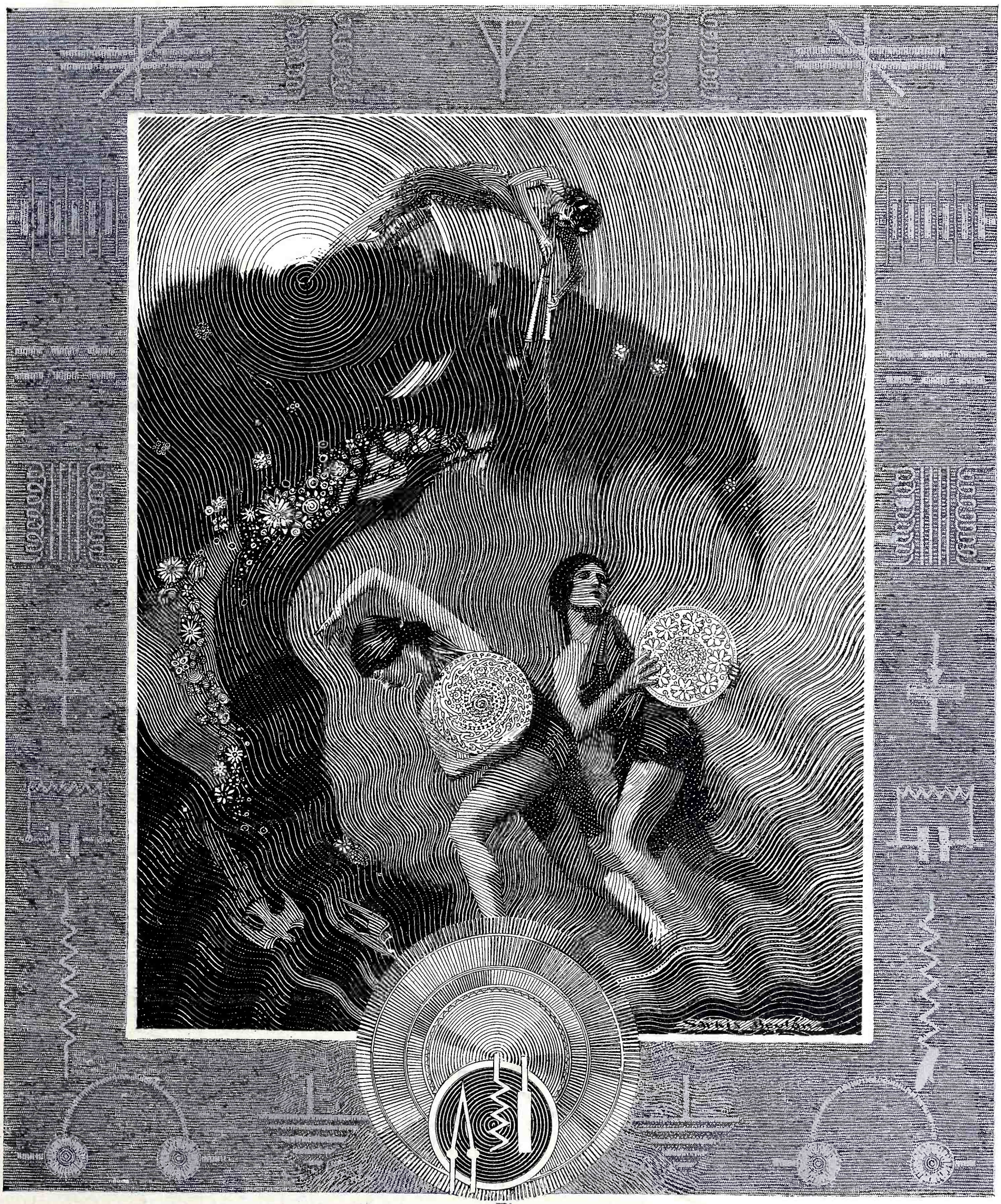
FEBRUARY, 1927 25 CENTS

RADIO

(Reg. U. S. Patent Off.)



RADIO

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VOLUME IX FEBRUARY, 1927 NUMBER 2

CONTENTS

Forecast of Contributions for March Issue

The next contribution in the Infradyne series of articles which E. M. Sargent is contributing exclusively to this magazine deals with its operation from a *B* battery eliminator, a problem which has bothered several constructors of these sets. While the infradyne was designed primarily for operation with batteries, an eliminator can be used if certain precautions are observed.

— : —

G. M. Best discusses the theory and operation of trickle chargers with special reference to the effect of their continued use on storage batteries.

— : —

Samuel G. McMeen continues his discussion of approved practice in the equipment of an experimental shop for radio constructors. The next installment tells how to make taps, care for tools, prepare adhesives, and do soldering properly.

— : —

David Grimes describes the actual construction of his new inverse duplex receiver whose principles have been oulined in previous issues of this magazine.

— : —

Harry A. Nickerson gives some helpful pointers on testing fixed condensers and audio transformers, together with various kinks.

— : —

Complete details will be given for a new Browning-Drake arrangement using three stages of impedance and resistance coupled audio amplification. This combination is claimed to give especially fine tone quality with a *B* eliminator.

— : —

Willis L. Nye, in the course of an article on "Radio Parts Salvage," outlines a method for a general clean-up of the junk-box so that old parts can be put in condition for new work.

— : —

Harry R. Lubcke describes the construction and calibration of an inexpensive voltmeter multiplier.

— : —

Boris S. Naimark tells about a vacuum tube oscillator for testing receivers, measuring constants, and general laboratory use.

— : —

Lester I. Wiltse gives an unusually clear explanation and analysis of the circuit diagrams used in several superheterodyne receivers.

— : —

Perry S. Graffam has designed an interesting receiver for installation in a phonograph cabinet. It uses a single control r.f. tuner with three stages of impedance coupled audio.

— : —

The fiction feature, in addition to some new "Letters from Larry" by Jack Bront, is a story entitled "The Amplified God" by B. W. Wilson.

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

This is the Heavy-Duty Battery in which the new Layerbilt construction provides greater economy

THERE'S an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duty batteries cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layerbilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical —we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Layerbilt's remarkable life is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections.

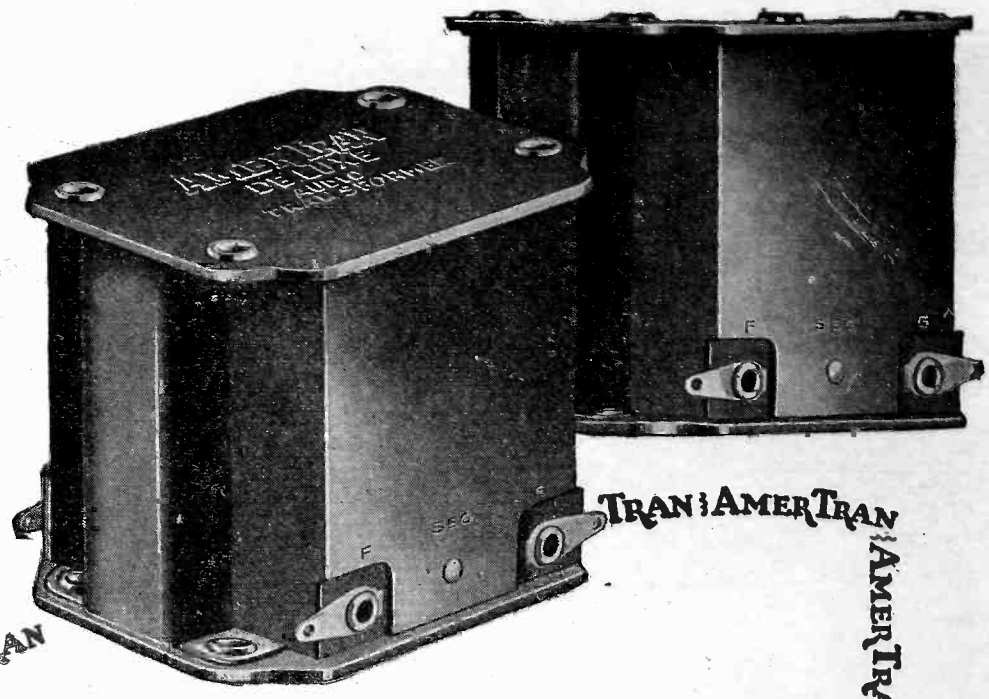
Several years ago we struck boldly out, away from this tradition, seeking a better method. We wanted to avoid waste space, minimize soldering, and get more current and longer life from a given quantity of active materials. The Eveready Layerbilt is the result.

This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Layerbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

NATIONAL CARBON CO., INC.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

AmerTran Radio Products



The AmerTran
De Luxe Audio Transformer
Sets a new Standard of excellence
in Audio Amplification
Made for 1st and 2nd Stages

For Satisfaction—
Buy These Dependable Parts

Audio transformers and power supply units are today the largest selling groups of parts. The American Transformer Company manufactures both. Experience, plus the willingness to make only products that measure up to laboratory standards are responsible for the high efficiency of AmerTran products.

Such parts are worth buying. They out-perform and out-last units less skillfully designed and made. They mean permanent satisfaction. You are not saving money on cheaper radio parts which break, wear out, and even when new cannot come up to the AmerTran standard.

Keep these facts in mind when buying for replacement, for a new circuit or power supply equipment. You will get most value and most enjoyment if your dollars are spent for dependable AmerTran products.

Write for free booklet

"IMPROVING THE AUDIO AMPLIFIER"

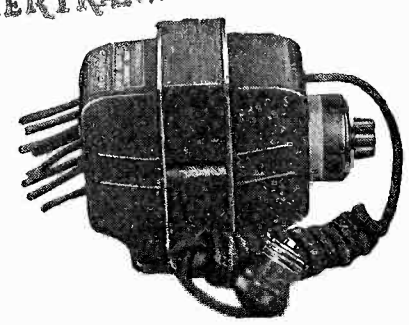
It contains valuable technical data.

American Transformer Company

178 Emmet St. **Newark, N. J.**

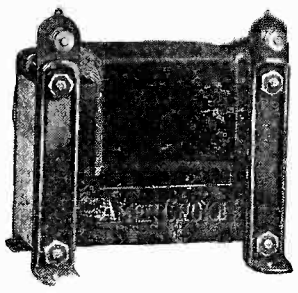
"Transformer Builders for over twenty-six years."

Pacific Coast Office:
Rialto Building, San Francisco



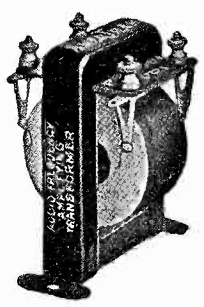
The AmerTran Power Transformer Type PF-52

Type PF-52 is intended for use in the better type of power supply developments. It will convert the standard 110 volt, 60 cycle alternating house lighting current to a higher voltage for the plate and lower voltage for filament supply.



The AmerChoke Type 854

This is a scientifically designed impedance or choke coil of general utility, designed primarily for use in filter circuits. As an output impedance for by-passing direct current from the loud speaker it is both efficient and economical.



AmerTran Types AF-7 and AF-6

AmerTran Audio Transformers, types AF-7 and AF-6, have been considered for years among the leaders in audio amplification: These popular and efficient models are made in two types — AF-7 (ratio 3½:1)—AF-6 (ratio 5:1).

22 leading manufacturers *and Raytheon* solve the problem of radio light socket power

Now you can have unfailing radio B power *without batteries*

Cornell Voltage Supply

Zenith B Eliminator

APCO Raytheon Rectodyne

ERLA Hum-Free B Eliminator

Modern "B" Power

Burns B-Battery Eliminator

Kingston B-Battery Eliminator

General Radio Plate Supply

Stepad Power Unit

Sparton Radio

Bosch No Battry

Majestic "B" Current Supply

Electron

Maydian B Supply

Valley B-Power Unit

All-American Constant-B Battery Eliminator

Sterling B Power

Webco B-Power Units

Acme B-Power Supply

Timmons Blim

Crosley Radio

These radio manufacturers, foremost in their field, use the Raytheon Long Life Rectifying Tube *in their B-power supply units. They have accepted Raytheon as* THE HEART OF RELIABLE RADIO POWER.

That the manufacturers whose names appear on this page were quick to standardize on the Raytheon Long Life Rectifying Tube for use in their B-power supply units is a tribute to the Raytheon research organization.

The development of the Raytheon rectifier from a mere idea to a remarkable scientific achievement has made possible the sale of nearly $20,000,000 worth of B-power units, Raytheon-equipped, in the comparatively short time since it was first announced to the radio world.

This means that there are already more than 500,000 satisfied users of B-power units, Raytheon-equipped.

These B-power units utilize the electric current which is furnished by the ordinary domestic lighting system. They do away entirely with B-batteries.

The manufacturers who are listed on this page have built B-power units to suit various types and styles of radio receiving sets, according to their own individual designs and the specifications of their own engineers.

All of these supply units, however, have this one thing in common — they use the Raytheon Long Life Rectifying Tube, the perfection of which was made possible by the development of the principle of gaseous conduction. The Raytheon rectifier has no filaments or liquid solutions. It has no parts to be replaced, and nothing which requires attention.

When you buy a Raytheon-equipped B-power unit you will get not only the most reliable rectifier that scientific methods can produce, but you will also have absolutely reliable, unfailing B-power, improved reception, and freedom from the annoyance of run-down B-batteries. You can dispense with B-batteries entirely.

For your protection, the Raytheon Long Life Rectifying Tube is sold only to those manufacturers whose B-power units have passed the rigid laboratory tests of the Raytheon engineers. Look for the Raytheon Tube. It is used by the manufacturers whose names appear on this page in their B-power supply units. The Raytheon trade-mark is the symbol which guarantees unfailing, reliable radio power direct from your light socket.

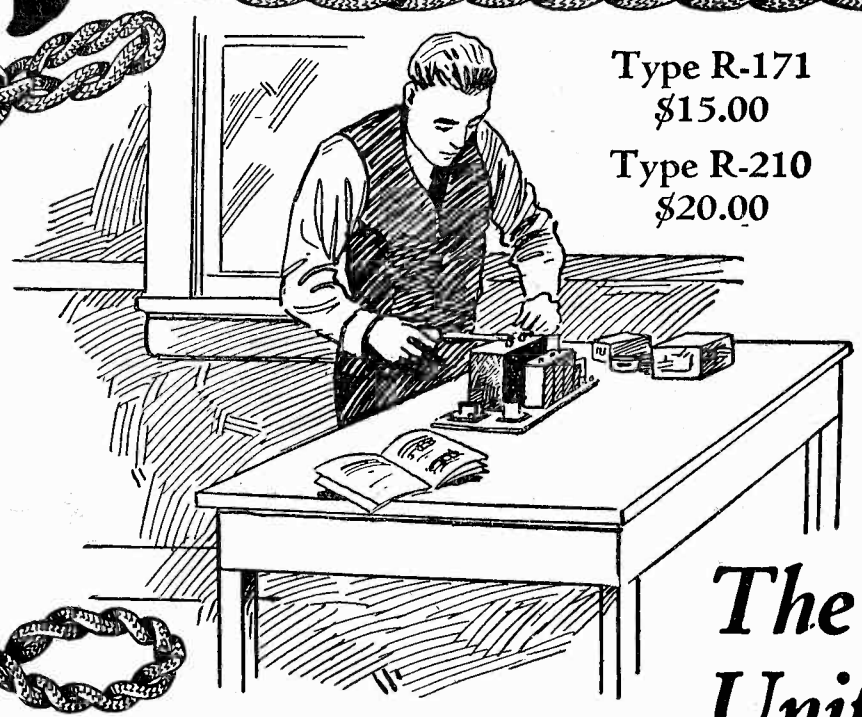
Ask your radio dealer for a B-power unit, Raytheon-equipped. He has them —or can get one for you.

Raytheon Manufacturing Company
CAMBRIDGE, MASSACHUSETTS

Raytheon
LONG LIFE RECTIFYING TUBE

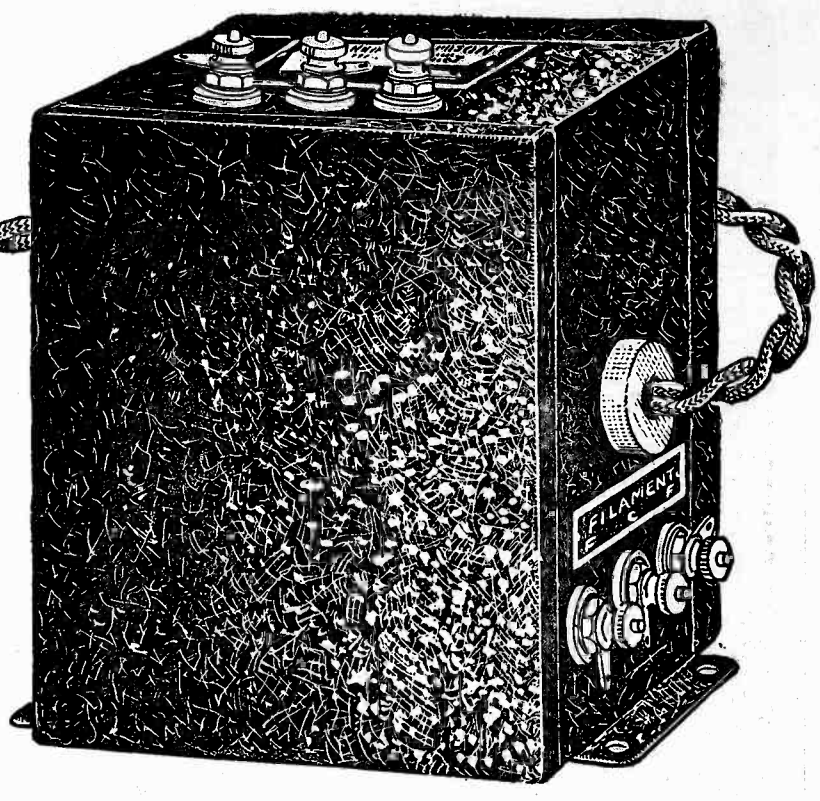
RAYTHEON IS THE HEART OF RELIABLE RADIO POWER

Power from the Light Circuit



Type R-171
$15.00

Type R-210
$20.00



The Complete Foundation Unit for Home Constructed Power Amplifiers

HERE is what you have been waiting for — a silent and efficient power amplifier and B eliminator that will equal anything on the market—one that you can build yourself in less than an hour.

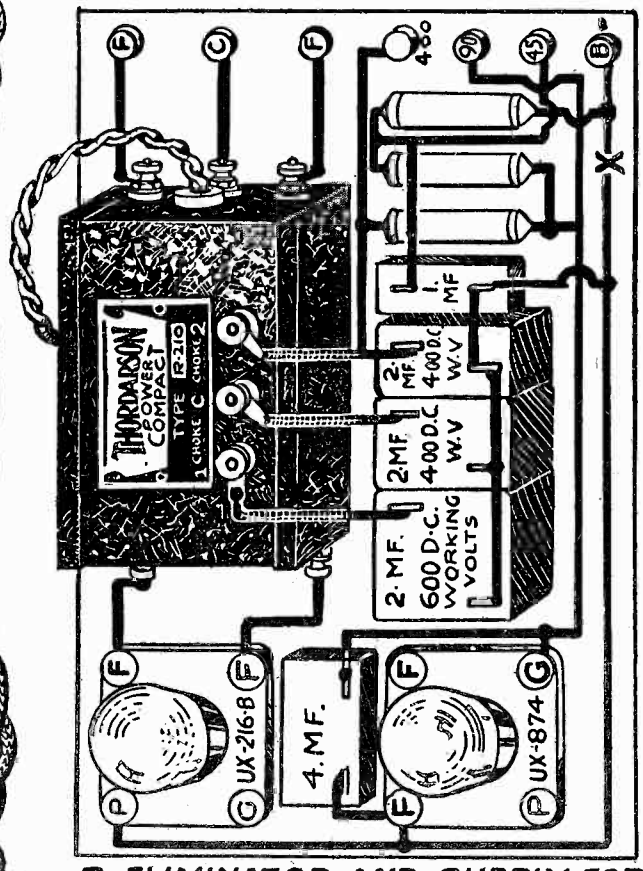
The Thordarson Power Compact is the complete foundation unit for power amplification. It contains: (1) a power supply transformer, (2) two filter choke coils of 30 henries, and (3) a power tube filament supply, tapped at the exact electrical center (an exclusive Thordarson feature), all in one compound filled case.

Two types of Power Compact are available: R-171 is designed for use with power tube UX-171 and Raytheon BH rectifier. Type R-210 is designed for use with power tube UX-210 and UX 216-B rectifier. Each type of compact supplies the proper values of current for maximum efficiency operation of its corresponding power tube.

Packed with each compact is a complete set of instructions which can easily be followed, even by the man with no radio experience.

Remember that when you buy a Thordarson product it is guaranteed and backed by over thirty years' manufacturing of reliable transformers.

For Sale at Good Dealers Everywhere or Direct from Factory



B-ELIMINATOR AND SUPPLY FOR UX-210 POWER AMPLIFIER—

This Booklet is Yours for the Asking:

"POWER FROM THE LIGHT CIRCUIT"

THORDARSON ELECTRIC MFG. CO.
500 W. Huron St., Chicago, Ill.
Gentlemen:

I would greatly appreciate receiving a copy of your new booklet "Power from the Light Circuit."

Name.....

Address.....

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

THORDARSON POWER COMPACT

THORDARSON ELECTRIC MANUFACTURING CO.
Transformer specialists since 1895
WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS
Chicago, U.S.A.

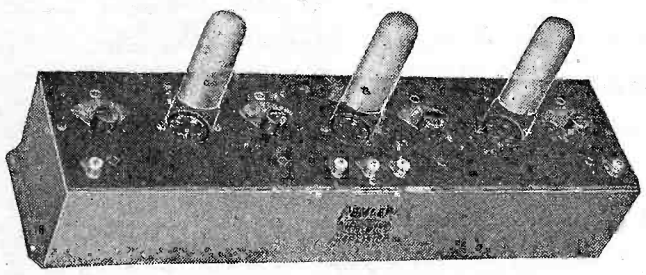
power selectivity distance tone

-as never before!

The True Radio Enthusiast KNOWS

Remember the night you first listened in on a crystal set? What a "kick" and thrill there was—the Mystery of Radio. Today many listeners are still fascinated by the Mystery of Radio. They are still satisfied with their '25 and '26 receivers.

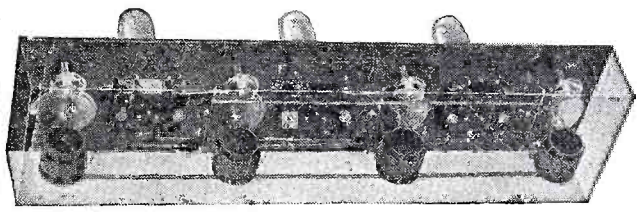
The Real Radio Enthusiast is different. He doesn't drive a two-cylinder car, and he won't accept anything short of 1927 radio performance. He knows that the Remler Infradyne Amplifier is the last giant stride in radio progress. He is installing it with associated parts in his neutrodyne or tuned radio frequency set. Nothing less than the Infradyne will satisfy the Real Radio Enthusiast.



Front view, showing bakelite panel and copper case.

REMLER INFRA-DYNE AMPLIFIER

The heart of the Infradyne Circuit, amplifying at a fixed short wave length of eighty-six meters.



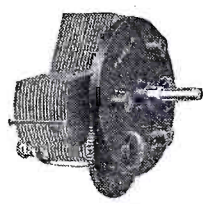
Rear view, showing coils and fixed condensers.

Write for descriptive folder and two color circular

Remler Improved Socket

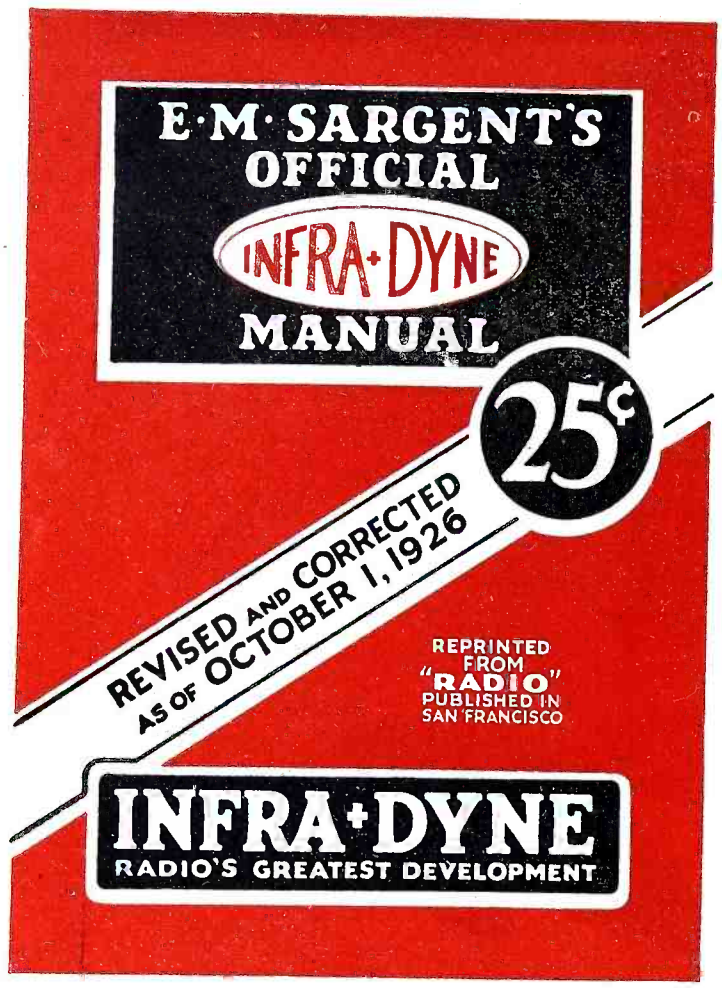
REMLER
DIVISION OF
GRAY & DANIELSON MFG. CO.
260 First Street · San Francisco

Remler Twin Rotor Condenser



Chicago

New York



THE INFRA-DYNE MANUAL

Tells You How To Build Radio's Greatest Receiver

25 cents

Start NOW! Build the receiver that has revolutionized radio reception. Get a copy of Sargent's Official Infradyne Manual—telling you all about it. Diagrams, illustrations and directions for building and operating the Infradyne. The complete story of this receiver in a handy pamphlet — selling for twenty-five cents. More than 20,000 have already been sold. It tells you how to balance and adjust the circuit—how to wire it for maximum results and how to get the most out of it. If you are a prospective radio set builder it will be to your advantage to get a copy of this Manual. Copies will be sent postpaid upon receipt of a quarter in coin.

The story of the Infradyne is contained in this Manual. People everywhere are discussing the Infradyne. It has convinced thousands that no circuit in the history of radio is as good as the Infradyne. Back ground noise is eliminated, stations come in on only one point of the dial. Stations from 10 to 20 kilocycles apart are brought right through the powerful locals and long distance reception on the loud speaker from stations two thousand miles away is easily accomplished under normal conditions. The inventors built 500 models before the circuit was announced to the public. Years of research are behind the Infradyne. It is the last word in radio.

Send the Coupon and 25 cents for your copy

"RADIO,"
Pacific Building,
San Francisco, Calif.

Send me Sargent's Official Infradyne Manual by return mail. I enclose a quarter in coin.

Name.....

Address.....

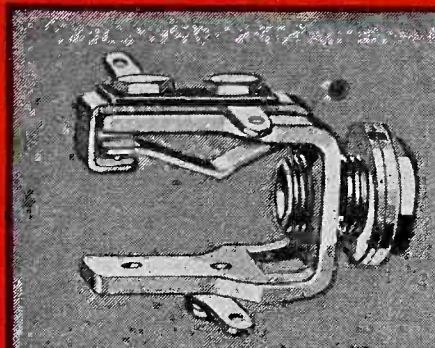
Published by the

Publishers of "RADIO"

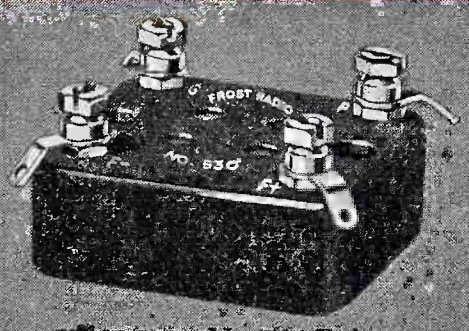
Pacific Bldg., San Francisco

Northern California dealers can secure copies from the United Radio Supplies Co., 693 Mission St., San Francisco, California.

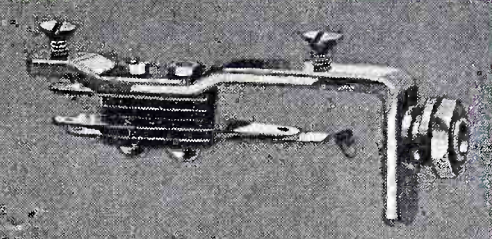
Jobbers and Dealers are invited to write for trade proposition. Every radio dealer should have this manual to know what the Infradyne is and does.



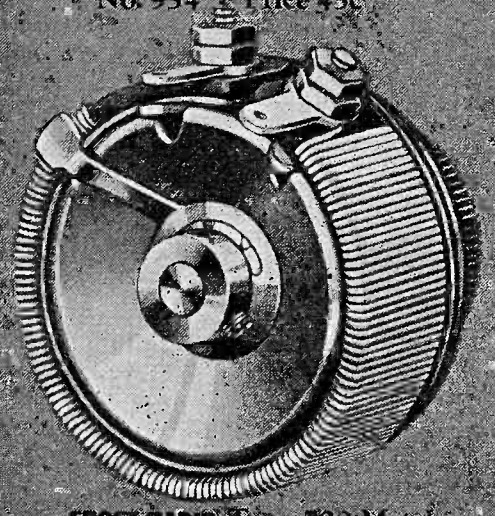
FROST-RADIO Gem-Jac
No. 954 . . Price 45c



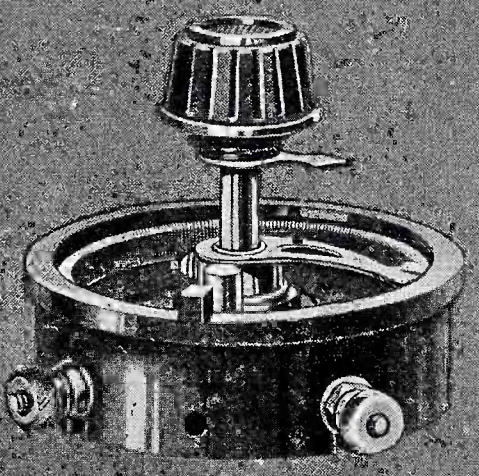
FROST-RADIO No. 530 Bakelite Socket . . Price 40c



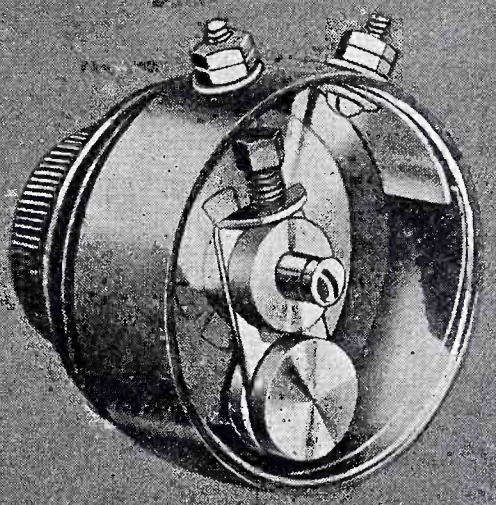
FROST-RADIO Pan-Tab Jack
No. 234 . . . Price 75c



FROST-RADIO Type 700 Metal Frame Rheostat . . Price 50c



FROST-RADIO Type 660 Bakelite Rheostat for base mounting Price 75c



FROST-RADIO Type 886 Super Variable High Resistance, Price **$1.50**

INFRA-DYNE
TRADE MARK

FROST-RADIO
Parts for the Infradyne

When you decide to build your Infradyne set you will build it because you want better, finer results. If you want to be sure of getting the utmost efficiency from this receiver it is not only important to use the principal parts specified, but to see that every part that goes into your set is of the highest quality. Don't overlook such parts as sockets, jacks, rheostats and high resistance units. Once these parts are installed they are usually forgotten, but later they often prove a source of trouble that is hard to locate.

Make sure that these parts bear the name **FROST-RADIO** and you can be absolutely certain of permanent electrical and mechanical properties. Just install them and forget them.

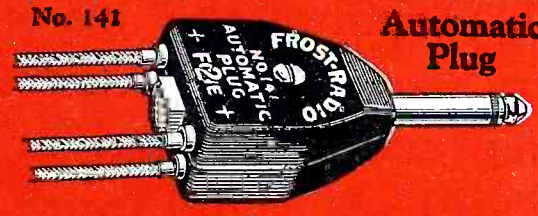
Ask Your Dealer for these **FROST-RADIO** *Infradyne Parts*

		LIST
No. 660	**FROST-RADIO** Bakelite Rheostat, base mounting	$0.75
No. 530	**FROST-RADIO** Bakelite Socket	.40
No. 730	**FROST-RADIO** Metal Frame Rheostat, 30 ohm	.50
	or, if preferred,	
No. 830	**FROST-RADIO** Bakelite Rheostat, 30 ohm	.75
No. 710	**FROST-RADIO** Metal Frame Rheostat, 10 ohm	.50
	or, if preferred,	
No. 810	**FROST-RADIO** Bakelite Rheostat, 10 ohm	.75
No. 886	**FROST-RADIO** Super-Variable Resistance, 50,000 ohms	1.50
No. 608	**FROST-RADIO** Push-Pull Switch	.30
No. 954	**FROST-RADIO** Gem-Jack	.45
	or, if preferred,	
No. 234	**FROST-RADIO** Pan-Tab Jack	.75
No. 953	**FROST-RADIO** Gem-Jack	.40
	or, if preferred,	
No. 233	**FROST-RADIO** Pan-Tab Jack	.65

MEMBER RMA

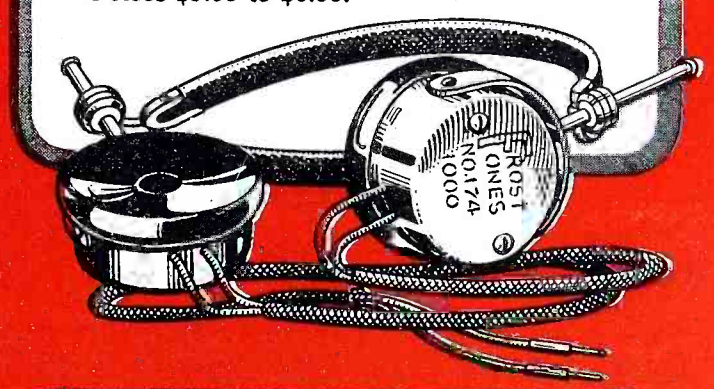
FROST-RADIO
Parts and Accessories

No. 141 Automatic Plug Price 75c



FROST-FONES

Nothing else can quite replace a pair of sensitive **FROST-FONES** when tone quality and clearness on distant stations are what you want most. On those favorite far-off stations **FROST-FONES** turn weak signals into clear, pure reception. Being only about half the weight of old style head sets they are worn with perfect comfort. Try them and compare with others at your dealer's. Prices $3.00 to $6.00.



HERBERT H. FROST, Inc.
160 North La Salle Street
CHICAGO
New York Los Angeles

Working Blue-Prints
for the new 1927 model
of Best's Super

Described in this issue of "RADIO"

The new shielded 52,000 cycle super described in this issue of "RADIO" is more easily constructed by working from a large set of blue-prints, showing the pictorial wiring diagram as well as the schematic. The blue prints are in half size. You can't go wrong if you have a set of these prints before you when building the set. A small quantity have been prepared and are ready for delivery to you on January 25th. These blue prints are printed on heavy stock and will withstand much wear. You will appreciate the careful attention which has been paid to minute details in preparing these prints.

One Dollar — Postpaid

The Coupon Saves Time

MAIL IT NOW. Prompt Delivery Assured

----------COUPON----------

PACIFIC RADIO PUBLISHING CO.
Pacific Building, San Francisco, Calif.

Here is one dollar for a set of working blue prints for building the 1927 Model 45,000 cycle Super by Best.

Name.....

Address.....

City.....*State*.....

NOTICE

Of New Distribution For Infradyne Blue Prints

Effective November 20th, 1926, the Official Infradyne Blueprints will be exclusively distributed to the trade East of the Rockies by the Herbert H. Frost organization. Distribution to radio dealers will be made from any of the Frost offices listed below.

Delivery will be made on and after November 26th. Stocks of blueprints will be carried at each Frost office.

Radio dealers are invited to write now for trade prices. The new blueprints have been prepared by L. C. Rayment and have been revised and corrected as of November 20th. There will be no changes in the blueprints for at least six months, thus affording full protection to the dealer and set builder.

Herbert H. Frost, Inc.
160 North La Salle St., Chicago, Ill.

P. A. KILEY
30 Church St., New York, N. Y.

B. B. DOWNS & SON
2360 University Ave.
St. Paul, Minn.

M. A. WETMORE
1324 Hibernian Bank Bldg.
New Orleans, La.

H. B. PARK
305 Seventh Ave., Pittsburgh, Pa.

CAMPBELL & KNIBB
Colorado Bldg., Room 520
Washington, D. C.

EAMES CORPORATION
10 High St., Boston, Mass.

S. J. HUTCHINSON JR.
Bourse Bldg., Philadelphia, Pa.

Official Service Representative of Infradyne

AFTER thorough investigation of our facilities and experience, we have been appointed official service station for the New York Metropolitan area by Mr. E. M. Sargent, inventor of the Infradyne Circuit.

We also received from "Radio," which sponsored this circuit, official recognition and approval as service station on the circuit for the New York Metropolitan territory.

Radio RTM Service

Rossiter, Tyler & McDonell, Inc.
Telephone Rector 2538
136 Liberty Street, New York

Now—

The Publishers of "RADIO"

Announce

A New Service to Our Readers

OUR Technical Editor, Gerald M. Best, has answered on an average of fifteen thousand radio questions a year as a part of his work with the publishers of "RADIO". His advice is eagerly solicited by people from practically every part of the world. Mr. Best has received so many requests for testing and matching radio parts that we have decided to offer a new service to our readers —a "MATCHING AND TESTING SERVICE." You are about to build a radio set — or you have already finished your set and the coils do not match—the tubes are not all alike and you are in doubt as to the characteristics of the transformers. Here is where we can serve you. Let us match the parts —everything from tubes to transformers. And be insured in advance that you will get the most out of your set. Before you invest a hundred dollars — or less — in a radio set you want to KNOW that the set, when properly wired, will perform to your satisfaction.

If you contemplate building a radio set and your dealer cannot supply you with matched parts, we will secure the parts for you—test and match them—and sell them to you at the regular list price. There is no extra cost for this service. You pay the forwarding charges to your address.

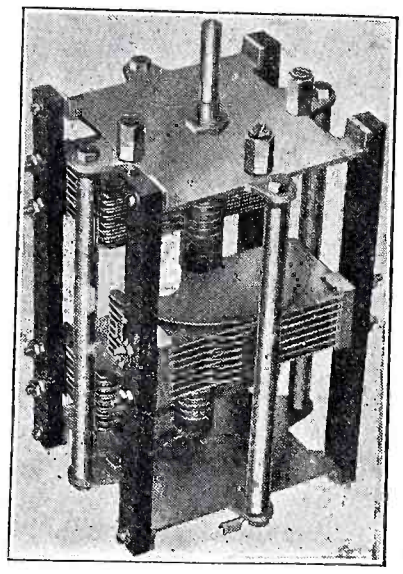
If you already have parts on hand and want us to match them for you we will render this service at a very reasonable price. Write for rate schedule. Dealers are also invited to use this new service. It is open to all.

The testing and matching laboratory will be conducted by Gerald M. Best and D. B. McGown. Mr. McGown is known to all readers of "RADIO." He was formerly a Radio Inspector in the sixth radio district. Let Best and McGown show you the way to better radio by availing yourselves of this new service.

PACIFIC RADIO PUBLISHING COMPANY

Cardwell Condensers

"Specified for the Infradyne"



TYPE 317-C

E. M. SARGENT
1200 FRANKLIN STREET
OAKLAND 7, CALIFORNIA

Dec. 16, 1926

Mr. Bert E. Smith,
% Allen D. Cardwell Co.,
81 Prospect St.,
Brooklyn, N.Y.,

Dear Bert,

This is to acknowledge the receipt of the trouble inquiry that you sent me from Spokane. I have attended to it and believe your man will be satisfied.

Mr. Rayment and I are very well pleased with our choice of the Cardwell condenser for the Infradyne circuit. Since I last wrote to you, I have tried out a great many others and dont mind telling you that the Cardwell is by far the best we have seen so far. It is not uncommon to find them so accurate that once the trimmers have been adjusted, they may be completely ignored and the set operated as if they werent on the panel. Keep up the good work.

Best holiday wishes.

Sincerely,
E. M. Sargent

INFRA-DYNE

"THE STANDARD OF COMPARISON"

Send 15c for illustrated booklet.
Allen D. Cardwell Mfg. Corp.,
81 Prospect Street Brooklyn, N.Y.

Pacific Coast Agents
BALDWIN PACIFIC CO.,
Pacific Bldg., San Francisco, Cal.

$118.00 for all of the parts needed for the INFRADYNE

Here Are the Official Parts Which We Sell:

1 Remler Infradyne Amplifier
1 Cardwell three-gang condenser
3 Silver Marshall No. 340 condensers
1 Remler .00035 condenser
1 Frost No. 886 Resistance, 50,000 ohms
1 Tapped inductance
1 30 ohm baseboard rheostat
1 Set, 3 Camfield coils
2 National Dials, Type B, CCW
7 Benjamin UX base sockets
1 112 amperite
1 No. 1 amperite
1 30 ohm panel rheostat
1 Centralab 200,000 ohm resistance
3 2-inch dials
1 Filament switch, Electrad
1 Single closed jack, Frost
1 Single open jack, Frost
1 Jewell Pat. 135 voltmeter
1 Electrad grid leak mount
1 1 meg. Durham grid leak
1 2 meg. Durham grid leak
1 .0001 Fixed condenser, Electrad
1 .00025 Fixed condenser, Sangamo
2 .0005 Fixed condensers, Electrad
2 Silver Marshall audio transformers
2 1 mfd. Electrad condensers
2 Binding post strips with Eby Posts
1 Bakelite Panel, drilled and engraved, 3/16" thick
1 Baseboard, Poplar, Egyptian lacquered

All of Above, $118.00

LET us simply your problem of purchasing specified parts for the Infradyne. Order everything from us. For the past three months we have been supplying the wants of the Infradyne builder. We have shipped our merchandise to widely scattered parts of the U. S. and Canada. We give you prompt service—the kind you are entitled to. Sargent and Rayment specify a list of parts made by reputable manufacturers of high-quality merchandise. To get the most out of your Infradyne you need GOOD PARTS. We have assembled all of these SPECIFIED parts for you in one box—ready for shipment. Complete instructions for building the Infradyne go with each set of parts.

When ordering please address your inquiries to Department M. Telegraph orders filled if half cash goes with wire Balance C.O.D. We ship prepaid if the compete set of parts is purchased from us.

We Test, Repair Service and Guarantee Infradynes—SUCCESS ASSURED

International Radio Sales Co.

5441 California Street, San Francisco, Calif.—Dept. M

Selected for the Infradyne

Approved by the designers of the Infradyne because it's

Metallized!

THE Durham Metallized Resistor is a laboratory perfected grid-resistor developed by two scientists of a leading university.

A tiny glass wire is passed through an ingenious, chemical and high-temperature process, forming a thin conducting layer of high resistance. The Metallized unit is next treated with a protective insulating material, rendering it impervious to atmospheric conditions. It is then mounted in a glass tube and soldered to terminal, brass caps.

Specified in

"Diamond of the Air"

10 megohms to 500 ohms, from 50 cts. to $1.00

DURHAM METALLIZED RESISTORS

International Resistance Co.

Perry Bldg., Philadelphia, Pa.

Tell them that you saw it in RADIO

LOG 'EM--

You hear so many stations on your Infradyne that you will need a log book with many pages to keep an accurate record of the stations heard. The publishers of "RADIO" have prepared an inexpensive 8-page pamphlet for logging stations. It is just the thing for the Infradyne. You can use separate pages for local and DX listings and each column is so arranged as to give ample room for making notations, such as oscillator settings, etc. It's a mighty handy little pamphlet to keep in front of you at all times. LOG THE STATIONS AS YOU HEAR THEM and then you will have no difficulty in finding them later. The Log Book sells for ten cents. It will be mailed to you, postpaid, on the day your order is received. Stamps or coin accepted. Because only a limited number of these booklets have been printed, we will not be able to supply copies to dealers or jobbers.

The Coupon and 10c Brings It to You

"RADIO,"
Pacific Building,
San Francisco, Calif.

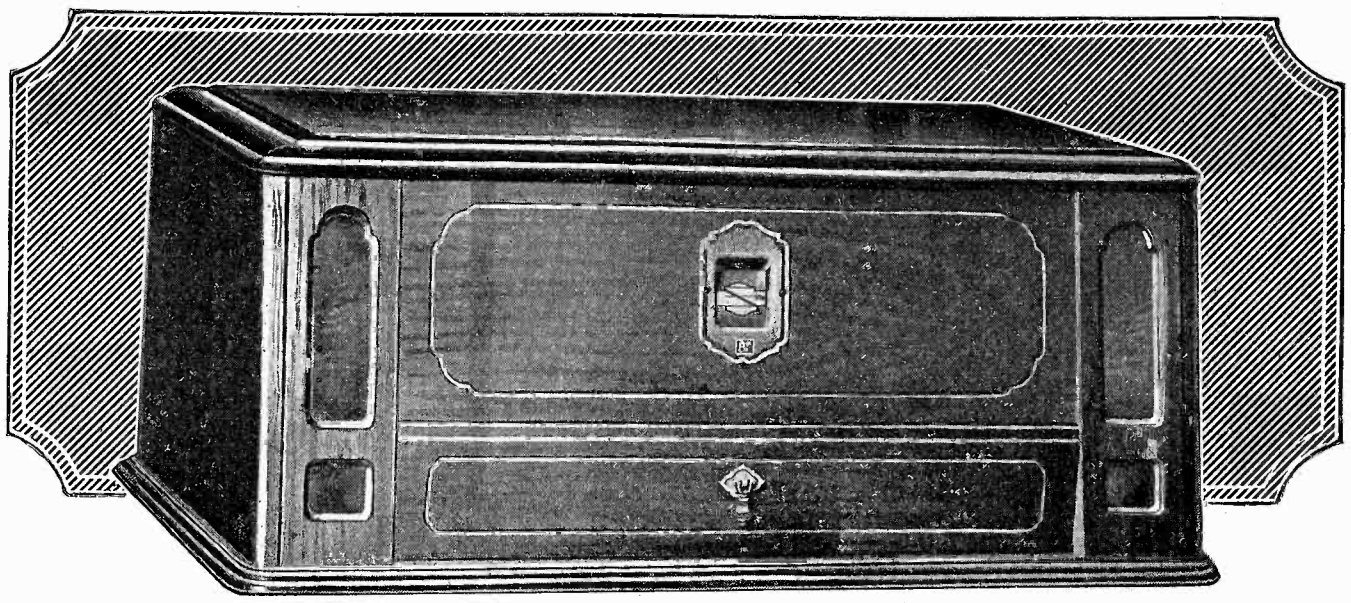
Here is 10c. Send me a copy of the RADIO LOG BOOK.

Name.....

Address.....

City and State.....

BREMER-TULLY
COUNTERPHASE–EIGHT



Here is a receiver that is "SINGLE CONTROL" and also sufficiently selective for YOUR requirements no matter where you live.

It sounds impossible? It would be except for the REJECTOR STAGE, an old principle now applied successfully for the first time in radio. It's a feature you'll find only in the *counterphase-Eight* and *Six*.

STATION INDICATOR

Another exclusive B-T feature:

Read wave lengths direct without dial numbers or log book.

On every set, on any part of the scale—a glance at the *Station Indicator* tells you the mathematically exact wave length to which your set is tuned.

It tells where to turn for the wave length you want. There are no allowances or variations. Each set is calibrated to hair-line accuracy.

The daylight records made by users in all sections of the country are proof of the superiority of the *Counterphase*.

Here is a sample letter:

Niles, Mich., Nov. 15, 1926.

We are submitting a signed statement of reception on a B-T Counterphase-Eight sold to a doctor in this city.

The stations listed below were received at the Doctor's home in Niles between the hours of 1:30 *and* 4:35, *Saturday afternoon, Nov.* 13, 1926 (*daylight reception*).

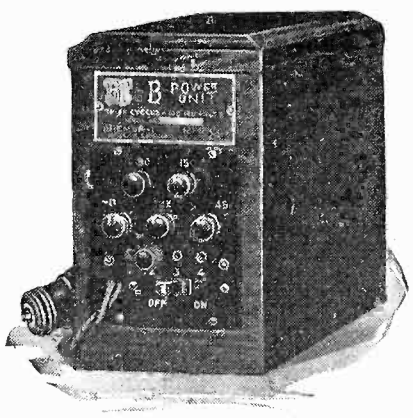
WEAO	*Columbus*	*WEAF*	*New York*
WBT	*Charlotte, N. C.*	*WOC*	*Davenport*
WSMB	*New Orleans*	*WOS*	*Jefferson City*
WHA	*Madison, Wis.*	*WDOD*	*Chattanooga*
WCCO	*Minneapolis*	*KMOX*	*St. Louis*
WJZ	*New York*	*WHAS*	*Louisville*
WWJ	*Detroit*	*KOA*	*Denver, Colo.*
WTAM	*Cleveland*		

RADIO SERVICE LABORATORIES
(*The doctor has certified this reception*)

The New Counterphase is a set full of surprises. The tone will give you a new standard by which to judge radio. Tuning is simplicity itself. The cabinet design is exclusively B-T and there is no better furniture in radio.

You must hear this set to appreciate its superiority. ANY AUTHORIZED DEALER WILL DEMONSTRATE. Circulars free on request.

B-T POWER UNIT



The B-T Power Unit introduced a new design which without any doubt will become the only one as soon as the public understands it.

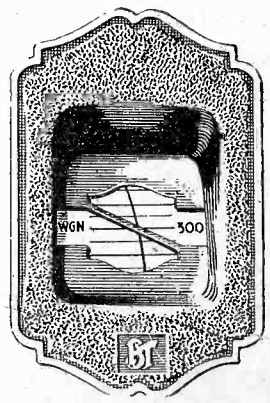
There are no variable resistances—no knobs to turn—no guess work about the voltage delivered.

Eventually you'll use this type. Save trouble and money by buying it first.

Maximum capacity 150 volts at 60 mils.
Price, east of Rockies - - - - $49.50

BREMER-TULLY MFG. COMPANY

520 SO. CANAL ST., CHICAGO, ILL.



STATION INDICATOR
(Pat. 9-28-26)

Full Size Working Blue Prints *and* Drilling Templates for Building

THE INFRADYNE

Prepared by SARGENT and RAYMENT

To get the best results from the 1927 De Luxe Model Sargent-Rayment Infradyne we urge you to use the latest Official Blue Prints, prepared by the inventors of the circuit, Mr. E. M. Sargent and Mr. L. C. Rayment. In order that accuracy may be assured Mr. Rayment is personally taking care of order for these blue prints, mailing them to you on the day your order is received. There is a large pictorial wiring diagram which has been prepared from the set used by the inventors themselves. This pictorial diagram shows you exactly where each wire should be placed and how it should be bent. Wiring the INFRADYNE is a simple matter if you have these new blue prints before you. The importance of correctly running the grid and plate leads is clearly demonstrated in these new blue prints. Then there is a baseboard layout in full size. It shows where each part is to be placed on the baseboard. It is essential that the placing of parts be in accordance with the suggestions of Sargent and Rayment. The parts are arranged in such a manner as to make wiring easy. The instructions must be closely followed for perfect results. A complete instruction book goes with each set of blue prints. This book explains the construction of the INFRADYNE step by step. Another booklet tells how to "shoot trouble" and how to test out each part of the circuit. Those who have already built an INFRADYNE should get this booklet. The complete set of blue prints, instruction books, list of parts required, full size drilling templates, etc., are all put up in a convenient package, ready for mailing. If your dealer cannot supply you with the OFFICIAL working blue prints and instruction books by SARGENT and RAYMENT please order direct from this advertisement. Delivery will be made on the same day your order is received.

