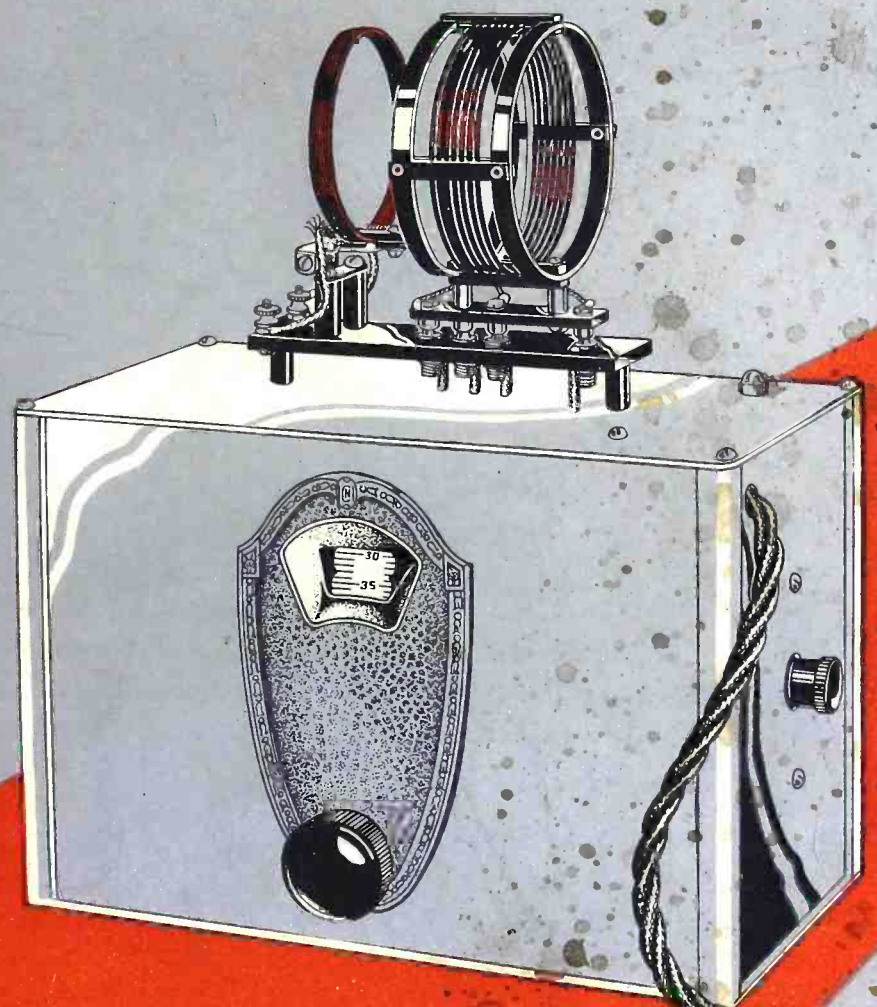
Popular Radio

and TELEVISION

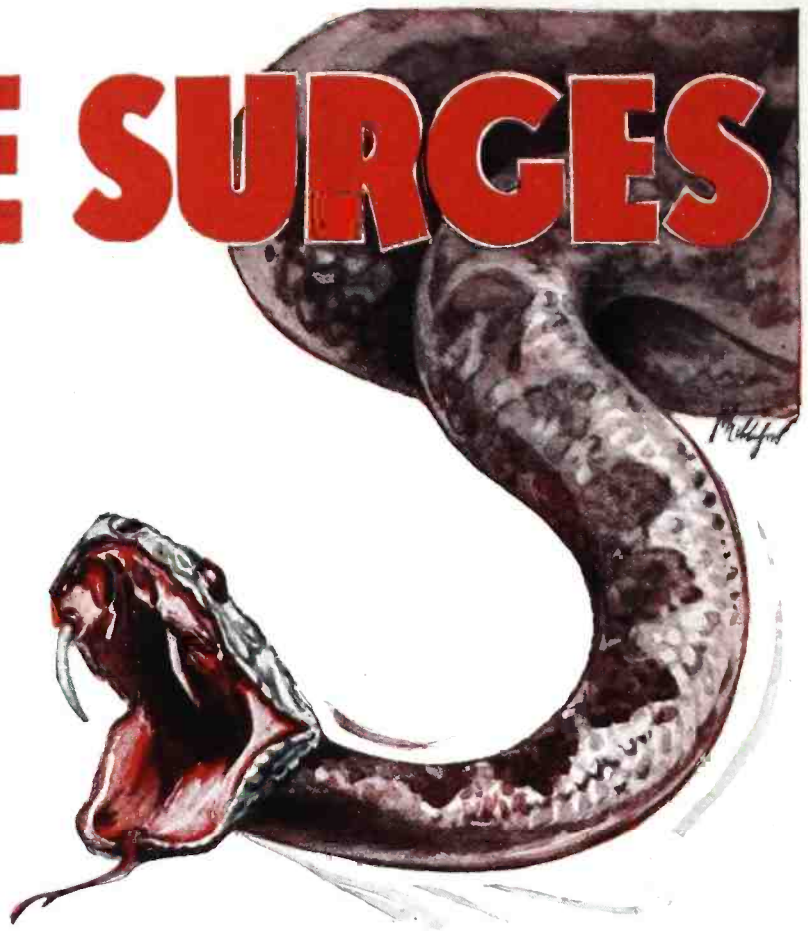
25¢

APRIL · 1928★



21 Big Features

VOLTAGE SURGES



Deadly as a Serpent's Fangs!

Play Safe With

PARVOLTS!

VOLTAGE Surges in electric-powered radio strike at filter condensers with the lightning speed and deadly power of a venomous snake.

Imperfect condensers, improperly rated condensers, non-uniform condensers—all break down sooner or later under the destructive action of voltage overloads. Blown condensers usually mean blown tubes, burned out transformers and chokes and even the destruction of speaker units.

Why take chances with ordinary condensers when ACME PARVOLTS give you positive protection?

These condensers are made only from highest grade insulation papers and special foils. Every detail of manufacture is under the constant supervision of experts who have devoted many years to the manufacture of condensers for heavy and continuous industrial duty.

ACME PARVOLT FILTER CONDENSERS *are supplied in all standard mfd. capacities for 200, 400, 600, 800, 1000, and 1500 Volt D.C. requirements. Uniform height and width for easy stacking. Supplied singly or in complete housed blocks for the important power supply units such as Thordarson, Samson and others.*

ACME PARVOLT BY-PASS CONDENSERS *are supplied in all standard mfd. capacities and for all required voltages.*

Every PARVOLT is tested to R.M.A. and N.E.M.A. standards and can be relied upon for accuracy and CONTINUOUS DUTY. Sold by leading jobbers and dealers.

Made by THE ACME WIRE CO., New Haven, Conn., manufacturers of magnet and enameled wire, varnished insulations, coil windings, insulalated tubing and radio cables.

ACME PARVOLT CONDENSERS

Made by the Manufacturers of

ACME CELATSITE HOOK-UP WIRE

ENAMELED AERIAL WIRE

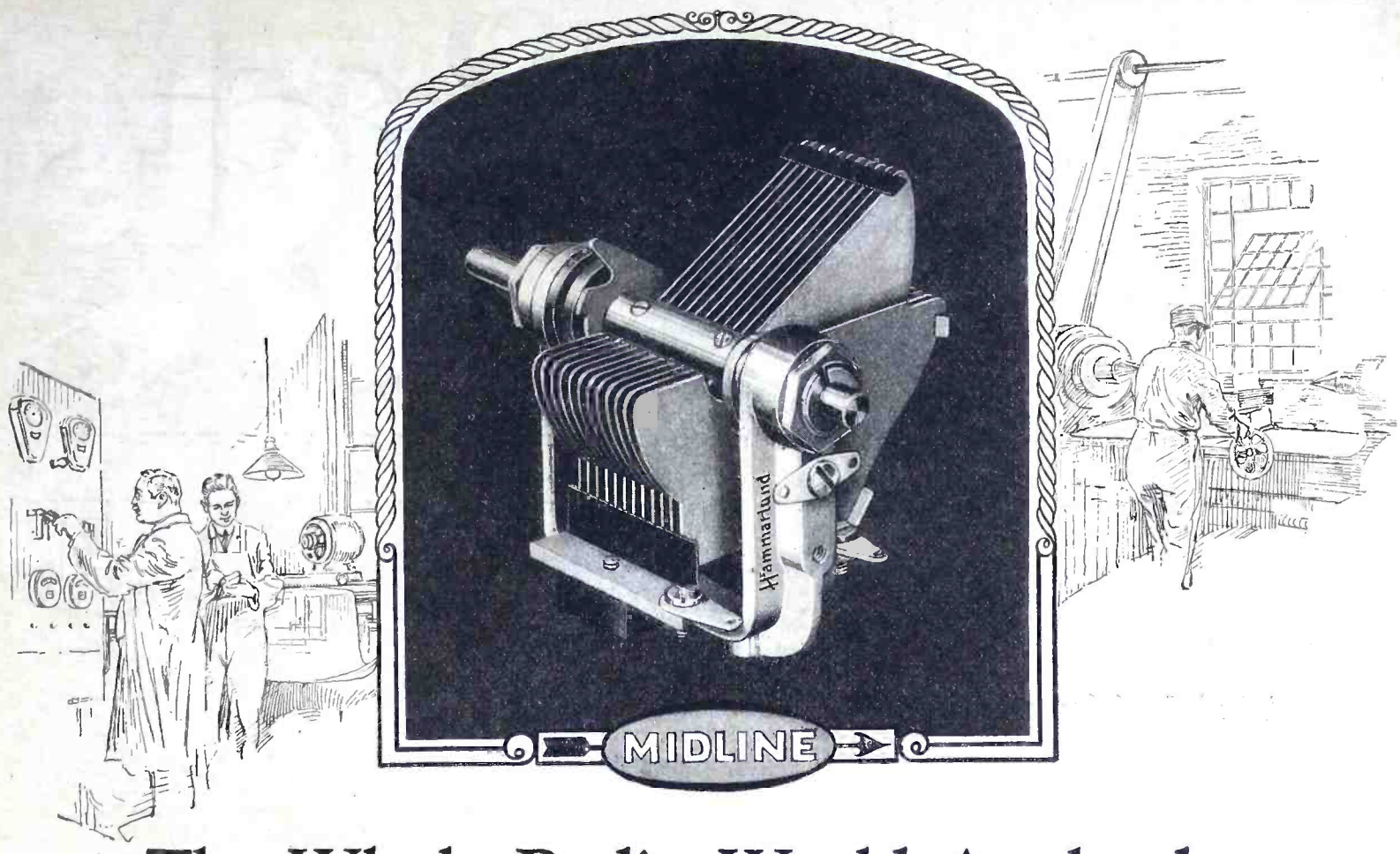
Enameled copper wire in both stranded and solid types. Also Acme Lead-ins, Battery Cables, Indoor and Loop Aerial Wire.

CELATSITE FLEXIBLE and SOLID

For all types of radio wiring. High insulation value; non-inflammable. 10 colors.

ACME SPAGHETTI

A superior cambric tubing for all practical radio and other electrical requirements. Supplied in 10 colors.



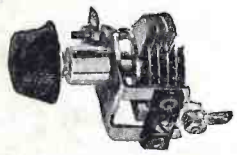
The Whole Radio World Applauds HAMMARLUND PRODUCTS

Wherever radio is known, Hammarlund Precision Products have won the enthusiastic praise of fans, amateurs and professional designers. The more they know about technical perfection the stronger their admiration for Hammarlund standards of workmanship.

From the famous Hammarlund Midline Condenser, in single and dual models, clear through to the tiny equalizing condenser, you will find assurance of high quality and superior performance.

Illuminated
DRUM DIAL

Makes single-control of multiple circuits practicable. Two circuits tuned as one, or individually. Translucent wave length scales illuminated from back. Beautifully embossed, oxidized bronze escutcheon plate gives distinction to panel.



A new, high-ratio midget condenser with all the distinctive Hammarlund features—plus sturdier, simplified construction. Has new locking device for fixing rotor plates in any position. Knob included.

Improved
"HAMMARLUND, JR."

HAMMARLUND PRODUCTS
Are Officially Specified For the Following Circuits

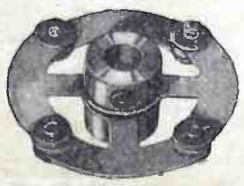
HAMMARLUND-ROBERTS
A. C. Hi-Q SIX
L. C. 28
HARKNESS A. C.
New THORDARSON
and
A Score or More of Other Featured Circuits

Radio-Frequency
CHOKE COIL

Special winding and impregnating gives minimum distributed capacity for a given inductance and provides extremely high impedance to all broadcast frequencies. Distinctive Bakelite case. Two sizes: 85 and 250 millihenries.

Equalizing
CONDENSER

For neutralizing R.F. circuits or equalizing multiple tuning units. Small size fits limited space. Bakelite base, mica dielectric, phosphor-bronze spring plate.



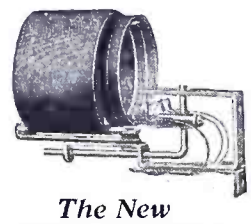
Flexible
COUPLING

Permits coupling condensers in tandem without exact alignment. Two sides electrically independent. Bakelite insulation.

Write for Folders

HAMMARLUND MANUFACTURING CO.
424-438 W. 33rd St. New York

For Better Radio
Hammarlund
PRECISION
PRODUCTS



The New
AUTO-COUPLE

Designed for use with the Hammarlund Drum Dial. Specified for the New Hammarlund-Roberts Hi-Q Six Receiver.

Popular Radio

EDITED *by* RAYMOND FRANCIS YATES

FOUNDED 1911

VOLUME XIII — April, 1928 — NUMBER 4

CONTENTS

(*Cover Design by A. G. Hagstrom*)

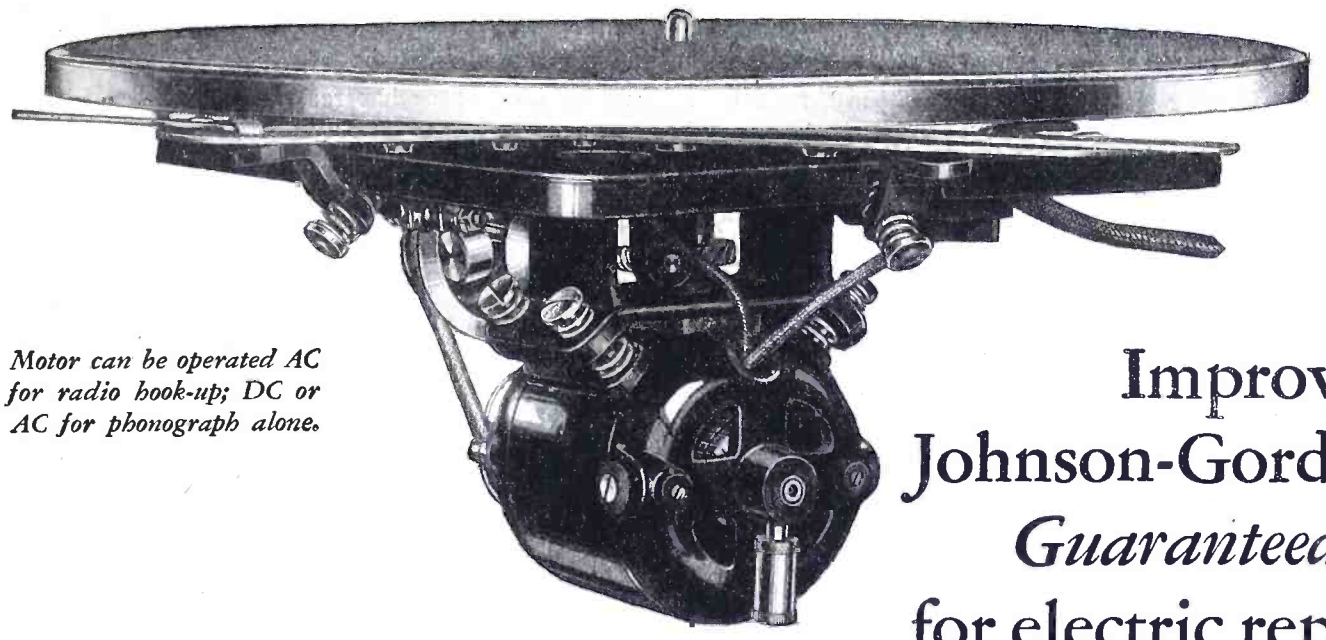
DEPARTMENTS

VOLUME XIII — APRIL, 1928 — NUMBER 4

Published monthly by Popular Radio, Inc., 119 West 57th St., New York, N. Y.; telephone number, Circle 8180; Douglas H. Cooke, President and Treasurer; Laurence M. Cockaday, Vice-president; Emma A. Harm, Secretary. Price, 25 cents a copy; subscription, $3.00 a year in the U. S., Canada and all countries within the domestic postal zone; elsewhere, $3.50 a year, payable in advance. The International News Company, Ltd., No. 5 Bream's Bldg., London, E. C. 4, sole distributors in England. Entered as second-class matter April 7, 1922, at the Post Office at New York, N. Y., under the act of March 3, 1879. Additional entry at Jamaica, L. I., N. Y. *For advertising rates, address* Popular Radio, Inc., 119 West 57th St., New York, or 225 North Michigan Ave., Chicago.
Printed in U. S. A.

LAURENCE M. COCKADAY, *Technical Editor* — CHARLES L. DAVIS, *Managing Editor*

No annoying hum-m-m-m-m



Motor can be operated AC for radio hook-up; DC or AC for phonograph alone.

Improved Johnson-Gordon Motor *Guaranteed Quiet* for electric reproduction

Now is announced a development of great importance to all manufacturers of radio-phonograph combinations, as well as to makers of phonographs:

An improved electric motor that will not hum-m-m-m-m when used in machines having electrical reproduction and amplification; a quiet motor that briskly goes about its job of driving the turntable without fuss or "interference," a fool-proof and almost care-proof motor that serves well and lasts long. All proved, not only by laboratory tests, but by actual performance in the homes of thousands of users.

Every manufacturing precaution and craftsman's precision make the *Improved Johnson-Gordon Motor* sweet-running and dependable. It is a quality job clear through—and looks it.

The motor is universal, operating on either DC or AC (25 and 60 cycles), with high starting torque that gives correct turntable speed from the second the switch is turned on, with a wonderful governor that insures absolutely no change or variation in turntable r. p. m. even when the line voltage fluctuates.

As illustrated, the motor is supplied complete with turntable, speed regulator, and automatic stop. Write for detailed specifications, prices, and discounts.

NOTE: *We are now in a position to furnish turntables for all types of electric-drive motors. Manufacturers are invited to investigate the facilities of our turntable department.*

SAAL COMPANY

1800 MONTROSE AVENUE, CHICAGO, ILL.

A Page With The Editor

During the past month the Editor's mail basket has been daily filled to overflowing with letters from readers itching for information concerning short waves and their reception. Popular Radio's article, "Get Ready to Listen to 36 Stations You Never Hear," stirred up a veritable hornet's nest and sent the Technical Staff hying off to the Laboratory in search of better short-wave adapters.

* *

This issue carries the details of a new type of adapter that has recently come forth from the Laboratory. Those who are looking for new thrills in reception are urged to retire immediately to the attic and build one. See page 309 for the details.

* *

Popular Radio believes that radio experimenters will be tuning to television transmission before the fall of this year. It appears, however, that "certain interests" who manufacture the necessary wherewithals are moving heaven and earth to prevent television apparatus and data from reaching the hands of the anxious fans. Several test letters of inquiry have been dispatched from this office to these "interests," yet nothing but ominous silence has resulted.

* *

Can it be true that those who would monopolize television, as they have attempted to monopolize sound broadcasting, are fearful of a duplication of the enthusiasm that has so devastatingly upset the market for factory-made receivers? It would seem so. The effort to strangle amateur participation in television has to date been so clumsy and so undiplomatic as to be amusing.

* *

All of which brings up the provoking query: "Who invented television?" One might just as well ask: "Who invented the automobile?" Nipkow, back in 1884, invented the scanning disc. Tesla designed the first synchronous motor years ago, and the principle of the photo-electric cell is the discovery of Hallwachs. Moore's original patents on the neon lamp have long since grown musty.

* *

Despite this work, and the work of such unsung pioneers as Jenkins and Baird, the scientific moguls of Schenectady officially and ceremoniously reinvented television during January of this year, when a staggering barrage of newspaper publicity was laid down on the unsuspecting and gullible public.

* *

Out of the research laboratories of the Thordarson Electric Mfg. Company of Chicago there comes a most interesting new receiver development—the QSA-5 receiver. It reached the Popular Radio Laboratory accompanied by a modest but convincing letter telling of its unusual performance. Subsequent tests in our own Laboratory corroborated these claims and, consequently, we are presenting some interesting advance information on pages 293-4 of this issue. Constructional details will follow in the May number.

* *

Many of our contemporaries have, during the past month, been busy releasing notices of changing advertising and editorial policies to the radio trade. Popular Radio, however, still has the courage of its convictions, and it will continue to serve its readers the same as it has in the past, brooking no armistice with its competitors.

* *

A London department store has recently featured the sale of television apparatus for amateur use. Not to be outdone by our genial English cousins, a New York radio dealer pioneered with a similar offer of television merchandise. He may not be making a great deal of money, but he *is* modern.

* *

If that dealer remains in business for another year, the Editor will wager that his sale of television and telephotographic equipment will top by an appalling margin his sale of conventional broadcast equipment.

* *

In talking of television, a recent visitor to the editorial sanctum cried, almost convincingly, "It can't be done." Seventh grade arithmetic, he maintained, was all that was needed to prove to the most sanguine supporter of television that scanning speeds necessary for anything but laboratory monkey-shines were utterly unattainable with our present equipment; and, further, that the prospects of perfecting new and better means were somewhat remote.

* *

Our pessimistic informer was adroitly reminded of that renowned English mathematician who postulated heatedly, with word and formula, concerning the impossibility of a steamship's crossing the Atlantic under its own power. It could not carry sufficient fuel, he argued, in writing to an American friend. His letter was dispatched just in time to catch the first steamboat that made the trip!

* *

Mathematics is often a means of thinking rather than doing. Prior to De Forest's hanging a hairpin between the filament and plate of Fleming's valve, broadcasting, as we know it today, was also impossible. Incidentally, the Editor has recently witnessed television reception sufficiently good to count the freckles on one's nose. That should be good enough for a start.

* *

With this issue Popular Radio bows to the public as Popular Radio and Television. During the past few months such great strides have been made in this new science, and the volume of letters reaching the editorial offices asking for information has been so great and so insistent that the editorial department has found it necessary to make arrangements for the publication of more material on this subject.

* *

Incidentally, Popular Radio is the first magazine in the United States to officially recognize this bristling new art, and while the material in this number is not as voluminous or as exhaustive as it will be in subsequent issues (May, for instance), Popular Radio has at least broken the ice. Our readers must remember that the publication is entering a new field, and we must always creep before we can run, or even walk.

* *

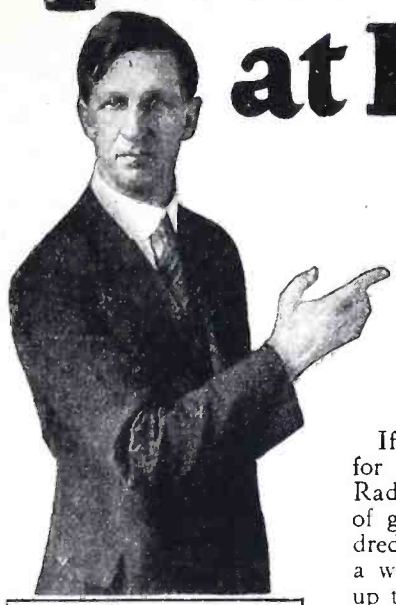
The laboratory has been working nights on television problems, and the May number will contain much material that will gladden the hearts of those serious experimenters who are itching to delve into the fascinating problems of "seeing by radio."

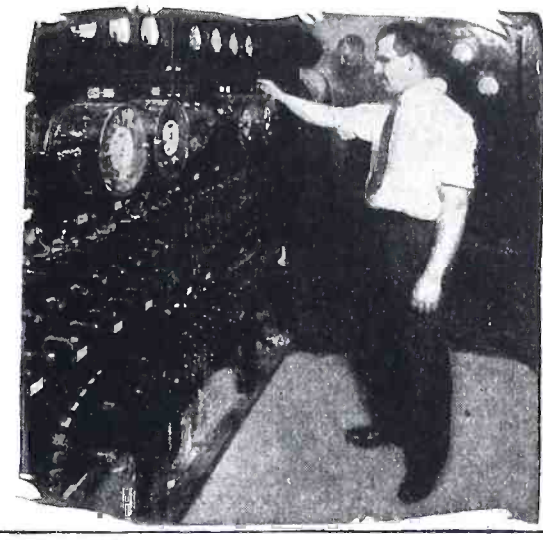
* *

The May issue will contain information as to where all the necessary appurtenances for television may be purchased, including motors, scanning discs, neon lamps and photoelectric cells.

Raymond F. Yates

I Will Train You at Home to Fill a Big-Pay Radio Job





If you are earning a penny less than $50 a week, send for my book of information on the opportunities in Radio. It's FREE. Clip the coupon NOW. A flood of gold is pouring into this new business, creating hundreds of big-pay jobs. Why go along at $25, $30 or $45 a week when the good jobs in Radio pay $50, $75 and up to $250 a week. My book "Rich Rewards in Radio" gives full information on these big jobs and explains how you can quickly become a Radio Expert through my easy, practical home-study training.

Salaries of $50 to $250 a Week Not Unusual

Get into this live-wire profession of quick success. Radio needs trained men. The amazing growth of the Radio business has astounded the world. In a few short years three hundred thousand jobs have been created. And the biggest growth in Radio is still to come. That's why salaries of $50 to $250 a week are not unusual. Radio simply hasn't got nearly the number of thoroughly trained men it needs. Study Radio and after a short time land yourself a REAL job with a REAL future.

You Can Learn Quickly and Easily in Spare Time

Hundreds of N. R. I. trained men are today making big money—holding down big jobs—in the Radio field. Men just like you—their only advantage is training. You, too, can become a Radio Expert just as they did by our new practical methods. Our tested, clear training makes it easy for you to learn. You can stay home, hold your job, and learn quickly in your spare time. Lack of education or experience are no drawbacks. You can read and write. That's enough.

Many Earn $15, $20, $30 Weekly On the Side While Learning

My Radio course is the famous course "that pays for itself." I teach you to begin making money almost the day you enroll.

My new practical method makes this possible. I give you SIX BIG OUTFITS of Radio parts with my course. You are taught to build practically every type of receiving set known. M. E. Sullivan, 412 73rd Street, Brooklyn, N. Y., writes, "I made $720 while studying." Earle Cummings, 18 Webster Street, Haverhill, Mass.: "I made $375 in one month." G. W. Page, 1807 21st Avenue, Nashville, Tenn.: "I picked up $935 in my spare time while studying."

Your Money Back If Not Satisfied

I'll give you just the training you need to get into the Radio business. My course fits you for all lines—manufacturing, selling, servicing sets, in business for yourself, operating on board ship or in a broadcasting station—and many others. I back up my training with a signed agreement to refund every penny of your money if, after completion you are not satisfied with the course I give you.

ACT NOW — 64-page Book is FREE

Send for this big book of Radio information. It won't cost you a penny. It has put hundreds of fellows on the road to bigger pay and success. Get it. Investigate. See what Radio has to offer you, and how my Employment Department helps you get into Radio after you graduate. Clip or tear out the coupon and mail it RIGHT NOW.

J. E. Smith, President
Dept. 4K, National Radio Institute
Washington, D. C.

Here's the PROOF

Made $185 in Three Weeks' Spare Time

"I have met with continued success. For instance, recently I realized a profit of $185 in three weeks for spare time work. I charge $1.50 an hour. Right now I am making more money in my spare time than I am making in my regular job. I have been making good money almost from the time I enrolled. I am going to give up my present position and open a Radio shop. The N. R. I. has put me on the solid road to success." Peter J. Dunn, 901 N. Monroe St., Baltimore, Md.

Made $588 in One Month

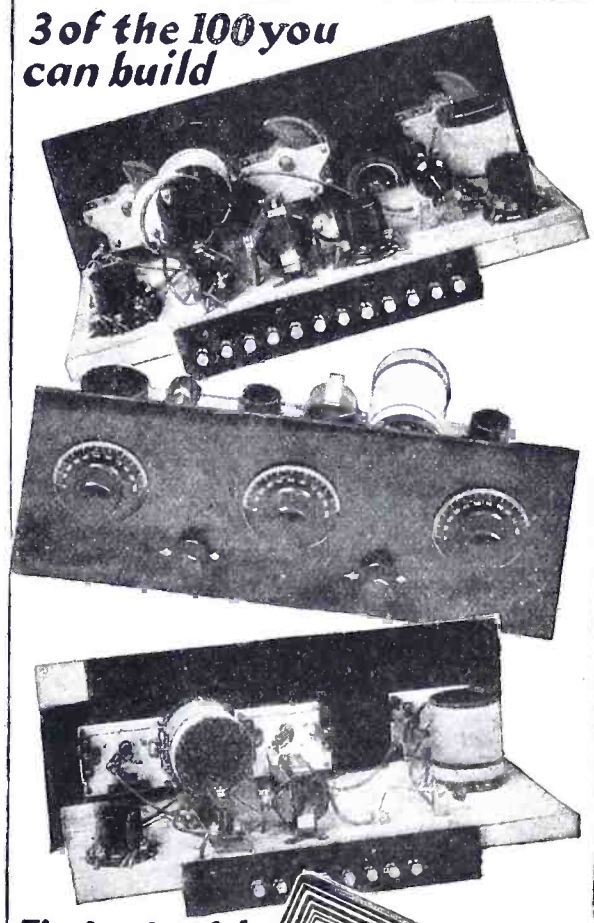
"The training I received from you has done me a world of good. Some time ago during one of our busy months I made $588. I am servicing all makes of Radio receiving sets. I haven't found anything so far that I could not handle alone. My boss is highly pleased with my work since I have been able to handle our entire output of sets here alone." Herbert Reese, 2215 South "E" Street, Elwood, Indiana.

Earns Price of Course in One Week Spare Time

"I have been so busy with Radio work that I have not had time to study. The other week, in spare time, I earned enough to pay for my course. I have more work than I can do. Recently I made enough money in one month spare time to pay for a $375 beautiful console all-electric Radio. When I enrolled I did not know the difference between a rheostat and a coil. Now I am making all kinds of money." Earle Cummings, 18 Webster Street, Haverhill, Mass.

You can build 100 circuits with the six big outfits of Radio parts I give you

3 of the 100 you can build



Find out quick about this practical way to big pay

Mail This FREE COUPON Today

J. E. Smith, President,
Dept, 4K, National Radio Institute,
Washington, D. C.

Dear Mr. Smith:—Kindly send me your big book "Rich Rewards in Radio," giving information on the big money opportunities in Radio and your practical method of teaching, with six big Outfits. I understand this book is free, and that this places me under no obligation whatever.

Name..... Age.....

Address.....

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

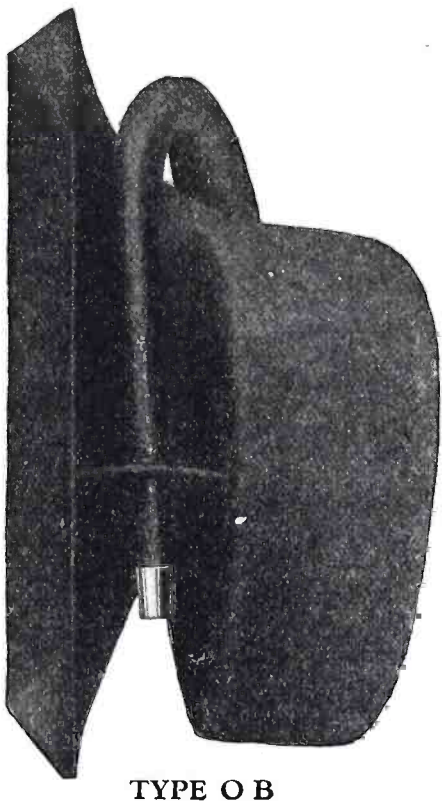
Occupation.....

Employment Service to all Graduates

Originators of Radio Home Study Training

RACON - EXPONENTIAL - HORNS

Supply the High Quality Reproduction Demanded by the Consumers of Today



TYPE O B
No. 1315

Air Column—104 inches
Bell—18″ x 24″
Depth—13″ Price $18.00

Through mechanical perfection you have planned to reach the reason of your prospective customers, and through cabinets of beautiful design you appeal to their eye—*but*—only through *perfect audition* do you break down the last barrier and influence a sale.

To include the Racon Exponential Horn in the models you are now designing assures added perfection to your present equipment, greater customer satisfaction, unusual demonstration value, more sales and more profits.

As premier Horn Manufacturers we have developed the Exponential, Air Column Horn to its present state of efficiency. Nationally known Acoustical Engineers have pronounced it the finest reproducer made. Our Engineers are available to help you solve your individual problems. Write or wire your cabinet measurements, stating sample required.

The Racon Process and Materials used are protected by Patents in the United States, Canada and Great Britain.

Immediate Delivery from Stock models to fit all standard size cabinets; 6½″ depth upwards.

Distinctive and Exclusive Features of Racon EXPONENTIAL Horns

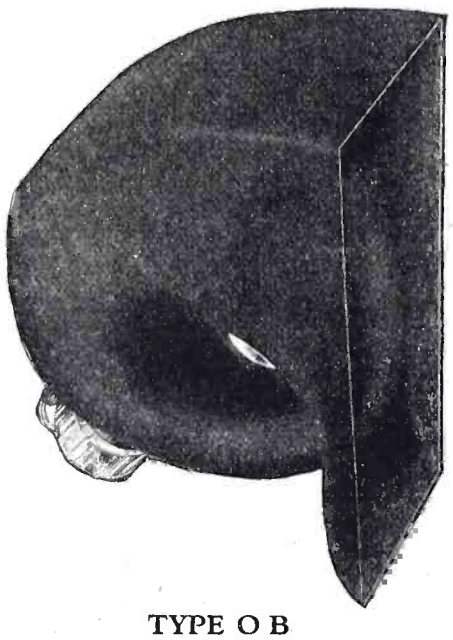
Made of impregnated and hardened fabric, therefore they may be made into *any* shape, to your exact specifications and yet have the deepest possible air column in a given space.

Vibrationless and a perfect medium for acoustic amplification. Unequaled in performance.

Lightest horn made, non-porous and fits snugly into beautifully designed cabinets of all sizes.

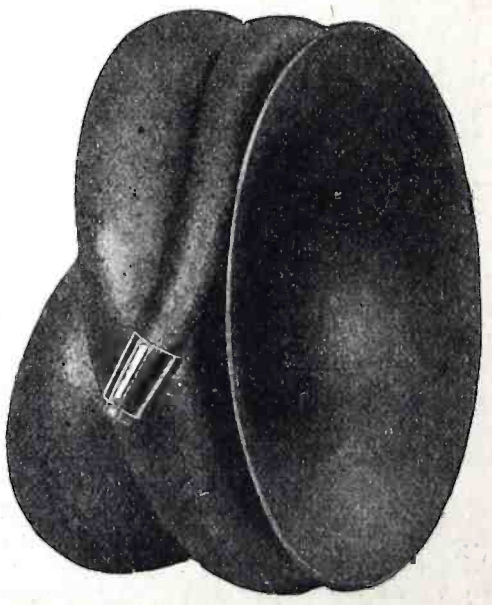
All air columns of every Racon Horn are designed along standard, accepted lines as authorized by Expert Acoustical Engineers.

Every Racon Horn is guaranteed uniform and to withstand every climatic condition without altering the perfection of its reproduction. Ordinary abuse in handling does no damage. Safe shipping assured.



TYPE O B
No. 320

Air Column—78 inches
Bell—10″ x 20″
Depth 13½″ Price $9.00



TYPE A S
No. 100

Air Column—84 inches
Bell—14″ round
Depth—9″

Racon's New Sensation—for the Home. To be Announced Soon!

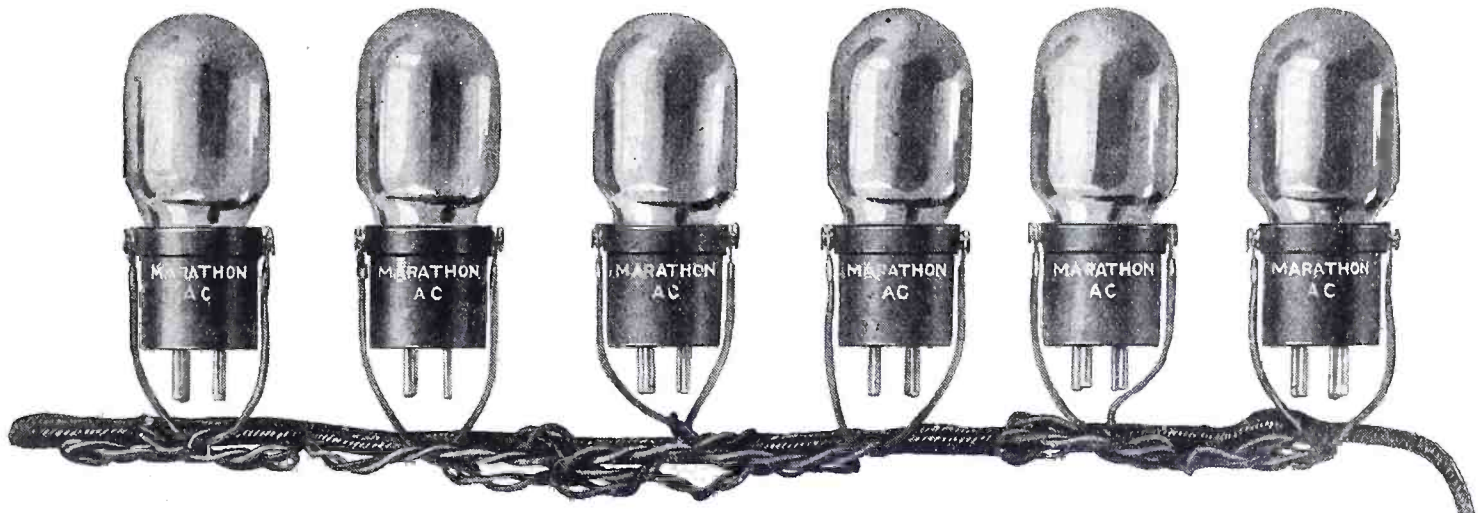
RACON ELECTRIC COMPANY, Inc.

FACTORIES

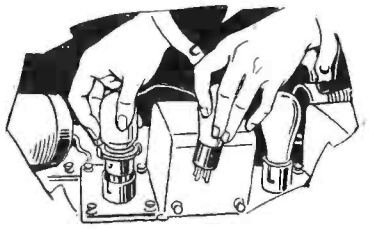
105 Sherbourne St., Toronto, Canada — 18 to 24 Washington Place, New York, N. Y. — Slough, Bucks, England

MARATHON *A-C KIT*

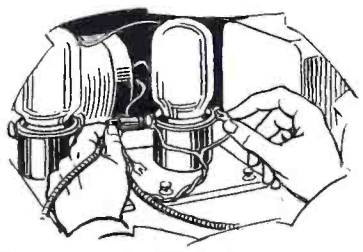
Electrifies any set



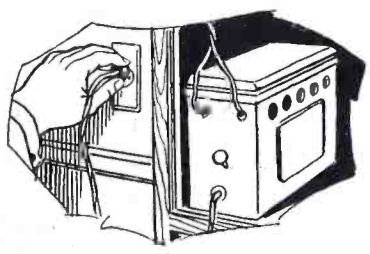
SIMPLE AS A-B-C



Replace your old Tubes with Marathon A-C Tubes



Connect the harness



Plug in the light socket

-that's all there is to do

YOU CAN'T MAKE IT COMPLICATED

No re-wiring—no adapters—no by-pass condensers—no center-tap resistors—no additional "C" Batteries

AT last you can electrify your set within a few minutes—without changing a single wire, without using by-pass condensers, adapters, center-tap resistors or additional "C" batteries.

The change from DC to AC is as simple as the illustrations to the left show—you can not make it complicated. Anyone, no matter how ignorant of radio, can do it.

Marathon AC Tubes Guaranteed for a Year

The amazing, self-biasing Marathon AC Tube—an entirely new development in the radio art—automatically takes care of every condition. No other tube is like it. It is built on an entirely new principle and guaranteed for a year!

Guaranteed to Operate Satisfactorily on Your Set

No need to wonder if the Marathon AC Kit will work on your set. If you have a set now operating from an "A" battery (drycells or storage), employing UX sockets, and 5, 6, 7 or 8 tubes we guarantee perfect satisfaction. We will not tell you about the increased efficiency the Marathon AC Tubes will give your set, but you will be agreeably surprised.

Complete Kit—Nothing Else to Buy

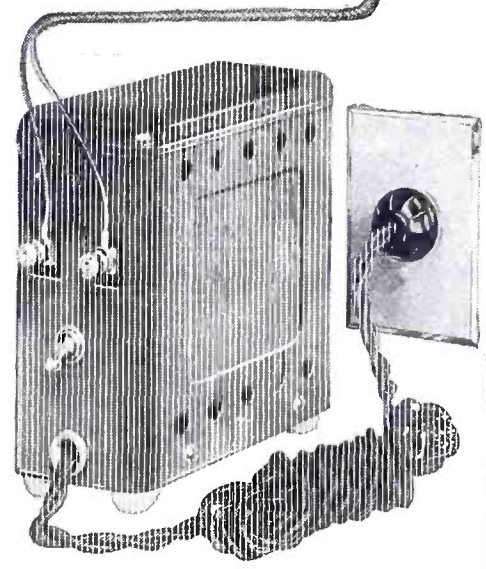
The Marathon AC Kit is complete. The six tube Kit, for example, includes 6 Marathon AC Tubes, a universal harness which fits all six tube sets, a Transformer which steps down the voltage to 6 volts (on which all of the tubes operate), and a volume control. Nothing else to buy.

