the regenerative receiver. With this in place and with the 50 ft. antenna, WEBH still covers from 285 to 500 meters but is nearly three times as strong as formerly. Cutting the antenna to 20 ft. reduces the interference band to 330 to 400 meters but WEBH is now as strong at resonance with a 20 ft. antenna and two tubes as formerly with a 50 ft. antenna and one tube. With the same signal strength on WEBH therefore the selectivity of the set has been doubled, but the selectivity has not been doubled with the original pickup which represents the maximum sensitivity. By oscillating the detector tube a carrier wave from WTAM can now be picked up, although nothing can be distinguished through the interference from WEBH. More stages of radio frequency are now added to amplify WTAM. WEBH again becomes too strong for the set, and a further

(*Continued on Page 44*)

Perhaps you, too, can cut your "B" battery costs in half. Just follow the chart. It gives you the secret of "B" battery economy.



THOUSANDS of people have made the discovery that Eveready "B" Batteries, when used in the proper size, and on sets equipped with a "C" battery*, are a most economical, reliable and satisfactory source of radio current.

Here is the secret of "B" battery economy, reliability and satisfaction:

On all but single tube sets —Connect a "C" battery. The length of service given below is based on its use.*

On 1 to 3 tubes—Use Eveready No. 772. Listening in on the average of 2 hours daily, it will last you a year or more.

On 4 or more tubes—Use the Heavy-Duty "B" Batteries, either No. 770 or the even longer-lived Eveready Layerbilt No. 486. Used on the average of 2 hours daily, these will last 8 months or longer.

These figures are based on the average use of receivers, which a country-wide survey has shown to be two hours daily throughout the year. If you listen longer, of course, your batteries will have a somewhat shorter life, and if you listen less, they will last longer.

Evereadys give you their remarkable service to the full only when they are correctly matched in capacity to the demands made upon them by your receiver. It is wasteful to buy batteries that are too small. Follow the chart.

In addition to the batteries illustrated, which fit practically all the receivers in use, we also make a number of other types for special purposes. There is an Eveready Radio Battery for every radio use. To learn more about the entire Eveready line, write for the booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you on request. There is an Eveready dealer nearby.

Manufactured and guaranteed by
NATIONAL CARBON CO., INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a "C" battery.

EVEREADY
Radio Batteries
-they last longer

MORE ABOUT THE INFRADYNE

(*Continued from Page* 42)

shortening of the antenna is necessary. Finally a point is reached where the proper balance between pickup and amplification and selectivity is effected and WTAM comes through without interference. Obviously the range of this receiver could be greatly increased if it could be connected up to the 50 ft. antenna but this could be done only at the sacrifice of some of the selectivity.

These rules also apply to a superheterodyne and govern the size of loop to be used. With the infradyne they determine the size of the antenna. A single circuit receiver on a 400 ft. antenna will receive the same distance that a super or an infradyne will, but it has no selectivity. To get both the distance and selectivity which we have learned to regard as necessary eight or ten tubes are essential, and a smaller number of tubes means less of each of these valuable qualities.

The recent development of power tubes and power amplifying transformers, while doing wonders for tone quality and volume, has also increased the microphonic tendencies of receiving sets, particularly when used with cone speakers. These "microphonics," which result in a continuous howling of the speaker, are built up by tremendous amount of audio amplification used. They are particularly noticeable when the UX-112 or UX-171 type power tubes are used because these tubes give a great deal more amplification than the older ones. Using spring sockets and putting pieces of sponge rubber under the corners of the cabinet will help some to eliminate microphonics, but sometimes the trouble is caused by a direct feedback through the air from the diaphram of the cone speaker to the glass shells of the tubes. Closing the cover on the radio cabinet will sometimes stop this, otherwise a 20 ft. extension loud speaker lead is recommended. Do not, under any conditions set the speaker on top of the radio cabinet if these microphonics are troublesome.

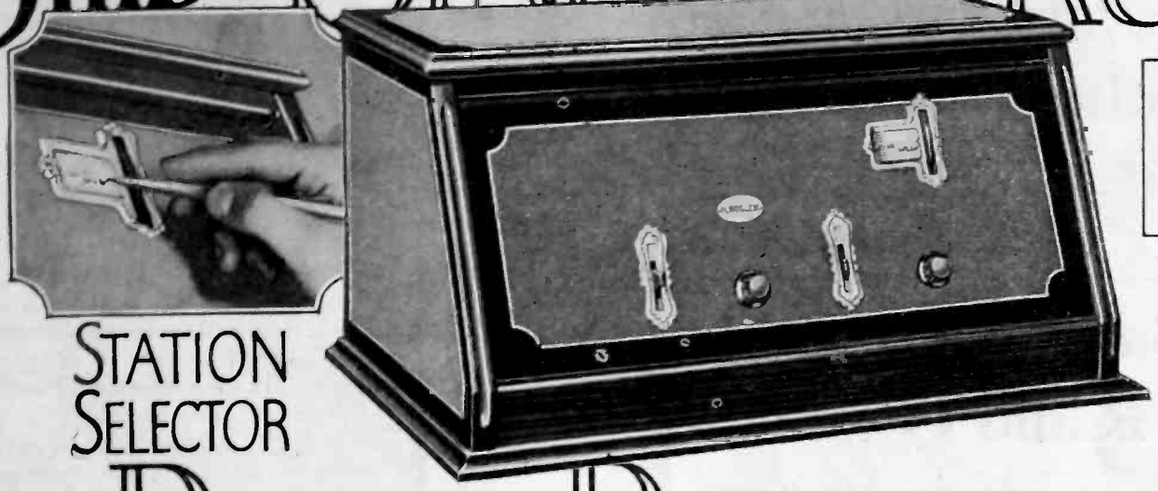
In the infradyne article in August RADIO the writer should have laid more stress on "lining up" the 2 stages of radio frequency controlled by the triple condenser. Although this triple condenser is equipped with sliding vernier plates, the capacities introduced by circuit wiring and antenna capacities are sometimes so large that these circuits are thrown too far out of resonance for the verniers to bring them back. When this happens, the set will not come up to oscillation above 400 meters, and the tuning on all wavelengths will be "broad."

This trouble may be remedied as follows: Slide the vernier plates as far as they will go towards one end of the condenser and notice where they hit the projecting brass supports of the stators. Then remove the two vernier plates from the condenser and cut away this interfering part with a pair of tin shears. The vernier plates can then be slid right up against the stator, and their balancing ability will be increased many times over. Be careful that the verniers do not come in actual contact with the stator plates, because if this should happen the incoming signal would be grounded and the set would be dead. If there is danger of such a short circuit, glue a thin piece of paper on one side of either plate so as to provide an insulating layer. This will not in any way impair the efficiency of the condenser.

The screw marked *increase* on the infradyne intermediate amplifier should bring the signals up to a peak and throw the amplifier into oscillation when screwed down. If it does not do so, a small choke coil inserted in the *B* battery lead of the intermediate amplifier will rectify the trouble. This choke coil is very small, consisting of 8 or 10 turns of silk or cotton covered wire No. 20, 22, or 24 wound around the finger. Bunch the turns and tie them in two or three places with string so they won't spring apart. Solder this choke right in series

(*Continued on Page* 46)

5 tube SINGLE DRUM STATION SELECTOR RADIO RECEIVER



6 Other Crosley Radio Achievements

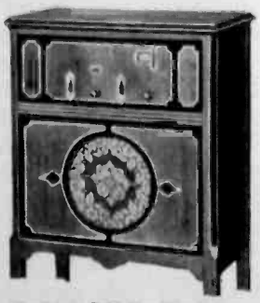
The Crosley 1-tube "Pup"—$9.75—a double-circuit set, with which laymen have heard radio signals probably the greatest distances.

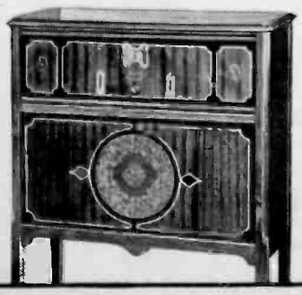
The 4-tube 4-29—$29—a 4-tube receiver of amazing efficiency. Already proven its right to a permanent position in the Crosley line. CRESCENDON equipped!