ORDER BY MAIL

When sending mail orders for Blue Prints use the coupon at the bottom of this page and send it to L. C. Rayment with your remittance of $1.00. We will pay the postage.

DEALERS AND JOBBERS

We can supply you with these Blue Prints. Write us for details. The Herbert Frost organization will also furnish you with distribution information. Write to nearest office.

$1.00 Postpaid

Success assured if you follow the Official Instructions. Everything—in complete package form for one dollar. Will save you time and trouble. Simplify construction of your INFRADYNE by working from these blue prints. They have been carefully checked and are CORRECT. You need these prints.

R227

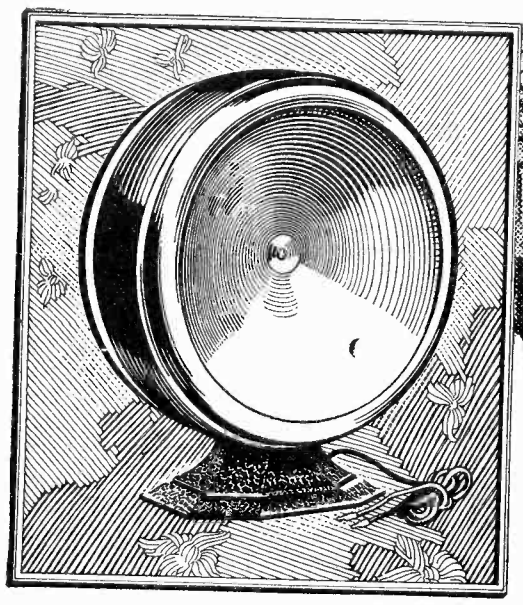
L. C. RAYMENT
1200 Franklin St.
Oakland, California

One dollar is enclosed for a complete package of the Official Blue Prints by Sargent and Rayment for building the DeLuxe 1927 Model Infradyne.

Name.....*Address*.....

City.....*State*.....

"Remarkable—*to hear each instrument*"



Acme K-1 Enclosed Double Free Edge Cone Speaker, (shown above). Diameter of Cone, 14 ins. Tan metal case. Price: **$25.00**

Acme K-3 Enclosed Single Free Edge Cone Speaker. Diameter of Cone, 11 ins. Green bronze metal case. Price: **$18.50**

* * *

Acme Enclosed Free Edge Cones and Acme Reproducing Units, (Designed for use exclusively with the free edge cone) eliminate resonance and preserve the tones, pure, round and clear. A fixed edge cone, to produce the same results, would have to be three times the diameter, too clumsy for your living-room. High notes are reproduced toward the center of the cone; low notes, toward the edge. The laws of vibration make it possible to produce low notes with a small cone, provided the edge is free and enclosed, and provided the reproducing unit is especially designed for use with a free edge cone.

Write us for circular describing full line of Acme products.

"We were *never before* so thrilled by radio reproduction!"

"... that's remarkable: of all the radio we've ever heard, we've never been so thrilled as today, when, with our new Acme Speaker, which daddy got us, we could plainly hear every instrument that was playing in the orchestra..."

The wonderful new Acme Loud Speaker successfully reproduces voices and music in your own home as clearly as they were originally created in the broadcasting studio. It reproduces the voice of the singer in all its thrilling, tender beauty. It brings out the different personality in each voice, so that you can tell one voice from another. It recreates orchestral music so clearly that you can hear each instrument playing. It reproduces low notes and tones as clearly as high notes and tones. You hear the bass and treble, harmony and melody.

All this was not done in a moment, Acme engineers worked five years and made 256 experimental speakers, before they arrived at the new Acme Enclosed Free Edge Cone and Acme Reproducing Unit, which together are responsible for this great increase in radio enjoyment.

See this new Acme at your dealer's

TRY OUT this new Acme for yourself. See if all we have said about it is not true. Compare it with others in the dealers' store. Drop in at your dealer's today and hear this remarkable new speaker. Made by Acme Apparatus Co., Pioneer Radio and Transformer Engineers and Manufacturers, Cambridge, Mass., U. S. A.

Send for this Acme Book

"Amplification Without Distortion," now in its 13th edition. 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 speakers—and includes details of the complete Acme line of transformers, impedances, condensers, potrehos, choke coils, etc. Send coupon below.

Mail this Coupon for "Amplification Without Distortion"

ACME
for amplification

Acme Apparatus Co.
Dept. D-24, Cambridge, Mass.

Enclosed find 10 cents (stamps or coin) to cover cost of sending me one copy of "Amplification Without Distortion," 13th edition.

Name .....

Street .....

City ..... *State* .....

RADIO

WITH WHICH IS INCORPORATED "RADIO JOURNAL"

VOLUME IX FEBRUARY, 1927 No. 2

Radiotorial Comment

THE enactment of a permanent radio law during the present session of Congress appears unlikely. So many conflicting ideas are yet to be reconciled that further delay seems inevitable. While this is most deplorable and disappointing, the situation might be worse if any hastily-considered legislation were rushed through.

A temporary measure may be passed to meet the emergency. This expedient will probably prohibit the granting of licenses for new stations, thus closing the door and serving as a stop-gap to the horde of would-be immigrants into radioland.

That there are already too many stations no one can deny. The open-door policy of the past may even require some deportations in the future. The investment in millions of good receivers has been depreciated by their inability to separate the wanted from the unwanted.

One of the most thorough analyses of the situation is that contained in a report from the American Bar Association. This organization's Air Law Committee suggests that, until such time as a Secretary of Communications is added to the President's cabinet, the control of radio should be exercised by the Secretary of Commerce. The committee furthermore believes that a higher standard of programs would be maintained and the public more greatly benefitted by a license unlimited as to time but revocable for cause at any time.

When a license is revoked the committee suggests that the owner be compensated for the station's use and good will value as determined by a compensation board. This compensation could be paid from the proceeds of a tax on the remaining stations whose value would be enhanced by the ensuing freedom from interference.

These suggestions appear to be of a more constructive nature than many that have been submitted. As they have been made before any legislation has been passed and as they are based upon good legal precedent, they should help to minimize any litigation that may follow the passage of a permanent bill.

As a further suggestion, it might be well to secure the listeners' opinions as to what stations should be retained. While it is conceivable that local prejudice might react unjustly against some stations, such an expression would doubtless help the officials in making the final determination.

The improbability of a permanent law now has reopened many discussions about radio legislation. The lawyers have spoken wisely of exclusion. The engineers also have a proposal which would exclude none. In the higher frequencies (short wave lengths) are great open spaces with plenty of room for all comers. Here much pioneer work remains to be done, but with great opportunity for worth-while results.

Perhaps the two ideas could be combined: no new settlers in the present broadcast band, but a chance for everyone in newly-opened reservations. This would stimulate the development of the art and eventually provide nearly perfect reception. While immediate permanent legislation is still improbable, it is not impossible. If Congress does act, it is to be hoped that all the faults in preceding bills will be eliminated.

THE radio engineer has inherited most of his knowledge regarding radio circuits from electrical engineers who were primarily interested in the transmission and utilization of great amounts of power. Along with much that is readily adaptable to his problems in efficiently handling the very small amount of power with which he usually works, he has also inherited certain things which do not adequately meet his peculiar requirements. Among these is the term "power factor," which has been a frequent cause of confusion to radio men.

This confusion is largely due to entirely different usages to which these two groups of engineers apply the same term. In any alternating current circuit the power factor is the numerical ratio between the actual power in watts available for useful work and the apparent power resulting from the product of volts and amperes.

As the power engineer is usually interested in providing a conductor that will deliver the greatest possible amount of useful power, he tries to get a high power factor. But as the radio engineer is more generally concerned with providing an insulator that conducts as little power as possible, he endeavors to get a low power factor. The efficient performance of condenser, for instance, is largely dependent upon its being built with an insulating material having the small conductivity indicated by a low power factor. A perfect insulator would have a zero power factor just as a perfect conductor would have a power factor of unity or one hundred per cent.

A good conductor may fall far short of unity power factor and yet be conveniently rated by this term. But any good insulator so closely approximates zero power factor that it may be more conveniently rated in terms of the very small amount by which it falls short of being a perfect insulator. This gives a positive measure of excellence which seems preferable to the negative standard set up by defining it in terms of power factor.

Consequently radio engineers are gradually ceasing to use the term power factor as applied to insulators or condensers and adopting the more logical "phase difference" or very small angle by which a material falls short of being a perfect insulator. As this practice becomes more general it is probable that much of the prevalent confusion about the power factor of an insulator or dielectric will be obviated.

Radio Photography and Television

A Brief Survey of Some Recent Developments and Future Possibilities

By Dr. E. F. W. Alexanderson

Consulting Engineer, General Electric Co.

IN the well known play by George Bernard Shaw, "Back To Methuselah," is described a scene which is supposed to take place in the year 2170. The head of the British Government holds conferences with his various cabinet ministers several hundred miles away. At his desk is a switchboard and in the background of the room is a silver screen. When he selects the right key at the switchboard a life sized image is flashed on the screen of the person with whom he is speaking at the same time as he hears the voice.

A passage of this sort by a great writer is significant. The new things that civilization brings into our lives are not created or invented by anybody in particular; it seems to be predestined by a combination of circumstances that certain things are going to happen at certain times. It is the great writers and the great statesmen who have the first presentiment of what is coming next. Then the inventors and engineers take hold of the same ideas and dress them up in practical form. It is now several years since Mr. Owen D. Young at a banquet expressed his hope that radio would soon give us visual means of communication. The idea seemed at the time absurd to many of the technical men present but work was promptly started and we have at least gotten so far that a commercial radio picture service across the Atlantic ocean is in operation. It takes twenty minutes to send one of these pictures, whereas the imagination of Bernard Shaw forecasts a direct vision of moving objects.

From moving picture practice we know that for this to be realized would require the transmission of a series of pictures at the rate of sixteen per second. It is a long way from twenty minutes to one-sixteenth of a second. It means that we must work twenty thousand times faster than we do now. However, we have tackled this problem and I shall attempt to show what prospects we have of realizing practical television. In doing so we shall think of the scene described by Bernard Shaw as the ultimate goal.

Typical Radio Photograph Transmitted by Modulator Method.

The principle for picture transmission over wires or radio was worked out about fifty years ago and all work done at the present time is based on this same principle. The work of fifty years ago though described in many books and patents fell into neglect, but the development of radio has renewed interest in the subject. We have also some new tools to work with, such as, the vacuum tube amplifier and the photo-electric cell. Radio photography has thus become an established fact. A practical realization of television, or the art of seeing moving objects by radio, involves some difficulties which have heretofore seemed almost insurmountable.

However, before dealing with the problems of the future I shall give a brief picture of the contemporary art of telephotography. So much has already been published on this subject that I need only give a few references. Since the interest in telephotography was revived the work was taken up simultaneously in America, France, England, and Germany and the names of a number of engineers have become familiar such as Korn, Belin, Jenkins, Ranger, Ives, Karolus, Petersen and Baird. I hesitate to give names because there are surely some equally important ones that I have left out.

The accompanying illustration shows a telephotograph made in Schenectady. The recording instrument is a standard General Electric oscillograph with some adaptations. The availability of this highly developed instrument made it possible to make rapid progress in the

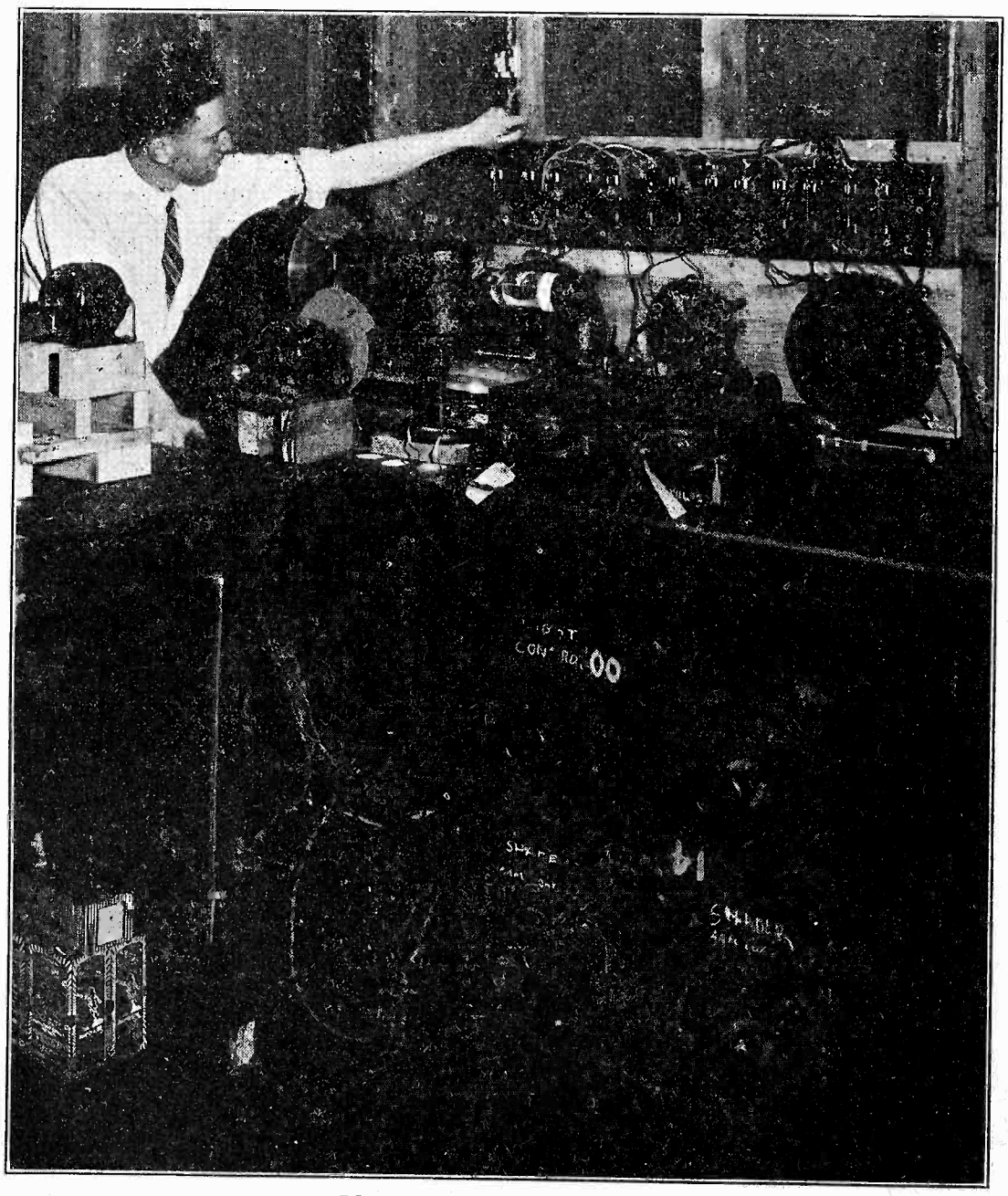


Photo Radio Transmitter.

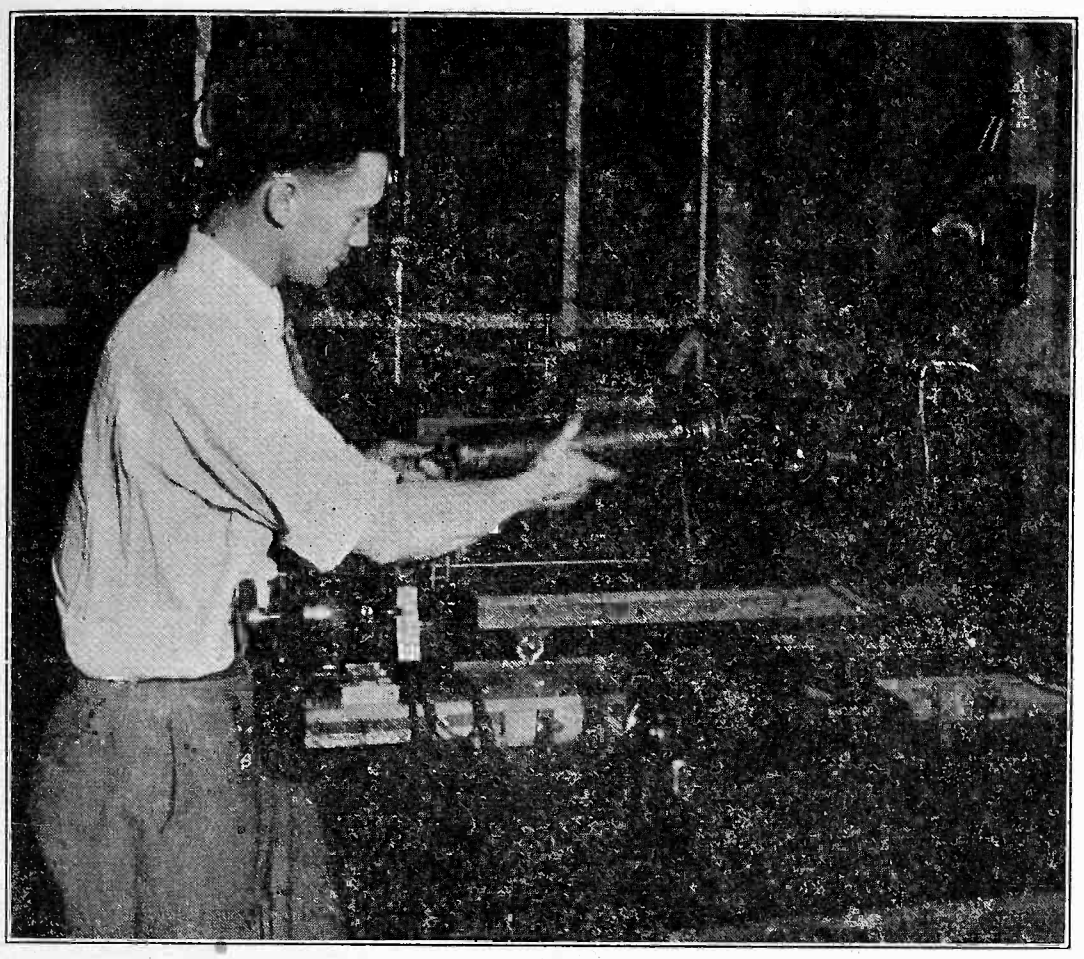


Photo Radio Receiver.

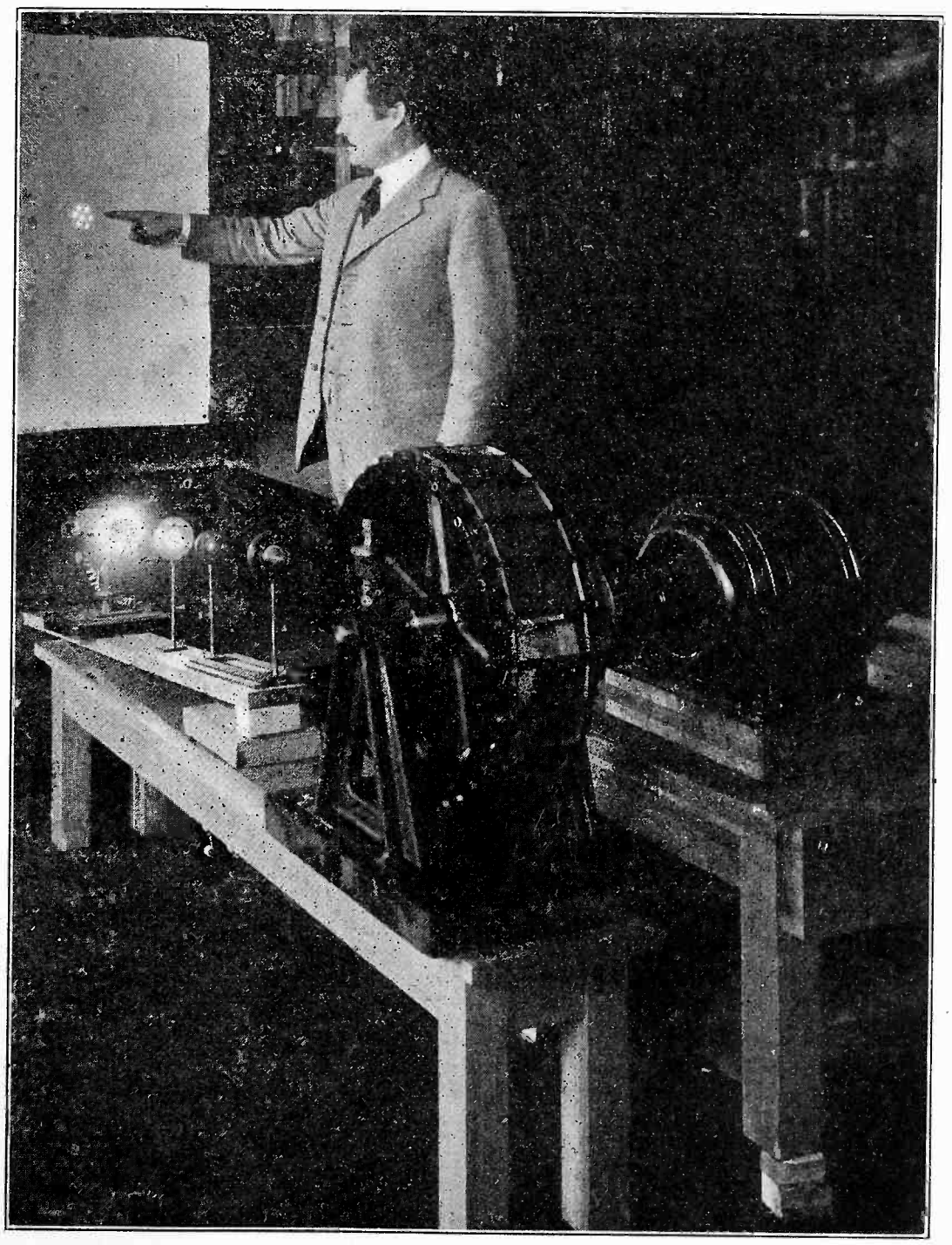
development of a practical technique in telephotography so that our energies can be devoted largely to the main problem, which is the adaptation of the radio art to this new use and particularly to devise ways of dealing with our old enemies — static and fading — when we wish to transmit pictures over long distances.

The radio art has developed two distinct methods of signalling: by modulation and by interruption. The first is usually associated with broadcasting and the second with telegraphy. Both of these methods of signalling may be adapted to radio photography and each will have its distinct field. The effective range of a broadcast station is very much shorter than a telegraph station of the same power but within this range it gives a service of excellent quality. The accompanying picture was made with a modulation frequency of 3000 cycles, which can easily be transmitted by the ordinary broadcast stations. It is therefore possible that a picture service may be given by these same stations which will be of the same standard of quality as the musical entertainments. Freedom from disturbances is insured by having a large number of stations, interlinked by a wire system so that a good selection of entertainment is available in all parts of the country. This method of dealing with static and fading may be characterized as brute force, but after all it is this mode of operation that has developed radio into the great industry that it is now. This whole broadcasting machinery is now available, should the public become interested in radio photography for entertainment or otherwise.

For long distance communication we have fortunately another method of using the radio wave which is much more sensitive and economical. The most striking illustrations of this are the feats of the amateurs in communicating with their friends on the other side of the earth with a small home made set. So far this method of signalling has been limited to dots and dashes. But the possibilities are ahead of us of using this wonderful medium of communication to transmit pictures, facsimile of letters or printed pages, moving picture films and ultimately to see by radio. It is these fascinating possibilities that have induced so many investigators to work on this problem.

In our research work on the development of radio photography and television we have looked upon the adaptation of the telegraphic method of communication to picture transmission as one of the essential problems and a system has been worked out for transmitting half tone pictures in a way which takes advantage of the more efficient methods used in radio telegraphy. The underlying principle which makes this possible is the use of a system of signalling in which the results are independent of the signal strength. Thus if the signal is strong enough to be recorded at all it gives the same kind of records at the maximum as at the minimum signal intensity. This makes the recording independent of fading. If furthermore the signals are stronger than the prevailing static, it is possible to eliminate the effects of static by introducing a threshold value of signal strength in the receiver so that nothing is received unless the signal exceeds this value.

(*Continued on page* 48)



Television Projector.

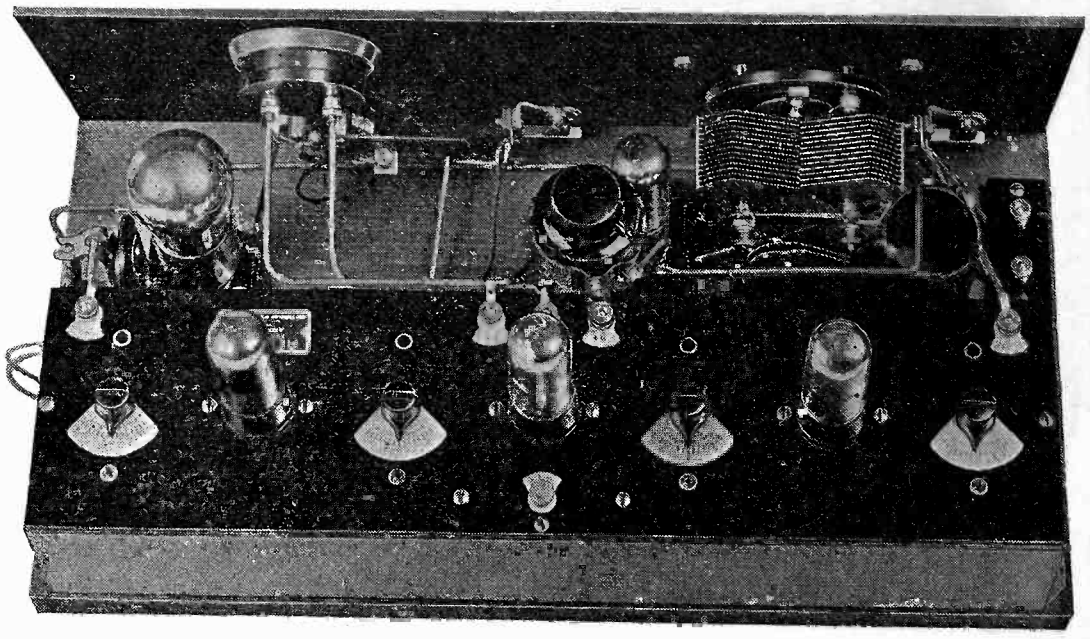
Copied

Infradyning R. F. Receivers

Directions for Adding An Infradyne Amplifier To Give Greater Range and Selectivity to Four Standard Circuits

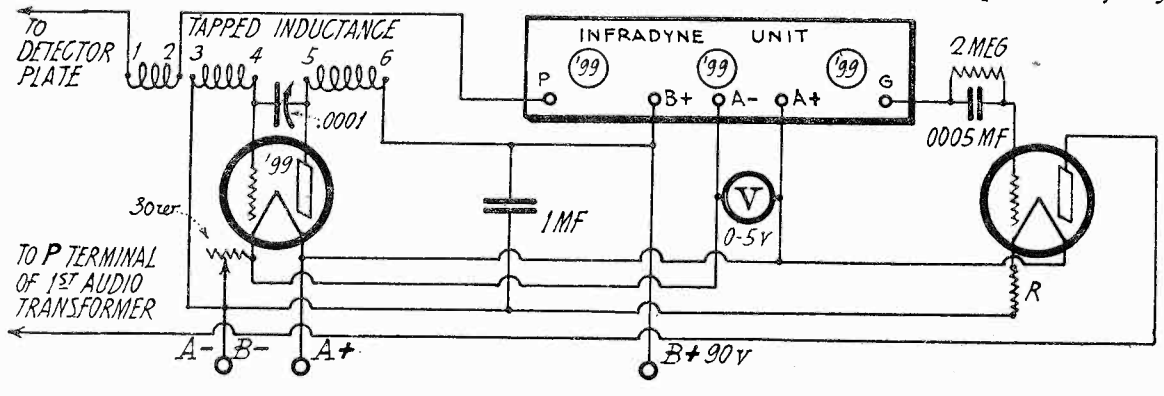
By E. M. Sargent

THE great sensitivity and selectivity now necessary in order to receive distant stations through local interference may easily be secured by adding an infradyne amplifier to almost any standard circuit. The general directions for doing this, as described by the writer in October, 1926, RADIO, brought many questions regarding its application to specific circuits. Consequently this text is written to give detailed directions for converting four popular kit sets, the Browning-Drake, Hi-Q, Counterphase, and Silver Six, into an infradyne.



Separate Infradyne Adapter With Switch Control.

The Sargent-Rayment infradyne is merely a well-designed tuned r. f. and audio amplifier *plus* a mixer tube, oscillator, and a three stage 86 meter amplifier, which are inserted between the last r. f. stage and the detector. Any similar tuned r. f. set can be likewise adapted, either incorporating the complete infradyne unit as an integral part of the set or using it as an external unit mounted in a separate cabinet.

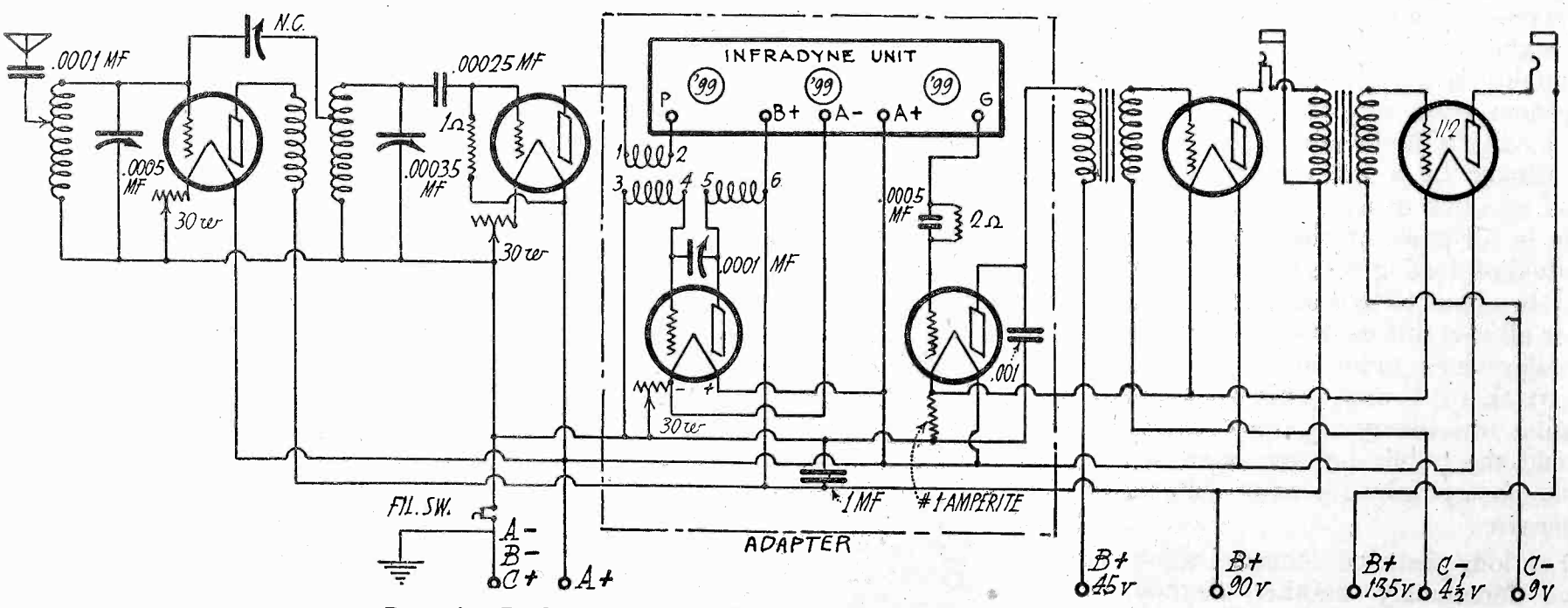


Circuit Diagram of Separate Infradyne Adapter.

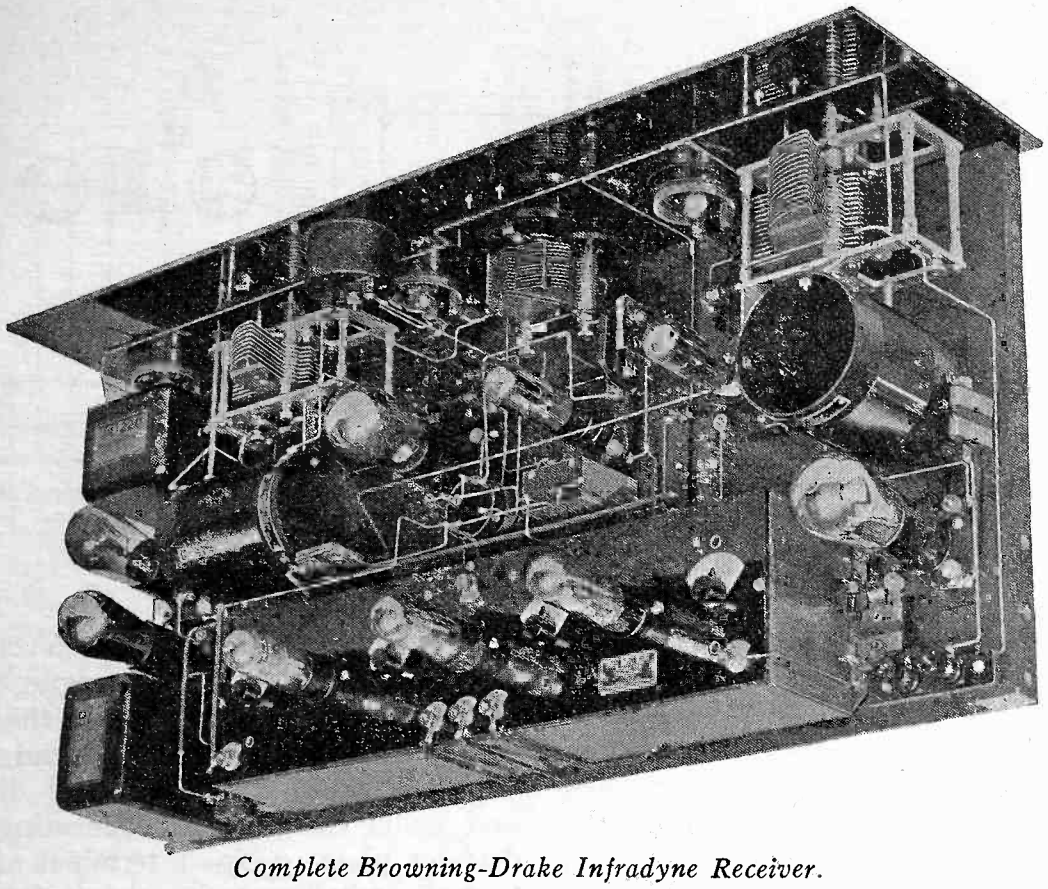
Infradyning the Browning-Drake

THE former method is illustrated in the picture and diagram of the converted four-tube Browning-Drake receiver. This circuit uses one stage of neutralized tuned r.f., a regenerative detector, and two stages of audio frequency amplification, although three stages of audio are often used, in connection with impedance or resistance coupling.

In order to shorten the high frequency leads, the infradyne unit was turned around so that the grid, or input lead, was at the left end of the baseboard, looking at the set from the back, with the mixer tube placed directly back of the Browning-Drake regenaformer. The detector tube, connected to the output of the infradyne amplifier, has a long plate lead to the audio frequency amplifier, which is placed at the extreme left end of the baseboard near the input of the infradyne amplifier. But as a .001 mfd. by-pass condenser prevents r.f. from going through this lead, no harm is done. The r.f. tube is controlled by a 30 ohm filament rheostat, which is placed at the right of the panel, looking at it from the front. The 30 ohm rheostat in the mixer tube filament circuit is at the left of the panel, and controls the volume of the set, while the r.f. rheostat controls the sensitivity.



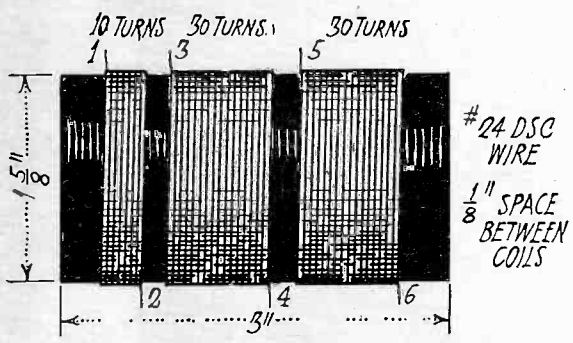
Browning-Drake Circuit With Infradyne Adapter Permanently Wired.



Complete Browning-Drake Infradyne Receiver.

As it was found that a type A tube could be used equally as well as the type 99 shown in the picture, the circuit diagram is drawn for an A tube. The connections to the tickler are not shown in the diagram, as it developed that sufficient regeneration was had in the r.f. tube as it approached the oscillating point. The tickler can be connected in the plate circuit of the mixer tube, next to the tube plate, if wanted.

The infradyne oscillator as shown in all diagrams herewith, is tuned by a .0001 mfd. Remler straight line frequency condenser, used in conjunction with a tapped inductance having the



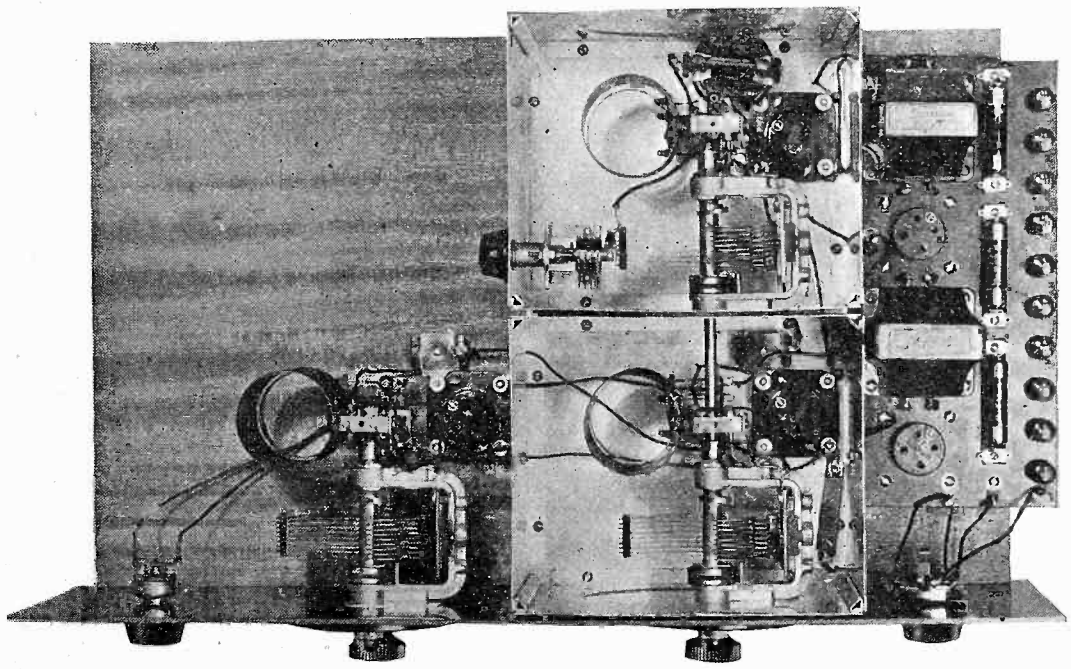
Tapped Inductance Specifications.

dimensions shown in sketch. Thus definite directions for setting the oscillator condenser for minimum and maximum wavelength settings can be given once for all. In the regular infradyne circuit a .00035 mfd. variable condenser is used in series with a .0005 mfd. fixed condenser with a tapped inductance having less turns. Using the .0001 mfd. variable condenser, the Remler dial will set at about 48 degrees for 550 meters, and 142 degrees for 200 meters. Since it is a straight line frequency condenser, there will be 96 ten kilocycle channels in the 94 degrees swing of the condensers, practically one degree per channel.

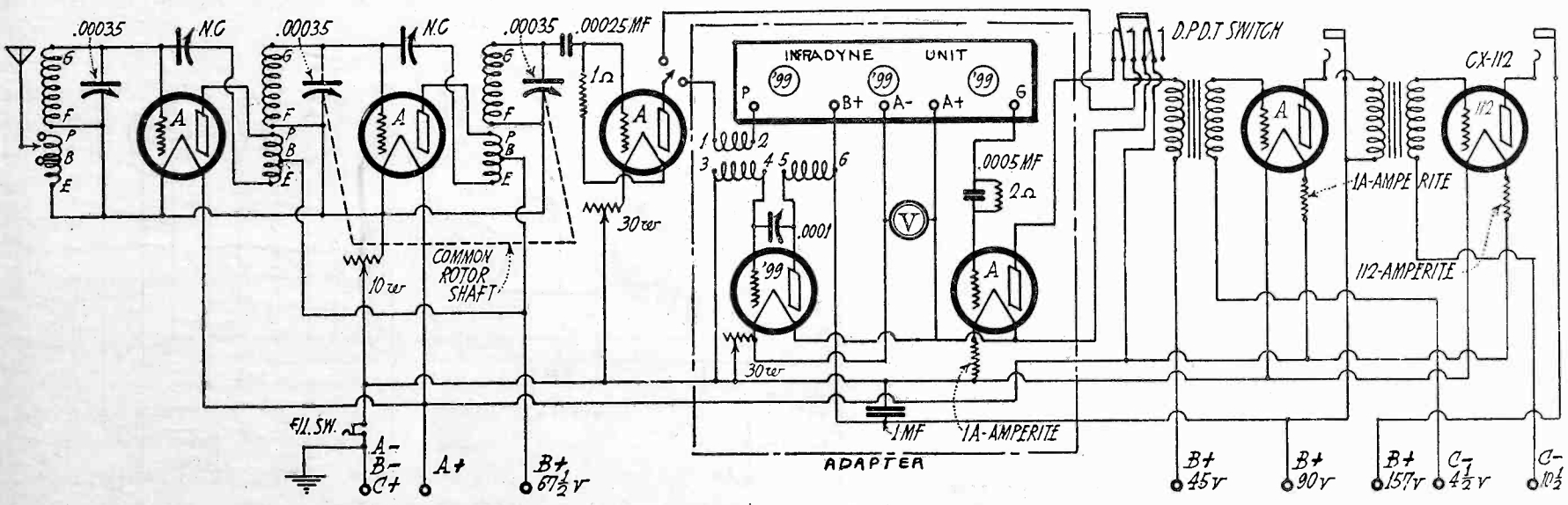
Adaptation of the HiQ

A TYPICAL five-tube circuit is the new Hammarlund HiQ shielded receiver. It consists of two stages of shielded tuned r.f., shielded detector and two stages of transformer coupled audio. As this set comes in kit form, it is easiest to build it in the usual manner, installing the adapter after the five-tube set is completed and working properly. The general arrangement of the HiQ can be seen in the picture, which shows the two shielded stages with twin condensers on one shaft, making an admirable front end combination for the infradyne amplifier.

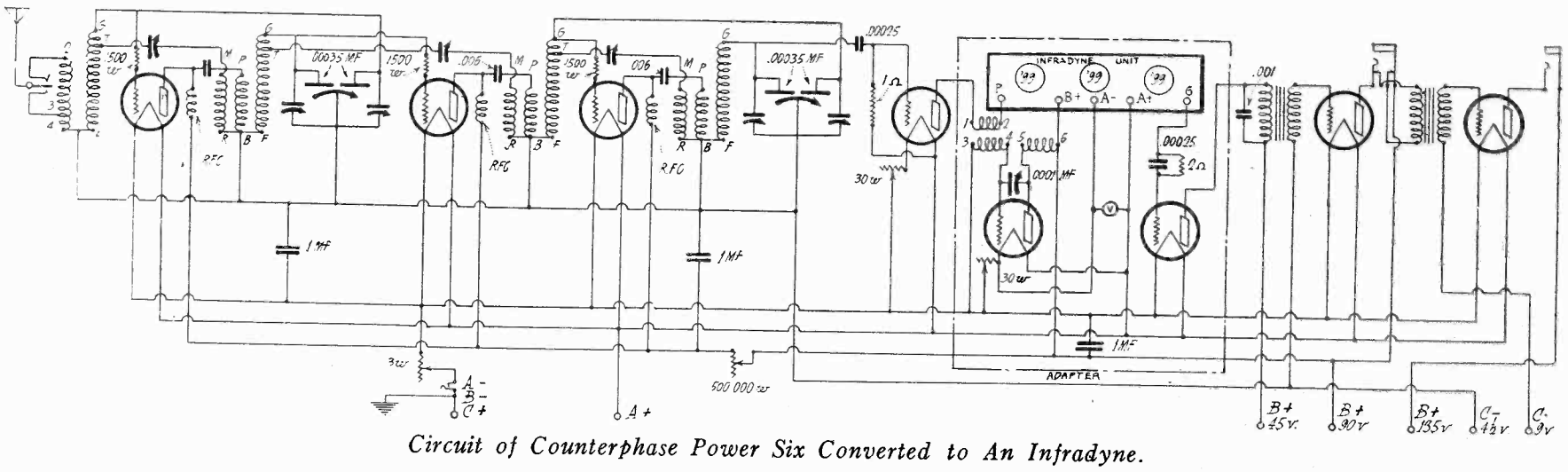
The diagram of the adapted HiQ shows a switching circuit whereby the adapter can be cut out, and the filaments of the adapter tubes turned off when the five tube set is to be used alone. This scheme requires two switches so as to avoid long 86 meter leads and capacity between switch blades which would occur if the two switches were combined in one. The switch in the detector plate should be a Federal No. 1424W anti-capacity key, it being a four-pole double-throw switch with little capacity between switch blades. The switch in the mixer tube plate circuit may be a Yaxley antenna switch having three contacts. One of the four switch groups of the Federal key should be used to turn off the filaments of the five tubes in the adapter when not in use, as is shown in the diagram. This switching device can be employed in any other



The Hammarlund HiQ Receiver.



Schematic Diagram of Hammarlund HiQ Receiver With Infradyne Adapter.



Circuit of Counterphase Power Six Converted to An Infradyne.

set, but is shown in the HiQ circuit only so as not to confuse the reader if the switches are not wanted.

The necessary changes in wiring the HiQ set are as follows: Disconnect the wire leading from terminal P of socket No. 3, as designated in the instruction manual accompanying the HiQ kit, and run flexible leads from terminal *P* of the socket, and terminal *P* of audio transformer No. 1, to the switches on the adapter. The detector tube in the HiQ set becomes the mixer, and the new detector tube in the adapter has its plate connected to terminal *P* of the first audio transformer, as is shown in the diagram. No other changes are necessary, and the adjustment of the two r.f. transformers, or of the audio end need not be changed in any way.

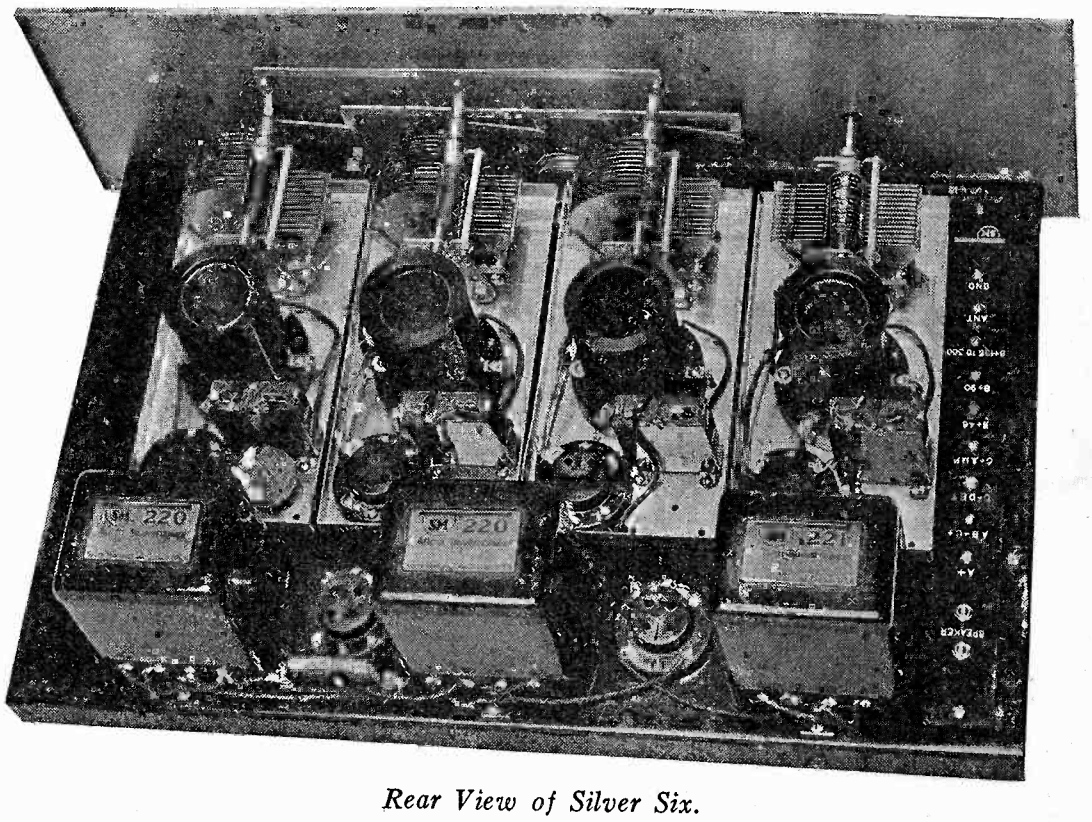
The circuit diagram shows the grid leaks connected from the grid to the filament. It may be left shunted across the grid condenser as in the regular HiQ circuit with equally good results.

If it is inconvenient to solder a wire to the *P* terminal of socket No. 3, the old wire coming out of the hole in the side of the shield can be extended by splicing the piece of flexible wire to it, with the joint carefully taped to prevent a short circuit with the shield. As the HiQ set has all important r.f. leads shielded, the adapter may be placed in a cabinet, and set on top of the HiQ cabinet, so that its tuning dial will be directly over the HiQ tuning dials so as to facilitate tuning.

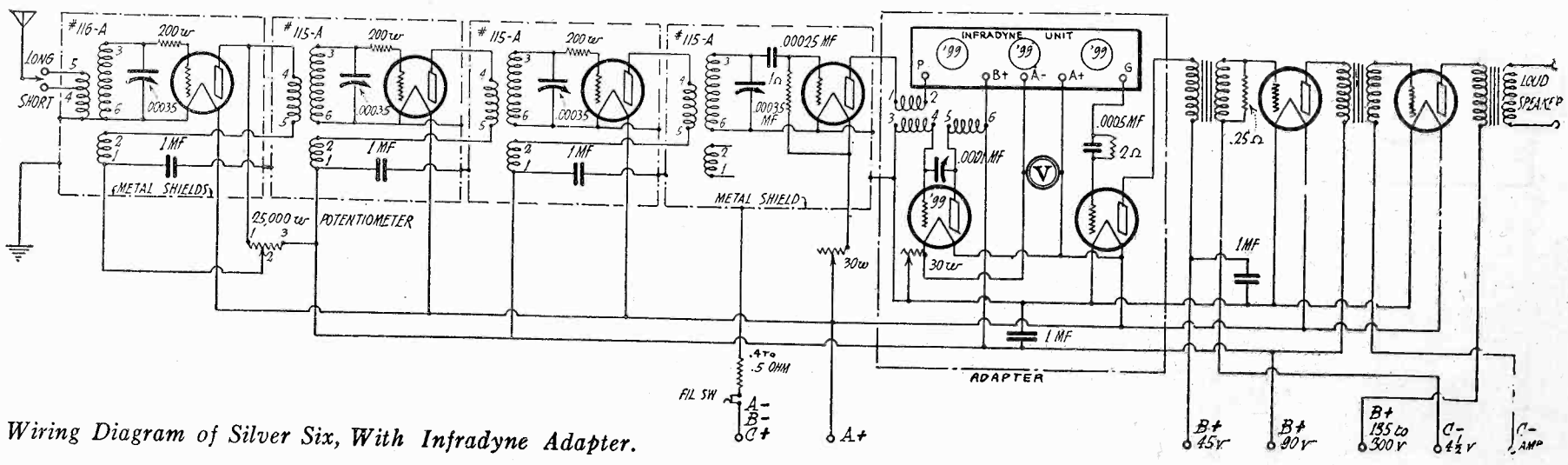
Conversion of the B. T. Counterphase

THE six-tube unshielded receiver employing toroid or other enclosed field coils, is represented by the Bremer-Tully Counterphase Power Six, described in December, 1926, RADIO. Here the three stages of tuned r.f. are controlled by two twin condensers. The changes in wiring are simple, since the detector plate lead is easily reached with the soldering iron. It is advisable to mount the infradyne adapter to the left of the Counterphase, so that there will be no interconnection between the wiring of the adapter, and the r.f. end of the Counterphase. The diagram is shown as a complete unit, as though the infradyne were built in the set, but to convert a Counterphase to an infradyne, it is only necessary to proceed as in the HiQ case and disconnect the plate lead from the detector to the *P* terminal of the first audio transformer, connecting the detector plate to No. 1 terminal of the tapped inductance in the infradyne adapter, and the plate of the detector in the adapter unit to the *P* terminal of the first audio transformer. If the switch combination is desired, use the same manner of connections as is shown in the HiQ diagram, making certain of the connections to the filament breaking contacts of the anti-capacity key, so that when the adapter is not in use, its filaments will not be lighted.