Complete "A" "B" "C" Also!

Marathon A-C Kits for A B & C Elimination include tubes, Power Pack, volume control, pendant switch. Power Pack has taps for 6 volts for the Marathon Tubes, 45, 90, 135, 180 "B" and 4½ to 9 volts "C". Prices for complete Kit 5 or 6 Tubes, $59.50; 7 tubes $64.50; 8 tubes $69.50. Send the coupon below for complete information, if you have any difficulty in finding the Marathon AC Kits at your dealer.

Northern Manufacturing Company
Newark, N. J.

LIST PRICES
5 or 6 Tube Kit $30.00
7 Tube $35.00
8 Tube $40.00
COMPLETE



NORTHERN MANUFACTURING CO.,
381 Ogden Street, Newark, N. J.

Send me complete information on the Marathon AC Kit.

☐ Jobber ☐ Dealer ☐ Professional Set Builder
☐ User (Please check your classification)

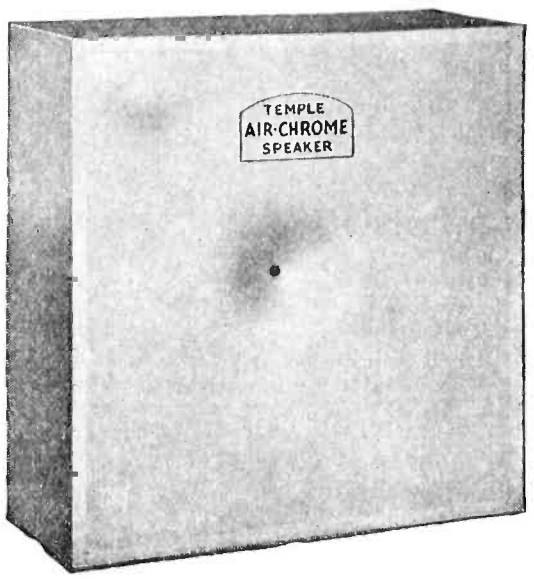
Name .....

Address .....

.....

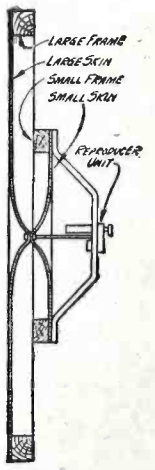
TEMPLE

The New Temple Air-Chrome Speaker



THE new Temple Air-Chrome represents one of the most startling speaker developments that the industry has seen. It couples Temple engineering and experience in speaker manufacturing with one of the most advanced principles ever developed in sound reproduction.

The Temple Air-Chrome Speaker is licensed under the Air-Chrome inventions and is of the balance tension, open radiator type. Two diaphrams of specially treated air-plane linen are brought together to a balanced center. At this point the drive pin of the unit operates. Because of this balance tension there is no dead weight on the driving unit and the slightest impulse is transmitted immediately to the two taut diaphrams without any loss.



This, and the fact that a specially developed powerful Temple Double Action Unit is employed, accounts for its enormous volume. It is why the bass notes are full and round—why the high treble notes are clear and true in definition—with no idea of flatness and with all their over-tones.

The Temple Air-Chrome Speaker will handle any power output—it is ideally suited for any kind of power amplifier output stage—it will not chatter—but will show a natural response to all frequencies to an amazing degree of clarity in its realistic reproduction.

Three Models Now Available

Three models of the manufacturers' type of the Temple Air-Chrome Speaker are now available. The 14 by 14 inch size, which is 7 inches deep, lists at $20.00; the 18 by 23 inch size, 8½ inches deep, at $23.00 and the 24 by 24 inch size, which is 9 inches in depth, lists for $25.00. They will fit practically every cabinet or console dimension for size. Two standard models will be ready soon—one will be of the small "clock type" speaker—the other will be of the floor table or console type.

Temple Double Action Units, horn type, for use in connection with exponential air columns, lists $6.00.

AIR-CHROME DIVISION

TEMPLE, INC.

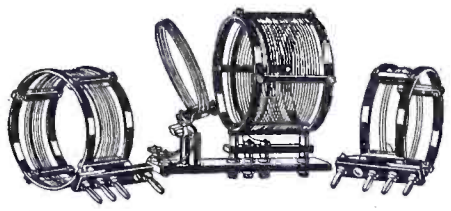
1925 S. Western Ave. Chicago, Ill.

LEADERS IN SPEAKER DESIGN

Build the Short-Wave Converter Described in This Issue!

Here are the AERO COILS you will need

This kit is the basis of the short wave converter described in this issue.



Experts and amateurs everywhere have found that this Aero Kit improves any circuit.

AERO LOW WAVE TUNER KIT
Code No. L. W. T. 125, Price $12.50

EVERYONE interested in short wave reception should read about the short wave converter described elsewhere in this issue of POPULAR RADIO. This superlative set is designed on sound engineering principles and produces extremely satisfactory results.

Always the prime favorite of experts and amateurs insistent upon extraordinary short wave performance, the Aero Low Wave Tuner Kit is again specified in this set. Greater volume, finer selectivity, better tone quality and flexibility to a degree never before thought possible is assured by use of these coils.

The Aero Low Wave Tuner Kit illustrated above is completely interchangeable. The kit itself includes three coils and base mounting covering U. S. bands 20, 30 and 80 meters. You can increase the range to 725 meters or decrease the range to 13 meters by securing Aero Interchangeable Coils Number 0, 4 and 5. All coils fit the same base and use the same condensers.

NEW AERO CHOKE COILS

The new Aero Choke 60 has a uniform choking action over a wide range of wave lengths. It eliminates so-called "holes" in the tuning range and is exceptionally efficient in every respect.

Price..... $1.50

The Aero Choke 248 is an unusually efficient transmitter choke. It presents a high impedance over the usual amateur wave lengths and handles transmitters up to 100 watts.

Price..... $1.50

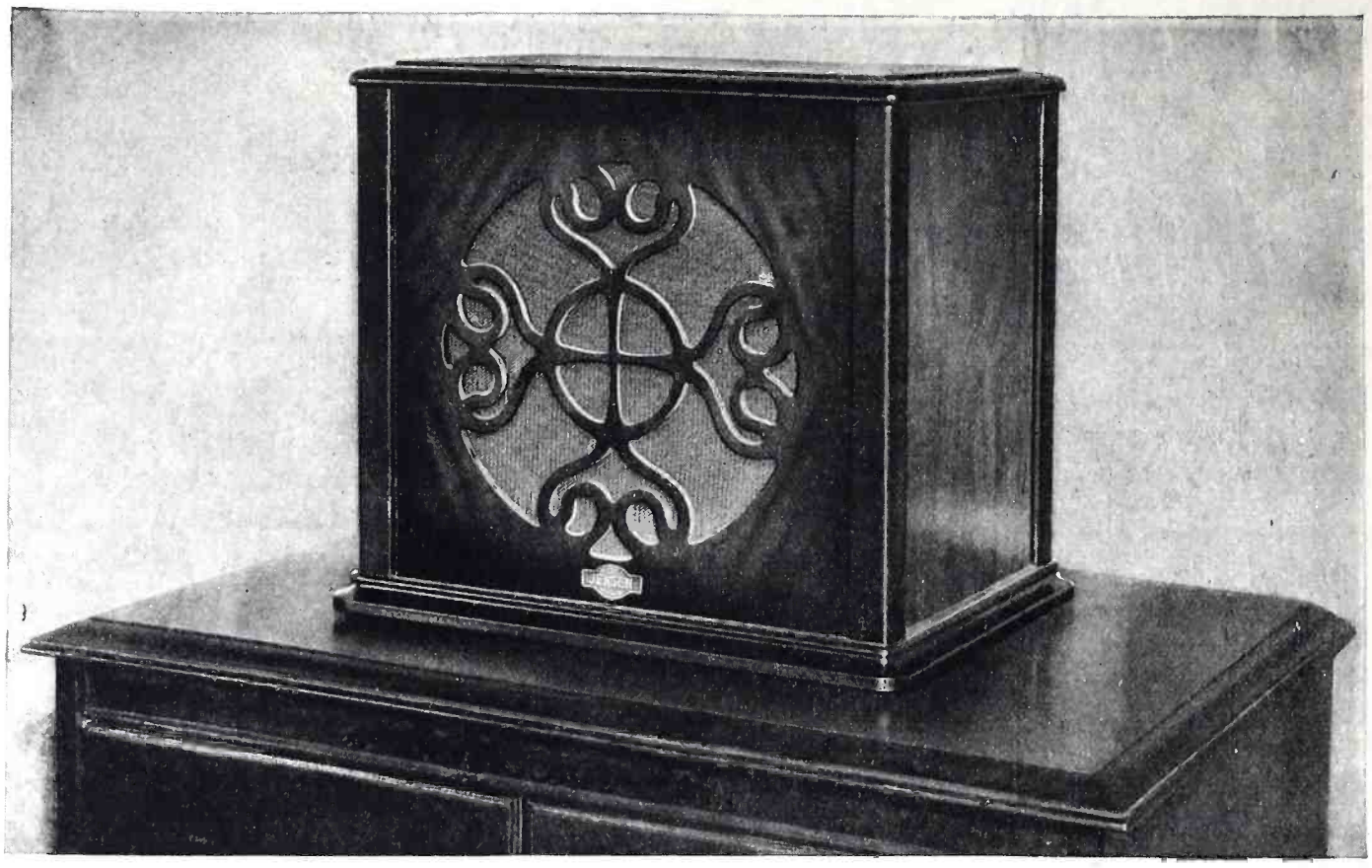
Plan for DX Records NOW

Order any of these Aero Coils direct from us if your dealer doesn't happen to have them. Be sure to specify code numbers when ordering.

AERO PRODUCTS, Inc., 1772 WILSON AVE., CHICAGO

Dept. 104

It will pay you to investigate the new Aero Amateur Transmitter Coils and improved Aero Universal Coil, designed for broadcast band usage. These coils are supplied in complete kits for the improved Aero-Dyne Six, the Aero Seven, the Aero Four and other popular circuits. Write for interesting descriptive literature on these and other new Aero products.



A Masterful Contribution
to the Radio Industry

THE enthusiastic and immediate national acceptance, by radio experts everywhere, of the New Jensen Dynamic Speaker is an acknowledgment of the value to the radio industry of this incomparable cone speaker.

Recognizing that only when the Dynamic Cone is used can tone fidelity be reproduced in its original life-like quality, Peter L. Jensen has perfected the Jensen Dynamic Speaker, which stands as a revelation of radio engineering genius.

The radio public has become conscious that any radio set, regardless of price, is largely dependent for tone quality upon the reproducer, whether built into the cabinet or used as a separate unit.

All cabinet types are finished in a beautiful burled walnut, ranging in price from $65.00 to $75.00. Unit alone for radio or phonograph installation, $47.50 to $57.50.

JENSEN RADIO MFG. CO. . MAIN OFFICE AND FACTORY 212 Ninth St., Oakland, Calif.

JENSEN
DYNAMIC SPEAKER
The Finest in Radio

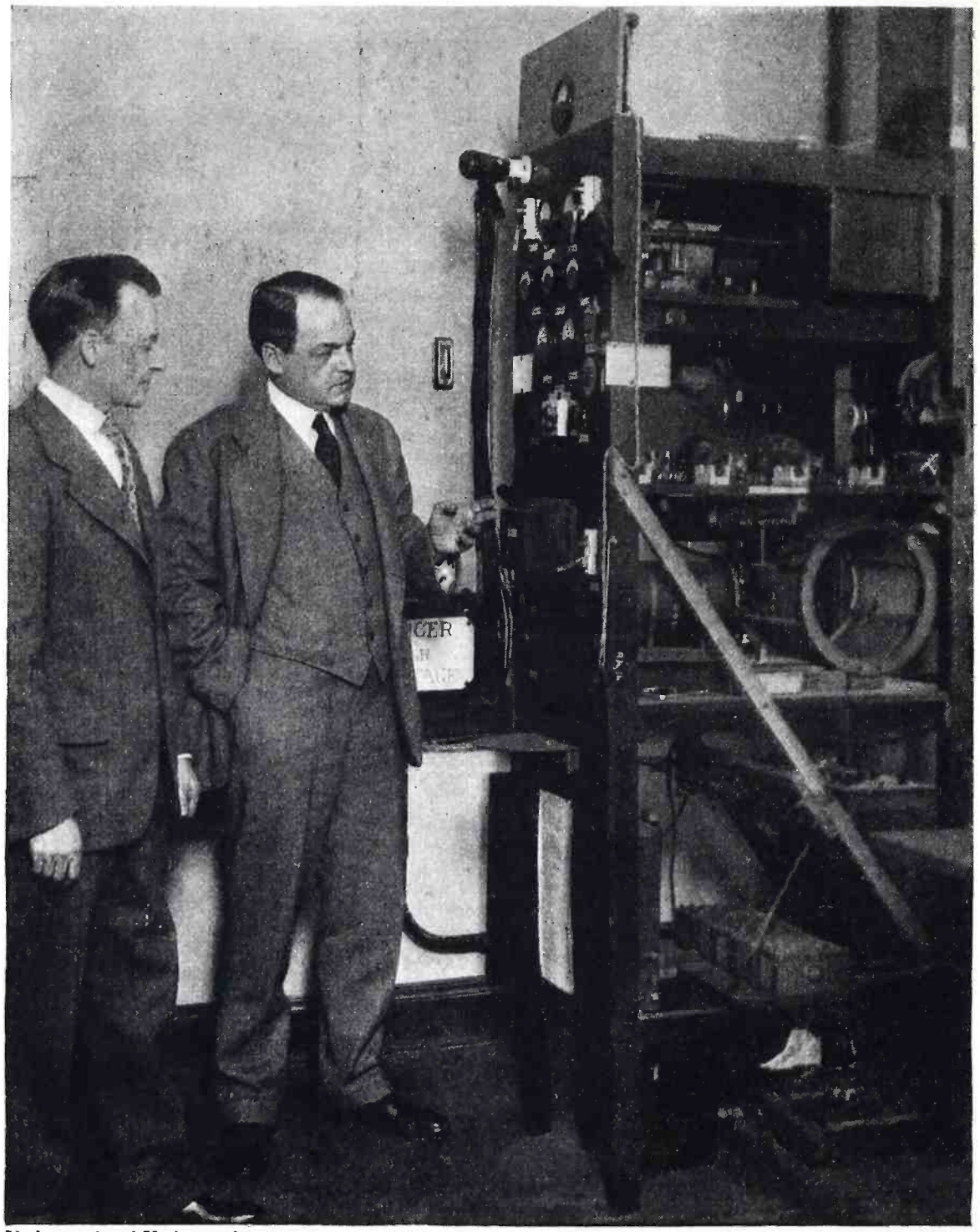
Licensed under Magnavox Patents

"Popular Radio's Progressive Spirit . . ."

"I have always been a silent admirer of POPULAR RADIO'S *progressive spirit, and I think I should give expression to this admiration which I feel. Especially do I recognize the service that the publication renders to its readers in telling them how to employ in their radio experiments only the best of manufactured products."*

S. S. Cole

TREASURER
AEROVOX WIRELESS CORPORATION



Underwood and Underwood

The Watchdog of the Ether

The instrument shown above is probably the most accurately tuned radio transmitter in the world. It is known as station WWV, and it is operated by the United States Bureau of Standards for the purpose of giving the broadcasters of the land an accurate check on the frequencies at which they broadcast. Once a month WWV goes on the air with a "program" of standard frequency broadcasts. At each broadcast eight standard frequencies are transmitted, consisting of an announcement of the frequency followed by a series of long dashes of the correct frequency. Broadcasters and experimenters not on the exact wavelength of the transmission may obtain their calibration by means of harmonics. Station WWV is under the watchful care of Dr. J. H. Dellinger, who is shown here (left) explaining its operation to Radio Commissioner Orestes H. Caldwell.

Popular Radio

VOLUME XIII April, 1928 NUMBER 4

Radio Sounds That Burn

Sounds that burn, that disintegrate animal blood, that cause terrific unheavals among the molecules of matter that is exposed to them—such sounds have been produced by transforming the rapid oscillation of high-frequency radio currents into mechanical vibrations. These "sounds," of course, are inaudible, for they lie far beyond the limit of the human ear and can be reproduced only with the aid of a piezo crystal "loudspeaker"; yet their existence is testified to by the amazing effects they are able to produce.

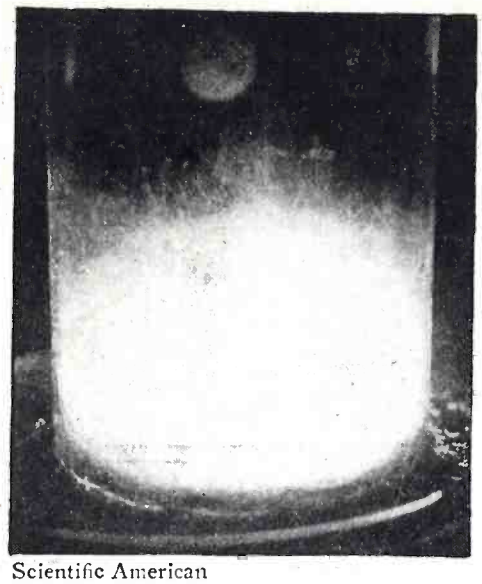
By KELVIN THORNTON

EVER since electrical science reached its age of discretion, the idea of a ray or vibration fatal to human life has held the imagination of the experimenter and the general public alike. Death rays have continually been "discovered," and usually exposed as fakes, and volumes have been written of the possible dire consequences of wars waged with destructive electrical vibrations. The conversion of electrical vibration of the order of those used in radio transmission into mechanical vibration has been suggested frequently in the past as a means of producing this imagined death vibration, but until recently this conversion has been confined to paper speculation and popular novels. It has remained for Professor Wood, LL.D., of the Johns-Hopkins University, to make the actual test of the consequences of producing physical vibrations of the order of 300,000 cycles—a frequency equal to that of a 1,000-meter radio transmitter. And, although it cannot be said that the "death vibration" which writers have fancied has been produced, the effects of this vibration are so amazing that they add a new chapter to the wonders of science.

Of course, the results of the experiments were, to a certain extent, predicted in the work of John Tyndall, the brilliant English physicist of the 19th century, whose researches are embodied in the classic work, "Heat as a Mode of Motion." In this treatise Tyndall speaks of temperature as being caused by the unorganized vibration of the atoms of matter. While the frequencies of these caloric vibrations are far higher than any of those used in Dr. Wood's experiments, the latter's experiments prove that very astonishing heat effects can be produced by mechanical vibrations of the order of the high-frequency currents used in radio.

It is quite easy to produce electrical vibrations of a very high order. With short-wave oscillators, electrons can be made to swing back and forth in circuits as rapidly as ten million times a second. However, we have no sound reproducing apparatus that would respond to these prodigious speeds. If we should let such currents flow through an ordinary loudspeaker, nothing but silence would prevail. In the first place, the diaphragm of the loudspeaker would be too bulky and massive to respond to these rapidly-moving currents and, even if it were able to respond, the human hearing apparatus would not be able to detect the sounds produced. Thirty thousand vibrations per second represents the absolute limit of the capacity of the human ear drum.

In his search for a "loudspeaker" that would dance to the tune of these ultra-rapid vibrations, Professor Wood turned to the use of quartz crystals. It is well known that a plate of quartz, cut from a crystal in the proper directions, has the curious property of expanding and contracting under the influence of a periodic electrical field which may be supplied by two thin metal plates in contact with the opposite surfaces of the quartz, and joined to the terminals of a high-frequency electrical oscillator of sufficient power. Calculations show that a quartz crystal or plate 1 cm. in thickness will respond to a natural frequency of about 300,000 vibrations per second. Consequently, if the crystal is placed in a circuit of powerful electrical oscillators tuned to the same frequency, resonance occurs, and the amplitude of the vibrations of the quartz crystal becomes very great.



Scientific American

RADIO SOUNDS MAKE "SMOKE" FROM LIQUID

Benzol placed on water and brought into contact with matter vibrating at the rate of 100,000 cycles a second, suffers such severe molecular shock that it is rapidly dissipated into the thin, white vapor shown above. Here again the rapid vibrations demonstrate phenomena that have heretofore been associated only with vibrations in the heat portion of the spectrum.

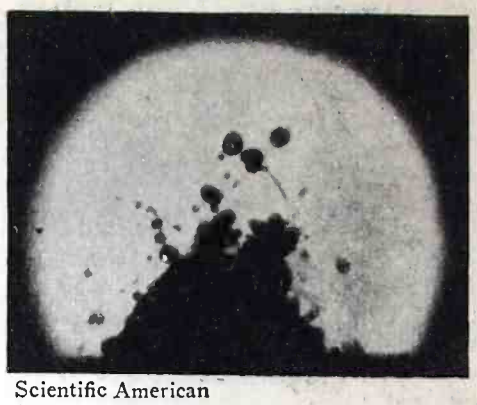
It was by the use of a crystal of this type that Professor Wood was able to study the mechanical effects of such astounding rates of vibration.

The "still" sounds produced in this way are capable of many curious feats. A glass tube, vibrated at a rate of 300,000 oscillations per second, will sear the flesh of the fingers if it is squeezed tightly. Benzol on water is thrown into such violent action that it is driven off into the air as fine mist or smoke. Frogs swimming in liquids vibrating at this high rate are killed, and glass tubes eventually succumb to the super-sonic frequencies that disrupt the ordinary molecular organization.

While ordinary quartz crystals such as those sometimes employed in amateur transmitters may be made to vibrate at super-audible frequencies by the use of a small oscillator, the amplitude of their vibrations is very small and unsuited for the work which Dr. Wood undertook. To obtain sufficient intensity, a 2-kilowatt oscillator which had originally been designed for an induction furnace was used, together with a bank of oil condensers and a large variable air condenser used with several pairs of coaxial coils for raising the voltage. The primary coils were made up of from 7 to 20 turns of Litzendraht cable, the resulting coils varying from 16 to 20 centimeters in diameter. The secondary coils, wound on glass cylinders and containing from 100 to 250 turns, were mounted within the primaries.

Equipped with this generator of super-sonic frequencies, a diagram of which is illustrated in Figure 1, Professor Wood set out to explore the wonderland of sounds that burn and explode. By the use of this apparatus with a quartz crystal cut to suitable size, sounds—if they may be called sounds—were generated with frequencies of from 100,000 to 700,000 cycles per second. The plates, which were in the form of circular discs, rested on sheets of lead at the bottom of a dish of transformer oil. The top electrode, which was formed by a disc of very thin sheet metal, rested on the upper surface of the quartz.

It was during his early researches that Professor Wood found that it was necessary to immerse the quartz in oil, to accommodate the potential of 50,000 volts generated by the powerful oscillator. With the use of such high voltage, it was found impossible to produce the effects outlined without the immersion in oil. Not only would there be sparking around the edges of the electrodes, but the quartz plate would be broken to pieces as a result of the extreme vibrations that would be induced in it by the action of the currents. By immersing the crystal in the oil bath, sparking was overcome and part of the energy imparted to the crystal was sufficiently dissipated by the emission of compressional waves in the oil. Ever with this arrangement, Professor Wood was always on the borderland of danger; for it was found that increasing the voltage much beyond this point resulted in a loss of crystals.



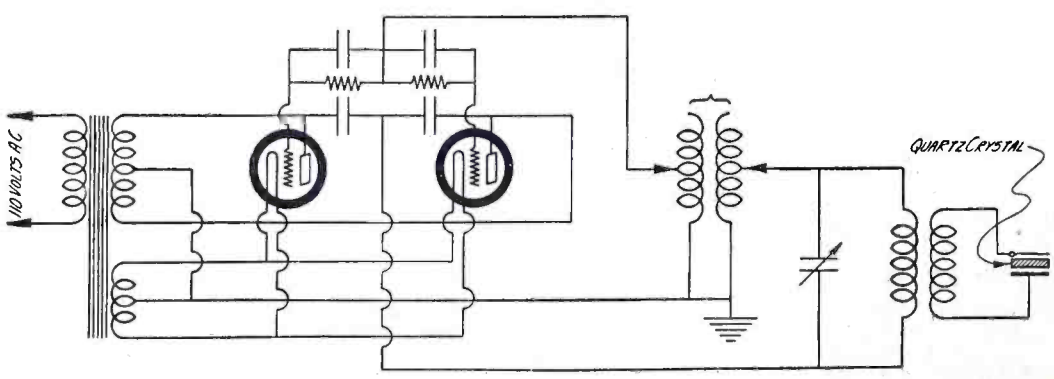
Scientific American

SOUND ERUPTIONS IN OIL

This miniature volcanic eruption took place on the surface of a vessel of oil which was subjected to high-frequency sound. The terrific shock sustained by the particles of oil is very apparent in the heaped up mound of liquid and the flying particles of oil.

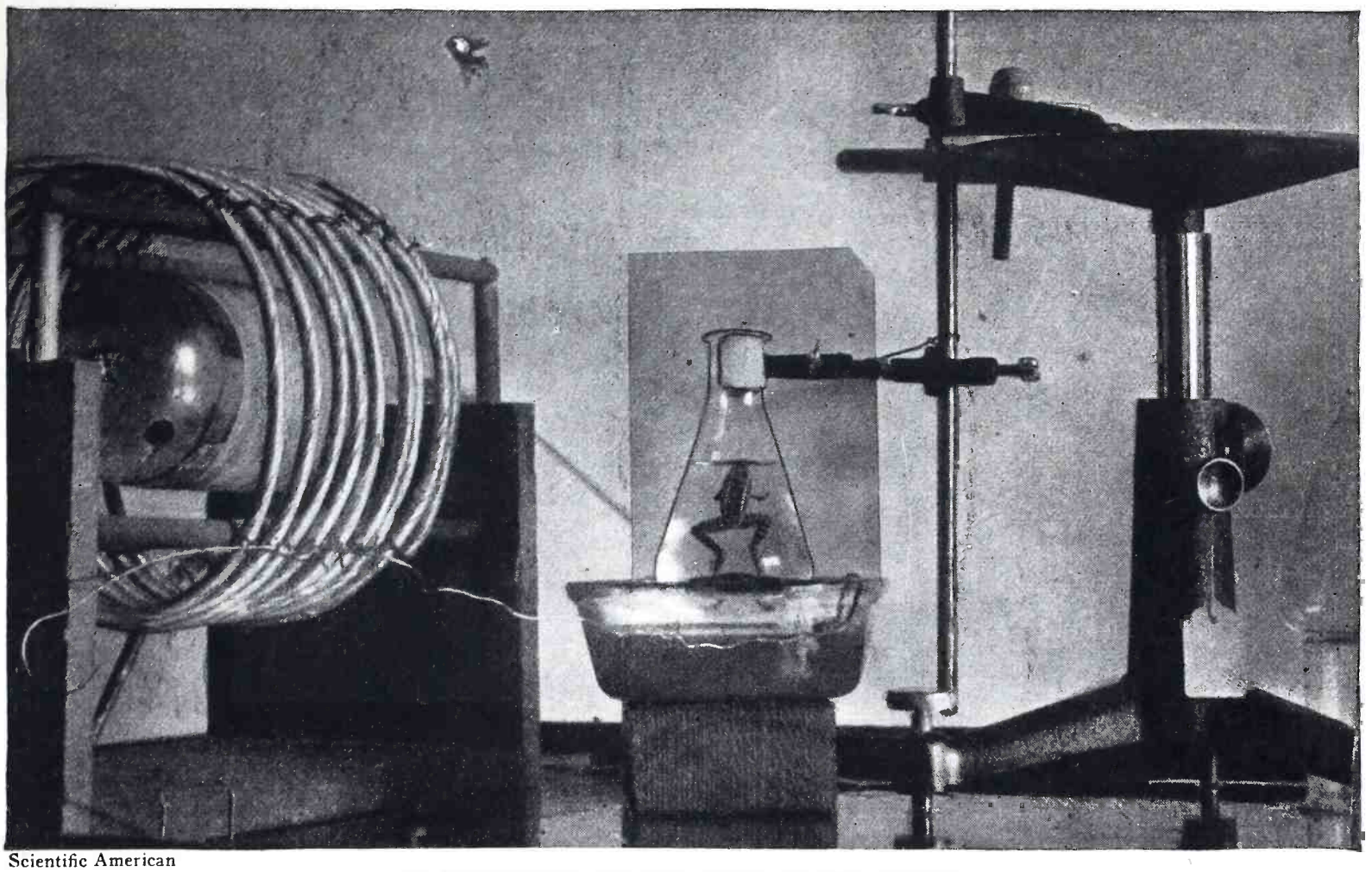
A beaker of water lowered to a point beneath the surface of the oil demonstrated a most remarkable phenomenon. The super-sonic frequencies at which the molecules of oil were responding was instantly communicated through the glass to the water in the beaker. The surface of the water was at once pushed up into a mound, while millions of infinitesimal air bubbles appeared in the fluid. When water is heated, precisely the same effect is produced; there is a rapid movement of dissolved air in the form of bubbles to the surface of the water. In this particular case, however, the bubbles did not go immediately to the surface but became entrapped in the nodes of the standing waves which had been formed by interference from the direct waves with those reflected down from the surface. When subjected to the same process, mercury was blown into clouds of fine particles projected up through the water, which soon became as black as ink.

Maximum heating effects were produced with a small flat-bottomed conical flask drawn out to a rod at the top of about ½ millimeter in diameter. The flask was mounted on a solid support in a vertical ring and pinion device, and the distance between the flask and the crystal plate could be accurately adjusted. By bringing pine chips in contact with the top of the rod, these were caused to emit sparks and holes were burned through them.



THE OSCILLATOR CIRCUIT

The input from the 110-volt AC lines is amplified by means of the vacuum valve oscillator circuit in the center; the output of the valves is fed into the tuned primary of the coil at the right. The secondary of this coil actuates the crystal which translates the electrical vibrations into mechanical vibrations.



Scientific American

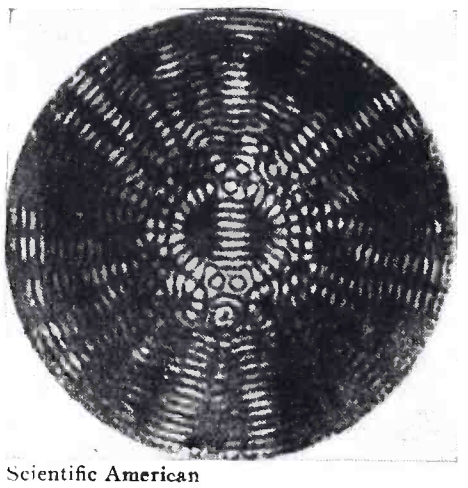
AN EXECUTION STAGED WITH SILENT SOUND

This view shows clearly the arrangement of apparatus used in the execution of a frog by means of supersonic sound. At the left is one of the coils of the oscillator used for generating high-frequency electric currents. The small dish in the center is filled with oil, and the leads from the oscillator are connected to a crystal immersed in it. Dipping into the oil is a flask of water in which a frog awaits execution when the vibrations of the crystal are transmitted through the oil to the water in the flask.

When a chip of wood was pressed tightly against a glass rod in contact with the sound generator, the rod was set to vibrating at high speed, and the chip burned. When the same glass tube was permitted to come in contact with a plate of glass, it pushed its way through, displacing the glass in the form of fine white powder. By dusting circular glass plates with lycopodium, and subjecting the plates to the ultra-rapid vibrations, the powder arranged itself in symmetrical forms having a lace-like appearance.

Among other interesting experiments performed by Dr. Wood was that of drawing out a glass tube and spraying the constricted area with oil. When exposed to the extreme vibrations by placing the bottom of the glass tube in contact with the rapidly vibrating supersonic generator, the oil escaped into the surrounding atmosphere in the form of fine mist or spray, which fully demonstrated the exceptionally violent action into which the molecules of the oil were thrown.

Perhaps the most interesting of all these many experiments was that which tested the biological effect produced by the vibration. Red blood corpuscles were completely destroyed and the salt solution in which they are suspended quickly lost its turpidity and became a clear, red color very similar to the solution that would be produced by aniline dyes. Unicellular organisms, such as paramecia, were almost instantly dispatched and the cells torn open.



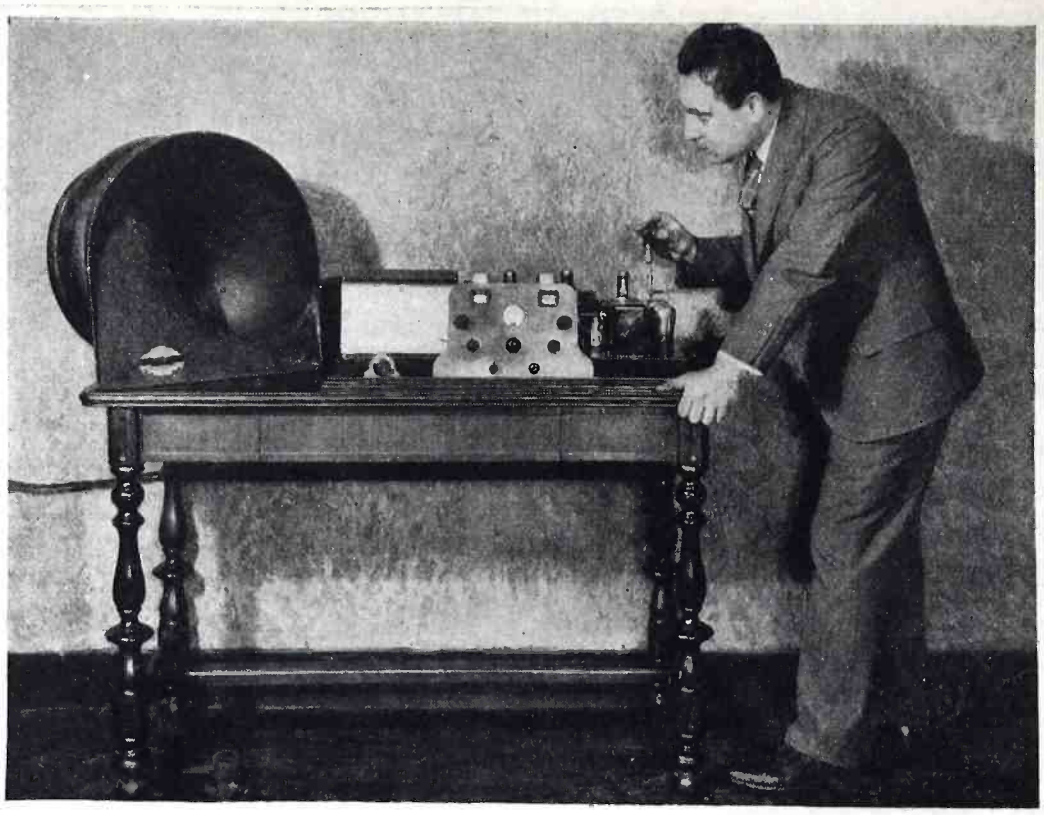
Scientific American

RADIO SOUND WEAVES THIS LACE-LIKE PATTERN

Although this intricate pattern is worthy of a Flemish needlewoman, it was produced when a fine powder of lycopodium was dusted over a piece of glass and vibrated at a supersonic frequency. The figures are formed by the interference of waves reflected from the rim of the plate to those radiating outward from the center.

An especially beautiful and revealing experiment was performed by coating the inside of a two-foot length of glass tube, one inch in diameter, with a film of very heavy oil. When the end of the tube was dipped into the vibrating bath, the film immediately gathered itself into a system of equidistant rings. These rings lined the tube from top to bottom and showed the positions of the nodes of the stationary waves formed by interference of the high-frequency vibrations which were at the time running up and down the tube.

The increase in temperature caused by supersonic sound vibration was easily measurable, using an ordinary centigrade thermometer. As a matter of fact, it was during the application of the thermometer to the oil bath in which the crystal was immersed, that the experimenter actually discovered the uncomfortable effects produced by the high rate vibrations. Upon immersing the thermometer in the bath it was found that the friction between the vibrating glass and the skin of the operator became so great that a searing of the flesh resulted.



ADJUSTING THE INFRADYNE AMPLIFIER

Since the Infradyne amplifier works on one frequency, it needs no attention after its initial tuning when the set is built. For local reception it may be switched out of the receiver circuit, with a consequent saving in operating voltages.

Plenty of New Ideas *in* the Remler Infradyne

By LAURENCE M. COCKADAY

By inverting the principles of the superhetrodyne, the Remler 10-valve Infradyne receiver, whose construction is described here, gives the set builder a brand-new circuit to play with — a circuit that brings in distant stations like locals, and gives the locals a volume and quality that few other receivers can match.

THERE are few radically new circuits for radio reception offered to the experimenter or the radio enthusiast who builds his own set. The infradyne system, however, *is* different and offers some advantages that are not found in any other type of receiver circuit.

In the first place, the new infradyne receiver is a ten-valve set and is arranged so that instantaneous conversion may be made for local reception so that only five valves, with single dial control, are used. In this condition the infradyne comprises two stages of tuned-high-frequency amplification, a detector and two stages of low-frequency amplification. Operated on this circuit the receiver is sufficiently selective and will produce excellent tone quality on local reception. By a mere turn of the switch the set is changed so that two stages of high-frequency amplification are used, after which the signals are rectified by a detector valve, and a beat frequency produced by means of a local oscillator of approximately 3,500 kilocycles, at which frequency three extra stages of high-frequency amplification are used, working into a second detector and two final stages of low-frequency amplification.

The receiver is not a superheterodyne; in fact, it works in exactly the opposite manner from the superheterodyne. Instead of the beat frequency being the difference between the initial frequency and that of the local oscillator frequency, it is the sum of these two frequencies, so that the signal will appear on but one setting of the dial. Of course, the beat frequency is on a very short wavelength and the three-stage short-wave amplifier operates with the utmost selectivity without cutting sidebands or impairing quality of reproduction. This new form of amplification, beside amplifying the received signal to a remarkable extent, helps also to suppress a large amount of the noises that are amplified through the standard wavelength amplifiers ordinarily used.

An inspection of the new infradyne, as shown in the accompanying illustrations, will show that the new receiver presents a neat and pleasing appearance, that it is sturdy in design and compact in construction, and that in it have been incorporated all the latest improvements and electrical features in keeping with the latest developments in the field of radio. The schematic wiring diagram in Figure 4 gives the theoretical circuit in its entirety.