The 5-tube 5-38—$38. The 5-tube tuned radio frequency set incorporating the CRESCENDON—a spectacularly popular model.

The 5-tube RFL 75—$65—true cascade amplification; non-oscillating—non-radiating, regardless of how it may be mishandled.

The 5-tube 5-75—$75—embodying the 5-tube single control, with drum station selector, as offered in a table model at $50. SOLID MAHOGANY cabinet. Musicone built-in—41 inches high.





The 5-tube RFL 90—$90—introducing the double drum station selector! Solid mahogany cabinet. Musicone built-in—ample room for batteries and all accessories, 41 inches high, 30 1-2 inches wide.

Prices slightly higher West of the Rockies.

Crosley manufactures radio receiving sets which are licensed under Armstrong U. S. Patent No. 1,113,149 or, under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

$50.

Contrast the surpassing performance of this new type of Crosley Radio with what has hitherto been considered radio perfection.

The cabinet is solid mahogany, beautifully finished in two-tone and striped in gold. Metal fittings are rose gold finish.

The metal shielded chassis is divided into three compartments. The units shielded from each other, prevent interstage as well as external coupling. This improves stability of circuit and increases selectivity. This has never before been offered in sets of moderate price.

Crescendon Control affords unusual volume from distant stations.

Heretofore single dial control sacrificed selectivity. By means of the Acuminators, very sharp tuning is accomplished where the reception from local stations spreads broadly over the dial. Under average conditions, when once adjusted, these acuminators do not have to be touched again.

With the Graphic Station Selector, Stations from one end of the wave band to the other, are easily brought in at all times—IN THE SAME PLACE.

The CROSLEY MUSICONES

The announcement of the new Super-Musicone is predicated on the success of the Regular (12 inch cone) Crosley Musicone in replacing hundreds of thousands of old type loud speakers. **Musicone Regular 12 inch cone $12.50. Super-Musicone 16 inch cone $14.75. Musiconsole with built in Musicone $32.00.**

Crosley Musicones are manufactured under basic patents issued and pending, controlled by Crosley.

CROSLEY · RADIO

BETTER ... COSTS LESS

Write Dept. 19 CROSLEY RADIO CORPORATION, CINCINNATI, O.

AN ACCURATE DIRECTION FINDER

(*Continued from Page* 20)

loud, and when rotated 180 degrees the signal decreases greatly in intensity. While in this position carefully readjust uni-directional balance and the signal should be made to disappear entirely or nearly so.

Let us assume that the transmitter actually is known to lie in the direction indicated by our first bearing, viz:—90 degrees, and further that when the loop is rotated for uni-directional bearing one side of the loop will show a maximum signal when toward the station and the other side will give minimum signal when rotated so that it is toward the station. Having determined which side of the loop gives a minimum signal when toward the station, the direction of which is known, place a designating mark upon that side of the loop or upon the stem, as thereafter all uni-directional bearings will be determined by this means. This designating mark will correspond to the pointer in the photograph shown to the right of the azimuth circle.

Briefly then, the procedure is to tune in a signal for maximum, with switch in directional position. Tuning adjustments should be carefully made. Rotate the loop then and locate the "bearing" which at this juncture need not be accurately determined. Throwing the switch for uni-directional rotate loop approximately 90 degrees, so that its plane is in the line of bearing and adjust carefully for zero signal. If minimum cannot be achieved with loop in first setting rotate 180 degrees, and adjust. When minimum is achieved, an imaginary line drawn from the center of the loop through the side giving minimum signal will determine the direction of the transmitter. That narrows the actual bearing of the station to within very narrow limits. Throwing switch to first position, carefully adjust direction balance as loop is slowly swung, until a sharp minimum is obtained, and read the bearing from the dumb compass.

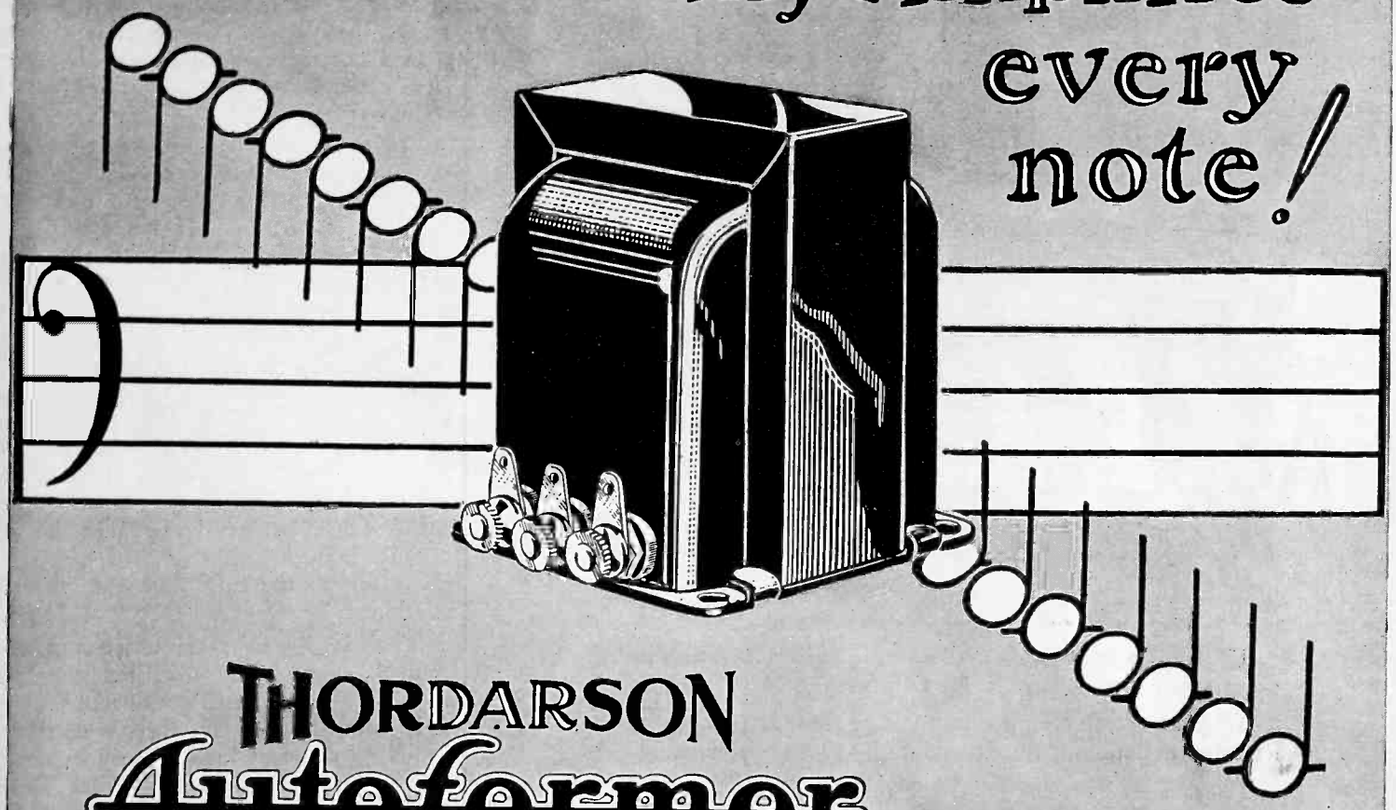
A reliable scale map of the city or locality upon which the bearings may be plotted as taken, completes the equipment.

MORE ABOUT THE INFRADYNE

(*Continued from Page* 44)

with the amplifier *B* battery lead that goes to the post marked *B*. The effect will be magical, as the volume will be increased threefold and the selectivity will be much greater. The choke coil does not have to be mounted on anything —simply suspend it in the air. If it has too many turns the oscillation will be uncontrollable, and turns must be stripped off until the right balance is found.

Fully Amplifies every note!