(*Continued on page* 54)



Rear View of Silver Six.



Wiring Diagram of Silver Six, With Infradyne Adapter.

A Four-Electrode Tube and Circuit

R. F. Amplification, Detection, and A. F. Amplification with One Vacuum Tube

By H. de A. Donisthorpe

FOUR-ELECTRODE tubes and their associated circuits do not seem to have found much favor with radio experimenters. It is hard to account for this, as the results are quite worthy of experimentation and compare favorably with those obtained with the more popular three electrode tube.

Different types of four electrode tubes have been evolved by inventors, some with two grids, and some with three anodes in addition to the cathode or filament. In each case it has been the aim of the inventor to obtain more work from the energetic electron stream from the filament as compared with that from the cathode of a three element tube.

The type made by the M. O. Valve Co. of England has been successfully employed commercially and is to be found on many transatlantic lines. Its general appearance is depicted in Fig. 1. It is 3¾ in. long and ⅞ in. in diameter.

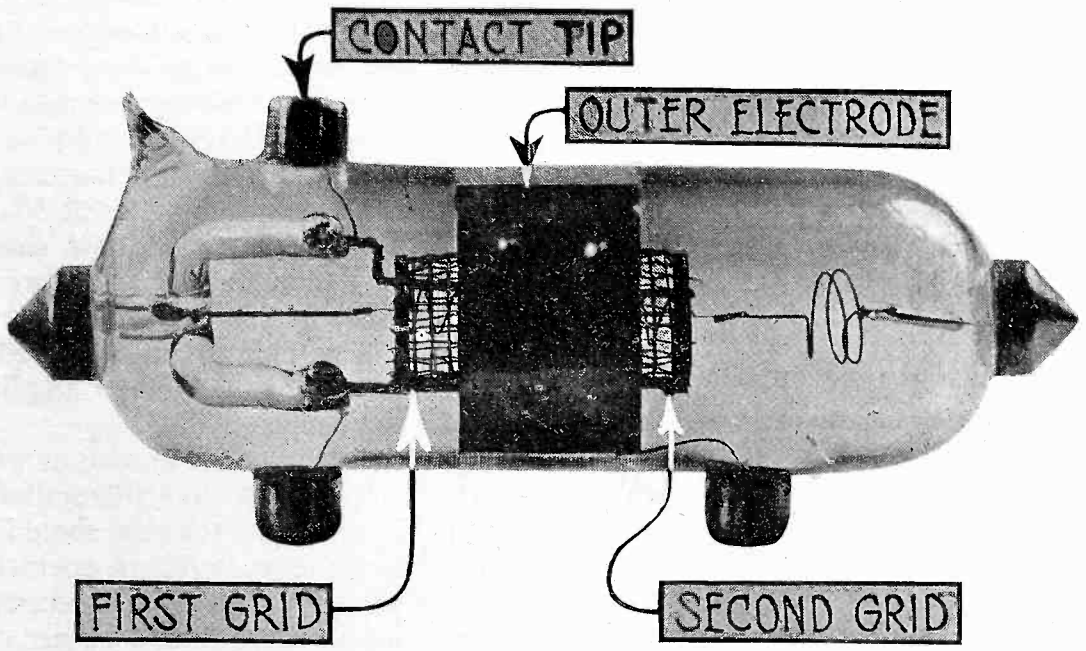


Fig. 1. The "MO" Four-Electrode Tube.

This tube has one cathode or filament and three anodes. One anode, the "outer electrode,' resembles the usual plate of a three element tube and concentrically surrounds the two "grids." One of these performs the usual grid function and the second grid, in addition, acts like a plate. In fact if so connected while the outer electrode is not connected the tube will give a straight line characteristic curve and a rectification saturation value of about 80 micro-amps. when 45 volts are applied to the "anode."

The filament is of the bright emitter type and takes 1.2 amps. at 4½ volts. With 90 volts on the anode a current of .75 milliamperes is established between the filament and the outer electrode.

In the complete circuit shown in Fig. 2, the tube can actually be made to perform three operations simultaneously: radio amplification, rectification, and audio amplification. It can therefore be said that the tube will do the work of three, three-element tubes. Although it is quite possible to make a three electrode tube perform the first two functions simultaneously, the efficiency of such an arrangement is not of a very high order and will tend to cause interference to neighboring receiving sets.

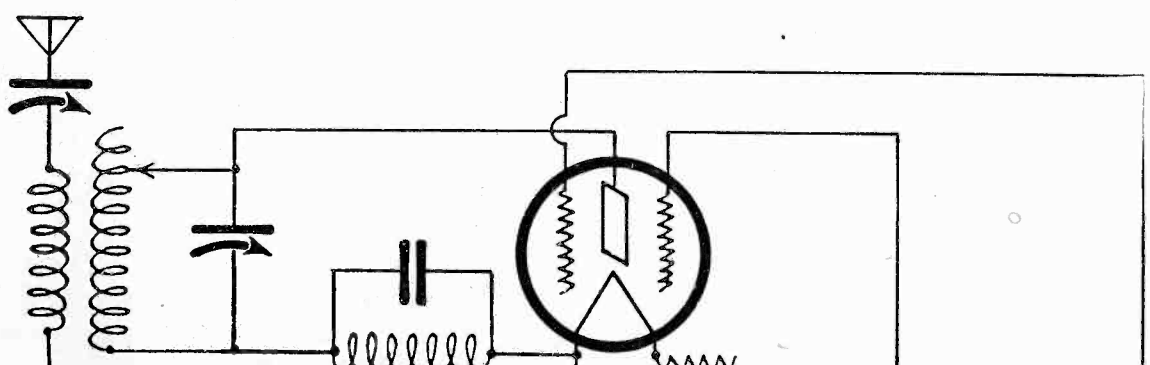


Fig. 3. Rectification Circuit.

Fig. 3 shows the circuit for rectifying only. The second electrode functions as the anode of a three element tube, being connected to the positive *B* battery. If a positive potential is given to the first grid, electrons from the filament will rush towards the second grid, owing to its positive potential. Due to their inertia they pass through its mesh and travel on towards the outer electrode. As this is connected to the negative filament, the speed on the electrons when they reach the outer electrode is equal to the speed of the electrons at the filament, which is zero.

Thus if an alternating voltage due to received signals be impressed across the negative limb of the filament and the outer electrode, the positive halves of the incoming oscillations will render the outer electrode positive so that the electrons will arrive at that outer electrode with a velocity and a current will flow in that circuit which will be recorded in the earphones. This function corresponds to that of the well known two electrode tube of the early days of radio and the results obtained are comparable to those expected from a crystal.

The incoming oscillations may be amplified before rectification by connecting

Fig. 2. Complete Four-Electrode Tube Circuit.

as shown in Fig. 4. Here it will be noted that the primary of a radio frequency transformer is placed in the circuit of the second grid and the secondary in the circuit of the outer electrode. It is obvious that small voltage variations in the first grid produce large variations in the flow of electrons to the second grid. These amplified radio oscillations in the second grid, as they pass through the primary, produce an alternating voltage across the secondary of the transformer, or across the negative limb of the filament and the outer electrode. These oscillations are rectified and the signals heard in the headphones. The potential of the first grid must be adjusted so that the tube is

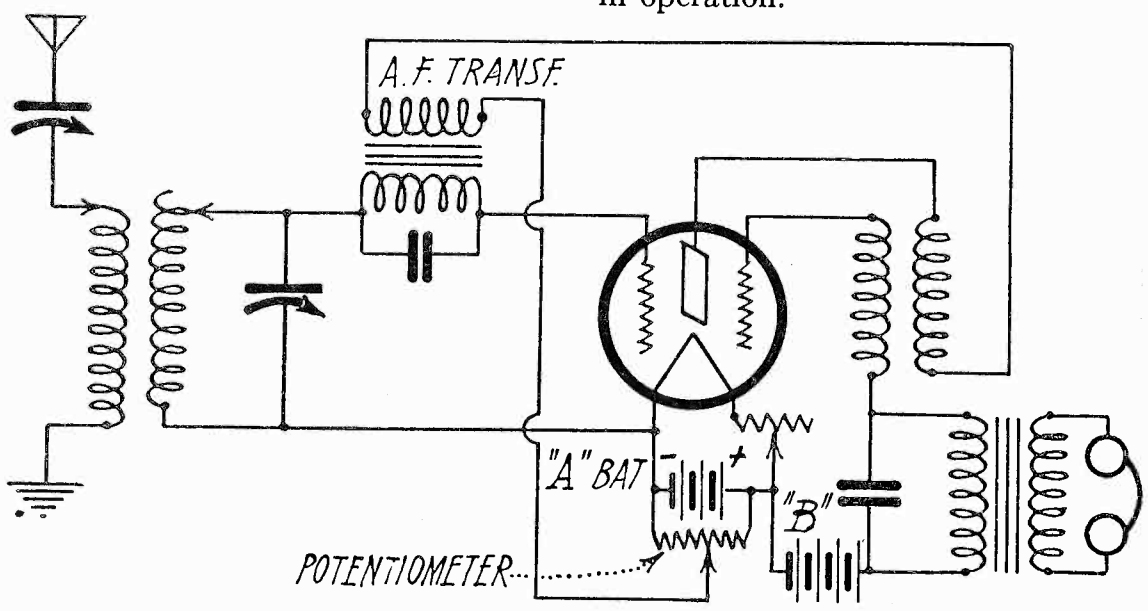
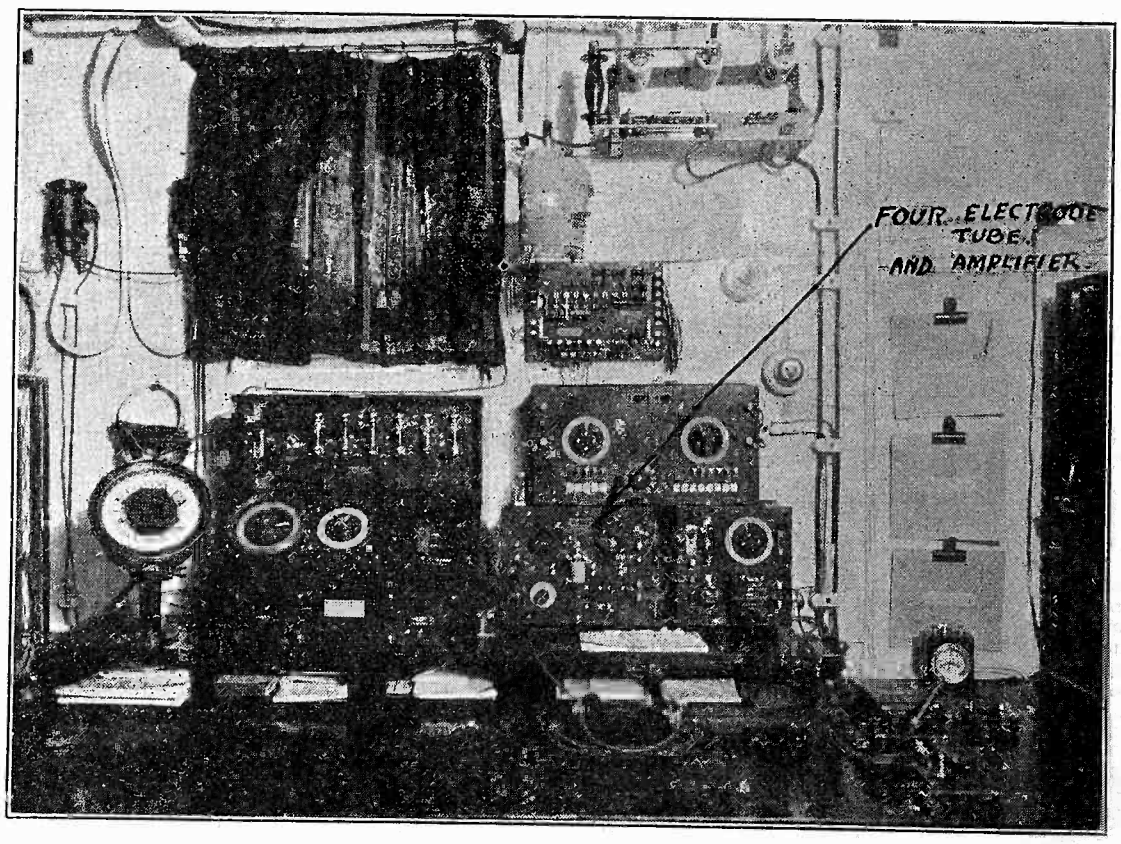


Fig. 4. R. F. Amplifier and Rectifier Circuit.

operating on the straight portion of the characteristic curve so as to get amplification.

The addition of a 1:1 audio transformer to impress the rectified signals back on the first grid is shown in Fig. 2, the headphones being placed in the second grid circuit. The primary is shunted by a condenser to by-pass the high frequency oscillations.

By winding the r. f. transformer in three sections, switch-controlled, it is possible to cover the range from 200 to 2800 meters. The author has used these tubes with much success and advises other experimenters to try them.



Four-Electrode Tube In Use on Atlantic Liner.

Resistors for Radio Circuits

By Joseph Morgan

One of the most important, and likewise most frequently neglected, elements of a radio set is the high resistance unit. No part of a set is more influential in its satisfactory operation and more difficult to design. Whether used as a grid-leak in the detector circuit, as a coupler or as a shunt in the audio circuit, as a stabilizer in the radio frequency circuit, or in a *B* eliminator, it should be selected for its quietness and constancy in operation.

If the grid leak is not of proper value at all times it causes distortion and loss of energy. The correct value for average signals on all except the special detector tubes is between 2 and 5 megohms. These values should be doubled for weak distant signals. A type 200 tube should have a grid leak of from ½ to 2 megohms and a 200A of from 1 to 3 megohms for average signals, doubling for weak signals.

Better tone quality can be secured from most audio transformers by connecting a ½ megohm resistance across the transformer secondary. This flattens the characteristic curve so as to make fairly equal response for all frequencies between 70 and 7000 cycles. While it causes a slight loss of energy in the amplifier system, the gain in quality more than compensates.

Of course a well-designed resistance coupled amplifier gives the best tone quality. But this advantage is lost unless the very best resistors and condensers are used. After the detector tube the coupling resistor between the plate and the *B* battery should be of about 100,000 ohms, and in the case of standard amplifier tubes of about 50,000 ohms. The coupling condenser should never be less than ½ mfd., and preferably 2 mfd., the higher the value the better. A ¼ megohm resistor should be used between the grid of each amplifier tube and the negative *A*.

In each of these cases, as well as when used as a "losser" to prevent oscillation in r. f. circuits, the resistor should be accurate in value, noiseless in operation, and capable of carrying the necessary current without more than a 10 per cent change in resistance.

A resistor for use in a *B* battery eliminator, where it must carry heavy currents without changing resistance or causing distortion, should be able to dissipate 1/5 of a watt. All of these requirements are met by the metallized filament type of enclosed resistance, which does not crystallize after continued use and holds constant value.

Resistance Coupled Amplifiers With B-Battery Eliminators

All of the disagreeable noises that have resulted from the operation of resistance coupled audio amplifiers by *B* battery eliminators can be stopped by making a few changes in the amplifier resistors. These noises include a low-pitched hum, a high-pitched squeal, or a slow "clucking" noise. At times the amplifier may be even completely blocked. (*Continued on page 78*)

The 1927 Model of Best's Superheterodyne

An Easily Built Nine Tube Shielded Set with Two Tuning Dials and One Tuned R. F. Stage Ahead of the Super

By G. M. Best

MANY readers who built 1924, 1925 or 1926 model superheterodynes, as previously described in these columns, want to rebuild their sets so as to get even greater range and selectivity, using as many of the old parts as possible. Consequently complete directions are here given for constructing a new model which also has better tone quality and volume as well as more accessible wiring.

One stage of tuned r.f. with outside aerial gives greater range. Increased selectivity is obtained by placing the tuned r.f. apparatus in three shielded compartments, this also preventing possible radiation. A power tube in the last stage with some of the newer transformers improves tone quality and volume. The wiring is made more accessible by using a sub-panel and brackets instead of a baseboard.

Fig. 1 shows the circuit details. The first seven tubes are 99's, the first audio is an A, and the last is a power tube. All are operated from a 6-volt battery with reducing resistance for the 3-volt tubes.

The intermediate frequency transformers are designed to peak at 52,000 cycles when used with '99 tubes. The peak is 40,000 cycles when A tubes are used, which is undesirable if a 52,000 cycle filter transformer is used. This difference is caused by the greater grid-filament capacity of the A— tube, which is shunted across the transformer secondary. This capacity has little or no effect on the filter transformer, so that its frequency does not change when using the A tube.

The picture of the rear of the set shows the general construction, the shields and the center inductance coil being removed to show the arrangement of condensers and coils in the compartment. The r.f. amplifier is in the left compartment, the first detector in the center, with the two condensers controlled by one dial through a link motion, and the oscillator coil and condenser in the right.

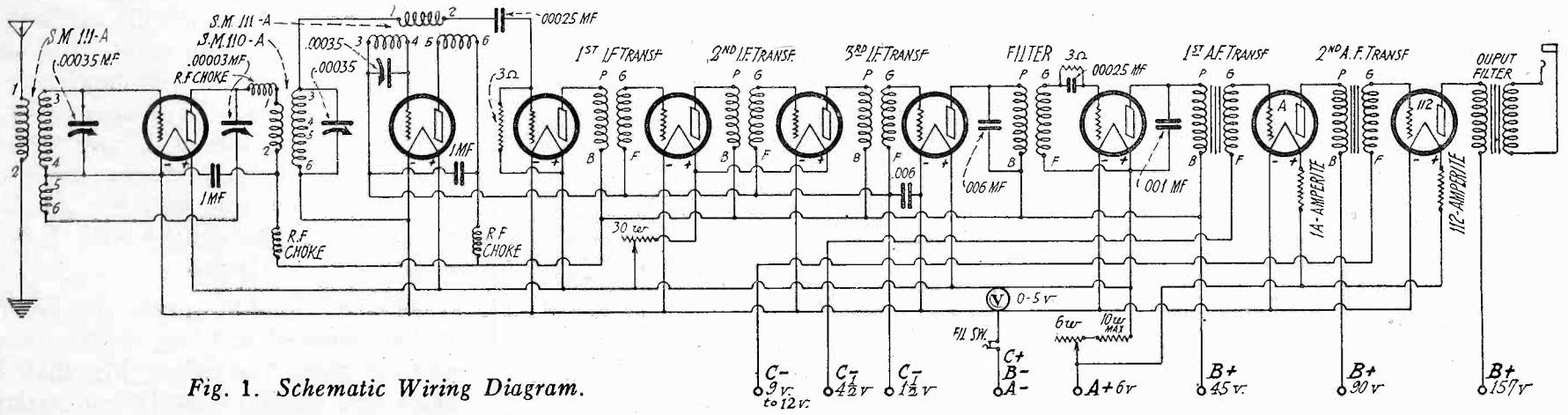
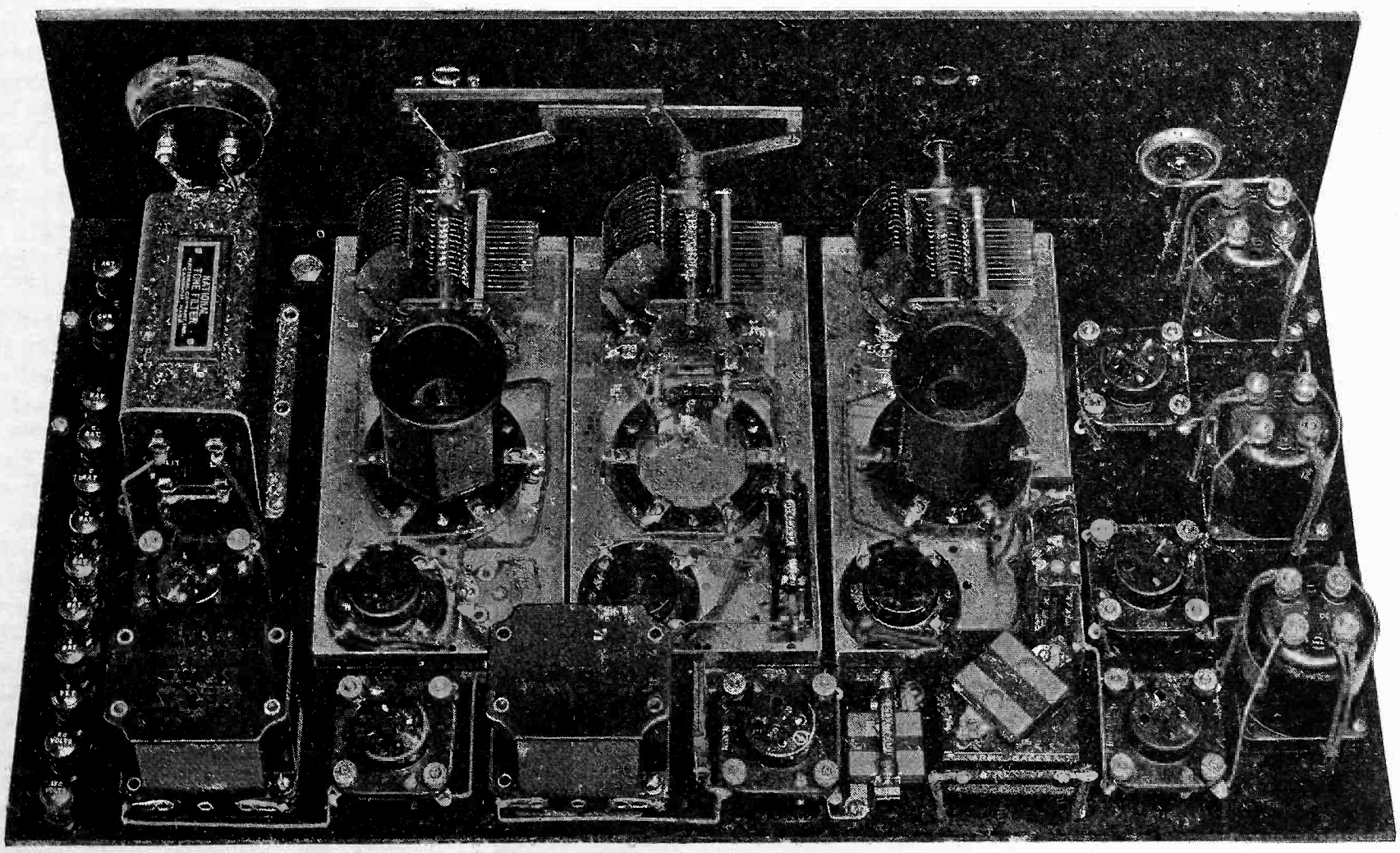


Fig. 1. Schematic Wiring Diagram.



Rear View of Receiver, with Shields Removed.

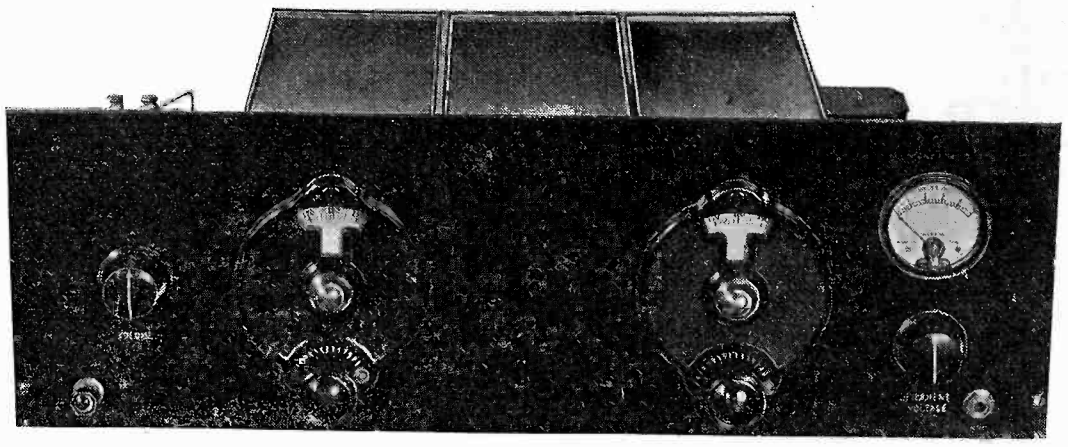
The three intermediate frequency transformers are placed at the right edge of the sub-panel. The filter transformer and two audio transformers with associated sockets along the back edge, the power tube socket and the output filter at the left end.

This design minimizes the length of connecting wires, makes every soldering terminal in the set easy to reach with the soldering iron, and facilitates the testing of the completed set. Connecting wires between the shielded compartments are all brought through holes in the bottom of the shields underneath the sub-panel, so that the metal cans can be removed whenever adjustment is required.

The list of parts gives those used in building the model shown, although substitutions can be made at the option of the builder. The design has been worked out for one make of shielding into which it is known that these parts will fit. It is important to use a small 6 ohm rheostat, for a large one underneath the voltmeter would interfere with the sub-panel, and require the cutting of a recess in order to make a perfect fit.

The panel template in Fig. 2 gives the exact position of all panel parts. After it has been drilled, a pencil line should be drawn on the back of the panel at the points indicated by the dotted lines in Fig. 2, to indicate the top edge of the sub-panel. Otherwise the shafts of the variable condensers may not project through the exact center of the holes in the panel.

Assemble the two brackets with their flanges underneath and pointing towards each other, as shown in the picture of the under part of the sub-panel. Lay the front panel face down on the table, and line up the sub-panel so that the top edge fits the pencil line on the back of the front panel, and mark the holes which must be drilled through the front panel, to fasten the brackets. Drill these holes, and secure the brackets to the panel with four 6-32 round head brass machine screws. A No. 28 drill will be required for drilling the holes through the panel. The panel apparatus, except the dials, can now be mounted in place,



Panel View, Showing Shields in Place.

LIST OF PARTS

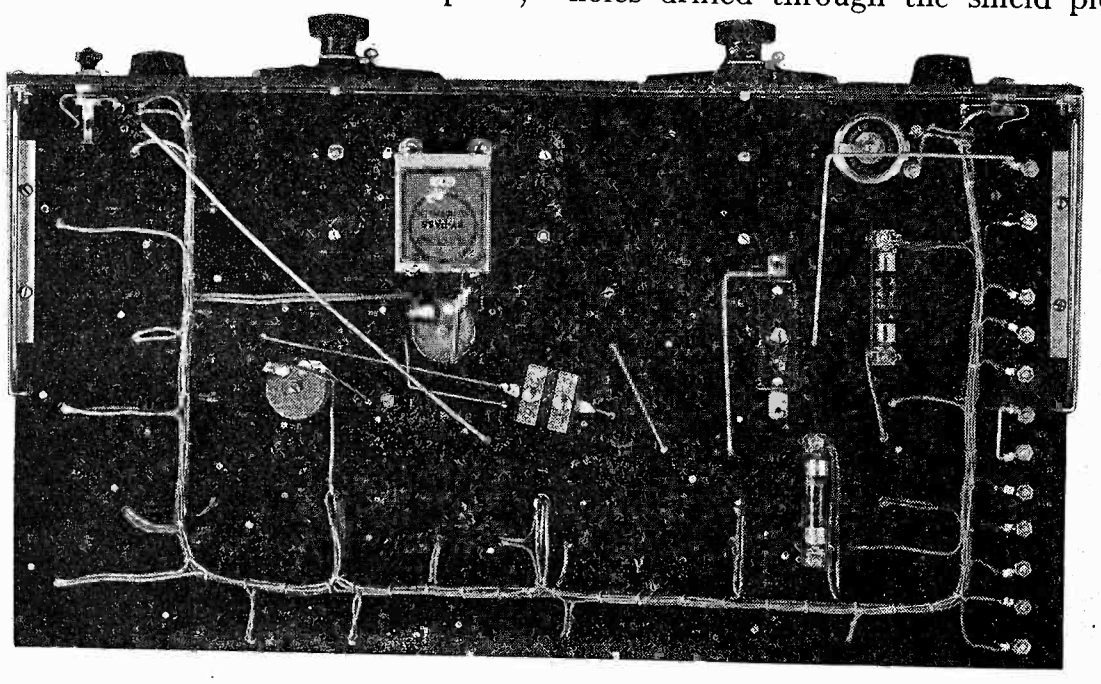
3—No. 631 Silver Marshall stage shields.
3—No. 515 Silver Marshall coil sockets.
3—No. 511 Silver Marshall tube sockets.
1—Carter Midget rheostat 6 ohms.
1—Carter Midget rheostat 30 ohms.
1—Carter Adjustable resistance 10 ohms.
2—No. 316-B Silver Marshall condensers .00035 mfd.
1—No. 316-A Silver Marshall condenser .00035 mfd.
1—No. 275 Silver Marshall r.f. choke.
2—No. 276 Silver Marshall r.f. choke.
2—Electrad 1 mfd bypass condensers.
2—Silver Marshall No. 111-A coils.
1—Silver Marshall No. 110-A coil.
6—Benjamin Cushion Sockets UX base.
3—Intermediate frequency transformers—52 kilocycle.
1—Filter transformer—52 kilocycle.
2—AmerTran DeLuxe Audio Transformers.
1—Output filter or transformer.
1—Electrad Filament Switch.
1—Electrad Single Contact Jack.
1—Weston Model 506 Voltmeter 0-5 volts.
2—National Type B Dials.
2—Silver Marshall No. 540 Brackets.
1—Electrad .00025 mfd. fixed condenser.
1—Electrad .00025 mfd. grid condenser, with clips.
2—Electrad 3 megohm fixed metallic leaks.
1—1-A Amperite.
1—112 Amperite.
1—XL Model N neutralizing condenser.
1—Electrad Grid Leak Mounting.
1—.006 mfd. Electrad Fixed Condenser.
1—.002 mfd. Electrad Fixed Condenser.
12—Eby Binding Posts.
1—Silver Marshall No. 632 link motion.
1—Formica or bakelite panel 7x21x3/16 in.
1—Formica or bakelite sub-panel 11 x 21 x 3/16 in.

with the terminals of the two rheostats mounted upwards so as to be accessible.

Now lay the three bottom pieces of the shielded compartments on the sub-panel so that their front edges are exactly ⅝ in. from the back of the front panel. Line them up evenly so that the center line of the two outside pieces is exactly even with the two holes drilled through the front panel for the condenser shafts. This can easily be done by temporarily resting the two variable condensers with the long shafts over the holes drilled through the shield pieces, projecting the shafts through the front panel holes. These shields are ready drilled for the two condenser mounting screws and the screws for the coil and tube sockets. The back of the shield may be identified by a ¼ in. hole drilled through its center.

If the condenser shafts are above the center of the holes in the panel, the sub-panel has not been lined up exactly according to the dimensions in Fig. 2, or else the panel has not been drilled properly. After the position of the outside two shield bottoms has been located, carefully remove the two variable condensers, without disturbing the shield pieces, and mark the holes to be drilled in the sub-panel for the condenser, coil and tube sockets. Drill these holes with a No. 33 machine drill, and tap them for a 6-32 machine screw, except the two holes for the variable condenser, which should be drilled with a No. 27 drill, and not tapped.

The two outside shields are now ready to be mounted in place, but before this can be done, the Silver Marshall three shaft link motion must be converted into a two shaft link, by cutting off one shaft collar and its connecting rods with a pair of cutting pliers. The variable condenser in the r.f. amplifier compartment should be one of the two long shaft condensers, and one of the collars of the link motion should now be slipped on the shaft, as is shown in the picture of the rear of the set. Mount the condenser in place on the sub-panel by passing two round head 6-32 machine screws up through the sub-panel and shield bottom and by screwing them into tapped holes in the condenser supports. Fasten the coil and tube sockets in place with round head 6-32 screws, and repeat the operation for the right hand shield assembly, except that the link motion is not installed. Now slip the shaft of the short shaft condenser into the remaining collar of the link motion, and by lining up the holes in the condenser supports with those of the shield bottom, at the same time adjusting the link motion so that it operates smoothly, the position of the center shield bottom can be determined, and the holes spotted. Remove the short shaft condenser from the link motion, drill the holes and tap them as for the previous shields, and assemble the center shield compartment.



Wiring Details of Sub-Panel.

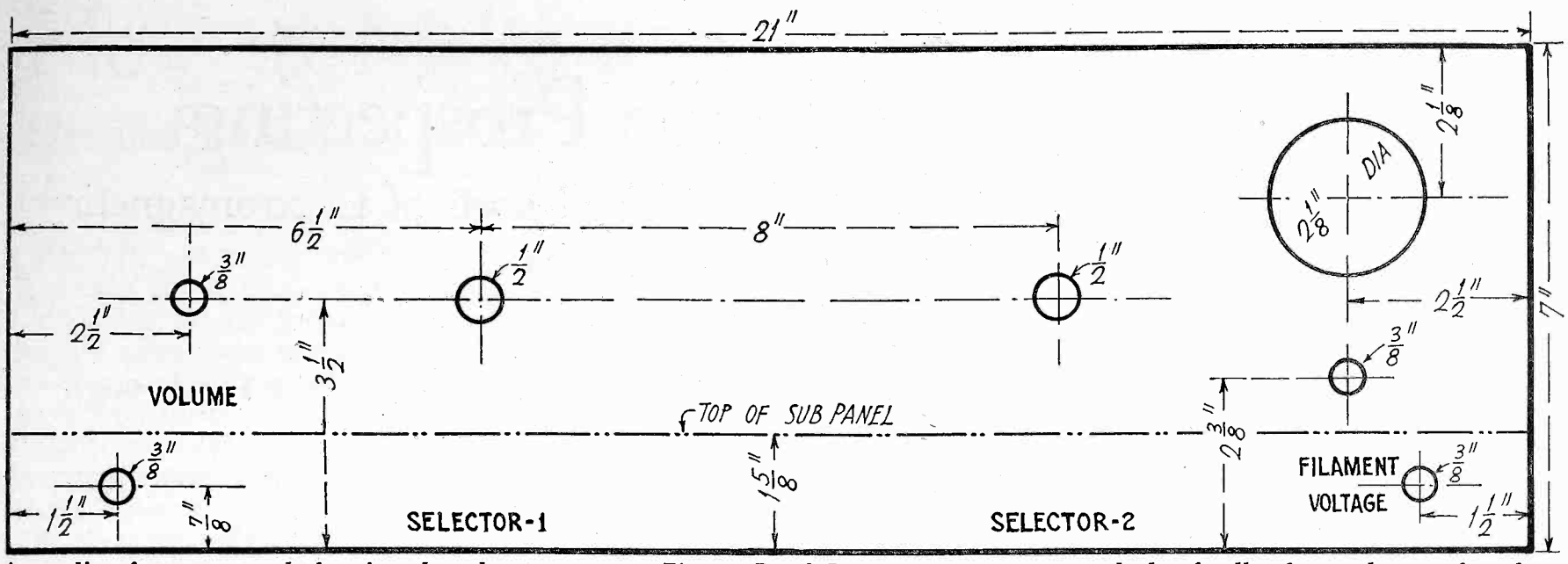


Fig. 2. Panel Layout.

A radio frequency choke is placed near the tube socket in the r.f. tube compartment, a grid leak mounting in the center compartment, and a by-pass condenser in the right hand compartment, as is shown in the picture. In order to keep the terminal screws of the grid leak mounting from shorting to the shield, the mounting is kept away from the base by means of a small strip of bakelite.

Mount the intermediate frequency transformers, filter, audio transformers, output filter and tube sockets in the positions indicated in the pictorial wiring diagram, Fig. 3, with the grid condenser for the 2nd detector placed between the tube socket and the filter transformer. Underneath the sub-panel are mounted two large size Silver Marshall No. 276 r.f. chokes, in the positions shown, using two 1 in. 6-32 machine screws, so that the connecting leads to the apparatus in the shielded compartments will be short. The by-pass condenser for the r.f. amplifier tube is placed near its associated r.f. choke, and the feedback condenser for the r.f. stage is placed nearby, the latter requiring two 1 in. 4-36 machine screws. The adjustable resistance for the filament circuit, and the two automatic resistances for the 5 volt tubes complete the apparatus placed underneath the sub-panel. Along the right hand edge of the sub-panel, looking at the set from the rear, are mounted the 12 binding posts, with the antenna and ground near the front panel. Do not mount the posts too close to the edge of the sub-panel,

(*Continued on page 71*)

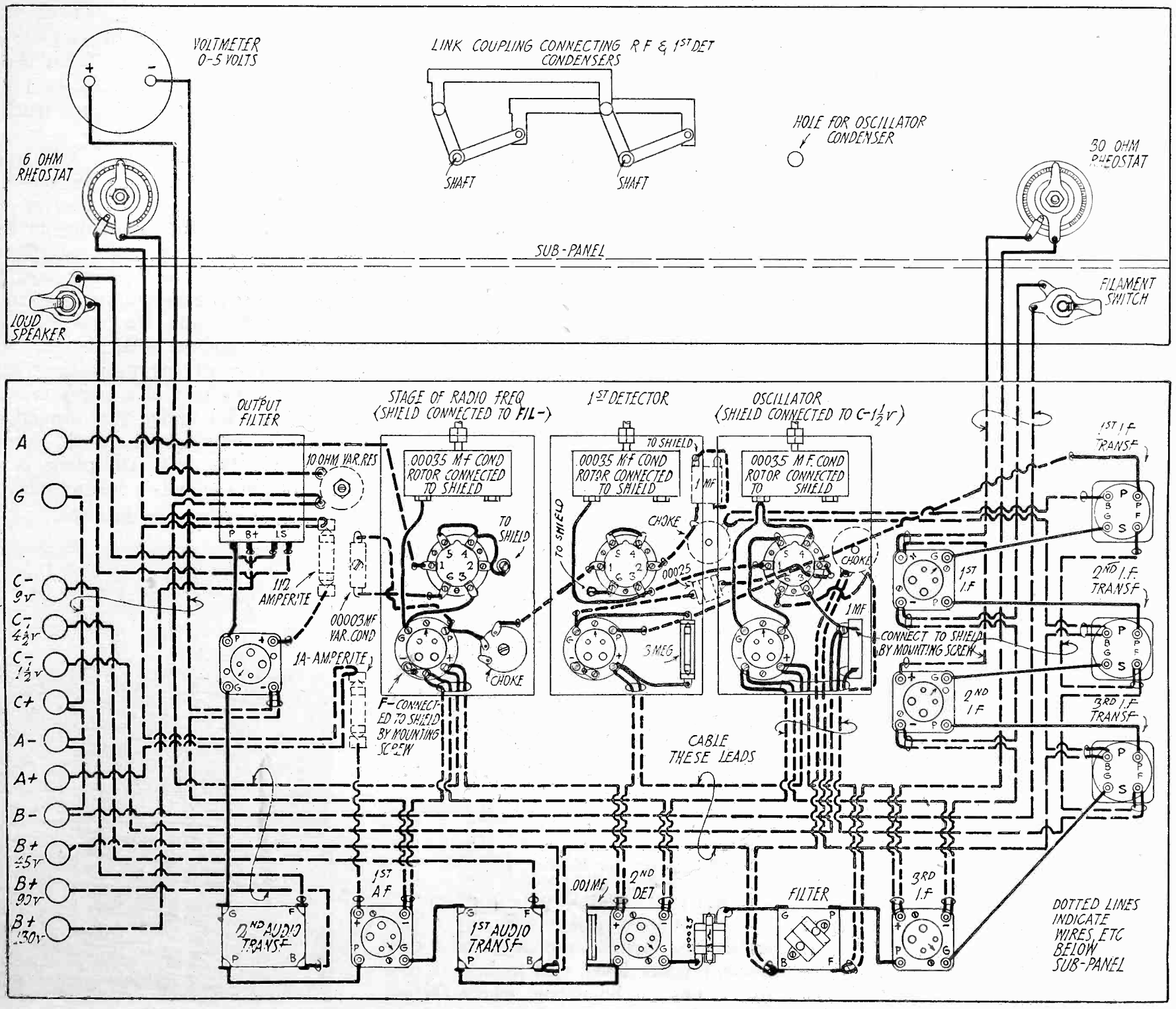


Fig. 3. Pictorial Wiring Diagram.

Experiments in Radio Prospecting

Suggestions for Locating Mineral Deposits by Means of Electromagnetic Wavefront Measurements

By J. Gibson Alverson

ALTHOUGH many impossible claims have been made for equipment designed to locate gold, silver, and other metals by the use of some radio device, there is enough theoretical justification for the belief that it may be eventually accomplished. To the knowledge of the author, there never has been a sure-fire machine for locating commercial ore deposits without the aid of a geologist or perhaps a fake spiritualist. But having been engaged in scientific experiments of this character for some months, I am passing on my findings for the benefit of whomever may be interested.

The chances for success were enough to justify the financial backing of a man who is not interested in promoting a stock company. The equipment comprises a regular radio transmitter and receiver designed to operate on long wavelengths. Certain patents and data found only by experience are deemed sufficient protection.

The theoretical basis for the experiments is found in Dr. J. Zenneck's "Wireless Telegraphy." He considers the propagation of a plane electric wave over a surface bounding two media of different conductivity and dielectric constant. In Fig. 1 is illustrated the forces

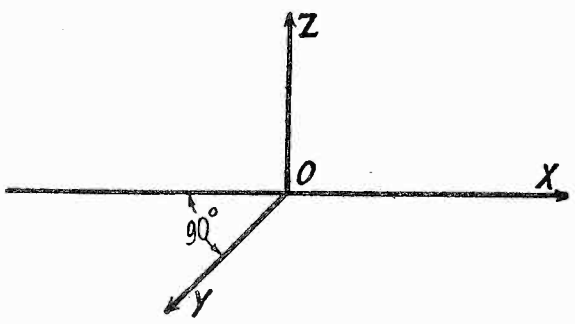


Fig. 1. Theoretical Wave Front.

that make up the wavefront, where the earth is a perfect conductor and the atmosphere a standard value, OX being the line of propagation, OY being the horizontal plane of the magnetic field, and OZ the plane of the electric field. Such a condition can not exist on the surface of the earth because of the finite conductivity of the crust. And for that reason the wave assumes a different form in passing over the crust of the earth. It would be well to state that no readings of the wave values are taken near the antenna because of its inductive field. All considerations are for some distance beyond one wavelength.

In Fig. 2 consider A as the line of propagation of the electric wave AB. It is moving over the earth (In this case a perfect conducting surface). The electric component is vertical and the

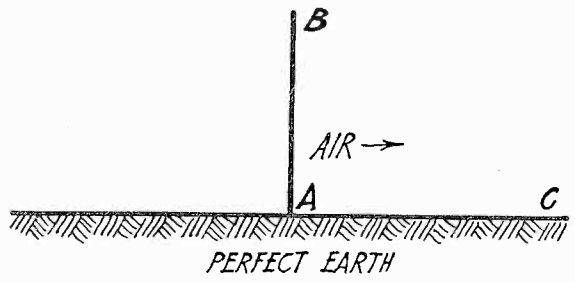


Fig. 2. Propagation Over Perfect Conductor.

magnetic field is horizontal. In Fig. 2a we have the resistance of the surface as is normally the case, and dielectric constant of the earth at a value as is usually found. The wave drags over the surface as well as penetrates to a depth dependent on the conductivity and dielectric constant. The angle of drag is

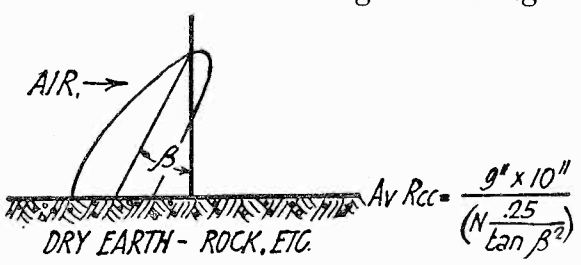


Fig. 2a. Propagation Over Imperfect Conductor.

termed B, and as the conductivity becomes very low the wave may be represented by the rotating radius vector of an ellipse, the major axis which is inclined forward, in the direction of propagation. Using a Hertzian rod, the angle B of the electric wave is measured, from which we calculate approximately the resistivity of the strata and crust of the earth to a depth dependent on the wavelength employed and nature of the substance making up the crust.

The angle B relation to conductivity is expressed to fairly close degree by tan $B = \frac{1}{2}\sqrt{N\sigma}$, where N is the frequency of the wave and σ the conductivity in absolute electrostatic units, equivalent to $R_{cc} = \frac{9 \times 10^{11}}{\sigma}$ ohms per centimeter cube.

The following kinds of matter have approximately the resistance indicated:

Ocean Water	15	ohms per	c. c.
Iron Ore Fe_2O_3	10,000	ohms per	c. c.
Pure Copper	1.5	Micro ohms per	c. c.
Pure Iron	75	" "	"
Pure Lead	20	" "	"
Pure Silver	1.5	" "	"
Limestone	10,000 up & down	per	c. c.
Granite	60,000	" "	"
Shales	10,000	" "	"
Slate	30,000	" "	"
Marble	100,000	" "	"
Quartz ($Si O_2$)	1,000,000	" "	"

Rock and earth have normally a high resistance, down to the depth of a permanent water level. In metasomatized formations, in limestone, where certain types of ore occur, and not very deep,

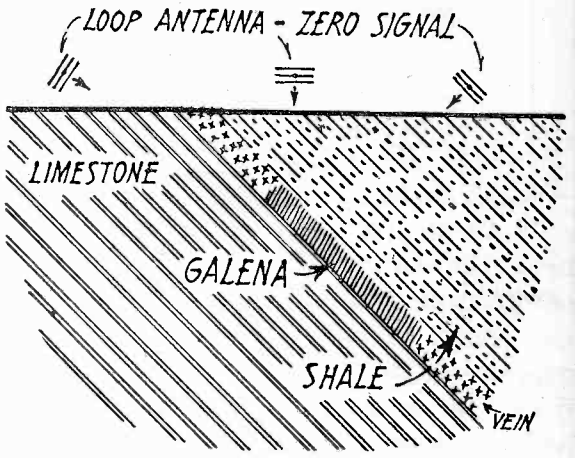


Fig. 3. Effects of Magnetic Field Near Vein.

it is very easy to locate a low resistant area, and invariably such is caused by the presence of metals. A metal body may run as low as 50 ohms or less, per cubic centimeter, where in the solid limestone a calculation of 10,000 to 15,000 ohms is obtained.

The transmitter used in the tests was a simple vacuum tube oscillator with a wavelength range from 1000 to 13,000 meters. It was mounted on a truck so as to be portable.

Two receivers were used, one equipped with two 16 in. loops and one with a Hertzian rod. Each receiver was swung like a plumb bob from an engineer's transit. The loops or the rod were mounted on the telescope axis. The loops gave directions within an accuracy of one degree and the rod gave the deviations from the vertical.

The action of the magnetic component in the vicinity of a heavy mineralized vein is not unlike that around any conductor carrying an electric current. When over the vein, the plane of the coils for zero signal is horizontal (axis

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Receiver With Hertzian Rod.

How to Make a Single-Phase Wattmeter

Detailed Directions for the Construction of a Cheap But Effective Instrument

By Harry R. Lubcke

WITH alternating current the true power in a circuit is not equal to the product of the readings of an ammeter and a voltmeter, due to the "power factor." The product of the current flowing through a circuit and of the voltage across it gives the "apparent power." Consequently an alternating current wattmeter is necessary to give the true power directly.

With a wattmeter, ammeter, and voltmeter in a circuit we can determine the power-factor, phase-angle, inductance, and other circuit characteristics that are valuable in radio and electrical calculations. Such a wattmeter can be made by the average radio fan or experimenter.

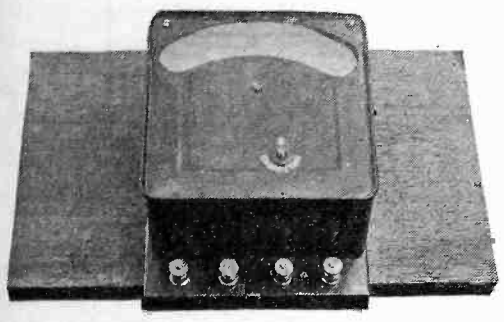

Fig. 1. Completed Wattmeter as Made by Author.

A picture of one constructed by the writer is shown in Fig. 1. Fig. 2 shows the case removed to reveal the inside construction. The actual cost should not be over $2.00, even if all the material must be purchased. In its construction an attempt was made to use parts that could be easily obtained and to use them to best advantage so that a workable (and might we say neat?) meter would result.

The "electrodynamometer" type of movement is used for the indicating mechanism because of its ease of construction and its suitability for power measurement. The wiring diagram is shown in Fig. 3 from which the operation of this movement can be explained. The main features of the instrument are: the current coil *C*, the potential coil *V*, and the potential coil series resistance *R*.

The action is quite simple. The current coil *C* is connected in series with one side of the line so that all the current consumed by the load passes through it, thus producing a magnetic field around and through the coil. The near-by potential coil *V* is connected across the line, in series with the potential coil series resistance *R*. Since the resistance of this circuit is constant, the current flowing through it will be proportional to the line voltage. It also will produce a magnetic field in and around coil *V;* the strength of the field, in both cases, being proportional to the current flowing through the coil. These two magnetic fields interact and tend to move *V* so that they will be "in-line", magnetically. The motion is opposed by the restoring torque of a spring; so that the pointer, being attached to *V*, takes a position where the forces due to the magnetic fields and the spring are in equilibrium.

The final position of the pointer is dependent upon the strengths of the fields and hence upon the current through the circuit and the voltage across it which causes them. Thus, we have virtually an ammeter and a voltmeter which automatically multiply their readings to give power. The indication is true power because the resultant torque at any instant is due to the instantaneous values of both current and voltage, any "lagging" or "leading" of the current (the cause of power-factor) being thus taken into consideration.

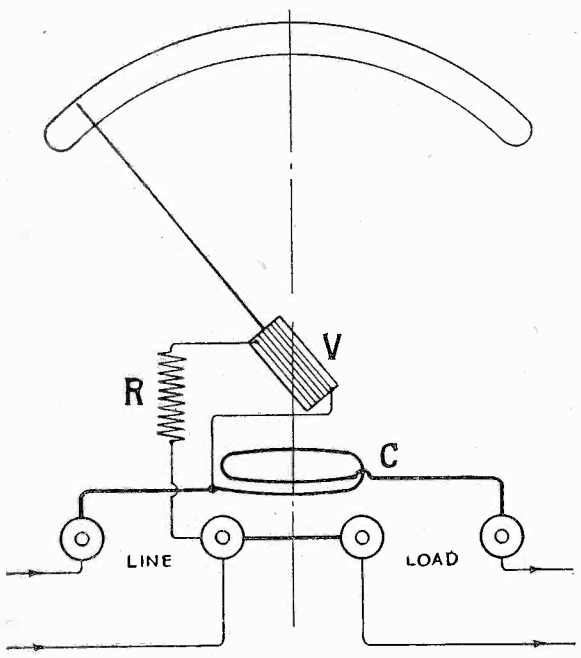

Fig. 3. Circuit Diagram of Wattmeter.