In construction this new set can be built by any one whether he is familiar with radio or not. When it is completed the constructor will have a re-

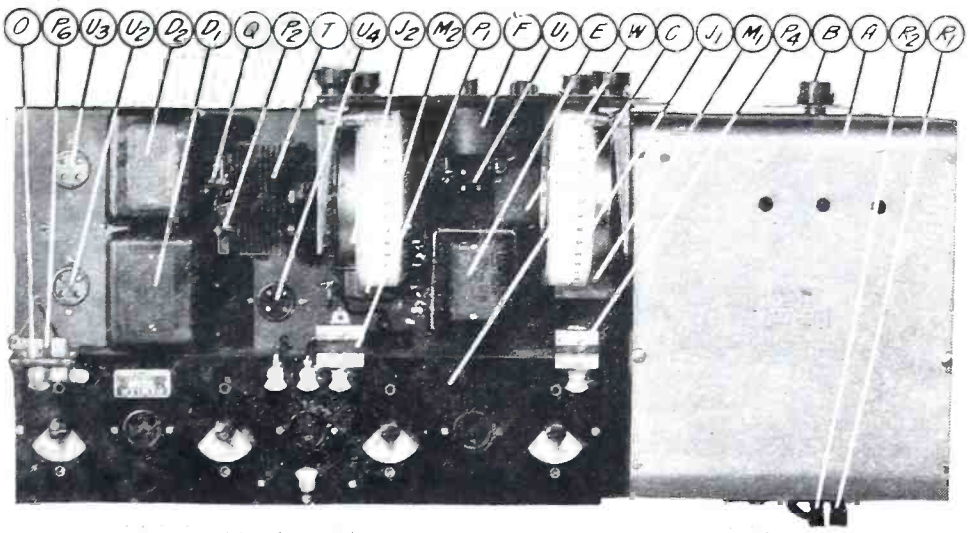
POPULAR RADIO WORK SHEET

The Remler Infradyne Receiver

List of Parts for Building This Receiver

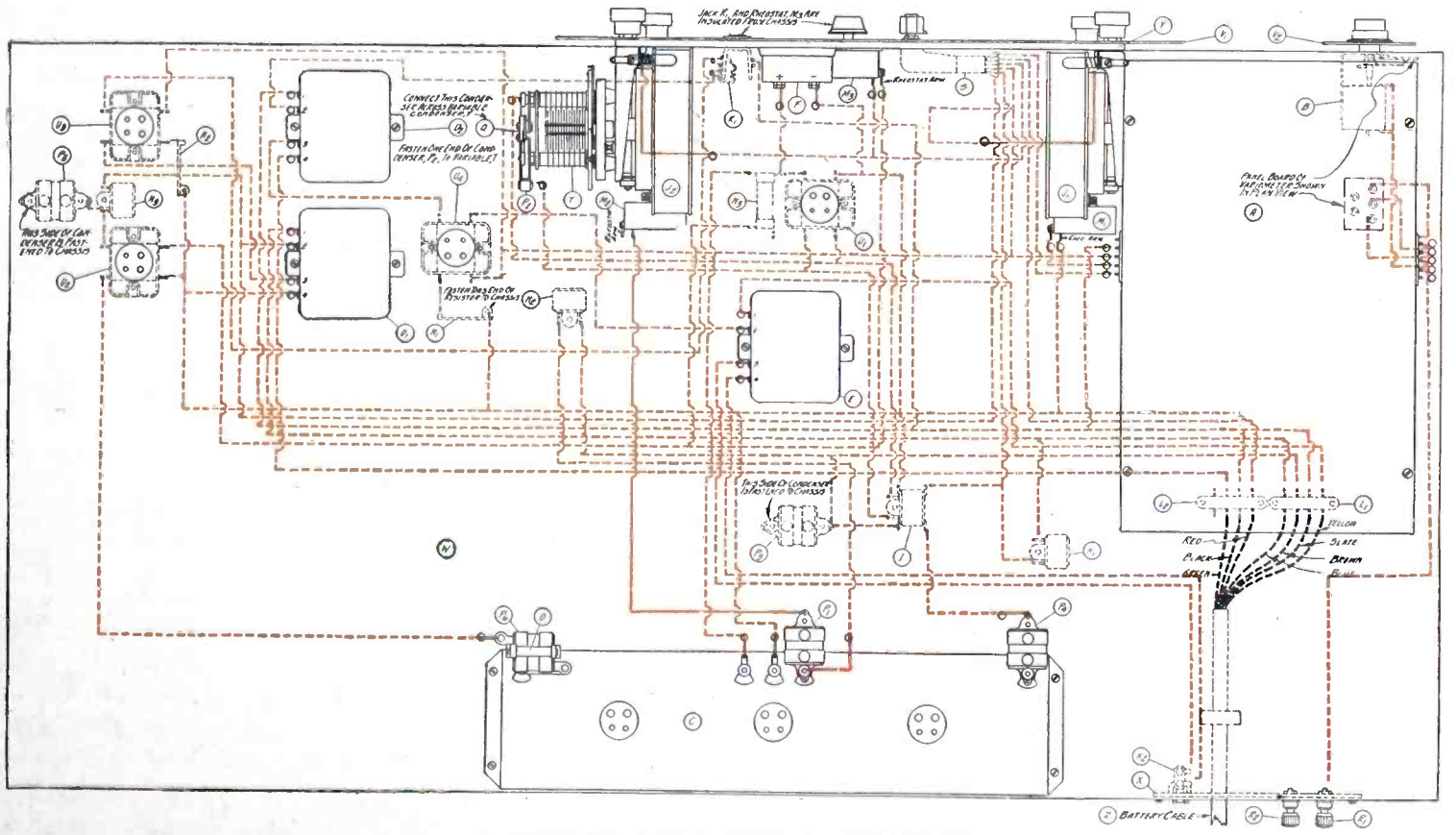
Cost of Parts—*Not over $180.00*

A—Remler high-frequency amplifier, No. 710;
B—Remler antenna compensator;
C—Remler Infradyne amplifier, No. 700;
D1 and D2—Silver-Marshall low-frequency transformers, type 220;
E—Silver-Marshall output transformer, type 221;
F—Weston voltmeter, Model 506, 0 to 5 volts;
G1 and G2—Remler cabinet and wooden base, No. 760;
Remler Infradyne foundation kit, No. 750, consisting of:
H1 to H3—Remler high-frequency chokes, type No. 35;
I—Remler special oscillator coil;
J1—Remler drum dial, No. 110-L;
J2—Remler drum dial, No. 110-R;
K1—Frost Gem Jac, No. 954, equipped with oxidized metal bushing;
K2—Frost Gem Jac, No. 953;
L1 and L2—Remler special bakelite terminal blocks;
M1—Frost 10-ohm rheostat with extension shaft;
M2—Frost 2½-ohm rheostat with extension shaft;
M3—Frost 4-ohm rheostat;
N1 to N3—Frost fixed resistances, 2 ohms, 4 ohms and 6 ohms, respectively;
O—Durham metalized resistor, 4 megohms;
P1 to P3—Electrad fixed condensers, .005 mfd., type P;
P4—Electrad fixed condenser, .001 mfd., type P;
P5—Electrad fixed condenser, .00025 mfd., type P;
P6—Electrad fixed condenser, .00025 mfd., type GS, equipped with grid-leak bracket;
Q—Special adjustable condenser with bracket attached;
R1 and R2—Eby binding posts, marked *antenna* and *ground;*
S—Yaxley switch, No. 69;
T—Remler variable condenser, type 659;
U1 to U4—Remler sockets, No. 50;
V1—Remler bronze control panel;
V2—Remler bronze antenna panel;
W—Remler steel chassis;
X—Bakelite binding-post strip, 4 by ¾ by ⅛ inch;
Y—Pressed steel instrument panel;
Z—Battery cable;
Connecting wires, screws, nuts, etc.;
Instruction book and blue prints.



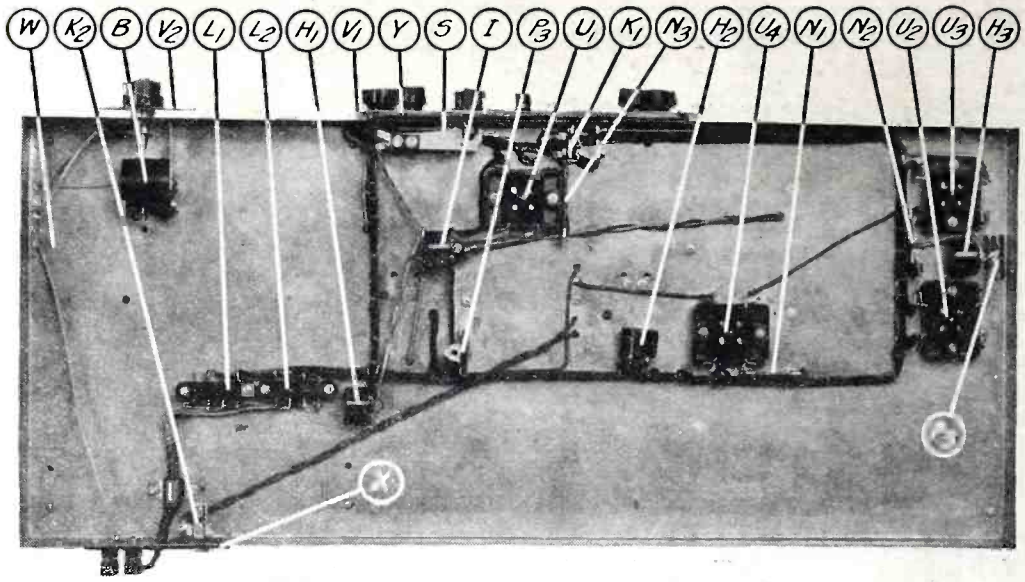
THE RECEIVER VIEWED FROM ABOVE

FIGURE 1: *The high-frequency amplifier, encased in its shield, appears at the right, the infradyne amplifier may be seen at the bottom of the picture, at the left.*



HOW TO WIRE THE RECEIVER

FIGURE 2: *The wiring of the receiver is simplified by the fact that the high-frequency amplifier and the infradyne amplifier may be obtained completely wired.*



THE UNDER SIDE OF THE SUB-PANEL

FIGURE 3: *The method of cabling the wiring and the connections to the instruments mounted under the sub-panel are clearly shown in this view of the set.*

ceiver that is absolutely up-to-date in design and performance, producing such excellent results for selectivity, sensitiveness and reproduction qualities that he will be very proud to own it.

How to Construct the Receiver

The first job will be to mount the various instruments, parts and amplifiers on the metal chassis, W. It is preferable to start with the bottom side and to mount the antenna compensator, B, the terminal blocks, L1 and L2, the choke coils, H1, H2 and H3, the four sockets, U1, U2, U3 and U4, the condensers, P3 and P5, the resistances, N1, N2 and N3, the jack, K2, and the binding post strip, X, on the underneath side of the chassis, W. The correct positions for these instruments are shown in Figure 1. They are to be mounted on the chassis, in the screw holes provided for them, by means of the screws, washers and nuts that are provided in the envelopes in which the instruments come packed.

After this is done the various instruments on the top side of the chassis should be mounted, including the high-frequency amplifier, A, the infradyne amplifier, C, the transformers, D1, D2 and E, the condensers, P1, P4 and P6, and the grid-leak, O.

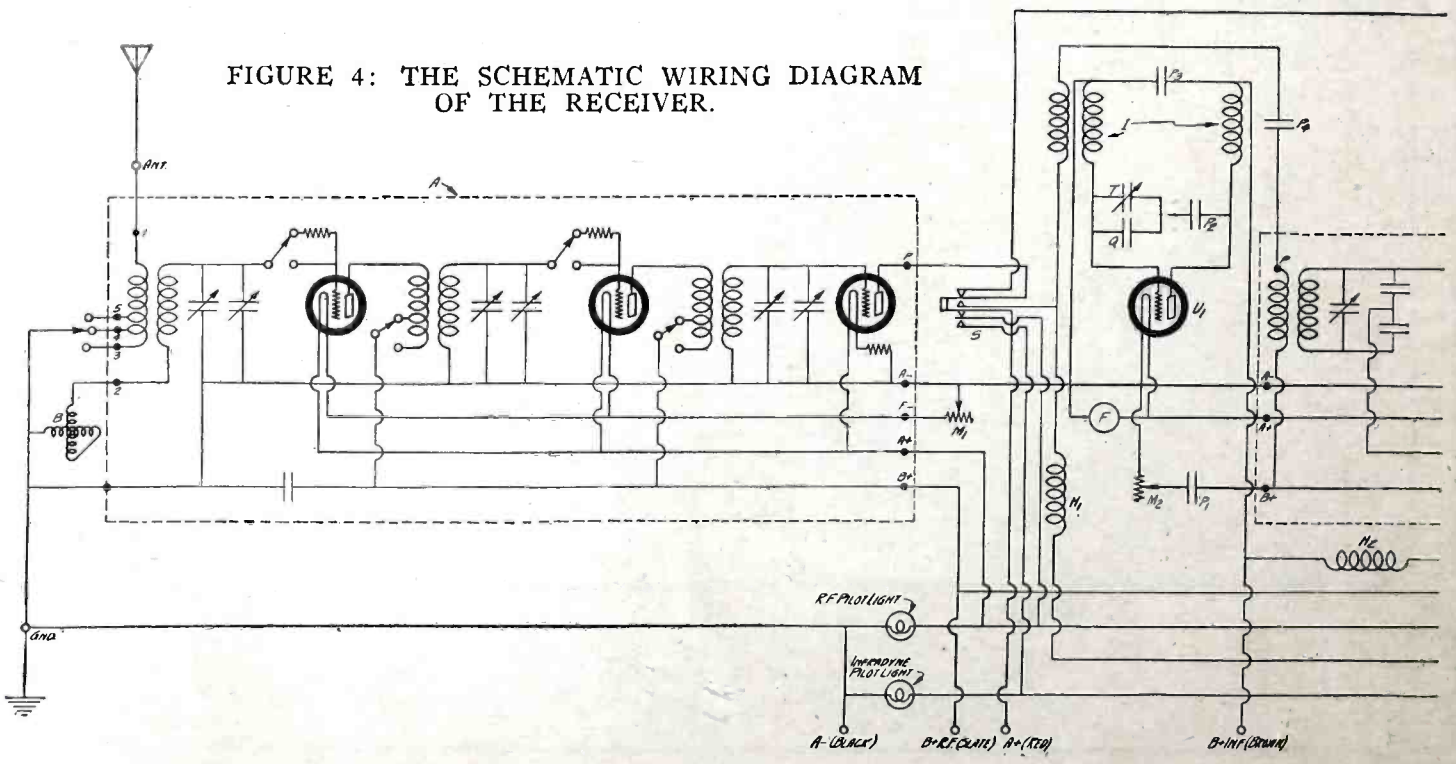
Next mount the pressed steel instrument panel, Y, on the chassis, W. An envelope will be found containing screws for this purpose. When the instrument panel has been attached to the base mount on it the switch, S, the jack, K1, the right and left-hand drum dials, J1 and J2, the voltmeter, F, and the rheostats, M1, M2 and M3. These should be mounted without attaching the dials. Next put in place the bronze escutcheon plate, B1, and attach all the dials to the shafts of the instruments, as well as the front of the jack, K1. The rheostat, M3, should be insulated with an insulating washer that is packed in one of the envelopes. Next attach the variable condenser, T, and on it mount the condenser, P2, and the adjustable condenser, Q.

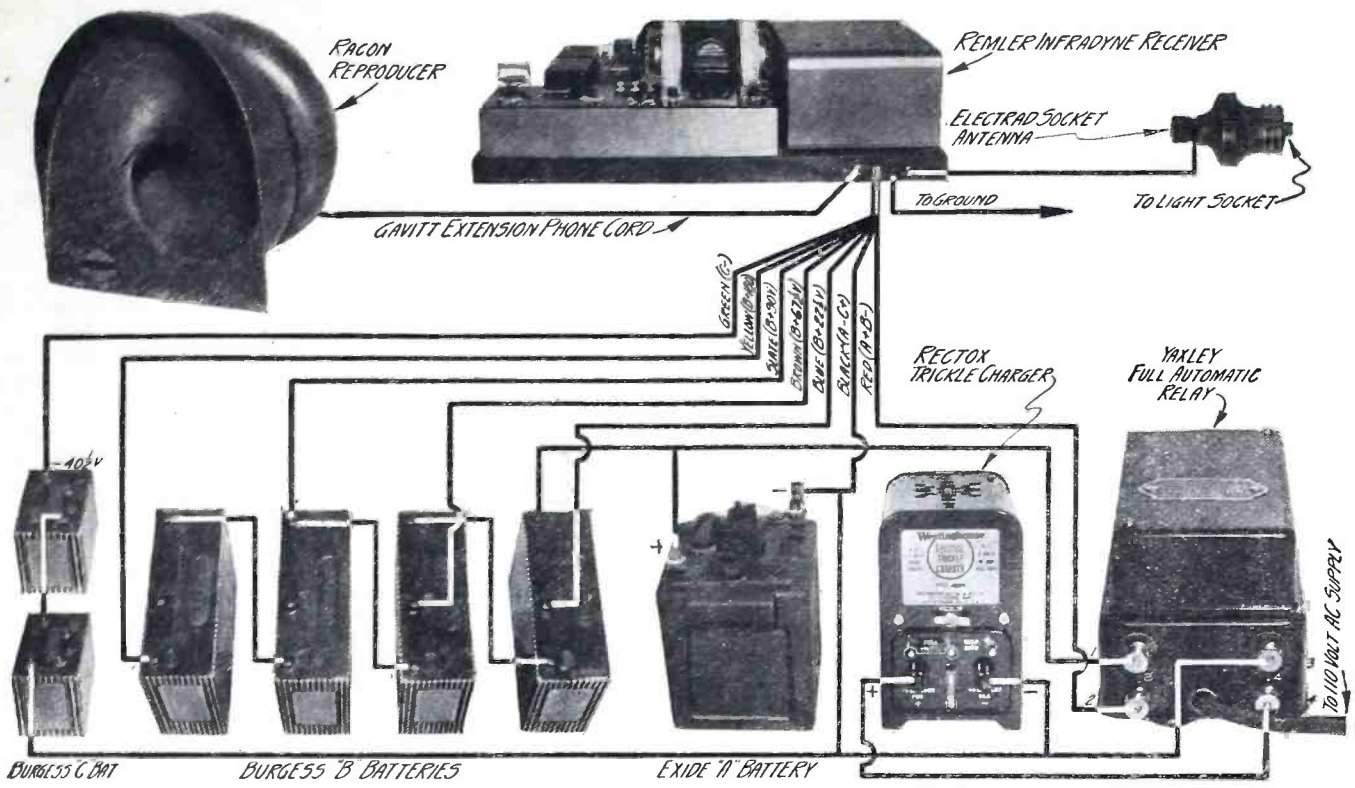
The next work to be done is to prepare the cable harness and the battery cable. Cut about four inches of the outside covering from one end of the battery cable, Z, and fifteen inches from the other end; wrap binding cords around the ends to keep them from fraying. Pass the ends of the cable having the four-inch leads through the terminal strip, X, from the outside and cut the individual wires the correct lengths for connection to the terminal blocks in accordance with the picture wiring diagram in Figure 2.

Now we are ready to build up the cable harness. With the foundation kit is supplied a full size sheet which is reproduced in Figure 7. On the lower part of this diagram are small numbered circles. Procure a flat, soft-wood board about ten inches wide and two feet long. The full size template should be placed on top of this board and nails driven in part of the way through each of the numbered circles.

At the top of the template are ten detailed drawings, each for a wire of different color. These detailed drawings are numbered from one to ten, inclusive. Cut the separate wires of the correct length, following the detailed drawings in natural sequence, laying out, in each case, the wire of the color called for. When all of the wires have been placed in position and twisted around the nails, as shown in Figure 7, they may be tied together with cord, using the form of knot known as the "half

FIGURE 4: THE SCHEMATIC WIRING DIAGRAM OF THE RECEIVER.





HOW TO HOOK UP THE RECEIVER

FIGURE 5: *All the connections between the receiver and the "A," "B" and "C" supplies, as well as the reproducer, ground and antenna, are shown in* BLACK *lines. For ordinary local reception, without the use of the infradyne amplifier, it will be found that the current drain is very low.*

hitch." In tying the cable be particularly careful to make the hitches at all branches, starting at the upper left-hand corner.

The cable harness can now be put into the bottom of the pressed steel base and the various leads soldered to the terminals of the units mounted under the chassis. In making these connections refer to the picture wiring diagram in Figure 2. Figure 3 also shows these connections and the holes through which a number of them are to be passed up to the top side of the set.

The connections to the various instruments and terminals on the top side of the receiver should be made in accordance with the picture diagram shown in Figure 2.

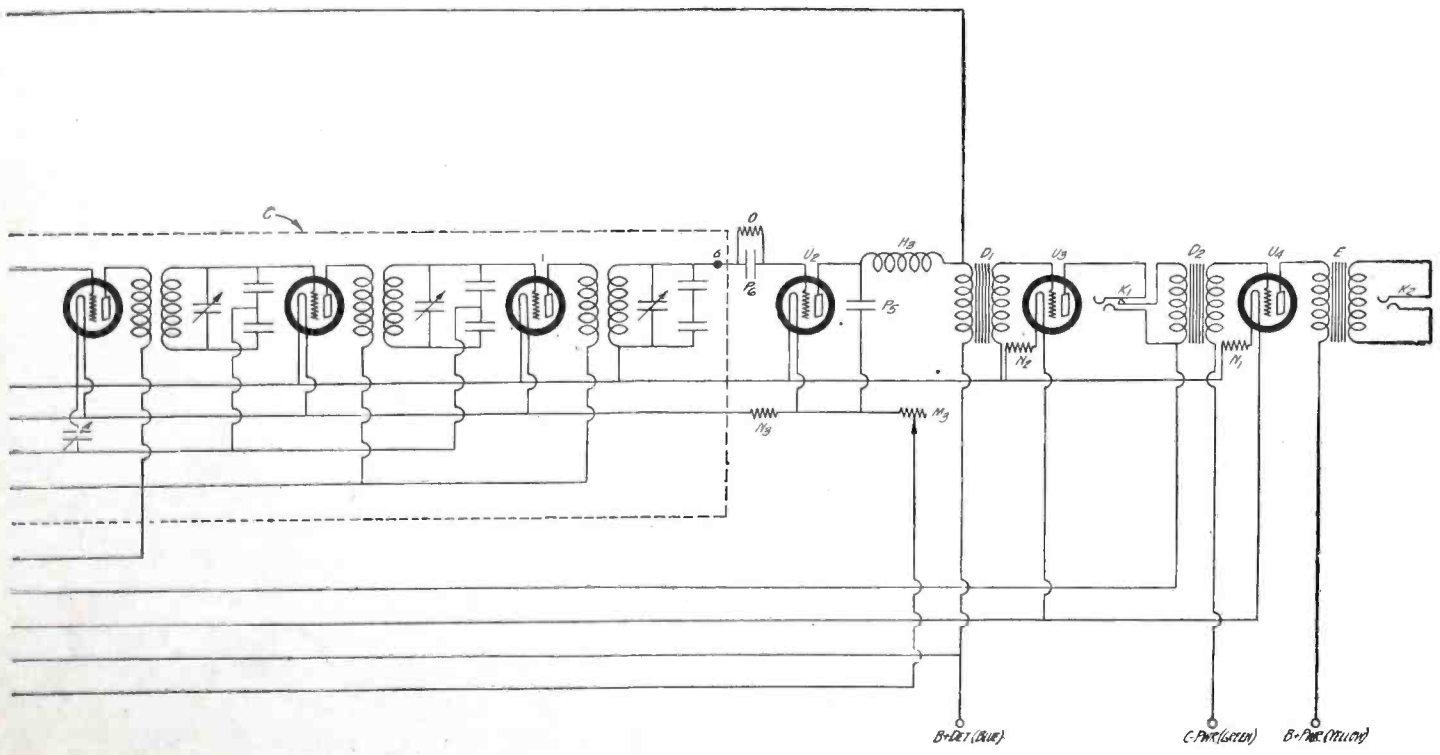
Packed with the foundation kit is an instruction booklet and full size blue prints showing the exact connection for each colored wire. These should be followed explicitly and checked with the picture wiring diagram shown in Figure 2.

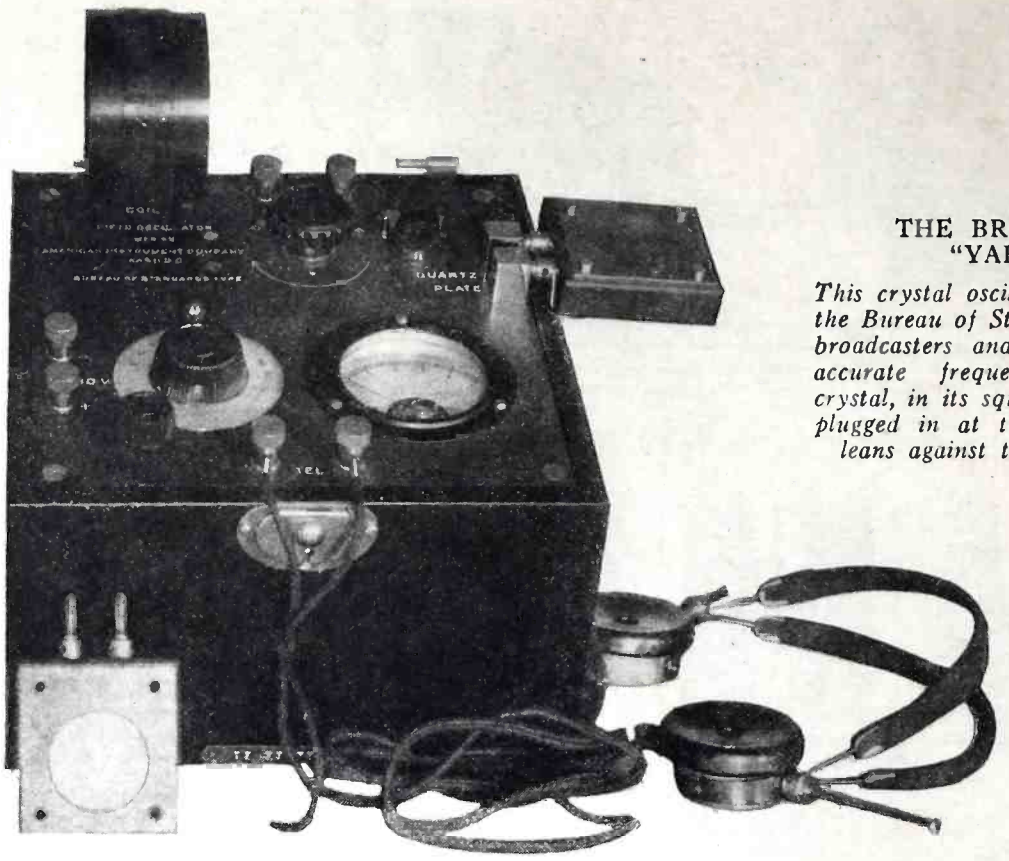
When the wiring has been completed the set is ready for installation and may be fastened to the wooden base, G2, and the set is ready for operation.

How to Install and Operate the Set

We are now ready to install the vacuum valves and to put the set into operation. Remove the top from the amplifier, A, and insert three CX-301-a type valves and replace the metal top. Next place three CX-299 type valves in the socket of the infradyne amplifier, C, and in the socket located in the steel chassis immediately below and back of the voltmeter. This is designated in Figure 1 as socket U1. Place two CX-301-a type valves in

(*Continued on page 340*)





THE BROADCASTER'S "YARDSTICK"

This crystal oscillator was designed by the Bureau of Standards to be used by broadcasters and experimenters as an accurate frequency standard. One crystal, in its square case, may be seen plugged in at the right, and another leans against the front of the box.

Finding The "Yardsticks" of Radio At the Bureau of Standards*

By DR. J. H. DELLINGER
Chief of the Radio Staff
U. S. Bureau of Standards

Tasks which vary from the designing of condensers to investigation of the cause of fading come within the great work which the radio section of the United States Bureau of Standards is carrying on for the advancement of radio. Here is the story of how our Government's skilled staff of experts has solved or is solving many of radio's most baffling puzzles.

OF all the kinds of work upon which the Bureau of Standards is engaged, none has more absorbing interest or more direct value to the public than the researches of the radio section. To an extent little realized by the average man, progress in radio is a direct result of the application of scientific knowledge and methods. Radio waves are so elusive and the signals they carry so delicate that they can be handled only by means of scientific instruments of high sensitivity and precision. The ordinary processes of touching, seeing, or measuring are useless, for the most part. The reader can perhaps appreciate this when he considers that radio waves and currents are alternating at the rate of a million or more times per second.

While it may not be easy to understand what makes the radio wheels go round, it is easy to see how the work of this Bureau is helping to make radio a more obedient and efficient servant of mankind. Here is a list of some of the things that Uncle Sam has accomplished through the work of the Bureau's Radio Laboratory:

1. Developed the radio beacon and radio direction finder, the only reliance of ships in fog;
2. Demonstrated the practicability of using radio for broadcasting music, market reports, etc.;
3. Devised the first and only practical means of radio communication with submerged submarines;
4. Devised the directive beacon, capacity altimeter, and other aids to airplane navigation;
5. Made surveys to determine distance range of broadcasting stations, effects of interference, etc.;
6. Designed the straight-line-frequency condenser;
7. Reduced the heterodyne interference between broadcast stations through special work on frequency measurements and standards;
8. Worked out the explanation of fading, night radio transmission through the upper air, etc., forming basis of present-day theories;
9. Made scientific studies of antennas, coils, and many of the other components of radio apparatus, giving the basis for much present-day radio design;
10. Published treatises on many radio subjects.

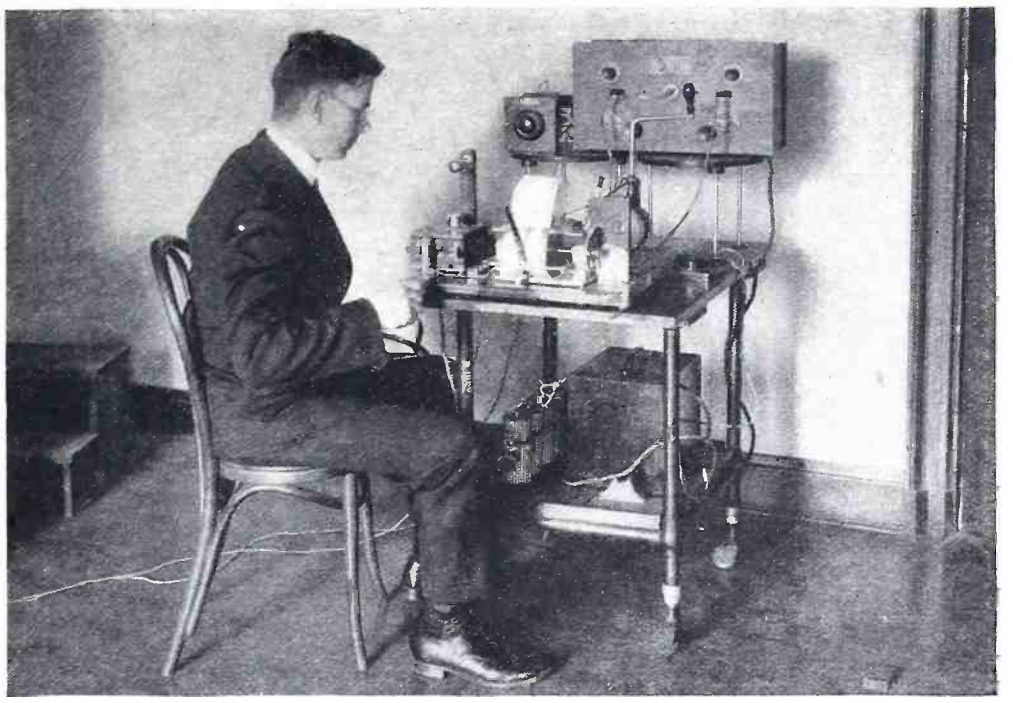
Some of the Bureau's present activities in radio are:

1. Reduction of interference be-

* Publication approved by the Director of the Bureau of Standards of the United States Department of Commerce.

tween broadcasting stations by design and standardization of special devices for holding them on the licensed frequency;

2. Determination of the actual capacity of stations to give service and to cause interference, through development of apparatus for measuring their radiation at a distance;
3. Development of piezo-electric and other frequency standards of great precision;
4. Studies of the vagaries of radio wave transmission, fading, static, etc., in co-operation with other laboratories;
5. Dissemination of frequency standards, by standard frequency signals;
6. Studies of radio measurement methods, design, etc.;
7. Improvements in radio direction finders;
8. Development of radio aids to aviation, including radio telephony, beacon system, and landing devices.



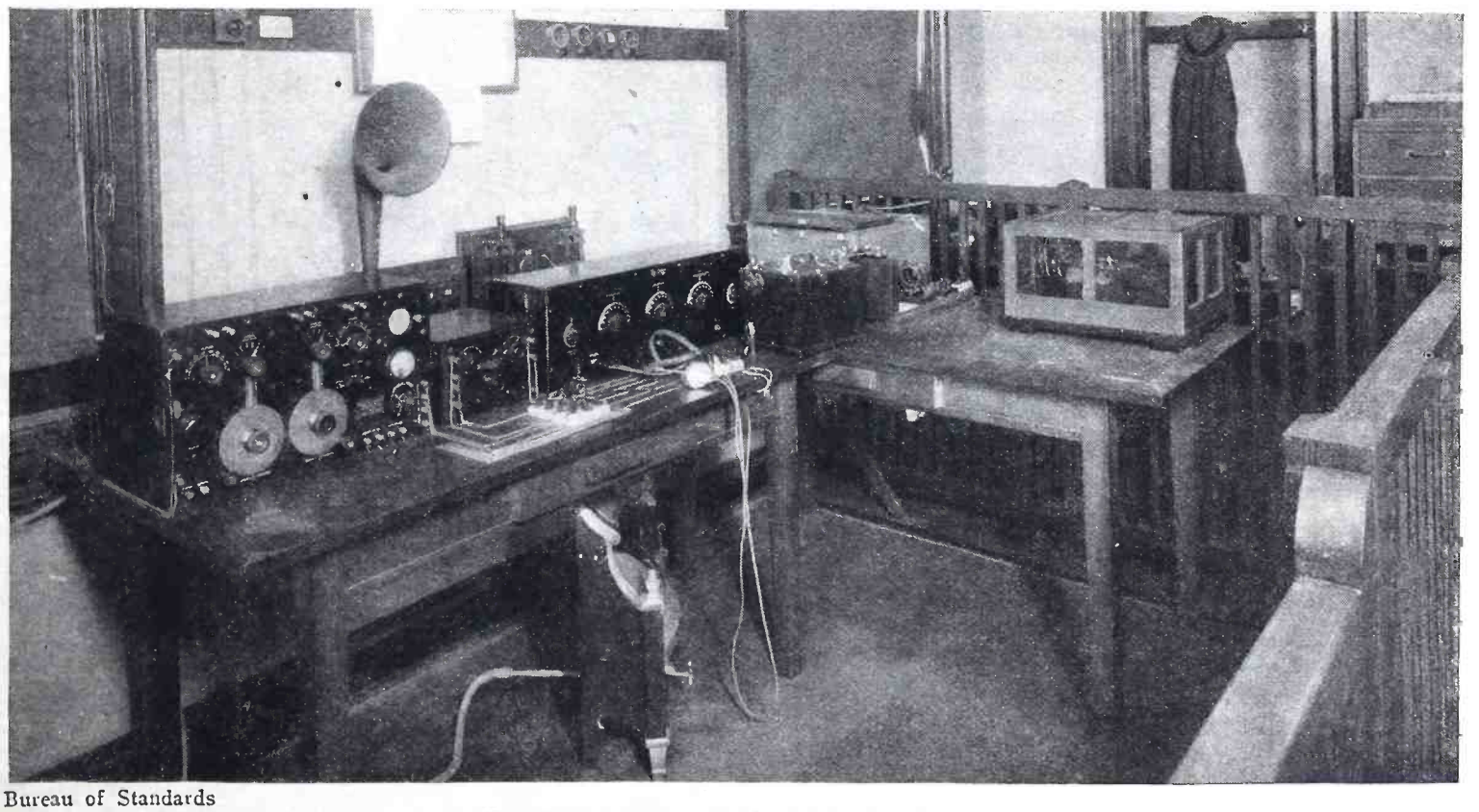
FADING SIGNALS WRITE THEIR STORY

The recording apparatus shown above enables Bureau of Standards investigators to get a permanent record of the fading of signals received by the set on the back of the table. Careful study of these records is of great value in determining the exact cause of this baffling phenomenon.

The Bureau's radio section is only one of eighty sections in this great institution having a total personnel of 900. The radio section has twenty scientific workers, one draftsman and four mechanicians. In addition to maintaining its own radio laboratory, the Bureau cooperates with the National Research Council in the maintenance of a group of three workers on special radio transmission problems, and also provides facilities for a small laboratory which the Signal Corps maintains at the Bureau.

Radio broadcasting as it now is, has come as the fruition of many years of scientific research, inventive genius, and commercial development. The question, "Who invented broadcasting?" is much like the old question, "Who won the war?" The Bureau of Standards enters no claims in this debate, but it has been steadily identified with the developments which have established the present broadcasting service. In 1920, at the request of the Department of Agriculture, the Bureau ran, for four

(*Continued on page 336*)



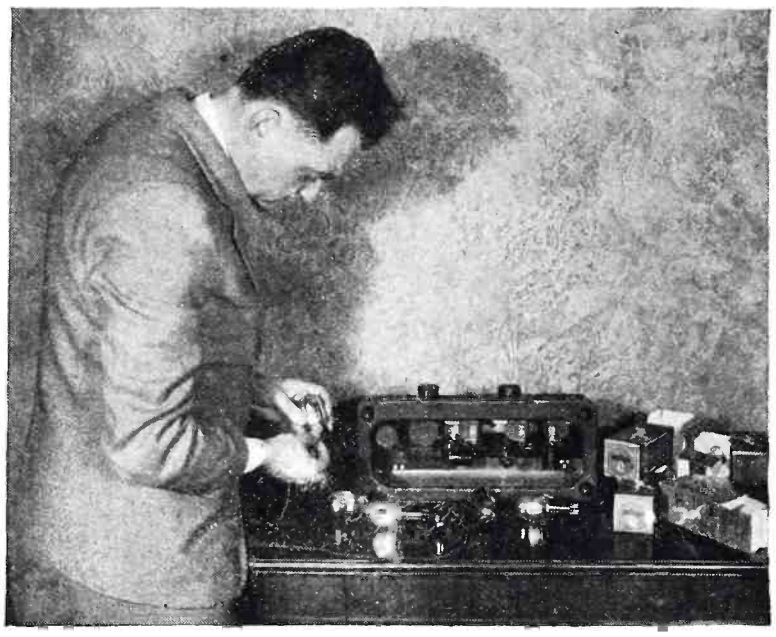
Bureau of Standards

KEEPING TABS ON THE WAVE JUMPER

This receiving apparatus is used by the Bureau of Standards in determining the frequencies of broadcasting stations. In the days when wave jumping was more prevalent than at present, the Department published a monthly honor list of stations which stuck to their assigned frequencies.

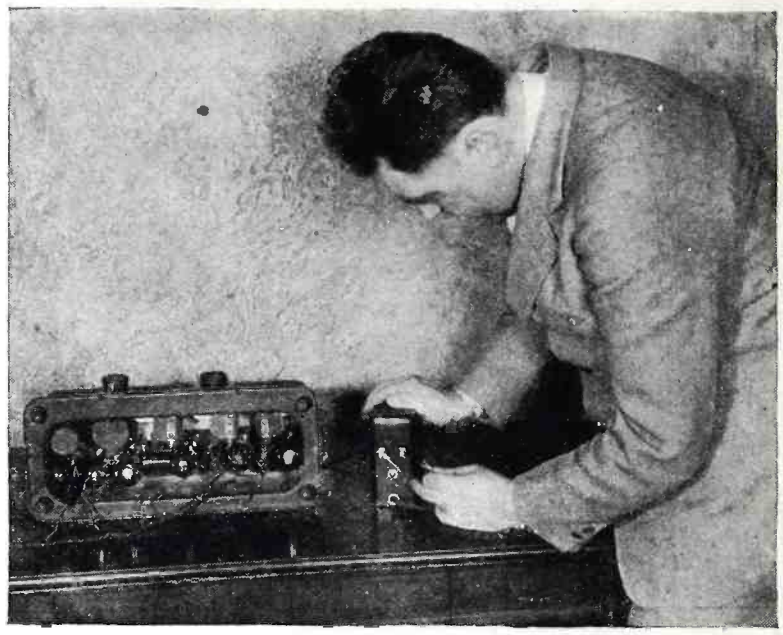
From Battery to Socket—Quick!

No matter how old your DC receiver may be, it can be brought right up to the minute with this AC kit. Only four principal operations are involved in bringing about the change. If you take your time, ten minutes may be required. If you are in a hurry, only one minute may be spent on each operation. The four pictures on this page illustrate the operations involved in the conversion of the DC Atwater-Kent five-valve receiver.



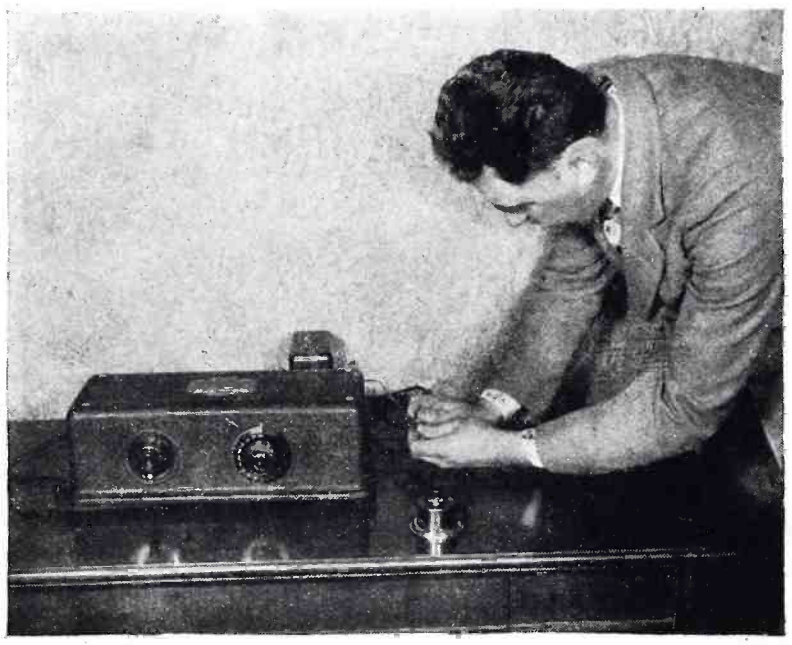
HARNESSING UP THE VALVES

1 THE *first operation involved in the change to AC operation is to remove the DC valves. The connector clips of the harness are then slipped onto the special heater terminals of the new Marathon valves. These valves operate direct from AC current, so there is no need to be concerned about the polarity of the connectors.*



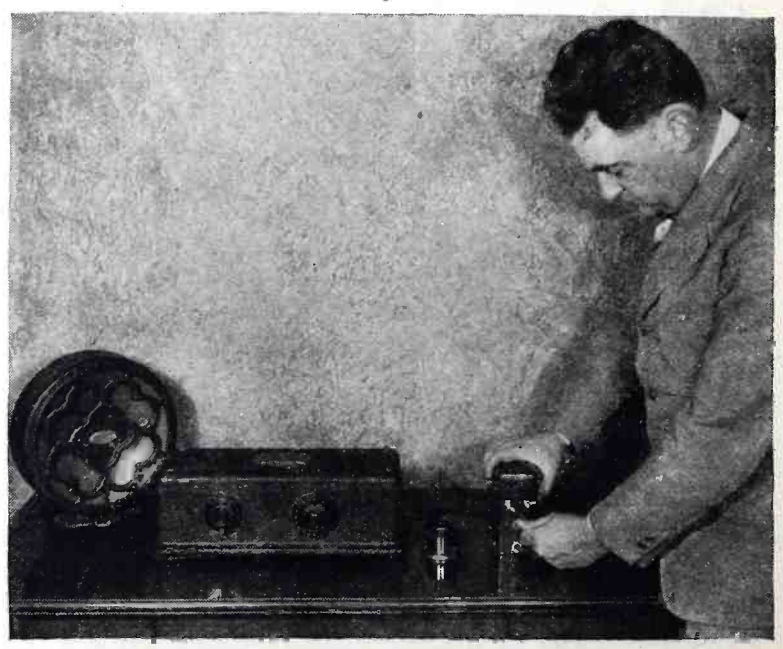
CONNECTING THE HEATER TRANSFORMER

2 AFTER *the valves are connected to the harness and inserted in the sockets, the two connector clips left at the end of the harness are brought to the filament heater transformer of the kit. There is no need to pay attention to polarity. The core lead on the heater transformer is then connected to the receiver ground.*



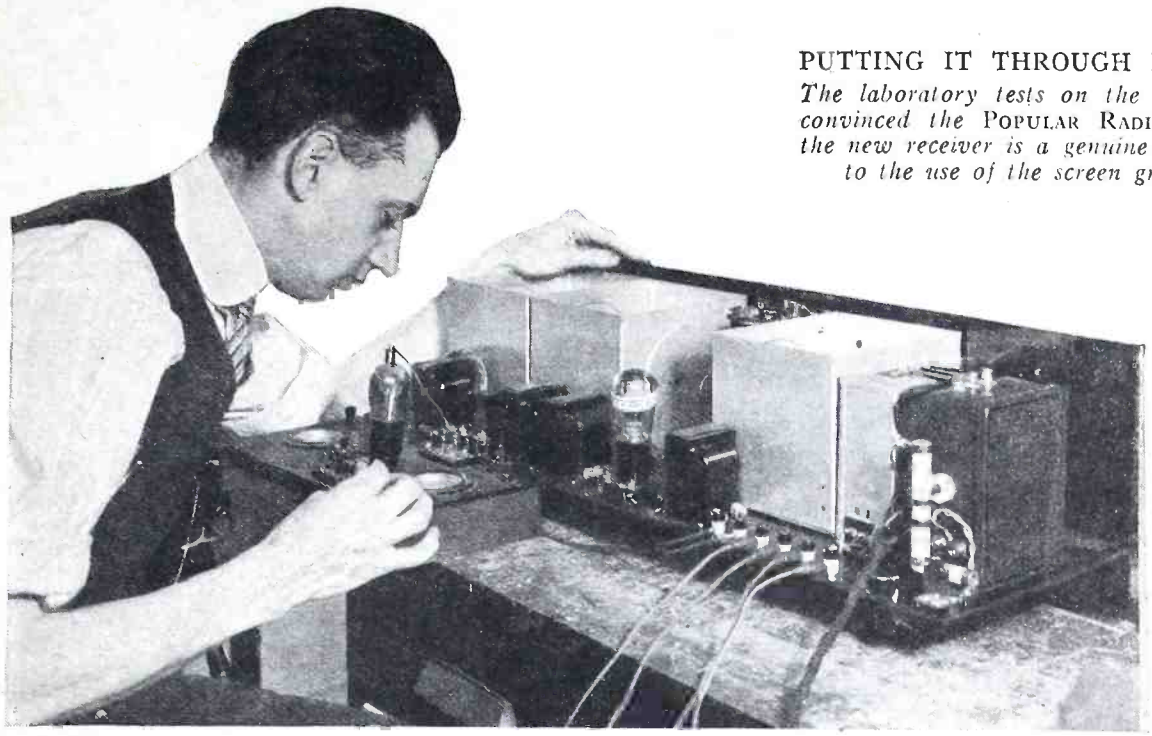
A NEW WAY OF CONTROLLING VOLUME

3 SINCE *it is impossible to use rheostats on the heaters of AC valves, volume is controlled by a potentiometer. One side of this potentiometer is connected to the aerial and the other side to the ground of the receiver being converted. The filament rheostat of the receiver is no longer used to control the volume.*



SNAP THE SWITCH AND TUNE IN!