THORDARSON Autoformer

Step-up Impedance Coupled Amplifier

Full Amplification of Bass Notes

Improved Reception of Weaker Stations

Greater Clarity on all Programs

Better Volume Control

Impedance coupling is universally accepted as the most perfect form of amplification from a reproductive standpoint—But the amplification increase of the straight impedance is low.

The Thordarson Autoformer is an impedance with a step-up ratio—It combines the faithful reproduction of the impedance with the amplification increase of the transformer, paving the way for the release of the deeper tones with increased volume and unrestrained quality.

Price each $5.00

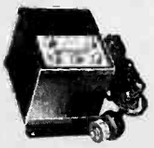
Note: Only Thordarson makes the Autoformer

POWER From the A. C. Line

Power Amplifier Supply Transformer, R-198 furnishes current for both plate and filament of the power stage using the U. X. 210 power tube with 400 volts on the plate and 7½ volts on the filament. In addition furnishes complete B-supply for the set.

Price.....$12.00

B-Eliminator Transformer R-195 is designed for use with the Raytheon tube, furnishing B voltages for the entire receiver. Capable of supplying 140 volts at 40 milliamperes. Conservatively rated. Will not heat up in continuous service.



Price $7.00

30 Henry Choke Coil R-196 is used in the filter circuits of power amplifiers and B-eliminators operating from the house lighting current. D. C. resistance 280 ohms. Capacity 70 milliamperes.

Price.....$5.00

THORDARSON ELECTRIC MANUFACTURING CO.

Transformer specialists since 1895

WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS

Chicago, U.S.A.

TUNING IN ON ELWOOD GLOVER

(*Continued from Page 24*)

being pushed under a cold shower; and then the room became so quiet that a graveyard would sound like a boiler-works beside it. Cragmire — which turned out to be the dark complexioned chap's name—cleared his throat, and went on:

"In order to avoid any embarrassing consequences, we have decided to give the—uh—culprit an opportunity to return the securities. If he will do so before twelve o'clock tonight, the matter will be held in strictest confidence, and there will be no arrest made. Of course, any attempt to leave these premises will tend to create suspicion; so I would advise everyone to remain here until midnight. If, by that time, the—uh—guilty party has not returned the bonds, we will proceed to disclose his identity and have him placed under arrest. Oh, yes, we know who he is; because there is only one guest here who knew where the safe was and what it contained."

Thrilling—what? Here we were marooned, so to speak, like the chap on the desert island, with nothing to eat but food, and a thief in sheep's clothing, prowling amongst us. I was just about to pipe up with some wise crack about the affair, when all of a sudden the awful truth burst over me. *I was the one they suspected!*

I suppose Raffles or Jimmy Valentine or some of those other clever crook chaps would have met the situation with a certain amount of composure. But I have to admit that it left me a big goggly. The more I thought about it, the more I saw that everything pointed an accusing finger at me. The fact that I was the only one who knew about the safe, that I refused to leave the party and drive Curtiss back to town, that I didn't come down to breakfast. What's more, as the day wore on I continually found myself doing things that seemed suspicious. When I went to my room, it appeared as if I were hiding my shame; and when I mixed with the crowd, it looked like I was trying to brazen the thing out. Worse than that, I noticed that every time I joined a group of friends, they'd suddenly stop what they were talking about and begin remarking about the weather. It all commenced to tell on my usually bountiful supply of joi-de-vivre.

Afterwhile, I wandered out into the garden, and encountered Curtiss.

"Look here, Bill," I blurted out, "this business is a trifle too muggy."

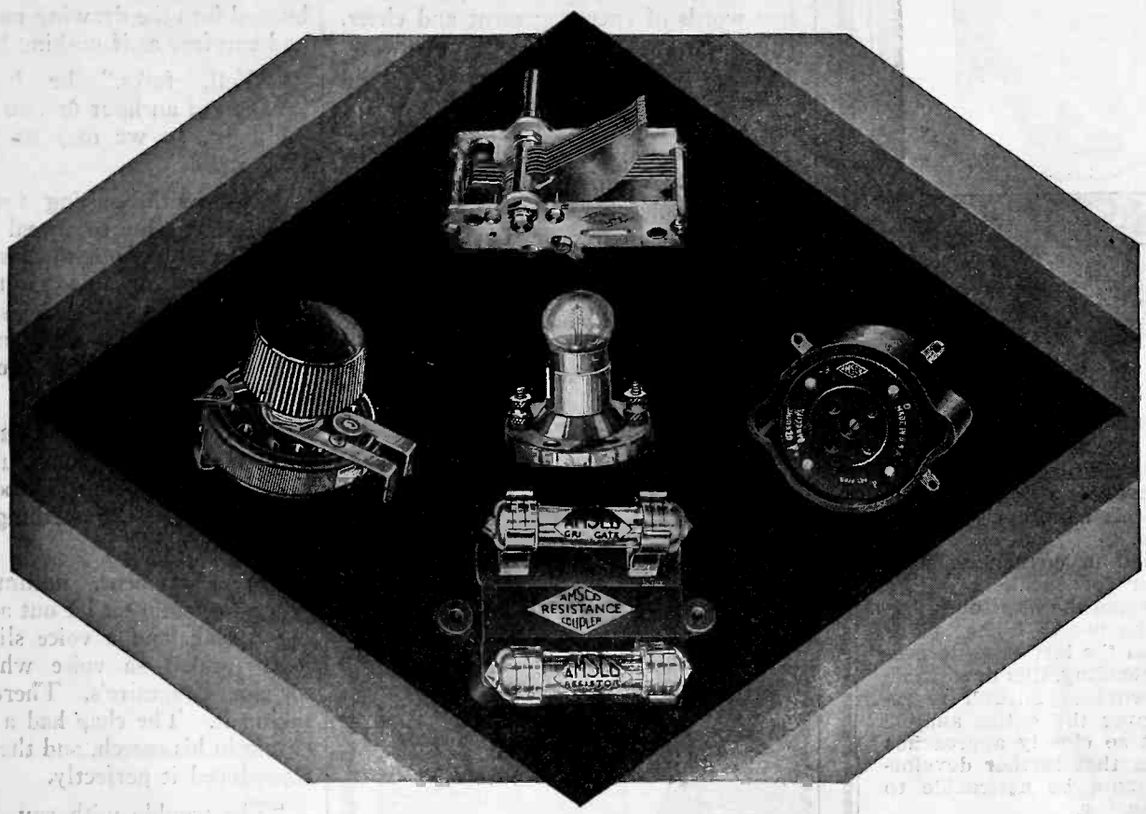
"You mean about the bonds?" he asked coldly, still a bit piqued over my refusal to drive him back to town.

"Yes, about the bonds," I dashed on, anxious to unburden my bleeding soul,

(*Continued on Page 50*)

AMSCO

FOR EXCELLENCE



NEW!

AMSCO Announces new apparatus of new electrical and mechanical perfection for the new Radio year of 1926-27.

ALLOCATING CONDENSERS . . . . . *Spread the stations with engineering precision*

METALOID GRID GATES . *Superseding grid leaks*

METALOID RESISTORS . . *Stable, Silent and Sure*

RESISTIVE COUPLING AMPLIFIER UNITS . . *Most Compact and Efficient*

AMSCO FILATROLS . *Perfected Automatic Rheostats*

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AMSCO TOM THUMB RHEOSTATS . . . . *The midgets for giant performance*

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Exhibitors: New York and Chicago Radio Shows

AMSCO

MEMBER RMA

TUNING IN ON ELWOOD GLOVER

(*Continued from Page* 48)

so to speak. "You know, they think I took them."

Naturally, in view of the circumstances, I expected him to forgive and forget our unpleasant little tilt of the preceding evening, and to pass out a few words of encouragement and cheer. But instead of that, he went on to drawl a picture of the effects of dishonesty, and to point out how little things, like cracking a safe, eventually led to real crime. The thing to do, he advised, was to make a clean breast of the matter and go straight while there was still time. It was all very impressive, but I'm bound to say it had quite the opposite effect of bucking me up. Here was good old Curtiss, pal of my boyhood days and all that sort of thing, absolutely believing down in his heart that I was a thief. It was more than I could bear. I tottered weakly back to my room, pondering whether to send out for a flask of carbolic acid and end it all, or to dress for dinner.