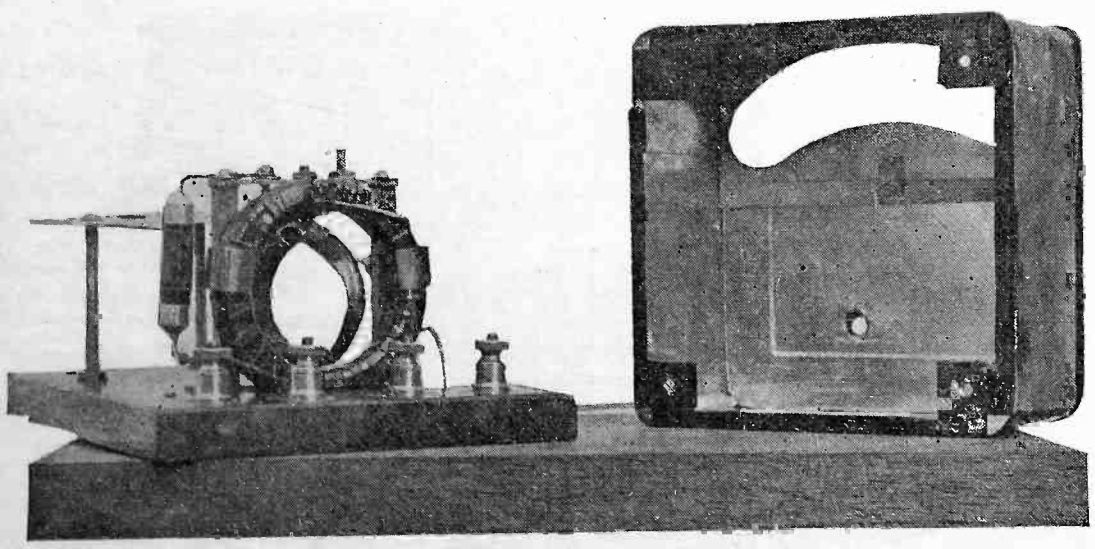

Fig. 2. Interior Construction of Finished Instrument.

In the design of the coils, *C* should consist of relatively few turns of large wire so that its resistance, and consequently the power consumed by the meter, will be as small as possible. The resistance of the potential circuit *V* and *R* should be great so as to reduce the current to about 30 milliamperes. This is accomplished by many turns of small wire in *V* and about 2500 ohms of non-inductive resistance in *R*.

The movable system should be as light as possible so as to be sensitive and enable the use of a weak spring. For the movable coil of a meter with a 0-300 watt range, the writer wound 300 turns of No. 40 insulated wire on a cardboard tube 1½ in. in diameter and ¼ in. long with $\frac{1}{16}$ in. wall. The cardboard was made rigid with two coats of shellac, and collodion was applied after each layer was wound so as to secure the wire. Sufficient length for flexible connections was left on both ends.

Pivots, bearings, and springs were taken from an old voltmeter bought cheaply from a repair man. Parts from an alarm clock balance wheel might also be used, the hardened shaft being broken in the center, since it cannot be cut. The top and bottom pivots are soldered to pieces of No. 36 gauge copper which fit around the coil and are shown in Fig. 4 as "movable coil pivot holders." Regular instrument pivots are generally supplied with mounting plates which can be conveniently soldered to the pivot holders. If springs can be used for top and bottom, so much the better, and the flexible leads can be dispensed with. Two pieces of thin empire cloth are placed around the coil where the pivot holders are to be clamped to protect the wire. After clamping, the pivots are soldered in place at the same time that the pointer is soldered to the top holder. As little solder as possible should be used.

The pointer is made of No. 36 sheet aluminum as shown in Fig. 4. A knife edge is formed at the thin end so that readings can be determined accurately. The pointer must be copper plated so that it can be soldered to the pivot

holders and so that solder can be applied at the short end for balancing. This is accomplished by cleaning the aluminum with a knife or fine emery paper, placing it in a cleaning solution, washing in water, and then in a small plating vat. The cleaning solution consists of fairly concentrated hydrochloric acid. If the aluminum bubbles violently, two minutes in the solution will be sufficient.

with the solution. These include the "balance cross" and the central junction where the cross joins the pointer proper.

The spring should be of phosphor bronze so as to have a small temperature coefficient, thus minimizing any change of torque with temperature.

The current coil is made of approximately 80 turns, 1⅞ in. inside diameter, of No. 18 wire. The type of covering is immaterial. It is wound on a form

pass that secure it to the columns. It is insulated for the double purpose of preventing "eddy currents" in the frame and to provide a contact junction where one of the flexible leads from *V* is connected to *R* as shown in Fig. 2. Angle clamps of spring brass are held by 6-32 screws in the center of the uprights for clamping the stationary coil in place. These are detailed in Fig. 6.

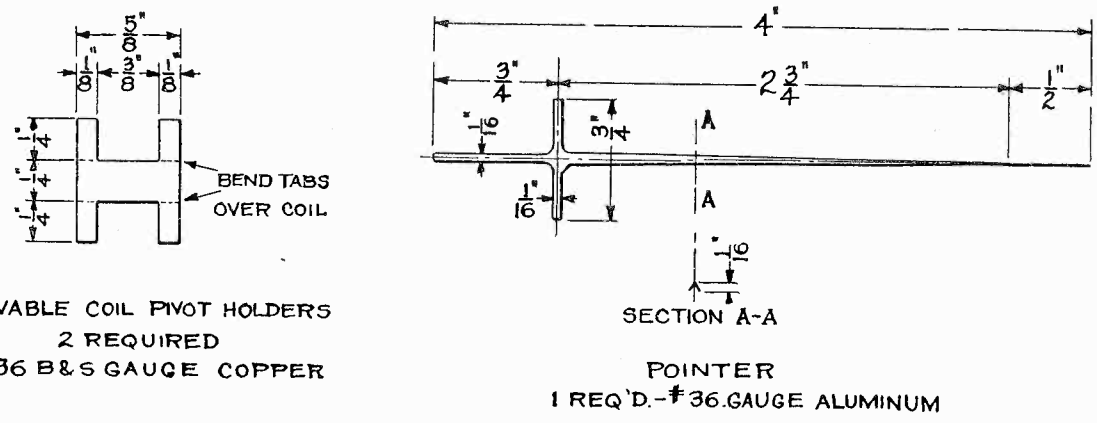

Fig. 4. Details of Pivot Holder and Pointer.

The plating vat can be a jelly-glass, beaker, or similar container. It is fitted with a positive electrode of No. 14 bare copper wire while the article to be plated forms the negative electrode. The solution consists of 20 parts of chemically pure copper sulphate, by weight, 10 parts of pure sulphuric acid, and 150 parts of distilled water.

A voltage of 0.2 volt should be impressed across the vat, which will cause a current of approximately 0.04 ampere to flow. This can conveniently be obtained by placing a resistance of 42 ohms in series with a two-volt storage cell. Usually one-half an hour is sufficient to secure a good deposit, which should be a fine even layer of "flesh-colored" copper. If it is dark, granular, and can be wiped off with the hand, more resistance is needed as the current density is too great. Only those parts of the pointer that are to be plated should be allowed to come in contact

that is turned up in a lathe, if possible, so that the coil will have an even rectangular cross-section. As shown in Fig. 6 the winding space is $\frac{7}{16}$ in. long, allowing the coil to be wound in 8 layers of 10 turns each. If it is desired a tap can be taken off at the 40th turn to give a double scale range of 0-600 watts.

As the resistance, for 110 volt work, in the potential circuit should be not less than 3,000 ohms, of which the impedance of *V* supplies about 500 ohms, the series resistance *R* should be 2,500 ohms. A discarded non-inductive resistance or a Bradleyunit or clarostat will suffice. It must carry a comparatively heavy current.

Fig. 5 shows the frame which supports *C* and holds the bearings for the pivots of *V*. The top piece is insulated from the two columns and the base by fiber washers. One washer is employed above the piece, one below, and one in an oversize hole through which the bolts

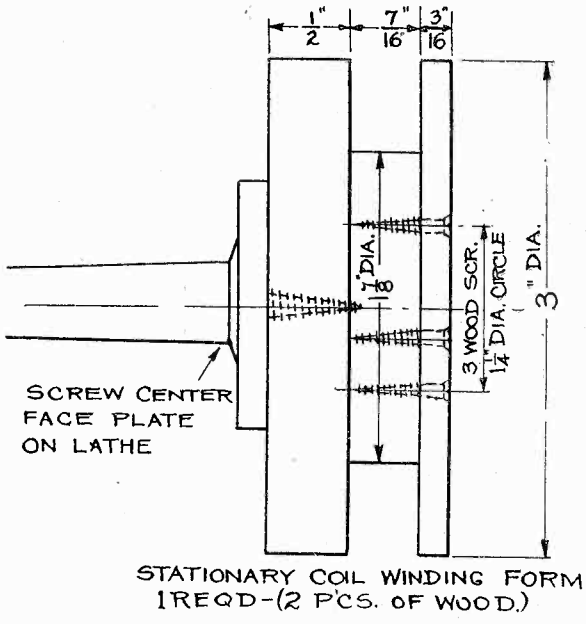

Fig. 6. Angle Clamp Details.

A cone shaped hole is provided in the base and a set screw with a similar hole on the top for the pivot bearings. If jewels are available they should be soldered in position by soldering their holders to the frame and set screw respectively. A zero adjustment screw holds the free end of the spring by means of a notched wire (No. 18, copper), the other end of which is soldered in a hole in its extremity. A nut with tight fitting threads is soldered to the frame for the zero adjustment screw to pass through so that it will turn hard and remain in any position that it is placed.

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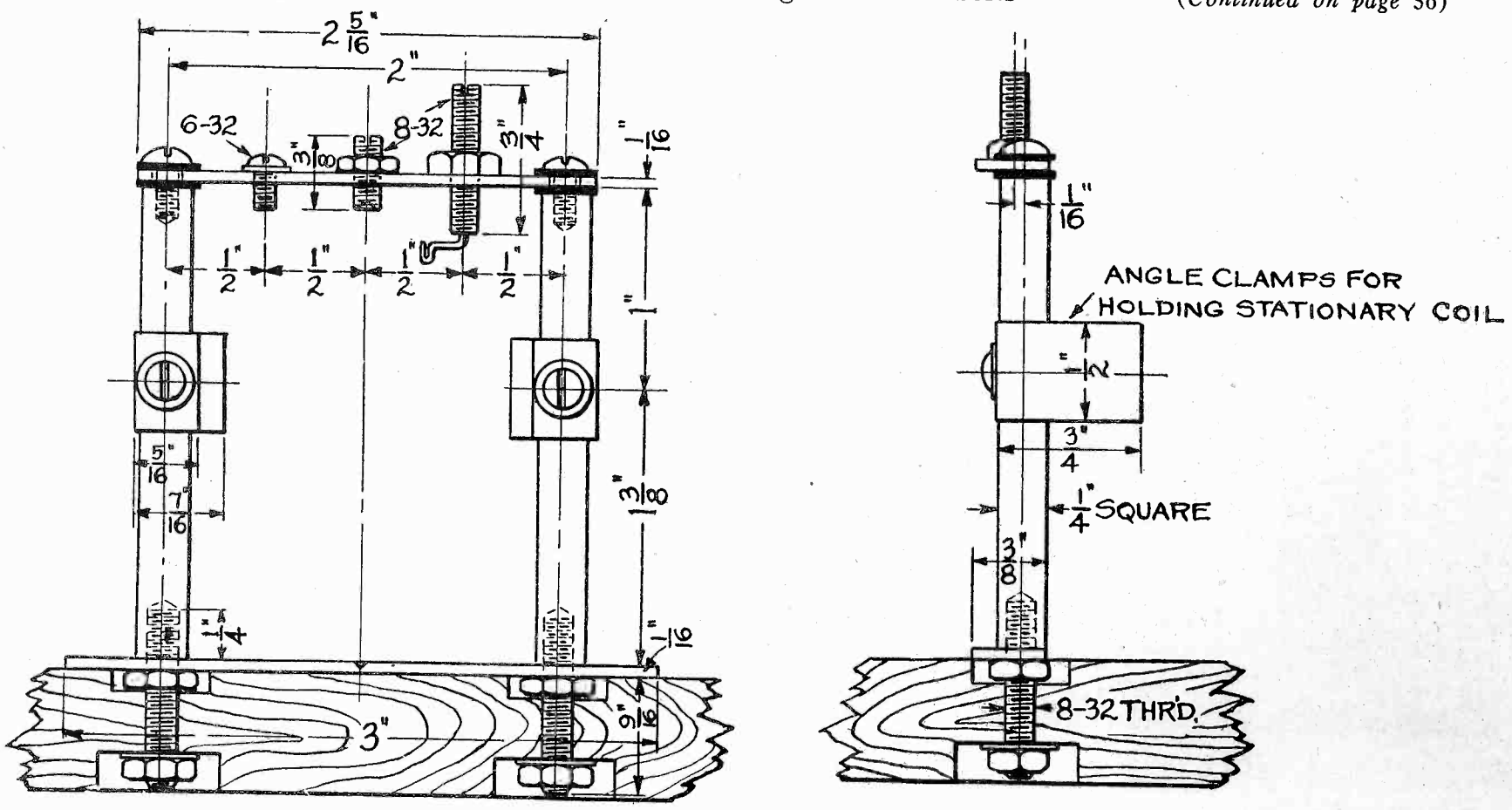


Fig. 5. Supporting Frame.

Principles of R. F. Amplifier Design

And Their Application to the Construction of the Five Tube Aerodyne Receiver

By C. W. Morris

THE main requisites of a tuned radio frequency amplifier are selectivity and freedom from oscillation. One of the most generally accepted methods of stabilizing the circuit or preventing oscillation is by means of a variable resistance in the r. f. plate line. The variations in voltage thus produced allow sufficient adjustment of the voltage applied to the plate to give maximum regeneration at any frequency without oscillation or distortion.

It is easy to get either high selectivity or sensitivity, but difficult to get both at the same time. The several factors of transformer design necessary to attain both of these desired qualities are interlocking, so that the modification of one usually changes the characteristics of another.

One important factor is that the secondary or tuned circuit of the transformer must have a high inductance with reference to its resistance. This may be attained by using as many turns of fairly heavy gauge wire as possible with a condenser tuning to the broadcast spectrum, 200 to 550 meters. Furthermore the winding should be supported so as to place a minimum of solid dielectric within the field of the coil.

Another important factor in r.f. transformer design and operation depends upon the effect of the output load on the secondary. This is, of course, the input or grid-filament circuit of the next tube. Whenever there is a signal voltage of sufficient magnitude to make the grid positive, the tube will draw some current, and therefore power, from the tuned circuit. This is detrimental to the amplification and selectivity of that particular stage and is mainly responsible for the usual broadness of the detector tuning dial in the ordinary five tube receiver. It is obviated in the r. f. stages by putting a negative *C* bias on both the r. f. tubes.

Panel View of Completed Receiver.

The low resistance of the input load, whether the antenna in the first stage or the plate-filament circuit of the previous amplifier tube in the second stage, requires a large primary to give maximum amplification in the r. f. stages. But this broadens the tuning and the amplification is also decreased as the plate resistance is increased to stop oscillation.

The best compromise can be found only by laboratory measurement of the r. f. amplifier set up as shown in Fig. 1. The value of the input is known as obtained from a laboratory oscillator. The value of the output is measured by the vacuum-tube voltmeter. Output divided by input gives the relative amplification. A series of such readings at 300 meters for various primary taps and plate resistances may be plotted in a curve, Fig. 2, to indicate what size of coil gives maximum amplification.

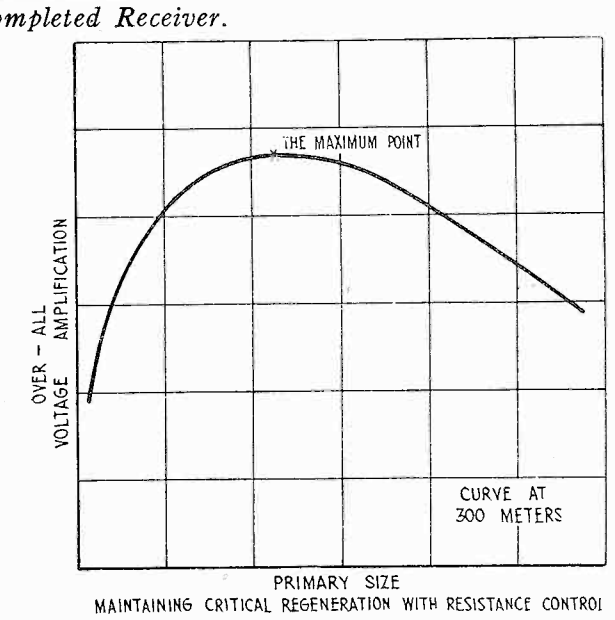


Fig. 2. Curve of Over-all Amplification with Primary Turns at Critical Regeneration.

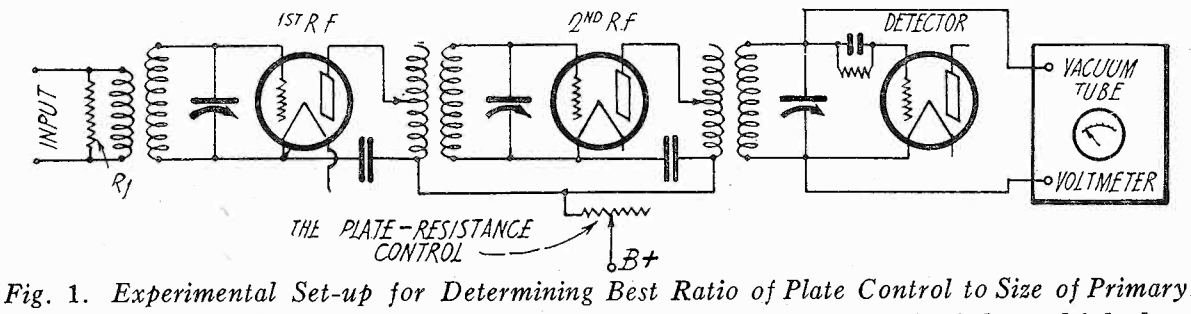
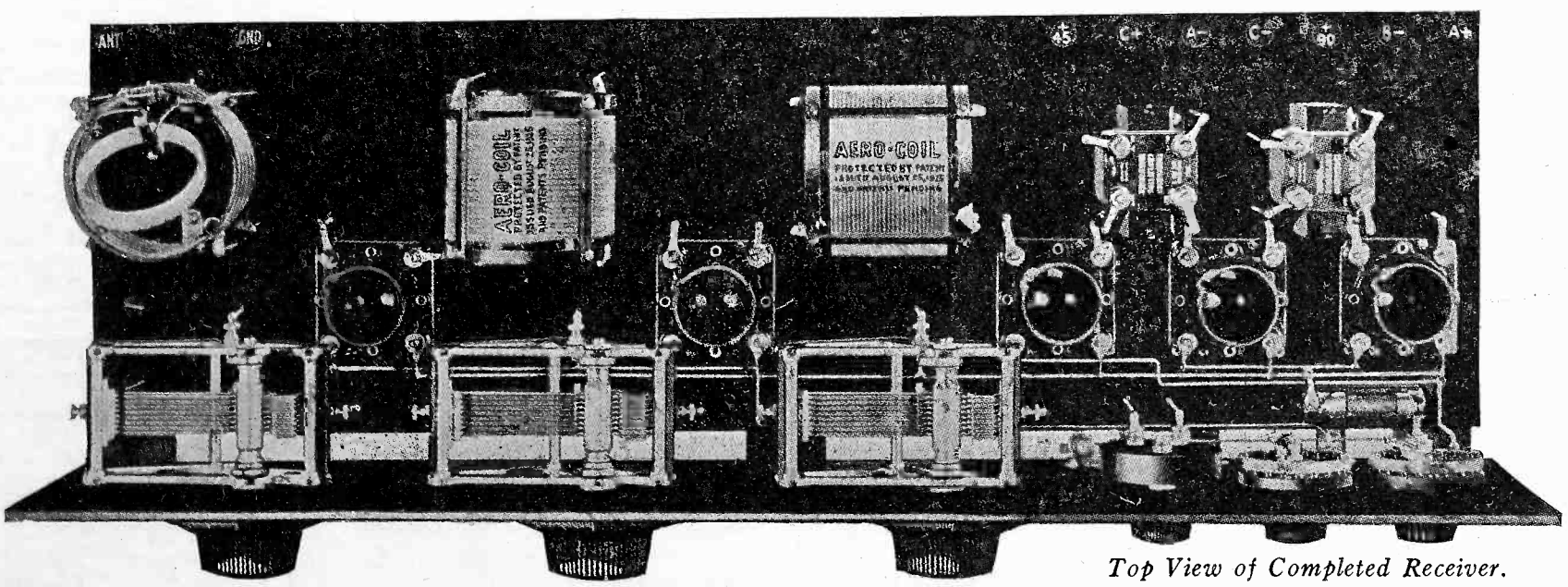


Fig. 1. Experimental Set-up for Determining Best Ratio of Plate Control to Size of Primary.

These are the principles which have governed the design of the three r. f. transformers used in the Aerodyne receiver whose circuit diagram is shown in Fig. 3. The construction of the receiver using the parts listed herewith is illustrated in the acccompanying pictures.



Top View of Completed Receiver.

This is an easy set to assemble. The condensers, rheostats, jacks and switch are first mounted on the drilled panel. The sockets, transformers, and Aerocoils are then mounted on the baseboard, which is joined to the panel by means of the brackets.

Next wire the filament circuit, plus *A* first and minus *A* next, testing it with tubes in the sockets and *A* battery connected before proceeding with the *B* battery, audio, and *C* battery leads. These should be bunched and cabled unless bare bus wire is used. The r. f. leads, *i.e.*, grid leads in the radio and detector circuits and their connection between coil, condenser and tube socket, should be short and well separated from others. This completes the wiring, and the receiver may be connected to batteries, speaker, antenna and ground, as indicated, and is ready for operation.

Operating the Aerodyne is extremely simple, but familiarity with a few of its advantageous features is desirable for the maximum results. The three dials are tuned to approximately the same settings as in any receiver of this type. The variable high resistance is an adjustment which allows volume control on local stations and sensitivity on distance. In order to obtain the maximum volume from a weak station this control should be kept just under the oscillating point for each wavelength, thereby taking the utmost advantage from the regenerative action within the r.f. stages. The control is not critical except in extreme cases and can quickly be understood.

The detector and r.f. filaments are not critical and may usually be kept from three-quarters to full on, depending upon the condition of the battery. The variable antenna coil is a distinct advantage under conditions of extreme local interferences as it allows a very weak coupling when desired, which by retuning and careful adjustment of the plate resistor, brings back the distant station without interference from the local. This also compensates for the size of the antenna, a large antenna necessitating loose coupling, and a small, the reverse. Longer wave stations will

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Loop Aerials

By Charles F. Felstead

THERE are two types of loop aerials in common use today: the spiral and solenoid types. Fig. 1 shows the actual appearance of a spiral,

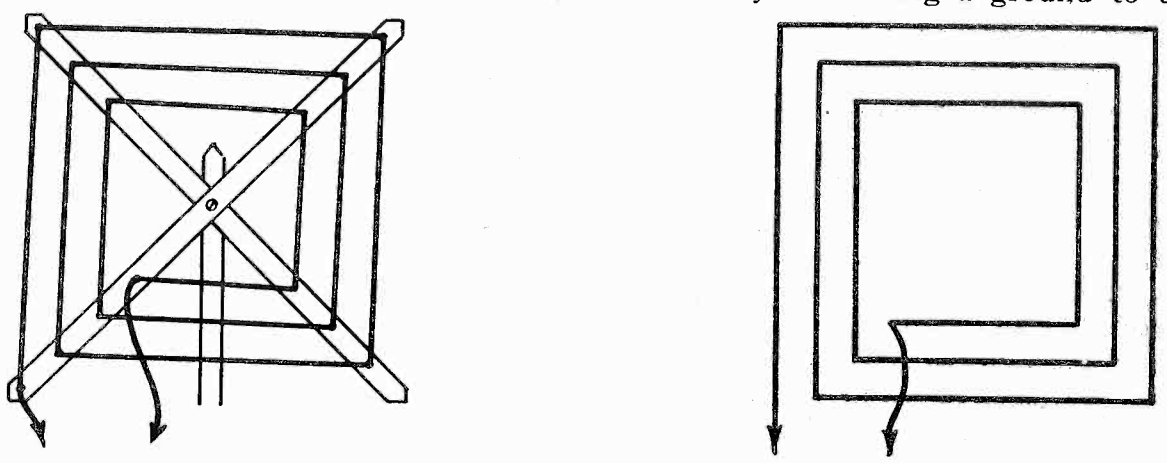

Fig. 1. *Spiral Loop.*

or "pancake" loop and its representation in circuit drawings. Fig. 2 illustrates how a solenoid loop actually looks and also shows how it is drawn in diagrams. The pancake, or spiral, loop gives slightly less signal strength than the solenoid loop; but it is much more directional because it presents a narrower edge to the incoming radio waves. For

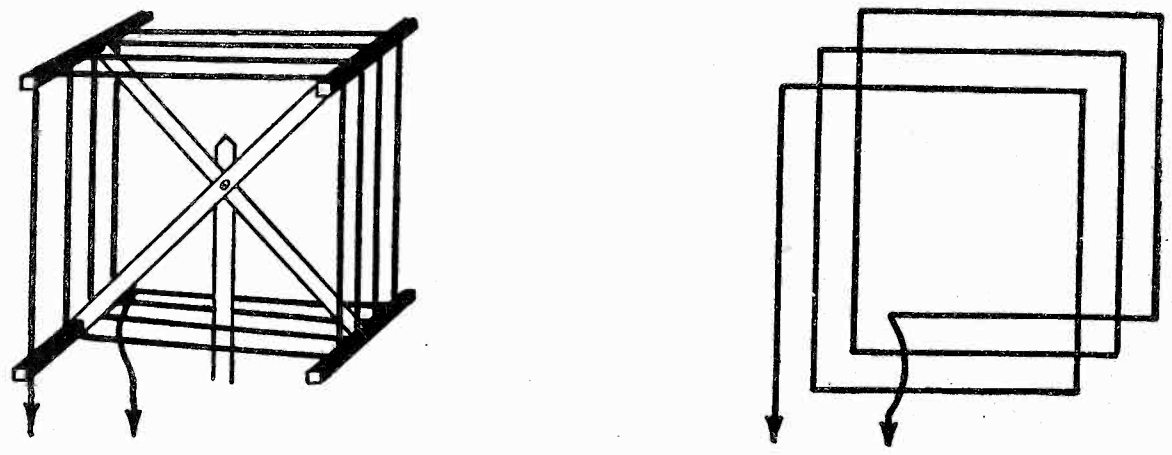

Fig. 2. *Solenoid Loop.*

direction finding work, the spiral loop is best; but for general all-around reception, the solenoid loop is somewhat better because of its less directional qualities. The pancake loop, as will be seen in the diagram, is a flat loop; while the solenoid loop is square shaped, as though it had been wound around a box.

With a receiving set using a loop aerial of either type, the audibility of signals can sometimes be more than doubled by connecting a ground to the terminal of the loop that attaches to the filament of the detector tube. Be careful that no other part of the set is grounded when this stunt is tried, or some tubes may be burned out. Tuning will be slightly broader with this arrangement; but the range of the set will be increased, and set noise and hand-capacity effects somewhat reduced.

A *C* battery should be used in every radio or audio-frequency amplifier where the *B* battery voltage exceeds 60 volts. The *C* battery not only helps to clarify the received signal; but it also makes the set much more economical in *B* battery consumption. When a *C* battery is used

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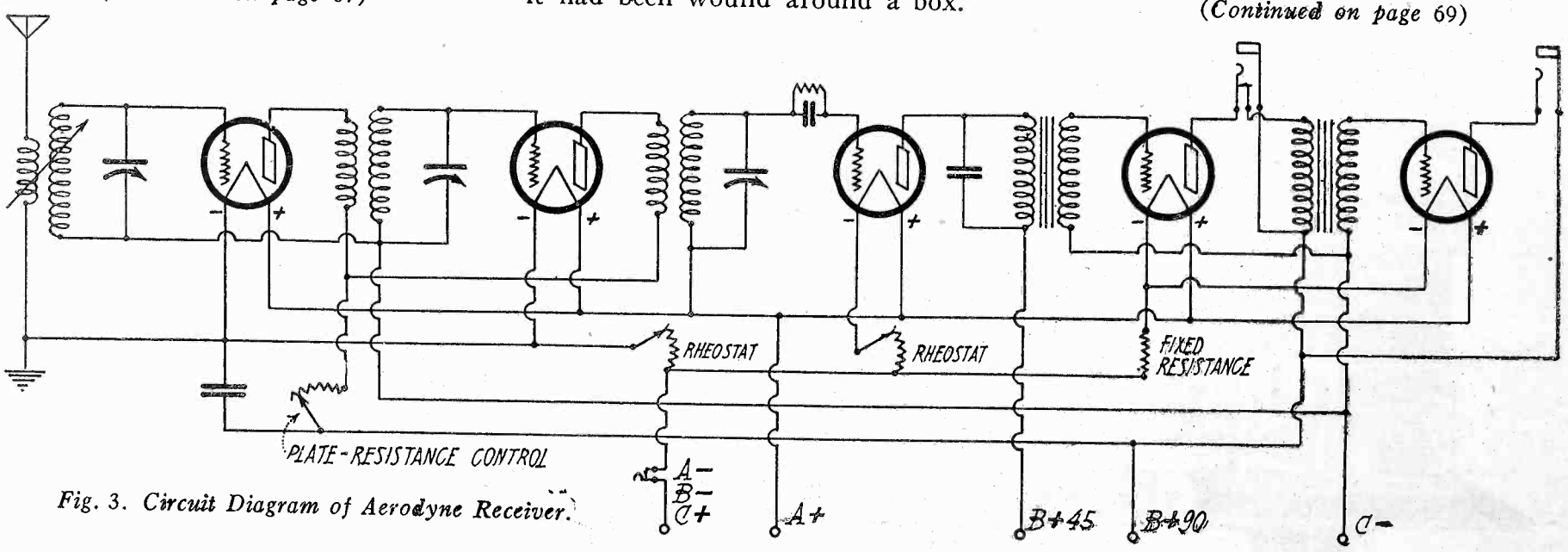


Fig. 3. *Circuit Diagram of Aerodyne Receiver.*

The Well Equipped Radio Work Shop

Practical Suggestions on the Choice of A Lathe, Drill Press, Saw Table Jointer, Saws, Drills and Abrasives

By Samuel G. McMeen

THE heart and center of such a shop as is indicated by the title is a good precision lathe. But this does not necessarily mean that it must cost a large sum of money even though fully correct in its bearings and capable of making the finest tools.

To fulfill all the needs of a well equipped shop, it should be fitted with collets,—also known as wire chucks and as split chucks. These are cylindrical devices with enlarged, tapered heads, and are engaged by a drawing spindle passing through the head of the lathe. When the screw of the drawing spindle engages the end of the collet, the latter is in position to be drawn back into the conically formed female portion of the head, with the result that the "splits" of the collet are closed up slightly, engaging the piece that is held in the collet.

In other words, the hole in the collet is automatically made slightly smaller than its normal size, and so grips the work. The gripping is from all sides, as against gripping in three or four places, as is the case if a scroll chuck be used. In the latter case it is only a miracle if the work can be taken out of the chuck and rechucked again in the same position of centrality as before. In the case of the collet there is no doubt about the matter. The work *must* center as well the second time as it did the first.

For this reason of accuracy there is no question of choice between collets and all other methods, no matter what the excellence of the other types of chucks. It is a case of "collets first, all other chucks nowhere." So, even at the cost of a lump in your throat, try to accomplish the collets, even though some other part of the shop has to be neglected.

Collets mean head-spindles, and head-spindles mean hollow spindles. The existence of a hollow spindle in a precision lathe means the ability to feed the stock through the head, the ability to work on the end of a long piece, and many other useful things.

The tailstock of the lathe should be equipped with a chuck for holding drills, end mills and other special tools. At the risk of indulging in questionable practice in specifying particular makes of devices, let us say that the Jacobs chuck is admirable for tailstock uses, and has wide acceptance. It is of the type that is set with a rotating key engaging teeth on the chuck, and while less accurate than a collet it is nevertheless admirable.

The lathe should further be equipped with a slide rest of the compound type. That is, it should have two screw motions, one to move the tool it bears endwise with relation to the bed of the lathe, and the other crosswise. It should also have the ability to turn the endwise feed to an angle with the bed of the lathe, and thus enable the tool to be fed at that angle and to turn a taper on the work in the chuck. Usually this degree of offset from the "straight and narrow path" of parallelism with the bed of the lathe is readable in degrees, which can be interpreted into inches-taper per foot-of-length when desired.

Two other graduations are desirable. One is the division on the spindle of the lengthwise motion of the slide rest, whereby the revolutions of that motion can be interpreted in terms of fractions of an inch. Often such graduations are 25 per revolution, with a screw of 20 threads to the inch. This gives .002 in. per division of the graduation. The graduations are readable to half a division, or .001 in. A similar division of the cross-slide enables equally fine knowledge of operations to be had of such motions. It is not to be inferred that all operations on the lathe require accuracy to the thousandth of an inch, or that the rule of thumb or free hand method will not very generally suffice. But there is a real thrill in having the most exact methods at hand, and in full protection against ultimate requirements.

The next most important item of the shop equipment is a drill press. One that stands on a bench is as satisfactory as one that stands on the floor, and costs less. As to clearance, the front and the sides are all that need consideration, in marked contrast with the saw-table and the jointer (planer) to be mentioned later. This device, like the tailstock of the lathe, may well be equipped with a Jacobs chuck. As the wrench for this chuck is used so often and is needed so promptly when it is needed, it is a convenient wrinkle to bore a hole in the edge of the bench adjacent to the press, into which hole one handle of the wrench is inserted as its resting place, and further to mark with red paint on the surface of the bench the location of that hole. Trivial? It is of such trivialities that the substance of shop practice is made.

The third element of necessary equipment of the shop is a saw table for sawing both wood and metal, as well as rubber, bakelite and the like. What shall be sawed depends on the saw and not on the table. But the table is important, and should be selected carefully. For one thing, its top should be tiltable fore and aft, so as to permit the sawing of slots less in depth than the thickness of the material being sawed. For another, there should be side guides and separate cross guides for ripping and for cross cutting. In a choice between types, the better is the arrangement having a motor set some distance from the mandrel shaft, because a long belt is better than a short one. It gives better gripping power on the driven shaft. This motor setting can be arranged very satisfactorily in connection with the mounting next to be described.

The prime problem of a saw table is to enable it to cross-cut and rip equally satisfactorily in a small shop. Unless the room is large, to both cross-cut and rip will be difficult unless the saw table is mounted on wheels. Piano casters are good. It can then be shifted about so as to solve all problems of ripping and cross-cutting.

The same problems of ripping and cross-cutting long timber appear in the case of wood-working jointer or planer. The two terms mean the same thing, though the latter name applies also to a metal working tool, which a jointer is not. The best type for the small shop is a jointer taking work up to about 4 in. wide, as most of the work is edging. Its speed should be not less than 3000 r.p.m.

The needs of the saw-table and the jointer being similar as to the direction of feed of the worked material, it is good practice to mount the jointer on the side of the structure that supports the saw. The proper height of the saw table top is 40 in. from the floor, and that of the jointer 34 in. The saw and the jointer, mounted as a unit on a common base with wheels under it, can be turned so as to saw (rip) or plane through an open doorway if necessary.

There are two things a circular saw can not do. One is to saw on a curve and the other is to make a square-ended cut. Where either of these things is needed, one needs a band saw or a jig saw. The band saw is the better tool, because it cuts all the time. The jig saw is the cheaper tool. Usually jig saws of workmanlike size are driven by foot power, an unsatisfactory method where

(*Continued on page* 58)

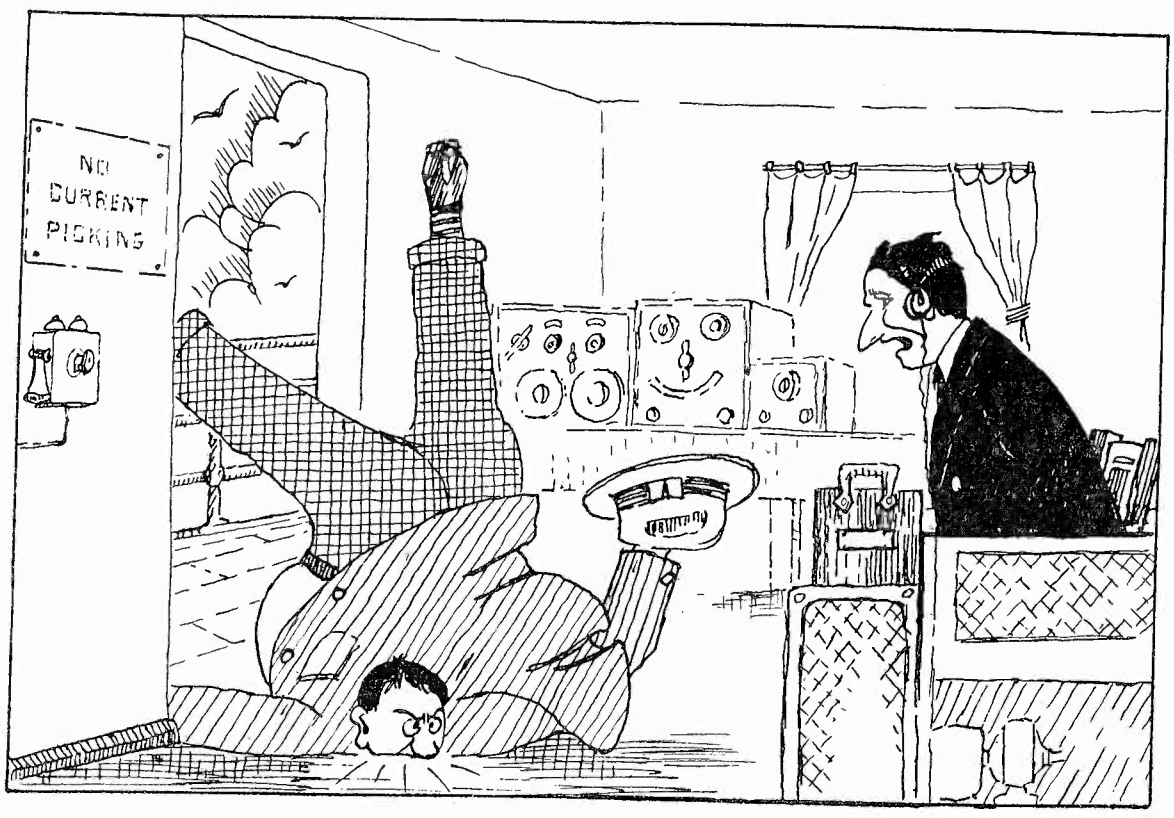
"Letters From Larry"

By Jack Bront

Nr. 257 Check $9.98, Radio SS. Lake Discomfort Filed Date. George Hassenpeffer, 218 River Street, Hoboken.

Dear old horse (stop) Well OM it sure was foggy this trip coming down (stop) It was so thick that Honk said he couldnt find the way to the room (stop) He meets the mate OM and says mister will you please lead me to the room (stop) Lead you to your room says the mate why man alive Im walking around here trying to find the ship (stop)

Last Wednesday OM a passenger slipped on the wet deck and landed after a few gyrations in the radio shack (stop) Hey I says we dont allow deck sports in the radio cabin (stop) Why he saws it was pure accident—I fell on my word of honor (stop) Well I says if you fell on what you said your word of honor is sure busted now (stop) Ha ha he says well well (stop) Oh I says youre all well now (stop) He sure was a generous guy OM because he shook hands with all of us (stop) I told him after his gyrations on deck he ought to get a job with the ss co as a gyro-compass OM (stop)



"We don't allow deck sports in the radio cabin"

Well OM the third was sick and didnt stand watch all trip (stop) My swell stewardess friend quote Blonde Preferred unquote made Scotch broth for him and I was green with envy OM (stop) She sat up all night with him in the ship's horsepistol (stop) Preferred I says when you make that Scotch broth again be sure and dont break the string you suspend the pea with in the hot water—we sure dont want the pea to fall right in and ruin the thirds stomach with those rich vitamines (stop) Oh she says stick to your wavelength yours causing chaos in the air she says OM (stop)

Well last evening OM Preferred come up and she says my crystal set works KO but theres a station I cant tune out OM (stop) Well I says Preferred personally I never did have any luck getting music out of a violet ray machine OM (stop) And I says if you shut it down you wont hear that funny station (stop) Anyway I says Preferred that ray outfit aint of any use to you anyway I says because your already a very beautiful young woman (stop) Oh I can be subtle-like OM when I want to (stop) Oh cut down your feedback and stop the squawk she says (stop)

Say OM I seen Gink Morse last trip (stop) He was in the 8ieme at the station near Bordeaux during the war (stop) Well they sent a frog down and he was to get a test (stop) He got 20 to copy but he only shook his head (stop) We cut down to 10 and finally to 5 per (stop) Well he began to write then and Gink says in Anglaise he says this dude sure aint no speeding juggernaut with the code (stop) Just then the frog hands me the paper (stop) It said I am deaf (stop) No wonder OM he just come down from the artillery beyond Sedan (stop)

And say OM you ought to have seen the set the signal corps had—a variometer tuned set made out of telephone wire wrapped around two tomato cases (stop) Two men had to tune the set (stop) The cases had tomatoes in them OM (stop)

Say OM I see the Milwaukee R R has installed short wave sets for dispatching (stop) Honk massaged brass on the old defunct Buffalo & Southwestern when he tried out his first spark coil on a train order for a station six miles away (stop) The op got it all wrong OM and nearly wrecked the system because they had all their trains running that week—both of them (stop) Well OM when the op came over to interview Honk he told friends that he always knew his track training at college would come in handy sometime OM (stop)

Say OM Honk has a one-third meter oscillator now (stop) It sure will be swell when he gets it working (stop) He took the vacuum tube out of our thermos bottle OM and he says for it to oscillate at its natural period of ⅓ meter you dont need any connections at all (stop) He says wires attached to it causes harmonicas fierce (stop) Honk says it will sure be great after it starts working (stop) Of course he says getting it started working is the hardest part OM (stop) Well I says Honk its a good thing our swell stewardess Blonde Preferred studied nursing with her stewardess duties—she sure has some material to work on I says (stop) Ho says Honk its funny how some peoples minds wander he says and he says and often otherwise they are sound (stop) Gee Honk I says what a comfort we can be to each other (stop)

Well OM we are just docking and the RI wont be down this PX so Honk and I and Preferred are going up to a swell cafeteria to eat (stop) I sure hope its crowded OM because I sure hate to have to buy another overcoat this season (stop) More next trip OM (stop)
73 (sig) Larry

Nr. 273 Check $7.32, Radio, SS. Lake Discomfort, 9.98 Pm, Date. George Hassenpeffer, 218 River Street, Hoboken.

Dear OM (stop) Well OM the QRN static was so bad coming down this trip that we couldnt even hear the navy boys rehearsing the code (stop)

Irish Rabinowitz came aboard among the passengers and he come up to the shack and he says who won the ball game (stop) Well OM I says we dont copy the news from the loan offices (stop)

Well OM Gunk Fenney come aboard down south and he says he worked 7000 miles on 70.6 metres (stop) Honk takes his feet off the wave switch long enough to set up and he says how far was it (stop) Well Gunk says it was 4000 miles anyway (stop) Huh says Honk thats the number of your Ford you old spellbinder (stop) Well Gunk says how far was it then Honk (stop) Well OM Honk

(Continued on page 62)

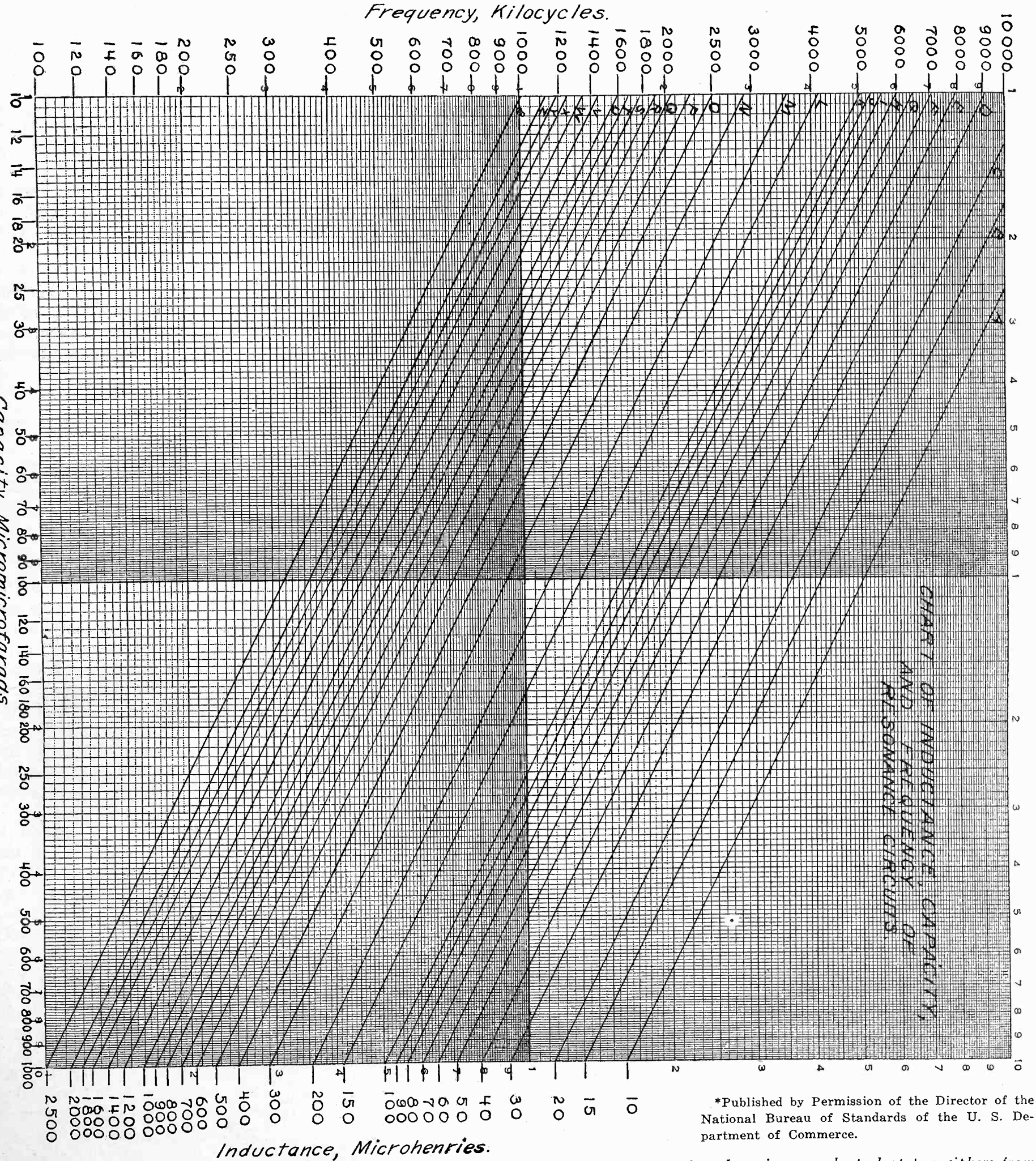
*Chart for Radio Circuit Calculations

By E. L. Hall

MOST radio experimenters and enthusiasts are familiar with the formula which expresses the relation between the inductance and capacity of a radio circuit and the resulting frequency. This formula may be stated as $f = 5033 \div \sqrt{LC}$, where f=frequency in kilocycles per second, L=inductance in microhenries, and C=capacity in micro-microfarads.

To many persons, the above formula is a more or less vague expression or else involves too much calculation to be applied to the various circuits in the workshop. Consequently, apparatus is built or experiments are made with coils and condensers of sizes specified in some periodical. There is of course no objection to this procedure but it is more interesting to figure out some of the sizes of the different parts for one's self. The accompanying chart makes it possible to estimate any one of the three quantities in the above equation if two of these quantities are given.

The chart is useful also to radio engineers as a check upon inductance, capacity, or frequency calculations in



Rule for use of chart: For numerical values greater than those given on the chart, always add two ciphers to inductance or capacity number on chart and drop one cipher from frequency number on chart; for numerical values less than given on chart, drop two ciphers from inductance or capacity number and add one cipher to frequency number.

*Published by Permission of the Director of the National Bureau of Standards of the U. S. Department of Commerce.

tuned circuits. It enables one to rapidly check up on laboratory data to see that radio measurements have been made or are going to be made at the fundamental frequency of the circuit. This chart, in conjunction with that given on page 22 of the October, 1926, RADIO, enables one to make a complete set of calculations upon a coil and determine to what frequencies it will tune when used with a given condenser.

It will be noticed that the chart is prepared on logarithmic paper. Frequency in kilocycles is plotted on the left as the ordinate while capacity in micro-microfarads is plotted along the bottom of the chart as the abscissa. Across the sheet a number of slanting lines are drawn which are lettered and given inductance values in microhenries at the right-hand side of the chart. It will be noticed from the numerical values given that frequencies from 100 to 10,000 kilocycles (3000 to 30 meters) can be read directly or estimated. Capacities from 10 to 1,000 micromicrofarads and inductances from 10 to 2,500 microhenries can also be read directly or estimated. Those who prefer working in terms of meters instead of in kilocycles can obtain a kilocycle-meter conversion table for 5 cents by writing to the Superintendent of Documents, Government Printing Office, Washington, D. C. The table is listed as Miscellaneous Publication of the Bureau of Standards, No. 67.

When interpolating between the inductance values represented by the slanting lines, remember that these values progress logarithmically. Therefore, a point falling somewhere between two slanting lines will represent a value slightly less than that given by a linear interpolation.

A rule extending the use of the chart is as follows: For numerical values greater than given on the chart always add two ciphers to inductance or capacity number on chart and drop one cipher from frequency number on chart; for numerical values less than given on the chart, drop two ciphers from inductance or capacity number and add one cipher to frequency number.

The chart considers lumped capacity and inductance. In other words the inductance of the connecting wires between the coil and condenser is neglected as is also the capacity of the coil. Such errors become smaller as the inductance and capacity values become larger.

Some examples of the use of the chart will now be given. (1) What must be the inductance of a coil to tune to 550 kilocycles with a 0.0005 microfarad condenser? Answer: 0.0005 microfarad$=$ $0.0005 \times 1{,}000{,}000 = 500$ micromicrofarads. Find the vertical line for 500 mmfd., run up this line till the line for 550 kc is found. These two lines cross one another between the inductance lines L and M. The inductance value then is estimated as 170 microhenries.

(2) What is the highest frequency to which the above coil will tune when the minimum capacity of the condenser is 22 micromicrofarads?

Answer: Lay a straight edge or ruler between lines L and M and parallel to them through the 170-point found. Find where the ruler cuts the vertical line for 22 micromicrofarads. Read the corresponding frequency as 2630 kilocycles. This is a case where the inductance of the connecting leads and capacity of the coil will act to reduce the frequency considerably. Hence, it is best to make calculations of the size of coil required, with the maximum capacity of the condenser rather than the minimum capacity.

(3) What must be the maximum capacity of a variable condenser to tune to 550 kilocycles with a coil of 240 microhenries?

Answer: Estimate the location of the slanting line for 240 microhenries lying between lines M and N. Find where this estimated line intersects the 550 kc ordinate. Referring to the capacity scale at the bottom of the chart, the capacity is found to be 350 micromicrofarads.