4 THE *transformer supplied with the Marathon kit is provided with a switch which breaks the primary current of the filament transformer. This is used in place of the filament switch on the receiver. After turning the transformer on, about twenty seconds will elapse before the valves are ready for operation.*



PUTTING IT THROUGH ITS PACES
The laboratory tests on the QSA-5 have convinced the POPULAR RADIO *Staff that the new receiver is a genuine contribution to the use of the screen grid valve.*

The Screen Grid Valve Finds a New Job in the QSA-5 Receiver

In the new Thordarson QSA-5 receiver screen grid valves are used not only in the high-frequency amplifier, but in the low-frequency as well—a new departure in circuit design that should interest every experimenter and fan. In this descriptive article the reader will see that this new use is not an attempt at a "trick" circuit, but constitutes a real advance in modern receiver engineering.

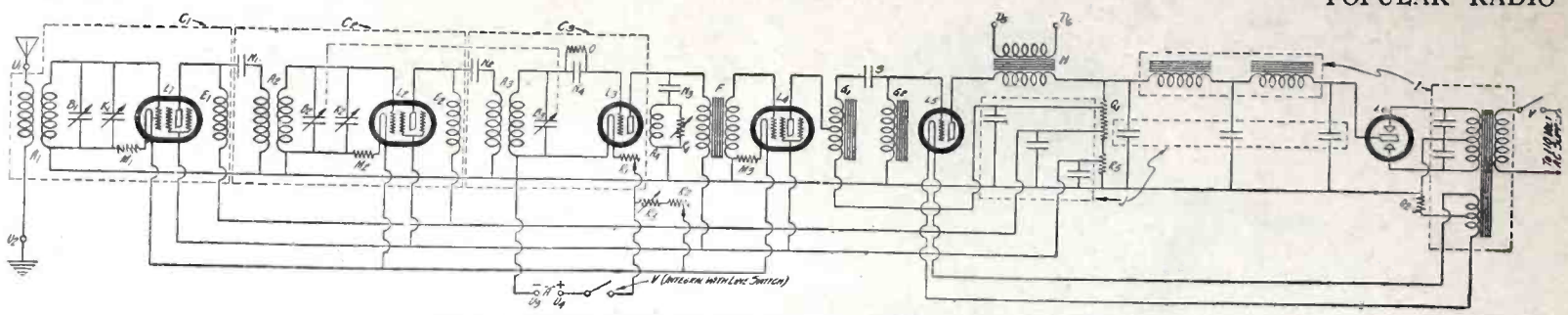
By G. P. STEWART

THE hours which have been spent in overcoming the effects of internal feedback through three-element vacuum valves can never be counted. Undesired oscillation, which has been the most noticeable effect, has remained the chief foe of amplification since the adoption of tuned-high-frequency stages ahead of the detector. This particular difficulty has recently been eliminated almost completely by the addition of a simple screen located within the valve. This screen or shield so reduces the effective internal capacity that the remaining feedback is negligible, and we find the four-element vacuum valve, now commonly called the screen grid valve, opening many opportunities for change in our previous notions of circuit design.

In designing the QSA-5 receiver, which will be described in detail in the next issue of this magazine, four things were sought for. The first was a degree of selectivity which would allow reception of distant stations with the receiver placed in a congested district. The second requirement was sensitivity sufficient to allow reception of these distant stations with volume enough to make listening a pleasure rather than an achievement. The third requirement was fidelity of tone and the fourth was a total cost within a reasonable limit, considering the results obtained. In passing, it may be mentioned that the letters "QSA" form the radio code abbreviation for "Your signals are strong."

The desired soltution for the QSA-5 receiver was found in the coupling method shown in Figure 1. Voltage is applied in the high-frequency amplifier to the valve's plate through a choke coil of high impedance which carries the direct current for the plate supply. The path for the high-frequency current is completed through another part of the plate circuit which includes a coupling condenser and the primary winding of a high-frequency transformer, the secondary of this transformer being tuned with the usual variable condenser. The primary winding consists of forty turns, closely coupled to the secondary. Since no high-voltage direct current enters any part of the transformer, it is possible to ground one end of the primary winding, one end of the secondary and one side of the tuning condenser.

Amplification or sensitivity, with the new screen grid valve, depends chiefly on the impedance introduced into its plate circuit. The arrangement adopted in the QSA-5 does not introduce the maximum possible impedance, but does introduce a very high impedance considering the selectivity attained. High-frequency current in the plate circuit has a choice between two paths, one the choke coil and the other the tuned transformer. The choke coil offers great opposition, forcing most of the high-frequency current through the transformer. The close coupling between primary and secondary, combined with the fact that the secondary is tuned, has much the same effect as a tuned plate circuit in this path, and satisfactory amplification results.



THE SCHEMATIC DIAGRAM OF THE QSA-5 CIRCUIT

FIGURE 1: *The screen grid valves are used in the two high-frequency stages and in the first low-frequency stage. The second low-frequency stage employs a power valve of the 371 type. At the right of the diagram is the power supply incorporated in the receiver.*

As may be seen from Figure 2 and the schematic diagram in Figure 1, the receiver includes a high-frequency amplifying system, a low-frequency amplifying system and a complete plate power supply, all mounted upon the one sub-panel and arranged for housing in a cabinet of standard dimensions. Screen grid valves are put to use both in the high-frequency amplifier and in the low-frequency amplifier.

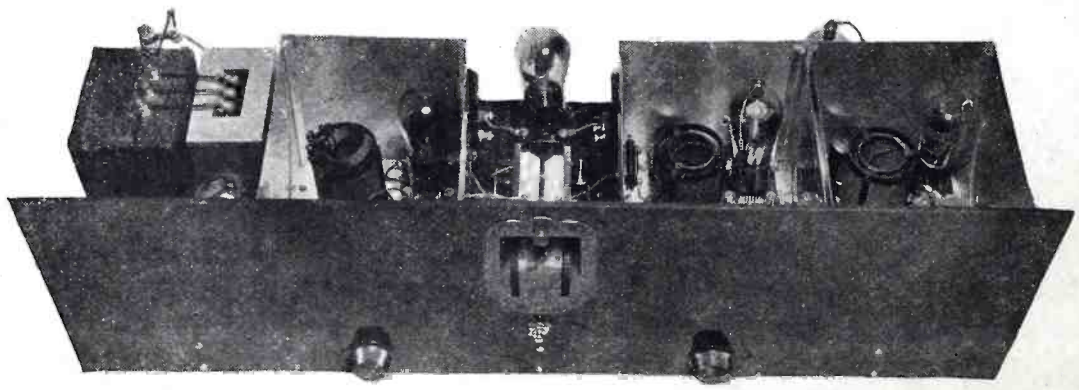
Screen grid valves are used in both the high-frequency stages. For a detector it is possible to use either the usual CX-301-a type of valve, one of the special gas-content detectors, or a power valve of the 312 type. In the first stage of low-frequency amplification another screen grid valve is used, and the final stage is fitted with a power valve of the 371 type.

The Operating Controls

Tuning is accomplished by means of a double-drum dial. The left-hand part of the dial operates the tuning condenser, B1, in the antenna stage. The right-hand part of the dial operates the remaining two tuning condensers, B2 and B3, which are connected together through a flexible coupling. The two tuning condensers, B1 and B2, nearest the dial, are each provided with parallel-connected adjustable condensers, K1 and K2, of small capacity. The small condenser, K1, for the first stage allows the two halves of the dial to operate approximately together over a large part of the scale. The small condenser, K2, for the second stage, allows the capacity in this circuit to be matched with that in the detector circuit so that these two circuits are both in resonance to the same frequency at a given setting.

In any receiver there is a natural and inherent gain in amplification at the higher frequencies or lower wavelengths. This is due chiefly to the greater impedance and greater voltages in all circuits at high frequencies. In order to allow uniform volume at all dial settings it is necessary either to increase that naturally available at low frequencies or else to decrease that naturally available at high frequencies. Both methods are employed in the QSA receiver by fitting two separate controls which may be used together or independently.

One control is a simple rheostat which reduces the filament temperature of the screen grid valves. The volume may be raised and lowered by means of this control, but it is impossible to produce oscillation with it. The second control provides a limited degree of regeneration in the detector stage. The high-frequency current in the plate circuit of the detector valve is carried through a fixed condenser, N3, to a coil, A4, having inductance sufficient to produce regeneration even at the lower frequencies. This action is due to the detector being provided with what amounts to a tuned plate circuit, or with sufficient inductance in its plate circuit to cause a feedback through this valve. The amount of feedback and the consequent regeneration are controlled by a variable resistance, R4, mounted on the front panel and connected across the ends of the plate coil, A4. The rheostat control, R3, is on the left-hand side of the front panel and the regeneration control knob, R4, is on the right The rheostat, R3, is the only control needed for nearby stations and for all stations below about "50" on the tuning dials. For distant stations, tuned in at higher dial settings, the right-hand regeneration control, R4, may be used.



HOW THE INSTRUMENTS ARE ARRANGED

FIGURE 2: *The layout of parts in the new receiver is particularly attractive and workmanlike. Complete shielding is employed for the high-frequency stage and the detector. The power supply is shown at the left end of the panel.*

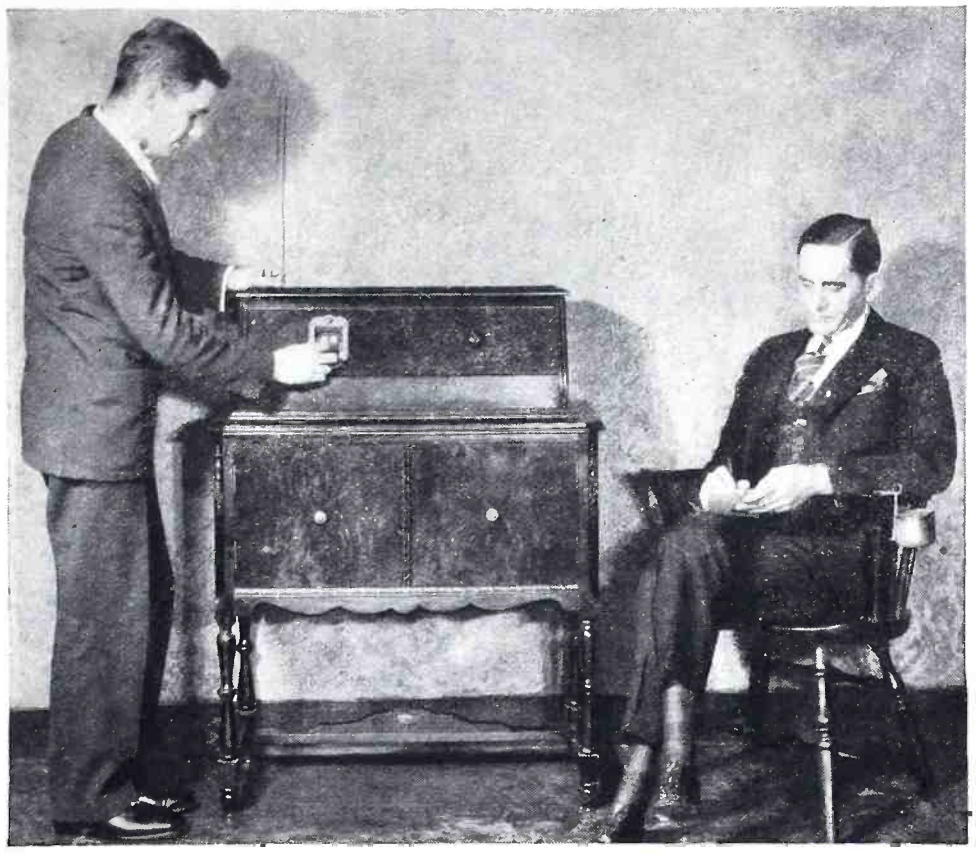
The Low-Frequency Amplifier

The low-frequency amplifying system utilizes transformer coupling between the detector and the first low-frequency amplifying valve, which is of the screen grid type. The plate circuit of this screen grid valve is connected to an autoformer, G1, which provides a step-up type of impedance coupling. A second autoformer, G2, here acting as a straight impedance, is placed in the grid circuit of the power valve, this impedance replacing the grid-leak ordinarily employed with impedance amplification. The output of the power valve passes through the primary of a coupling transformer, H, of which the secondary is connected to the reproducer.

The coupling used between the screen grid low-frequency valve and the power valve is rather unusual. The current in the plate circuit of this screen grid valve first builds up a voltage across part of the winding of the autoformer. This winding is in two sections so that there is a step-up effect and the magnified voltage is applied to the grid of the power valve through a coupling condenser of a capacity unusually large for this work.

The high-voltage amplification of the screen grid valve was found to be very favorable in its effect on the 371 type of power valve, which is able to handle considerable changes of grid voltage when given a correspondingly great grid bias. With the type of grid circuit usually employed with the autoformer

(*Continued on page 324*)



SUPREME IN DX

The 15-inch wire by the left hand of the man at the left is the antenna with which this model of the LC-28 brought in the stations on the West Coast.

A New Standard for the Distance Hunter!

The Screen Grid LC-28

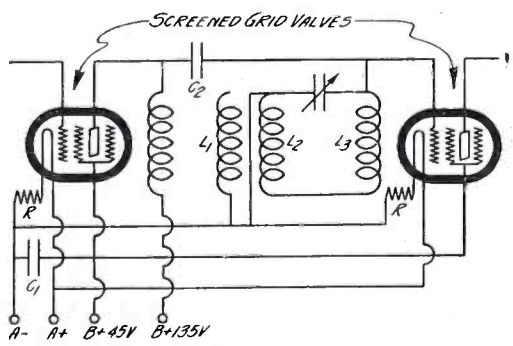
The combining of the virtues of the standard LC-28 with the new features of the screen grid valve offers the builder and fan a unique opportunity for constructing a set that incorporates the finest in power, quality, ease of operation and distance-getting ability. And it is quite simple to construct the new model described here, or to convert the standard set for the use of screen grid valves.

By LAURENCE M. COCKADAY

ABOUT the time that the author was experimenting with the original model of the LC-28 receiver, the Laboratory procured a number of the British type of four-element valves, now more commonly known as screen grid valves. A few weeks of experiment with this type of valve convinced the engineers in the Laboratory that this was a long step ahead of the three-element valve for high-frequency amplification work because much higher amplification could be obtained with the newer type.

Set builders and experimenters will remember the circuit details of the LC-28 receiver incorporated the use of a shunt-plate-feed arrangement, supplying the amplified currents out of the valves into a primary coil inductively-coupled to a secondary tuning coil.

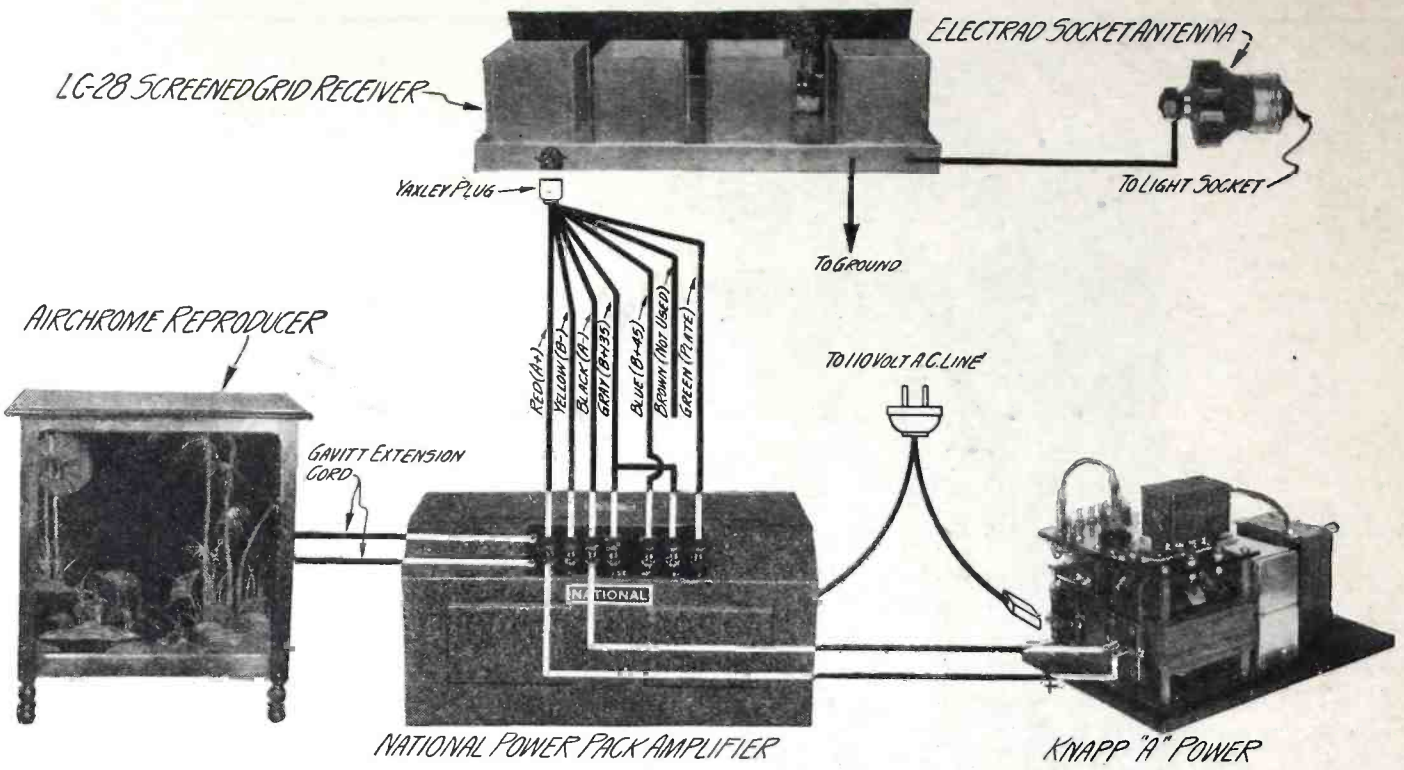
It was decided during the earlier periods of experimentation to use the same coils, tuning and shielding arrangement for the four-element valves, the only radical change being that the primaries of the coils would be left unused and the amplified current would be impressed directly onto the secondary coils. This arrangement is shown in the small schematic diagram in Figure 1. In this diagram a positive potential of 45 volts is applied to the secondary grids which are by-passed with a fixed condenser, C1, to the filament circuit. The coupling condenser, C2, is decreased in capacity and coupled directly to the secondary coils, L2 and L3. The primary coil, L1, is left disconnected. The filament resistors, R, are increased in value so that the proper bias is obtained by the voltage drop in these resistors. These are the only really radical changes in the circuit.



THE CIRCUIT CHANGES

FIGURE 1: *This diagram shows how the circuits of the high-frequency stages of the LC-28 are modified for the use of screen grid valve amplification.*

When the American valves appeared on the market, it was a simple matter to revise the LC-28 circuit so that they should be utilized in the receiver to greatly enhance the value of amplification obtained in each stage. Whereas



HOW TO HOOK UP THE NEW LC-28

FIGURE 2: *The operating hook-up shown here has been found to give exceptional results. As explained in the text, the antenna may be an ordinary wire about two or three feet in length. For extreme distance, however, an outdoor antenna is recommended.*

a value of voltage amplification of approximately 10 per stage is secured with standard valves, the newer type screen grid valves, employing the circuit outlined, produces a voltage amplification of approximately 40 per stage, so that an outdoor antenna may be done away with. Antennas of from four inches to ten or fifteen feet long give ample results in distance reception, according to the location.

With the receiver wired up and reconstructed, as shown in Figures 3 and 4 and the picture wiring diagram in Figure 5, reception, on a six foot antenna, of signals three and four thousand miles distant is a regular occurrence, and is thoroughly enjoyable provided the static level is not too high at the time of reception.

The receiver incorporating the new valves is not at all difficult to construct and, it is believed, gives to the set builder a standard design that exemplifies the most modern ideas in high-frequency amplification and tuning combined in any broadcast receiver.

How to Make the Change

The mechanical changes necessary in the receiver are few and simple. The three high-frequency amplifier sockets should be replaced with the sub-chassis type of socket, as shown in Figures 3 and 4. Also, the three original filament resistors of four ohms each are to be replaced by the resistor units, I1, I2 and I3, all ten ohms each. The coupling condensers, K1, K2 and K3, are replaced with new coupling condensers of .00005 mfd. each. The rheostat, S, is replaced with a new combination switch and rheostat of ten ohms and an added fixed resistor of four ohms is placed in the common filament circuit of the three high-frequency amplifier valves. The by-pass condenser, G, of .25 mfd. is added to by-pass the high-frequency current from the screening grid to the filament circuit.

One more addition, a Hammarlund equalizing condenser, should be attached to the first tuning condenser, J1, to balance it up so that its dial reading will match the dial readings of the other three condensers.

It will be advisable, when assembling the screen grid model of the LC-28, to obtain a copy of the October, 1927, issue of POPULAR RADIO for further constructional details.

How to Wire the Instruments.

The picture wiring diagram in Figure 5 gives the exact wiring details in connecting up the receiver for screen grid operation in the high-frequency amplifier stages. The wiring of this circuit to the Yaxley plug and cable is specifically made to be operated in conjunction with the National resistance-coupled power amplifier which will furnish all of the plate voltages necessary for the converted receiver, as well as the screening-grid voltage that is necessary with the new type valves.

It is recommended that the set builder follow these details in wiring conscientiously, and that he check them carefully before the set is placed in operation.

It will be noticed that the connection to the control grid is made to the

(*Continued on page 334*)

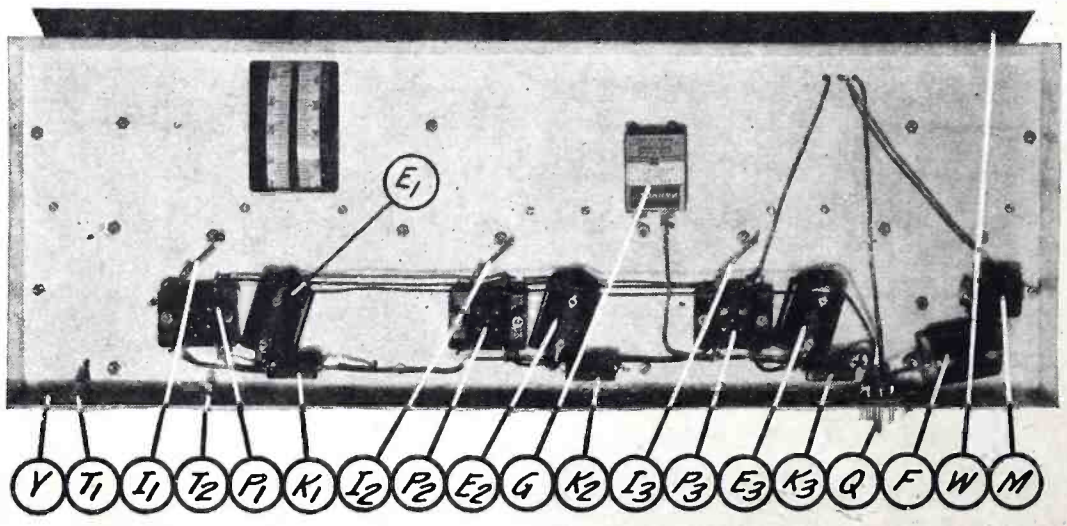


FIGURE 3: THE UNDER SIDE OF THE SUB-PANEL

POPULAR RADIO WORK SHEET

The Screen Grid LC-28

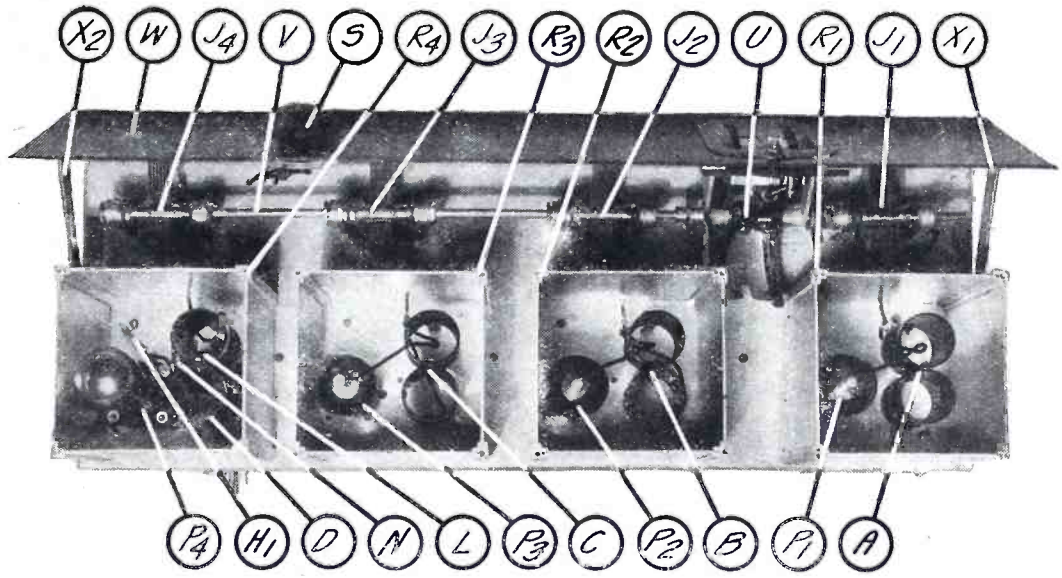


FIGURE 3: THE RECEIVER VIEWED FROM ABOVE.

List of Parts Used in Building This Receiver

Cost of Parts—*Not over $83.00*

A, B, C and D—Precision high-frequency transformers (4 transformers), type 4-B;
E1 to E3—Samson high-frequency chokes, type No. 125;
F—Samson high-frequency choke, type No. 85;
G—Acme Parvolt by-pass condenser, ¼ mfd., Series A;
H1 and H2—Yaxley resistance units, 4 ohms, type No. 804;
I1 to I3—Yaxley resistance units, 10 ohms, type No. 810;
J1 to J4—Hammarlund mid-line variable condensers, .000275 mfd.;
K1 to K3—Aerovox moulded condensers, .00005 mfd.;
L—Aerovox moulded condenser, .00025 mfd.;
M—Aerovox moulded condenser, .00075 mfd.;
N—Durham metallized resistor, 6 megohms;
O—Hammarlund equalizer;
P1 to P3—Remler sockets, No. 50;
P4—Benjamin vibrationless socket, No. 9040;
Q—Yaxley cable connector plug with cable, type 660;
R1 to R4—Special small size aluminum box shields for LC-28, made by the Aluminum Company of America;
S—Yaxley combination switch and rheostat, 10 ohms, type No. 910-K;
T1 and T2—Carter "Imp" plugs and tip jacks, marked *Antenna* and *Ground*, respectively, with insulating washers for the antenna;
U—Hammarlund double-drum dial;
V—Brass extension shaft, 16½ inches long and ¼ inch in diameter;
W—Aluminum panel, 6 by 26 inches, drilled and decorated, made by the Wholesale Radio Service Company;
X1 and X2—Tait brackets;
Y—Aluminum chassis for the LC-28, made by the Aluminum Company of America;
Z—Lynch single-resistance mounting;
Hook-up wire, mounting bolts and nuts, solder, etc.

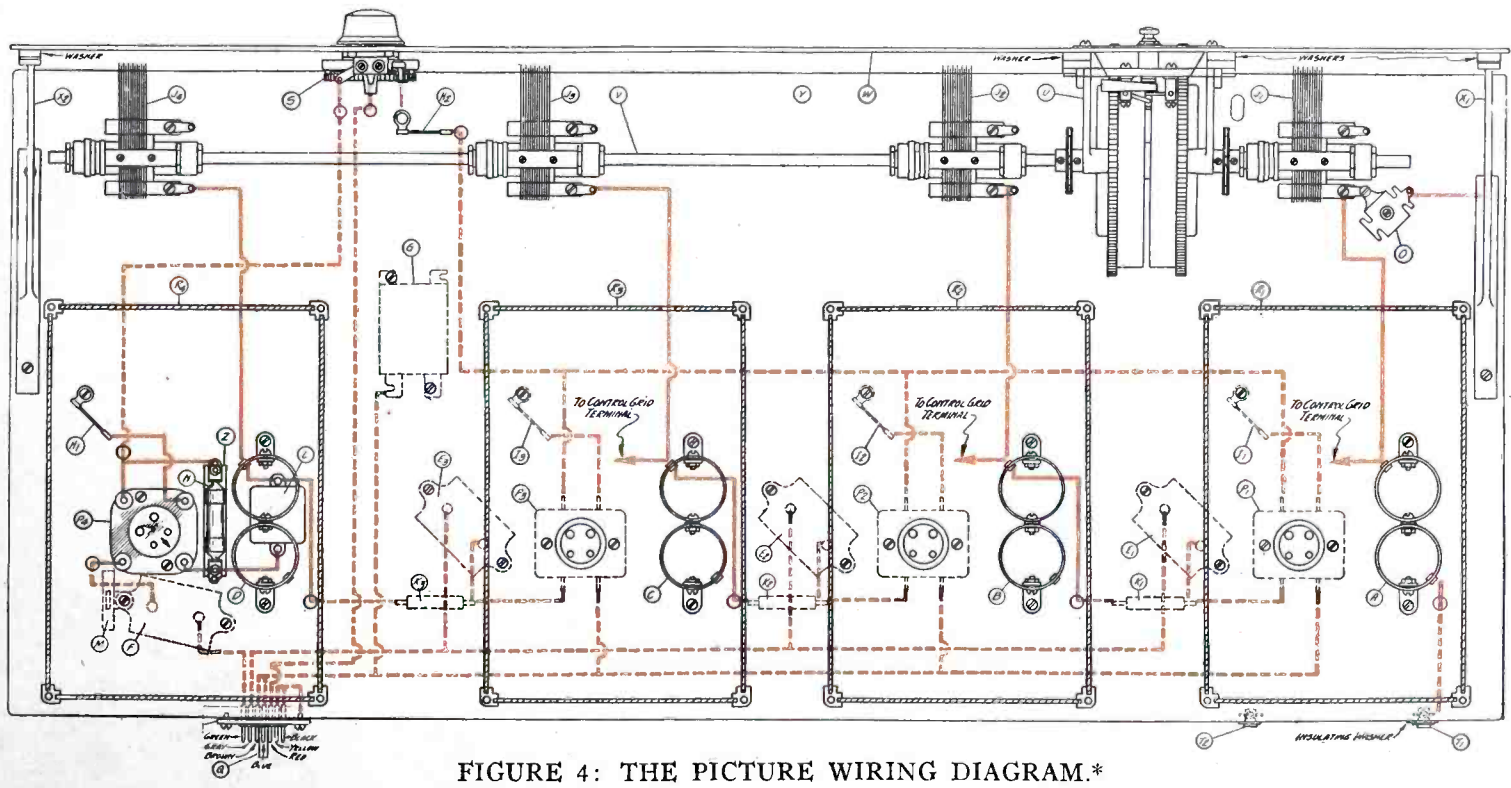
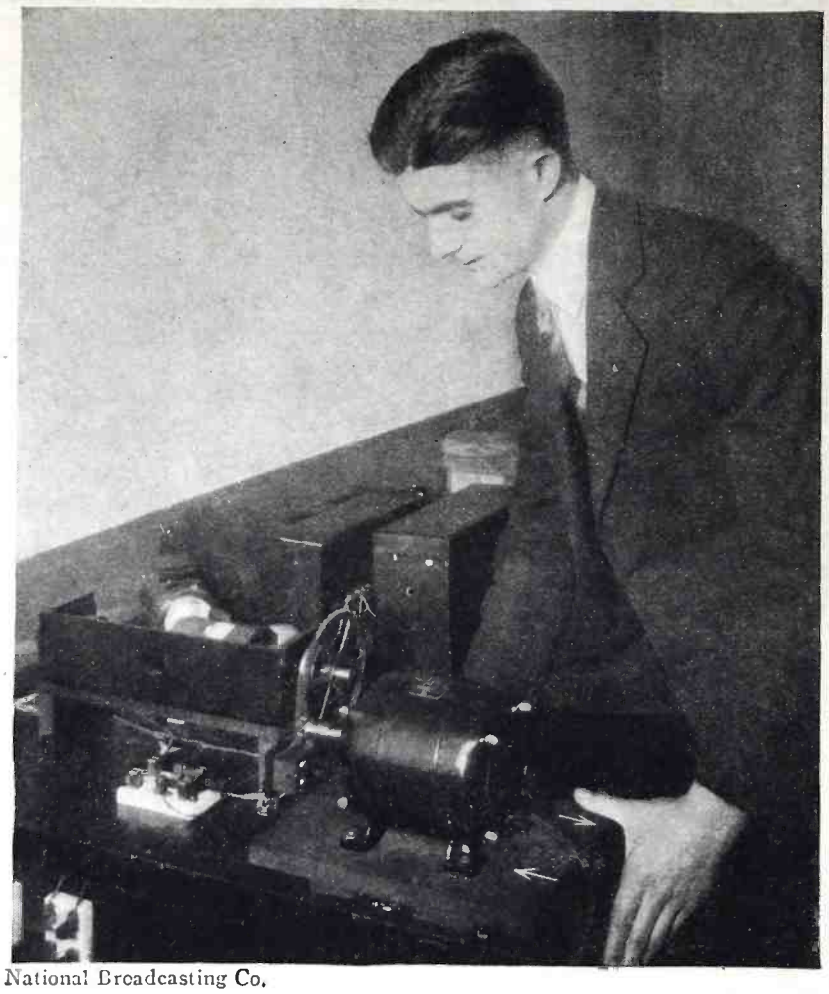


FIGURE 4: THE PICTURE WIRING DIAGRAM.*

** Through error the above diagram omits a connection from the P terminal of socket P4 to one lug of condenser M. The other lug of the condenser is grounded by screwing it to the chassis.*



RADIO PUTS ITS "EYES" TO USE

This picture shows part of the apparatus used in a recent demonstration of the radio transmission of pictures. The motor in the foreground revolves the cylinder on which the picture to be transmitted is placed, thus exposing every part of the picture to the photo-electric cell.

National Broadcasting Co.

How the Photo-electric cell is used for

The "Eye" of Television

No up-to-date follower of the progress of radio can afford to be ignorant of the principles which underlie the operation of radio's newest aid in wonder working, the photo-electric cell. The theory of photo-electric action, and its relation to modern ideas of light and atomic structure, are here explained with such clarity that the mystery which has surrounded this phenomenon is completely dispelled.

Article No. 2

By DR. LEWIS KOLLER
Research Laboratory, General Electric Company

THE story of the development of the photo-electric cell, from the experiments of Hallwachs, in 1888, to the potassium and cæsium cells of today, was told in the March, 1928, number of POPULAR RADIO. It would be interesting now to consider these modern cells from a theoretical point of view, and show how their action is in accord with modern theories of electricity and atomic structure.

It is a very interesting fact that the number of electrons which are emitted from the sensitive surface of a cell depends upon the intensity of the light, but that the velocity with which they are shot out from the surface depends only on the color of the light and is entirely independent of the intensity. This fact is explained by the quantum theory of the nature of light.

The quantum theory postulates that light energy cannot be indefinitely subdivided, but exists in definite units called quanta. In other words, light has a granular or atomic structure. The size of each of these units, or rather the energy of each quantum, is equal to a universal constant, h, times the frequency of the light. The higher the frequency, accordingly, the more energy is associated with the quantum.

According to this theory, each quantum of energy will cause the emission of one and only one electron. The velocity of that electron will depend upon the kind of quantum, that is, on the frequency of the radiation.

The phenomena of photo-electricity furnish strong evidence in favor of the quantum theory. A simple calculation will show that when the light from a one-candlepower source at a distance of one meter falls upon 1 sq. cm. of a photo-sensitive surface, each atom of

that surface receives an amount of energy equivalent to 10^{-22} watts/sec.

The energy which is necessary to free one electron is 4×10^{-19} watts/sec. In order to accumulate sufficient energy at this rate to free an electron if the light fell uniformly over the surface, it would have to fall on the surface for over an hour. We know, however, that the photo-electric effect is instantaneous and that the current starts the instant the light is allowed to fall on the photo-sensitive surface.

The explanation of the discrepancy is that the light does not fall uniformly over the surface, as would be the case if the old wave theory of light were true, but is concentrated in these quantum units, each of which causes the ejection of an electron.

Of course, these photo-currents are small, so that in order to avoid the necessity for using high sensitivity instruments amplification is resorted to. This may be done by means of vacuum valves, as in radio work; but there is also a method of amplification within the photo-electric cell itself which is of great value. This method makes use of the ionization of gases. For this purpose, after the cell has been exhausted, gas at a very low pressure is introduced. This pressure ranges from .02 mm. of mercury in some of the larger types of cells to 1 mm. in the very smallest cells. The gas used must not react with the sensitive cell surface and it must also not "clean up" or disappear during the life of the tube. The gases which satisfy these requirements are the rare gases of the atmosphere, and of these argon, neon and helium are the most frequently used.

The theory of the part played by the gases is as follows:

When light falls upon the sensitive cell surface, electrons are emitted and are drawn towards the anode, due to its positive potential. Some of these electrons naturally will chance to collide with gas molecules. As a matter of fact, at a pressure of .02 mm. there are 7×10^{14} gas molecules in each cubic centimeter of space. Calculations show that an electron traveling through a gas at this pressure will make two collisions in each centimeter of its path, on the average. It is the consequence of these collisions that is of interest. The collision may be of the same type as when two rubber balls come together. They will fly apart again, perhaps moving in different directions and at different speeds than before, but otherwise unchanged. Such a collision is of no use in producing amplification. On the other hand, a collision may take place with disastrous consequences to the gas molecule.

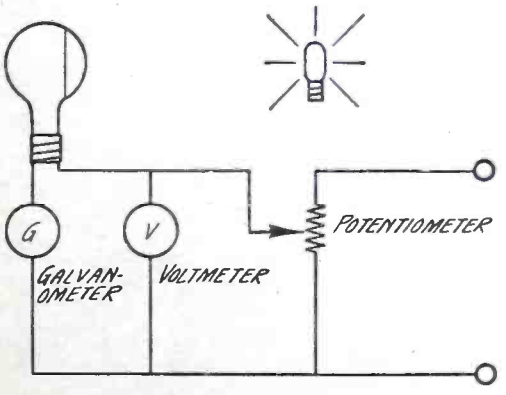
When a collision of the second kind takes place the photo-electron actually knocks one of the electrons in the outermost orbit completely out of the gas molecule, thus ionizing it. The result is that instead of the original electron and a neutral molecule we have two electrons moving over to the positive electrode, and the remainder of the gas molecule, which is now positively charged and is called a positive ion, moving towards the cathode. We have thus multiplied the original charge threefold. There is still the possibility of the two electrons making still more collisions before they reach their destination. This is no violation of the law of the conservation of energy, because the energy required is drawn from the battery across the cell terminals. The result of this process is that for each electron which the action of the light liberates at the surface of the cathode we may have several arriving at the anode of the photo-electric cell.

Since the flow of electrons constitutes the current, the gas may be said to amplify the photo-current internally.

P. & A.

STARTING MACHINERY WITH A BEAM OF LIGHT

This picture gives some idea of the sensitiveness of the response of a photo-electric cell to small changes in light intensity. The shadow of demonstrator's hand falling upon a cell within the large cylinder causes a change in current which starts the electric washing machine.