I decided upon dinner. It proved to be a rather cold and clammy affair, with Glover looking more worried than ever, and Cragmire piercing my soul with accusing glances—the kind that make you feel as if you have an ink spot on your collar. I noticed that Curtiss wasn't among those present, apparently preferring starvation to another session with the sprightly blond damsel. But after the coffee had been served, and Glover and Cragmire had sneaked away—no doubt to telephone to the police—he buzzed into the drawing room as chipper and carefree as if nothing had happened.

"Well, folks," he began briskly, "we've got an hour or two to wait until midnight, so we may as well enjoy a little radio."

What with waiting for the solemn stroke of twelve to reveal the thief, no one seemed very enthusiastic about his suggestion. I mean to say that the situation was a bit tense and strained. But Curtiss went right ahead as if we were all gathered there for an evening of light-hearted fun and frolic.

"I think there'll be a little entertainment on the air which you'll find interesting," he continued, fooling around with the dials. "Something—ah—something unusual."

For a moment, nothing happened. Then the radio set let out a slow, lingering squeak, and a voice slid out of the loud speaker—a voice which I recognized as Cragmire's. There was no mistaking it. The chap had a sort of nasal twang in his speech, and the loud-speaker reproduced it perfectly.

"The trouble with you, Glover," the voice was saying, "it that you're a quitter."

"Quitter, nothing!" It was Glover's

(*Continued on Page* 52)

INTRODUCED nearly three years ago as the product of one of the world's greatest experimental laboratories, THE BROWNING-DRAKE RECEIVER remains the outstanding example of scientific design in radio reception. Countless names and trick circuits have come and gone, emphasizing the mathematical soundness of the principles underlying Browning-Drake which continues to increase enormously in prestige and good-will with the years.

Distributed under a sound policy through jobbers and dealers who will remain factors in the industry in the years to come, Browning-Drake will continue in the confidence of the American public as it has in the past. The enthusiastic support of a hundred thousand Browning-Drake fans we consider our greatest asset.

One model is produced embodying the best that is known in the science of radio reception and backed by research facilities which guarantee constant improvement, together with permanent value. Greatest radio frequency amplification of any transformer on the market is combined with the perfect tone quality of resistance amplification in a reasonably priced receiver.

The
BROWNING-DRAKE FIVE

For further information address the Browning-Drake Corporation, Brighton, Mass.

BROWNING-DRAKE

TUNING IN ON ELWOOD GLOVER

(*Continued from Page* 50)

voice which replied. "I'm telling you that the clothing business is on the rocks. In a month or two, everybody will know it. They'll be wondering where all my dough comes from. It'll look suspicious. We've got the bonds; and I'm going to take my share and beat it out of the country."

"Incriminate yourself right at the start, eh?" Cragmire's voice again, with an ugly sneer in it. "And get me in bad, too. The thing to do is to sit tight. Stick the bonds away, and play poverty for awhile. Let 'em arrest young Rockford-Peebles, and send him up. We've got a dead open and shut case against him. Then in a few years after the affair blows over, you can step out without anyone suspecting anything. Besides, if you sneak now, your nephew is bound to get wise; while with my plan, he'll naturally believe Rockford-Peebles is the——."

There was some more talk, but it was lost in the roar of surprise that went up as the significance of the conversation began to sink in. The bonds belonged to Glover's nephew, and Glover had stolen them himself. The week-end party, the business of showing me the safe, the whole thing was a frame-up to build up evidence against me.

What would have happened to Glover and his little playmate, Cragmire, would have undoubtedly been extremely messy if, at that moment, the two plain clothes men hadn't arrived. Curtiss, followed by the rest of the crowd, encountered them in the hall just as the butler admitted them.

"These gentlemen wish to see Mr. Cragmire," the butler explained. "They say he telephoned——."

"It's about the bond robbery," one of the sleuths put in. "We're from headquarters. I understood you've got the guilty party."

"Two of 'em," Curtiss replied with a grin. "Two of 'em. You'll find them, and Mr. Cragmire, upstairs in Mr. Glover's bedroom."

. . . . . .

WE WERE half way back to town before I got the old bean functioning smoothly enough even to ask questions. I mean to say I was a bit dazed.

"But I don't see yet," I admitted to Curtiss, "how you ever got the idea it was Glover."

"Oh, that was easy," he answered, modestly. "In the first place, it's common knowledge in business circles that Glover is broke; so his buying a seven thousand dollar picture struck me as being rather peculiar. Second, I noticed the butler bringing his bags downstairs and putting them in his car."

"Yes, yes, go on," I breathed. The fellow was positively maddening.

(*Continued on Page* 54)

Constant Dependable B Power Direct from Your Light Socket is Now a Reality in Majestic Units

THE DAY of better radio reception is here. Improved tone quality, greater volume, and more reliable all-round service are now made possible by MAJESTIC B Power Units. They attach direct to your light socket saving you constant bother and attention. No acids to spill. No "Hum". Reliable, unvarying power at an average cost of about one-tenth cent an hour. Economical, powerful---Lasts as long as Any Receiver. Fully guaranteed.

MAJESTIC STANDARD-B CURRENT SUPPLY

Especially adapted for sets having not more than seven 201-A tubes, or, six 201-A plus one 135-150 volt power tube. Popularly priced for the average set. Improves tone---betters reception.

Price $32.50
West of Rocky Mts. 35.00

MAJESTIC SUPER-B CURRENT SUPPLY

Capacity 1 to 12 tubes, including the use of 135-150 volt power tubes. Complete with switch to control current from light socket.

Price $35.00
West of Rocky Mts. 37.50

MAJESTIC MASTER-B CURRENT SUPPLY

Rating 60 mils at 150 volts. Particularly adapted for Radiola 25, 28, and 30 and superheterodynes. Will operate all power tubes, also the new super power tube UV-171 (180 volts). Unequalled for sets having a very heavy current draw.

Price $42.50
West of Rocky Mts. 45.00

Majestic "B" Current Supply

delivers pure direct current-From your light socket

Their low purchase cost and the savings they bring to you make them an investment that soon is repaid. Don't delay---see your dealer at once or write for free literature.

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TUNING IN ON ELWOOD GLOVER

(*Continued from Page* 52)

"Well, that looked like he was contemplating a sudden journey. And when the news of the robbery broke—I just put two and two together; and there you are."

"How about that trick with the radio?" I insisted.

"See here, Freddie," he replied, with a note of pity in his voice, "you're not a radio bug, so I'll have to explain it in words of one syllable. Under certain conditions, a loud-speaker will act as a microphone — that is, it will magnify sounds which come into it. To bring about those conditions, you first turn out the filaments of your radio frequency and detector tubes. Next you connect the terminals of the loud-speaker to the primary binding posts of the first audio transformer. Then when you plug your headphones in on the second stage and light the audio amplifier tubes, you can hear, by means of the headphones, sounds which occur in the room—voices, people moving, everything. Do you follow me thus far?"

"Righto!" I shouted. "Lead on."

"Very well. Now suppose you reverse this procedure, placing the headphones across the primary of the first audio transformer and plugging the speaker into the second stage jack. In such a case, sounds entering the headphones will be reproduced in the loud-speaker. Assuming, now, that Glover had stolen the bonds and was planning a quick getaway, I knew he would make final preparations in his bedroom. So while the rest of you were at dinner, I hooked up the set in the bedroom with the one in the drawing room, in the manner I have just described—that is, in such a way that sounds in the bedroom would be amplified by the loud-speaker in the drawing room. That's all there was to it."

I let this penetrate a minute before I fired my next question.

"If you really suspected Glover, why did you pretend that you thought I hooked the bally bonds."

"That, Freddy, old dear," he replied, "was revenge. I thought I'd let you suffer a little for the mean trick you played on me in dragging me into the affair. The next time——."

Then suddenly an idea hit me squarely between the eyes.