(4) The lowest frequency at which an oscillator will operate is 80 kc when a condenser of 40,000 micromicrofarads is connected across the oscillator coil. Find the inductance of the coil.

Answer: Remembering the rule, add two ciphers to the 400 micromicrofarads given on the chart making 40,000. According to the rule, we must drop one cipher from the frequency value on the chart. Dropping a cipher from 800 on the chart gives the desired frequency of 80 kc. The inductance we find will therefore be read directly. Running up the 40,000 microhenry line and coming across on the 80 kc line we find the intersection near line K, or at approximately 99 microhenries, which is the inductance of the oscillator coil.

The chart will allow calculations to be made without actually figuring out the values mathematically, and will give results correct within a few per cent. It is particularly convenient for rapid checking of data and constants of tuned circuits.

AUSTRALIAN BROADCAST NOTES

1YA (Auckland, New Zealand) has been brought up-to-date by the installation of a standard W. E. 500 watt transmitter, which is operated nightly on a wavelength of 420 meters. Several other stations are to be equipped with similar apparatus in the near future, being located at Wellington, Christchurch and Dunedin, New Zealand.

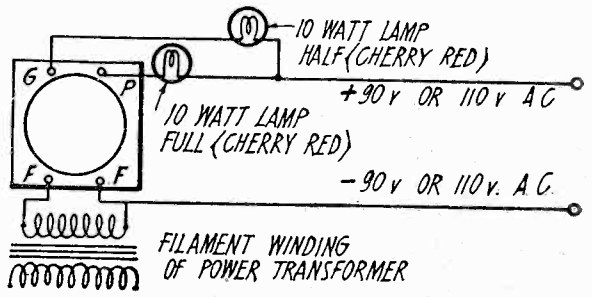
TROUBLE SHOOTING CURRENT SUPPLY SETS

By MAX P. GILLILAND

OF the several troubles that may develop in any type of rectifier and filter which supplies direct current from the a. c. socket, the most obvious is the failure of a rectifier tube to light. The most likely cause is in the a. c. supply, a loose connection in the outlet plug, a faulty snap switch, or a broken cord. These faults may be located by a 110 volt test lamp placed across the supply terminals.

If there is no sound when the tube is lit, check the eliminator output with a voltmeter, if necessary tracing out a break in the battery cable. This may be readily determined by making a continuity test of all the wires with a battery in series with a voltmeter. Should this part of the equipment test o. k., the next place to look is in the rectifying tube. If, for any reason, it should prove to have a low filament emission, you may know that this is one of the sources of your trouble.

A simple test for these tubes is to place them in an ordinary socket connected to the filament winding of the transformer of the current supply set, as shown in the accompanying diagram.



Circuit for Testing Rectifier Tube.

To the plate of the tube apply plus 90 volts. Tie the minus of the high tension into one side of the filament circuit. In series with the plate lead of this arrangement place an ordinary incandescent lamp in a porcelain receptacle. When all connections are made, the lamp filament will glow a cherry red color, provided that the tube under test is all right. A low emission tube will either just barely light the lamp or else not at all.

This same test may be applied to power amplifier tubes as well. In this case another positive lead is run to the grid of the tube with another 10 watt lamp in series. The grid circuit will usually glow at about half the brilliancy of the plate circuit. Should the lamps light to almost normal brilliance, it is a sign of a gassy or soft tube. 110 volts a. c. may be used in absence of 90 volts d. c. though the direct current is preferable. A broken grid support in a tube causing an internal short (this applies to the power amplifier) will allow no signal to pass. Another source of

(*Continued on page* 64)

Radio KNT, Zane Grey's "Fisherman"

A Description of the Transmitting and Receiving Equipment Used on this South Seas Cruiser

By Wilford Deming, Jr.

NOT least important in the equipment of Zane Grey's *Fisherman,* in which he is making a semi-scientific trip to the South Seas, is radio apparatus. This includes a commercial wave transmitter and receiver, a long wave receiver and a short wave transmitter and receiver.

The ship is a three masted schooner, each mast reaching over 125 ft. above the water. On the tops of these three masts, insulated with long Pyrex insulators, is a two wire flat-top antenna, using 7 strands No. 18 bronze. On the foremast, near the top, is a 30 ft. beam, extending out over the sides of the ship, and to the port end of this is led the lead from the big flat-top antenna, and down to a bulk head insulator, and then under the decks to the commercial wave transmitter. All receivers are coupled to this antenna.

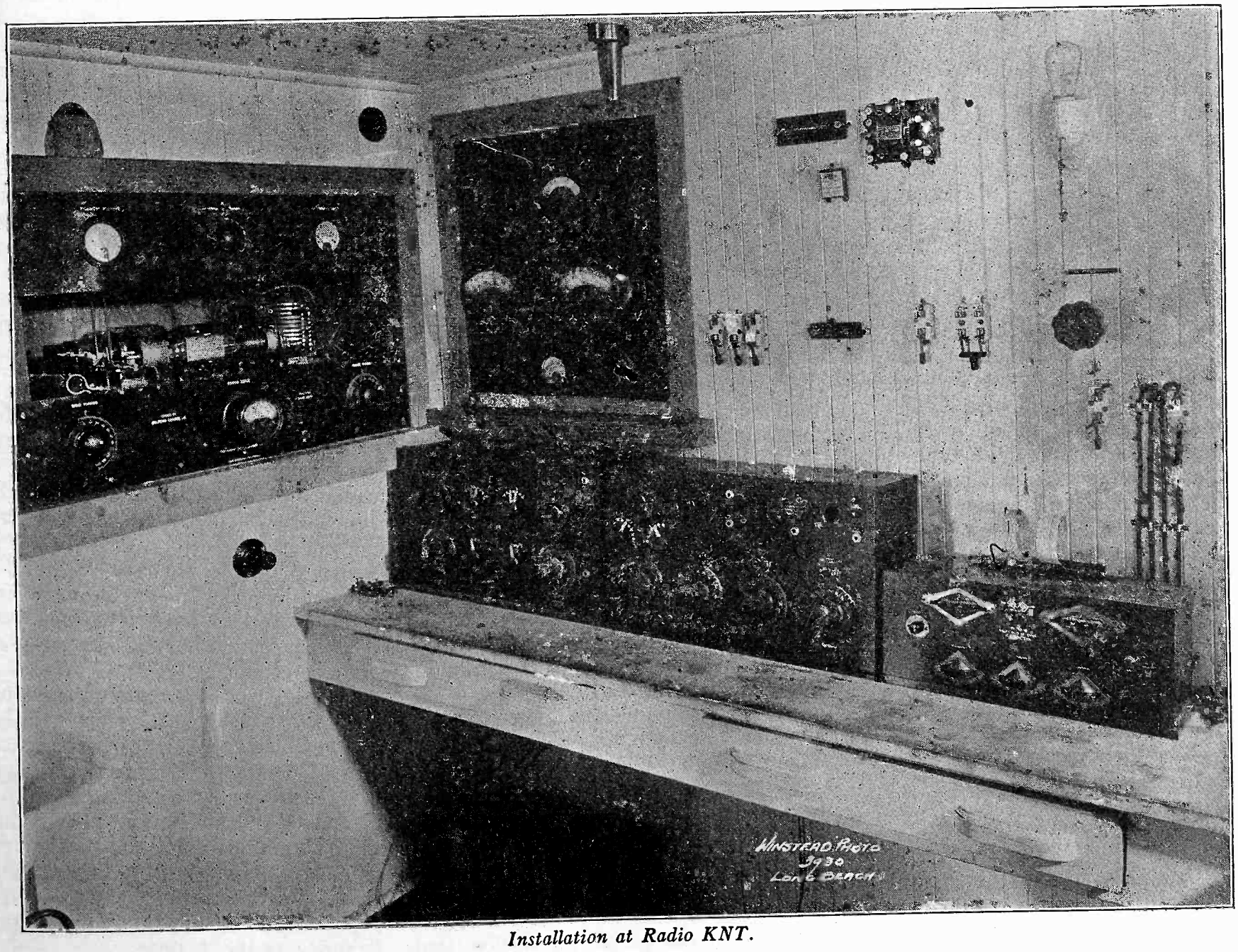
From the port, or right end of this top-mast spar, there drops the vertical short wave antenna, using No. 12 enameled wire, and topped with a 5 in. copper ball and two 12 in. Pyrex Insulators, in series. This antenna drops directly to a Pyrex bowl lead-in insulator and directly to the high-frequency transmitter. The ground strip is composed of heavy copper ribbon, 3 in. in width, and extending to the water's edge where it is brazed to the copper bottom of the ship.

The 30-42 meter transmitter may be seen flush with the wall at the left of the picture. Each panel is 7x35 in. with the same spacing between them. On the upper panel, left to right, is the filament voltmeter, the variable antenna tuning condenser and the antenna ammeter. The lower panel, from left to right, holds the grid tuning condenser, the wattmeter and the plate tuning condenser. National .0001 mfd. high voltage variable condensers were used in grid, plate and antenna circuits.

The tuned plate-tuned grid circuit is used. On the left, mounted vertically, and variable upon two glass rods, are the antenna and plate coils, the antenna on top, and the bottom end of the plate coil at ground potential. At the right, mounted horizontally can be seen the grid coil. The grid chokes, 100 turns to each grid, are wound in opposite direction on a 1¼ in. glass tube placed just above the grid coil. Two 10,000 ohm grid leaks are mounted just below the tube end mounts.

At opposite ends, just under the plate mounts, is a similar glass tube mounted choke for the oscillator plate circuits. The grid and plate blocking condensers are .000025 mfd. Faradon's. Just under the tubes can be seen the Acme 150 watt filament heating transformer.

Primary supply to this transformer is from a 100 watt rotary converter, running on the ship's power of 110 d. c. and giving 75 volts, 60 cycle a. c. Push-pull oscillator current supply, using two UV 204A tubes, with a normal input of 1 kw. is used with great satisfaction, the resulting tone from a 500 cycle source being easily readable at great distances.



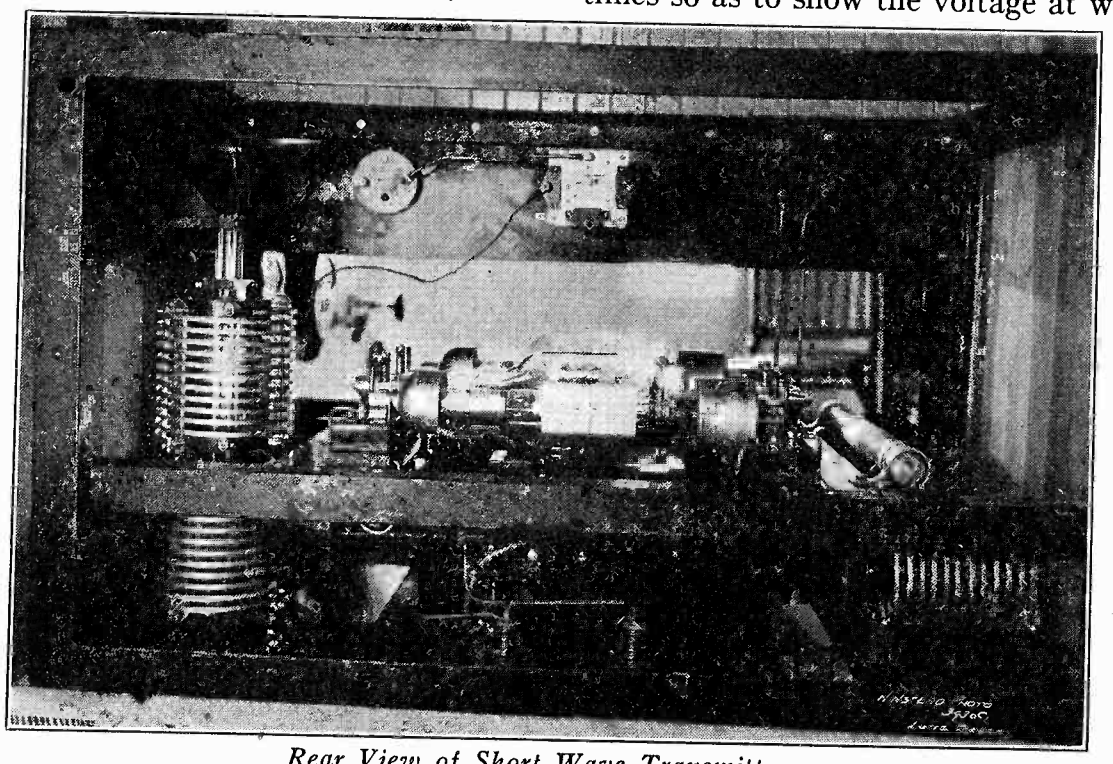
Installation at Radio KNT.

The commercial wave transmitter is controlled from the large panel above the receiver. It is a ½ kw. tube transmitter converted from a Marconi quenched spark. It is tuned to 600, 706 and 800 meters. Full wave rectification from a 500 cycle source is also used in this transmitter.

At the right of the picture is a Leach relay which keys both transmitters and gives break-in reception on all receivers while transmitting. Below are the generator field rheostat and the switches for charging the antenna from receiver to receiver and the power from one transmitter to the other.

On the left of the operating table is a Grebe CR 7 long wave receiver, in the center is a Grebe CR 6 intermediate wave receiver, for commercial broadcast work, and on the right, the new Grebe CR 18, short wave receiver. At either end of the table can be seen the transmitting keys, for either transmitter. The Burgess *B* batteries may be seen on the floor beneath the table.

Karl E. Zindt is the radio operator. The author superintended the installation with the assistance of Fred L. Dewey. Any communication sent to the author at 1404 Magnolia Ave., Los Angeles, will be forwarded to KNT.



Rear View of Short Wave Transmitter.

CIRCUIT CALCULATIONS

In series connection of several resistances, or inductances, the total resistance, or inductance, is equal to the sum of the individual resistances, or inductances. Thus $R_{series}=r_1+r_2+r_3+\ldots$, $L_{series}=l_1+l_2+l_3+\ldots$. Likewise in parallel connection of several condensers the total capacity is equal to the sum of the individual capacities. Thus $C_{parallel}=c_1+c_2+c_3+\ldots$. In parallel connection of resistances, or inductances, and in series connection of condensers, the total is equal to the reciprocal of the sum of their reciprocals.

Thus $R_{parallel}=\dfrac{1}{1/r_1+1/r_2+1/r_3+\ldots,}$

$L_{parallel}=\dfrac{1}{1/l_1+1/l_2+1/l_3,}$

$C_{series}=\dfrac{1}{1/c_1+1/c_2+1/c_3.}$

Data on the '99 Type Tube

By Paul Oard

Notwithstanding the obvious advantage of its low filament current consumption, there seems to be a widespread prejudice against the '99 tube. To show that this is ill-founded is my prime purpose.

It is a 3-volt tube and requires .06 amperes, which is one-fourth the current consumption of the 5-volt type, which requires .25 amperes. It is fully as rugged in construction and as well able to withstand overload as the larger tube. Its failure is usually due to overvoltage supply, being normally operated from three dry cells in series. Their combined 4½ volts should be reduced to 3 volts by a rheostat, but this is often neglected. Consequently it is subjected to 50 per cent overload whereas a 5-volt tube or a 6-volt storage battery has only 20 per cent overload.

A receiver using 3-volt tubes should always be equipped with a high resistance voltmeter which is in circuit at all times so as to show the voltage at which the tubes are operating. The tube should never be driven above 3.2 volts when the *B* battery is connected. If the set does not then give proper volume, either it or the tubes are defective.

A certain percentage of tubes become "gassy"" or lose their vacuum after they have been packed and shipped to the distributor. Consequently the careful buyer should insist that his tubes be tested, not only to see that they "light," but also that they contain no gas. The test meter should show full "filament emission" without drop for 15 seconds. The tube that does not then show a downward movement of the needle may be rated as perfect.

Because of the fact that the '99 tube was introduced primarily as a dry cell tube, and at a time when the price of a storage battery was an important factor, there is a widespread impression that the '99 tube will not operate on storage battery. This impression is being dispelled in part by the recent development of small storage batteries of the two cell type, furnishing four volts. As a matter of fact, the standard six volt battery is entirely satisfactory, providing that a resistance is placed in the main line leading from the battery, and set so that current fed into the tubes does not exceed 3¼ volts. In fact, there is much in favor of the installation of a heavy duty six volt battery, of say 100 or more ampere hour capacity, such a battery oftimes not requiring charging more than once every two to three months. When it is considered that 8 of the '99 type tubes draw only one-half ampere of current, as against one and one-quarter amperes in the average five tube set using A tubes, the economy is apparent.

As to volume, it is true that in the audio frequency part of the circuit, that the '99 tube does not develop as much as does the A tube. In the radio frequency side of the circuit, however, the '99 type is every bit as efficient as far as sensitivity is concerned, with the added advantage of low current consumption. The power tube takes care of the objection of volume in the audio circuit, the average six tube set, using five '99 tubes and one power tube, furnishing more volume than can be handled by the average loud speaker. The '99 type is easier to neutralize and balance in radio frequency circuits than is the A type. In audio circuits, it is possible to utilize two or three of the dry cell power tubes with remarkable results, the warning injunction pasted on many of this type, "for use in last stage only" being intended to apply to sets not equipped to otherwise handle more than one of this type.

The drain on the *B* battery is also proportionately less than that of the A type. Where receivers are properly equipped with fixed by-pass condensers to take care of resistance built up as the *B* current falls, and with the correct size of battery, the operator may use dry cell *B* batteries with all the satisfaction that would be experienced were wet cell *B* batteries used. As an example, the writer has noted several superheterodynes, using 8 of the '99 type tube, whose *B* batteries have functioned satisfactorily for eight months or more before replacement became necessary. Operated at the proper voltage, in a receiver correctly built, and with an occasional "rejuvenation" to maintain filament emission, and the correct application of storage battery current where this is practical, one may expect the '99 type of tube to function fully as satisfactorily as the A type.

What You Should Know About Tubes

By Kirk B. Morcross

THE vacuum tube is the most important unit in the modern radio receiving set. It is important of course in the sense that it is indispensable (the crystal set furnishing a single exception) but it is most specifically important because sensitivity and quality of reproduction, two of the most desirable attributes of the radio set, depend upon proper tubes properly used.

A "key" to an understanding of the vacuum tube is found in the fact that it has three elements; its filament may be one of three different types, it requires three batteries or sources of voltage for its operation, and it has three important characteristics.

Of the three elements of the vacuum tube, the filament comes first in importance. It is the source of the electrons, tiny particles of negatively charged electricity. Upon their emission from the heated filament depends the tube's action. The filament may be either plain tungsten, oxide coated, or thoriated.

The tungsten filament requires a high temperature to secure satisfactory electron emission. It is found in tubes designed especially for use as detectors—the UV-200 and C-300 types—and requires a storage battery for satisfactory operation. It also requires careful regulation of filament current and plate voltage but for those experimenters who are interested in distant reception there is the reward of great sensitivity. A new type of sensitive detector tube employs a thoriated filament and consumes less filament current.

Oxide filaments — "dull emitters" — give satisfactory electron emission at much lower temperatures. Such filaments are made by baking oxides of calcium, strontium, or barium on a metallic filament. Western Electric tubes and tubes of the WD-12 and C-12 types use the oxide filament.

The thoriated filament is of tungsten with which is combined the metal thorium. Like the oxide filament, it gives satisfactory electron emission with small current consumption. This filament is used in tubes of the '99 and A types.

The plate of a tube is maintained at a positive voltage by the *B* battery. Since the electrons are negative, they are attracted to the plate from the heated filament. The number of electrons determines the plate current. Within limits, therefore, increasing the plate voltage and the filament current causes a certain increase in plate current. However, if the process is carried too far, there is proportionately less and less increase in plate current.

In practice, the plate and filament voltages remain constant and the variations in grid voltage determine the electron flow, hence the plate current. The grid charge varies with the signal fluctuation and thus the amplified signal is reproduced by the plate current.

There is a common impression that the changes in grid voltage should always produce proportional changes in plate current in order that the tube may function. This is a proper condition for operation without distortion when the tube is used as an amplifier but this condition would render the tube inoperative as a detector. To have detection there must be some distortion. A full discussion of this question requires reference to characteristic curves supplemented by mathematics. The subject is therefore outside the scope of this article. An explanation of this portion of vacuum tube theory is found in an article by Raymond B. Thorpe in RADIO for October, 1926.

The rather common expression, "working on the straight portion of the curve," applies to the use of the tube as an amplifier and refers to the well known characteristic curve obtained by plotting values of grid voltage against corresponding values of plate current. It means, simply, that under the conditions of use the changes in grid voltage produce proportional changes in plate current.

A *C* battery connected in the grid circuit of an amplifier tube makes the grid more strongly negative and permits greater *B* battery voltages while working on the straight portion of the curve. Louder signals are thus obtained without distortion and the current drain upon the *B* battery is reduced.

From our "key" to the study of tubes we recall that the tube has three important characteristics. First, there is the "amplification factor" or "amplification constant," terms which owe their definition to the action of the grid, which has a much greater effect on the plate current than changing the *B* battery voltage. Amplification constant is equal to the *change in plate voltage* divided by the *change in grid voltage,* when the individual change in plate and grid voltages would produce the *same change* in plate current. For example, if a change of 6 volts in the grid and a change in *B* battery voltage of 45 each produce the same change in plate current, the amplification constant is $45 \div 6 = 7.5$.

"Plate impedance," the second important characteristic, is the quotient obtained by dividing a *change in plate voltage* by the corresponding *change produced in plate current.* To illustrate, suppose that the plate voltage is changed from 90 to 45 volts and this changes the plate current from .0081 to .0029 amperes. The plate impedance is, therefore, $(90—45) \div (.0081—.0029) = 8564$ ohms.

"Mutual conductance," the third characteristic, is the quotient of *plate current change* and *grid voltage change.* This result is expressed in "mhos," a word obtained by spelling "ohms" backwards except that the "s" is not displaced. To illustrate, if a change of 9 volts on the grid causes a change of .0058 amperes in the plate current the mutual conductance is $.0058 \div 9 = .000644$ mhos or 644 "micro mhos."

There is one general point to remember about these three tube characteristics: they are not fixed, even for a particular tube, but vary with plate voltage and grid voltage. An understanding of these characteristics is not only of value as a basis of a more detailed study of vacuum tube theory but it is also of assistance in choosing a tube for a particular purpose. For instance if you wish to select a tube for power amplification, that is, for use in an amplifier where a considerable volume of sound is required, it is best to use a tube of low plate impedance. A tube of high impedance may cut off the low notes of the musical scale. Again, if you have a resistance or impedance coupled amplifier, tubes of high amplification constants should be used.

The old "standard" base is provided with four prongs of uniform size and a pin is imbedded at the side of the base so that the tube may be locked in the socket. The socket is a shell of metal or insulating material which *should* be accurately dimensioned inside so that the tube fits snugly. Owing to the difficulties of attaining accuracy in quantity production, this condition is not always fulfilled. As a result, the contact springs in the socket push the tube out of a true vertical position, giving unequal pressure which frequently results in a poor connection. This condition is made worse because the prongs are tipped with solder which corrodes easily. The 199 type of base is similar to the old standard base; it is, however of smaller diameter and the prongs are shorter.

The prongs on the WD-11 base are not of uniform size and this prevents the tube being placed in the socket in the wrong position. Good contact is

(*Continued on page* 63)

How to Build an Electric Phonograph

Complete Details for Construction of Power Amplifier and Battery Eliminator To be Used with Electric Pick-Up Device

By Clinton Osborne

ANY old style phonograph can be easily and cheaply converted into a satisfactory electrical instrument by substituting an electromagnetic pick-up device, audio amplifier, and cone type loud speaker for the mechanical pick-up and tone chamber of the old instrument. These, combined with a socket power unit for supplying *A*, *B* and *C* voltages, are shown in the circuit diagram of Fig. 1 and accompanying pictures. To be completely electrical in operation the phonograph should have a motor-driven turn table.

In the upright model here illustrated the record compartment was used to house the electrical equipment. This, of course, can be housed in a separate cabinet. Naturally, also, the baseboard dimensions will depend upon the size of available space. The parts used by the author gave eminent satisfaction. If substitutions are made they should be of as high a grade. If cheaper parts are used there is a likelihood that the results will be little better than those from the old phonograph and thus not justify the expense for the amplifier.

The first operation is to remove the old tone arm and reproducer from the phonograph, and in its place mount the new electromagnetic pick-up unit. The base of this unit is screwed to the board supporting the turntable, so that the arc through which the reproducer swings will keep the vertical plane of the reproducer case at right angles to a line drawn from the center of the record to the tip of the steel phonograph needle. If this angle is not very near a right angle, the needle will jump the lines and scratch the record when very loud, and low frequency notes are being reproduced. The easiest method to judge the position for the reproducer and base is to place a worn out record on the turntable, and try different settings of the reproducer and base until the best position is found. The base should then be screwed to the wooden panel, and a hole drilled through the board so that the two output leads from the pick-up unit can be run to the bottom compartment.

The power plant used to operate the two stage audio amplifier is similar in circuit to the *ABC* eliminator described in past issues of RADIO by G. M. Best, except that a Raytheon Type BH rectifier tube is used. The power plant consists of a power transformer, with 110 volt primary, two 350 volt secondaries in series, and a 5 volt filament lighting secondary. The Raytheon tube is connected in the secondary circuit of the

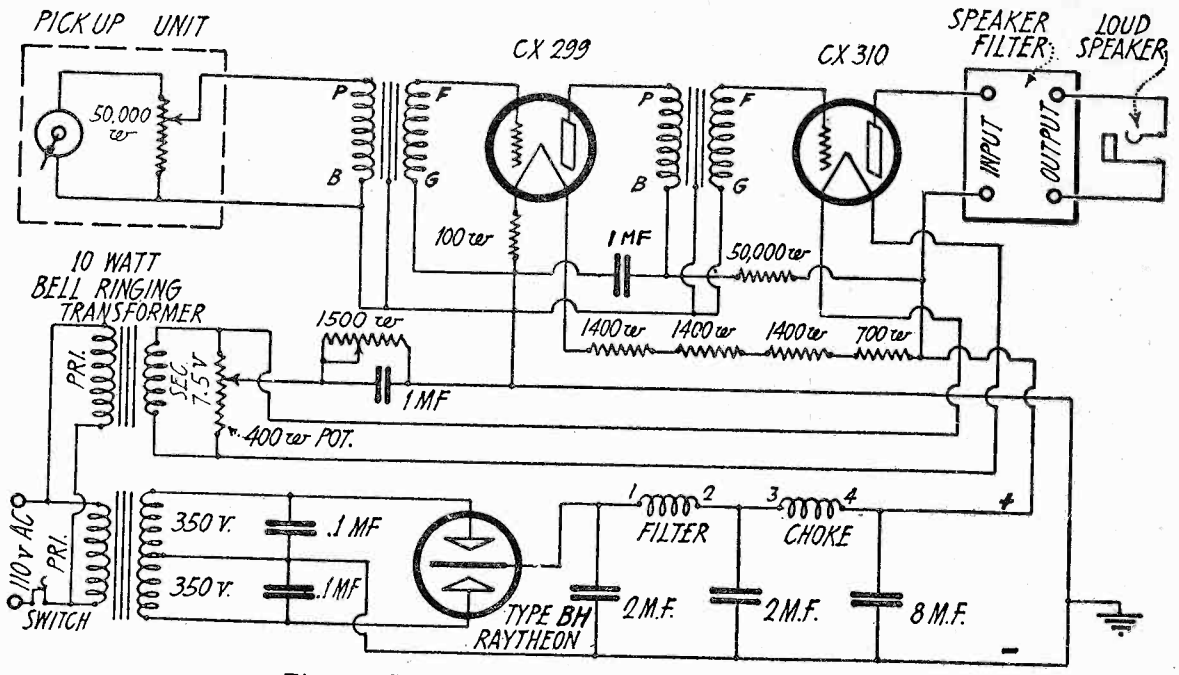
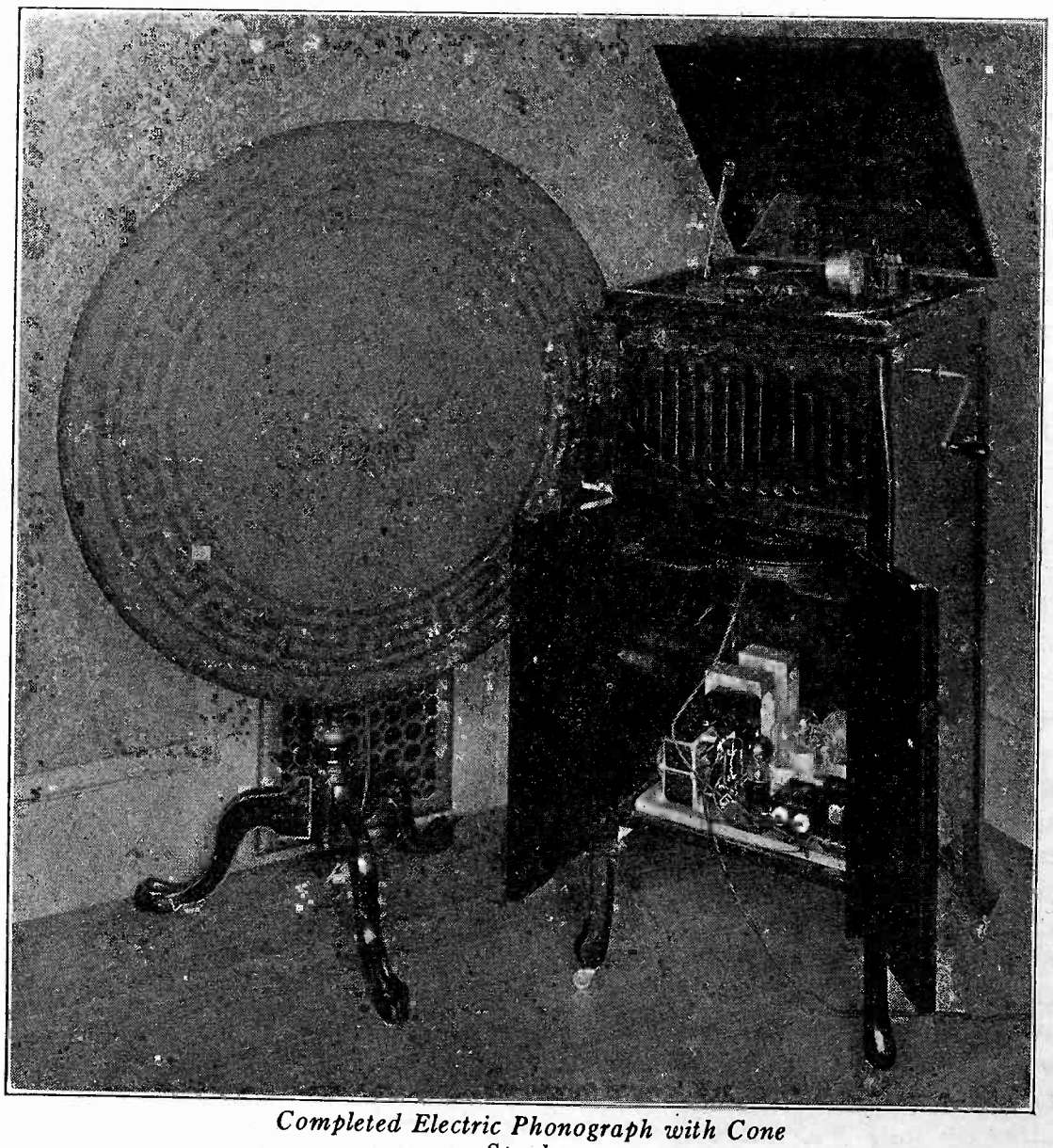


Fig. 1. Schematic Wiring Diagram of Electric Phonograph

transformer, so that each element of the tube receives a potential of 350 volts. The rectified output of the tube, with 350 volts input per element, will be about 300 volts at 80 milliamperes. This current is passed through a two winding filter choke which is used in conjunction with 12 mfd. to form an efficient filter system. After passing through the choke, the effective voltage at 80 milliamperes will be about 275, which is available for the plate of the power amplifier tube.

The first audio tube is a type 99, re-



Completed Electric Phonograph with Cone Speaker

quiring 60 milliamperes at 3 volts, so that this current is obtained from the filter output, the voltage being cut from 275 to 3 volts by means of a set of reducing resistances, having a total value of approximately 5000 ohms. This resistance can be made up cheaply and efficiently by connecting three 10 watt and one 25 watt, 110 volt mazda lamps in series, between the positive terminal of the filter output, and the positive 99 tube filament connection. Plate voltage for the 99 tube is obtained in the same manner, by means of a reducing resistance of 50,000 ohms, which lowers the effective plate voltage to 90, from 275 volts, and permits a plate current of 2½ milliamperes.

The second amplifier tube may be either a CX-112, CX-371 or CX-310, preferably the latter, in order that the full voltage of the power plant may be utilized. In the author's experimental layout, the 112 and 371 power tubes were tried, and it was found necessary to insert a resistance for reducing the effective plate voltage to the maximum permissible amount, 180 volts. This limits the volume obtainable to a point considerably below that possible with the 310 tube, so that the full possibilities of the power plant were not used. As the power transformer has a filament lighting secondary of only 5 volts, a separate filament transformer was installed, with a secondary voltage output of 7.5 volts at 1.25 amperes. This slight additional expense is well warranted, in view of the increased volume obtained.

A 400 ohm potentiometer is shunted across the power tube filament, as is shown in the diagram, so that the exact center of balance can be obtained, and the power hum in the loud speaker completely eliminated. Bias voltage for the first audio tube is obtained by means of a 100 ohm fixed resistance placed between the negative end of the tube filament, and the negative *B* supply terminal. The voltage drop across this resistance, with 60 milliamperes flowing through it, is 6 volts, which is the proper *C* voltage for the 99 tube with from 90 to 100 volts plate.

LIST OF PARTS USED BY WRITER

1 General Radio Type 273 H.P. transformer 110-350-350-5 volts.
1 General Radio Type 366 Filter choke—50 henries when passing 85 milliamperes.
2 Tobe-Deutschmann 4 mfd. No. 404 filter condensers—400 volts.
2 Tobe 2 mfd. No. 402 2 mfd. filter condensers—400 volts.
1 Tobe 1 mfd. No. 401 filter condenser—400 volts.
2 Tobe .1 mfd. No. 410 filter condensers—400 volts.
1 Raytheon BH tube.
1 Carter 100 ohm fixed resistance.
2 General Radio No. 285-D audio transformers.
1 General Radio No. 387 Speaker Filter.
3 General Radio No. 349 sockets.
1 Clarostat—For C biasing resistance.
1 1 mfd. Tobe by-pass condenser.
1 General Radio No. 214A 400 ohm potentiometer.
1 Electrad double grid leak mounting.
1 Electrad .05 megohm fixed metallic leak.
1 Thordarson three-way transformer—110-6-8-12 volts.
4 Porcelain lamp sockets.
3 10 watt 110 volt Mazda lamps.
1 25 watt 110 volt mazda lamp.
1 Hanscom Super-Unit phonograph pick-up.
1 Snap switch.
1 Single contact jack.
1 Weston Model 506 0-100 m.a. milliammeter (optional).

The method employed for providing *C* voltage for the power tube is somewhat different, although it uses the voltage drop principle. A variable resistance, having a minimum of 1000 ohms and a maximum above 2000 ohms is placed in the negative *B* voltage lead to the power tube, as is shown in Fig. 1, and the voltage drop in the plate voltage supply is used as *C* potential. With a resistance setting of 1000 ohms, which can be obtained by screwing in the knob of the Clarostat as far as it will go, the plate current will be approximately 18 milliamperes, and the *C* voltage will thus be 18 volts. A 1 mfd. condenser must be shunted across this resistance, to prevent the amplifier from howling. It is not necessary to use a high voltage condenser at this point, as only 18 volts will be impressed across its terminals.

To insulate the power tube from the loud speaker, insofar as direct current is concerned, an output device must be used, either of the impedance coupled or transformer type. It is particularly important that the device be capable of transmitting all audio frequencies alike, as a considerable amount of power is handled, and an output filter which was a poor match for the impedances of the tube and speaker would be worse than none at all.

Connect all audio transformer cases to the negative filter circuit, and to ground, running in a ground wire to the phonograph just as you would to a radio set. The plus *B* terminal of the first audio transformer should be grounded, and it is important that the main frame of the phonograph pick-up unit be connected to this terminal. In the Hanscom unit this wire has a red tracer.

The filter choke must pass 85 milliamperes without heating and maintain an inductance of at least 50 henries with this value of current passing through it. The filter condensers must be able to withstand 400 volts d.c. continuously, and the .1 mfd. buffer condensers across the Raytheon tube plates should be of the same type. The ordinary *B* block of filter condensers designed for 200 volt *B* eliminator service will not do, as they would soon break down under the strain of 350 volt service. A 1 mfd. 400 volt condenser must also be used to by-pass the a.c. component in the plate circuit of the first audio tube.

After all the apparatus is mounted on the baseboard, in the general manner of Fig. 2, the wiring can be installed, using a good grade of insulated wire capable of withstanding 400 volts. Keep the grid and plate leads of the audio amplifier tubes away from the 7½ volt a.c. filament leads to the power tube, and be particularly careful in insulating the wires from the power transformer to the Raytheon tube, as an unpleasant shock would result if any of the power transformer terminals were touched when the body was grounded. It will be found advisable to run the ground wire first, as it goes to practically every piece of apparatus on the board, the most convenient route being from the center terminals of the power transformer secondary to the case of the filter, to the bottom lugs of the filter condensers, to their cases, to the frame of the output filter, thence to the audio transformer cases, and ending with the negative side of the *C* biasing resistance of the first audio

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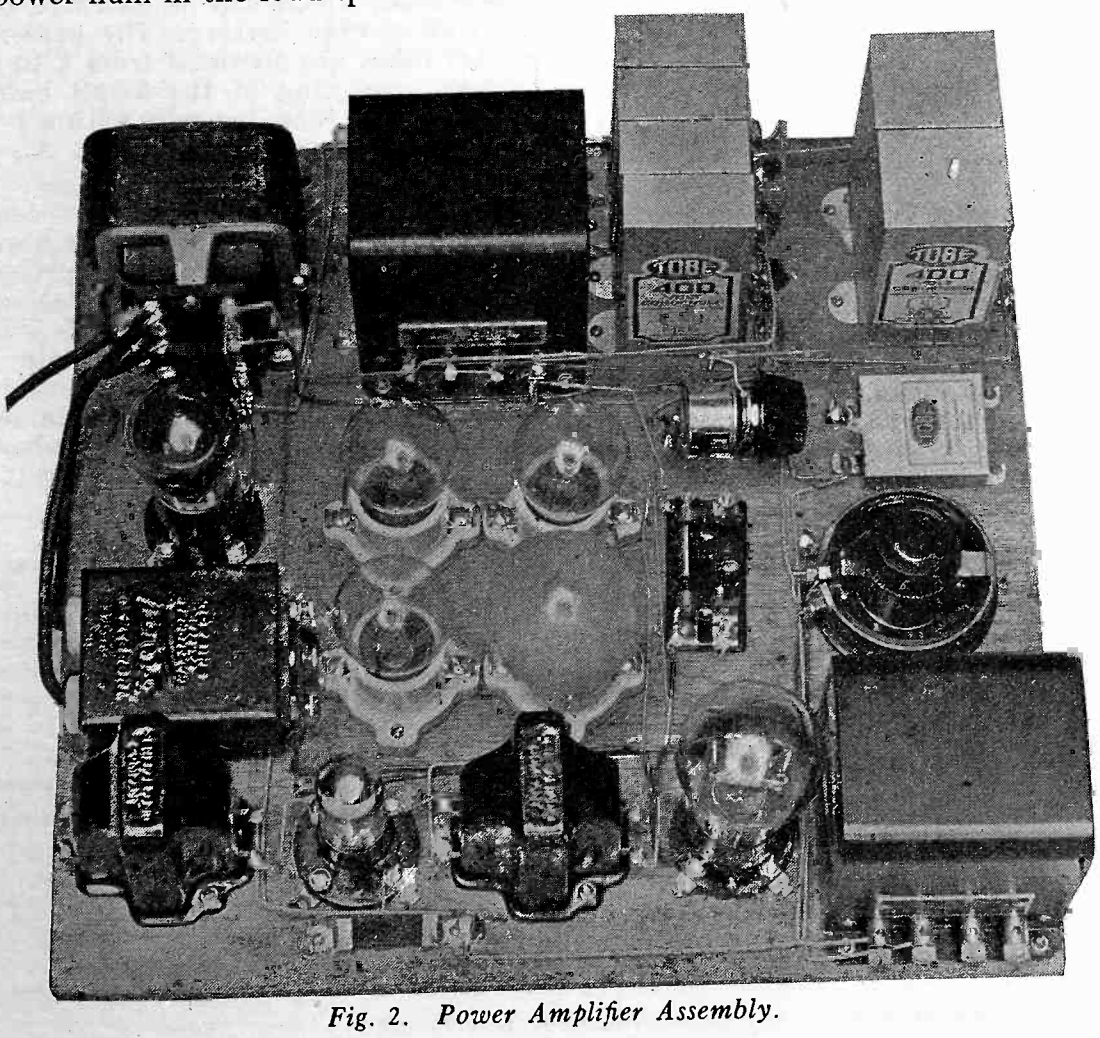
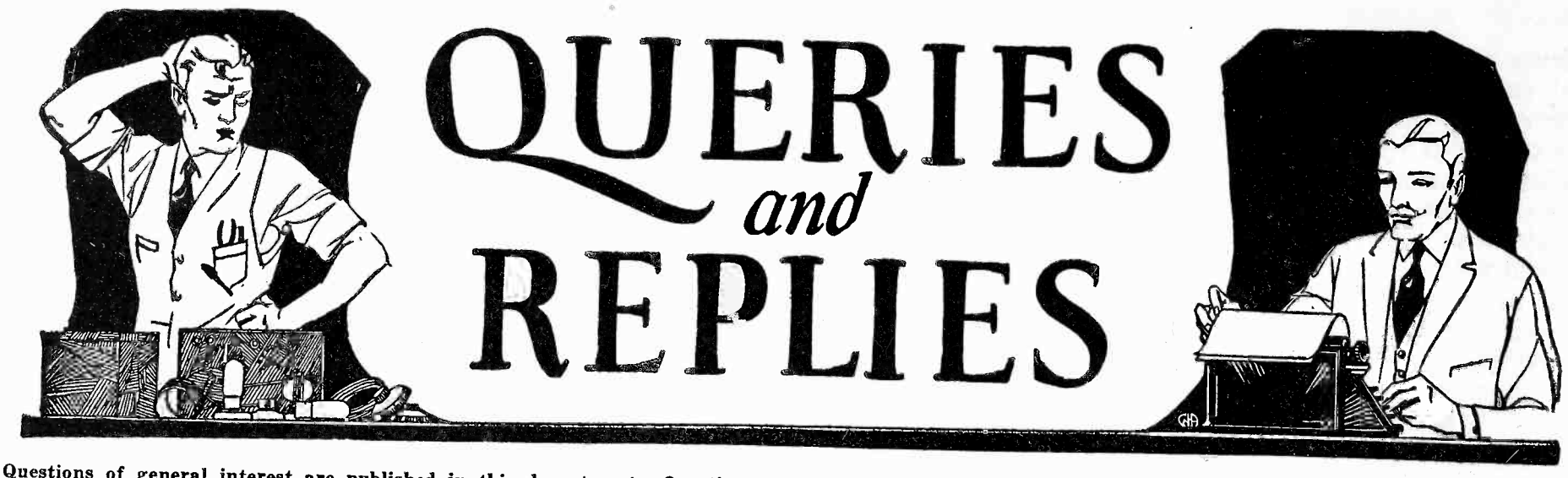


Fig. 2. Power Amplifier Assembly.



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.

Would like to convert my 4 tube Universal receiver into a 5 tube set. Please publish a circuit showing how to do this, with data on how to add an output transformer.—C. R. W., Dunsmuir, Calif.

A circuit diagram of the Universal receiver, with a stage of tuned r.f. added,

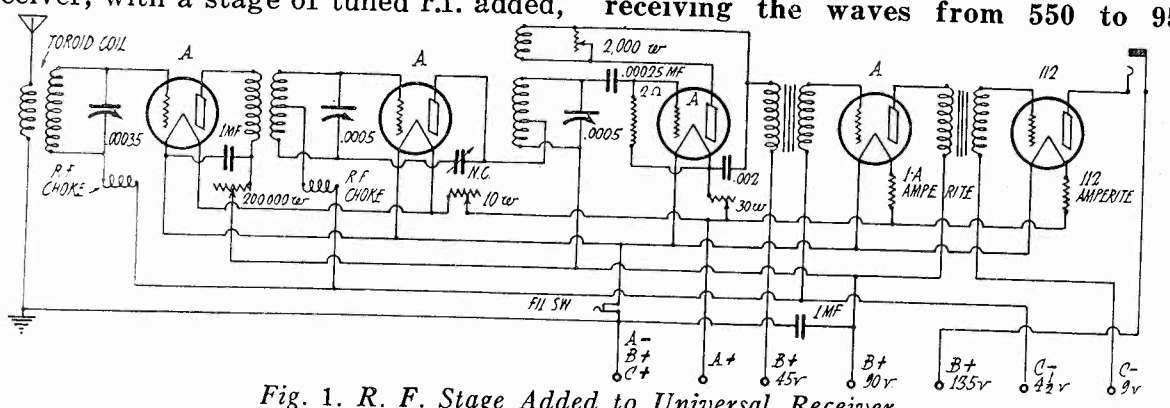


Fig. 1. R. F. Stage Added to Universal Receiver.

is shown in Fig. 1. The extra r.f. transformer should preferably be of the toroid, or other enclosed field coil, in order to avoid coupling between r.f. stages. An output transformer is shown, with connections for the 371 type power tube.

Have a five tube receiver of popular make, and am having trouble due to powerful local stations interfering with distance reception. Would the infradyne amplifier unit adapted to this set improve the selectivity and cut out the locals? Would the short wave adapter published in November RADIO work with my broadcast receiver?—C. H. H., Oakland, Calif.

You can either add an infradyne adapter, using the same instructions as apply to the Hammarlund HiQ receiver contained in Mr. Sargent's article in this issue, or you can tune the antenna circuit. A .0005 mfd. variable condenser placed in series with a coil consisting of 100 turns of No. 24 d.c.c. wire wound on a 2½ in. tube, connected between the antenna and the antenna binding post on the set will enable tuning the antenna system to the exact wave of the distant station wanted, so that the interfering locals will be tuned out. The infradyne adapter will increase both the sensitivity and selectivity of the receiver to a considerable degree, however, while the antenna tuner will only improve the selectivity.

I want to build a 3 tube receiver for receiving the waves from 550 to 950 meters, covered by the marine commercial traffic, and would like a circuit for such a receiver, with a stage of tuned r.f., regenerative detector and one stage of transformer coupled audio amplification.—H. R. W., Str. San Juan.

The set you need is a modified Browning-Drake, with inductances suitable for the 600 meter band. The circuit diagram

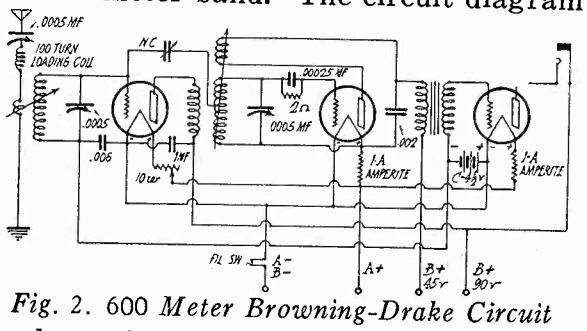


Fig. 2. 600 Meter Browning-Drake Circuit

is shown in Fig. 2, and the data for the inductances are as follows: Antenna loading coil 150 turns No. 24 d.c.c. on a 2½ in. tube. Antenna coupling coil 15 turns No. 24 d.c.c. on a 2 in. tube, and placed inside the secondary, which consists of 70 turns of No. 24 d.c.c. wound on a 3 in. tube. The r.f. transformer primary will need 30 turns of No. 28 double silk wire wound in jumble fashion at the filament end of the secondary, which is wound with 70 turns of No. 24 d.c.c. wire on a 3 in. tube. The tickler coil is placed inside the secondary at the end opposite to the primary, and should have 35 turns of No. 28 double silk wire on a 2 in. tube, and arranged with shaft projecting through the panel so that the coupling can be varied. There are three tuning controls on this set, but the increased selectivity obtained with the antenna circuit tuned makes the extra control well worth while. If the r.f. tube oscillates badly when the filament rheostat is turned on full, it may be necessary to take out a neutralizing tap at the 16th turn from the grid end of the r.f. transformer secondary, connecting the neutralizing condenser as is shown in the circuit diagram. If the antenna tuned circuit is not needed, the condenser and loading coil can be strapped out, so as to make the antenna circuit aperiodic.

Am very much interested in the completely shielded nine-tube superheterodyne described in October and November RADIO, but as my set has Northern Electric 215-A tubes, and their filaments are operated in series, I am unable to modify my present circuit diagram. Kindly publish the above circuit for series filament operation, except for the power tube, which will be operated from a 6-volt storage battery. The present 7 peanut tubes are operated from a 10-volt battery consisting of the 6-volt battery for the power tube, in series with a 4-volt small size storage battery.—H. A., Atlanta, Ga.

The circuit diagram for series operated filament circuit, using 215-A tubes, is shown in Fig. 3. It is similar in principle to the shielded set described in October RADIO, or the semi-shielded set described in this issue. In order to obtain the proper grid voltages for the various tubes, the arrangement of tube filaments has been changed from that published in these columns some time ago, and the

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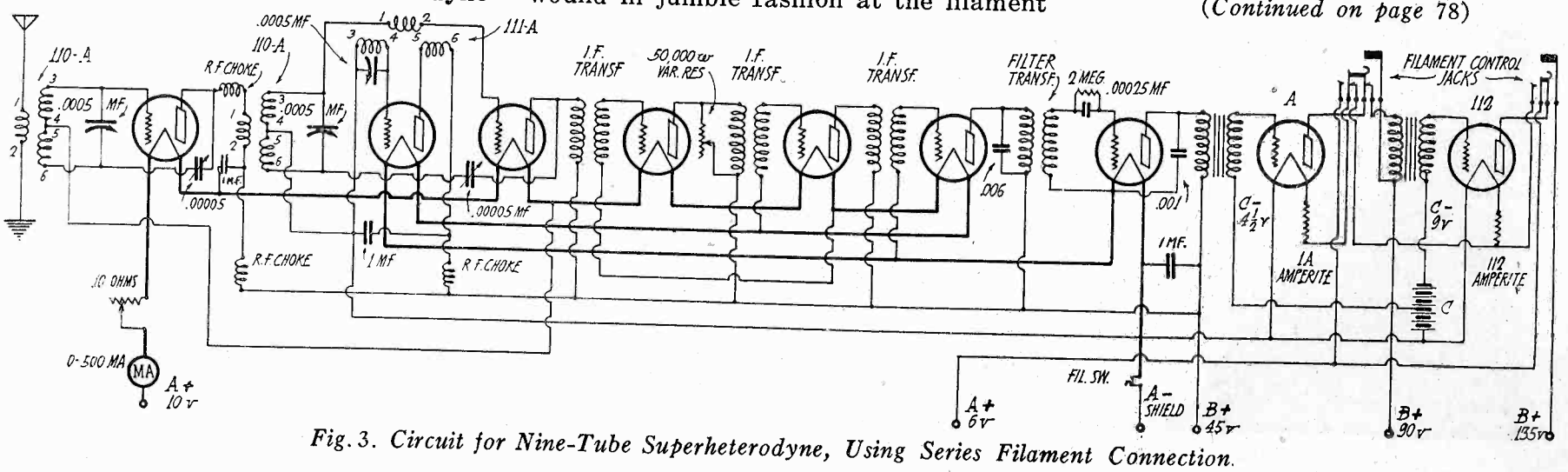
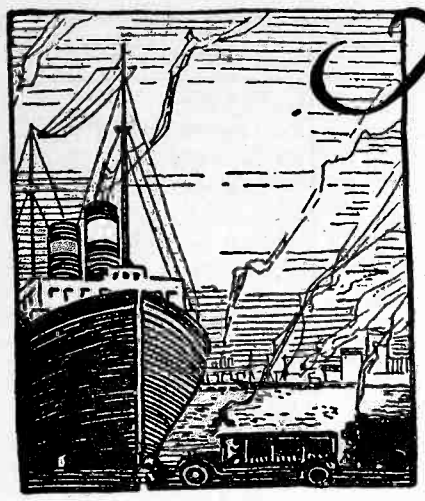
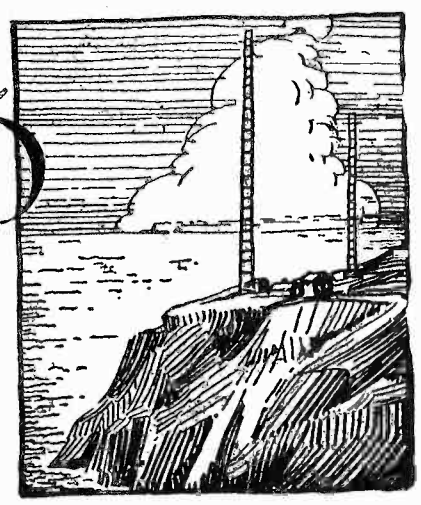


Fig. 3. Circuit for Nine-Tube Superheterodyne, Using Series Filament Connection.