HOW THE CELL CHARACTERISTICS ARE DETERMINED

FIGURE 1: *The set-up shown here is used for the determination of the volt-ampere characteristics of a cell such as are shown in the charts in Figures 2 and 3.*

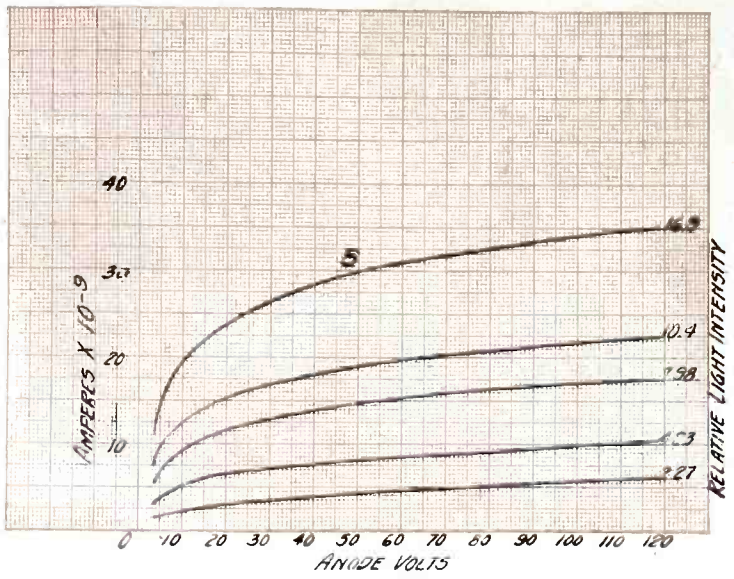


FIGURE 2: VOLT-AMPERE CURVES FOR A VACUUM PHOTO-ELECTRIC CELL.

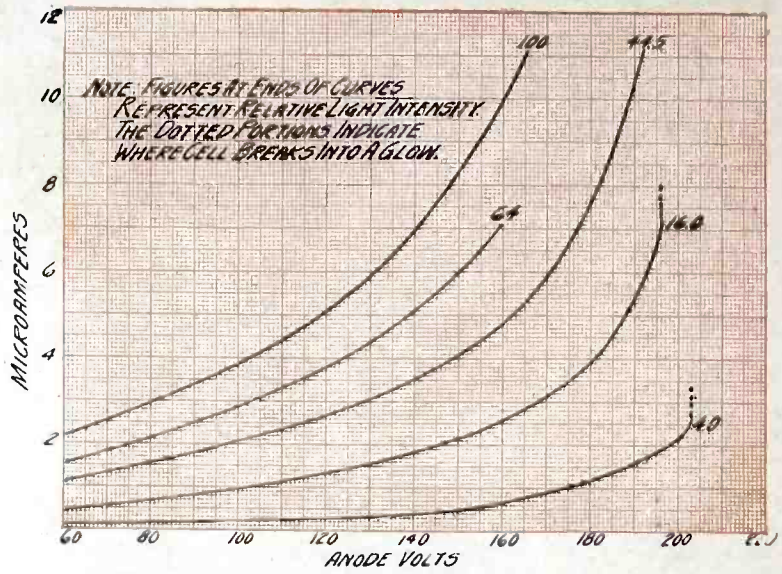


FIGURE 3: VOLT-AMPERE CURVES FOR A GAS-FILLED PHOTO-ELECTRIC CELL.

The amount of amplification obtainable in this fashion depends on the nature of the gas, the intensity of the light source, the construction of the cell, and the voltage applied across the cell.

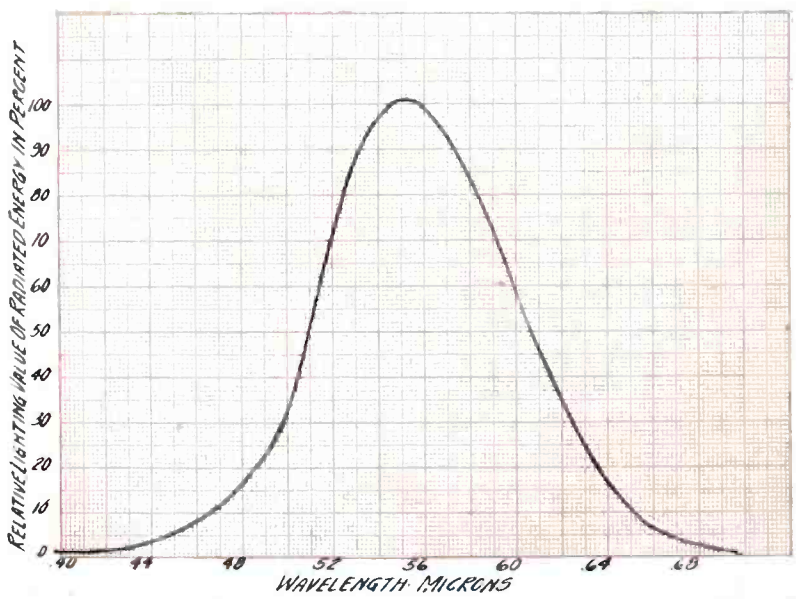
The relation between the voltage applied to the cell and the current through it, called the "volt-ampere characteristic," is of great use in determining operating conditions. Such data is obtained by means of the set-up shown in Figure 1. The voltage is varied by means of the potentiometer, and the current through the cell is read on the galvanometer. Such curves can be obtained for different conditions of illumination by moving the light nearer to, or farther away, from the cell.

Figure 2 shows a family of such characteristics for a vacuum photo-electric cell. The lowest curve is for a very weak illumination. It will be seen that at low potentials the current rises rapidly with the voltage. The current, of course, is simply a measure of the number of electrons which reach the anode. At first sight, this variable current would seem to be inconsistent with the fact that the number of electrons set free from the cathode depends only upon the intensity of the incident light. The apparent inconsistency is due to the fact that at low voltages all of the emitted electrons do not reach the anode. As the voltage is increased, a larger proportion of them reach their goal, and at the point S the voltage is high enough to draw over all the emitted electrons. That is why further increases in voltage do not produce any further change in current and the curve continues as a straight, horizontal line. The voltage which is necessary to draw over all the electrons is called the saturation voltage. In order that the current may be a real measure of the light intensity, the voltage must always be above the saturation voltage. If the light intensity is now increased, a curve is obtained of the same shape as before, but the saturation value is higher to correspond to the new value of light intensity.

In the case of gas-filled cells, the curves are radically different in form, as is shown in Figure 3. As soon as a definite voltage called the ionization voltage is exceeded, some gas molecules become ionized. As the voltage is increased, still more ions are produced, so that instead of being flat, as in the case of the vacuum cell, the curve of current against voltage continues to rise. Eventually this curve becomes quite steep and the cell breaks into a glow.

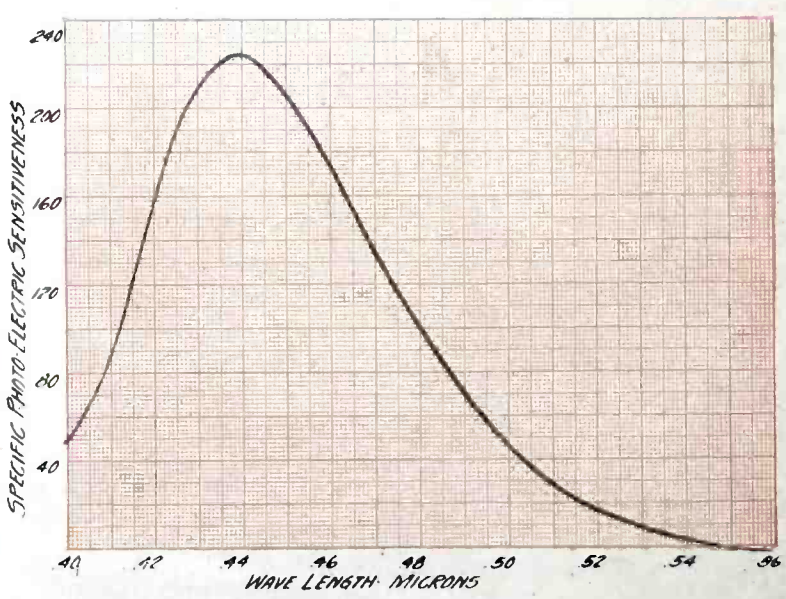
It has been stated that the current through a photo-electric cell is directly

(*Continued on page 348*)



HOW THE HUMAN EYE RESPONDS TO COLOR

FIGURE 4: *This curve shows the relative sensitiveness of the human eye to the light spectrum. The band of greatest sensitiveness lies between .54 and .58 microns, or green light. Outside this band the response of the eye drops.*



HOW THE ELECTRIC EYE RESPONDS TO COLOR

FIGURE 5: *A comparison of this curve with that in Figure 3 shows how photo-electric "sight" differs from human sight. The potassium cell whose curve is shown here is most sensitive to light in the violet-blue portion of the spectrum.*

The Phonograph's New Lease on Life

Radio principles of reproduction have so rejuvenated the phonograph art that even people who do not own radio sets are clamoring for radio amplifiers for their old phonograph. The details given in this article tell exactly how to wire and install the electrical units for obtaining radio-quality reproduction from any old phonograph. The model converted in the POPULAR RADIO *laboratory is shown at the right.*

1928 Reproduction from a 1910 Phonograph

By MORRIS M. SILVER

THERE have been described in POPULAR RADIO, during the past nine months, various methods whereby old phonographs may be rejuvenated by using radio amplification and an electrical pick-up with a radio reproducer, so that a great improvement in reproduction will be possible.

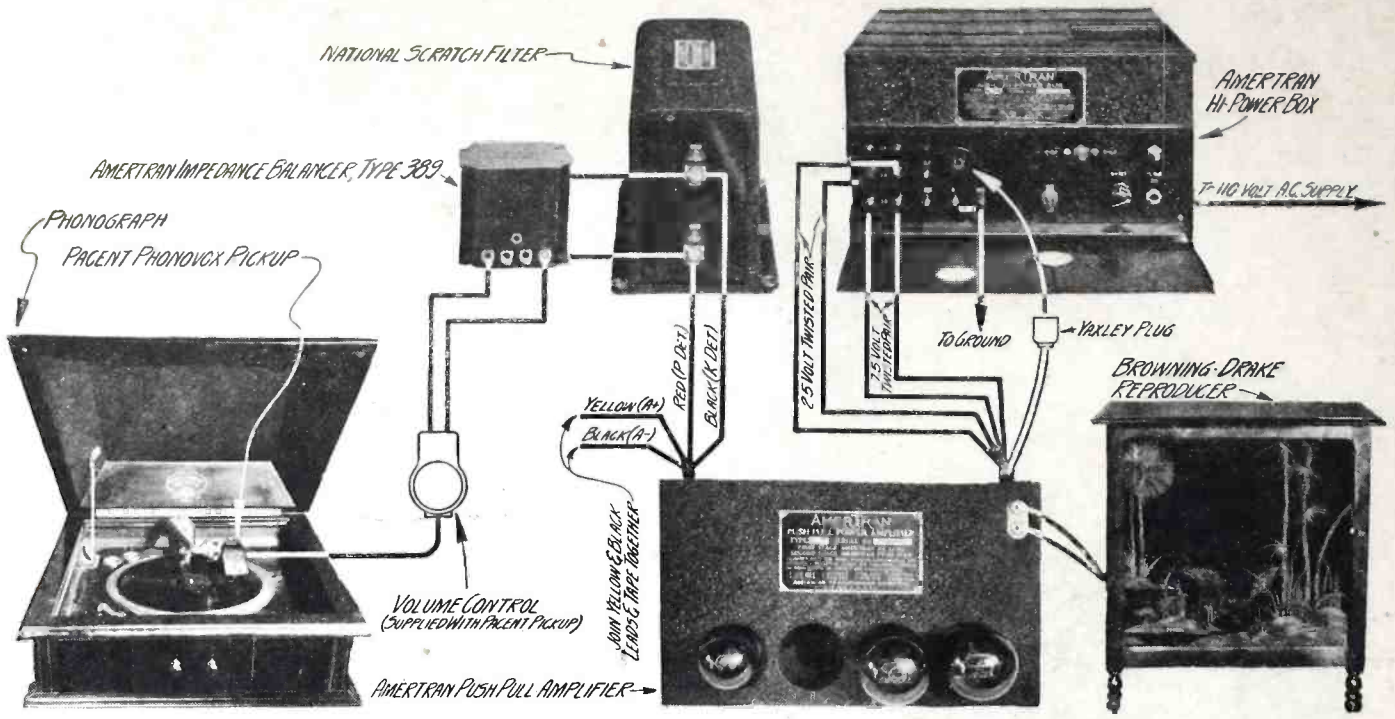
All of these articles, however, have dealt with the electrical apparatus and circuits and the different combinations or complete systems for accomplishing these results. The judgment of the reader has been relied on for the actual assembly of the apparatus in a phonograph.

There have been so many letters received, however, during the last few months, for specific information in converting various types of old phonographs that the laboratory has taken one of the more popular models and installed in it a complete amplification and reproduction system. The model is one of the vertical cabinet type, with a spring motor and turntable located under the lifting lid. Directly under this, in front, is a shutter arrangement for the horn, and underneath this are two folding doors opening outward upon a shelved compartment for holding phonograph records.

After considering the type of apparatus that would be used it was decided to place it, in bulk, in the shelved record compartment, and leave the horn compartment untouched, although the horn was not to be used.

How to Make the Installation

First of all, the mechanical tone chamber is removed and replaced with a Pacent Phonovox electrical pick-up, which attaches to the tone arm with a set screw. The cord on the pick-up unit should be threaded down through the metal tone arm and past the point where the metal of the horn joins the wood; there a hole should be drilled and the cord pulled through the top side of the wooden portion of the horn into the space between the horn and the cabinet itself. Then the volume control, which is furnished with the Phonovox, is placed in a convenient position in one of the corners, not occupied by the turntable, and three holes drilled in the wooden top shelf of the



HOW TO HOOK UP THE INSTRUMENTS

FIGURE 1: *The amplifier, the high-power box, the impedance balancer and the scratch filter are all placed in the lower part of the console cabinet of the phonograph. The reproducer should preferably be placed on the opposite side of the room. All the connections between these instruments are here shown in heavy black lines.*

phonograph for the three terminals and cords on the volume control. Two connections are in the cord from the Phonovox. The connections themselves are clearly shown in the photo-diagram in Figure 1. The remaining cord of the volume control is fed down through holes drilled in the partitions to the lower compartment that holds the phonograph records.

HOW THE AMPLIFIER IS PLACED IN THE CABINET

FIGURE 2: *The high-power box is placed in the lower part of the cabinet of the phonograph, while the amplifier, the needle-scratch filter, and the impedance balancer are placed on one of the shelves that formerly held the records. The other record shelves are taken out to make room for the instruments.*

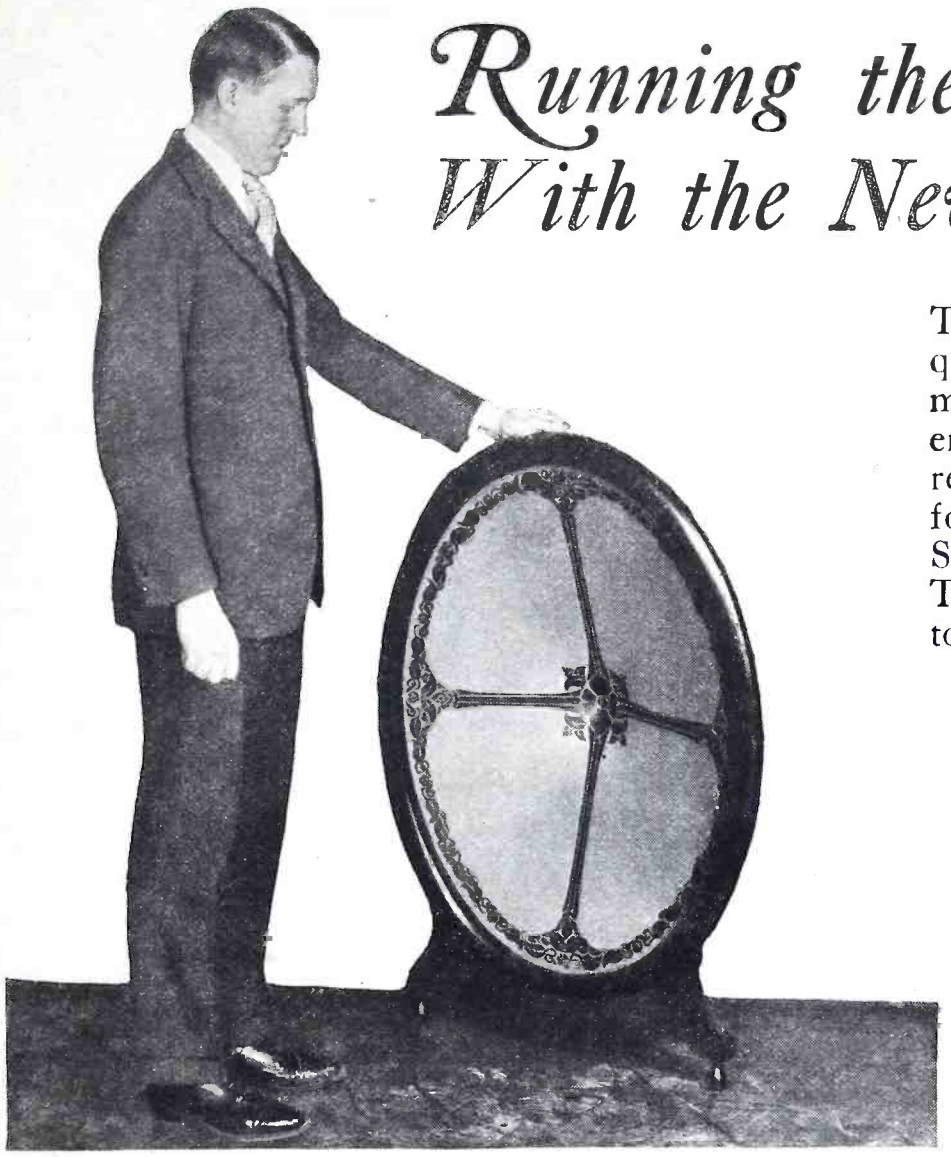
The next job is to remove the two front side strips holding the shelving in place in the record compartment and to take out all of the shelves except one, which is the fourth from the bottom. This may be slipped out and turned around so that the curved cut-out faces the rear of the cabinet and may be used for passing the connection wires. Then the two side strips may be replaced.

The installation chosen for this phonograph is similar to that shown in the February, 1928, issue of POPULAR RADIO, except that a scratch filter has been added for eliminating from the final reproduction the noise of the needle passing over the record.

The AmerTran high-power box is installed in the lower portion of the record compartment with the switch and front panel turned to the front, while the AmerTran push-pull amplifier is installed in the rear portion of the top shelf that has been left in the compartment. The National scratch filter is screwed down to the front part of the shelf, and the AmerTran equalizor is placed alongside it. All of these instruments are to be connected up as shown in the photo-diagram in Figure 1. Figure 2 shows how the instruments are arranged in the record compartment. The ground wire and the reproducer cord and the extension cord and plug (to be run to the 110 volt 60 cycle lighting lines) are brought out through holes in the rear of the cabinet. The AC extension cord and the exten-

(*Continued on page 330*)

Running the Musical Scale With the New SPN Speaker



The enormous advance in low-frequency amplification methods has made the old-fashioned reproducer entirely inadequate. Among the new reproducers that have been designed for use with high-power amplifiers the SPN speaker stands well in the front. The unit is able to handle, without distortion, the output of the most powerful 210 or 250 amplifier.

By FRANCIS D. BUSHNELL

THE attainment of quality in reproducers involves many intricate problems of acoustics that are not generally understood by laymen. The characteristics of a loudspeaker might be entirely upset by some trivial change in its design. The thickness of the quality of paper forming the diaphragm, for instance, has a most important bearing upon the sound frequencies to which a speaker will respond. The quality of the magnets in the driving motor, or the length of the driving rod, all have important bearings. Yet with all of these confusing details, sound physicists have, during the past two years, made great strides in the perfection of speakers that will accommodate not only great power, but will respond to sound frequencies as low or as high as those that will be passed by the average low-frequency transformer.

POPULAR RADIO has in the past several months given its readers the details of all the principal developments in reproduction, ranging from exponential horns to balanced-tension speakers. There is still another development which has won its place in the esteem of the laboratory staff and which would seem to mark still another improvement in sound reproducing devices. This is the SPN speaker, a gigantic cone in oval form, measuring 30 inches across its widest point, with a height of 44 inches. There is scientific justification in employing this particular form of cone. It has been found that this shape will accommodate both the lower and the higher audible frequencies, due to the wide variation in its diameter that exists between the narrowest and widest points.

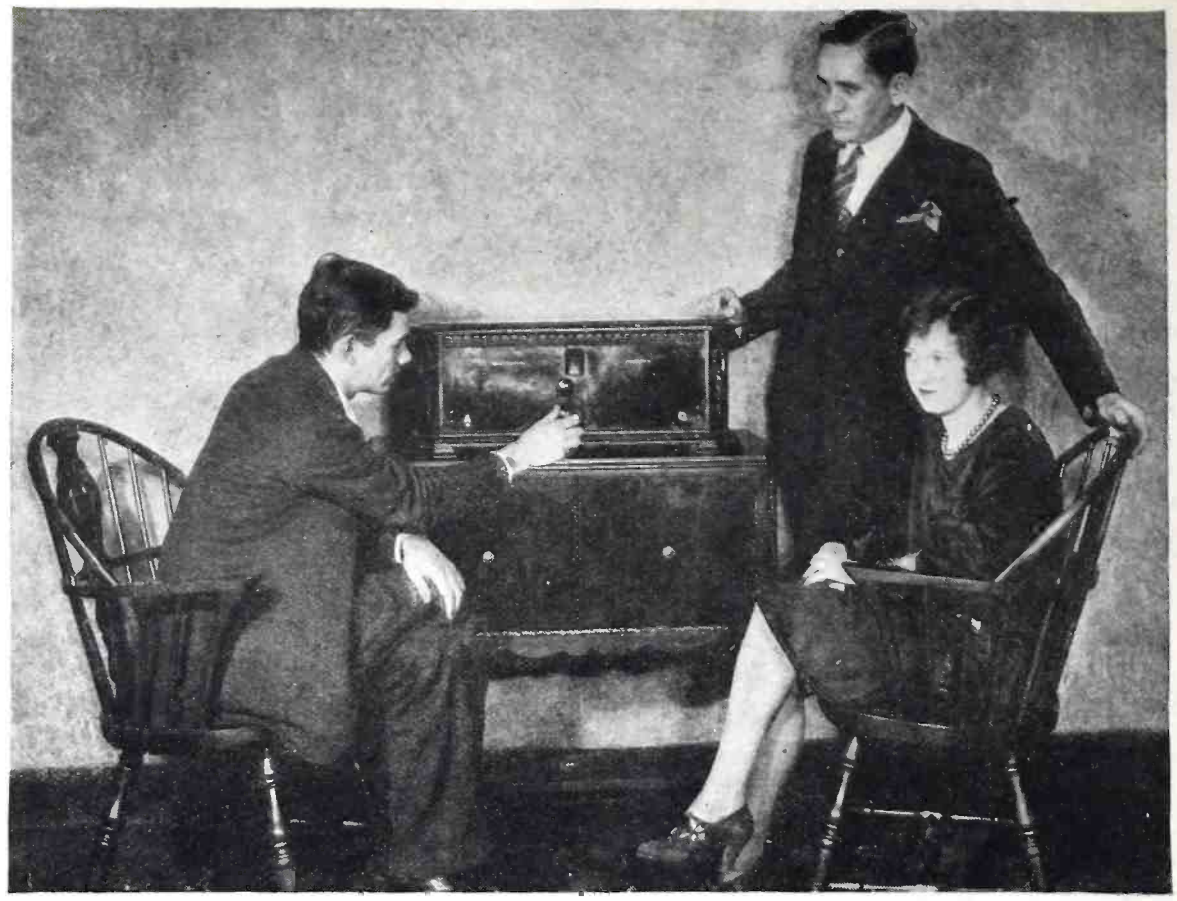
The SPN speaker employs what is technically known as a free-edge cone. In this case, however, perhaps the term "semi-free edge" would be more accurate, inasmuch as the edges of the cone are laced to the oval wood frame which encircles the cone.

The rod of the driving motor is so attached that the cone can be moved either backward or forward by simply adjusting a thumb nut. Adjustment at this point is important, and the user of the device will find that by sliding the cone backward and forward on the driving rod a certain point will be reached where the device will reproduce at maximum efficiency.

During tests that were conducted in the POPULAR RADIO laboratory, it was found that this cone could easily take an output of two 210 amplifier valves arranged in a push-pull stage. The output current during the test ran as high as 49 milliamperes, with voltage on the lower end of the frequency range varying between 1,000 and 1,280. The speaker performed remarkably well with this great load and was free not only from standing waves, but from harmonic distortion as well.

The driving motor of the SPN speaker is exceptionally massive and is able to handle large amounts of energy with ease. The field of the driving motor is supplied with four large permanent magnets of the usual horseshoe shape. Careful tests showed that this unit was able to carry high power at very low frequencies.

Those who have made a study of reproducer operation are aware that a large part of the distortion is due to resonance; that is, of excessive vibrations at particular frequencies. These resonance points of a reproducer cause it to over-emphasize certain frequencies at the expense of others. In many instances harshness is caused at the high frequencies and unpleasant drumminess at the low frequencies. There is loss of sharpness in definition which causes sort of a hangover effect, permitting one note to blend or overlap into another. The SPN speaker has had such intrusion guarded against by the designing of a special suspension method so as to neutralize the vibrations reflected at the edge of the cone. The design is so arranged so as to make use of the relative phase-shifting occurring at forced and free boundries. This does not cause a loss of energy from the use of damping devices.



COUNTERFONIC RECEPTION WITHOUT BATTERIES

Installed in its Corbett cabinet, and hooked to the AC lighting lines, the Counterfonic makes as good an appearance as much more expensive sets, and gives reception fully commensurate with the cost of building it.

AC-*izing the Counterfonic*

With the demand for socket operation sweeping the country, it is quite natural that fans should be demanding an AC model of so popular a set as the Counterfonic "Six." Here are all the data for making the simple changes in the old receiver and building a small power-pack, which will make the Counterfonic a completely batteryless job—as told by the originator of the circuit himself—

KENNETH HARKNESS

SET BUILDERS who constructed the earlier models of the Harkness Counterfonic "Six" receiver have had such good results, at an economical expenditure for the complete set, that many letters have been received inquiring whether the receiver can be operated on alternating current, without batteries.

The advantages of AC operation in eliminating operating expense and service work are well known to all radio fans. With these advantages in view, during the past two months many experiments have been made with various power units by means of which the desired result might be accomplished.

The power unit to be described in this article is the one that gave the results which have been most thoroughly satisfactory. The cost for parts is relatively little and the construction is simple. Only a few changes are necessary in the receiver itself for the efficient use of AC valves receiving their operating voltages from the new power-pack.

The new power-pack utilizes a standard Raytheon BH type rectifier valve, operating in conjunction with a power transformer, a heater transformer for supplying the AC heater voltages for the AC valves, and a simple filter circuit for obtaining the correct "B" voltages for the set. When used with the receiver, in conjunction with AC valves, more power can be obtained from the set, as well as an added improvement in quality of reproduction.

How to Change the Receiver for AC Operation

The first job will be to re-wire part of the receiver to accommodate the AC valves. Refer to the picture wiring diagram in Figure 2, the top view in Figure 1, and the bottom view in Figure 3 while making the changes for light-socket operation.

First remove all of the filament-circuit wiring from the "A" negative (—) and "A" positive (+) binding posts through the filament switch and the resistors to the filament terminals of the valve sockets. Also disconnect the wiring to the pilot light.

Next take out all the grid-return wiring, that is, the wiring connected to

POPULAR RADIO WORK SHEET

The AC Counterfonic Six

List of Parts For Building This Receiver

Cost of Parts—*Not over $73.00*

A, B and C—Harkness Counterfonic high-frequency transformers;
D1, D2 and D3—Cylindrical copper shields;
E1, E2 and E3—Harkness tuned double-impedance audio-couplers for the first, second and third stages;
F—Harkness audio-output-filter unit;
G—Harkness high-frequency choke coil;
H1 and H2—Aerovox moulded by-pass condensers, 1 mfd., type 250;
I—Silver-Marshall drum dial;
J1 and J2—Harkness brackets;
K1, K2 and K3—U. S. L. three-gang variable condenser, .00035 mfd. capacity in each condenser section;
L—Westinghouse Micarta drilled sub-panel with 5 sockets attached;
M1—Carter midget potentiometer, 500 ohms, type MW-500;
M2—Carter adjustable resistor, 10 ohms, type AP-10;
N—Carter Imp battery switch;
O1—Carter center-tapped resistor, 40 ohms, type CU-40;

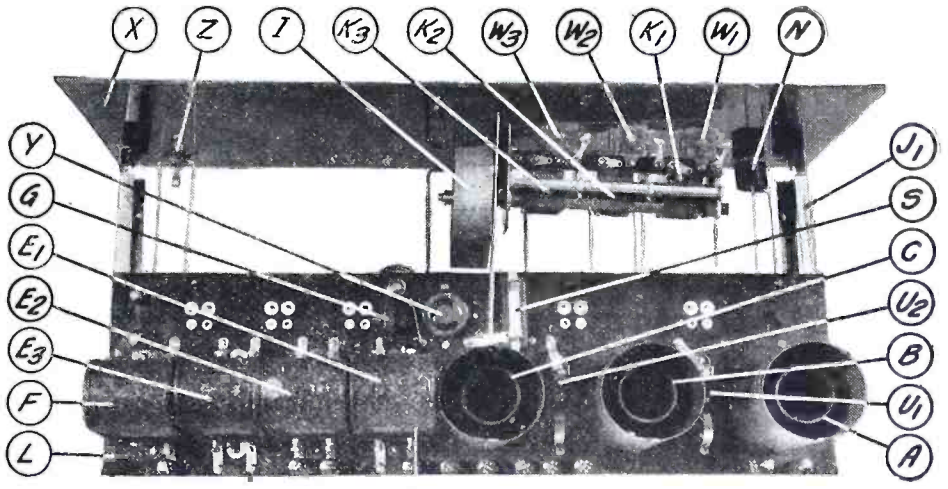


FIGURE 1: THE AC RECEIVER FROM ABOVE

O2—Carter center-tapped resistor, 10 ohms, type CU-10;
O3—Carter fixed resistor, 1,500 ohms, type H;
P—Aerovox fixed condenser, .0001 mfd.;
Q—Aerovox fixed condenser, .00025 mfd.;
R—Aerovox fixed condenser, .001 mfd.;
S—Lynch grid-leak, 2 megohms;
T—Lynch grid-leak mounting;
U1 and U2—XL neutralizing condensers, .0001 mfd., Model G-5;
V1 to V13—Eby binding posts;
W1 to W3—Hammarlund equalizers;
X—Westinghouse Micarta drilled and engraved front panel;
Y3—Eby UY 5-prong socket;
Z—Carter "short" jack, open circuit, type No. 1;
Wire, screws, solder, etc.

List of Parts for Building the Counterfonic Power-Pack

Cost of Parts—*Not over $43.00*

A—Silver-Marshall power transformer, type No. 329-A;
B—Silver-Marshall unichoke, type No. 331;
C—Aerovox buffer condenser, .1 mfd. and .1 mfd., center tapped, type No. 646;
D—Aerovox filter condenser block, type BH-420;
E—Aerovox moulded by-pass condenser, 1 mfd., type 250;
F—Aerovox Pyrohm tapped resistor, 13,000 ohms, type 994-171;
G—Eby UX socket;
H1 to H11—Eby binding posts;
I—Wooden baseboard, 17 by 4 by ½ inch;
J—Micarta binding-post strip, 11½ by ¾ by 3/16 inch;
K1 and K2—Binding-post strip brackets, 2 inches high by ½ inch wide.

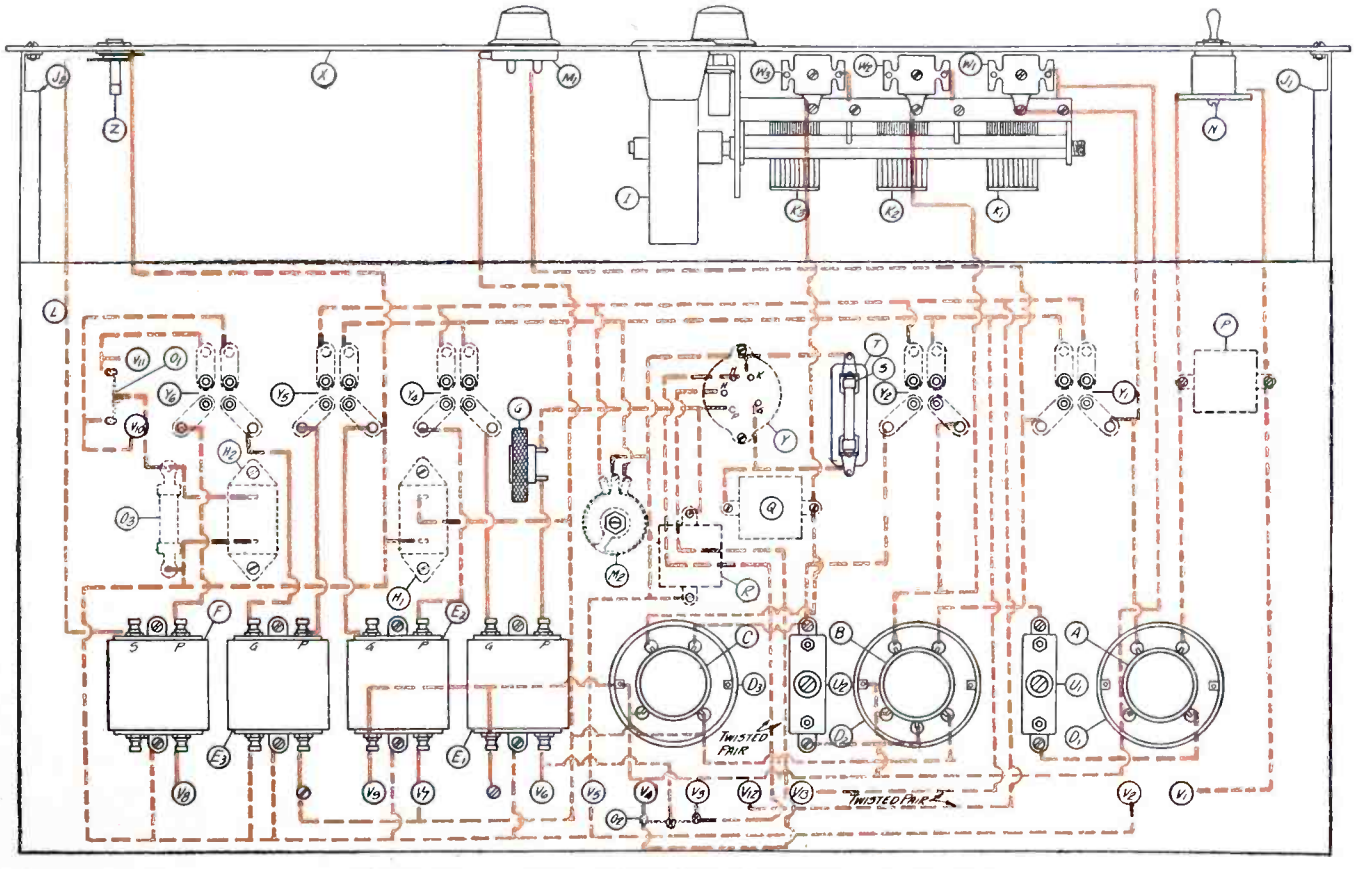
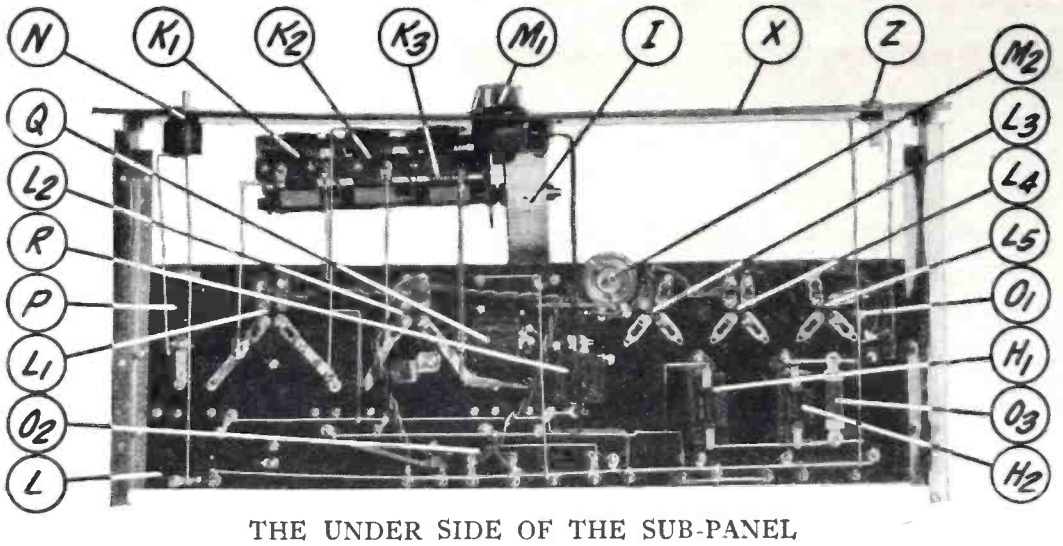


FIGURE 2: THE PICTURE WIRING DIAGRAM



THE UNDER SIDE OF THE SUB-PANEL

FIGURE 3: *Notice the twisted cables for the filament circuits of the AC valves, which replace the bus bar wiring of the DC model of the receiver. Most of the additional parts necessary for AC operation are mounted under the sub-panel, and are shown above.*

the "F" terminals of the double impedances and the corresponding terminals of the high-frequency transformers.

Then remove the "B" negative (—) wiring including the connections to the various fixed condensers, the grid-leak, the reproducer binding post and the instrument case grounds. Take out the connection from the output filter to the other reproducer binding post. Remove the filament rheostat and replace it with the Carter midget potentiometer, M1.

Remove the detector socket by drilling a hole sufficiently large to insert the top of an Eby 5-prong socket. The large hole may be made by drilling a series of small connecting holes around a circle of the correct size and filing the edges smooth after knocking out the center. Insert the 5-prong socket under the sub-panel with the cathode and one heater terminal at the front of the set and fasten with brass machine screws and nuts to the sub-panel.

Now mount the Carter adjustable resistor, M2, under the sub-panel between the detector and the first low-frequency socket. Remove the filament switch and replace it with the Carter jack, Z. Install an additional Aerovox by-pass condenser, H2, under the sub-panel.

Insert new binding posts as are shown to be necessary according to the picture wiring diagram in Figure 2.

The new wiring can now be started. Connect the grid and plate terminals of the 5-prong detector socket to the same instruments to which the corresponding terminals of the DC detector socket were connected. Figure 2 shows the correct wiring for the unit.

Connect the two 2½-volt AC binding posts to the filament terminals of sockets one, two, four and five, and to the two outside terminals of the Carter adjustable resistor, M2. Use a twisted pair of wires for all AC filament wiring.

The two 2½-volt AC binding posts are connected to the heater terminals of socket Y. Also connect the Carter center-tapped 10-ohm resistor, O2, directly across the same AC binding posts and connect the mid-point of this resistor to the "B" 45-volt positive (+) binding post.

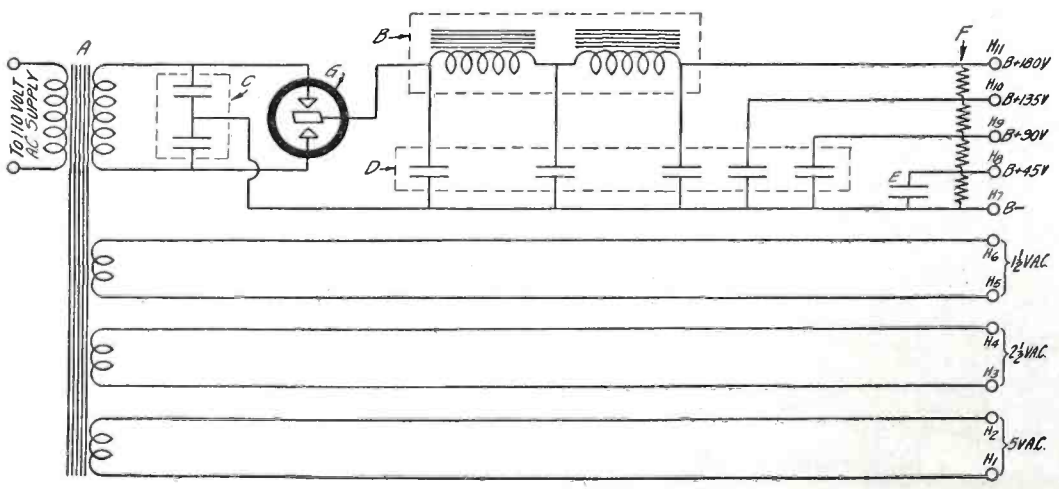
The two 5-volt AC binding posts should be connected to the filament terminals of socket six and to the pilot light. Also connect the Carter center-tapped 40-ohm resistor, O1, directly across these AC binding posts. Connect the mid-point of this resistor to one side of the Aerovox by-pass condenser, H2, and to one end of the Carter 1500-ohm fixed resistor, O3.

Now connect the "B" negative (—) binding post to the ground binding post, the cathode terminal of the detector socket, the grid-leak, S, the pointer of the Carter adjustable resistor, M2, the Aerovox fixed condenser, R, the by-pass condensers, H1 and H2, the Carter fixed resistor, O3, the "F" terminal of the third double impedance, E3, the frame terminal of the Carter jack, Z, the cases of all the double impedances and the output unit.

Connect the open terminal of the output unit, F, to the remaining terminal of the jack, Z.

Connect the "C" negative (—) binding post to the "F" terminals of the first two double impedances, to the "F" terminals of the three high-frequency transformers and to the frame of the triple condenser.