"Hold on there," I said. "I brought you down to Glover's place to decide a bet, didn't I? And the bet was that Glover had a radio set which would pick up sounds right out of the air, without their having been sent out from a broadcasting station. Well, according to your own statement, that's exactly what the set did. If you don't happen to have the twenty-five with you, just write me out a check."

Rather neat, what? Even if I do say it myself.

TUNED RADIO FREQUENCY

(*Continued from Page* 31)

condensers which results in low selectivity, and since the rotor plates are not grounded, bad hand capacity effects are had unless condensers with insulated shafts are used.

The arrangement of the primary in the tuned r.f transformer is of particular importance. The success of the Browning-Drake circuit has shown that the way to obtain amplification is to reduce the capacity relation of the primary to the secondary by reducing the primary area, keeping the inductance value at the proper amount, of course. The method used in the Browning-Drake transformer construction is to employ a primary wound with very small wire, placing it in a narrow slot mounted at a favorable position in relation to the secondary, at the filament end. This type of transformer is excellent to use in the circuit of Fig. 3b, up to two stages of r.f. amplification.

It has been asserted that the selectivity as well as the amplification is controlled by the number of turns in the primary coils. This is only partly true, as a correct antenna coupling method will aid selectivity more than at any other point. In some sets an attempt is made to increase the selectivity by decreasing the turns in the primary coils to 3 or 4, but this cuts down the total amplification by a large amount, and only produces an apparent improvement in selectivity. In the new shielded sets, as many as four stages of tuned r.f. are used, each stage being completely shielded, and with a relatively small amount of amplification per stage by using a small primary winding.

CALLS HEARD

By 8DED, William G. Sakkers, 53 East 7th St., Holland, Michigan
Heard on 40 meters

Australia: 2cm, 2ij, (2lk), (2lo), 3bd, (3bk), (3ef), (3kb), (3tm), (3wm), 4ab, (4an), (4cm), 5ak, 5kn, (7cw), 7cs, (7dx), 7pf. Brazil: 5ab. Canada: 1ar, (3bt), (3gg), (3zb), (5ef), 5go. France: (8lp), 8jn, 8kf. Hawaii: 6aff, (6def), (fx1). Mexico: (1k), 9a, 9m, jh. Porto Rico: (4sa), (4rx). South Africa: (a3b), a6f. New Zealand: 1ao, 1ax, 2nm, 2xa, 4aa, (4ac), 4ak, (4am). Miscellaneous: kegk, fea, (nkf), nau, nitc, nitz. Pse rept mi sigs. Tnx.

By (9APY), 3337 Oak Park Ave., Berwyn, Ill.
Heard on both the 40 and 80 meter bands.

1aap, 1air, 1ajp, 1ans, 1xf, 1amd, 2axq, 2cua, 2tb, 3aln, 3cva, 4aah, 4cj, 4dd, 4dy, 4ll, 4mj, 4rm, 4ry, 5aad, 5api, 5aq, 5aqt, 5ask, 5avf, 5dl, 5em, 5kc, 5lg, 5pi, 5wi, 6alr, 6apl, 6cwk, 6daq, 6dp, 6xi, 8ahc, 8ayp, 8brc, 8cbr, 8daq. Porto Rico: 4rn. Canadian: 3el. Miscellaneous: kio, naw, npg, wnp. Card for card fellows. How about it?

By Harold W. Johnston, Radio Operator, S. S. WEST CADRON, Portland, Ore.

6CGL on S. S. "WEST CADRON" 40 meter band, Portland to Yokohama, May 13, 1800 miles from Columbia River: 6abg, 6aqq, hu6axw, hj6bdl. May 30 and June 1 at Osaka, Japan 6bq, 6rd, 6rw, 6rj, 6dag, 6dcq, 7wu, pl1hr. June 8, Cebu for Kobe 90 miles from Kobe: u1zq. June 10, at Nagoya, Japan: 6rw, 7it, pl1hr, picd8. Will gladly QSL any of above upon request.

By Kiyosi Kawahara, JBJB, care Huzino, Amiya, Hakozaki, nr. Hukuoka, Kyuusyuu, Japan

Au: 3ae. C.: 6bk, 2kd. Fc.: 84m, ffz. G: 2bz. J.: too numerous. M.: 6o, 3g. Pi.: 1au, 1dl, 1hr, 3aa, 8ll. cd8. Siberia: ral9. U.: 1cnp. 2bk, 6ax, 6bbq, 6bls, 6bye, 6cto, 6dcq, 6dbq, 6dbk, 6ll, 6nc, 6xi, 7it, 8qkf, kel, whb, wsn, wes, wiz. Misc.: ?4za, ?6bx, andir, ansan, dgm, dl4, pgn, pln, pcg, ppn, unst, vgf, z4f, zhc.

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

40 meters—1ag, 1ci, 1cp, 1ue, 1aal, 1aao, 1acy, 1aru, 1bxg, 1ckp, 1cmx, 3zo, 3bwt, 4al, 4by, 4kb, 4ku, 4ll, 4qa, 4rl, 4rr, 4vl, 4wf, 5dl, 5om, 5ql, 5wi, 5acy, 5agl, 5akc, 5akl, 5akn, 5anx, 5zaz, 6cz, 6abg, 6bmw, 6cua, 6cwk, 8bn, 8dp, 8im, 8pl, 8ayp, 8bqk, 8bth, 8buy, 8cbr, 8ccq, 8cdw, 8cgz, 8daq, 8dem, 8dok, 9ir, 9aaw, 9aeo, 9baz, 9ctg, 9cub, 9dpv, 9eez, 9egu, bzlaw, bz2aj, clar, clcx, c9ac, c9ay, f8cs, f8df, ilas, m1n, getn, nyt, wiz.

80 meters—1gh, 1ajm, 1bco, 1bzq, 1cot, 3vg, 3al, 3ade, 3bln, 3blz, 4im, 8eu, 8gi, 8avk, 8avn, 8cmo, 8cgy, 8blp, 9crv. Will answer all cards.

By u7MF, Harold DeVoe, 1310 West Main St., Medford, Ore.

Australian: 2bb, 2bk, (2cg), (2cs), 2gc, 2ij, 2jr, 2lk, 2tm, (2yl), 3ad, (3ak), 3bd, (3ef), 3en, 3kb, 3wm, 4an, 4bo, 5kn, 7cw, 7dx, (7hl), vis. Alaskan: 7co, (7kx), 7mn. Brazil: 9qa. Canadian: (4dt), (4hh), (4lo), 5bf, 5cr, (5ef), (5go). Chilian: 2ar. Hawaiian: 6ajl, 6asr, 6axw, 6bdl, 6buc, (6dbl), 6oa, 6xg, fxi. Japanese: 1kk, (its), joc. Mexican: (1aa), 9. South African: a3e. Philippines: 1hr. Uruguay: 1cd. New Zealand: (1ao), 1ax, 2ac, (2bx), (2gc), 2xa, 3ae, (3ag), (3al), 3aj, 4aa, (4ac), (4am), 4av. Miscellaneous: fb2, kel, (nem), nkf, nimr, niss, noh, npg, npm, pjc, rxy, wiz, wwdo, ti-7ap, x-87q.

7MF is on 40 meter band with one UV-203-A and any reports would be appreciated. All cards will be answered promptly. 73's.

By 9APY, 3337 Oak Park Ave., Berwyn, Ill.
(June, 1926, 40 and 80)

(1acd), 1aci, 1amd, 1blf, 1byx, 1cib, 1fs, 1zd, 2abt, 2afv, 2aws, 2bnz, 2cpd, 2cqz, 2cvj, 2cxl, 3acu, 3adl, 3aiy, (3bmn), 3ccv, 3jh, 3kp, 3tr, 4al, 4eo, 4kl, (4ll), 4ml, 4nh,

(*Continued on Page* 61)

LO-LOSS' DREAM

(*Continued from Page 17*)

Loloss shall be honored among the sons of men!"

Presently, wearied from his labors, the primordial man sank down upon the sand and slept. And as he slept a vision came to him.

. . . . . .