The COMMERCIAL BRASSPOUNDER

A Department for the Operator at Sea and Ashore



R. O. Koch, *Great Lakes Correspondent*

Edited by P. S. Lucas

C. W. Rados, *Boston Correspondent*

PROGRESS

Tempus shure do fugit. But for that matter it has to in order to keep up with the march of events and the advance of science. Since the beginning of the Industrial Revolution in 1750 our scientists and inventors have kept the guns going just as insistently as some of the political revolutionists of certain of our Southern neighbors. And in spite of this fervent craving for progress, most of us seem to have an inherent dislike of abandoning the "good old" things to which we have become accustomed, in favor of new and more modern "contraptions."

So it has been in the radio industry. After the receiving detector had gone through the coherer, tikker, carborundum and other crystal stages, we'll bet there were a good many men who prophesied that the audion would never be a success, commercially. Too many flashlite batteries, filament wouldn't last a whole trip—nix, galena for us. And, as static room gossip has it, the inventor of those fine old double-filament Audiotrons went out one nice evening and drank himself to death. Whether this was because of certain insulting sea-going language directed at one of his little tubes or not has never been determined; all that is known is that he took his "recipe" with him.

Of all the inventions for the ship's wireless shack, the transmitting tube has probably had the hardest time finding a place in the hearts of the operators. In the first place, it had to overcome a great deal of sentiment in replacing the spark, with the latter's identifying note and the sense of power felt by the operator in sending out a circle of blue lightning every time he pressed the key.

When KPH first switched to ICW about three years ago, his well-loved sink note was sorely missed out on the Pacific. And it was with some smug satisfaction that some of us began to realize that KFS was getting in on most of the traffic. Hadn't we been assuring each other that the bottle had no place in marine wireless? Well, KPH proved that we were right.

Not for long, though, for KPH made a comeback—and now we are trying to forget our prophecies and our backwoods arguments against modernization. Even the spark stations which once outclassed the tubes are gradually being converted to the eventually universal type of transmitter equipment.

Thus passeth an old love—reluctant though we are to let it go. And just as we have held onto the spark, will our successors hold onto the tube when the time comes for that, also, to pass into the unforgotten and glorified past.

The 11th district U. S. Lighthouse depot at Detroit is building a large number of 100-watt automatic radio fog signals for use on the Great Lakes, Atlantic and Pacific coasts. They are 500 cycle, self-rectifying full wave, using four 50-watt Signal Corps tubes.

R. F. AMPLIFICATION IN MARINE WORK

By W. L. Jepson

Radio frequency amplification, while common in broadcast receivers, is seldom found in ship receivers. The marine operator bloops no one with a regenerative receiver and with a sensitive detector tube is able to drag in signals from a great distance. A three-coil honeycomb regenerative combination, properly handled, is hard to beat for selectivity and sensitivity.

Yet there is a demand for less complicated tuning and even greater selectivity and sensitivity which can be attained by adding an r.f. amplifier for use with a shorter aerial. The old superdyne circuit can be well adapted for this purpose on 600 meters. The circuit is shown in Fig. 1.

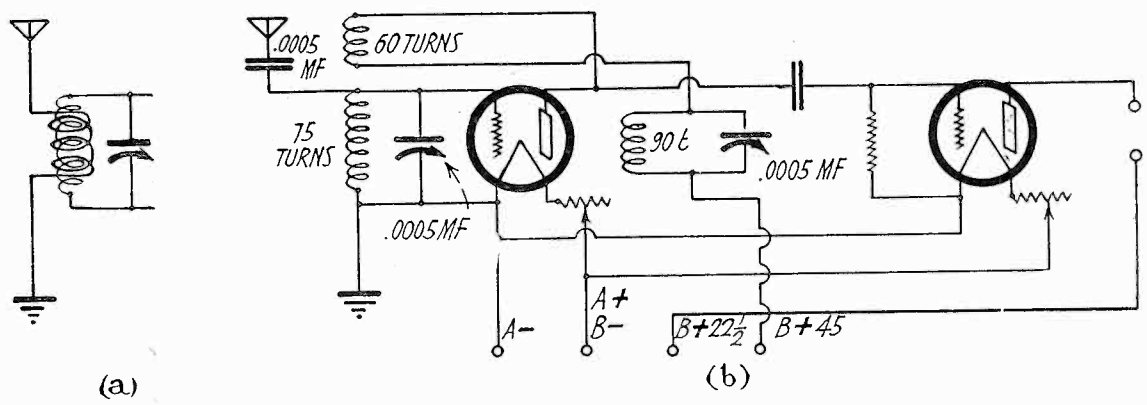


Fig. 1. Adaptation of Superdyne Circuit for Long Wave.

It uses tuned impedance coupling between amplifier and detector. This resonant plate circuit builds up high grid voltages on the detector tube, which is needed in spark work to get a booming signal. A reversed tickler feed back offsets the oscillations produced by the positive feed back of the tube. Oscillation is stopped by increasing (tightening) the tickler coupling. Thus the plate circuit may be brought right up to resonance and the non-oscillatory condition easily maintained.

For a given wave length, as 600 meters, a point just below oscillation may be found which will remain fairly constant over a small band. But for close work, as with the ordinary regenerative circuit, the point just below oscillation is the best for spark and I. C. W. reception and the point just above oscillation gives best results on C. W.

The feedback varies with the grid tuning, though it is not quite so critical as a regenerative detector. The tube shouldn't be kept too far below the point of oscillation, as the sensitivity is lessened too much.

The question of antenna coupling arises next. Beyond question the use of a tuned primary with variable coupling affords closest tuning and if we were considering a straight regenerative tuner it would be not only my first but my only choice. But where we have one step of R. F. having two resonant circuits before the detector tube, the antenna circuit may be closely coupled to the grid circuit through the medium of a coil having spaced turns wound about the secondary or the aerial may be connected to the grid through a fixed condenser of about .0005 mfd. capacity; the filaments are grounded in that case. This gives sufficient selectivity when using a short receiving aerial run up to the stack or between the boat davits, which is all that is required with this circuit to get real results.

The same batteries may be used for all tubes. It will be seen that the grid leak resistance cannot be shunted across grid condenser of detector tube as then the plate voltage will be impressed upon the grid of detector tube. The leak, of course, can go from grid to filament. A pencil or ink line run between the grid and filament prongs on the base of the tube provides a good variable resistance.

Now a word about the receiver itself. I used a regular honeycomb tuner in this circuit so successfully that I never bothered to wind coils for such a set (2LZ (?)-MIN). This tuner comprised a 3-coil mounting and two .0005 mfd. tuning condensers. All that was needed was a fixed or variable .0005 mfd. antenna condenser and a tube and rheostat. The left-hand arm of the mounting holds the amplifier grid coil which was a 75-turn D. L. or H. C. coil. The middle arm holds the tickler which was a 60-turn coil, as was used for tickler before. The plate impedance coil may be a larger coil than the grid coil and it should be swung away out at right angles to the center coil and left that way, as there should be no coupling between it and the others.

The operation is simple, as there are but the two condensers and one coupling adjustment which can be set for a small variation of wave-length. The plate tuning condenser is the major wave-length control and the grid coil is drawn towards the tickler coil to prevent tube from oscillating which will tend to occur as the circuits are brought into resonance.

This circuit can be used for all wave-lengths and works fine on 2100 meter C. W.

stuff with the usual D. L. or H. C. coils. On these waves negative feedback is not particularly necessary but can be used to keep the tube from oscillating too strongly. This circuit, minus the negative feedback arrangement, was used extensively in Europe for long-wave work.

Not having a honeycomb set, coils can easily be wound to cover the 600-800 meter band. The grid coil might consist of 80 turns bank-wound on a four-inch tube. The plate coil should have around 90 turns and the tickler coil should have about 60 turns. Some sort of variable coupling would have to be devised for tickler, however.

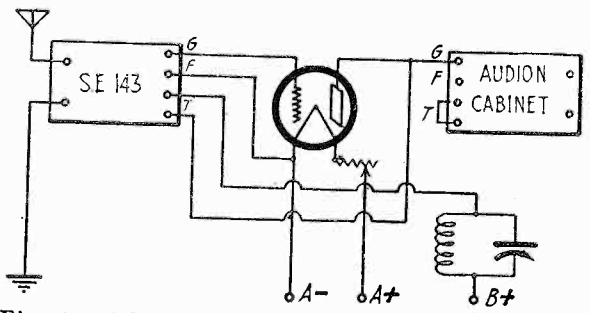


Fig. 2. Adaptation of Superdyne to S. E. 143 Receiver.

It has occurred to me that this circuit could easily be used in connection with a standard regenerative receiver such as the SE-143. The amplifier tube and impedance could be connected between the tuner cabinet and the amplifier control box as shown in Fig. 2. The tickler connections will have to be tried one way or the other. Only the grid post on amplifier cabinet is used and the tickler posts of course must be shorted. The plate coil could be such as to cover entire range of tuner by taps or plug in arrangement.

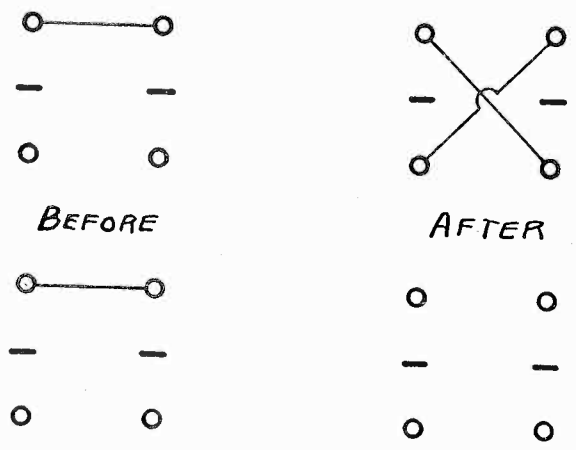
Perhaps I should say wot I 'eard!

While sailing in the Gulf of Mexico in '24 I could copy WSA (spk.) and WIM (ICW) and WCY (spk.), all near New York, during noon hours any day in the Central Gulf. Those of you who know that run realize that that's no little feat, eh? Generally speaking, the daylight range of a good coastal station can be increased from 700 miles to better than a 1000. Well, men, let's hear through these columns of your experiences with the Superdyne.

SE 143 TICKLER CONNECTIONS

By HAROLD LARSON, *SS West Cajoot.*

When an SE143 receiver is used with an SE1071 V. T. control it is usually necessary to reverse the tickler connections for reception on some wavelengths. This is, as a rule, accomplished by means of an external DPDT switch or by disconnecting and reversing the leads between the tickler binding posts on the 143 and the 1071.



If the connections on the *"OSCLR-DET"* key switch on the tube control panel are changed as shown in the diagram, this switch may be used to reverse the tickler connections when on the *"DET"* position instead of cutting out and shorting the tickler coil as it does normally. Simply remove the two wires shown in Fig. 1 and connect the two shown in Fig. 2.

(*Continued on page* 68)

TIME SIGNALS OF THE WORLD

By Wm. A. Bremiman, S. S., West Henshaw

P. C. T.	E. C. T.	G. M. T.	CALL	WAVE	SYS.	LOCATION
Midnight	3.00 AM	08.00	LY	23,400	CW	LaFayette
Midnight	3.00 AM	08.00	CRZ	600	Spk	Portuguese E. Africa
12.10 AM	3.10 AM	08.10	LY	23,400	CW	LaFayette
12.20 AM	3.20 AM	08.20	YN	15,500	CW	Lyon-Dona
12.54 AM X	3.54 AM	08.54	FFZ	750	Spk	Shanghai
12.56 AM	3.56 AM	08.56	ISG	2,850	Spk	Italian Somaliland
1.00 AM	4.00 AM	09.00	YN	15,500	CW	Lyon-Dona
1.00 AM X	4.00 AM	09.00	VLY	600	Spk	Wellington NZ
1.00 AM X	4.00 AM	09.00	VLW	600	Spk	Wellington
1.28 AM	4.28 AM	09.28	FL	2,600	Spk	Eiffel Tower Paris
1.55 AM X	4.55 AM	09.55	NBA	6,663	CW	Balboa
1.55 AM	4.55 AM	09.55	NAX	1,817	Spk	Colon
2.00 AM	5.00 AM	10.00	JJC	4,000	Spk	Funabashi
2.00 AM	5.00 AM	10.00	JCS	600	Spk	Chosi Japan
2.00 AM	5.00 AM	10.00	FL	2,600	Spk	Eiffel Tower, Paris
2.00 AM	5.00 AM	10.00	ICX	11,150	CW	Eritrea
2.45 AM	5.45 AM	10.45	FL	2,600	Spk	Eiffel Tower, Paris
3.00 AM	6.00 AM	11.00	XDA	5,800	CW	Mexico City
3.00 AM	6.00 AM	11.00	VTC	600	Spk	Mesopotamia
3.58 AM	6.58 AM	11.58	POZ	3,100	Spk	Nauen, Germany
3.58 AM	6.58 AM	11.58	POZ	18,050	CW	Nauen, Germany
4.00 AM	7.00 AM	12.00	POZ	3,100	Spk	Nauen, Germany
4.00 AM	7.00 AM	12.00	POZ	18,050	CW	Nauen, Germany
4.56 AM	7.56 AM	12.56	BXY	2,000	Spk	Hong Kong
4.56 AM	7.56 AM	12.56	VPS	600	Spk	Hong Kong
5.55 AM	8.55 AM	13.55	NPO	2,700	Spk	Cavite (Manila)
5.55 AM	8.55 AM	13.55	NPO	5,260	CW	Cavite (Manila)
6.00 AM	9.00 AM	14.00	VIM	600	Spk	Melbourne, Australia
6.00 AM	9.00 AM	14.00	SOH	1,800	Spk	Rio de Janeiro
6.00 AM	9.00 AM	14.00	VCS	600	Spk	Halifax, Canada
6.30 AM	9.30 AM	14.30	VIA	600	Spk	Adelaide, Australia
7.00 AM	10.00 AM	15.00	VIP	600	Spk	Perth, Australia
8.27 AM	11.27 AM	16.27	VWC	2,000	Spk	Calcutta
8.55 AM	11.55 AM	16.55	NAJ	1,988	Spk	Great Lakes
8.55 AM	11.55 AM	16.55	NAT	2,697	Spk	New Orleans
8.55 AM	11.55 AM	16.55	NAA	2,655	CW	Arlington
8.55 AM	11.55 AM	16.55	NSS	17,130	CW	Annapolis
8.55 AM	11.55 AM	16.55	NAR	1,463	Spk	Key West
8.57 AM	11.57 AM	16.57	VPB	600	Spk	Columbo, Ceylon
9.00 AM	NOON	17.00	VIP	600	Spk	Perth, Australia
9.55 AM	12.55 PM	17.55	NAX	1,817	Spk	Colon, Panama
9.55 AM	12.55 PM	17.55	NBA	6,663	CW	Balboa, Panama
9.57 AM	12.57 PM	17.57	VPB	2,300	CW	Columbo, Ceylon
10.58 AM	1.58 PM	18.58	RET	7,100	CW	Petrograd, Russia
11.02 AM	2.02 PM	19.02	RET	7,100	CW	Petrograd, Russia
11.55 AM	2.55 PM	19.55	NPL	9,801	CW	San Diego
11.55 AM	2.55 PM	19.55	NPG	1,436	CW	San Francisco
11.55 AM	2.55 PM	19.55	NPG	3,338	CW	San Francisco
11.55 AM	2.55 PM	19.55	NPW	3,156	CW	Eureka, Calif.
11.55 AM	2.55 PM	19.55	NPE	2,726	Spk	North Head, Washington
NOON	3.00 PM	20.00	YN	23,400	CW	LaFayette
12.27 PM	3.27 PM	20.27	VWC	2,000	Spk	Calcutta
12.55 PM	3.55 PM	20.55	RAI	7,480	CW Spk	Moscow, Russia
12.59 PM	3.59 PM	20.59	VNC	600	Spk	Cape Town
1.02 PM	4.02 PM	21.02	RAI	7,480	CW Spk	Moscow, Russia
1.30 PM	4.30 PM	21.30	HZA	20,800	CW	Saigon, Indo China
1.58 PM	4.58 PM	21.58	SAX	1,200	Spk	Athens, Greece
2.00 PM	5.00 PM	22.00	FL	2,600	Spk	Eiffel Tower, Paris
2.45 PM	5.45 PM	22.45	FL	2,600	Spk	Eiffel Tower, Paris
3.00 PM	6.00 PM	23.00	VLY	600	Spk	Wellington, N. Z.
3.00 PM	6.00 PM	23.00	VLW	600	Spk	Wellington, N. Z.
3.55 PM	6.55 PM	23.55	NPM	26,245	Spk	Honolulu, T. H.
3.55 PM	6.55 PM	23.55	NPM	11,490	CW	Honolulu
3.55 PM	6.55 PM	23.55	CCE	1,000	Spk	Valparaiso, Chile
3.58 PM	6.58 PM	23.58	POZ	3,100	CW	Nauen, Germany
3.58 PM	6.58 PM	23.58	POZ	18,050	CW	Nauen, Germany
4.00 PM	7.00 PM	00.00	POZ	18,050	CW	Nauen, Germany
4.00 PM	7.00 PM	00.00	POZ	3,100	CW	Nauen, Germany
4.00 PM	7.00 PM	00.00	SOH	1,800	Spk	Rio de Janeiro
4.58 PM	7.00 PM	00.58	PKX	7,700	CW	Malabar, Java
5.00 PM	8.00 PM	01.00	XDA	1,200	Spk	Mexico City
5.00 PM	8.00 PM	01.00	PKB	600	Spk	Java, Batavia
5.56 PM	8.56 PM	01.56	BXY	2,000		Hong Kong
5.56 PM	8.56 PM	01.56	VPS	600	Spk	Hong Kong
5.56 PM	8.56 PM	01.56	LIH	1,000	Spk	Buenos Aires, Argentina
6.00 PM	9.00 PM	02.00	VIM	600	Spk	Melbourne, Australia
6.10 PM	9.10 PM	02.10	PKH	600	Spk	Surabaya, Java
6.15 PM	9.15 PM	02.15	HVB	1,200	Spk	French Indo China
6.30 PM	9.30 PM	02.30	VIA	600	Spk	Adelaide, Australia
6.55 PM	9.55 PM	02.55	NAA	2,655	CW	Arlington
6.55 PM	9.55 PM	02.55	NSS	17,130	CW	Annapolis
6.55 PM	9.55 PM	02.55	NAR	1,463	Spk	Key West
6.55 PM	9.55 PM	02.55	NPO	2,700	CW	Cavite, Manila, P. I.
6.55 PM	9.55 PM	02.55	NPO	5,260	CW	Cavite, Manila
6.55 PM	9.55 PM	02.55	FFZ	750	Spk	Shanghai, China
7.00 PM	10.00 PM	03.00	REA	600	Spk	Archangel, Russia
8.56 PM	11.56 PM	04.56	ICX	3,500	Spk	Massawa

(*Continued on page* 68)

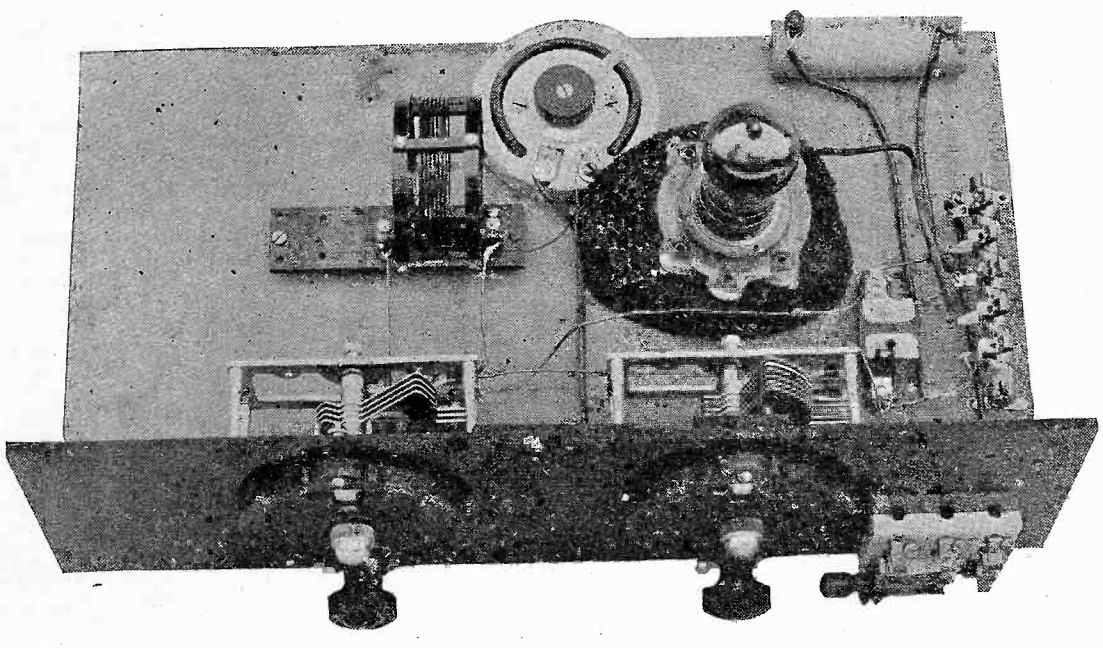
With the Amateur Operators

BROWNING-DRAKE 30 METER RECEIVER

By DON C. WALLACE, *u6AM*

The Browning-Drake receiver has proved satisfactory for broadcast reception, and now is proving itself just as satisfactory for reception in the so-called 40-meter band. When we arrived in California, bringing the equipment of 9ZT along continuous and almost unanimous statements were heard from the West Coast amateurs to the effect that Europe could not be heard out here, consistently.

After listening in for a week on the receiver described in April RADIO, the veracity of their statements seemed quite evident. Accordingly something else had to be done; something more sensitive was necessary in order to hear Europe regularly. About the middle of October the receiver, about which this story is written, was built and almost immediately



Browning-Drake 30 Meter Receiver.

seven different European short-wave stations were tuned in. On another occasion, when working Argentine HB5, he switched to phone, and the receiver was fully capable of hearing this phone that could not be made out on the ordinary type of short-wave receiver.

The main advantages of a set similar to that pictured are the small amount of added apparatus, and the fact that it fits in nicely with the present layout of almost any existing short-wave set.

The list of parts is as follows:

1 National 11-plate equicycle condenser.
1 National 11-plate equicycle condenser, cut down to 7 plates.
2 National type B variable ratio vernier dials.
1 3-pole double throw miniature knife switch. (2 pole O.K.)
1 Lynch single better built mounting.
1 Dubilier .0001 MF fixed mica condenser.
1 Connecting strip with 5 connections.
1 Rheostat. A Lynch equalizer would be preferable, as the filament current is not critical.
1 RF choke, constructed as below described.
1 Pyrex or equivalent socket, mounted on a large sponge, or good springs.
1 Aero products short-wave set of coils and mounting.
1 Small storage battery, 6-volt.
1 Type 201 A tube.
90 volts of B battery.
Connecting wire, baseboard, panel and cabinet.

By referring to the diagram it will be noted that no neutralizing arrangement is used for the r.f. tube. The neutralizing arrangements are almost always connected directly to the grid of the r.f. tube, and this obviously shunts much of the high frequency energy around the first tube, and into the detector, without securing the full added amplification to be gained from the first tube. Right here lies the sensitiveness of the receiver, and as long as the set can be easily built without the use of this neutralization source of loss, a very sensitive and useful receiver results.

The complete absence of the necessity for neutralization is furthermore evinced by the ease with which this set can be tuned. The 11-plate coupling antenna condenser determines to a large extent the selectivity of the arrangement. Where strong local stations within a radius of three to four blocks exist, this feature is quite useful. Then, too, the volume of received signals can be increased, as the maximum is reached. If dead spots are found where the detector portion of the set will not oscillate freely, a reduction in the capacity of this 11-plate antenna condenser will lessen the effect of the dead spot.

No ground is used, since the ground appears to increase power leak noises in greater proportion than the incoming signal. The shielding of the receiver, detector and 1 step audio portion, is not grounded for this same reason, although the shielding reduces body capacity, sharpens local signals, and helps reduce power leak noises. All the batteries for this portion of the circuit are also enclosed with the detector and one step, while separate *A* and *B* batteries are used for the r.f. circuit. This shielding, together with the use of separate *A* and *B* batteries undoubtedly accounts for the fact that no neutralization is necessary.

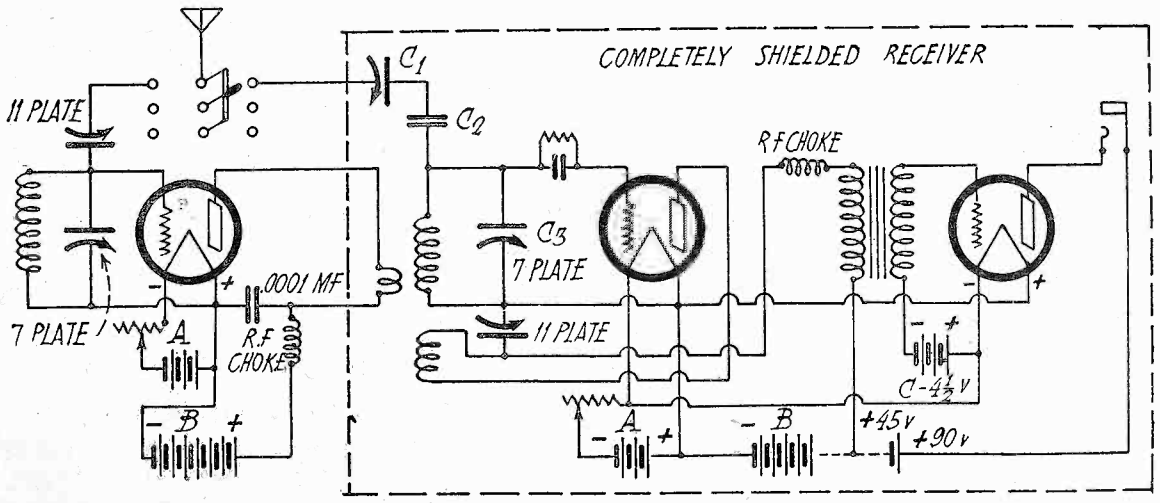
The extreme ease with which such a receiver can be built will be readily realized from examination of the picture. The fact that the present receiver is not to be touched, is a great incentive to adding the unit as shown, placing it on top of the existing set if desired. The plate coupling coil from the r.f. circuit consists of three turns. More turns were found to cause oscillations and critical tuning with virtually no increase in sensitivity. Two turns were obviously weaker. They are wound right over the filament end of the secondary coil of the previous receiver. Three spacing blocks of ¼ in. wood are used to separate the plate winding outside the secondary coil.

National condensers are used because they give 270 degrees of rotation instead of the usual 180 degrees, thus giving greater spacing between stations.

One turn was taken off the Aero Products coil to coincide with the range of wavelength on the writer's own set. If these coils were to be used throughout, the factory number of turns would be correct. The wavelength of the existing system is from 29 to 46 meters, taking in both the high wave Europeans, and the lower wavelength South Americans. No changes in coils are necessary to cover this band.

The r.f. choke is wound on a 1 in. cardboard tube, some 200 turns of No. 34 DCC being used. The 3 pole double throw miniature switch allows the use of the receiver, detector and 1 step in its prior form. The Schnell arrangement as shown gives perfectly satisfactory results, although when the switch is thrown to the left many stations can be tuned in which, at the time, are unreadable, and in many cases inaudible when the switch is thrown to the right. The condenser C_1 serves as a vernier as usual in either case. Condenser C_2 is two 2-in. square pieces of aluminum, ¼ in. apart in air.

The middle blade of the 3 pole switch connects the *A* battery to the r.f. when switch is thrown to left. The bottom blade connects the *A* battery of the detector-amplifier when switch is thrown either way. These connections are not shown, as they are easily put in and might serve to confuse the diagram, as their use is entirely optional. When they are connected the switch then does all three things, shifts antenna, turns on the regenerative set on one side and both the regenerative set and the



Circuit Diagram for Browning-Drake 30 Meter Receiver.

r.f. set on the other side.

In the actual tuning of the set the r.f. tuning condenser is simply set for the desired band of two to four meters. For instance, if this condenser is set at 32 meters, and the detector secondary condenser set to a station coming in on 33 meters, very little increase in signal strength is noted when the r.f. tuning condenser is tuned to 33 meters likewise. For all ordinary work, it is rarely touched, simply moved to the next higher or lower portion of the dial, as the secondary tuning condenser is very carefully tuned as usual.

The amazing thing about the whole proposition is that stations which come in with R-3 to R-5 volume with the 3 pole switch to the r.f. side cannot even be found when the switch is put to the right. The change in setting is so slight on condenser C_3 with the switch either way, that the successful logging of stations is very nearly the same on either position, further simplifying the actual handling of the receiver. So the new man in building up this addition to his present receiver will not have to learn where such and such a station comes in on his dial. We have every reason to believe, however, that he will get much enjoyment and pleasure out of hearing stations he never heard before, or at least never heard so often. Many of those visiting the station have voluntarily stated that they have never heard anything which in any way compared to that heard on this set.

NEW INTERNATIONAL INTERMEDIATES, EFFECTIVE 0000 G.M.T., FEBRUARY 1, 1927

EUROPE

EA—Austria
EB—Belgium
EC—Czechoslovakia
ED—Denmark and Faroe Ids.
EE—Spain and Andorra
EF—France and Monaco
EG—Great Britain and Northern Ireland
EH—Switzerland
EL—Italy
EJ—Jugo-Slavia
EK—Germany
EL—Norway, Spitzbergen and Franz Josef Land
EM—Sweden
EN—The Netherlands
EO—Irish Free State
EP—Portugal, Madeira Is., and the Azores
EQ—Bulgaria
ER—Rumania
ES—Suomi (Finland)
ET—Poland, Esthonia, Latvia, Courland and Lithuania
EU—U. S. S. R. ("Russia"), including Ukraine
EV—Albania
EW—Hungary
EX—Luxemburg
EY—Greece
EZ—Zone of the Straits

ASIA

AA—Arabia
AB—Afghanistan
AC—China (including Treaty Ports) including Manchuria, Mongolia, and Tibet.
AD—Aden
AE—Siam
AF—French Indo-China
AG—Georgia, Armenia and Azerbaijan
AH—Hedjaz
AI—India (and Baluchistan) and Goa
AJ—Japan and Chosen (Korea)
AK—(Unassigned)
AL—(Unassigned)
AM—Federated Malay States (with Straits Settlements)
AN—Nepal
AO—Oman
AP—Palestine
AQ—Iraq (Mesopotamia)
AR—Syria
AS—Siberia, including "Central Asia"
AT—Turkey
AU—(Unassigned)
AV—(Unassigned)
AW—(Unassigned)
AX—(Unassigned)
AY—Cyprus
AZ—Persia

NORTH AMERICA

NA—Alaska
NB—Bermuda Id.
NC—Canada, Newfoundland and Labrador
ND—Dominican Republic
NE—(Unassigned)
NF—Bahama Ids.
NG—Guatemala
NH—Honduras
NI—Iceland
NJ—Jamaica
NK—(Unassigned)
NL—Lesser Antilles
NM—Mexico
NN—Nicaragua
NO—British Honduras
NP—Porto Rico and Virgin Ids.
NQ—Cuba and Isle of Pines
NR—Costa Rica
NS—Salvador
NT—Haiti
NU—United States of America
NV—(Unassigned)
NW—(Unassigned)
NX—Greenland
NY—Panama
NZ—Canal Zone

SOUTH AMERICA

SA—Argentina
SB—Brazil, Trinidad Id., and St. Paul Id.
SC—Chile
SD—Dutch Guiana
SE—Ecuador and Galapagos Archipelago
SF—French Guiana
SG—Paraguay
SH—British Guiana
SI—(Unassigned)
SJ—(Unassigned)
SK—Falkland Ids. and Falkland Dependencies
SL—Colombia
SM—(Unassigned)
SN—Ascension Id.
SO—Bolivia
SP—Peru
SQ—(Unassigned)
SR—(Unassigned)
SS—(Unassigned)
ST—(Unassigned)
SU—Uruguay
SV—Venezuela and Trinidad
SW—(Unassigned)
SX—(Unassigned)
SY—(Unassigned)
SZ—(Unassigned)

AFRICA

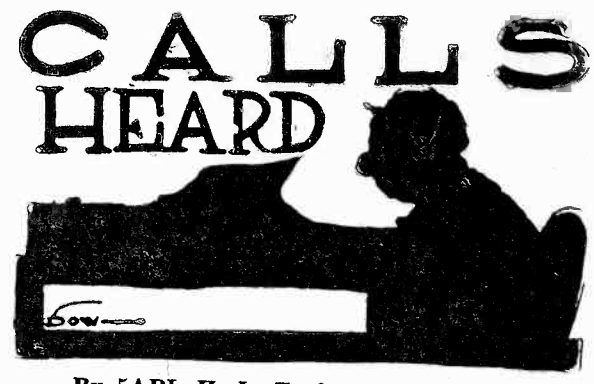
FA—Abyssinia
FB—Madagascar, Reunion Id., Comoro Id., etc.
FC—Belgian Congo, Ruanda, Urundi
FD—Angola and Kabinda
FE—Egypt
FF—French West Africa, including French Sudan, Mauritania, Senegal, French Guinea, Ivory Coast, Upper Volta, Dahomey, Civil Ter. of the Niger, French Togoland, etc.
FG—Gambia
FH—Italian Somaliland
FI—Italian Libya (Tripolitania and Cyrenaica)
FJ—Somaliland Protectorate and Socotra
FK—Kenya, Zanzibar Protectorate, Uganda, Anglo-Egyptian Sudan, and Tanganyika Territory.
FL—Liberia
FM—Tunisia, Algeria, Morocco (including the Spanish Zone), Tangier
FN—Nigeria
FO—Union of South Africa, Northern and Southern Rhodesia, Bechuanaland Protectorate, and Southwest Africa
FP—Portuguese Guinea and Cape Verde Ids.
FQ—French Equatorial Africa and Cameroons
FR—Rio de Oro and adjacent Spanish Zones, Ifni, and Canary Ids.
FS—Sierra Leone
FT—Eritrea
FU—Rio Muni (Spanish Guinea) and Fernando Po
FV—French Somaliland
FW—Gold Coast Colony, Ashanti, Northern Territories and British Togoland
FX—Seychelle Dependencies
FY—(Unassigned)
FZ—Mozambique

OCEANIA

OA—Australia (and Tasmania)
OD—Dutch East Indies*
OE—Melanesia*
OH—Hawaiian Ids.
OI—Micronesia*
OO—Polynesia*
OP—Philippine Ids.
OZ—New Zealand
*To be further partitioned when activity warrants.

SHIP STATIONS

Ship stations with amateur calls will place an X before their usual intermediate. E. g., Australian 3AA at sea, calling U. S. 1AW, would send "1AW NUXOA 3AA". The reply would be "3AA XOANU 1AW".



By 5API, H. L. Treft, Cleveland, Miss.

1adw, 1bns, 1bvb, 1caa, 1cpb, 1cti, 1ctn, 1cuq, 1fl, 1ga, 1gv, 1hj, 1ic, 1kf, 1nx, 1qb, 1ql, 1qv, 1sl, 1ue, 1vz, 2abp, 2aes, 2ahk, 2alw, 2ate, 2bgz, 2bl, 2blm, 2bui, 2bur, 2cin, 2cjb, 2cpa, 2cuq, 2cqz, 2dy, 2ef, 2ev, 2egy, 2ln, 2lr, 2oj, 2rz, 2sf, 3ab, 3aig, 3afu, 3ajt, 3auw, 3bgt, 3bkt, 3ceb, 3ef, 3ex, 3fy, 3gb, 3jh, 3jm, 3ku, 3ld, 3mp, 3tf, 3ut, 3uv, 4ad, 4bq, 4bu, 4ee, 4iw, 4kz, 4lv, 4le, 4ll, 4nf, 4om, 4qb, 4si, 4sp, 4tv, 6acz, 6anc, 6api, 6asn, 6bbn, 6baj, 6bpn, 6btx, 6bvd, 6bxi, 6bxn, 6byh, 6bzn, 6cgm, 6cng, 6cuw, 6el, 6hj, 6kf, 6np, 6ob, 6rf, 7dd, 7fh, 7uw, 8aax, 8abu, 8acu, 8agt, 8akx, 8alk, 8anc, 8ane, 8avx, 8azd, 8ayf, 8baj, 8bir, 8bqr, 8cek, 8ddn, 8drs, 8eq, 8gk, 8qb, 8rh, 8tf, 9abr, 9acf, 9ajd, 9aot, 9apy, 9avb, 9bbn, 9bcn, 9bdg, 9bjv, 9brc, 9cbh, 9cft, 9cjp, 9cok, 9cn, 9csb, 9csi, 9cxq, 9dax, 9dka, 9dvk, 9dzb, 9ebp, 9ei, 9ek, 9ekn, 9elb, 9jt, 9nw, 9sz, 9sk, 9th. Miscellaneous: A8q, BE-VED, KJOE, NAU, PR9C. Mexican: M-jh, M-9a. Canadian: 1ak, 2al, 2bq, 2cc, 3mp, 4dq.

By M. W. Pilpel, G2BZC, 38 Purley Avenue, London, N.W. 2, England.

1aae, 1aao, 1aci, 1ag, 1ahv, 1beb, 1bgc, 1bjk, 1ch, 1ckp, 1cmx, 1ga, 1rd, 1xv, 2ags, 2axy, 2bwa, 2cje, 2cvj, 2cxl,, 2px, 2tp, 3blc, 3cdv, 3gp, 3ld, 3lw, 3mv, 3pf, 3sj, 4ak, 4ft, 5ev, 8alr, 8atv, 8bau, 8ben, 8ccr, 8bcw, 8csv, 8ul, 8yx, 9cej, 9cia, 9ejg, 9ell, bzlan, bzlaq, bzlbi, bz2ab, ch2ab. All calls qsl'd.

By 9CN, 4183 Barry Avenue, Chicago, Ill.

1cfl, 1bhm, 1lc, 1es, 1apy, 1boq, 1aer, 1cnz, 1rd, 1cti, 1bnl, 1ej, 1lv, 1ch, 1bkp, 1bez, 1nl, 1ahb, 1ckb, 1csy, 2tf, 2afz, 2agt, 2agb, 2aun, 2bqz, 2bui, 2aas, 2bsc, 2bwa, 2bs, 2aut, 2ctn, 2adl, 2kh, 2cty, 2ar, 2bbx, 2all, 2aii, 2rrr, 2gy, 2cej, 2afg, 2cuq, 2axq, 3bmc, bms, 3bk, 3ef, 4pf, 4dd, 4ft, 4iz, 4lk, 5apg, 5aei, 5ql, 5apm, 5cf, 5sh, 5auz, 5ef, 5ii, 5adz, 6bzd, 6bhz, 6kb, 6bye, 6bau, 6dan, 6csw, 6azs, 6cuc, 6ih, 6agr, 6bxi, 6chq, 6csd, 6awq, 6bba, 6cfr, 6am, 6ob, 6akm, 6bk, 6zat, 6cuw, 6cae, 6chb, 6ddx, 7uy, 7tj, 7gc, 7ek, 7oy, 7bb, 7jo, 7uw. Australia: 3ef, 5wh, 5ma, 7cw, 3fk, 5bg, 5hg, 5wh, 4cg, 2yi, 3xo, 2sh, 7dx, 2rx, 3tm. New Zealand: 3ar, 2xa, 4ak. Uruguay: 2ar, 1cd, 1yd, 2ak. South Africa: a5o, a5z, a3b, 1sr. Miscellaneous: rxy, C4dw, m9a, mjh, octn, nau, nmi, vgjl, q8kp, bbt, jm2pz, c8azs, pcrl, sih, kdgl, f8fk.

By U7PH—U7AB (ex7HE), 2119 McDougall Avenue, Everett, Washington, U. S. A.

United States: 1axa, 1xm, 2gy, 2tl, 3ot, 4hl, 4xt, 5am, 5eh, 5ek, 5im, 5lg, 5tt, 6aah, 6ae, 6ak, 6akm, 6aaf, 6aos, 6aov, 6ari, 6aiw, 6aij, 6adt, 6bx, 6bz, 6bq, 6bgu, 6btm, 6bmr, 6bp, 6bnu, 6bau, 6bjx, 6baf, 6bys, 6bcn, 6baf, 6cu, 6cf, 6cs, 6cnj, 6cj, 6cau, 6cua, 6ccl, 6ckk, 6cxe, 6ch, 6dp, 6dcq, 6de, 6ha, 6hm, 6oi, 6ul, 6ge, 6zx, 6xm, 6it, 6lx, 6lq, 6gf, 6uf, 6nx, 7aab, 7aah, 7aaf, 7aat, 7abb, 7acm, 7am, 7agn, 7ae, 7bb, 7bm, 7bu, 7cs, 7df, 7dd, 7ef, 7en, 7ek, 7fn, 7fd, 7ge, 7hi, 7cs, 7df, 7mz, 7mk, 7mf, 7nh, 7no, 7nt, 7pp, 7pu, 7qui, 7tk, 7to, 7uo, 7vr, 7vv, 7ya, 8aa, 8drt, 8gz, 8ze, 9ae, 9aek, 9ai, 9bh, 9bt, 9ccq, 9ct, 9dk, 9du, 9dj, 9ek, 9ep, 9hl, 9lae, 9odg, 9ri, 9xax, 9zi, c4ag, a3hl, z2ac, z2xa, rCB8, rTUK, piNPO, piJHR, au7BH, f8ds, fc8em, fm8mb, oh5m, oh6n, poz, por, kft, numm, npo, ndf, nkf, nhds, wiz, wwdo, kegk, kel, wbwi, gdvb, bam, bb3, ba3, wsi, fy, rxy, rrp, rdw, dx7, kel, buv, kel, dmz, ho, och, ma, lp, smy, on one tube. If u hv mi sigs pse qsl! Aw-B-A-Gud-sport. Be gld to arrange schedules with hams. I-QSL, QSR —do you? U7PH.

By 6RO, 284 4th St., San Francisco, Calif.

2uo, 2xa, 3zo, 4rm, 4kb, 5acl, 5ade, 5akl, 5aq, 5auz, 5ew, 5ff, 5kc, 5lg. 5tt, 5 va, hu-6aff, 6ail, 6bus, 6xk, 7aae, 7akk, 7ef, 7eo, 7do, 7jc, 7ly, 7mz, 7mf, 7ne, 7ob, 7or, 7oq, 7wv, 8bpl, 8dbb, 8ly, 8ra, 9aek, 9bdq, 9che, 9cor, 9ctg, 9cuc, 9cww, 9cwq, 9cxl, 9eel, 9eez, 9ye, 9vg. Others: negt, nnc, npm, npo, wvy, zdj, rl.

6ALH, 2604 Prosser, Sawtelle, Calif., U. S. A.

1ae, 1aer, 1aci, 1aff, 1 akz, 1 ami, 1azr, 1beq, 1bez, 1bhg, 1bhs, 1bxh, 1cjh, 1kc, 1xm, 1xv, 2cxl, 2afv, 2alm, 2arn, 2uo, 2gy, 2im, 3vm, 3bls, 3mv, 4xe, 4aa, 7ww, 7gw, 7hx, 7ob, 7oo, 7tj, 8eu, 8yor, 9dkm, 9dka. Australian: A2ar, A3an, A2sh, A4om, A5bo, A5gn, A2bg. Brazilian: 1aw, 2af, 1ax. Canadian: 1bf,, 1ar, 2bg. Chile: 2ar, 2ld, 3ld. Hawaii: 6aff, 6axw, 6dea, 6asr. France: 8ct. Mexican: M9a. Italy: Ico, Iit. Japan: Its. New Zealand: 4aa, 4ag, 2xa, 1xa, 4ac. Bermuda: 4lk, 4ed. South African: a5o, a3e, a3g, a3q, a5f, a5h, a3s.—(Card for card.) ?!

SOUTH AFRICAN RADIO CALL LETTERS

(Continued from January RADIO)

A4N Tupholme, J. R., 81 Marco Bldgs, cor. Loveday and Anderson St., Johannesburg.
A4P Chenik, A., 4, View St., Krugersdorp.
A4Q **Collins, W. E.,** 6 King George Chambers, King George St., Johannesburg.
A4R **Goodman, J. M.,** care Auto Electric Supplies, Aliwal St., Durban.
A4S **Michael, G.,** "Granville," Romney Rd., Green Point.
A4T Ainslie, H. M., 9 Taylor St., Kingwilliamstown.
A4U Fraser, J. M., 126 7th Ave., Bez. Valley, Johannesburg.
A4V **Green, L. E.,** (S.A.R.R.L. Headquarters Stn.), care Box 7007, Johannesburg.
A4W **Barends, J. P.** (Sgt.-Instr.), Military College, Roberts Heights, Pretoria.
A4X **Rieder, H. J.,** "Glen Avis," Monastery Rd., Sea Point.
A4Y Gurland, H., "Frankford House," cor. Church St. and Frankford Rd., Muizenburg.
A4Z **Streeter, J. S.,** Myrtle Grove, Irwell St., Observatory, Capetown.
A5A Green, F. W., 124 8th Ave., Bez. Valley, Johannesburg.
A5Y **Stacey, A. T.,** 67 Warren St., Kimberley.
A5Z **McGregor, M. R.,** Church St., Caledon.
A6A **Goodman, A.,** 105 Hopkins St., Bellevue East, Johannesburg.
A6B **Beard, R. G.,** King's View, Bluff, Durban.
A6C **Yapp, W. G., 1,** Single Quarters, V.F.P., Box 27, Vereeniging.
A6D Roberts, Rev. N., The Rectory, Potchefstroom.
A6E O'Brien, B. A., Queen St., Adelaide, C. P.
A6F **Oehley, F. W. S.,** Warner Beach, Natal.
A6G Turner, J. B., 158 Berg St., Pietermaritzburg.
A6H Jamieson, D. M., 84 Currie Rd., East London.
A6J Rous, D. L., 138 Muller St., Bellevue East, Johannesburg.
A6K Wilson, H. J., Hillrise, Meyerton, Transvaal.
A6L **Beckley, R. J.,** 79 Auckland Ave., Johannesburg.
A6M **Beckley, C. P.,** 78 Auckland Ave., Johannesburg.
A6N **Swart, Major J. G.,** Cambridge House, Milnerton, C. P.
A6O **Smits, G. W.,** Estantia Estate, Hendrina, East Transvaal.
A6P **Olsen, R. F.,** 28 King Edward Rd., Bloemfontein.
A6Q Davidson, A., care Mr. Boyes, Orange Grove, Greenwood Park, near Durban.
A6R Thorne, E., Third Avenue, Fishhoek, C. P.
A6S Cliff, James H., "Alice Grange," Pietermaritzburg.
A6T The Registrar, University of Stellenbosch, Stellenbosch.
A6U **Card, P. E.** (Div. Hon. Sec., Div. 3), 9 Signal Hill, East London.
A6V Holmes, R. J., 21, 1st Infantry Lines, Roberts Heights, Transvaal.
A6W **Faull, A. S.,** Gordon's Bay Rd., Strand, Capetown.
A6X Bowles, Erf. No. 109, Piet Retief.
A6Y Smith, R. E. S., 6 Sussex Rd., Observatory, Capetown.

RHODESIA

1SR **Davidson, J. M.,** Box 580, Salisbury.
2SR **Musgrave, G.,** Box 38, Selukwe.
5SR **Whiteside, The Rev.,** St. George's School, Bulawayo.
6SR **Heaume, H. le P.,** P.O., Selukwe.
7SR **Pryce-Williams, A.,** Antelope Mine, Matopos.
8SR **Ryneveld, J. van,** Shepherds' Reef, Hartley.
9SR **Emptage, S.,** Salcombe, Plumtree.
SR **Mail, Captain Douglas,** care Div. Headquarters, Box 38, Selukwe.

SOUTHWEST AFRICA

Z3A **Robinson, L.,** Box 88, Luderitz.

BRITISH EAST AFRICA

KYIVP **Hughes, L. J.,** care Mombasa Radio Station.

PORTUGUESE EAST AFRICA

CVPE **Gariso, A.,** B. M. R. Telegraphs, Villa Pery.

Radio Photography

(*Continued from page* 19)

Half tone effects are produced by dividing up the picture in five or more separate shades such as, white, light gray, medium gray, dark gray, and black. The transmitting and receiving machines analyze and reassemble these shades automatically. Various methods may be worked out for translating light intensities into radio signals. One method would be to use five wave lengths, one for each shade. The usual practice, however, is to utilize a single wave length.

The transmitting machine automatically selects the shade that comes nearest to one of the five shades, and sends out a telegraphic signal which selects the corresponding shade in the receiving machine. This sounds more complicated than it really is because the telegraphic code by which different shades are selected depends upon the synchronization of the two machines which is necessary under all circumstances. Thus black in the picture is produced by exposure of the sensitive paper to the recording light spot during four successive revolutions, whereas, light gray is produced by a single exposure during one of the four revolutions and no exposure for the three succeeding revolutions. The overlapping exposure is progressive and the whole works as a continuous process.

Television

WHEN we embark on such an ambitious program as television, it behooves us to reason out, so far as it is possible, whether the results we expect to get are going to be worth while even if our most sanguine hopes are fulfilled. We have before us a struggle with imperfections of our technique, with problems which are difficult but which may be solved.

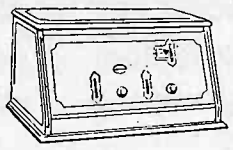
In every branch of engineering, there are, however, limitations which are not within our control. There is the question whether the medium with which we are dealing is capable of functioning in accordance with our expectations and desires. We are dealing with the photoelectric cell, the amplifier, the antenna and the radio wave. The photoelectric cell and the amplifier employ the medium of the electron which is extremely fast, but the use of the radio wave itself imposes certain speed limitations on account of the limited scale of available wave lengths. The question therefore remains, what quality of reproduction may we ultimately expect in a television system if we succeed to take full advantage of the ultimate working speed of the radio wave?

Using the selective shade process on a 12,000 meter wavelength (25,000 cycles) a recognizable picture can now be transmitted in two minutes. A longer time

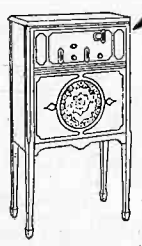
(*Continued on page* 50)

CROSLEY 1927 RADIOS

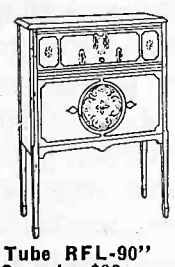
Each set giving the utmost in radio enjoyment at its price. All prices slightly higher West of the Rocky Mountains. All prices are without accessories.