The necessary changes for light-socket operation of the receiver have now been completed.



THE SCHEMATIC DIAGRAM OF THE AC POWER-PACK

FIGURE 4: *The wiring of the power-pack to be used in conjunction with the AC Counterfonic, to make the set socket operated, is so simple that a separate picture wiring diagram is not necessary. By reference to this circuit diagram, and the top view of the unit in Figure 6, the wiring may be easily done.*

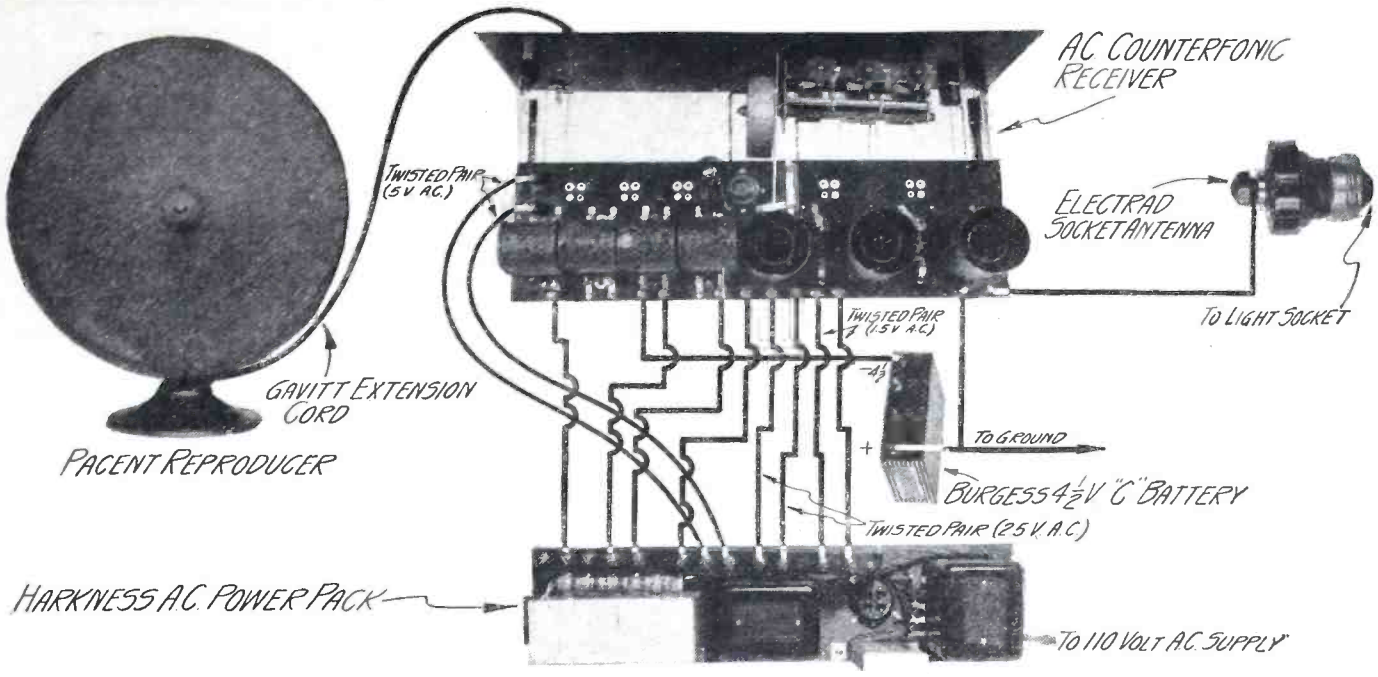
How to Build the AC Power-Pack for the Receiver

Refer to the circuit wiring diagram in Figure 4 and the top view in Figure 6 for the details of construction.

First mount the binding posts on the Micarta binding-post strip. Note that the "B" battery negative (—), 45-volt positive (+), 90-volt positive (+), 135-volt positive (+) and "B" positive (+) power binding posts are exactly opposite the first, third, fourth, fifth and sixth terminals of the Aerovox resistor, F. When the resistor is mounted, the lugs on it will be soldered directly to lugs on the binding posts opposite. Fasten the two binding-post strip brackets under the binding-post strip with the lower angles turned "out."

Place all the parts of the power-pack in position on the wooden baseboard, I, and mark the location of the mounting holes for the instruments on the baseboard with a pencil or an awl. Note that the terminals of all the instruments are faced in the direction shown in Figure 6.

Remove all parts from the base and



THE HOOK-UP FOR THE AC-IZED COUNTERFONIC

FIGURE 5: *Except for the small "C" battery, the current drain upon which is so slight that it is semi-permanent in life, the Counterfonic hook-up shown above is completely batteryless. In addition, the two units are remarkably compact in construction and take up much less space than is required by many socket-operated hook-ups.*

drill a small hole for starting each of the round-headed mounting screws.

First mount the Eby sockets, G, with the filament terminals towards the near end of the baseboard. Next, mount the S-M power transformer, A, with the high-voltage terminals towards the Eby socket. Then fasten the Aerovox buffer condenser, C, in place with the leads turned "away" from transformer A.

Mount the S-M uni-choke, B, with the terminals towards the binding-post strip. Also fasten the Aerovox filter-condenser block, D, in place with the terminals turned in the same direction.

Next fasten down the Aerovox by-pass condenser, E, at the end of the large condenser block.

Using two screws through the small angle brackets, fix the binding-post strip, J, in its position two inches above the base.

How to Wire the AC Power-Pack

Wire the instruments exactly as shown in the circuit wiring diagram in Figure 4. Use a twisted pair of wires for connecting each of the 1½, 2½ and 5-volt AC windings to the binding posts.

Support the Aerovox resistor, F, on the binding-post strip by soldering its terminals to lugs on the corresponding binding posts of the binding-post strip.

Follow the directions carefully and check with the picture wiring diagram. This completes the power-pack and it may then be attached to the receiver to furnish complete "A" and "B" power.

How to Install the AC Receiver and the Power-Pack

Place the receiver in a Corbett cabinet and fasten it in place with the wooden bar along the top edge of the panel.

Place the AC power-pack and the small "C" battery inside the table on which the cabinet stands.

Connect the corresponding terminals of the set to the power-pack with cables run out through the back of the cabinet and down through the holes at the rear of the table. See the composite diagram, Figure 5, for all connections.

Now connect the antenna binding post of the receiver to an Electrad socket antenna and the ground binding post to a water pipe ground. Plug a Pacent cone reproducer in the jack on the front of the receiver.

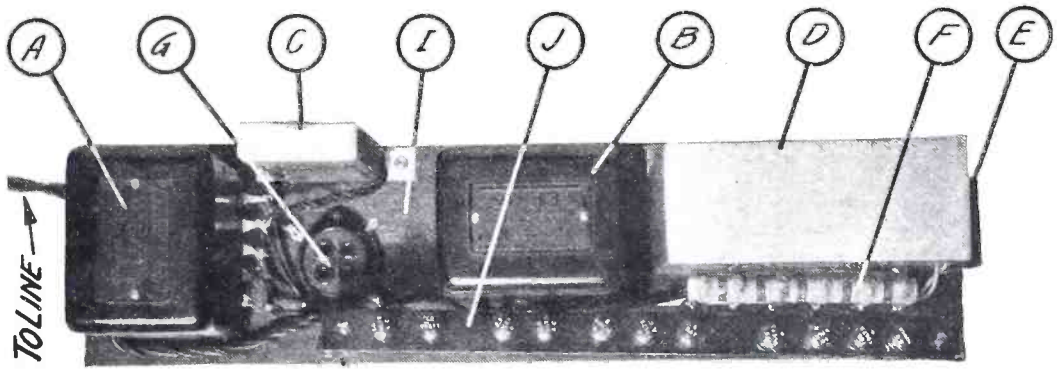
Insert a Raytheon BH rectifier valve in the socket of the power-pack, and four CX-326 type valves in the first, second, fourth and fifth sockets of the receiver. Place a C-327 type valve in the third socket of the receiver and a CX-371-a type valve in the sixth socket of the receiver.

Insert the plug on the AC lead from the power transformer of the power-pack into a 110-volt, AC lighting socket, and the receiver is ready for operation as soon as the detector valve heats up to the proper temperature.

It may be necessary to adjust the arm of the Carter resistor, M2, slightly to reduce the AC hum to a minimum.

The AC receiver is tuned in the same manner as the DC model and the reader is referred to the article in the January, 1928, issue of POPULAR RADIO for further details. It will be found to give better reproduction and quite improved general results because of the superior characteristics of the AC valves which are employed.

The real point of the change, however, is the complete AC operation of the receiver and an absence of worry over battery up-keep. The complete job is an economical receiver from every point of view and one well worth the time and money spent on it.



THE TOP VIEW OF THE POWER UNIT

FIGURE 6: *The power unit is built on a long, narrow panel so that it may be placed behind the receiver in the same cabinet. All of the wiring of this unit is done above the baseboard. It is indicated clearly in the schematic wiring diagram in Figure 4.*

POPULAR RADIO WORK SHEET

The PR Short-Wave Converter

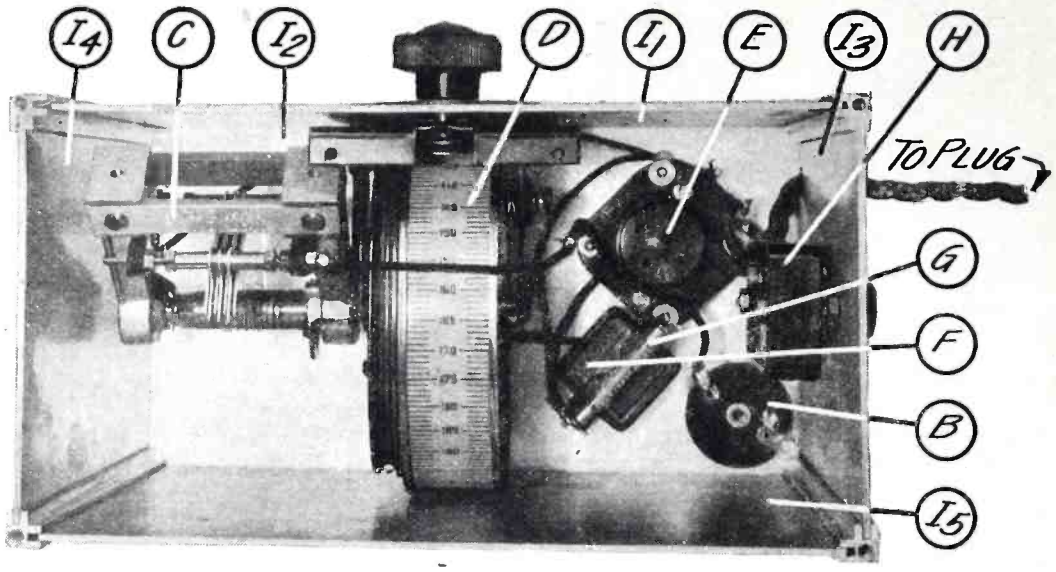


FIGURE 1: THE LAYOUT OF THE PARTS.

List of Parts for Building This Unit

Cost of Parts: *Not over $30*

A—Aero coil set, type LWT-125;
B—Aero choke, type No. 60;
C—National "Equitune" variable condenser, .00015 mfd.;
D—National velvet vernier drum dial, type F;
E—Benjamin Cle-ra-tone socket, No. 9040;
F—Aerovox moulded condenser, with clips for grid-leak mounting, .0001 mfd., type No. 1475;
G—Lynch resistor, 8 megohms;
H—Samson neutralizing condenser, type No. 61;
I—Standard aluminum box shield, 5 by 9 by 6 inches high, made by the Aluminum Company of America;
Wire, screws, nuts, etc.

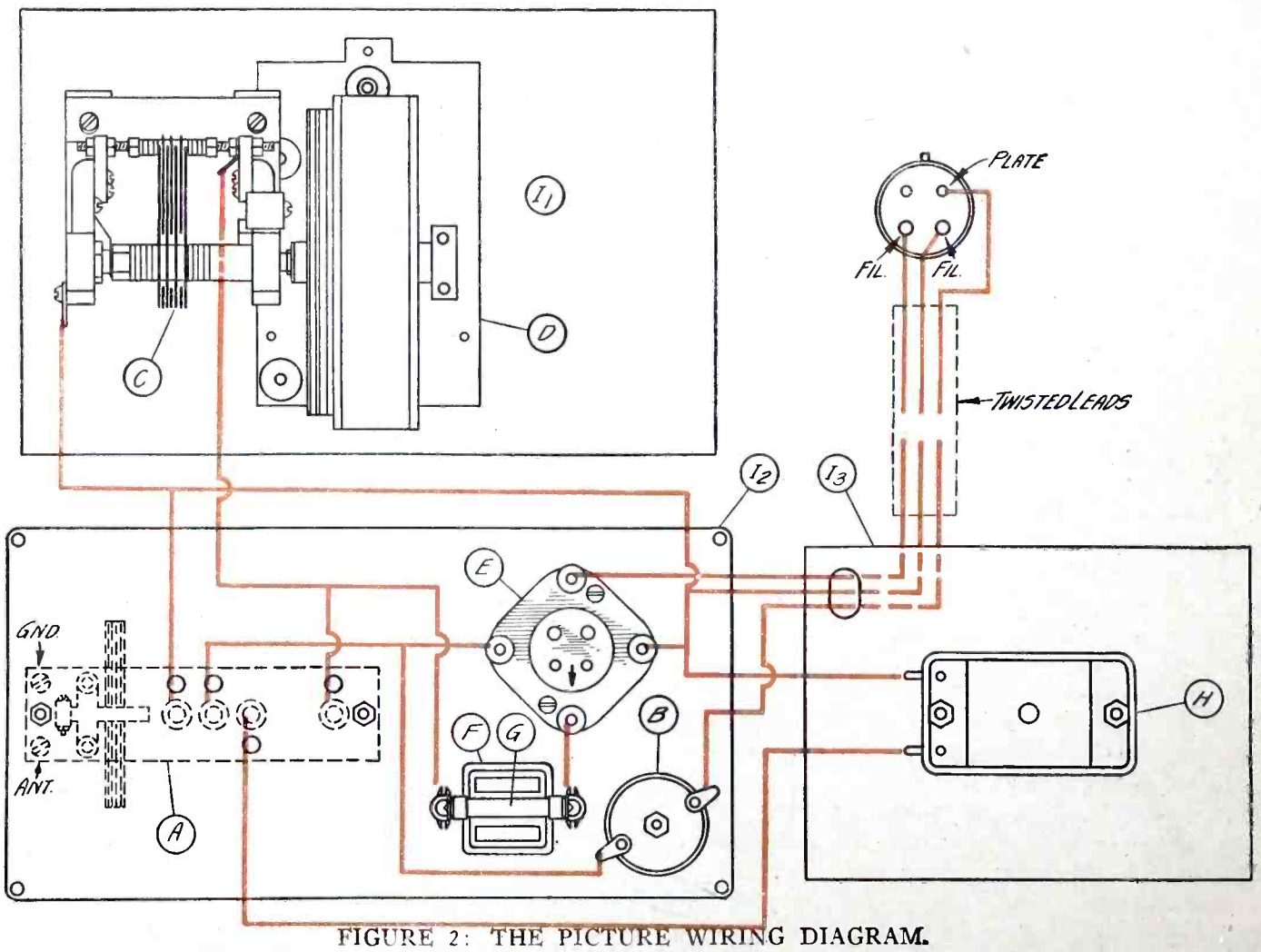
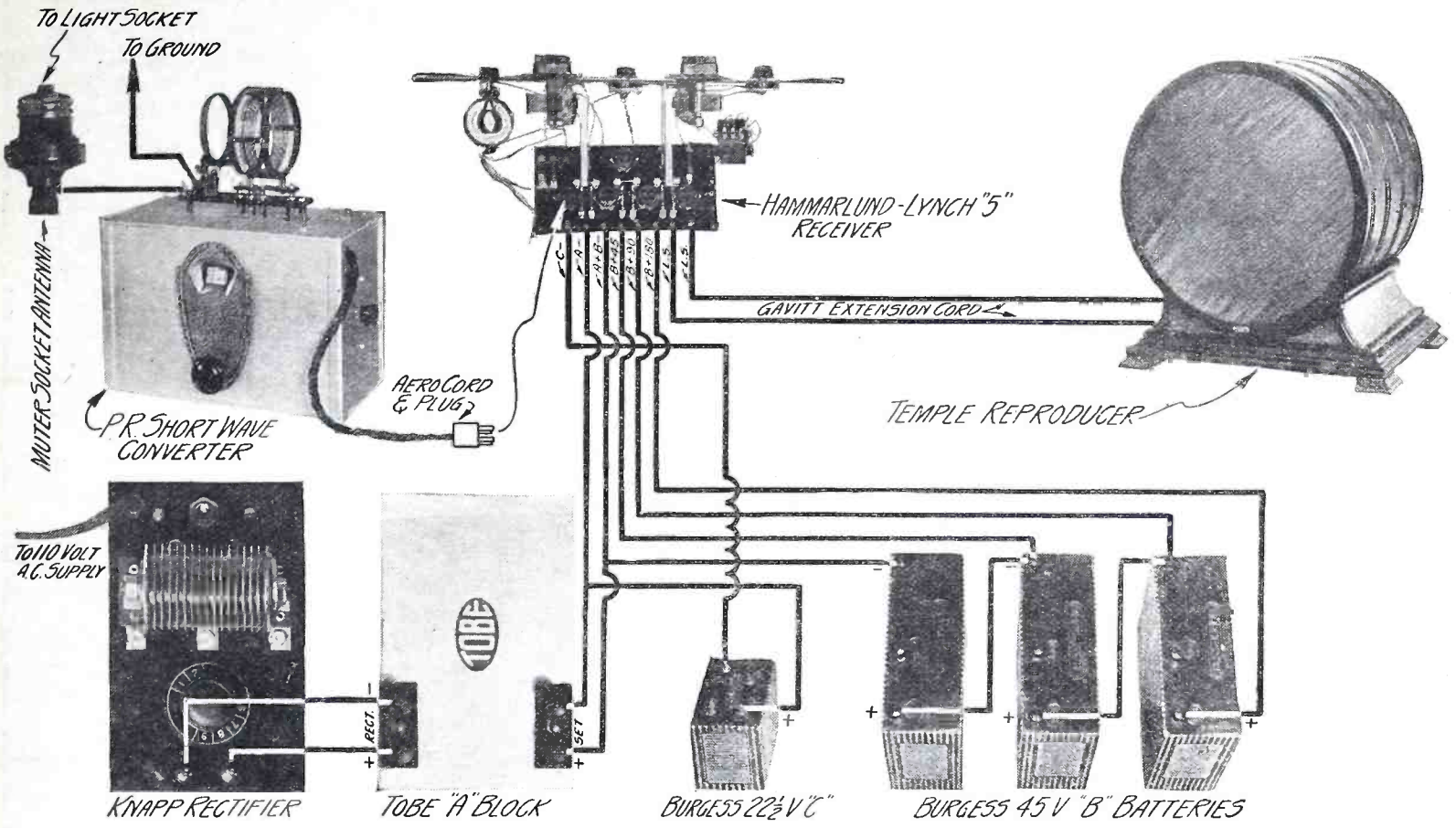


FIGURE 2: THE PICTURE WIRING DIAGRAM.



HOW THE CONVERTER IS HOOKED UP

FIGURE 3: *The Hammarlund-Lynch "5" is shown here as an example of broadcast receiver with which the PR converter may be used. The converter gets its operating voltages from the same units which supply the broadcast receiver.*

Use the PR Short-Wave Converter for Television Wavelengths

By CARL DORF

THE magic short wave and its fascinating possibilities for reception over great distances is bringing many new enthusiasts into this field of radio reception. In addition, with the prospects of regular broadcasting of television becoming more certain every day, the new unit will serve to make these broadcasts, which are transmitted on short waves, available to the experimenter in this fascinating new field.

The POPULAR RADIO Laboratory has been working on this problem strenuously for the past six months and has evolved a converter unit that, it is believed, must successfully solve the problem of short-wave reception with present-day receiving sets.

The new unit is shown on the cover of the magazine and has been designated the PR short-wave converter. It needs no batteries other than those used with the set and no connections other than an antenna and ground and the insertion of a plug into the detector socket of the receiver in use.

Here is POPULAR RADIO'S *contribution to the interest in short-wave reception—an easily built, easily installed and inexpensive converter that may be plugged into any receiver for the reception of short waves. Every fan should be anxious to open up this new field where the future of radio and television is now being made.*

The new unit is built entirely enclosed in a standard aluminum box shield, except for the tuning coil, which is mounted on top and which is of the plug-in type for changing wavelengths. It will receive, with the regular set of plug-in coils, on wavelengths continuously from 15 meters up to 130 meters, and can be made for regular broadcast reception by the addition of a standard wave coil, which also plugs into the same sockets.

As will be seen from Figures 1 and 2, all of the tuning is done with a single knob located on the front of the converter, to which is attached a drum dial of a new type that insures velvety operation at all frequencies. Regeneration is controlled by a small knob on the right side of the unit and hand capacity has been entirely eliminated. This is an important consideration for short-wave work.

The circuits used in the new converter contain no tricks or eccentricities, but employ a modified form of short-wave circuit that has been thoroughly tested by pioneers in short-wave work.

How to Construct the Converter

In constructing the short-wave converter, the first job will be to drill the necessary holes in the aluminum box shield, I, for mounting the instruments. It will probably be best to start by preparing the front panel, I1,

(*Continued on page 342*)

HOW FAR CAN ENGINEERS CARRY THIS NEW IDEA OF

SUPER-SIMPLIFIED RECEIVERS?

By A. DINSDALE

TENDENCIES of late in radio progress have been toward greater simplification, both in design and operation of sets. Such developments as single-control tuning and AC operation have reduced the manipulation of a receiver to its very lowest terms. And now many engineers and experimenters are turning their efforts towards bringing the design of the receiving circuit to its very lowest factor in terms of number of parts employed and amount of wiring required. Among the most outstanding of these super-simplified circuits are those designed by Mr. J. F. Johnson, an English experimenter and set designer.

The circuit diagram of one of the simplest forms of the circuit thus developed is given in Figure 1. The circuit is a simple detector and two low-frequency stages. It is hard to imagine how a receiving circuit could very well be simpler. It is so simple that, at first glance, it appears impossible that it could work. But it does, so we will proceed to examine it and see *how* it works.

The design is the result of months of laboratory experiments, using experimental apparatus with a multitude of controls, in order to arrive at the best values of constants for efficient and simple operation. No effort was made to obtain super results in any way, either in the direction of extreme range, selectivity or volume. The object aimed at was simply to obtain good loudspeaker reception of local stations with the minimum of apparatus and controls.

The particular set described was designed to operate off the 200-volt DC lighting lines, but where AC lines of this voltage are available rectified AC is just as suitable. Voltages above or below 200 can be arranged for by suitably altering the values of the resistances and choosing suitable valves.

Perfection comes with simplification, not with complication. Has radio receiver engineering now reached the apex of complication, and will the engineers of to-morrow bend their efforts toward simplification rather than toward further intricacy? How many radio parts are today superfluous? The question now before the radio engineers of the world is that of preserving efficiency with a minimum of parts. Perhaps we shall some day have a radio receiver with one valve and no more than a total of five important components connected together in a very simple way.

The secret of the circuit is that by making the filament of each valve a suitable degree positive with respect to the filament of the preceding valve, the necessity for coupling condensers and grid-leaks, as used in resistance-capacity coupling, is abolished. It is claimed that this results in greater efficiency and improved quality of reproduction.

The proper voltages for application to the various electrodes of the valves are obtained by connecting them to suitable points on a potential divider, which is, in turn, connected across the supply mains.

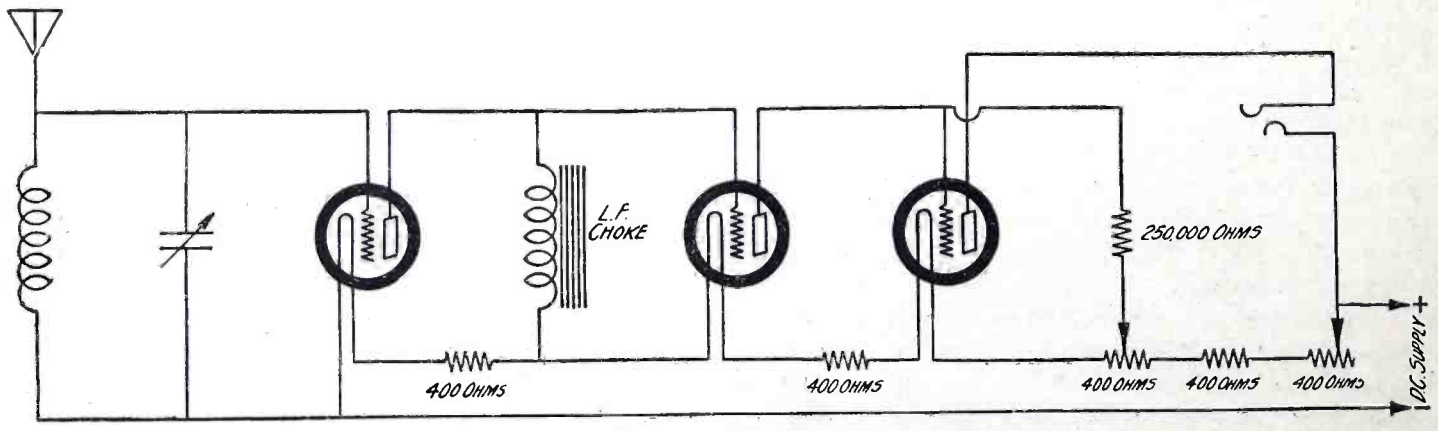
An important feature is that owing to the fact that any variations in the lighting circuit voltage affect the various electrodes in such a way as to cancel out, no smoothing arrangements or filter circuits are required.

Owing to the absence of grid-leaks and condensers, it appears at first glance that the grid of each valve must be hopelessly choked with positive potential impressed upon it from the plate of the preceding valve. But this is not the case, as a careful examination of the circuit diagram will show.

Let us consider the last valve first. The lighting circuit voltage, before it reaches the filament, is dropped in potential through three 400-ohm resistances connected in series. The plate, however, is at the full potential, so that there is a difference in potential between the plate and filament of the last valve.

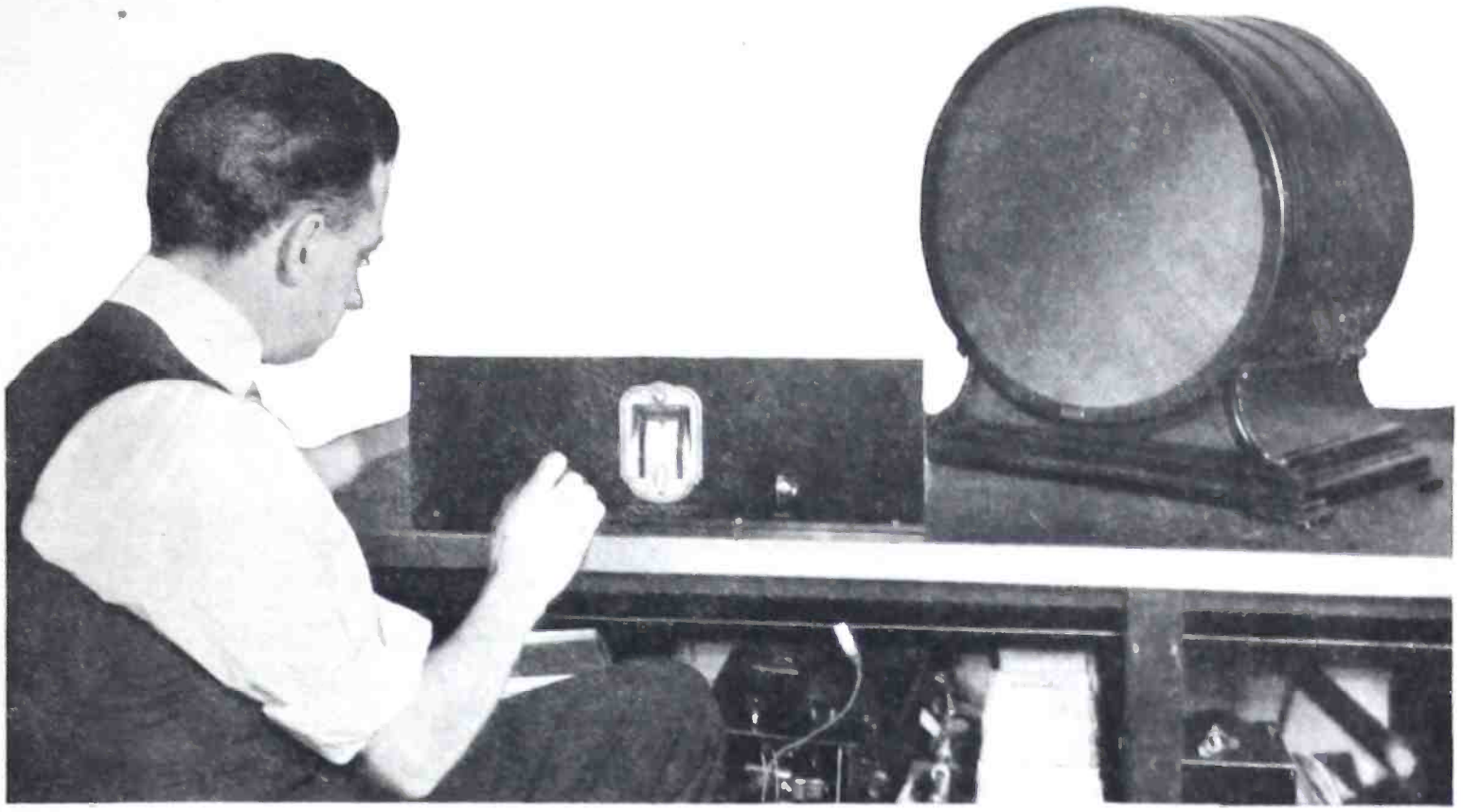
Before reaching the filament of the second valve, the lighting circuit potential is dropped through the three 400-ohm resistances, the filament of the last valve, and another 400-ohm resistance. The plate supply to the second valve is taken off the 400-ohm resistance immediately preceding the filament of the third valve, a variable tapping being provided. Before it reaches the plate, however, it has to go through

(*Continued on page 331*)



THE LAST WORD IN SIMPLIFICATION

FIGURE 1: *The circuit above is an example of how far simplification in receiver design can be carried. It was designed in England, for operation from the 200-volt DC lighting lines, and it gives good loudspeaker reception from local stations. By a change in resistance values it may be adapted for operation on the 110-volt DC lines that are used in some parts of this country.*



HOOK YOUR HI-Q *to the* SOCKET

The popularity of the Hi-Q "Six" has been so great that its designers have devised a socket operated model of the receiver for those fans who wish to combine the good features of the Hi-Q with the convenience of batteryless operation. With the data given in this article the older model may be easily converted, or a new AC receiver built.

By LESLIE BILES

SET BUILDERS who have built the Hammarlund-Roberts Hi-Q "Six" have requested information on a Hi-Q Six receiver that would be totally light-socket operated. They have also asked for the necessary information for converting some of the DC-operated sets, they have already built, for light-socket operation. The purpose of this article is to give the necessary details for accomplishing the complete elimination of batteries from the old sets, and the operation of the receiver from the AC lighting lines.

After a careful consideration of the subject, and numerous tests and experiments, the Hammarlund engineers decided to employ the new AC heater type valves throughout, except in the case of the last amplifier stage, in which a 371 type power valve is recommended.

An improved output filter has also been added to the receiver to handle more effectively the greater volume that is obtained.

How to Make the Mechanical Changes

In building up a new Hi-Q Six receiver of the AC type it would be best to refer to the article published in the November, 1927, issue of POPULAR RADIO. This article deals with the general assembly details and the set builder is recommended to follow it with the following exceptions:

The new AC valves require a new type of socket capable of receiving five prongs instead of four. These are mentioned in the new list of parts and their positions are designated with letters that correspond with those in Figure 3 and the picture wiring diagram in Figure 4.

Of course, with this type of valve, the filament resistors, R9, R10 and R11, will be eliminated, as well as the three amperites, P1, P2 and P3. A by-pass condenser, M1, has been added, shunted across a fixed resistor, S, for the "C" bias necessary on the amplifier valves. These two instruments are fastened underneath the chassis, R2, and they are shown in Figure 2.

Another addition is the 30-henry choke coil, K, and the Parvolt condenser, P, which is added to the last stage to act as an output filter. A Clarostat volume control has also been substituted for the Imp battery switch. The original Imp rheostat on the right-hand of the drum dial may be left on the panel, but it is not used in the new model.

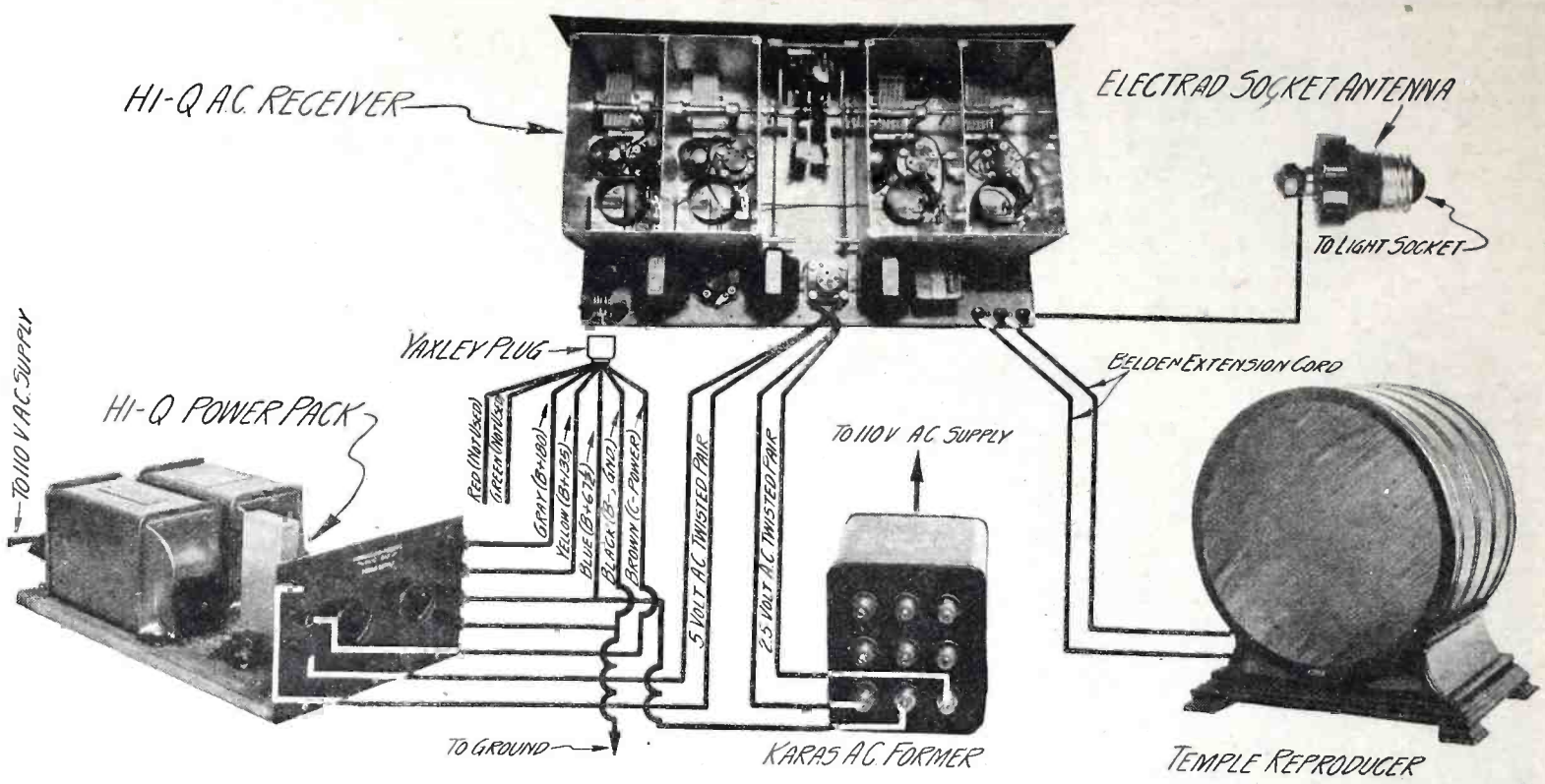
Of course, if a new panel is being made the holes for this latter instrument should not be drilled.

This takes care of the mechanical changes and when the work has progressed to this point the wiring may be started.

The Wiring Changes

In Figure 4, which is the new picture wiring diagram, all of the wiring details for the new receiver are given, with the wires that are to be run on top of the metal chassis shown in the heavy red lines. The dotted red lines indicate where the new wiring is to be run underneath the chassis. All of the instruments and parts are outlined in black lines; the dotted black lines indicate those parts that are to be mounted underneath the metal chassis.

By referring back to the picture



NO BATTERIES IN THIS OPERATING HOOK-UP

FIGURE 1: *With the Hi-Q power-pack supplying the "B" voltages, and the Karas AC-Former delivering the current for the AC valves, the Hi-Q becomes a completely socket-operated receiver system.*

wiring diagram of the DC receiver, in the November, 1927, issue, the changes that are necessary will be immediately evident. It is recommended that the AC model should be wired up with a rubber-covered insulated wire, such as the Gavitt hook-up wire. Follow the instructions given in the picture wiring diagram and the job will be easy. After the wiring has been accomplished it should be checked for possible errors.

How to Install the Receiver

When the conversion has been finally completed the completed receiver may be installed in its Corbett cabinet and connected up with the official Hi-Q power supply, which will furnish all of the "B" voltages necessary.

The vacuum valves recommended are the Ceco 27 type AC valves; these should be installed in all of the sockets except the last one, N6, in which a Ceco type F power valve should be inserted.

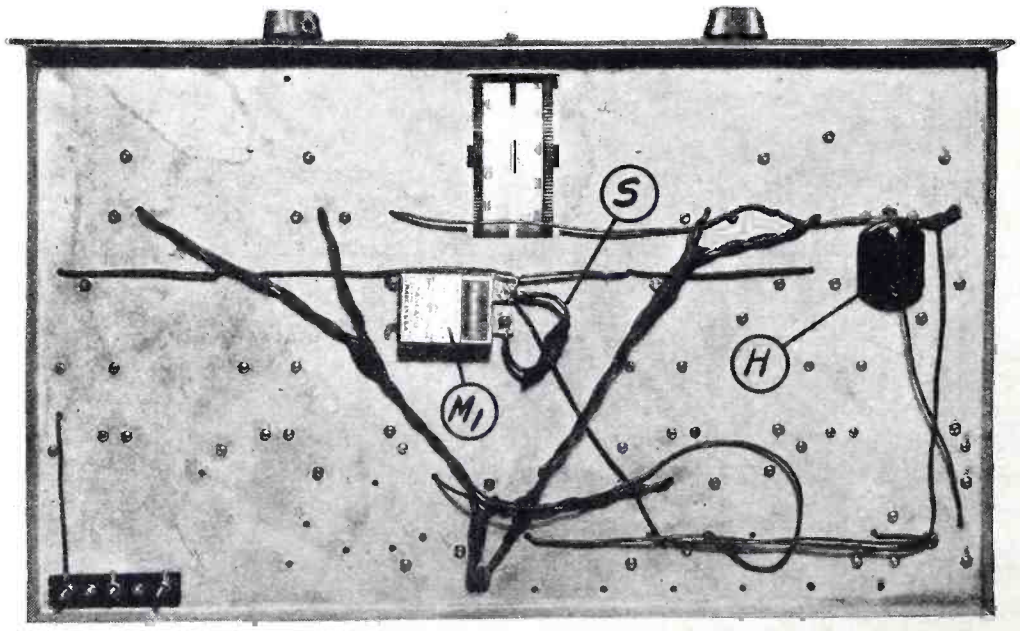
The photo-diagram in Figure 1 shows all of the connections to be made between the Karas filament-heating transformer, the Hi-Q power supply and the receiver. It also shows the connection to the light-socket antenna and the exponential reproducer. Follow out these connections exactly and when completed the receiver is ready for operation.

When you turn "on" the receiver the 110-volt cord and plug from the Hi-Q power-pack should also be connected to the input of the Karas filament-heating transformer and inserted in a socket of the 110-volt, AC lighting line. The socket switch should be turned "on" and the vacuum valves in the set should immediately begin to glow. A period of 15 to 30 seconds will then elapse before the receiver is in operating condition.

The tuning will then be carried on in the same manner as with the DC-operated set, and the volume control will be accomplished through the new variable resistor, J.

For further details of tuning and operation the reader is referred to the original article on the Hi-Q "Six" receiver. As stated before, the use of the AC valves in the receiver greatly improves its operation and makes a suitable job for the custom-built trade, and presents the custom set builder with a real receiver that he may be proud to sell to any client, knowing that he has something to offer that will compare favorably with any AC-operated receiver now on the market as well as include some features that are obtainable only in a custom-built model.

Once installed, the set should function indefinitely without attention.