In a gayly decorated room, filled as with the light of day by scores of electric bulbs, sat a company of young men and women in evening dress. Puny, pale-faced people, these, unlike the hairy brutes of Loloss' acquaintance.

At a table in the center was a strange object, unlike anything he had ever seen —a box of polished wood, adorned with shining black knobs and glistening metal levers. Beside it stood a huge black horn, not unlike that of the rhinoceros, he thought. From this horn, moreover, issued curious sounds. A man's voice, high-pitched, effeminate, was speaking:

"\. . . . . are being entertained by Jake Piffle's Crustaceans, broadcast by crossed wire from the Insipidia Cafe. Their next number will be 'My Sweetie Likes Grapefruit, I Saw It in Her Eye.'"

"Oh, goody!" cried one of the assembly, "Now we can do the 'Penobscot,'" and, as a deafening roar broke from the horn, they rose and began to go through weird contortions, all the while stamping their feet and shouting in glee. Some tribal ceremony, conjectured the cave man.

Suddenly the roar ceased, and above the din of voices Loloss made out the words:

"Station WQRM. You will now listen to the weekly meeting of the 'Pickled Oysters,' who, for no reason apparent to the naked eye, will meet in the Kennel Room of the Hotel Igloo."

As divers moans and yelps began to emanate from the horn, a voice, louder than the rest, reached Loloss' ear.

"Oh, wasn't it perfectly gorgeous of Hector to buy this Inferiodyne Radio?"

Radio! A great light broke upon the astonished cave man. This, then, was the future of his invention!

. . . . . .

Loloss woke with a start, a cold sweat upon his brow. His bewildered gaze fell upon the two boxes. He leaped to his feet, seized his stone mallet, and with a savage oath shattered them to bits, to be invented some millions of years later.

A high pitched singing noise in your *B* battery eliminator may be caused by direct induction between the radio receiving set and the power line, where the 60 cycle and third harmonic components are induced into the radio frequency portions of the circuit and then amplified. No filters nor other devices will eliminate this trouble. It may often be cured by removing the set from the current supply set.

QUERIES AND REPLIES

(Continued from Page 35)

d. c. flash test, and 710 volts continuous load. for if ordinary filter condensers such as are used in the conventional types of B eliminators are used, they will be quickly burned out. With 50 milliamperes plate current, the 1000 ohm resistance in the grid return circuit will furnish 50 volts negative grid, thus eliminating the C battery. If the plate voltage is higher than 710 at the plate of the tube, the plate current will be greater, and it may be necessary to increase the grid biasing resistance slightly. Be sure to insulate all connecting wires, and use an output transformer, for an unpleasant shock can be had from the output of the rectifier.

It is assumed that a pair of UV-203-A 50 watt tubes are used. Data for the power transformer are as follows: Core is the form of an H, with top and bottom closed, with cross section 1½x3 in., making a cross sectional area of 4½ sq. in. This makes the core pieces 1½ in. wide all around, and the core will stand 7 in. high. The windings are all placed on the cross piece of the H, with the primary first, then the two filament lighting secondaries and finally the plate winding. The primary, assuming a good grade of silicon steel for the core, should consist of 185 turns of No. 16 d. c. c. wire. Between it and the core should be placed a heavy layer of empire cloth, and the same between each winding. Over the primary wind two filament secondaries of 17 turns each, one center tapped, using No. 16 d. c. c. wire. The plate winding should consist of 1520 turns of No. 30 enamaled, cotton covered wire, and should be well insulated with empire cloth wound around the outside of the winding.

It will be noted in the diagram that two snap switches are required, and in turning on the amplifier, the plate circuit switch, in the negative B supply lead, should be left open until the filaments of the tubes have been lighted for about 10 seconds, and the elements of the tube heated. If this is not done, both tubes may be burned out.

Would like to construct a 200 kilocycle filter for use in a superheterodyne, and also an oscillator coupler for the same purpose. Please give me the constructional data on the above apparatus.—E. H. G., Milwaukee, Wis.

Construct a spool from hardwood or bakelite, with two 3½ in. slots placed about ¾ in. apart, and ¾ in. deep. The hub of each slot should be ¾ in., and the flanges may be made any suitable size. In one slot wind the primary, which should consist of 300 turns of No. 32 silk covered wire. The secondary should be wound with 800 turns of No. 36 single silk wire, in the remaining slot of the spool. The primary is tuned with a .0001 mfd. variable condenser, the secondary being untuned. The oscillator coil should be wound on a 3 in. tube, and consists of two stator windings, one being the grid coil, with 11 turns of No. 28 or 30 d.c.c. wire, and the other the plate coil, with 30 turns of the same sized wire. The grid coupling coil may be wound on a 1½ in. tube, placed inside the stator, and wound with 15 turns of No. 28 or 30 d.c.c. wire.

Please give me the data on a 2-tube receiver using the WEAGANT plug-in coil system.—R. M. P., Rio de Janeiro, Brazil.

A short wave receiver using this circuit was shown in Fig. 1, page 13 of August RADIO. For the 40 meter band, the grid coil should consist of 7 turns of No. 20 bare wire, space wound on a 3 in. form. The plate coil has 6 turns of No. 28 or 30 silk covered wire, wound at the filament end of the grid coil. The antenna coil should have 3 turns of No. 26 silk covered wire, and should be mounted so that it can be varied with respect to the secondary, to insure the proper coupling.

STATIC, INC.

(*Continued from Page* 17)

sopranos comes on the air, the wave form of the voice is not smooth, but is rough, irregular and has the same characteristics of the wave of some electrical disturbances. The static eliminator will filter out disturbances. The static eliminator will filter out the irregular component of the wave and leave a clear musical tone.

Beneficent Results of a Static Eliminator.

"So with a static eliminator that has a mechanical appreciation of the beautiful," concluded Mr. Jupiter, "the millennium of radio will have arrived."

And with this prophecy in our mind, we left, impressed and awed by that versatile business genius, George J. Jupiter.

R. F. AMPLIFIER

(*Continued from Page* 37)

between this choke and the other coils. It may be included in the amplifier panel, or connected on the outside near the battery.

The whole mess can be mounted behind a 7x8 panel, on a baseboard 8 in. deep. However, it is better to use a somewhat larger panel and board rather than to crowd the parts too close to the coils. A condenser having a low minimum capacity should be preferred. A Remler was used in my case. The only tools necessary are such as may be extracted from the—blankety blank 1st asst. engineer. All connections should be soldered, and not with acid or paste. Rosin is *the* solder. A double pole, double throw, switch is necessary to cut out the amplifier so that long wave stations may be copied.

The results are really surprising. Besides absolutely separating the bands, the increase in signal strength is very marked. Signals that are entirely inaudible without the amplifier are copied with good intensity. Coast stations at a distance of a thousand miles are copied readily, and also ships at six hundred miles or so; daylight. It surely is well worth the time and expense.

In tuning the receiver: First tune the amplifier condenser for the g r e a t e s t signal strength, then tune the secondary condenser to resonance. It is essential to have the primary condenser (the plate circuit) close to zero so that the amplifier will not oscillate while tuning. When the amplifier and secondary condensers are in resonance turn primary condenser towards maximum value until the set starts to oscillate, then turn it back—and, Presto!—there are the stations, coming in like a house a-fire. It is well to make a log of the different bands, so that the change from one to the other will be instantaneous. And that's that.

Let's make this department bloom like the cherry blossoms in Japan, fellows. Exchange of ideas are very helpful, they often bring forth startling results when incorporated.

Great Lakes loses a good man on account of physical disability, who is J. P. Mathews, ex-operator on S. S. Sancon, W. L. H. A good fist and traffic handler.

CALLS HEARD

(*Continued from Page 57*)

4pi, 4pz, 5aao, 5aav, 5ada, 5ade, 5afs, 5akn, 5amg, 5amo, (5anl), 5aub, 5dl, 5ef, 5mq, 5uk, 5ww, 6afs, 6akm, 6aps, 6cpf, 6cuw, 6xbr, 6zbj, 8ajk, 8amd, 8atc, (8ayp), 8axa, 8bqk, 8cbr, 8cug, 8rx. Canadian: c-4dw. Miscellaneous: 5ixc (?) Card for card is motto here.