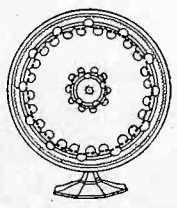
The 5-50—$50
Enthusiastic owners report amazing performance—a drum delivering stations loud, clear and sharp; each an almost imperceptible turn of the drum apart. Write station letters on drum, return to them at will. Single drum Station selector. Acuminators, power tube adaptability and all metal chassis that shields the units from each other. Beautifully finished. Mahogany cabinet, rose gold trimmings.



The 5-75 Console—$75
This set includes ideas for radio reception perfection not found in any other radio. Marvelous exclusive Crosley "Crescendon" and "Acuminators" increase volume on distant stations and bring in programs entirely missed and passed by on ordinary one-dial control radios. Console model stands 40 inches high. The Crosley Musicone is skillfully built into the cabinet in a manner which is both an artistic and an acoustical triumph. Ample space for batteries and accessories.



"6 Tube RFL-90" Console, $90
Introducing the double drum station selector! Crosley's winning non-oscillating perfectly balanced tuned radio set. Includes Musicone skillfully built into exquisite console mahogany cabinet of two-tone finish to match finest surroundings. Room for batteries and all accessories; 40 inches high; 30½ inches wide.



THE CROSLEY MUSICONE
The secret of the popularity of this biggest selling loud speaker on the market lies in its actuating unit. This and NOT the cone shape is the reason for its perfect reproduction of all audible sound. BEWARE of imitations. There is only one genuine Musicone. It is built solely by Crosley under mass production methods which makes its unmatchable value possible.

CROSLEY
BETTER COSTS LESS
RADIO

"-as long as I can pick up 27 programs in 30 minutes beside our 3 locals interference won't bother me

I sat down the other night with this Crosley set. One control. Beginning at one end of the broadcasting wave band, I tuned in 27 stations, loud and clear, just like the Cincinnati stations, three of which were going full blast. I listened to each program; identified it; didn't hear any others in the background, and passed on to the next,—all with one finger. It was between 7:00 and 7:30 P. M. Central Standard Time.

The air was certainly full. Some of the stations were less than a dial marking apart. It is amazing how the jiggers they call "acuminators" helped on such fine separation.

Even using a hundred foot aerial the local stations were easy to go through. One of them only a few blocks from my home.

Some radio, I call it $50.00 seems too little. I'd like to see some two hundred dollar sets do as well!"

Write Dept. 19 for Catalog

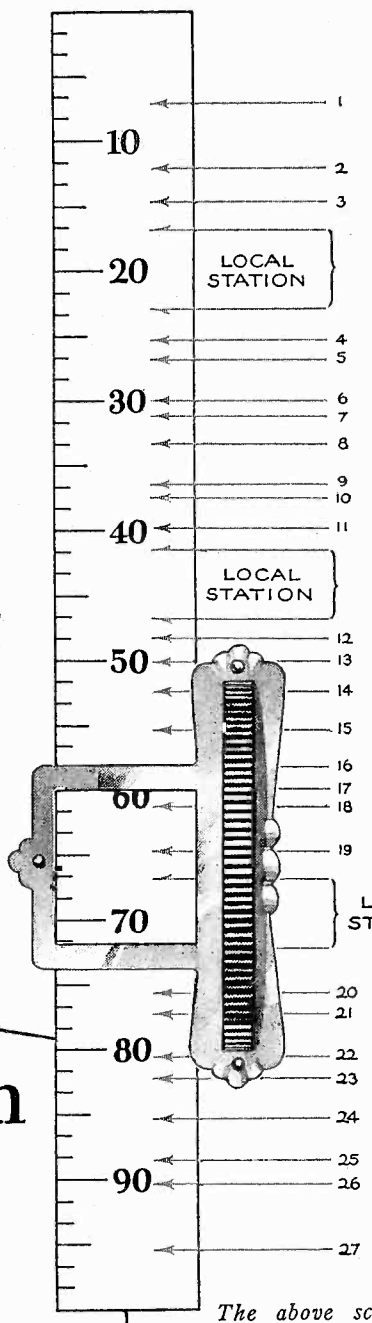
The Crosley Radio Corporation
Powel Crosley, Jr., Pres.
CINCINNATI, OHIO

Crosley sets 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.

Single Drum Control

$50.

Prices slightly higher West of the Rocky Mountains.



The above scale reading shows how stations picked up by Mr. X—appeared on the Crosley graphic drum station selector.

Name on request.

CROSLEY 1927 FEATURES

Many exclusive — others found only in highest priced radios.

THE "CRESCENDON"
When, on ordinary radios, ears must strain to catch a station miles away, a turn of the Crescendon on Crosley radios instantly swells reception to room filling volume. An exclusive Crosley feature.

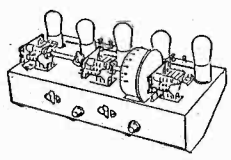
ALL-METAL SHIELDED CHASSIS

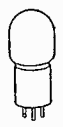
This truly great radio achievement, found in several Crosley sets, furnishes a substantial frame for mounting elements, produces excellent alignment of condensers, shields the units from each other, prevents interstage, improves the stability of the circuit, increases selectivity and saves costs by standardizing this phase of manufacture.

THE SINGLE-DRUM STATION SELECTOR

Nothing in radio equals the joy or the convenience of single drum control. Crosley single drum control enables you to find the stations sought without log book or "tuning."

"THE ACUMINATORS"
Crosley Acuminators permit tuning in—loud and clear—weak stations passed over and entirely missed by ordinary single dial radios. In tuning high powered and local stations they are not used. They are an exclusive Crosley feature.





POWER TUBES

Power tube adaptability marks the Crosley "5-50", "5-75" and "RFL" sets. This feature typifies Crosley provision for best radio reception at moderate cost.

RADIO PHOTOGRAPHY

(*Continued from page* 48)

gives a sharper picture. On a wavelength of 12 meters (25,000,000 cycles) it might be possible to transmit a picture in 1/1000th of this time or ⅛th second, if the photoelectric cell, amplifier and light control could keep up this pace. This could qualify as radio vision.

But Bernard Shaw specified a life size picture on the screen, which offers a fundamental difficulty. One of the accompanying pictures shows a television projector, consisting of a source of light, a lens, and a drum carrying a number of mirrors. When the drum is stationary, a spot of light is focused on the screen. This spot of light is the brush that paints the picture. When the drum revolves, the spot of light passes across the screen. Then as a new mirror set at a slightly different angle comes into line, the light spot passes over the screen again on a track adjacent to the first and so on until the whole screen is covered. If we expect to paint a light picture of fair quality, the least that we can be satisfied with is ten thousand separate strokes of the brush. This may mean that the spot of light should pass over the screen in one hundred parallel paths and that it should be capable of making one hundred separate impressions of light and darkness in each path. If we now repeat this process of painting the picture over and over again sixteen times in a second it means that we require 160,000 independent strokes of the brush of light in one second. To work at such a speed seems at first inconceivable; moreover, a good picture requires really a scanning process with more than 100 lines. This brings the speed requirements up to something like 300,000 picture units per second.

Besides having the theoretical possibility of employing waves capable of high speed of signalling, we must have a light of such brilliancy that it will illuminate the screen effectively, although it stays in one spot only one-three hundred thousandths of a second. This was one of the serious difficulties because even if we take the most brilliant arc light, we cannot figure out sufficient brilliancy to illuminate a large screen with a single spot of light. The model television projector was built in order to study this problem and to demonstrate the practicability of a new system which promises to give a solution to this difficulty.

The result of this study is briefly that, if we employ seven spots of light instead of one, we will get 49 times as much useful illumination. Off hand, it is not so easy to see why we gain in light by the square of the number of light spots used, but this can be explained with

reference to the model. The drum has twenty-four mirrors and, in one revolution of the drum, one light spot passes over the screen twenty-four times; and when we use seven sources of light and seven light spots we have a total of 170 light spot passages over the screen during one revolution of the drum.

The gain in using seven beams of light in multiple is twofold. In the first place we get the direct increase of illumination of 7:1 and we have the further advantage that the speed at which each light beam must travel on the screen has been reduced at a rate of 7 to 1, because each light spot has only 24 tracks to cover instead of 170. While the light itself may travel at any conceivable speed there are limitations of the speed at which we can operate a mirror drum or any other optical device and the drum with 24 mirrors has already been designed for the maximum permissible speed. A higher speed of the light spot can therefore be attained only by making the mirrors correspondingly smaller and a mirror one-seventh as large will reflect only one-seventh as much light. The brilliancy of the light spot would therefore be only one-seventh of what we realize by the multiple beam system, which gives seven light spots seven times as bright or 49 times as much total light.

There is another advantage in the use of the multiple light beam. Each light beam needs to move only one-seventh as fast and therefore needs to give only 43,000 instead of 300,000 independent impressions per second. A modulation speed of 43,000 per second is high with our present radio practice but yet within reason, being only ten times as high as we use in broadcasting.

The significance of the use of multiple light beams may be explained from another point of view. It is easy enough to design a television system with something like 40,000 picture units per second, but the images so obtained are so crude that they would have very little practical value. Our work on radio photography has shown us that an operating speed of 300,000 picture units per second will be needed to give pleasing results in television. This speeding up of the process is unfortunately one of those cases when the difficulties increase by the square of the speed. At the root of this difficulty is the fact that we have to depend upon moving mechanical parts.

If we knew of any way of sweeping a ray of light back and forth without the use of mechanical motion, the answer might be different. Perhaps some such way will be discovered, but we are not willing to wait for discovery that may never come. A cathode ray can be deflected by purely electro-magnetic means, and the use of the cathode ray oscillograph for televisions has been suggested. If however, we confine our

(*Continued on page* 52)

(*Continued from page* 51)

attention to the problem as first stated, of projecting a picture on a fair sized screen, we know of no way except by the use of mechanical motion. If we also insist upon a good image we find that we must speed up the process 7 times and in doing so we must reduce the dimensions so that we will have only one-forty-ninth as much light. Our solution to this difficulty is, not to attempt to speed up the mechanical process but to paint seven crude pictures simultaneously on the screen and interlace them optically so that the combination effect is that of a good picture.

Tests have been made with this model television projector to demonstrate the method of scanning the screen with seven beams of light working in parallel simultaneously. The seven spots of light may be seen on the screen as a cluster. When the drum is revolved these light spots trace seven lines on the screen simultaneously, and then pass over another adjacent track of seven lines until the whole screen is covered. A complete television system requires an independent control of the seven light spots. For this purpose seven photoelectric cells are located in a cluster at the transmitting machine and control a multiplex radio system with seven channels. A Hammond multiplex system may be used with seven intermediate carrier waves which are scrambled and sent out by a single transmitter and then unscrambled at the receiving station so that each controls one of the seven light beams.

Seven television carrier waves may thus be spaced 100 kilocycles apart and a complete television wave band should be 700 kilocycles wide. Such a radio channel might occupy the waves between 20 and 21 meters. If such use of this wave band will enable us to see across the ocean I think all will agree that this space in the ether is assigned for a good and worthy purpose.

How long it will take to attain this end I do not venture to say. Our work has, however, already proven that the expectation of television is not unreasonable and that it may be accomplished with means that are in our possession at the present day.

RADIO PROSPECTING

(*Continued from page* 28)

of the coil vertical) and when on the side of a vein, the magnetic field is distorted and the axis of the coil points toward the vein, giving, as it were, angles that intersect somewhere near the magnetic center of the mineral vein. Of course, allowance is made for errors due to local factors, as topography, and possible errors from water courses.

Many conditions arise in actual practice that necessitate special measures. Yet the operation is simple, and the calculations are not difficult. The success of operation depends on having a good geologist.

Insist on hearing RGS this receiver

42 Stations in 30 Minutes

Miami Beach at 5:30 in the afternoon from within one half mile of Station WBBR, New York City— Chicago on the same afternoon without an antenna—

THESE are just a few recent feats performed by an assembled R.G.S. Receiver. The R.G.S. Receiver, built by David Grimes for modern broadcast conditions and employing a new application of the Inverse Duplex System, is a development that will leave an indelible impression upon all receiver designs.

The R.G.S. is offered complete in kit form in order to keep the price down to "rock bottom," thus allowing more people to take immediate advantage of this new principle of construction that establishes new standards for selectivity, distance, sensitivity and tone quality. Price $69.70, without accessories or cabinet.

Authorities in the radio field, such as Arthur H. Lynch, R. W. Cotton, Robert S. Kruse, Volney Hurd, Willis Kingsley Wing and Zeh Bouck, have greeted the R.G.S. Receiver with unprecedented enthusiasm. They are as amazed by its performance as you will be.

Write today giving us your name and address and the name and address of your dealer. We will then arrange for a demonstration of an assembled R.G.S. Receiver in your territory and you can determine for yourself just what is behind our claims. No obligation.

Write

R. G. S. SALES DIVISION

GRIMES RADIO ENGINEERING COMPANY, *INC.*

285 MADISON AVE. NEW YORK CITY

DEALERS: Write for complete merchandising information

BUILT FOR MODERN (THESE TOOLS ONLY) BROADCAST CONDITIONS

INFRADYNING R. F. RECEIVERS

(*Continued from page 22*)

Changing the Silver Six

A GOOD example of a six-tube shielded receiver having three r.f. stages is shown in the rear view of the Silver Six. This receiver has all four tuned circuits, with associated tubes, enclosed in metal boxes, with interconnecting wiring on the under side of a metal base plate, so that solenoid type coils may be used, and a high degree of efficiency attained, as well as remarkably fine selectivity.

Here, as in the Counterphase, the adaptation of the circuit to the infradyne is relatively simple, and involves the removal of only one connecting wire, leading from the plate of the detector tube, down through the metal baseplate, and back through the plate to the *P* terminal of the first audio transformer. These two terminals are connected to the infradyne adapter as is shown in the schematic wiring diagram of the Silver Six with the adapter completely wired in place. A 30 ohm rheostat has been connected in the filament of the tube, which was originally the detector in the six-tube set, but is now the mixer tube, so that the sensitivity of the mixer may be properly adjusted. The detector in the regular Silver Six circuit uses a *C* battery, so that the *C* connection must be removed and a grid condenser and leak installed as shown in the diagram. As the set is completely shielded, the adapter unit can be mounted on top of the six-tube set, thereby shortening the space required on the table.

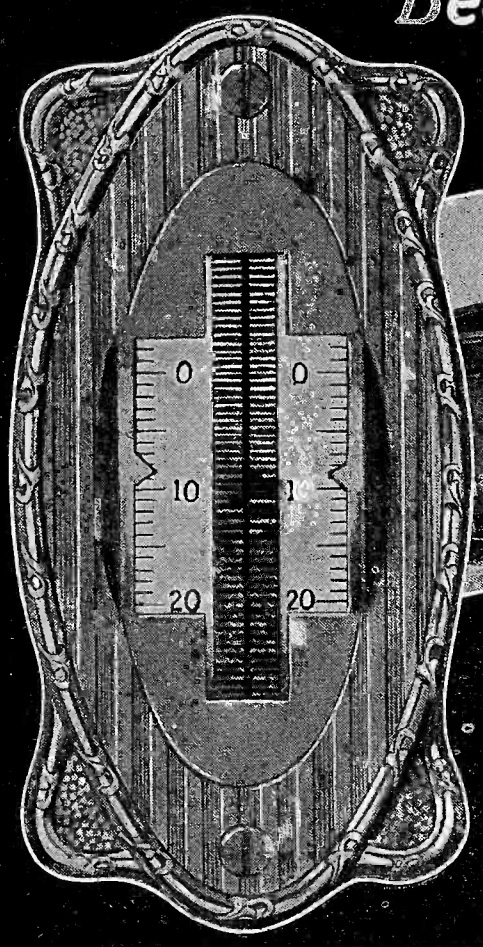
In the detector plate circuit of the Silver Six is installed an r.f. choke and a .001 mfd. by-pass condenser, which should be removed, as they are not necessary for the operation of the set with the infradyne adapter. As the r.f. component in the detector plate is approximately 3,500,000 cycles, the distributed capacity in the audio transformer primary is sufficient to by-pass the r.f. back to the filament. However, the condenser may be left in if desired, but the choke should be removed. No instructions for the shielded six are given, as a complete instruction book comes with the kit of parts, and space is not available for their inclusion here. Adjustment of the r.f. stages is made in as a six-tube set, and the switching combination can be used, if it is desired to dispense with the adapter on local stations.

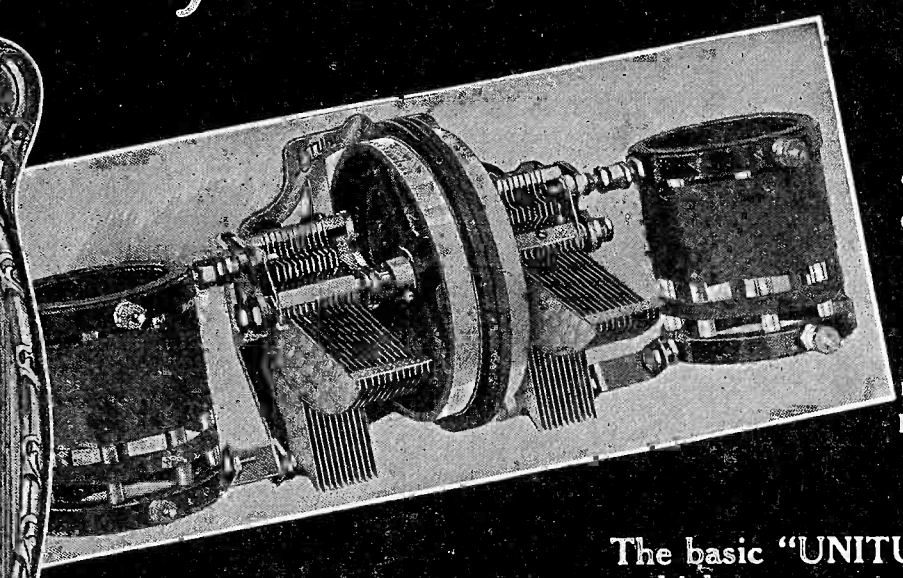
The 30 ohm filament rheostat in the mixer tube filament should be mounted on a small bakelite strip, placed alongside the first Silver Marshall audio transformer. As the space available is quite small, a Carter Midget rheostat should be used, with adjustment made by means of a set screw used in place of the knob ordinarily furnished for panel

(*Continued on page 78*)

THE **Simplicity** of tuning
THE **Efficiency** of the Bakelite Shaft Condensers and Quatzite Coils
and the **Beauty** of the Bronze Front Plate

"Bruno" UNITUNE THE HEART OF THE CIRCUIT





Makes the "UNITUNE" the most desirable tuning device ever designed.

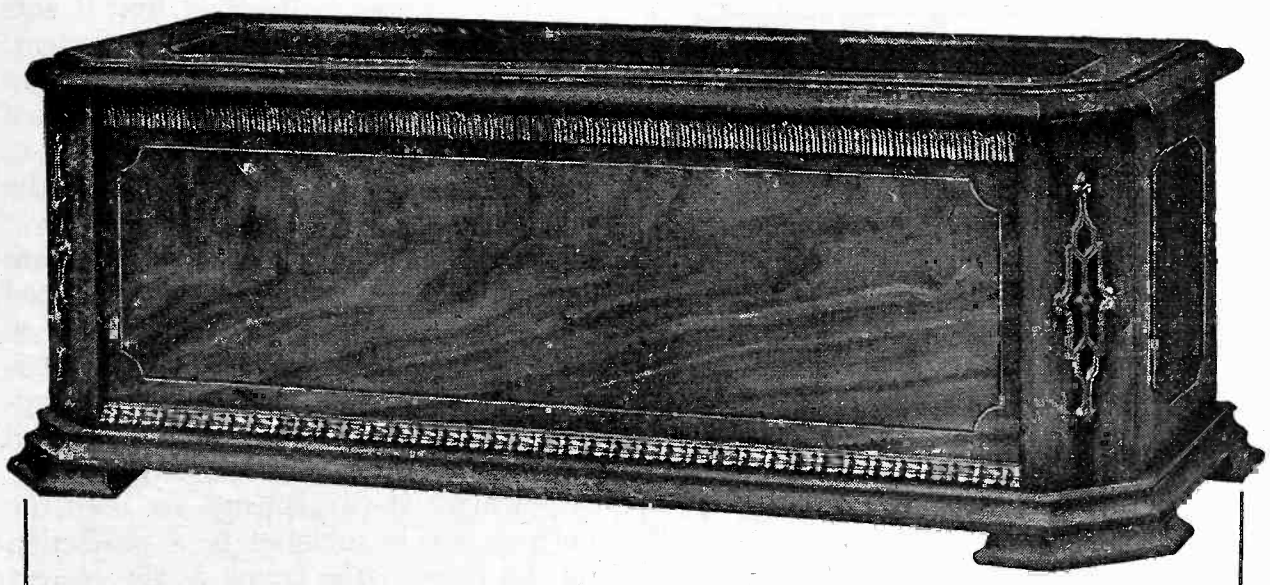
ALL BRUNO "UNITUNES" may be mounted on a panel with only two screws.

The basic "UNITUNE" consists of a frame upon which are mounted two condensers operated independently by two bakelite drums projecting thru a beautiful bronze plate. It may be obtained in all standard capacities. Completely assembled it lists at $11.00.

Other "UNITUNES" assembled with one or more Quartzite Coils for all popular circuits range from $12.00 to $21.00.

Booklet of Instruction and Blue Prints—25c

BRUNO RADIO CORP., LONG ISLAND CITY, N. Y.



GLORIFY YOUR INFRADYNE

EXQUISITE Beauty. An appropriate "dress" for your splendid Infradyne Receiver. Do justice to your set by housing it in a CORBETT cabinet — specially designed and built for the Sargent-Rayment Infradyne. The illustration fails to justify it. The workmanship is of the usual Corbett quality. We specialize in building radio cabinets. The Corbett Infradyne Cabinet will accommodate a 7x30-inch panel. The cabinet is 10 inches deep. Built of Walnut, beautifully finished. The lid is equipped with a continuous hinge. The cabinet is correctly moulded and decorated. Hand-rubbed duo-tone piano finish.

Each cabinet is securely packed and crated for shipment. Mail orders for these cabinets will receive prompt attention. Write for folders showing our complete line of radio furniture.

PRICES:

Walnut Cabinet for Infradyne, 7x30-inch panel space, 10 inches deep	$30.00
Corbett Walnut Plywood Panel to match	2.10
Splined and Varnished Mounting Board, 10x34 inches	2.00
Walnut Table to match, and for above cabinet with 14-inch high battery compartment	36.00

CORBETT CABINET MFG. COMPANY

ST. MARY'S PENNSYLVANIA

BUILD THESE WONDER CIRCUITS

SIMPLICITY 4 TUBE RECEIVER

as described in last issue — COMPLETE PARTS with instructions $52.50

Other popular kits ready for shipment. Every kit includes full instruction sheets for wiring.

NEW IMPROVED "DIAMOND OF THE AIR" KIT

complete parts $37.50

with ABC Eliminator Kit $75.00

Licensed under Armstrong Patent 1,113,149.

Manufactured by Clapp-Eastham Co. exclusively for the Bruno Radio Corp.

	Complete Kit
Hammarlund-Roberts Hi Q Improved	$63.05
Browning-Drake Receiver	$65.90
Henry-Lyford Receiver	$69.50
Silver-Marshall Shielded Six	$95.00
The Infradyne	$118.00

and other kits, eliminators, speakers, etc.

Always in stock.

Bruno PRODUCTS

Acme, Aero, Bodine, Carter, Samson, Silver-Marshall, Ceco tubes and others

Send for New Booklet

B. C. L. Radio Service Co., Inc.

221-R Fulton St. New York, N. Y.

How to Make a Single Phase Wattmeter

(*Continued from page 30*)

The Bradleyunit is mounted on the frame by means of a piece of No. 14 wire soldered in a hole, very conveniently provided in its cap, and held to the frame by a 6-32 bolt threaded into the top piece. One of the flexible leads from *V* is also brought to this bolt. This is clearly shown in Fig. 2, where the Bradleyunit is seen, mounted vertically, to the left of the frame.

The scale is made of bristol board and is glued to a piece of $\frac{1}{32}$ in. thick aluminum 4¾ in. long by 2 in. wide. The aluminum is polished and the scale cut away as shown in Fig. 7 (showing

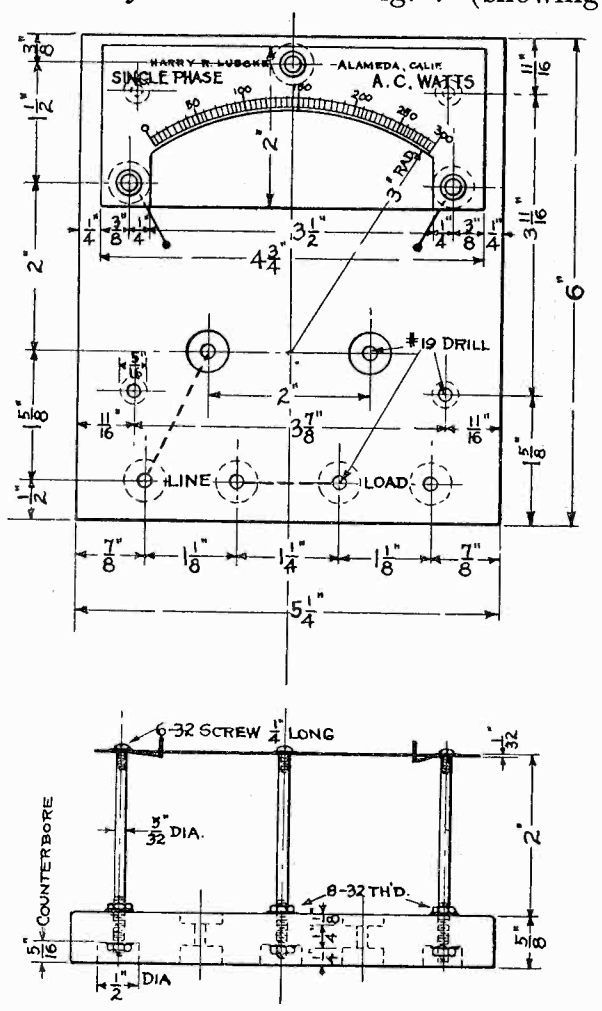


Fig. 7. Assembly Details.

the base with scale and supports in place) so that the metal may be used as a mirror for eliminating parallax when reading the pointer. Stops, against which the pointer can collide on violent throws, are fastened under the front scale holding down bolts as shown. They are made of a piece of No. 18 wire, looped and flattened at one end, and provided with buffers of electrician's tape at the other.

The case is made of a "Pedro" tobacco can which is suitably cut, soldered, and painted so that its original character is completely obliterated. The can measured 7½x5x4 in. It is cut at the end where the window is to be located, decreasing its length to 5 in.; allowing, however, ½ in. extra for telescoping one portion inside the other for soldering. The final height is 2⅞ in., but the metal is cut along a line 3 in. from the top, allowing a ⅛ in. flange around the inside at the bottom. Lugs are left in each corner, ⅞ in. long by ⅝ in. wide, which are subsequently soldered together to form holding down lugs and incidentally strengthen the sides. As can be seen in Fig. 2, where the bottom of the case is towards the reader, the lugs are drilled and threaded 8-32 so that they will engage the 8-32 screws placed in suitable holes in the base for the purpose of holding the case on. A hole is provided through which the adjustment screw protrudes, and three more at the opposite end for the clamps which hold the glass. The zero adjustment screw hole has a washer soldered over it to give a "finished" appearance.

The glass window, measuring 4⅞ by 2 in., is clamped over a piece of cardboard by small brass clamps shown in Fig. 6, which are held in place by 6-32 screws. The cardboard is shellacked to the case. Upon completion the case is given two coats of black automobile color varnish and the wood base two coats of shellac or varnish.

Since the case is made of iron it acts as a magnetic shield for the instrument. Any can of suitable size and shape can be used and the details can be worked out to suit the constructor's taste as they have little, if any, effect on the operation of the meter.

As a final step the various parts are assembled. The movable coil is placed in position and the bearings adjusted so that they do not bind. The spring is clamped in its notched wire on the adjustment screw and is adjusted until the pointer reads zero when no current is flowing. If two springs are used the bottom one is soldered to a projection on the base of the frame in the correct position and all adjustment secured by the top one and the adjustment screw. The movable system is next balanced by the application of solder to the three points of the balance cross until the pointer remains at the zero on the scale

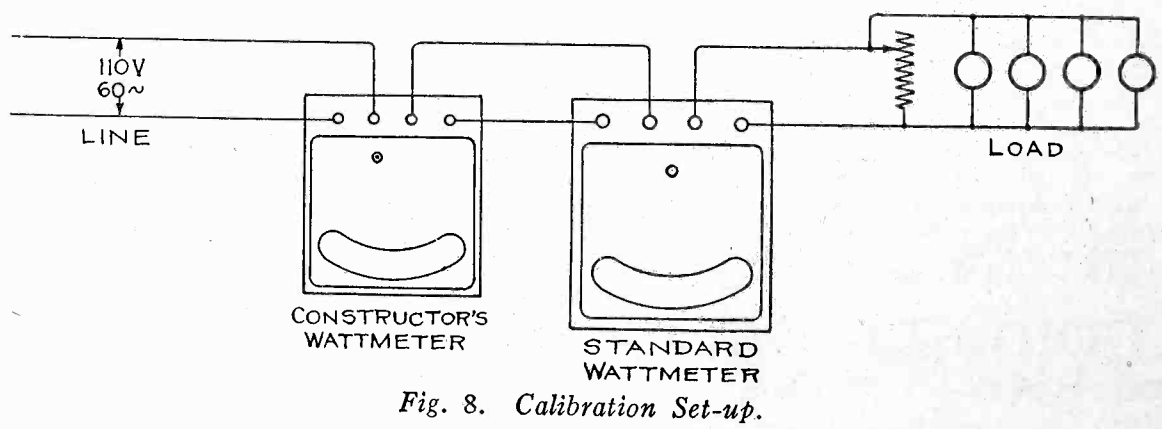


Fig. 8. Calibration Set-up.

regardless of how the instrument is tipped or turned. The balancing should be accomplished with the use of as little solder as possible in order to keep the movable system light.

A known load of about 300 watts is now applied and the deflection noted. If this oversteps the scale, making the maximum 250, or if it does not give a full scale deflection and the estimated range appears to be 400 or so, adjust *R* so that the desired scale range will be secured. If the pointer is thrown off the scale in the wrong direction the leads to the potential coil should be reversed.

For calibration, the instrument should be complete, with case on, and subject to the conditions that are to be expected in later service. If flexible leads are used they should be coiled up and given a permanent position where they will not interfere with the stationary parts. All connections and adjustments should be made with finality so that after calibration no unwanted variations will take place and destroy the accuracy of the meter. The glass may be left out so that the position of the pointer can be marked as various loads are applied.

The most desirable method of calibrating the meter is by a comparison test with a well made standard such as found in university, testing, or high school laboratories. The two meters are connected to a source of power, the constructor's meter nearest the line, and to a load that can be adjusted. If the meter is to be used chiefly on 110 volts a.c. then this source should be used so that operating conditions will be duplicated as far as possible. This is for the purpose of excluding any errors that might creep in due to variation of wave form, frequency, or voltage. It is customary among manufacturers to state the limits of amperage and voltage that are permissible with a wattmeter. With this meter we can safely pass 4½ amperes and handle a maximum voltage of approximately 140 volts. The normal values are 3 amperes and 100 volts.

Fig. 8 shows a characteristic calibration setup. In operation, the resistance and the lamp bank are adjusted until a convenient amount of power is being consumed, say 10 watts. The deflection of the pointer on the constructor's instrument is noted and its position marked accurately with a hard drawing pencil. The load is then adjusted to draw 20 watts as indicated by the standard instrument and the next point drawn in. This is repeated until the maximum reading is reached. Finally, the pencil marks are drawn in ink and a suitable scale, with figures and other embellishments desired by the constructor, made. If 5 watt divisions are wanted they can be determined by interpolation with negligible error, or determinations of every 5 watt increment may be made.

RADIO WORK SHOP

(*Continued from page* 33)

much work is to be done. It is a good thing to add a motor. One of a quarter horsepower will drive any jig saw now on the market.

As to saws for the circular saw table and the jig or band saw, there is this to be said: For the circular saw stock there should be several kinds, each adapted to a special work: set rip saws, set crosscut saws, metal cutting saws with no set, novelty saws for wood, also unset, and saws for fibre. The latter and the saws for metal look so much alike that there is much opportunity for confusing them. For this reason they should be marked at the time of purchase, by means of acid or iodine through cuttings in a wax film.

Some of these saws, such as the metal cutting saws, come in various thicknesses. A metal cutting saw about ⅛ in. thick, is useful for wood work, where a thin, smooth cut has to be taken from the edge of a piece. A thick saw can not bend away from the work, and so must stand up to it and cut to the line. A set saw will stay to the line but will leave the edge rough. A novelty saw will make a smooth cut but will bend away from the line.

The rip novelty saw has three short teeth in succession, followed by one long (deep) tooth, then a repetition of three and one as before. The cross-cut novelty saw has five short teeth followed by one long tooth. In both cases the long tooth is a cleaner, tending to smooth the cut. The work comes from the saw as smooth as if planed.

A thin-rim, special ground circular saw has a thick main portion to withstand the bending tendency and a thin edge to do the cutting. It is adapted to thin, light cuts, and should have a place in the aspiring laboratory.

Jig and band saws can be obtained with thin backs so as to give a desirable clearance at the rear edge. This gives a smooth cut and avoids the necessity of a set on the saw.

As the saw table needs saws, so the drill press needs drills. Here too the types are several. The most frequently needed are those for metal, and there are many shops and laboratories which have nothing but metal drills in their equipment. But it should not be so.

For the metal drills there should be two separate and complete equipments, one set from 1/16 in. to ½ in. by sixty-fourths, and one set from No. 60 to No. 1 by the graduated steps of the Morse twist drill scale. This equipment is the more important because all the drilling sizes for machine screw taps are found in the Morse drill sizes with the single exception of the size 18, which taps into a 15/64 in. hole.

The wood drill is exactly like the metal drill as far as the main body of the tool is concerned, but at the tip there

(*Continued on page* 60)

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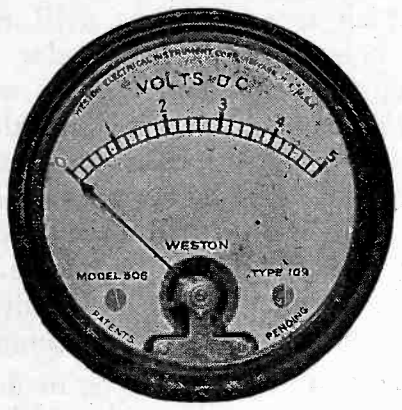

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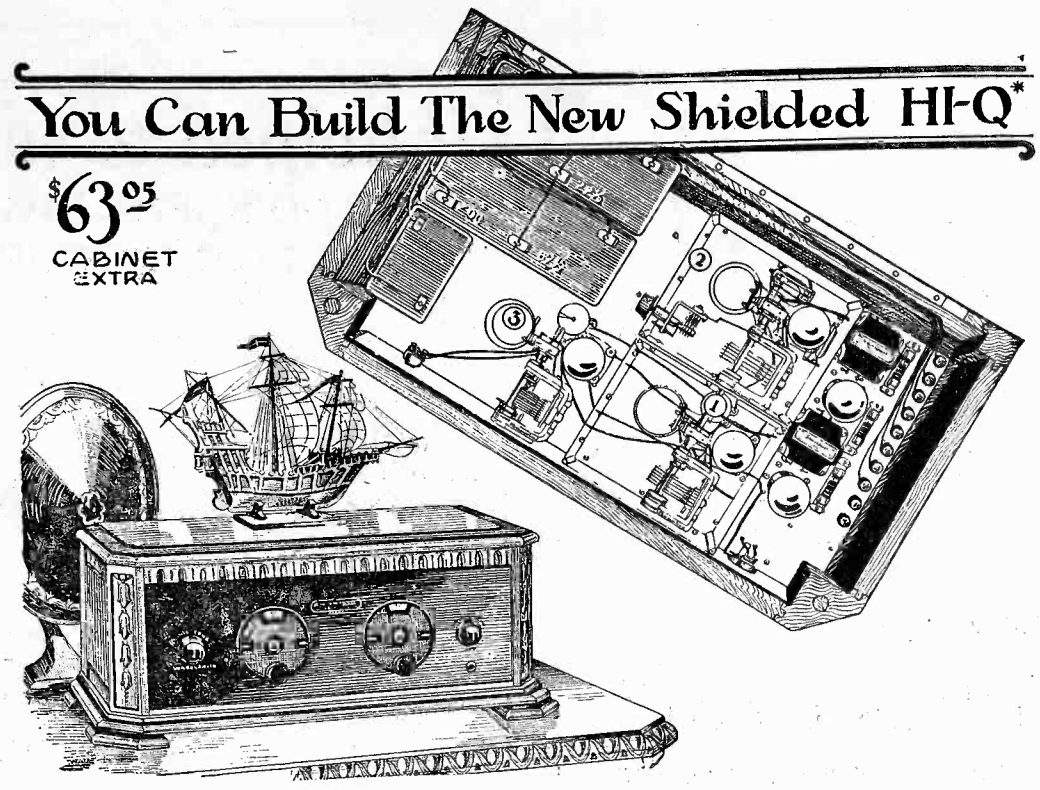

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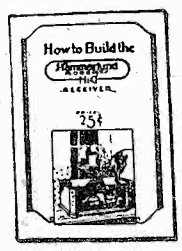

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RADIO WORK SHOP

(*Continued from page* 58)

are lips and a transverse cutting edge somewhat like an ordinary carpenter's auger. The resulting tool can cut any wood swiftly, cleanly and truly. Its sharp point, extending well beyond the cutting edges and lips, is adapted to pick up the small mark made by the scriber in laying out the work; the sharp lips cut to the diameter without any burring or splintering of either side even in the softest wood.

The final type of drill is the Forstner bit, which is adapted to drill flat-bottomed holes. It has a circular (hoop-like) cutting rim, and will do wonders in drilling parts of holes and the like. For counter-boring it is invaluable, as often in such a case there is nothing for the counter-boring drill to follow at its center. As the Forstner bit guides itself by its rim, there is no disadvantage in the absence of the center guidance.

Lathe tools should all be made from tungsten (high speed) steel, which stands the heat of its work better than carbon steel. Where the latter would get so hot as to draw its temper and soften it till it lost its edge, the tungsten steel will stand up to the work and often produce red-hot chips or turnings. Tungsten steel is very simply hardened. If it require shaping into a tool by forging, simply heat it till white sparkles appear at the edges and corners, then pound it into shape on the anvil or vise, then grind it to the desired final cutting form on the carborundum wheel; it is now ready to be hardened; to do this, heat the tool in the Bunsen gas flame or in an acetylene flame till the edges and corners show the same sparkles as before then quench in linseed oil. If only the steel be hot enough at the moment of quenching, it will be hard as it comes out of the oil, and will stand up under heavy work. If there is doubt about it, all that is necessary is to go over the process again, heating the metal to the right degree.

You will have noticed that we mentioned an acetylene flame. This is provided by hiring a tank of Prestolite gas, buying an acetylene blowpipe, uniting the two by a rubber hose and proceeding to the work of whatever kind requiring high heat. This is not an oxy-acetylene rig, as the only oxygen used is that of the 21 parts per unit volume of air consumed by the pipe. This amount, however, is enough for the purpose. The resulting flame is blue, is hot, and while it will not do welding, will melt many materials and will harden steel.

To distinguish carbon from tungsten steel, hold the questioned piece against the grinding wheel. If the sparks are bright and scintillating—star-like—appearing at intervals in the straight tangential bright line of spark—then the material is carbon steel. If the stream of

(*Continued on page* 62)

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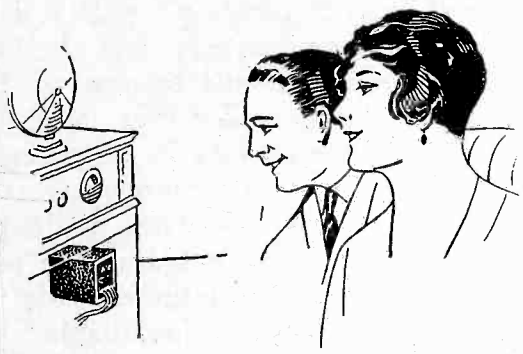

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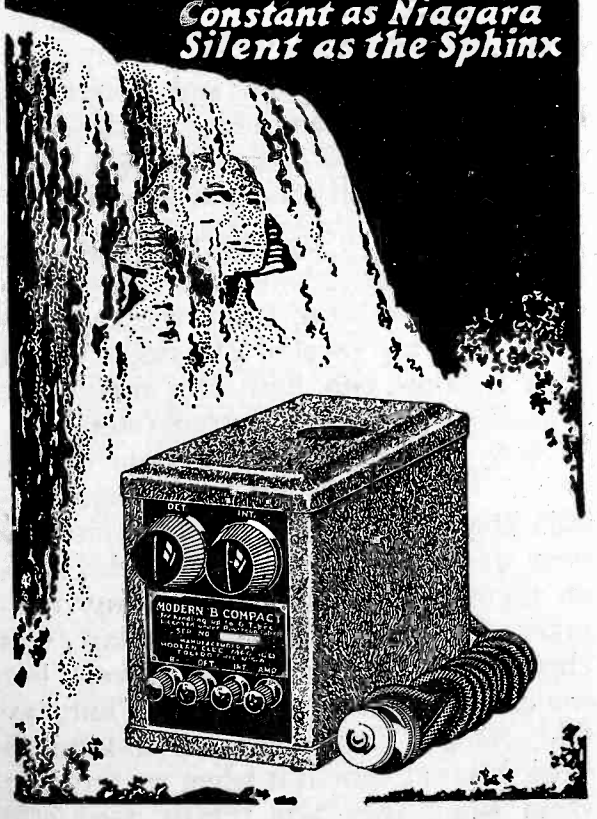

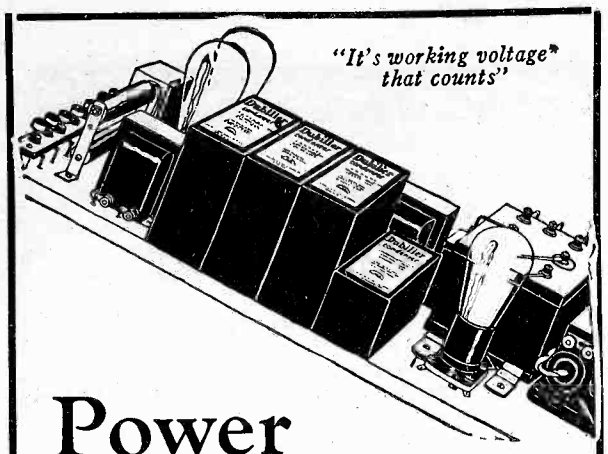

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RADIO WORK SHOP

(*Continued from page* 60)

fire is dull and uniform, without scintillating centers, then the material is high-speed steel.

Trouble from dull drills and their resultant botched work can best be obviated by a drill grinder that will furnish the proper edge and the proper clearance to the greatest accuracy. Such a device is not absolutely essential to the well equipped experimental shop, but is a joy if it can be possessed, and we urge thoughtfulness on the subject. These machines will grind, in the smaller sizes, a No. 60 drill, which work is the ultimate test in drill grinding. Such a drill is only .04 in. in diameter, and the task is all the more difficult because of the smallness. The grinder that does this will grind drills up to $\frac{3}{8}$ in. diameter.

A combined drill and center reamer is useful in starting a hole when drilling a rod in the lathe, thus avoiding the possibility of an off-center, elliptical hole. A "Ratcho" wrench is also invaluable.

Then there should be taps and dies, three sets is possible, covering U. S. standard, American Society of Automotive Engineers, and machine screw sizes.

Garnet paper and carborundum cloth are the outstanding abrasives, and should be supplied as a series of grits from the coarsest to the finest. They should be available both in the form of sheet rolls and disks. The latter can be attached to a faceplate on the end of the mandrel of the saw table, where it will be found indispensible for many uses.

An ample supply of wood and machine screws should always be on hand. The general stock can be stored in small drawers, and a lesser supply in glass "ointment" bottles with a screw top, set in a rack near the lathe. A sectional filing cabinet, such as used by dentists, is an excellent place for storing small tools, etc. The contents will not roll to the back if corrugated paper is pasted to the bottom of the drawer.

Bags fitted to the saw and jointer will help to keep dust and chips off the floor. A vacuum cleaner is also a handy accessory if fitted with a suction hose.

LETTERS FROM LARRY

(*Continued from page* 34)

says what you heard Gunk was the radiation from my crystal set (stop) Well I says I think you both can divide the armadillos suspender button (stop)

Now I says when we was out on the Orient run we sent out such strong signals that they was still in the air the next week (stop) We used to check up on them and see if there was any mistakes in them (stop) Monday was checkup day for the preceding week but sometimes we let them go till Thursday OM (stop) They was getting kind of weak by that time but when we received them again they was pretty good still

(stop) My gosh says Gunk was you ever inside a church (stop)

Say OM they just put a new amplifier on this packet (stop) It sure is working grate (stop) We almost heard something yesterday (stop) We got a dandy loudspeaker too OM (stop) Its all orsophoney (stop)

Mr Gillis was down on board from the office again today and he says we might not get that French run at all OM (stop) Remember when some Frog got reflex actions with signals from FL at Eiffel Tower using a frog leg (stop) I mean a regular frogs leg OM (stop)

Well you could have knocked me over with a pipe wrench yesterday (stop) The navy station sent out the weather report on schedule (stop) I called him up and asked whats the matter (stop) Oh he says I guess our clock was fast (stop) Well dont let it happen again OM (stop) Or Ill report it (stop) We cant have you sending out weather reports on time I says and I says we want them two hours behind time like they always are (stop)

Say OM a passenger just stuck his head in the radio room and he says Ha Ha Well Well So this is the radio room (stop) You been reading the papers I says (stop) We only got four transmitters three receivers and five amplifiers OM (stop) Maybe he though it was a factory for building strorberry shortcake OM (stop)

Well OM my wavemeter is all finished but it dont work good yet (stop) I guess theres something wrong OM (stop) I took out the coil and the condenser and it still didnt work (stop)

More next trip OM (stop) 73

(sig) Larry

TUBES

(*Continued from page 39*)

assured by springs which press on the sides of the tube prongs.

The "X" bases are essentially the same as the WD-11 type bases, that is, they fit in their sockets in much the same way. In using the new "X" tubes therefore, you have the immediate advantage of good contact and when your old tube burns out it may be worth the extra expense to replace it and the socket with the new types.

Adapters are now used very little but for those experimenters who deem them necessary a word of warning concerning them will be given. The adapter gives you eight contacts instead of four and your chances of trouble on that score are more than doubled. The source of trouble is also more difficult to locate. Hence to forestall the annoying difficulties of poor contact make sure that any adapters which you may employ are of sound mechanical construction and note particularly that means are provided for securing firm contact

TROUBLE SHOOTING

(*Continued from page* 36)

trouble encountered is an open winding in the output transformer.

A total lack of voltage may be traced to an open winding in the filter choke. More often the carbon pile resistances used to vary the value of the detector current, etc., will show an open circuit, especially after some months' service.

Should there be a lack of voltage with a corresponding heating of the rectifier plates, look for your trouble in one of two places. Either you have a tube with a plate to filament short or else one of the by-pass condensers in the filter circuit has broken down. This trouble may be easily located by testing the various units with a voltmeter in series with a battery.

If the plate of the power amplifier tube heats, it will probably be found that one of the load resistors in the current supply set has an open circuit.

In an *ABC* eliminator the plates of the power amplifier tube may become too hot. In such cases one of the load resistors in the filament supply circuit may have an open circuit, thus giving a plate voltage out of all proportion to the grid bias on the power amplifier.

A loud hum or ringing may sometimes be cleared up by reversing the plug on the 110 volt line. It is sometimes due to faulty tubes. Weak signals likewise may be caused by low emission tubes.

A faulty voltage regulator tube, if used, may flicker irregularly and cause a fluttering noise in the set. The manufacturer will replace defective tubes of this kind.

Many power supply sets use a resistance across the detector circuit. Often its regulating knob has to be screwed almost all of the way out. This results in a very light pressure on the carbon pile and a noise that may easily be mistaken for static discharges. The average resistor of this type requires a fairly firm pressure for quiet operation. Should this load be removed from the rectifier output by an open circuit within the unit itself the voltage will rise. This will be indicated by a distortion in the speaker or else by whistles caused by throwing some part of the circuit out of balance due to increased voltage.

A low voltage at the terminals of the battery cable may arise from various sources. The rectifier tubes may be low in emission. (See test described in first part of text.) The voltage delivered to the filaments of the rectifiers may be low. The filament temperature of these tubes is critical. It is fairly easy to determine whether this is the reason or not. The Rectrons will usually have the appearance of burning below their normal brilliancy. This latter difficulty may arise from either a defective filament winding of the power transformer or from a low line voltage, which may be determined by testing with an ordinary incandescent lamp.

Failure of the filaments in the set to light, but where a *B* potential is present, may be caused by an open filament of one of the 10 or 25 watt lamps in the power plant.

If the glow tube does not light and you are sure that it is all right, it will be reasonable to assume that one of the filter condensers has broken down. This is so, providing that the resistance in series with this tube is o. k. The voltage regulator should glow steadily, although a prolonged loud signal will cause it to dim slightly, due to the fact that in such a case the power tube consumes more plate current.

A good precaution is to take advantage of the strap connection within the base of the 874 tube. Two of the prongs are joined together. A number of the larger manufacturers place this in series with the 110 volt line thus protecting the filter condensers and other units in the power supply from surges of excess voltage caused by removing this ballast tube from its socket while the set is in operation. Full data covering this feature of the glow tube will be found in the instruction slip, which comes with each one.

ELECTRIC PHONOGRAPH

(*Continued from page* 41)

tube. The last wires to be placed will be the grid and plate leads of the amplifier tubes.

As soon as the wiring has been checked, insert the three 10 watt and the 25 mazda lamps in their sockets, and plug in the Raytheon tube. Connect the power transformer to the 110 volt a.c. mains, and short circuit the filament terminals of the first audio tube socket, the tube not being in the circuit. The 10 watt mazda lamps should light to a fair degree of brilliancy, with the 25 watt lamp glowing a dull red. If the filaments of the lamps do not light, the wiring should be checked for a short or open circuit.

A milliammeter having a 0-100 milliampere scale is handy for testing the circuit, placing it in series with the mazda lamp bank. The current through the lamps should be approximately 70 milliamperes when the first test is made, and if more than this current is indicated, the 25 watt lamp should be replaced with a 10 watt size.

Next insert the power tube, which should be a CX-310, and if the filament lighting transformer is properly connected, the filament of the tube should light quite brilliantly. The transformer recommended in the parts list has three secondary voltages, 6, 8 and 12, but these ratings are for loads of ½ ampere or less. Using the entire 12 volt secondary across the 310 tube filament, the voltage will drop to approximately 7½, so that no extra resistance is necessary. As soon as the power tube is inserted,

(*Continued on page* 66)

(*Continued from page 65*)

the current through the mazda lamp group will drop to 60 milliamperes, unless the *C* biasing resistance of the power tube is set at such a high value that no plate current flows in the power tube plate circuit. Now insert the milliammeter in the positive *B* lead of the power tube, by disconnecting the *B* terminal of the output filter, and measure the plate current flow. Move the knob of the Clarostat until the plate current is approximately 18 to 20 milliamperes, and the adjustment can be assumed to be completed.

Then place the milliammeter in the mazda lamp group once more, and make sure the current flow is approximately 60 to 62 milliamperes. Now turn off the a.c. supply and insert the 99 tube in its socket. Turn on the a.c. switch, and the filament current as indicated by the milliammeter should read 59 to 61 milliamperes. Do not unscrew any of the mazda lamps or otherwise open and close the filament circuit of the 99 tube while the rectifier is turned on, or the filament will surely burn out.

Insert a 50,000 ohm resistance in the clips provided for it on the baseboard, and measure the plate current of the 99 tube. If more than 2½ milliamperes, increase the value of the resistance by placing another resistance in series, an extra pair of clips being provided for that purpose with the double grid leak mounting. Ordinary metallic type grid leaks will do, as they will dissipate 1 watt of power without overheating, and the power dissipation in this particular service is below that amount.