THE UNDER SIDE OF THE SUB-PANEL

FIGURE 2: *The by-pass condenser, M1, is used in the AC model of the receiver, shunted across the fixed resistance, S, to provide "C" bias for the amplifier valves.*

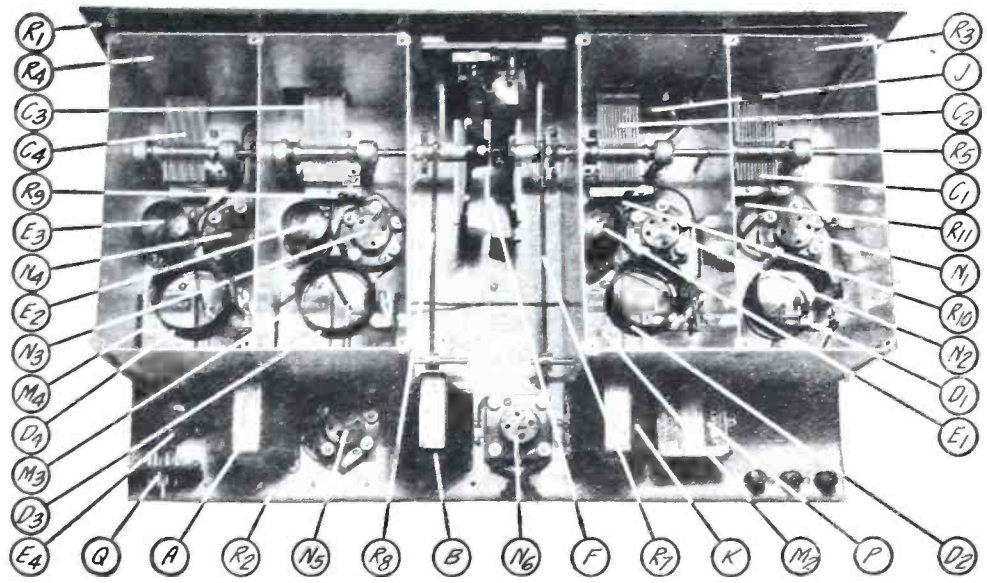
POPULAR RADIO WORK SHEET

The AC Hi-Q "Six"

List of Parts for Building This Receiver

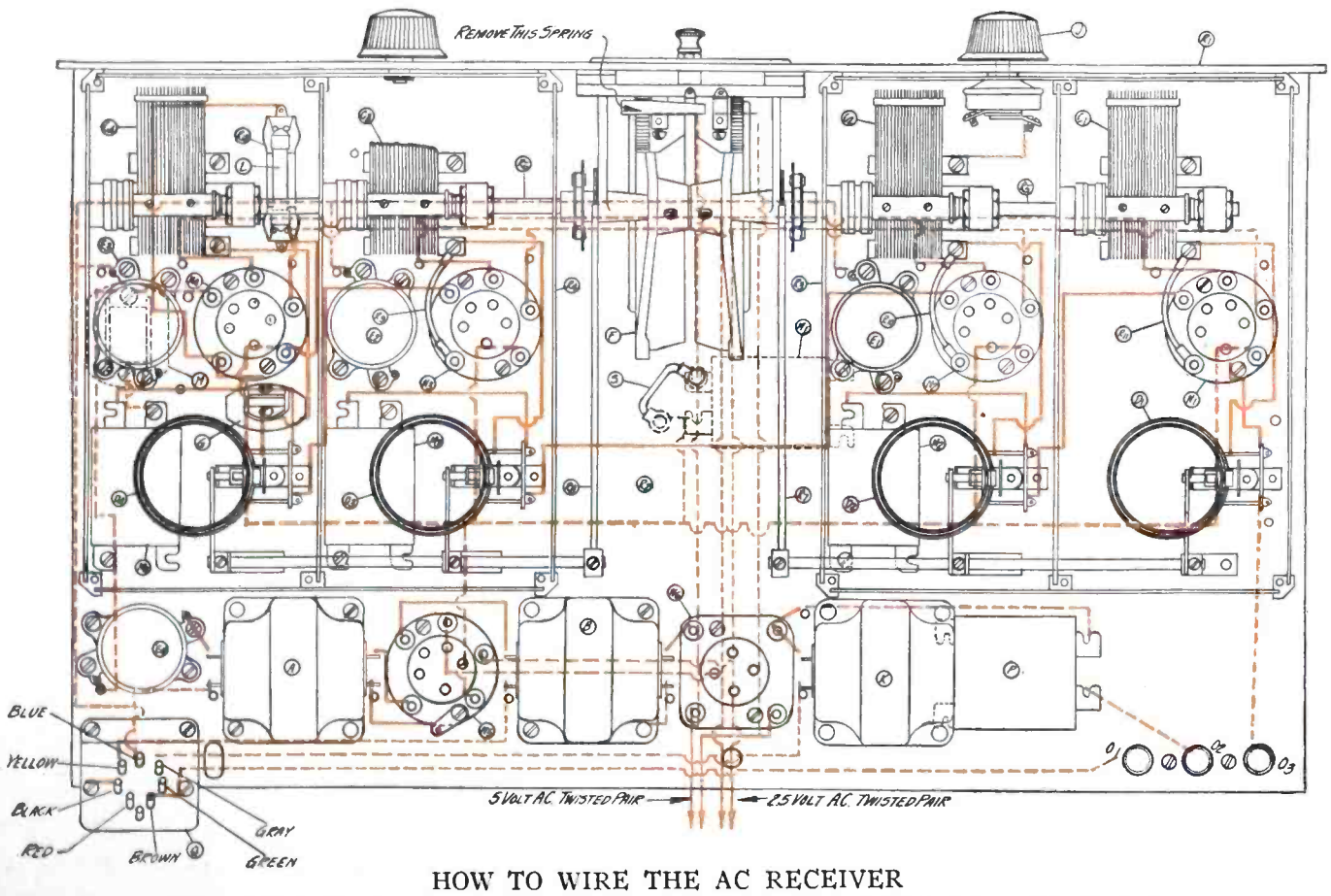
Cost of Parts—*Not over $104*

A—Samson symphonic transformer;
B—Samson 3-1 transformer, type HW-A-3;
C1 to C4—Hammarlund mid-line variable condensers, .0005 mfd.;
D1 to D4—Hammarlund auto-couple coils, HQ-64;
E1 to E4—Hammarlund chokes, type RFC-85;
F—Hammarlund illuminated double drum dial;
G—Sangamo mica fixed condenser, .00025 mfd.;
H—Sangamo mica fixed condenser, .001 mfd.;
I—Sangamo grid-leak clips;
J—Clarostat volume control;
K—Samson 30-henry choke;
L—Durham metallized resistor, 2 megohms;
M1 to M4—Acme Parvolt by-pass condensers, .5 mfd., Series A;
N1 to N5—Benjamin 5-prong sockets;
N6—Benjamin vibrationless socket, No. 9040;
O1, O2 and O3—Eby engraved binding posts, marked *Speaker plus*, *Speaker minus* and *Antenna*, respectively;
P—Acme Parvolt filter condenser, 2 mfd., Series A;
Q—Yaxley cable connector plug, No. 660;
R—Hi-Q "Six" foundation unit; containing:
R1—Drilled and engraved Micarta panel, 7 by 21 by ⅛ inch;
R2—Drilled metal chassis;
R3 and R4—Two-stage aluminum box shields;
R5 and R6—Brass extension shafts for variable condensers;
R7 and R8—Cam-operating assemblies;
R9—Grid suppressor (black);
R10 and R11—Grid suppressors (red);
R12—Bakelite grid-leak mounting block;
R13—Bakelite binding-post strip;
S—Electrad fixed grid resistance, 200 ohms;
Wire, screws, solder, etc.



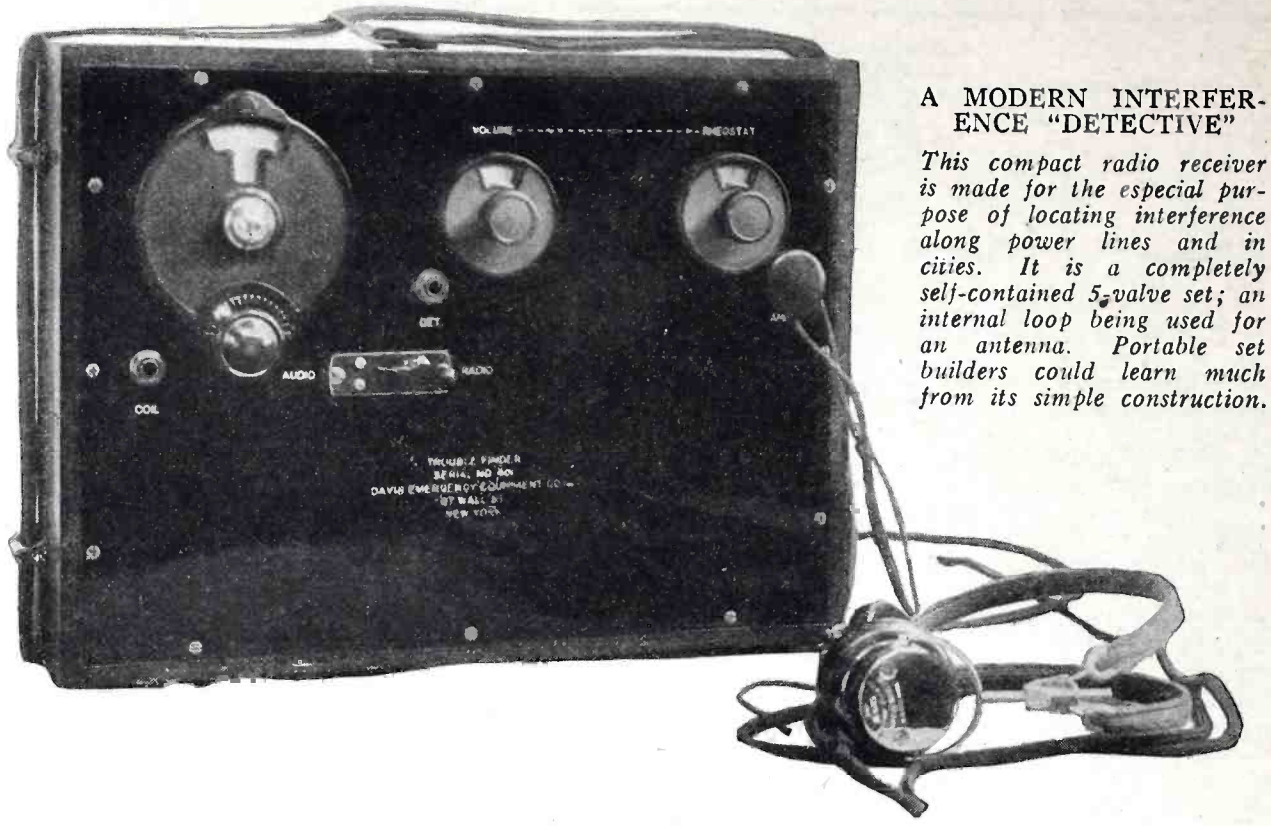
THE RECEIVER VIEWED FROM ABOVE

FIGURE 3: *The chief changes in the layout of instruments are the new sockets for the 5-prong valves that are used in all but the final stage of low-frequency amplification.*



HOW TO WIRE THE AC RECEIVER

FIGURE 4: *The wires that are run above the sub-panel are indicated in solid* RED *lines, and those beneath the sub-panel in dotted* RED *lines. The instruments are outlined in* BLACK. *Dotted* BLACK *lines indicate instruments mounted under the sub-panel.*



A MODERN INTERFERENCE "DETECTIVE"

This compact radio receiver is made for the especial purpose of locating interference along power lines and in cities. It is a completely self-contained 5-valve set; an internal loop being used for an antenna. Portable set builders could learn much from its simple construction.

Running Down the Radio Criminal— Interference

By CHARLES S. ENDERS

Man-made interference is going the way of earlier radio bugbears under the new scientific methods of interference finding practised by large power companies. In this article the broadcast listener will find how this balky problem is being solved, and the profesional man will get valuable pointers on trailing the power line hum to its lair.

LIKE all other departments of radio research, the methods used in locating interference have, within the past five years, and especially within the past two years, been greatly improved and reduced to an almost exact science. Improvements have been brought about not only in the perfection of apparatus suitable for this work, but in the methods employed in operating interference finders for maximum efficiency. There was a time when the location of interference was a matter of haphazard guesswork, involving a great deal of time, effort and money. Today vagrant sounds barely become audible before the "radio detective" corps has them traced down to their source.

This article has been prepared principally for those interested in the most modern methods of interference finding, and professional service men as well as power station operators will find in it many valuable suggestions that have come about through actual experiences in locating interference with an improved interference finder operated from the seat of a sedan. Naturally a car is a great asset in locating interference, since it provides for rapid transportation and relieves the operator of the burden of carrying the apparatus.

The make of car is not important, although a six-cylinder car is preferable to a four. A car with good springs and easy riding qualities is desirable, both for the comfort of the operator, and the quiet operation of the set. It also is quieter mechanically. Since the operator will have to be out in all kinds of weather a closed car is of advantage; a closed car also excludes street traffic noises. Where possible, the upper portion of the car should not be of metal. Where an all metal body type of car is used, it will probably be necessary to make provision for an external loop that can be fastened outside.

Careful attention should be given to eliminate interference caused by the electrical apparatus of the car itself. Some methods used for this purpose are as follows. The generator should receive periodic inspection. The commutator should be kept clean and the brushes properly adjusted. This helps to keep it in perfect condition at all times. If sparking occurs a condenser connected from the positive brush to the chassis will be of help. The distributor also should receive careful attention, care being taken that the contacts are kept bright and properly adjusted. All wiring, with the exception of the high tension leads, should be of the armored type. A shield may be made of lead or copper to fit over the motor block, enclosing the distributor, spark plugs and ignition wiring. This should be made so that it is readily removable, as access to the parts enclosed is often necessary. The shield must be perforated or be made with screening so that air circulation is possible. A condenser may be connected from one side of the primary of the ignition coil to the car frame, either at the ammeter

or directly at the coil. A choke may also be inserted in the primary lead. This should be of the same type as the one described elsewhere in this article.

One or more of these methods will serve to eliminate most of the interference from the car. Slight interference will always be present, due to the ignition system. This is not objectionable, as other forms of interference can be heard through it, and at the same time it serves as an indication that the set is in operating condition.

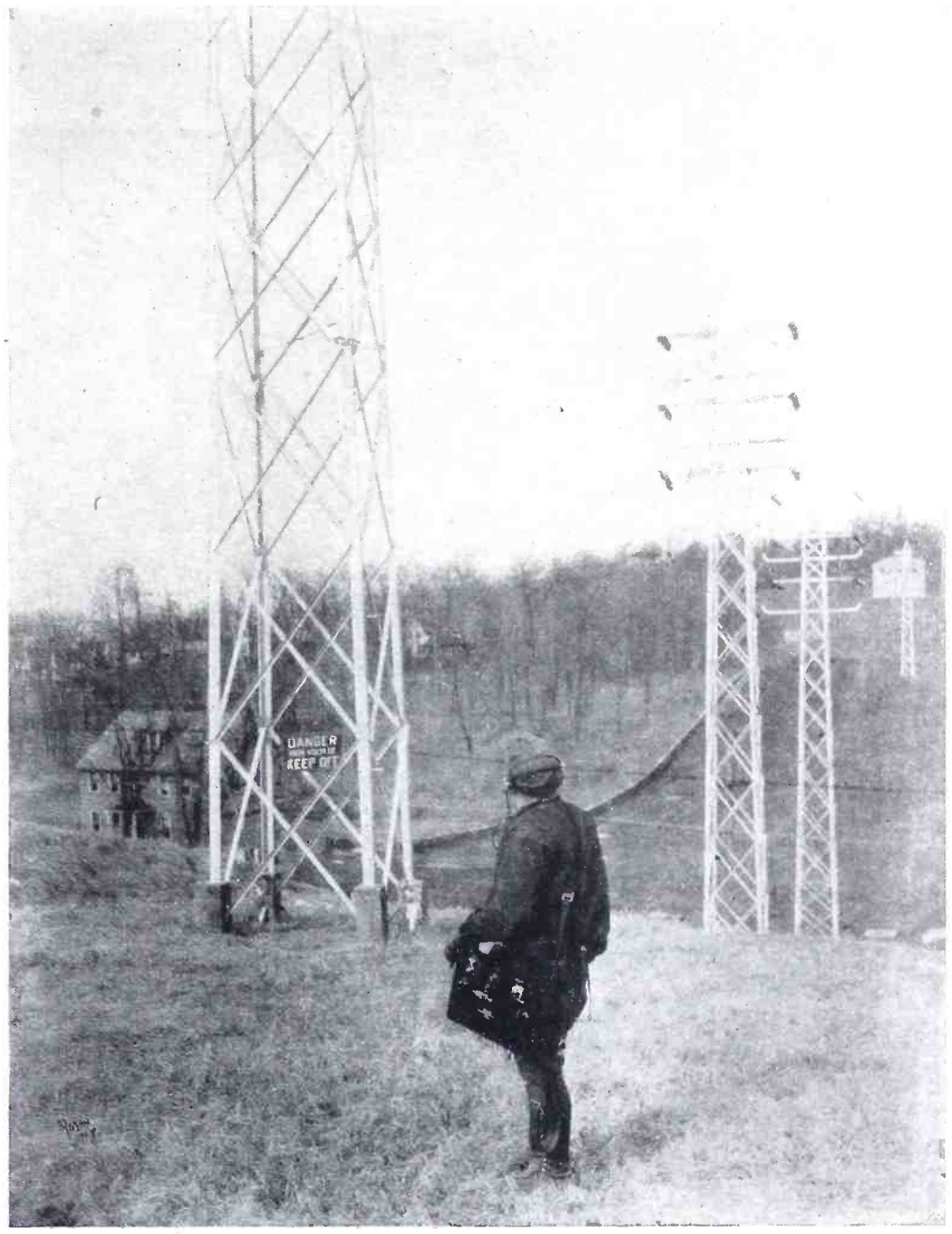
Radio Equipment Used in Trouble Finding

The sets for interference finding used are of many types. Some of them are made by the plant "radio bug." Other companies use sets manufactured for interference work. The type of these sets or "Trouble Finders," as they are called, manufactured by the Davis Emergency Equipment Company of New York, is shown in the accompanying illustrations. This set has been designed after several years of experimenting and as the result of the experience in the trouble hunting field by hundreds of power companies. It is a five-valve set, consisting of two stages of high-frequency amplification, a detector and two stages of low-frequency amplification. Provision is made for the plugging in of exploring coils or external loops by means of a jack which automatically disconnects the internal loop. The high-frequency stages and detector may be used without the low-frequency stages by means of a jack provided for this purpose. The volume and valve controls are equipped with calibrated dials to facilitate volume comparisons.

A switching arrangement is provided which cuts out the high-frequency stages and permits the use of the low-frequency stages alone. This has proved to be of great use in locating cases of trouble which are being radiated along an entire high tension or distribution line with equal intensity at all points. Cases of interference due to street lighting circuits which have been troublesome to locate in the past are also comparatively easy to locate with this set.

Ear phones of sensitive type are used in preference to a loudspeaker in conjunction with this trouble finder, as they help to shut out extraneous noises and enable the operator to hear weak signals which would hardly be audible on a speaker.

A loop receiver is universally used, as it is more compact and does not require the erection of an antenna. In most cases, the loop is mounted in a horizontal rather than a vertical plane, making it non-directional. The directional value of the loop is of very little use, although it has been greatly recommended by many writers in the past. The uselessness of a directional loop is easily understood when we consider that, from the point of view of interference finding in congested areas, we are dealing with signals that come from antenna systems miles in length that may completely surround the interference finder. It is obvious, of course, that the directional value in such cases is of no use, since the loop will always "throw back" to the nearest power line. The only real place where it may be of value is at corners or places where the lines branch in all directions. By getting directly beneath the lines at this point it may be possible to locate the line carrying the heaviest interference.



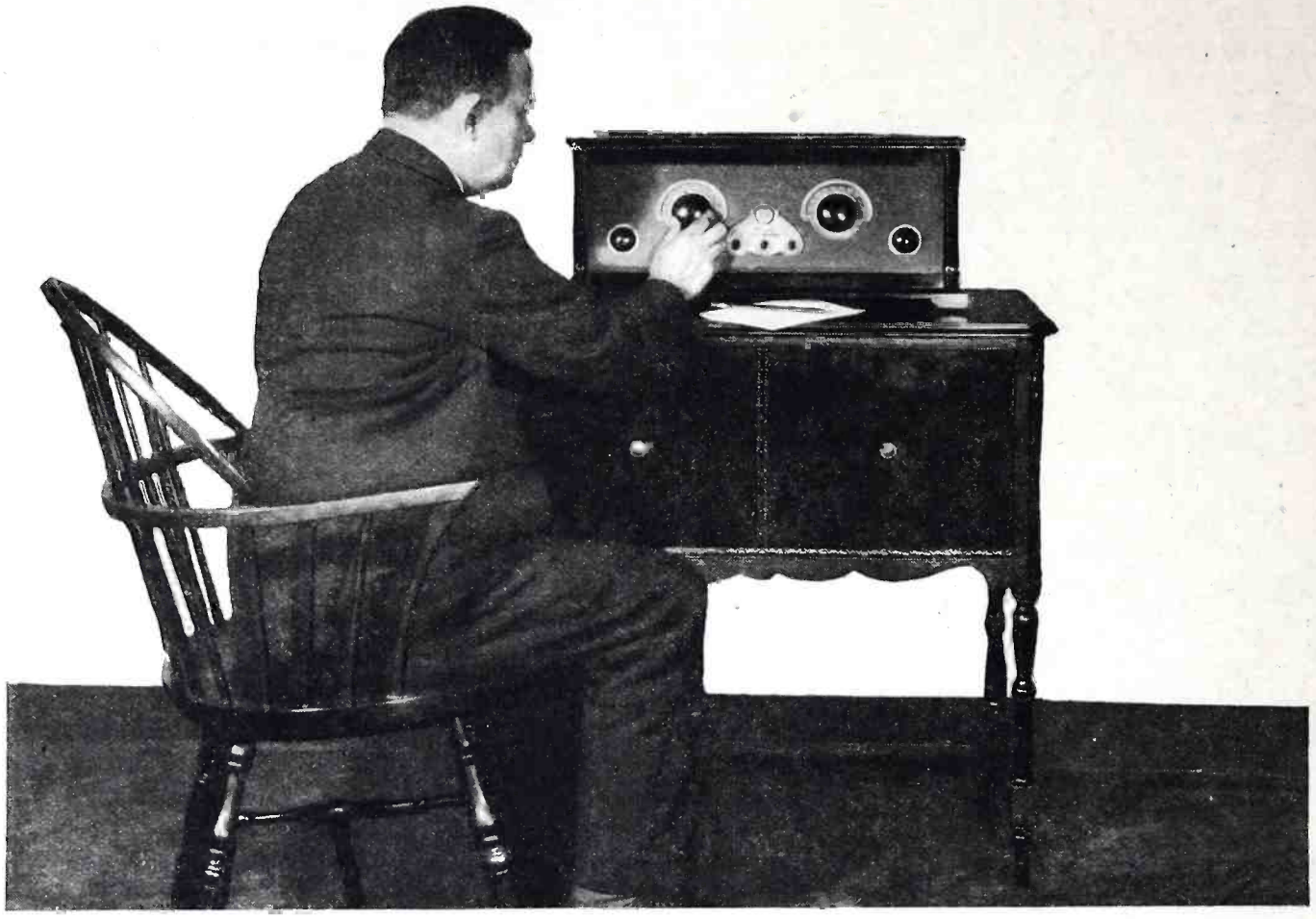
WHERE THE FIGHT AGAINST INTERFERENCE IS WAGED

All up-to-date power companies employ a corps of "interference trailers" to police their lines and locate the defects that cause hums and sputters in neighboring receivers. It is such constant vigilance as this picture illustrates that is making the country safe for the broadcast listener and fan.

Methods Used in Trouble Finding

The method more or less universally followed in locating trouble is to trace the source solely by volume indications. A careful survey is made and the central area of the disturbance is located. This is done by cutting down the sensitivity of the set until the interference is barely audible. The line or lines are patrolled in all directions until a point is reached where the volume again approaches maximum. Following this procedure narrows the search down within a small area. For an experienced operator this is comparatively easy. Further search in this area, by using the method outlined above, will in most cases disclose the source of trouble. The reason for cutting down the sensitivity of the set

(*Continued on page 332*)



An "Air Road" Test With the Marti Electric

By ALBERT G. CRAIG, *Driver*

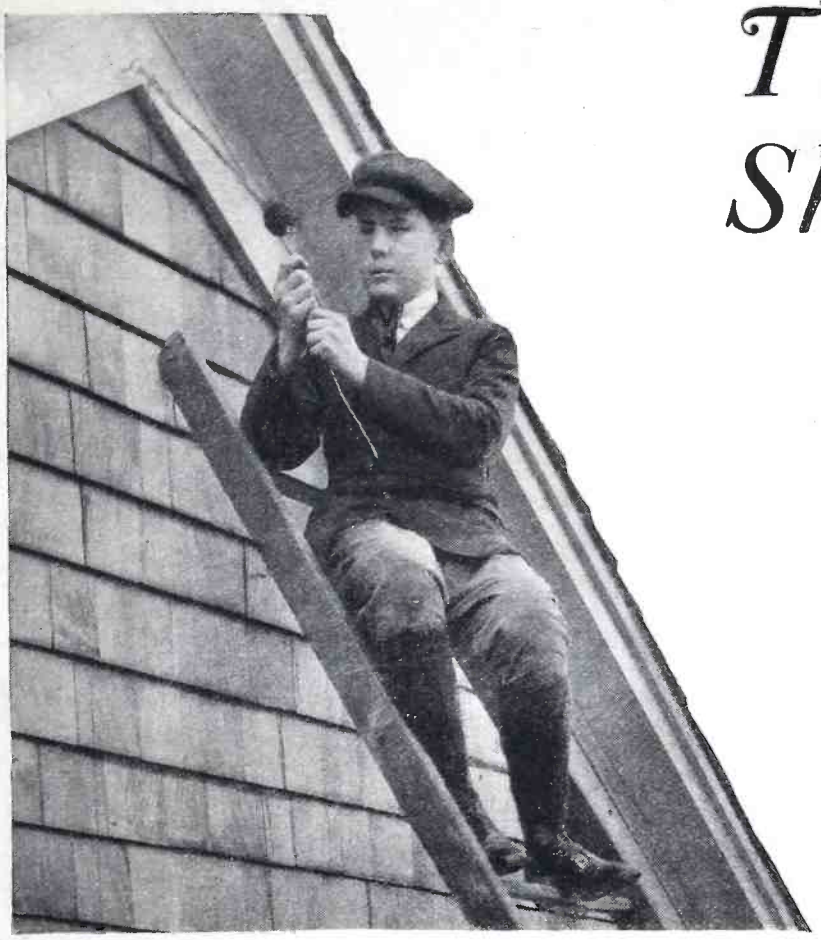
Just what will a good receiver do? It is this question, rather than the results of complicated laboratory tests, that most fans are interested in. Accordingly, POPULAR RADIO *here submits the first of a series of radio "tryouts" on standard receivers, showing exactly what the average set owner may expect from receivers under actual operating conditions.*

DURING its seven years of existence, the laboratory staff of POPULAR RADIO has been called upon to test many different types of radio receivers. This testing work has in the past been carried on elaborately, and Staff engineers have been known to devote as much as a week's time in determining the operating characteristics of a single receiver. Scientific measurement of amplification, current consumption, plate and grid biasing voltages and all such things have been determined in an effort to arrive at some definite conclusion as to the general overall efficiency of the receiver under examination.

While this testing work has added a great deal to the Staff's knowledge of the operation of many commercial receivers, it has been found, in the long run, to have been of little assistance to the average reader of POPULAR RADIO or to the lay reader, who seems to be more interested in generalities than in definite scientific facts. This type of radio user may be compared to the man who is interested in an automobile that will go over the top of a certain hill at 80 miles an hour. This, to him, is a measurement of the efficiency of the mechanism. He cares nothing about the engineering niceties that have made this prodigious power and speed possible. It is in an effort to satisfy the lay readers of POPULAR RADIO that a new method of outlining the operating characteristics of a receiver has been decided upon. While the engineering staff of POPULAR RADIO will still continue to accumulate its scientific data, the articles devoted to the operation of various receivers tested will be less technical. They will be more in the form of a report of what POPULAR RADIO is pleased to call an "air road test"; being the results obtained by an engineer who simply sits down in front of a receiver and idles the evening away in determining what radio "hills" he can climb and what "speeds" he may obtain. He might do this in the same spirit that an automobile engineer would jump into a snappy roadster and take it over the country roads to satisfy himself that it was either a good or a poor car.

The first radio set to be described under this new editorial policy is the Marti All-Electric receiver. The engineering staff of POPULAR RADIO has expressed a special interest in this receiver, inasmuch as it was one of the first all-electric instruments to make its appearance on the market. As a mat-

(*Continued on page 344*)



The Long and the Short of Aerials

No receiver is better than the antenna which feeds it. Here are some very practical data in regard to the correct method of erecting antennas and running lead-in wires that every set owner and every professional man should know. A properly constructed antenna, such as is described here, is like an extra stage of amplification.

By ROBERT W. TAIT

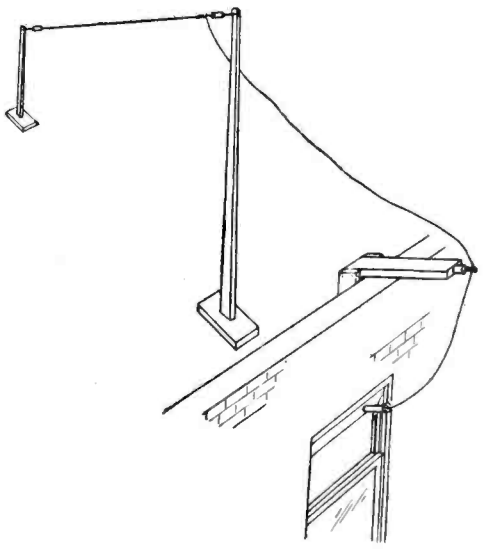
THE strange crisscrosses of wires that may be seen on the roofs of many apartments in large cities cause one to wonder why reception results are as good as they are. The "weeping willow" effects of sagging antennas that touch one another at points, or continuously, are the cause of countless radio griefs that many fans are at a loss to explain. Quite frequently good sets are blamed for poor results, and tinkered with and overhauled continuously, when a little care in erecting the antenna would have saved all the trouble in the beginning.

In the past two years various antenna kits have been placed on the market, containing the necessary parts for the erection of antennas. The items which should be included in such kits, for the erection of the ordinary single-wire antenna, are as follows:

100 feet of antenna wire, either stranded, plain, or enamel covered;
50 feet of lead-in wire and 25 feet of ground wire;
3 insulators of glass, porcelain or bakelite;
3 wall insulators (the best type is the eyelet with a porcelain insulator in the middle of the eye);
1 lead-in insulator;
1 lightning arrestor;
50 feet of guy wire (iron);
Large nails, tacks, etc.;
2 poles, pipes, or 2-by-4 studs, 10 feet long (these are usually purchased locally).

The erection of an ordinary antenna requires only a few simple tools: a saw, a hammer, a screw driver, drill and bit, and a pair of wire-cutting pliers. In addition, soldering material and a roll of electricians' tape will make for a neater and more efficient job.

It is well to consider, in the beginning, that an antenna is simply a collector of the energy necessary to operate the radio receiver in a satisfactory manner. Therefore, it is of the utmost importance that the antenna collect as much of this energy as possible, and then, having collected it, conserve it and deliver it to the radio set. Radio energy induced in an antenna continually seeks the shortest path to ground; hence, it is necessary that due precautions be taken to prevent any leakage or losses that will impair or lessen the reception.



A MODEL LEAD-IN

It is important that the lead-in wire be kept away from the face of wall down which it runs. In some cases a home-made bracket such as is shown here will be needed to accomplish this.

Having made sure that all the necessary material is on hand for the proper erection of an antenna, this material should be taken to the roof, with the exception of the lightning arrestor, the lead-in insulator, and the tacks, which will be used when we have finished our work on the roof.

With about two feet of antenna wire, fasten one of the insulators to the pole, with not less than two turns of this wire, to prevent it slipping down at some future date. About two feet lower than the antenna support which you just made, you may now wrap two turns of the iron wire around the pole, making sure that you cut this wire of sufficient length to reach some suitable support. These supporting wires should extend in a direction opposite that to which the antenna will extend. In some instances three guy wires are necessary. They are for the purpose of assuring the necessary back support for the antenna pole. One end of your antenna wire may now be connected to the free end of the insulator which is already fastened to the pole. Now unwind no more than about twelve feet of the antenna coil, for where a stranded wire is used there is a strong tendency on the part of the wire to become badly snarled unless kept under control.

(*Continued on page 330*)

In the Professional Set Builder's Shop

Practical pointers and kinks to increase the efficiency and earning power of those who construct, repair or service receivers for profit. If there is a better and easier way to do it, this department of POPULAR RADIO, *aided by a well-equipped Laboratory, will find it and present the details here to our readers in a practical and concise manner.*

Systematic Trouble Shooting With the POPULAR RADIO Kit

LAST month's issue contained a list of tools and accessories for the professional set builder. The object of this list was to provide an essential kit which would accomplish most of the repairs which the radio doctor would encounter. This article and those to follow, from month to month, will tell you how to use this testing equipment to the best advantage.

It is impossible in this short article to cover the entire ground of radio "trouble shooting," but it is the wish of the writer to instill in the mind of the professional set builders the necessity of a *systematic quick method of locating troubles.*

The moment you start in on the job test the "A" batteries, "B" batteries, "C" batteries, or their substitutes, and the reproducer. Apply your voltmeter to the "B" batteries, and in the event that they are below 36 volts for each 45-volt block, advise new ones. Test "C" batteries for voltage also and note their condition. Test each cell of the "A" battery, and if one of the cells seems to read below the others to a marked degree advise a thorough cleaning of the battery together with a cell replacement for the defective one.

With "B" eliminators, the procedure is slightly different. It is preferable to test the "B" eliminators for voltages with the set turned on, using a high-resistance voltmeter and the leads with clips. Check the voltage output under load. If the voltage readings are abnormally low it may indicate a short in one of the circuits of the eliminator. With the ordinary type of eliminator, a O-50 milliameter may be placed in series with each plus lead successively without endangering the instrument. A detector tap using but one detector valve should show a reading of ½ to one milliampere. The tap supplying the high-frequency valves should show about 3 mils per valve. Frequently the first stage of low frequency receives its plate supply from this same source. Therefore it follows that with two stages of high-frequency amplification and the first stage of low-frequency on one tap, the current should approximate 9 mils on this tap. With "C" bias on the high-frequency valves, and the low frequency it will probably be less. This current also varies with the applied voltage. The higher the voltage the more current or mils will be used.

The high voltage tap will vary in current with the type of valve used. Valves of 171 and 210 types draw considerably more than the 201-a type.

In the event that one of these taps draws considerably more than you think it should, it indicates trouble within the set. If it should happen to be the tap supplying the high-frequency valves, remove each of the valves in turn, and also the first low-frequency valve if it is supplied by this same tap. This is to make sure the valves are not at fault and contain no internal "short." Any sudden jump in voltage of 40 to 80 volts when a valve is removed would indicate a defective valve.

Next, remove the trouble-making taps from the set and observe if there is any change in voltage reading. With the tap not in use there should be a slight increase in voltage reading. (This would not apply to the detector taps, since the current drain is too small to make an observable increase in voltage. In any event the detector tap rarely gives trouble because of the low voltage and small current drain.)

The safety factor for condensers and resistances used for the detector tap is much larger than for the other taps.

If this increase in voltage does not occur, put a variable resistance or load in the circuit. If no current drain is shown by the milliameter it is certain that the circuit is open or that there is a direct short-circuit in the eliminator. The direct "short" is generally traceable to a by-pass condenser.

The reproducer should be tested with a "C" battery, phones and test clips, all in series. A loud click results when circuit is complete. Reproducer windings are sometimes open-circuited due to overload, or the tinsel cord with which the speaker is equipped may become frayed and open. Therefore, if there is no response in test, try again at the terminals of the reproducer unit. If the unit is open-circuited, it is generally advisable to send it to the manufacturers for repair, for with the facilities they possess, a better job is certain.

ROBERT W. TAIT.

(Continued on page 346)

Acme

PRESS THE BUTTON FOR YOUR FAVORITE STATION

Tuning is reduced to the simple operation of pressing a button in this receiver designed by Harry N. Marvin, of Rye, N. Y. Each prominent broadcasting station around New York has a button, and pressure on that button automatically tunes in the station. When other stations are wanted, the ordinary method of tuning in may be brought into use by throwing a switch.

What's New *in* Radio

Conducted by
THE TECHNICAL STAFF

The material listed in these columns has been carefully tested in the POPULAR RADIO Laboratory, which is acknowledged to be one of the most completely equipped institutions of its kind. Mention in the following pages signifies that the apparatus illustrated has met the approval of the POPULAR RADIO Engineering Staff.

A 120-Inch Exponential Horn

Name of instrument: Racon exponential horn.

Description: This new exponential horn, which is scientifically shaped and designed to meet the best standards of acoustical engineering, has a total length of 120 inches. The basic material from which the horn is made is a special fleeced underwear cloth, impregnated with compounds which will give the material the proper acoustical characteristics. The horn contains three convolutions and is responsive to a range of frequency as low as 54 and as high as 7,500. This frequency range will accommodate the best low-frequency amplifiers that are in use today. Due to the extreme hardness of the material with which the cloth is impregnated, the horn has a very substantial solidity and may be subjected to unusual abuse without danger of damage. The speaker unit is of the balanced armature type and capable of handling heavy overloads without distortion. Each speaker is made by hand over a special collapsible form, so that the characteristics of each horn are uniform. The horn has an overall width of 18 inches and a height of approximately 19 inches. Each one is provided with a speaker cord of sufficient length.

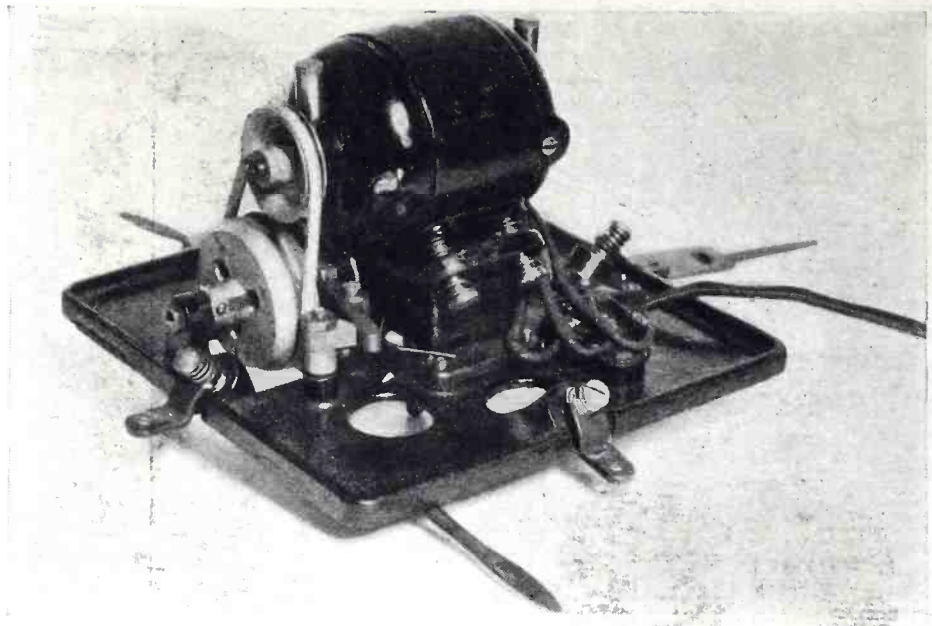
Outstanding features: Rigidity of construction. Wide frequency range. Tonal chamber 120 inches long, confined to a comparatively small space.

Maker: Racon Electric Co.

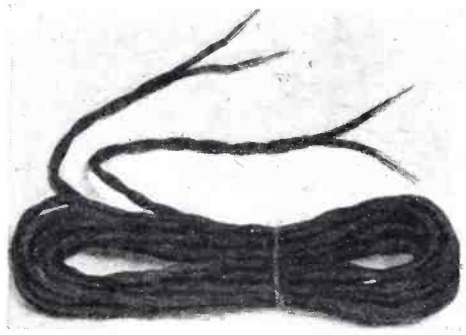
High Power Loudspeaker Cord

Name of instrument: High-power loudspeaker cord.

Description: This rubber-insulated, heavy-duty speaker cord is made to handle the output current and voltage of the more powerful low-frequency amplifiers in use today. Inasmuch as output current on the larger units runs



as high as 50 milliamperes, and the voltage on low notes anywhere between 400 and 1,300 volts, ordinary tinsel cords have been found more or less inadequate for this new service. This cord is impervious to moisture and has been successfully tested on voltages as high as 7,000 without showing signs of a breakdown. Thus it may be laid on the floor without danger of being rendered useless by water from steam radiators, or by rain entering open windows. It is obvious that cords with ordinary coverings are exceptionally susceptible to breakdowns in insulation due to the absorption of even a small amount of water. While this would be more or less inconsequential where such cords are used in connection with low-powered sets, high-powered receivers



with voltages that may easily reach 1,000 would be rendered inoperative through what would almost amount to a direct short-circuit. This new cord is made up of comparatively small stranded wire, twisted so as to minimize hum by induction where the cord is laid parallel to lamp and fixture cords that may be lying on the floor. The cord is provided with tips and supplied in lengths of 30, 50, and 100 feet.

Outstanding features: Extra-heavy insulation. Twisted so as to eliminate AC hum. Absolute freedom from danger of shock.

Maker: Gavitt Manufacturing Co.

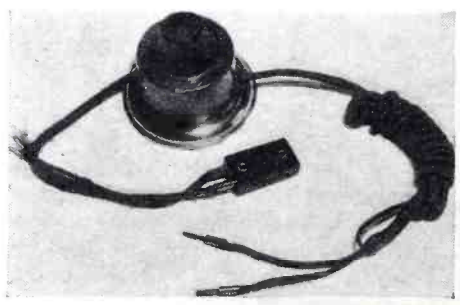
An Electric Phonograph Motor

Name of instrument: Johnson-Gordon Phonograph Motor.

Description: To satisfy the demands created by the thousands of radio fans who are now busy converting their old phonographs into modern electric reproducers, an extremely efficient and quiet electric driving motor has been placed on the market so that converted phonographs may not only have electrified reproduction, but electrified operation as well. The motor, which is a Universal type, is mounted on a spring suspension and connected to the driving disc through the medium of an elastic belt. The elastic belt drives a governor which is mounted on the same shaft with the large wheel. The turn table is driven through the medium of two spirally cut gears. Arrangements are also provided to adjust the speed of the turn table. The motor is mounted on a cast iron plate and also provided with an automatic stop. Each motor is equipped with an adjusting switch so that it can be made to operate on AC current from 25 to 60 cycles, or on DC current.