By 8ZE-8GX, Everett W. Thatcher, Oberlin College, Oberlin, Ohio.

a2bk, (8acm), (a2ds), a2ij, a2tm, a2yl, a3bd, a3bk, a3ef, a3lm, (a3ls), a3yx, a4do, a5da, a6ag, (a7dx), au, wwdo, be ber, (bziab), bziac, balan, bzlaq, bzlaw, bzlax, bz2ac, bz2af, c4gt, c4dw, c4ha, clar, (c5go), ch2ld, cz99x, f8ain, f8bgi, f8ip, f8ix, f8jn, f8qq, g2nm, g2sz, hu6aj, hu6buc, hu6clj, (hu6dbl), hu6tq, hu fxl, 1 per (?) mlaa, (mlb), mlg, (mlk), (mln), (mlx), m5c, (m9a), mjh), oa3b, oa3e, oa4z, (oa6n), plae, pr4ja, (pr4je), pr4dl, (pr4sa), q2hr, (2qlc), raa8, ssel, ziac, zlao, ziax, (z2ac), z2ae, z2gc, (z2xa), z3af, (z4aa), z4ac, (z4ag), (z4ak), z4am, z4as, (z4av), z4ax. Miscellaneous: ane, xda, nqgl, vl, fw, (nisr), nism, nisp, nsn, niss, nitc, nidk, nuxg, nve, (cg5), by4, 6zac, kfuh, kuqg, fbio, ur, voq, aqe, (rre), (QRA? QSL pse.)

By G. M. Best, 6XAO-6ZV, 1460 Grand Ave., Piedmont, Calif.—June and July

U. S.—1abt, 1adm, 1als, 1awe, 1axx, 1bgq, 1xv, 2aim, 2awz, 2cxl, 2ee, 2jb, 2uo, 3agc, 3jc, 3cjn, 3lk, 3wf, 3wm, 3zo, 4aae, 4iz, 4lk, 4mi, 4tn, 5ade, 5ahp, 5aky, 5amt, 5cr, 5dg, 5dl, 5lg, 5uk, 5zaz, 8abh, 8ahl, 8aip, 8apm, 8apn, 8bhm, 8buy, 8chp, 8ek, 8nd, 8qb, 9aca, 9aek, 9alt, 9bbw, 9bff, 9bjk, 9bnd, 9bqa, 9bqe, 9bpd, 9civ, 9clj, 9ctg, 9cwz, 9dbc, 9dbq, 9eas, 9eev, 9eji, 9ekf, 9eky, 9eli, 9qm, 9ez. New Zealand: 1aa, 1af, 1ao, 1fq, 2ac, 2ae, 2xa, 3ag, 3aj, 4aa, 4ac, 4am. Australia: 1ld, 2bb, 2bk, 2cs, 2gw, 2ij, 2lm, 2tm, 3aj, 3ls, 3yx, 4an, 4cm, 5kn, 7cw, 7hl, vjb. England: 2gc, 2od. Canada: 5ar, 4dy. Mexico: 1j, 9a, jh. Hawaii: 6dbl, 6aff, 6tq. Uruguay: 1cd, 1dg. Chile: 2ar.

By Frederick J. Barnett, F. M. S. Railways, Gemas, Federated Malay States

U. S. A.—6kb, 6nx, f6vc, 6akx, 6oi, 6bt, 6btm, 6bbv, 6js, 6da, 6cmg, 6sv, 6bjd, 6kw, 6cls, 6bjx, 6dat, 6ccv, 6nx, 6hm, 6dag, 6alv, 6ajm, 6amm, 6rj, 6awt, 6ccl, 6kg, 6ahp, 6aps, 6rn, 6js, 6vc, 6bmw, 6bcl, 5ay, 5da, 5agu, 1kk, 7ho, 7tm, 7sa, dp7, jv7, f8qq, a3xo, a6kxa, a2yi, a6kx, z2cm. India: y2bg. South Africa: a3e, a5x, jlaa. Russia: rcrl, tpav, ndirm, nupt, namg, npg, nsx. Hong Kong: wghm, 9ha.

NEWS OF THE AMATEUR OPERATORS

6EB, L. F. Seefred, 343 So. Fremont St., Los Angeles, Calif., is now on 20 meters. He was reported R6 while working New York *at night.*

COMMERCIAL LAND AND SHIP STATIONS

(Alphabetically by call signals)

KGAP, *read* Sonora; KINP, *read* Charles Christenson; KOTL, *read* Eleanor Christenson; KOZG, *read* Mana; WPF, *read* Camp Eustis, Va., Flagship Division 1; strike out all particulars following the call signals, KDDO, KDJB, KFGH, KFZN, KLQ, KLUU, KNEU, KOC, KUM, WAV, WFX, WMOA.

BROADCASTING STATIONS BY CALL SIGNALS

(Alterations and corrections to be made to the List of Radio Stations of the United States, edition of June 30, 1925, and list in Radio Service Bulletin No. 106, January 30, 1926).

KFJZ (Fort Worth, Tex,)—Owner of station, W. E. Branch.

KFKZ (Kirksville, Mo.)—Owner of station, Chamber of Commerce.

KFRW (Olympia, Wash.)—Owner of station, G. & G. Radio & Electric Shop.

KFUU (Oakland, Calif.)—Owner of station, H. C. Colburn and E. L. Mathewson.

KFWC (Upland, Calif.)—Changed to San Bernardino, Calif.; power, 5.

KFWM (Oakland, Calif.)—Power, 250.

KFXH (El Paso, Tex.)—Address, 115 South El Paso Street.

HAM RECEIVER

(*Continued from Page* 39)

tion control condenser does not have to a low-loss or good one, but merely someth of the approximate required capacity. T secondary tuning condenser has been scribed. The regeneration condenser .00025 microfarad capacity maximum.

The grid-condenser is .00004 mfd. cap ity and it can be used as low as .00001 m if procurable. The sole reason for keep the grid condenser small is to lower the cuit capacity effect from the tube and t make it possible to have a secondary c bration nearly independent of the tube us provided the same general type is adhe to. BC set users who find their dial re ings change with a change in tubes will f this trick useful—but only on regenerat sets. Several grid-leaks should be tried find a quiet one, probably between 8 a 10 megohms.

A single rheostat is used for both tu in the pictured set, but as the detector justment for decent regeneration control always below normal and the amplifier justment for volume is generally best at n mal position, the rheostat should be used the detector only and a fixed resistance su as the Amperite should be used on the a plifier. The detector rheostat if 30 ohms, v accommodate most tubes, including the n CX-300-A, UX-200-A detector.

The detector *B* battery voltage will be deciding factor in obtaining smooth ope tion and "easy" oscillation, but will ha to be found by trial. The amplifier uses tween 30 and 45 volts, depending upon volume wanted.

Any type of a.f. amplifier may be us especially one having old-style transforme which will not amplify stray low notes much as does a good quality transform A *B* voltage of 22½ makes for quieter op ation than 45 volts. Fig. 3 shows the circ used by the author.

The coil winding data are as follows:

	20 METER	40 METER
Primary	1 turn No. 28	1 turn No. 28
Secondary	9 turns bell-wire	15 turns bell-wi
Tickler	12 turns No. 34	10 turns No. 34

	80 METER	150-200 MET
Primary	2 turns No. 28	3 turns No.
Secondary	32 turns No. 20	65 turns No.
Tickler	15 turns No. 34	25 turns No.