The amplifier should now be ready for use, and may be mounted in the base of the phonograph, or in the external cabinet. A hole should be drilled in the wooden panel supporting the turntable and pick-up unit, large enough to enable mounting a snap switch for controlling the amplifier. A Cutler-Hammer filament switch is suitable for small power 110 volt work, and is easily installed. Insert the switch in one side of the 110 volt line, so that when the phonograph is to be used, the switch is operated, and the amplifier turned on.

The writer, possessing but one loud speaker, which must serve for both radio and phonograph, installed a phone jack on the back of the phonograph cabinet, the jack being connected to the output of the power amplifier. Another jack, which was connected to the output of the radio set, was mounted alongside the phonograph jack, so that the loud speaker could be shifted to one or the other of the combinations without complicated switch connections. Of course a double pole-double throw switch would do just as well, with the loud speaker connected to the moving contacts.

After the connections to the switch and jacks are complete, and the position of the pick-up unit properly made, finish the testing by playing a record in which low notes are plentiful, and locate the

proper adjustment of the volume control rheostat for normal room volume. If a squeal is heard in the loud speaker, when the frame of the pick-up unit is touched with the hand, the leads to the primary of the first audio transformer are reversed, and should be changed.

With a loud tone needle, it was found that sufficient energy output was obtained from the pick-up unit to overload the power tube with the volume about two-thirds on, so that the first audio transformer could be eliminated, and the quality slightly improved thereby. Using medium or soft tone steel, tungsten or fiber needles, however, the voltage step-up provided by the first audio transformer was required, to obtain the proper volume, particularly if the record was not a loud one.

While it is to be hoped that no trouble will develop after completing the phonograph, it would be a good idea to state a few of the troubles that might occur, and how to locate them.

MAZDA LAMPS DO NOT LIGHT, AND RAYTHEON TUBE OVERHEATS: One of the filter condensers has blown, and to locate the defective unit, disconnect the condenser terminals to the filter choke, one by one, until the lamps light and the short circuit is removed. A short circuit in the wiring of the positive and negative leads from the filter could also cause this trouble.

LOUD HUM IN SPEAKER; NO MUSIC WHEN RECORD IS PLAYED: Grid circuit of the 99 tube probably open. *C* voltage adjustment of the power tube too high; reduce the resistance in the *C* voltage supply by screwing in the Clarostat knob. Ground not properly made to negative *A* and *B* supply lead.

VOLUME LOW AND DISTORTION PRESENT: Filament current of 99 tube too low; plate voltage of 99 tube too low; decrease size of resistance in filament or plate supply leads.

R. F. AMPLIFIER DESIGN

(*Continued from page 32*)

be received with most volume when tight coupling is used, shorter waves the reverse, although the adjustment is not critical and under no condition should be used as a tuning control.

LIST OF PARTS

1—set matched Aero coils, TRF-120.
3—.00035 mfd. variable condensers.
5—cushion sockets.
2—audio transformers.
1—Formica panel 7x28x$\frac{3}{16}$.
1—sub-panel 7x27x$\frac{3}{16}$, or baseboard.
3—sub-panel brackets.
1—200,000 ohm variable resistance.
1—15 ohm and 1-20 ohm rheostat.
1—two circuit jack.
1—open circuit jack.
1—1 mfd. by-pass condenser.
1—.001 mfd. fixed condenser.
1—.00025 grid condenser and leak.
1—battery switch.
3—4 inch dials.
9—binding posts.
1—½ amp. amperite.
1—4½ volt C battery.

TIME SIGNALS OF THE WORLD, Con't.
By Wm. A. Bremiman, S. S., West Henshaw

P. C. T.	E. C. T.	G. M. T.	CALL	WAVE	SYS	LOCATION
8.57 PM	11.57 PM	04.57	VPB	600	Spk	Colombo, Ceylon
9.30 PM	11.30 PM	04.30	VWP	1,800	Spk	Peshawar
9.55 PM	11.55 PM	04.55	NPG	3,338	CW	San Francisco
9.55 PM	11.55 PM	04.55	NPG	1,436	CW	San Francisco
9.57 PM	11.57 PM	04.57	VPB	2,300	CW	Colombo, Ceylon

WHO'S WHO AND WHERE

(*Continued from page* 44)

Keith Levy has returned to L. A. from Buenos Aires via Cape Horn. He reports fine wx around about the Horn now, it being late summer there.

I. W. Pinkerton, ex-*Mojave, Santa Maria, et al,* has taken a whirl at short waves, signing up with the Western Air Express.

Dick Clark is not so far from civilization at Yukatat that he cannot find Christmas cards to send to his good friends. This in spite of the fact that he reports himself absolutely all alone up there. By the way, we'll bet a lead nickel that he would appreciate a line from any of the gang. His ads is Yukatat, Icy Bay, Alaska.

Robert Burns (no, not the original) has just come off the *Coalinga* and been assigned to the good old lumber schooner, *Florence Olsen*. Burns had quite a ride on the *Coalinga* last trip, having the pleasant (?) experience of being bounced along at the bottom of a hurricane.

Our Great Lakes correspondent, Bob Koch, branched out a little the other day and gave a talk to the Lions' Club of Manitowoc, Wis., home of WMW,, where Bob is stationed. As most of the Lions were just human beings, that is to say, BCLs, Koch talked about co-operation between said species and Brass-pounders, and got away with it. In fact, he got away with it to the extent that WMW has since been swamped with interested visitors, many of whom have shown a desire to learn the code. Gosh, jobs will soon be scarce around the Great Lakes if Bob converts all the BCLs.

The *U. S. S. Amaranth* and *U. S. S. Marigold* have new 100-watt tube sets capable of working Detroit from Duluth.

Carl Hesser is building a commercial station at Alpena, Mich.

LETTERS TO THE EDITOR

Sir: QLZ? No Siree — Haven't much to offer but what I have will be only too glad to give you.

1—When your ship is in the vicinity of the Caribbean Sea or east or west coast of Central America there will undoubtedly be times when you wish first class RDO communication with shore stations which are capable of quickly relaying your messages to and from U. S. points and elsewhere. This particular field is well served by the high power stations of the Tropical Radio Tel. Co. and by the stations of other companies affiliated with it in its service, all of which stations are listed below. The QSJ total exclusive of ships tolls, on messages from ships at sea, destined to the U. S. transmitted direct to WAX, Miami or WNU, New Orleans, or transmitted to any of the below mentioned stations for QSR to WAX or WNU is only 10 cents U. S. currency or 52 centimes per word foreign currency. Plus L. L. forwarding charges beyond Miami or New Orleans as the case may be.

The steamships of the Cuyamel, Standard, and Atlantic Fruit Company's are under the Honduran flag and are not listed in the International Radio Call Letter Book. (Operators on these ships are not required to have a license.)

VA—Managua
VB—Tegucigalpa
VC—Cieba
VD—Comaguaya
VF—Choluteca
VG—Comayagua
VH—Hibueras
VJ—Jamaica
VK—Amazon
VL—Olando
VM—Alegria
VN—Nicaro
VO—Omoa
VP—Copan
VQ—Quinstan
VS—Virginic
VU—Favorita
VY—Yoro
VW—Yuma
VX—Rama
VZ—Lempira
CR—Gatun
CP—Amapala
CD—Rio Grande
CJ—Granada

Would appreciate seeing a list of commercial stations utilizing short waves, their approximate wave and times of transmission.

P.S.—WNU, New Orleans, sends PX on 26 and 40 meters—5:30 a.m. and 11:30 p.m. 75 M. T.

VIGGO C. EBERLIN,
S. S. San Jose—Kdj
84 Glen Road, Yonkers, N. Y.

Sir—Have been reading the C. B. P. section since about the third issue and have found it very useful so am sending a schedule, a plea for help in getting "trs" in.

About the only press schedule that has not been mentioned for the Pacific Coast is "VAE" who sends press on 1800 meters at 1 a.m. (All time 120th meridian). "VAE" calls "GDVB"

(*Continued on page* 70)

Name of Station	*Radio Call Letters*	*Works on Meters*
Almirante, Panama	UB	600-1200-4075
Bluefields, Nicaragua	UQ	600-950-1850-2100
Cape Gracias, Nicaragua	UW	650-2000
1—Cartago, Costa Rica	UR	600-2200-4235
Limon, Costa Rica	UX	600-1425
Managua, Nicaragua	UL	600-1800-2400-4600
2—Miami, Florida	WAX	600-
Burrwood, Louisiana	WBW	600-675-1713
New Orleans, Louisiana	WNU	600-1700-3331
3—Puerto Castilla	UA	600-775-2450
Swan Island, Caribbean Sea	US	600-660-2450
4—Tela, Honduras	UC	600-1400
Tegucigalpa, Honduras	UG	600-1950-4330

1—Accounts should be rendered to Compania Radiografia Internacional de Costa Rica, First National Bank Bldg., Boston, Mass.

2—Due to hurricane damage high wave transmission antenna under repair, will announce same when repairs complete.

3—Accounts should be rendered to Truxillo RR. Co., I Federal St., Boston, Mass.

4—Accounts should be rendered to Tela RR. Co., I Federal St., Boston, Mass.

LOOP AERIALS

(*Continued from page 32*)

with a *B* battery of more than 60 volts, the current consumed from the *B* battery by the tubes is greatly reduced, and the life of the *B* battery correspondingly prolonged. The addition of a *C* battery often doubles or triples the life of a *B* battery.

When a receiving set has been built and is ready to use, to make sure that the battery connections are all right, put all the tubes in the sockets, put a phone plug in the last jack—if filament-control jacks are used,—and then connect the *A* battery (the filament battery) to the *B* battery binding posts. If any of the tubes light, it shows that some of the connections are wrong, and that those tubes would have been burned out if the *B* battery had been connected to the set in the regular manner. If none of the tubes light, then the *A* and *B* battery leads have not been mixed; and the batteries can be connected to their proper binding posts for the final test on an aerial.

The most common unit of capacity in radio work, the microfarad, is so unhandy to use that a new popular unit has been generally adopted. This is the micro-microfarad, abbreviated mmf., and it is equal to one-millionth of a microfarad. Thus, 0.001 microfarad, multiplied by one million, is equal to 1000 micro-microfarad; and 0.00025 mf. is equal to 250 mmf. To change mf. to mmf., move the decimal point six places to the right; and vice versa.

It is very important that the filament terminal voltage of the UV-199, C-299, UX-199, and CX-299 tubes be kept at three volts or less. If the terminal voltage exceeds three volts the life of the tubes will be greatly shortened; but, on the other hand, if the voltage is reduced too much below three volts, the tube will not function properly. It is almost impossible to keep the voltage just right by watching the brilliancy of the filament; the only way it can be kept right is to have a small direct-current voltmeter connected across the filament terminals on the tube sockets. A panel-mounting, 0 to 5 D.C. voltmeter is not expensive, and the prolonged life of the tubes will soon pay for it.

The old type of horn loudspeaker often distorts so badly that music is not recognizable. This can be remedied somewhat by connecting a 0.004 or 0.006 microfarad condenser across the loudspeaker terminals. The addition of the condenser makes the music slightly weaker; but the improvement in the tonal quality more than compensates for the slight loss in volume. This also applies to the addition of a 0.0005 microfarad condenser across the secondary of a poor audio amplifying transformer.

Don't let the static get you! Have you ever tried a single-tube loop set?

(*Continued on page 70*)

(*Continued from page* 69)

When you do, you will be surprised at how much DX and how little static you will get on it. Do not use any coils in the secondary circuit; but let the loop take the place of the secondary and tune it with a variable condenser. Tune the plate circuit with a variometer. A two-foot square solenoid loop having fourteen turns of fairly large wire (bell wire is good), with a 23-plate variable condenser shunted across it, will tune from about 200 to 550 meters. This makes a two-control set that is the acme of simplicity, and at the same time a wonder for DX when you once learn the knack of tuning it.

Placing the binding posts for the battery connections to a receiving set on the front of the panel is obsolete. To accord with present-day practice, they should be mounted on a small bakelite sub-panel at the back of the baseboard. Not only does the set look neater when the battery binding posts are put at the back; but it makes the set much easier to wire. Only four binding posts should ever be put on the front of the panel: they are the binding posts for the input and output of the set. The input binding posts, which are the aerial and ground binding posts, should be placed on the upper left-hand end of the panel; and the output binding posts, the loudspeaker binding posts, should be placed on the upper right-hand end of the panel. Mounting the battery binding posts on the front of the panel is like placing sails on a modern battleship—"it just isn't being done."

LETTERS TO THE EDITOR

(*Continued from page* 68)

and "QST" then goes ahead with his press and traffic for "GDVB." He sends about 30 minutes of it.

If any of you fellows have been listening for "WAX" on his 3:30 a.m. press schedule lately you have not found him for the simple reason that his towers were blown down at the time of the big hurricane that hit Miami. Since that time and until "WAX" gets his high power set into commission again "WNU" sends Miami's press at 3:30 a.m. on 3331 meters and has discontinued his 8:30 a.m. schedule, although he still sends weather and traffic at that time.

Here is a plea for help from an operator that wants to get his "tr" in every night just like most all you other fellows. If you fellows on the S. A., East Coast and Gulf runs will keep a 2 a.m. schedule we can all get our "trs" in. "KUCJ" is always glad to "QSR" for anyone.

Am "KSO" with "KOK," unless static is bad, about 2000 miles SE, sometimes more, and in the Gulf and sometimes while in the Caribbean. Now if all you fellows get up at that time you can clear your traffic and then at 3:30 "QSY" 3331 for "WNU" press. Can usually get about a sheet and a half from him. By the time "WNU" finishes it is getting along towards breakfast time and by the time you finish recopying his press (if you can't copy him directly onto press sheet) it is "chow" time.

"KUCJ" will probably have a new "op" when this goes into print as I am getting off in San Francisco. GILBERT THOMMEN,
"KUCJ"

1927 MODEL SUPERHETERODYNE

(*Continued from page 27*)

or some of them will be short circuited by the mounting bracket.

This completes the mechanical assembly of the receiver, except the adjustment of the link motion, and the mounting of the dials. A template is furnished with each dial. The three holes for the mounting screws should be drilled through the front panel, the dial being fastened in place with nuts placed over the screw ends on the back of the panel. The set screws on the two collars of the link motion should be temporarily fastened, and the long shaft condenser rotated back and forth to make sure that the two condensers are lined up perfectly straight. The two collars should point towards the rear of the set. When the condenser shafts are rotated so that the movable plates are entirely meshed, one arm of the link motion will point to the extreme right while the other arm on each shaft collar will point straight up. When the condenser plates are out of mesh, and one arm on each shaft points to the extreme left, the other arm will point straight down. If one of the links binds against the shaft of the condenser having the short shaft, the collar on this shaft is too close to the lock collar on the condenser itself. There should be $\frac{3}{16}$ in. space between the condenser and link motion collars, for it is in this space that the front edges of the shields must fit. Make sure that the two condensers controlled by the link motion have exactly the same setting for zero capacity, with the same air gap between rotor and stator plates when they are out of mesh, for otherwise the two tuned circuits will not be tuned identically over the entire broadcast band, and the set will lack sensitivity. No trimmer condenser will be required if this adjustment is carefully made.

Wiring the set should be easy if the pictorial diagram of Fig. 3 is followed. The filament wiring was first installed, in the experimental model, using "Belden hookup wire," cloth insulated. A path around the entire outer edge of the sub-panel was followed, drilling holes through the sub-panel for the wires to the tube sockets, and the *C* and *B* battery connections of the audio and intermediate transformers. After all these wires were placed, and the connections soldered, the wires were laced into a form with heavy twine. This system is now standard with most high grade factory built radio receivers, and certainly improves the appearance of any set. Note how the wires branch out from the main artery or trunk of the form, to the terminals of the apparatus under the sub-panel, or through the holes to the apparatus above. As all these wires are at or near ground potential, no harmful effects will occur from

(*Continued on page 72*)

(*Continued from page 71*)

the cabling of the wires, and the set will be equally as efficient as a set having battery wires which are separated.

After completing the cable form, the lacing is accomplished by tying a long piece of waxed twine to the end of the form underneath the 30 ohm volume rheostat, and then tying a half-hitch around the form every inch or so, until the other end of the form is reached at the opposite end of the panel.

The high frequency wiring, and the grid and plate leads of the audio tubes, were all made with No. 16 Celatsite, which is tinned copper wire insulated with cotton and spaghetti. The connecting wire between the r.f. amplifier tube plate and the primary of the r.f. transformer was run through holes drilled in the sub-panel, as were the other wires interconnecting the shielded units. The metal bottoms of the shield compartments are connected to the supporting frames of the variable condensers by direct contact, and for that reason no connecting wires are necessary. As the grid return for the oscillator tube is through the 1½ volt *C* battery, the shield for the oscillator is at a potential of 1½ volts negative with respect to the negative end of the filament. So the oscillator shield must under no circumstances be connected to the other shields, or a shorted *C* battery will result.

The 52,000 cycle intermediate frequency and filter transformers, if not otherwise available, may be made as follows: In Fig. 4a is shown the mech-

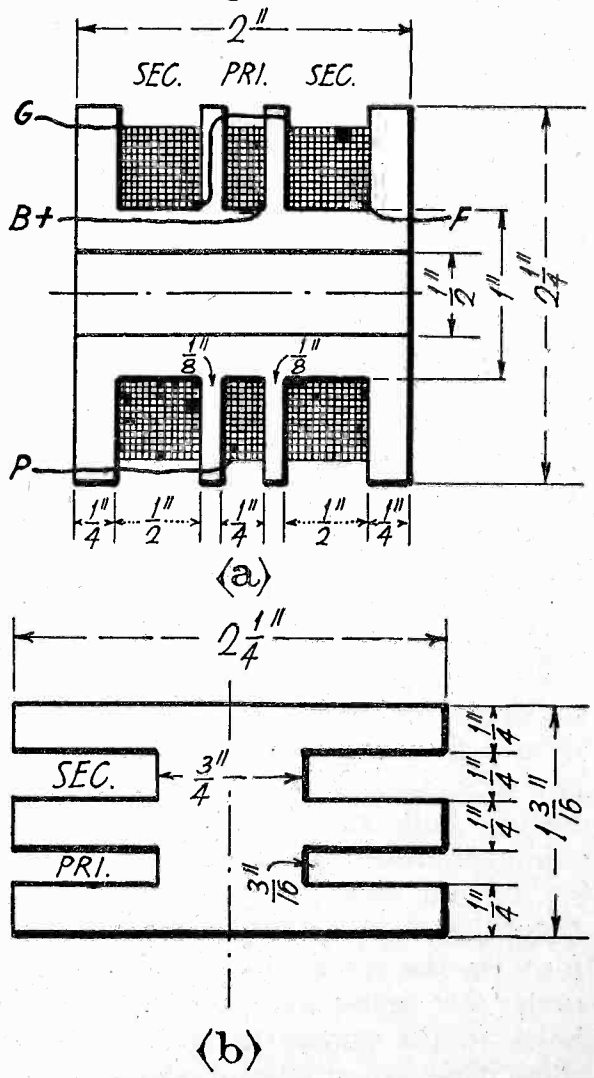


Fig. 4. Details of Transformer Construction.

anical assembly of the wooden or bakelite spools for the intermediate frequency

transformers, and Fig. 4b shows the assembly of the filter transformer. In the center slot of each of the three spools, built similar to the one in Fig. 4a, wind 500 turns of No. 32 single silk or cotton covered wire in a haphazard fashion. In each outside slot wind 1000 turns of No. 36 single silk wire, connecting the two secondaries series aiding, as is shown in the diagram. The hole drilled through the center of the spool should be filled with as much No. 36 soft iron wire as can be crowded in the space. If the wire is not to be had, thin strips of silicon steel or iron, ⅛ in. wide can be used instead.

The filter transformer primary, for 52 kilocycles, should have a 200 turn primary wound in the smaller of the two slots, with No. 30 silk or cotton covered wire. The secondary should have 1250 turns of No. 36 single silk wire, the outside terminal being connected to the grid condenser of the 2nd detector tube. The primary, with 200 turns, should have a .006 mfd. fixed mica condenser shunted across it, for 52 kilocycles. If other intermediate frequencies must be used in order to avoid interference, the following table gives the number of turns for the primary and secondary, for various frequencies.

Frequency in Kilocycles	*Primary Turns*	*Secondary Turns*	*Pri. Fixed Condenser*
27	375	2100	.0075 mfd.
32	375	2100	.006 mfd.
37	333	1950	.006 mfd.
42	295	1775	.006 mfd.
47	250	1500	.006 mfd
52	200	1250	.006 mfd.

The above data for the i. f. transformers depend upon the grade of iron used and various other factors. So the exact frequency of the filter will have to be determined after the i. f. transformers are built and tested. If the two settings of the oscillator condenser have two distinct humps, with the home-made transformers, try substituting first a .005 and then a .0075 mfd. fixed condenser in place of the one specified, to see if the humps can be made to coincide.

Checking over the completed set is done in the customary manner, connecting the negative *A* battery to its binding post, and successively connecting the positive *A* battery lead to all the binding posts in the set, first with the tubes out of their sockets, and then installed in them. If any of the tubes light when the plus lead is touched to either the *C* or *B* battery binding posts, there is a short circuit somewhere in the wiring. It should be located before the *B* batteries are connected.

Now install all the tubes, and connect the *A* battery to its terminals. With a screw driver, adjust the resistance on the sub-panel until it is all in the circuit. Turn on the filament switch and see that the two 5 volt tube filaments light. Observe the reading of the voltmeter, with the 6 ohm rheostat all cut out, and then adjust the sub-panel resistance

(*Continued on page* 74)

(*Continued from page 73*)

until the maximum voltage is about 3.5 volts. Swinging the 6 ohm rheostat through its arc will then lower the voltage to about 2.5, which gives adequate adjustment for the 99 tube filaments. Be careful in adjusting the sub-panel resistance, not to touch the metal shaft of the screwdriver to the metal shields, or the *A* battery will be shorted. Insert the plug-in inductances, using 111-A coils for the antenna and oscillator, and a 110-A for the r.f. transformer.

A 111-A coil can also be used for the r.f. transformer with good results, with terminals 1 and 2 of the coil mounting for the primary, terminal 3 for the grid and 4 for the filament, with terminals 5 and 6 abandoned.

Next connect the *B* batteries, with a 25 watt mazda lamp placed in series with the negative *B* lead. If the lamp lights up when any of the battery connections are made, there is a short circuit, and it should be traced before any further connections are made. After all battery connections are made, and it is ascertained that no short circuits exist, the lamp can be cut out of the negative *B* circuit, and the phones or loud speaker plugged in the output jack. Tapping the 2nd detector tube should produce a ringing sound in the loud speaker showing that the audio amplifier is functioning.

Connect the antenna and ground to the proper terminals, and adjust the coupling of the rotors in all three plug-in inductance coils to maximum. With the volume turned on full, and the right hand front panel dial set about halfway around, turn the oscillator dial back and forth until a station is heard. Tune the station to maximum volume by adjusting both dials, and cut down on the volume control rheostat if the station is coming in too loud. Locals will require a very low setting of the volume control. Adjust the coupling of the antenna coil and the r.f. transformer primary until any further loosening of the coupling will cause a material decrease in signal strength.

Since at least one station has been located on the dials, tune in a distant station on a nearby wavelength and adjust the coupling of the oscillator rotor coil until loosening it further will cause a falling off in volume.

The set should now be ready for adjustment of the r.f. feedback condenser, which is under the sub-panel. With the dials set at the distant station, and the volume control set at a point somewhat below maximum volume for the particular station being received, lift up the rear edge of the receiver so that a small screwdriver can reach the set-screw in the feedback condenser. Turn in this screw until a perceptible increase in volume is noted, or until a hissing sound indicates that the tube is oscillating. Then back off the set-screw slightly, and

you have the point of maximum sensitivity for that particular wavelength. It is best to adjust this condenser when the set is tuned to a wave around 250 meters, for if the adjustment is made at 500 meters, the r.f. amplifier tube will surely oscillate when the set is tuned to waves below 250. This condenser should not again be adjusted after the first time, and while the placing of the condenser on the panel might enable the squeezing of an additional mite of distance on the higher waves, the additional control is a nuisance to the average fan, and is often detrimental when improperly used.

When all adjustments are complete, fit the metal cans in place over the three baseplates, and make sure that the oscillator shield does not touch the 1st detector shield. If stations appear to be somewhat broad on the r.f. dial, and the set lacks sensitivity, the trouble is probably due to imperfect matching of the two condensers controlling the r.f. amplifier. Tune in a local, with a low volume setting, and loosen the set-screw on the link motion collar of the short shaft condenser. Move the rotor plates back and forth until the station is at a maximum, and reset the link motion collar. If this does not sharpen the tuning of the r.f. dial, reverse the procedure and let the short shaft condenser remain fixed while the other condenser is moved.

The receiver will operate satisfactorily with an antenna having an overall length of 50 feet or more, but cannot be used with a loop, as the settings of the loop and r.f. transformer tuning condensers would be different at most wavelengths, and the link motion could not be used. Of course, if the short shaft condenser were replaced with one of the long shaft type, a third dial could be installed, and the loop used in place of the secondary winding of the present antenna tuned circuit.

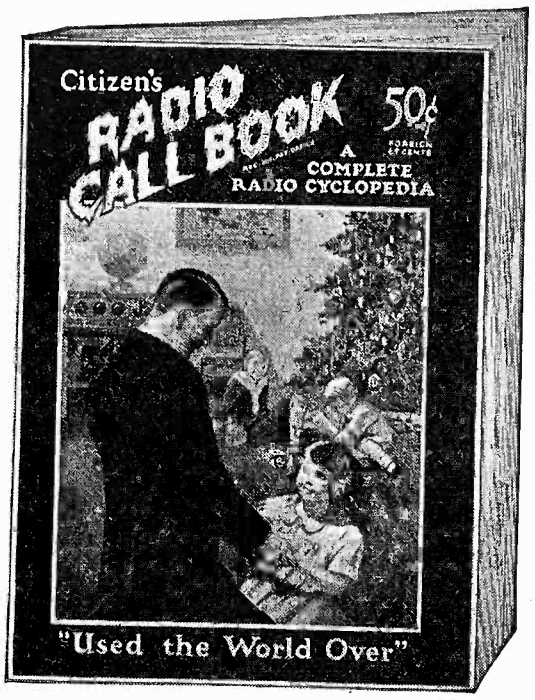
If the audio amplifier howls when the rest of the circuit has been adjusted connect the metal cases of the audio and output transformers to ground.

WHAT THE BRITISH USE

In talking with the operators of several British vessels it is found that they apparently still call the quenched gap transmitter a modern and efficient equipment. The large passenger vessels use excellent tube transmitters, direction finders, and tube receivers. But many of the smaller vessels are not even equipped with tube receivers. The Marconi Company is slowly changing over to tube receivers, but a careful inspection of the receivers will show how far behind contemporary American installations they are.

The San Francisco F.T. office needed two men, so the L. A. office lent them Spark Plug Guersdorf and they called it square. As this speedy master of the *Charleston* left L. A. a hunk of plaster fell out of the ceiling. The day after he arrived in S. F. that city experienced an earthquake. They ought to stop these new-fangled dances.

LEADING PUBLICATIONS



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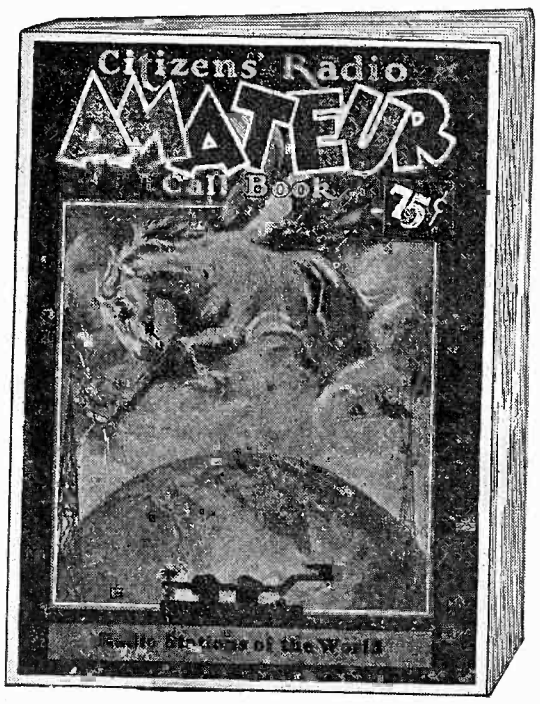


The CITIZENS RADIO AMATEUR CALL BOOK is an international list of call letters, names and addresses of the World's amateur transmitters — ARRL official traffic relay stations list. Compiled from official sources and the most authentic list obtainable anywhere. Remember, the whole World, U. S., Canada, Australia, France, Germany, etc. The whole international list. Also commercial ship and land stations.

Price only 75 cents postpaid

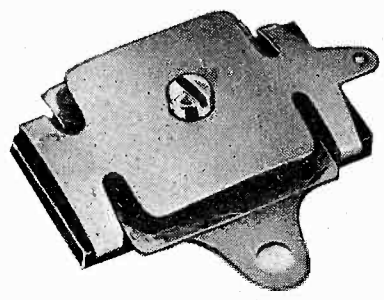
If you are unable to obtain either of the above mentioned publications from your news dealer or radio store, they will be sent postpaid upon receipt of the amount in U. S. stamps, coin check or P. O. money order.

Citizens' Radio Call Book

510 S. Dearborn St. Chicago, Ill.

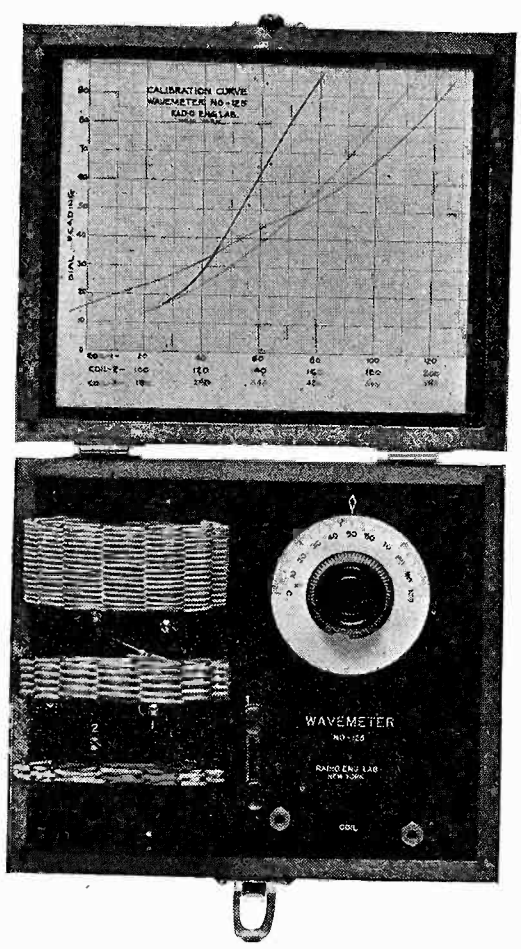
FROM the RADIO MANUFACTURERS

The Hammarlund equalizing condenser has a minimum capacity of 2 mmfd. and a maximum of 50 mmfd. It is intended as a neutralizing condenser in sets using the bridge method of balancing tube capacities or as a compensator for the



units of a gang tuning condenser. Turning the center screw gives gradual change in capacity. It can be directly attached to socket or condenser binding posts and occupies small space.

The R E L wavemeter from the Radio Engineering Laboratories, New York City, has a range from 17 to 530 meters, thus covering the short wave as well as

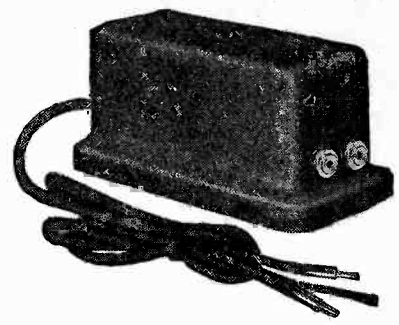


broadcast bands. This is a well made, convenient instrument which should be useful to every amateur and experimental radio laboratory.

NEW RADIO CATALOGS

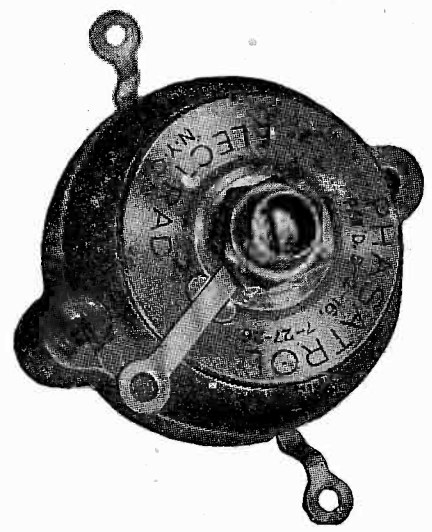
A complete line of radio insulating products is illustrated and described in Catalog No. 134 from the Insulating Co. of America, New York City. These include Insuline, Bakelite, Fenoline and hard rubber panels, tubing, sockets, dials and knobs, and knife switches. Drilled and engraved panels for over seventy popular circuits are listed.

The Amsco Orthophone combines a choke coil and condenser to be easily connected between any loud speaker and any radio receiver using a power tube. It protects the loud-speaker coils against



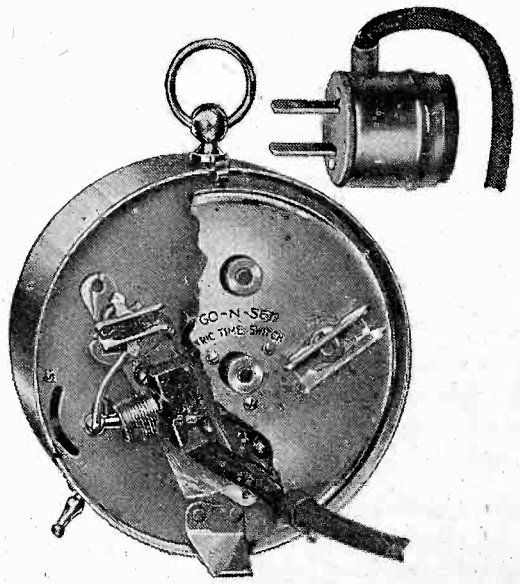
burn-out from direct current and against de-magnetization. It improves tonal quality and allows greater volume without distortion.

The Electrad "Phasatrol" is a new balancing device for stabilizing any tuned or untuned r.f. circuit. When inserted in the plate lead of an r.f. tube and adjusted by means of a small set screw in



the center it is claimed to prevent oscillation, distortion and radiation. It is easy to install in any set, requiring one or two hole panel mounting and three soldered connections.

The Go-N-Set time switch automatically turns off or on any electrical device, such as a radio set or battery



charger. It consists of a clock and a toggle switch controlled by the alarm apparatus. It is made in 3, 5 and 10 ampere models.

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Better Reception

Majestic "B" Current Supply

delivers pure direct current from your light socket

Majestic Standard-B
Capacity seven tubes or six plus 1 power tube. 45 milliamperes at 135 volts.
$29.00

Majestic Super-B
Capacity one to twelve tubes, including the use of power tubes. 45 mils at 150 volts.
$31.50
(As Illustrated)

Majestic Master-B
Positive control of all output voltage taps. For sets having high current draw or heavy biasing batteries.
$34.00

No Hum—Superior to Any Source of Power

The voltage can always be accurately adjusted to meet the varying conditions of every city and on any set.

Economical—cost a fraction of a cent per hour. No acid or liquids; Raytheon Tube $6.00 extra. No filaments to burn out.

See your dealer today. Insist on a demonstration on YOUR set immediately
(Can be purchased on deferred payments)

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W. J. Seroy, Pacific Coast Sales Manager, 4069 Hollis Street
Emeryville, (Oakland), California

QUERIES AND REPLIES

(*Continued from page 42*)

stage of tuned r.f. amplification has been added. As a total of eight 215-A tubes would require nearly 12 volts at the filament supply source, the first audio tube is a type A, operated in parallel with the power tube, so that only seven peanut tubes will be required, and the old first audio tube and socket can be moved to the r.f. amplifier compartment. The same r.f. and antenna coils specified for the Best Superheterodyne can be used with the 215-A tubes.

Is the Rice-Kellogg loud speaker described in September RADIO in an article on the Electric Phonograph available separately, and if so, what equipment would be needed to connect it to my six tube radio set?—R. N. E., Elkhart, Ind.

The Radiola No. 104 loud speaker is the one referred to, and comes complete with rectifier system and power amplifier tube, so that it can be connected directly to the output of the first audio amplifier tube in your present set. The loud speaker is not available except with the rectifier, which is required to supply the current necessary for the field windings of the speaker.

RESISTANCE COUPLED AMPLIFIER WITH ELIMINATOR

(*Continued from page 24*)

The changes involve but six substitutions of resistors: (1) a 1 megohm unit for the 1/10 megohm in the plate resistor of the first stage; (2) ¼ megohm for the usual 1 megohm grid resistor in the first stage; (3) ¼ megohm for the 1/10 megohm in the plate and (4) 1/10 megohm for ½ megohm in the grid circuit of the second stage; (5) ¼ megohm for the 1/10 megohm plate resistor and (6) 1/10 megohm for the ¼ megohm grid resistor in the third stage.

If these changes do not suffice it may be necessary to improve the characteristics of the *B* eliminator by shunting a 1 mfd. condenser from the negative terminal to each of the positive terminals, grounding the negative. In rare cases it may be necessary to place choke coils in one or more of the positive leads.

These changes have been found by William T. Taber and J. G. Alzmann of the Daven Laboratories to clear up all such troubles with Daven amplifiers. They have been checked by careful oscillograph observations to prove that all distortion is thereby obviated.

INFRADYNING R. F. RECEIVERS

(*Continued from page 54*)

mounting. It is important to insulate the rheostat from the base plate, which is of metal and grounded to the negative *A* battery.

Once the principles above outlined are understood, any similar set, whether home or factory built, can be converted into an infradyne. The author has had good results in using the infradyne amplifier unit with the Atwater-Kent Compacts, the Fada, Magnavox and Freed-Eiseman sets. If the set is already being operated from a *B* battery eliminator, it is well to use a separate *B* battery for the infradyne unit, pending publication next month of certain precautions to be used with eliminators.

RADIOADS

A Classified Advertising Section Read by Better Buyers

8 cents per word, net. Remittance must accompany all advertisements. Include name and address when counting words.

Ads for March Issue must reach us by February 3rd

WESTERN ELECTRIC three stage power amplifier with tubes, $40.00. N. D. Ashford, Tudor, California.

FOR SALE—following back issues of "RADIO."

1921	1922	1923	1924
Mar.	Jan.	Jan.	Jan.
Apr.	Feb.	Feb.	Feb.
May	Apr. (2)	Mar.	Apr.
July	May	Apr.	May
Aug.	June	May	July
Oct.	Sept. (2)	July	Aug.
Nov.	Oct.	Aug.	
Dec.	Nov.	Sept.	
		Oct.	
		Nov.	
		Dec.	

Raymond W. Lee, care of Post Office Box 800, Glendale, California.

A-1 CRYSTAL; guaranteed best crystal obtainable. Postpaid fifty cents each. Harry Grant, Jr., 904 Oak Grove Ave., Burlingame, Calif.

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.

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.

OLD NUMBERS WANTED. The New York Public Library, 476 Fifth Avenue, New York City, wants to acquire by gift or purchase, Nos. 1 to 5 of Vol. 1, Nos. 5 and 10 of Vol. 2, and Nos. 4 and 5 of Vol. 3 of "RADIO." Any reader willing to dispose of them is invited to write to the library.

GOSILCO—Latest Type Aerial Wire. Pure Gold over Silver Plated No. 14 Soft Copper. 3 cents per foot, postpaid or C.O.D. anywhere. Greatly increases Distance, Volume. Tunes much Sharper—Improves Tone. Endorsed by RADIO, Radio News, Popular Radio. AMERICAN LUMINOUS PRODUCTS CO., Huntington Park, Calif.

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

NEW UV 202's, $3.00 postpaid, while the last. All parts at reasonable prices. Harry Smith, 9APK, 2122 Sherman, Evanston, Ill.

FREE Selective Crystal Set Hook-up—Enclose two-cent postage stamp with request to California Radio Minerals, 904 Oak Grove Ave., Burlingame, Calif.

GENERAL-RADIO Amateur Band Wavemeter type 358, $18.00. Aero Short Wave Coil Kit, 15 to 130 meters, $9.50. Remler Infradyne Amplifier, $20.25. Bremer-Tully Counterphase Power-Six Kit, $31.00. All these parts are new and in their original cartons. Robert Williams, 1118 Wolfram Street, Chicago, Ill.

COMPLETE specified parts for the following sets, described in RADIO; Sargent-Rayment Infradyne, $89 (November issue); Karas Equamatic, $69 (October issue); Bremer-Tully Counterphase Power Six, $69 (December issue); Majestic Super-B Current Supply, $29; Thorola Cone Speaker, $17. Send 25% with order balance C.O.D. Robert Williams, 1118 Wolfram Street, Chicago, Ill.

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)

DO YOU GET TIRED of buying "B" batteries? A lifetime Edison will solve your 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. Paul Mills, Woodburn, Oregon.

MAKE $100 weekly in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, Inc., 431 N. LaSalle Ave. B, Chicago.

CRYSTAL SETS with crystal complete, 50c, stamps or money order. Nathan Bros., 2036 Polk St., San Francisco, Calif.

RADIO TROUBLES OVER. Hoff's trouble finder locates, explains remedy, 103 radio ailments. Particulars free. Smith, 516 Main, St. John, N. S.

I Will Train You At Home To Fill a Big Pay Radio Job

RADIO NEEDS TRAINED MEN!

"I give you all this apparatus so you can learn quickly at home *the Practical Way*"

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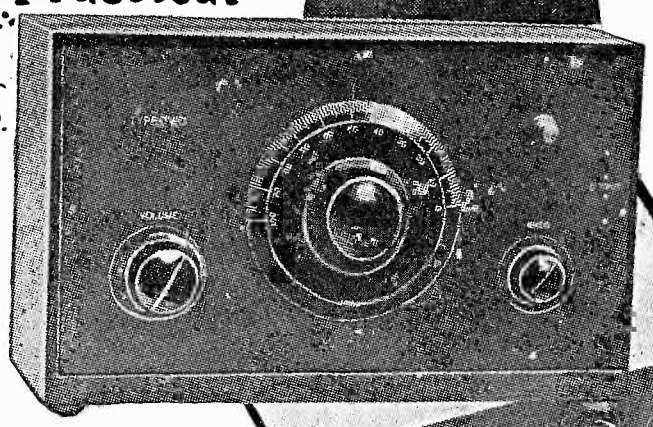

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So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods make it possible for you to start RIGHT AWAY toward one of the bigger Radio jobs. Many men in Radio now earning $50 to $250 a week. No delay, no losing time from work—no scrimping or scraping to get your training.

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"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

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All instruments shown here and others sent to all my students free of extra cost under special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.

$70 In One Day For T. M. Wilcox

"I am in business for myself and RECENTLY MADE $70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilcox, Belle Island, Newfoundland.

World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money QUICK when you take up this practical course. Work on millions of antennae, receiving sets, offers you big chance to make spare time cash while you're learning. I'll show you how—teach you the latest "dope," furnish you with business cards, show you how to get the business and make it pay. My students don't wait a year to increase their income—they report QUICK INCREASES as a result of this course—often two or three weeks after starting.

Howard Luce, Friedens, Pa. made $320 in 7 weeks during spare time. D. H. Suitt Newport, Ark., writes, "While taking the course I earned in spare time work about $900." Earl Wright, Omaha, reports making $400 in a short time while taking course—working at Radio in spare time! Sylvester Senso, Kaukauna, Wis., made $500. These records not unusual—these men a few of hundreds.

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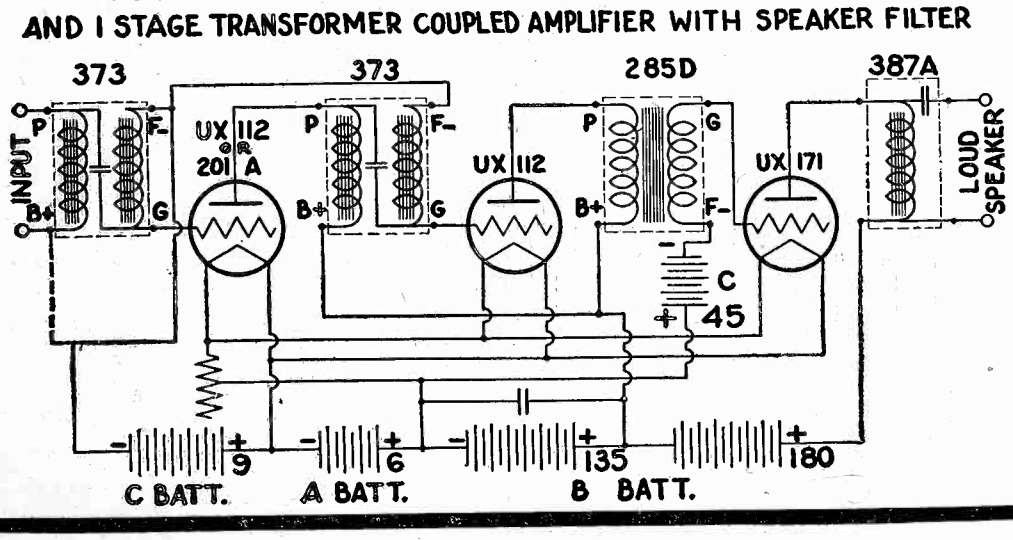
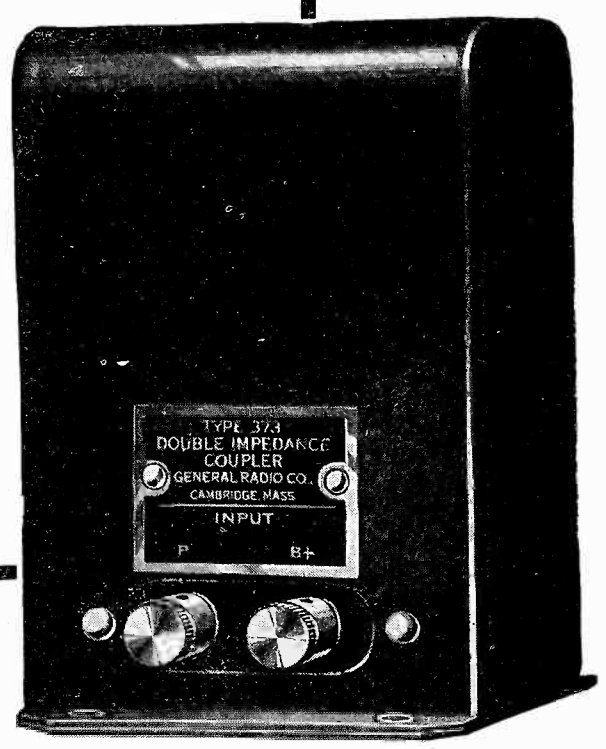
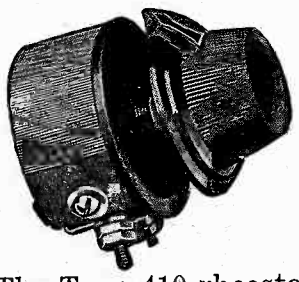




While the use of double impedances is not new in principle the General Radio Type 373 Double Impedance Coupler is unique in design and performance. To facilitate installation the complete unit, consisting of two impedances and a fixed condenser, is contained within a metal shell. It is connected in precisely the same manner in an audio amplifier circuit as a transformer.

Announcing a New Single Hole Mounting Rheostat



The Type 410 rheostats are similar in general appearance and construction to the well known Type 301 rheostat, except that they have the single hole mounting feature, and a flanged knob, with engraved pointer of moulded Bakelite.

Furnished with resistances of 6, 12, and 25 ohms.

Type 410 Rheostat $1.25

The extent of its range of even amplification is from appreciably below 100 cycles to over 10,000 cycles, with a gradual downward deviation of slightly less than 7% between 100 and 400 cycles. This deviation in an otherwise perfect amplification curve is so slight as to be practically negligible, because the ear of the average individual can not detect a variation of intensity of much less than 25%.

The amplification curve, in fact, compares favorably with that generally obtained with resistance coupled systems which have the disadvantage of large sacrifices of plate voltages.

The General Radio Double Impedance Couplers have the further advantage that when connected as shown in the above diagram, with one transformer coupled stage, they may be used with a properly designed Plate Supply Unit.

Type 373 Double Impedance Coupler $6.50

The following parts are used in the General Radio Laboratory Amplifier:

2—Type 373 Double Impedance Couplers	**$13.00**
1—Type 285-D Audio Transformer	**6.00**
1—Type 387-A Speaker Filter	**6.00**
3—Type 349 UX or CX Sockets	**1.50**
1—Type 410 or 301 Rheostat, 6 ohms	**1.25**
Complete cost of amplifier parts	**$27.75**

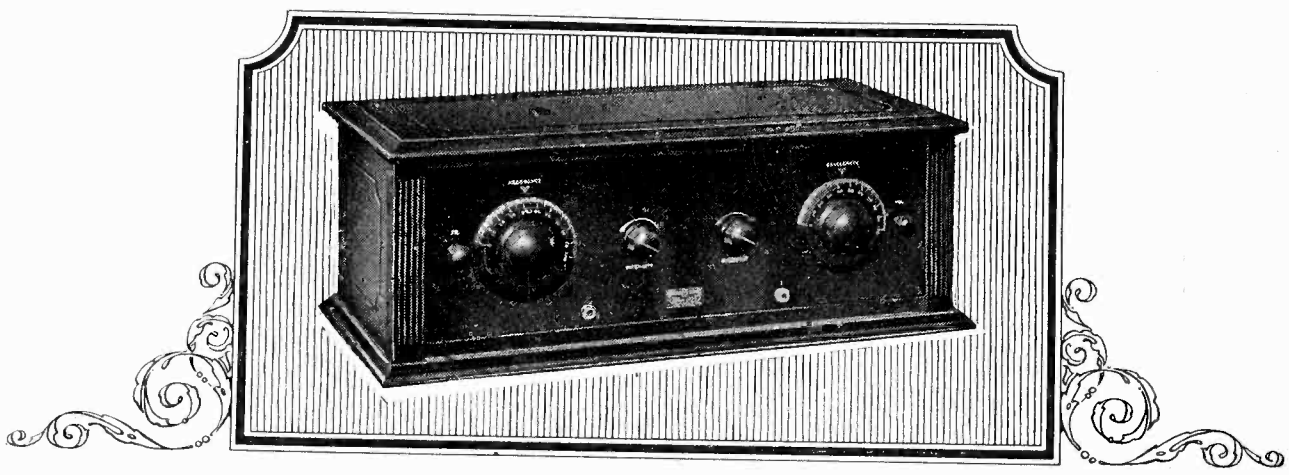
If your dealer is unable to supply you with any of the above items, we shall be glad to send them to you prepaid upon receipt of list price.

GENERAL RADIO
Parts and Accessories

GENERAL RADIO COMPANY **CAMBRIDGE - - - - MASS.**

"Behind the Panels of Better Built Sets"

BROWNING-DRAKE RADIO



FACTORY BUILT SETS AND COMPLETE KITS

BROWNING-DRAKE radio is known to almost every fan. Any development based on as sound scientific research as this work at Harvard University, was bound to endure. Consider the number of designs which have come and gone since 1923 and you will understand that this has been a receiver very much out of the ordinary.

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Complete factory-built receivers, backed by the same research facilities and with our guarantee of performance, are now standard on the market. If your dealer cannot supply you with the Browning-Drake Corporation kit or the complete receiver, send us his name and we will see that your requirements are taken care of.

DEALERS: The new Browning-Drake kit, designed complete in conjunction with several well-known manufacturers, will be available from your distributor very shortly. If you are unable to secure kits or sets from distributors in your territory, we will see that your order is filled.

BROWNING-DRAKE CORPORATION, Brighton, Mass.