The primary is wound at the end or on of the secondary. It should be adjusted the dead-spot due to resonance out of tuning range. This dead-spot can also shifted by cutting a .0001 mfd. series fi condenser in or out of the antenna circ The wavelength range can be changed adding or subtracting turns on the second

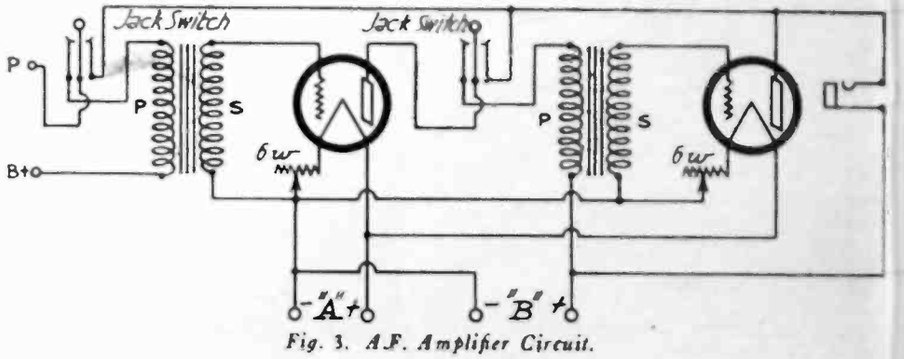

Fig. 3. A.F. Amplifier Circuit.

RADIOADS

A Classified Advertising Section Read by Better Buyers.

The rate per word is eight cents net. Remittance must accompany all advertisements. Include name and address when counting words.

Ads for the October Issue Must Reach Us by September Fifth

HOFF'S Radio Trouble Finder explains what to do when radio gets out of order. Contains list broadcasting stations. Postpaid $1.00 per copy. Information free. Heckenlively, Box 375, San Pedro, Calif.

A LIFETIME EDISON will solve your "B" battery troubles. Good, live, large size elements connected with pure nickel wire, electrically welded, 7c pair. All parts for sale. Sample cell and "dope" sheet, 10c. It will pay you to investigate. Paul Mills, Woodburn, Oregon.

CHOKES for Filter or Speaker Circuit: 5oh., 60ma., $2.10; Audio Transformers, $1.00; 275v Transformer from 110, $2.10. Use two for Raytheon tube. All postpaid. Write for lists of parts. RADIO PARTS SALE CO., Box 24, Orange, N. J.

ESCO GENERATOR, 1000 volts, 200 watts, practically new, $60. R. G. SIDNELL, 8AEA, 1314 W. 115th St., Cleveland, Ohio.

SEAGOING OPERATORS—Blueprint of two kilowatt spark converted to ICW and commercial radio traffic manual—only book of its kind in world. Both for one dollar. Howard S. Pyle, 1922 Transportation Building, Chicago. (TC)

MORO CRYSTAL: Guaranteed sensitive. Price, 50 cents. William Ebel, 3448 Hartford S.W., St. Louis, Mo.

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Get our list price on Parts also Knocked Down 1 and 3 Tube Sets Compare List Price with others then Deduct 20 to 50 per Cent Your Price A. C. HAYDEN CO., Brockton, Mass.

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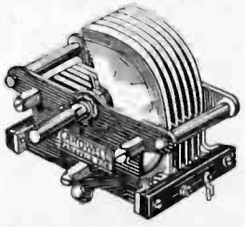
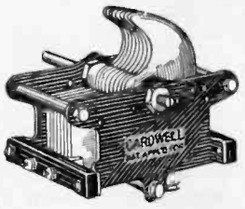
The Taper Plate Type "E"



Type "C" for more long wave separation



PRICES:

192 E	.0005	$5.00	173-C
169 E	.00035	$4.75	171-C
168 E	.00025	$4.25	170-C
167 E	.00015	$4.00	168-C

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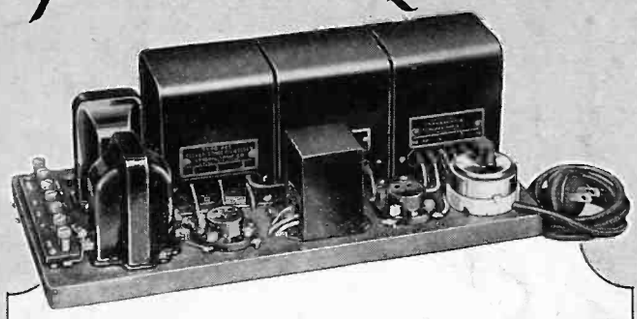
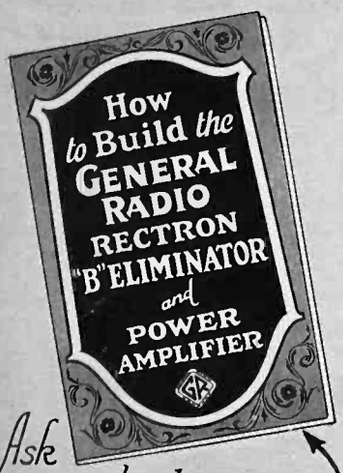
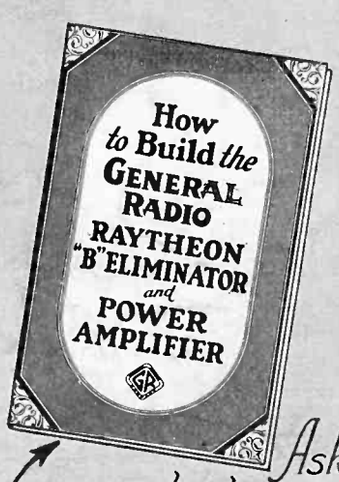
Not "How Far?"
Not "How Many Stations?"
But "HOW REALISTIC?"
is now the pertinent question of radio





Ask your dealer or write for this folder



Ask your dealer or write for this folder

THE SPELL of magic in radio is over. No longer are we mystified by programs from far-off cities. No longer do we spend whole evenings in dial-fishing for all the stations we can get—just for the sake of boasting a long list of call letters.

Today we are in a new era of radio—one of quality reproduction. Broadcast listeners everywhere are demanding above all else reception that is natural.

If your radio set has not been modernized by the improved type of loudspeaker, better transformers, "B" voltage supply units and power amplifiers, you can not appreciate what clear, sweet-toned music athrob with human expression is in store for you.

Ask your dealer to show you the new General Radio Rectron and Raytheon **"B"** Eliminator and Power Amplifier kits which you can easily assemble in a single evening. Ask him about the new type 387 Speaker Filter and the type 285-D transformer for use with the new 200A detector tube. If he is not prepared to supply you with the equipment or information write us for whatever details you require.

GENERAL RADIO CO.
CAMBRIDGE, MASS.

The Type 285-D
Audio Transformer
has a high impedance to match the output of the new 200-A detector tube. When used in the first stage of audio amplification following the 200-A the 285-D produces a very marked improvement in tone quality.
Price $6.00

The Type 387
Speaker Filter
adapts the impedance of the amplifier to the Western Electric and other cone speakers of similar design and quality so that unusual purity of tone is produced. It has a very wide frequency range.
Price $6.00

GENERAL RADIO PARTS
Behind the Panels of Better Built Sets

know these Radiotrons

and keep your set up to date

You can get fine, clear performance with one type of RCA Radiotron right through your set. Or you can change one tube in a set and get more *power*. Change another—if you have a storage battery set—and get bigger *distance reach*. Know the Radiotron family, and keep pace with the Radiotron laboratories, and you can keep your old set up to date. Here are the most important Radiotrons to know!

for dry battery sets

Radiotron UX-199 (or WD-11 or WX-12), for any or all sockets.
For big performance on small current.

Power Radiotron UX-120, for the last audio stage
For added power—bigger volume—clearer tone

for storage battery sets

Radiotron UX-201-A, for any or all sockets.
Efficient, long-lived under heavy usage.

Detector Radiotron UX-200, for the detector socket of specially built sets—for long range.

Super-detector Radiotron UX-200-A, for the detector socket where a 201-A is now used. A special tube that gives added sensitivity—longer distance reach.

Power Radiotron UX-112 or UX-171, for the last audio stage
For added power and finer tone.

for A.C. operated sets

Super-power Radiotron UX-210, for utmost loudspeaker volume—the most powerful receiving tube in existence.

Many a set can be kept long as its best efficiency—or carried onward with the development of radio—by knowing all the Radiotrons. Keep up with the Radiotron laboratories—and watching always, when you buy, for the mark on the glass and the base, to prove a tube is a genuine RCA Radiotron.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

RCA Radiotron

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