Outstanding features: Spring suspension. Automatic stopping. Speed adjustment. Quiet operation. Universal application.

Maker: The SAAL Co.



A Table Type Volume Control

Name of instrument: A table type Clar-o-Stat.

Description: The manufacturer of this volume control has given it an ornamental appearance, so that it may be used in conspicuous places without destroying the artistic values of its environment. The volume control is mounted in an antique copper case and provided with an adjustable knob of a color to match. The bottom of the instrument is covered with green felt to prevent its marring polished furniture on which it may be placed. Turning the knob to the right increases the resistance, while turning it to the left decreases the resistance. Inasmuch as the resistance is variable between extremely wide ranges, the Clar-o-Stat has a multitude of uses. Each unit is provided with two cords terminating in convenient tips. And there is also supplied a connector block, further to facilitate ready inclusion into radio circuits.

Outstanding features: Wide range of resistance. Artistic appearance and good mechanical construction.

Maker: American Mechanical Laboratories.

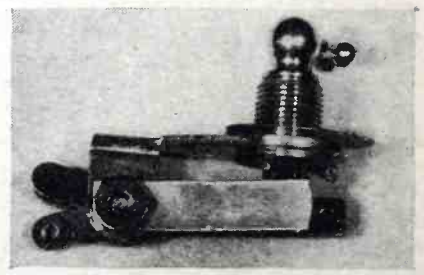
A Midget Volume Control

Name of instrument: Clar-o-Stat volume control.

Description: This volume control, while extremely small in size, although rugged in construction, is able to provide an unusual range of resistance that may be uniformly varied between approximately zero and 500,000 ohms. The resistance unit is of the compression type, and is encased within a polished nickel container, provided with bakelite insulation and terminals with machine screws. The instrument is made for single-hole panel mounting, and a well-designed bakelite knob is used to vary the resistance.

Outstanding features: Wide variation in range of resistance, with uniform graduation. Unusually good mechanical construction. Single-hole mounting.

Maker: American Mechanical Laboratories.



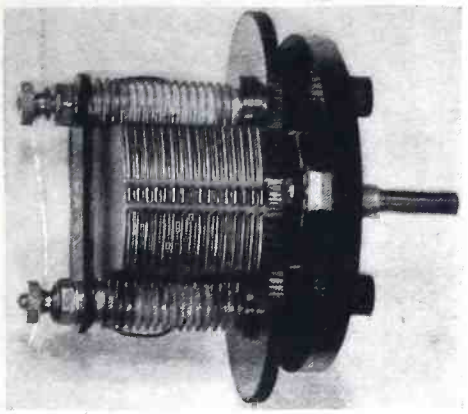
A Convenient Jack Switch

Name of instrument: Short jack switch.

Description: This switch is for single-hole panel mounting, with the toggle lever and marker plate on the front of the panel and the switch blades behind and parallel with the panel. This arrangement saves space, and the design is such as to provide positive contact. Switches of this kind are useful for antenna or "A" battery switching and are made in several different types, including single pole, single throw; single pole, double throw; double pole, single throw, and double pole, double throw.

Outstanding features: Low cost. Reliable contacts. Compact size.

Maker: Carter Radio Co.



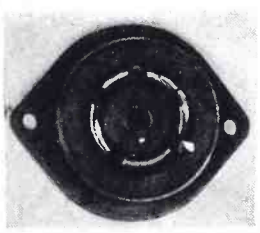
A Condenser With an Insulated Shaft

Name of instrument: Twin rotor variable condenser, type No. 639.

Description: This variable condenser is out of the ordinary in many ways, principally in the fact that neither set of plates is directly driven by the shaft. The two sets of brass plates are identical in appearance and are rectangular in shape. Each set is mounted on a bakelite gear wheel and these two gear wheels are engaged with a smaller brass gear wheel that is mounted directly on the end of the shaft. Thus when the shaft is turned the two sets of plates move and intermesh or separate, as the case may be, thus increasing or decreasing the capacity. The particular type described here has a maximum capacity of .0005 mfd. and the unusually low minimum capacity of .000003 mfd. This type of condenser is suitable for any use to which any variable condenser may be put, and is particularly well suited for use in circuits where neither side of the condenser is at low or ground potential because of the decreased body capacity effect brought around by the insulation of the shaft. A full revolution of the dial is required to vary the capacity from minimum to maximum, so the necessity for a vernier dial is eliminated.

Outstanding features: Insulated shaft provides effective shielding against body capacity. Available in either S. L. F. or S. L. W. types and in capacities from .0001 mfd. to .0005 mfd. May be mounted direct on metal panel, without requiring insulating bushings.

Maker: Remler Division of Gray & Danielson Mfg. Co.

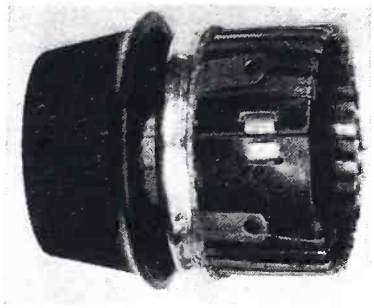


A Valve Socket for Baseboard or Sub-Panel Mounting

Description: This composition valve socket is made in two types, one for 4-prong valves and the other for 5-prong valves, such as the C-327. Either of these sockets may be mounted on a baseboard or on the top or under side of a sub-panel. The bases of the sockets are extended in the form of wings to accommodate two mounting screws. Inasmuch as the mounting screws are insulated from the contact springs, these sockets may be mounted on metal if so desired. A welcome diversion from standard practice is offered by the fact that the holes which accommodate the prongs of the valve are set down in a guide groove to make insertion of the valve a simple matter, even in the darkened interior of a receiver.

Outstanding features: Small size. Good contacts. Universal mounting. Furnished with guide groove. Direct contact soldering terminals.

Maker: H. H. Eby Mfg. Co.



A Heavy Duty Rheostat for AC Valve Circuits

Name of instrument: Heavy duty rheostat.

Description: The resistance material in this rheostat is in the shape of a flat ribbon which is wound flatwise on a composition strip. This type of winding provides adequate heat dissipating surface, as required in a really heavy-duty rheostat. The frame of this unit is of metal and the slider is especially designed to provide good contact, but at the same time slide easily. The rheostat will dissipate 6 watts and is available in resistances from 1/5 ohm to 50 ohms. It is capable of handling up to five of the 326 type valve filaments and the variety offered in the above range will meet all AC filament requirements.

Outstanding features: Rugged construction. Heavy current handling ability. Inexpensive. Well designed. Equipped with engraved knob and designed for single-hole panel mounting.

Maker: Carter Radio Co.

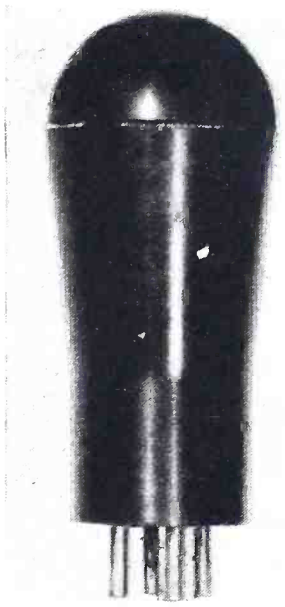
Make Your Receiver Do Stunts With This Unit

Name of instrument: B. M. S. Home Broadcaster.

Description: This home broadcasting outfit consists of a microphone, socket plug, extension cord and extension cord connector. When the microphone is connected to the socket plug and the latter is inserted in the detector socket of a receiver, in place of the detector valve, the low-frequency amplifier of the receiver may be used for the reproduction of the voice of anyone speaking into the microphone. Its use turns any receiver into a public address system on a small scale and offers innumerable possibilities for amusement and utility.

Outstanding features: Requires no alterations in the receiver or amplifier. Employs no extra batteries. Neat in appearance.

Maker: Brooklyn Metal Stamping Co.



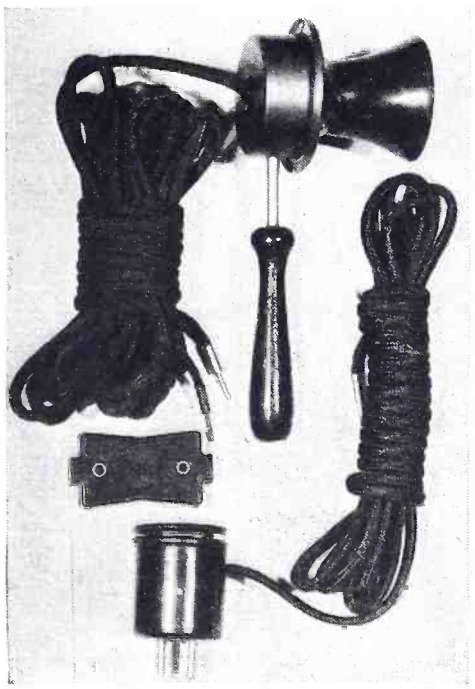
A Crystal Detector for Use in Any Receiver

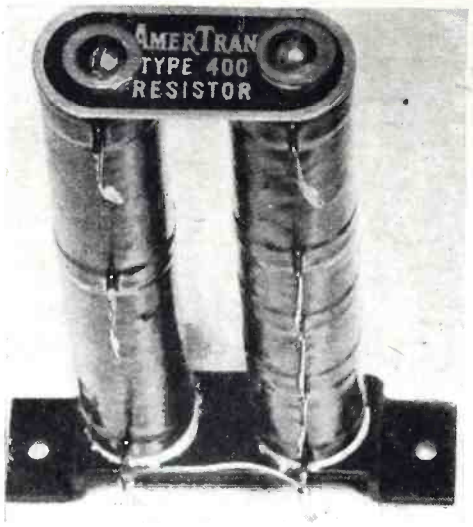
Name of instrument: Tube type carborundum detector unit.

Description: This new type of crystal detector takes the form of a vacuum valve, but it is made with composition walls instead of glass. It has a standard 4-prong UX-type base and fits into a standard valve socket. The detector consists of a carborundum detector and potentiometer which are completely inclosed within the composition bulb. The four prongs at the base of the unit correspond exactly with those of a standard vacuum valve base, and this crystal detector unit may therefore be incorporated in any receiver by simply removing the present vacuum valve detector and replacing it with the new crystal unit.

Outstanding features: The superior tonal qualities of the crystal detector may be taken advantage of in any receiver which was designed for the use of a valve detector. No changes in the wiring of the receiver are necessary in order to substitute the new crystal detector, nor are additional batteries or connections necessary.

Maker: The Carborundum Co.





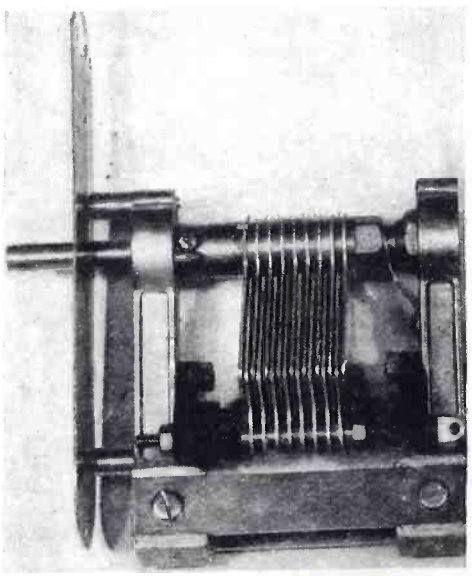
A Tapped Resistance for Voltage Control in Power-Packs

Name of instrument: AmerTran plate voltage tapped potentiometer.

Description: This resistance unit consists of two resistance coils connected in series and with a total "cold" resistance of approximately 41,000 ohms. The coils are mounted side by side in a vertical position, with mounting holes provided in the metal base. When connected as the voltage divider across the output of a high-voltage "B" power-pack, this unit will provide six different output voltages. Inasmuch as only three output voltages are normally required for this work, it is evident that this AmerTran unit will meet all normal requirements. The resistance is of the heavy-duty type and capable of handling the outputs of power-packs rated up to 500 volts. The entire unit, when mounted in a vertical position, occupies a baseboard space of only 3¼ by ⅞ inch. The height is 5¼ inches.

Outstanding features: Neatly made. Ample safety factor in power dissipation rating. Resistance windings sealed in composition material.

Maker: American Transformer Co.



A Fine Condenser for Simplified Tuning

Name of instrument: "Equitune" adjustable condenser.

Description: This aluminum condenser offers a number of unique and highly practical features to the set constructor or to the user of a receiver. It is of rigid construction and is carefully designed and assembled. Insulation is good and losses are low. The fabricated metal frame insures permanent characteristics. It is attached to the receiver panel by means of two mounting screws, and the subpanel of the receiver may be supported by the bottom of the condenser frame, thus eliminating brackets. The frame is drilled and tapped at the bottom for this purpose. The shaft is removable to permit the substitution of a long shaft where it is desired to gang several of the condensers on a single shaft for single control. This condenser provides straight-line frequency tuning throughout the lower half of the scale and straight-line wavelength tuning through the upper half. This design provides a very useful separation of broadcasting stations throughout the dial range.

Outstanding features: Combines SLF and SLW tuning. Serves both as tuning device and support for the receiver sub-panel. May be used either for base or panel mounting. Fine construction and accurate. A very worth-while piece of apparatus.

Maker: National Co.

Make Your Set a Short-Wave Receiver With This Unit

Name of instrument: "Submariner" short-wave adapter.

Description: The "Submariner" is a single-valve, short-wave receiver so designed as to permit it to be used with the low-frequency amplifier of any receiver to provide reception of broadcasting and code transmission on wavelengths below 100 meters. It is equipped with a cord and plug to insert in the detector valve socket of any standard receiver, thus making connection to the amplifier of the receiver. No changes in the wiring of the standard receiver are necessary, nor are additional batteries needed for the "Submariner." All connections are automatically made through the insertion of the plug in the detector socket of the receiver. All short-wave tuning is accomplished by means of the dial and knob on the front of the "Submariner." Any standard type of valve may be used in this unit.

Outstanding features: Permits reception of the short-wave broadcasting and amateur code transmission. Low price. Easily installed.

Maker: J-M-P Mfg. Co.

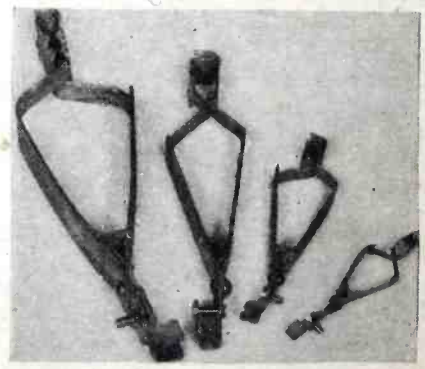
A Good Condenser for High-Voltage Work

Name of instrument: Filter condenser, type B.

Description: This condenser is of the high-voltage type and is especially designed for use in power-packs where the working voltage is less than 600 volts DC. It is convenient in size and equipped with mounting feet. Terminals are in the form of soldering lugs brought out through an insulating plate at the top of the unit.

Outstanding features: Rated at 600 volts, DC. Inexpensive. Easily mounted.

Maker: Polymet Mfg. Corp.



Sure Contact for Storage Battery Terminals

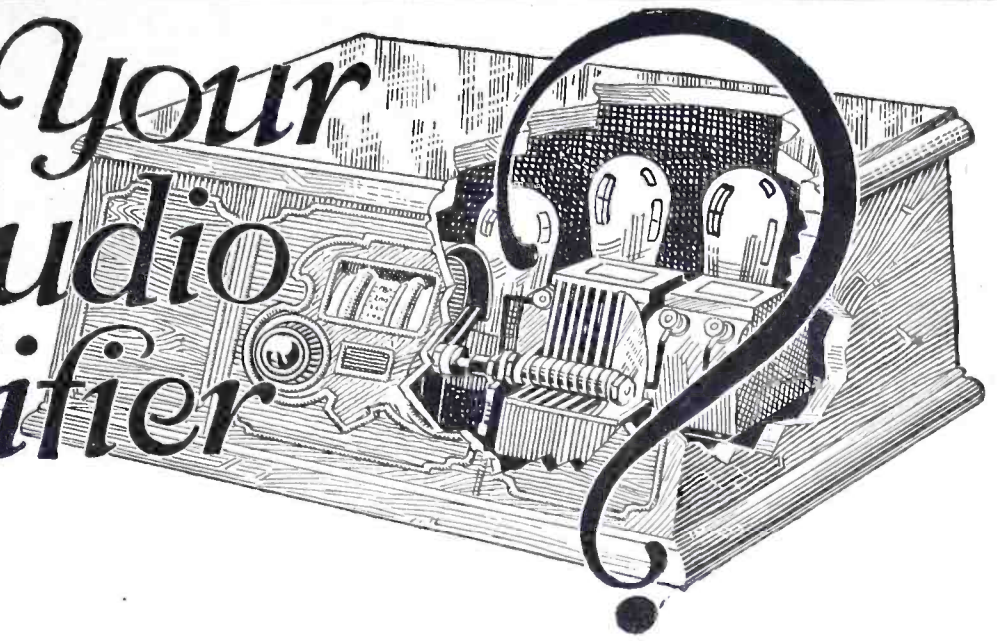
Name of instrument: "Shanco" battery clips.

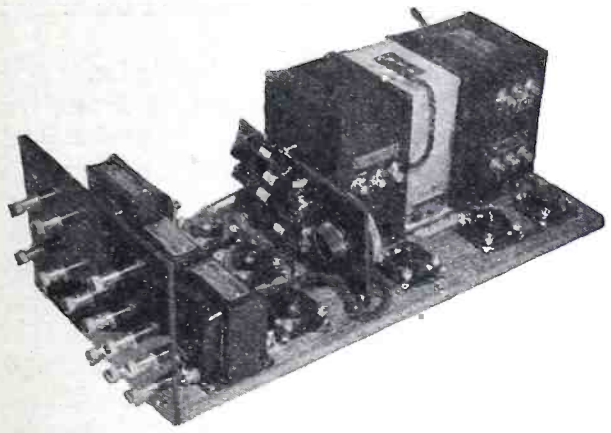
Description: These spring type battery clips consist of husky steel or iron springs with sharply toothed jaws which will dig into the lead terminals of a storage battery and provide a sure-fire contact. The clips are "dipped" with lead, to protect the spring metal from the corrosive action of the battery acid. They are equipped with screw terminals and saddle washers for attaching the connection wire.

Outstanding features: Strong grip. Protected from corrosion. Made in various sizes up to 5½ inches in overall length.

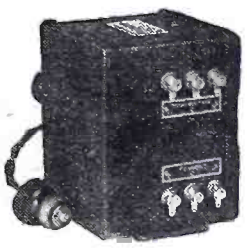
Maker: Shanklin Mfg. Co.

How's Your Old Audio Amplifier





This heavy duty amplifier is a complete audio system employing UX-210 tubes in push-pull, furnishing B-supply to the receiver, and designed to operate the new dynamic speakers. Fully described in March Popular Radio.



POWER SUPPLY TRANSFORMER T-2098

A heavy duty supply transformer that furnishes power for the above amplifier. Furnishes current for two UX-281 rectifiers. Capacity 130 milliamperes, sufficient current for any receiver regardless of drain. Price, $20.00.

DOUBLE CHOKE UNIT T-2099

Consists of two individual chokes of 30 henries, 130 milliamperes each, in one compound filled case. Price, $14.00.

R-200 Amplifying Transformer. An audio transformer with an unusually wide tonal range. Extremely faithful in reproduction. Price, $8.00.

Push-Pull Transformers. Quality reproduction that cannot be obtained with straight audio amplification is made possible by the Thordarson Power Push-Pull transformers. Input transformer T-2408, price $8.00. Output Choke T-02420, for high impedance speakers, $8.00. Output transformer for low impedance dynamic speakers, price, $10.00.

COMING!

THE THORDARSON

Z-COUPLER

WATCH FOR ANNOUNCEMENT NEXT MONTH

You Can Make Your Present Receiver a Real Musical Instrument

Recent developments in radio have all been centered around improved tonal reproduction—this means advancement in the systems of audio amplification.

No need to discard your present receiver, however, to enjoy the finest radio reproduction possible. A modern Thordarson Power Amplifier, coupled into a good loud-speaker will convert your radio set into a musical instrument beyond reproach.

Thordarson power amplifiers are simple to assemble. With a soldering iron, a pair of pliers, a screw-driver and a small drill you can assemble any unit in an evening in your own home.

The Thordarson label assures you of unquestionable quality and performance; Thordarson transformers are standard equipment on the world's finest receivers and power units.

Give your receiver a chance to reproduce real music. Write today for complete constructional booklets sent free on request.

THORDARSON

3579

THORDARSON ELECTRIC MANUFACTURING CO.

Transformer Specialists Since 1895

WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS

Huron and Kingsbury Streets — Chicago, Ill. U.S.A.

The Screen Grid Valve Finds a New Job in the QSA-5

(*Continued from page 294*)

it is found that the voltage changes are so great as to cause the power valve to block. To avoid this tendency and to allow handling of the full signal volume, the second autoformer is used to provide a high impedance for the signal frequency with a low resistance path for the escape of direct current from the grid of the power valve.

A self-contained power unit is placed at the extreme left-hand end of the sub-panel. The only other power supply required is a 6-volt "A" battery. Inclusion of the power apparatus with the amplifier eliminates five external wires as well as a separate housing for this essential part of the equipment. This portion of the apparatus includes a power compact, I, containing a transformer with one secondary winding for the plate supply and another for the power valve filament current. The compact also includes two filter chokes and two buffer condensers for the rectifier valve. The condenser block, J, contains the three filter condensers and two of the by-pass condensers, a third by-pass condenser, S, being separately mounted under the sub-panel.

Each of the three box shields, C1, C2 and C3, contains a complete stage of amplification, including the tuning coils or transformers, the tuning condensers, the coupling chokes and condensers, and the valves themselves.

All of the shields are connected to ground by means of a wire running underneath the sub-panel. The negative terminal post for the "A" battery is connected with this ground line and the greater part of the negative filament circuit is then completed through the shields by the attachment to them of the filament resistors of the screen grid valves and by a direct connection from the negative terminal of the detector socket. All grid and plate returns are likewise made through the shield metal and through the negative wiring by simply attaching to the shields the tuning coil windings and the tuning condensers.

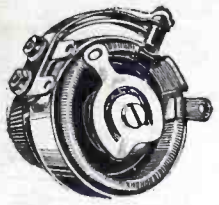
From the foregoing description it will be seen that the new QSA-5 receiver offers, to the amateur and professional set builder alike, a number of new features in the way of radio broadcast reception device not encountered in any other receiver. Its possibilities in the reception of long distance signals with a short antenna of only a few feet in length make it applicable for local and distance reception in crowded metropolitan areas, and at the same time the quality of reproduction has been preserved in getting the necessary selectivity for this work.

In the next issue complete constructional details of this new receiver will be given. For the benefit of those who wish to buy the parts for the receiver now, so as to have them on hand when the constructional data appears, the complete list is given below.

LIST OF PARTS FOR THE QSA-5 RECEIVER

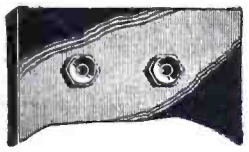
TO BE FEATURED IN POPULAR RADIO FOR MAY, 1928

A1—Aero antenna coil, type No. 96;
A2 and A3—Aero universal coils, type No. 43, equipped with two special Aero primary coils, type No. 111;
A4—Special home-made plate coil;
B1 to B3—Hammarlund midline variable condensers, .0005 mfd.;
C1 to C3—Hammarlund stage shields;
D—Hammarlund double-drum dial;
E1 and E2—Hammarlund high-frequency chokes, type No. 85;
F—Thordarson low-frequency transformer, type R-200;
G1 and G2—Thordarson autoformers, type R-190;
H—Thordarson speaker coupling transformer, type R-76;
I—Thordarson power compact, type R-171;
J—Aerovox filter condenser block, type TH-862;
K1 and K2—XL Vario-densers, type G-1;
L1 to L6—Benjamin Cle-ra-tone sockets, No. 9040;
M1 to M3—Aerovox wire-wound resistances, 10 ohms, type No. 980;
N1 and N2—Aerovox moulded condensers, .00025 mfd.;
N3—Aerovox moulded condenser, .001 mfd.;
N4—Aerovox moulded condenser, .00025 mfd., with grid-leak mounts;
O—Durham metallized resistor, 1 megohm;
P1 to P3—Control grid connectors;
Q1—Aerovox Pyrohm resistance, with two extra taps, 10,000 ohms, type 994-QSA;
Q2—Aerovox Pyrohm resistance, 2,000 ohms, type No. 992;
R1 and R2—Yaxley Junior rheostats, 10 ohms, type No. 510;
R3—Yaxley Junior rheostat, 3 ohms, type No. 503;
R4—Clarostat volume control;
R5—Centralab heavy-duty potentiometer, 5,000 ohms;
S—Aerovox filter condenser, type 200, .25 mfd.;
T1 to T3—Benjamin brackets, type No. 8629;
U1 to U6—XL push posts with new bakelite top;
V—Carter automatic power switch, type No. 115;
W—Westinghouse Micarta panel, 9 by 30 by 3/16 inch;
X—Westinghouse Micarta sub-panel, 10 by 30 by 3/16 inch;
Y—Hammarlund insulated flexible coupling;
Z—Hammarlund brass extension shaft, 7½ inches long and ¼ inch in diameter;
Gavitt rubber-covered hook-up wire, screws, nuts, brackets, etc.



Junior Rheostats

Made to a high standard. Rugged and dependable. Large radiating surface. Only 1⅜ inch diameter. Standard ratings. 75c

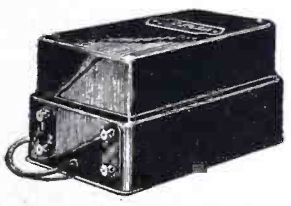


Insulated Phone Tip Jacks

In two colors. Red for positive and black for negative. Indispensable for use with power tubes. Per Pair.. 25c

Radio Convenience Outlets

Singly or in gang combinations for all radio house wiring. Fit any standard switch box. The No. 136 Aerial and Ground is illustrated.. $1.00



Full Automatic Power Control

For switching both the charger and B eliminator and also for automatically cutting out the A charger when the A battery is fully charged. No. 440..... $7.50

YAXLEY
APPROVED RADIO PRODUCTS

Distinction Reliability Refinement

All these you add to your set and to your enjoyment of radio, when you make that nice selection of parts which assures you these exclusively Yaxley features.

The Junior Rheostat

will give a velvet smooth touch and a sure, positive, non-fluctuating characteristic to your filament voltage control.

The Insulated Phone Tip Jacks

add a note of real distinction to the appearance of your panel and a feeling of security you have never known before.

The Full Automatic Power Control

assures you always plenty of power for full volume or bringing in the tiny whisper of the distant station, and gives you carefree operation at all times.

Wire Your Home for Radio

with Yaxley Radio Convenience Outlets. Keep batteries in some out of the way place. Enjoy your favorite programs in any room in the house. Bring in antenna and ground without marring the woodwork or trailing unsightly leads either inside or out. For both AC and DC receivers.

For full descriptions and illustrations of these and other Yaxley Approved Radio Products, send for new bulletin.

Yaxley Mfg. Co.

Dept. P-9 So. Clinton Street

Chicago, Ill.

POPULAR RADIO INDEX

of Quality Sets, Kits, Parts and Accessories

A Complete Classified Index of Every Item Required in the Successful Installation and Operation of the Best Radio Apparatus

THESE ARE THE PRODUCTS of the leading manufacturers, combining fine design with high standards of quality in material and workmanship, backed by the unqualified guarantee of satisfaction by reliable organizations of the best character and highest standing. In this connection, it should be realized that no radio receiving set is better than its poorest part or accessory, that a silk purse can't be made out of a sow's ear, and that no buyer can intelligently expect to get more than he pays for. Some of the sets, parts and accessories listed are better than others. In some cases they are larger and more powerful, in others they embody more costly design, more expensive material, finer finish, more skilled workmanship, and for those reasons naturally cost more. But each is the best of its type and in its respective price field. Each represents the maximum of value and actual worth, for which you have the skilled and experienced guarantee of POPULAR RADIO Laboratory, without reservation. You may use these products with confidence, satisfaction and complete success. If you wish more detailed information regarding these products than you find in the pages of POPULAR RADIO, it will be cheerfully and promptly furnished upon request to POPULAR RADIO SERVICE BUREAU, 119 West 57th Street, New York City. Enclose 4 cents in stamps to cover mailing.

Adapters—
H. H. Eby Mfg. Co., Inc.

Aerials (see Antenna)—

Ammeters, (see Instruments, measuring)—

Amplifiers, Low-Frequency, Complete—
American Transformer Co. (Amertran)
National Co., Inc.
Samson Electric Co.

Amplifiers, Low-Frequency Kits—
Samson Electric Co.
Thordarson Electric Mfg. Co.

Amplifier, Power (see Power Packs)—

Antenna Kits—
Cornish Wire Co.

Antenna, Light Socket—
Electrad, Inc.
Leslie H. Muter

Antenna, Loop—
George W. Walker Co. (Victoreen)

Arresters, Lightning—
Belden Mfg. Co.

Base-Boards—
Corbett
Micarta

Batteries, Dry Cell, A, B and C—
Burgess Battery Co.

Battery Chargers (see Chargers)—

Battery Eliminators (see Power Packs)—

Binding Posts—
H. H. Eby Mfg. Co., Inc.

Brackets, Angle and Panel—
Benjamin Electric Co.

Brackets, Pilot Light—
Yaxley Mfg. Co.

Broadcast Equipment, Special—
American Transformer Co. (Amertran)
Samson Electric Co.
Thordarson Electric Manufacturing Co.

Cabinets, Wood—
Corbett Cabinet Co.

Cables—
Belden Mfg. Co.
Gavitt Mfg. Co.
Yaxley Mfg. Co.

Cable Connector Devices—
Yaxley Mfg. Co.

Chargers, Battery—
Westinghouse Electric Manufacturing Co.

Chassis, Set—
Aluminum Co. of America
Van Doorn

Chokes, Low-Frequency Output—
American Transformer Co. (Amertran)
Leslie H. Muter
Pacent Electric Co.
Samson Electric Co.
Thordarson Electric Manufacturing Co.

Chokes, Filter—
American Transformer Co. (Amertran)
Leslie H. Muter
Pacent Electric Co.
Samson Electric Co.
Thordarson Electric Manufacturing Co.

Clamps, Ground—
N. M. Fleron & Sons

Clips, Test—
Fahnestock

Coils, High-Frequency Choke—
Aero Products, Inc.
Hammarlund Mfg. Co.
Gray and Danielson Mfg. Co. (Remler)
Samson Electric Co.

Coils, Coupler—
Aero Products, Inc.
Hammarlund Mfg. Co.
Samson Electric Co.

Coils, Inductance—
Aero Products, Inc.
General Radio Co.

Comparators—
Temple, Inc.

Condensers, Filter—
Acme Wire Co. (Parvolt)
Aerovox Wireless Corp.

Condensers, Fixed Mica—
Aerovox Wireless Corp.

Condensers, Neutralizing—
Hammarlund Mfg.
Samson Electric Co.

Condensers, Variable—
Hammarlund Mfg. Co.
National Co.
Gray Danielson (Remler)

Connector Devices, Cable—
Yaxley Mfg. Co.

Consoles (see Cabinets)—

Control, Automatic Power—
Yaxley Mfg. Co.

Converters, Short-Wave—
Aero Products, Inc.
Crosley Radio Corp.

Cord, Extension—
Belden Mfg. Co.
Gavitt Mfg. Co.

Cord, Flexible Lamp—
Belden Mfg. Co.
Gavitt Mfg. Co.

Cord, Telephone—
Belden Mfg. Co.
Gavitt Mfg. Co.

Dials—
Hammarlund Mfg. Co.
Karas Electric Co.
National Co.

Galvanometers (see Instruments)—

Grid Leaks, Fixed—
Aerovox Wireless Corp.
International Resistance Co. (Durham)
Arthur H. Lynch, Inc.

Grid Leaks, Variable—
Allen-Bradley Mfg. Co.

Grid Suppressors—
International Resistance Co. (Durham)
Arthur H. Lynch

Harness, AC—
H. H. Eby Co., Inc.
Gavitt Mfg. Co.
Northern Mfg. Co. (Marathon)

Horns (see Reproducers)—

Impedance Units, Low-Frequency Amplifying—
Leslie F. Muter Co.
Samson Electric Co.
Thordarson Electric Mfg. Co.

Instruments, Electrical Measuring—
General Radio Co.
Jewell Electrical Instrument Co.
Weston Electrical Instrument Co.

Insulation, Composition—
Westinghouse-Micarta

Insulators—
N. M. Fleron & Sons

Irons, Soldering—

Jacks—
Leslie F. Muter Co.
Pacent Electric Co.
Yaxley Mfg. Co.

Kits (see Receiving Sets and Amplifiers)—

Knobs—
Kursch-Kasch Co.
Yaxley Mfg. Co.

Lamps, Neon—
Cooper-Hewitt Co.
Donle-Bristol

Lights, Panel—
Yaxley Mfg. Co.

Markers, Cable—
Yaxley Mfg. Co.

Microphones, Transmitting—

Milliammeters (see Instruments)—

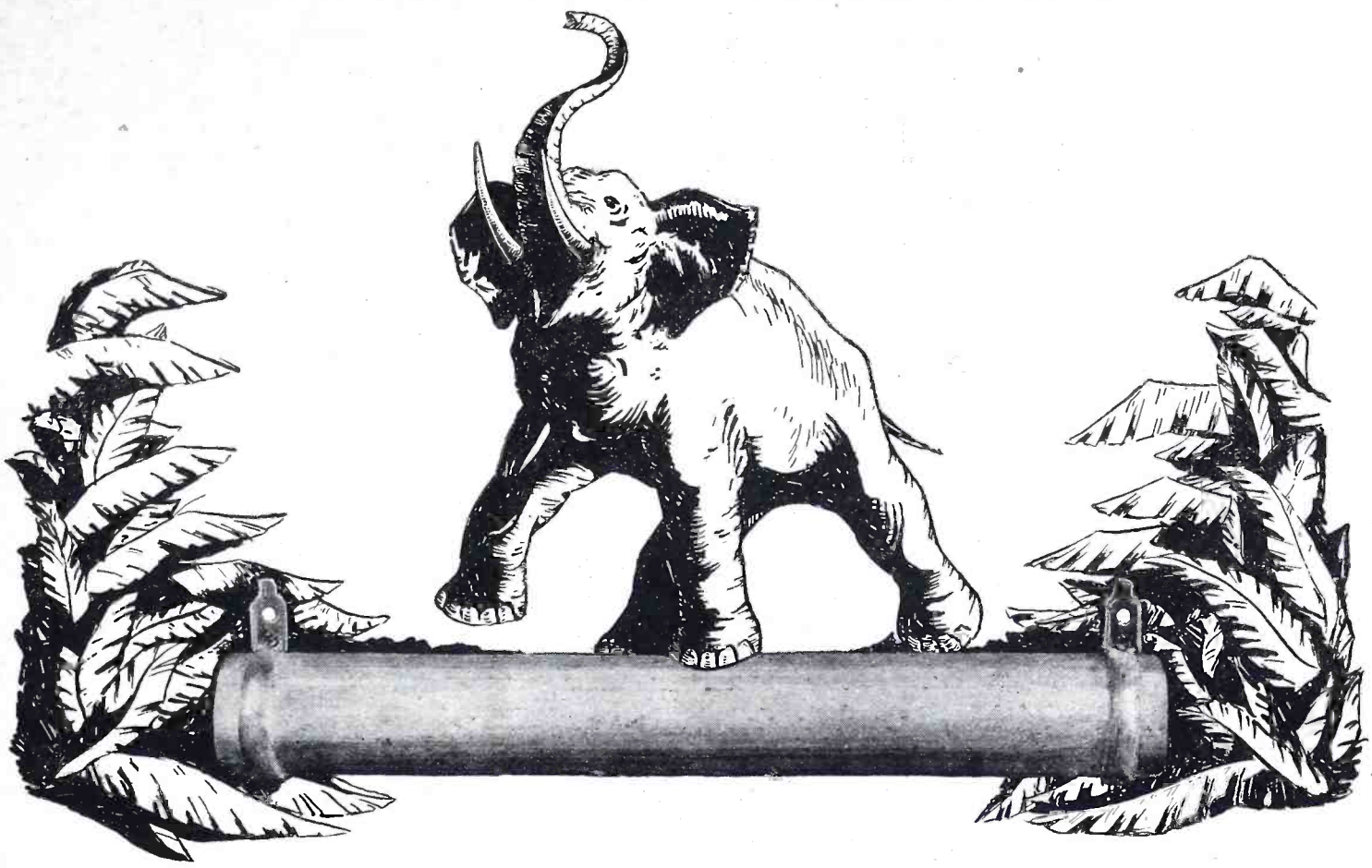
Oscillators, High-Frequency and Low-Frequency—
General Radio Co.

Oscillographs—
General Radio Co.

Outlets—
Yaxley Mfg. Co.

Output Units, Low-Frequency (see Chokes and Transformers)—

(*Continued on page 328*)



Carries the Load!

ESPECIALLY drawn resistance layer to insure constancy—Vitreous Enamel baked on for maximum heat dissipation and protection against oxidation and abrasion—Every test science can devise for the assurance of protection. Aerovox Pyrohms are built better—to last longer.

The Aerovox "Research Worker" is devoted to the dissemination of interesting and useful technical data Send for copy.

Aerovox Filter Condensers are made in single units and combination blocks to meet every socket power need.

AEROVOX

"Built Better"

70 Washington St. Brooklyn, N. Y.

Panels—
Aluminum Co. of America
Westinghouse-Micarta

Phonographs—
Adler Royal
Carryola
Gordon & Co.

Phonograph Pick-ups—
Donle-Bristol Corp.
Gordon & Co.
Pacent Electric Co.

Phonograph Records—
Columbia

Pick-up (see Phonograph Pick-ups)—

Plates, Name—
Yaxley Mfg. Co.

Plates, Outlet Gang—
Yaxley Mfg. Co.

Plugs, Socket—
Benjamin Electric Co.
Harvey Hubbell, Inc.

Plug and Cable (see Cable Connectors)—

Potentiometers—
Central Radio Laboratories (Centralab)
Yaxley Mfg. Co.

Power Packs, "A"—
Knapp Electric Corporation

Power Packs, "B"—
American Transformer Co. (Amertran)
Samson Electric Co.
Thordarson Electric Mfg. Co.

Power Packs, "ABC"—
American Transformer Co. (Amertran)
Samson Electric Co.
Thordarson Electric Mfg. Co.

Reactors, Transmission Plate—
American Transformer Co. (Amertran)
Thordarson Electric Mfg. Co.

Reactivators, Valve—

Receiving Sets, Complete—
Crosley Radio Corp.
Marti Radio Co.
Sparks-Withington Corp. (Sparton)

Receiving Sets, Kits—
Aero Products, Inc.
Browning-Drake Corp.
Gearhart
Hammarlund-Roberts, Inc.
Gray Danielson (Infradyne)
Kenneth Harkness, Inc. (Counterfonil)
LC-28
Lynch 5
National
New Home
Quadraformer
Remler Superheterodyne
Tyrman Electric Corp.
George W. Walker Co.

Rectifiers—
Knapp Electric Co.

Relays, Control—
L. S. Brach Co.
Yaxley Mfg. Co.

Reproducers—
Air Chrome Studios
Browning-Drake Speaker Corp.
Jensen Radio Mfg. Co.
Pacent Electric Co.
Racon Electric Co.
S. P. N.
Temple, Inc.

Reproducer Units—
Jensen Radio Mfg. Co
Pacent Electric Co.
Saal
Temple, Inc.

Resistances, Filament—
Allen-Bradley
Central Radio Laboratories (Centralab)
Arthur H. Lynch
Radiall Co. (Amperite)
Yaxley Mfg. Co.

Resistance, Grid (see Grid Suppressors)—

Resistance Units, Low Power—
International Resistance Co. (Durham)

Resistors, Power—
Aerovox Wireless Corp.
Allen-Bradley Mfg. Co.
Electrad, Inc.
Central Radio Laboratories (Centralab)
International Resistance Co. (Durham)

Rheostats—
Allen-Bradley Mfg. Co.
Arthur H. Lynch, Inc.
Radiall Co. (Amperite)
George W. Walker Co. (Victoreen)
Yaxley Mfg. Co.

Shielding—
Aluminum Co. of America
Copper & Brass Research Association
Hammarlund

Sockets, Vacuum Valve—
Benjamin Electric Co.
H. H. Eby Mfg. Co., Inc.
Gray Danielson (Remler)

Solder, Wire and Strip—
Chicago Solder Co.

Speakers (see Reproducers)—

Switches—
Leslie H. Muter
Yaxley Mfg. Co.

Transformers, Low-Frequency Amplifying—
American Transformer Co. (Amertran)
Ferranti, Inc.
Karas Electric Co.
Leslie H. Muter
Pacent Electric Co.
Samson Electric Co.
Thordarson Electric Mfg. Co.

Transformers, "B" Supply—
American Transformer Co. (Amertran)
Samson Electric Co.
Thordarson Electric Mfg. Co.

Transformers, Filament Supply—
American Transformer Co. (Amertran)
Jefferson (Chicago-Jefferson Fuse & Elec. Co.)
Karas Electric Co.
Thordarson Electric Mfg. Co.

Transformers, Line Input and Output—
American Transformer Co. (Amertran)
Samson Electric Co.
Thordarson Electric Mfg. Co.

Transformers, Microphone Coupling—
American Transformer Co. (Amertran)
Samson Electric Mfg. Co.
Thordarson Electric Mfg. Co.

Transformers, Power Amplifier Supply—
American Transformer Co. (Amertran)
Samson Electric Co.
Thordarson Electric Mfg. Co.

Transformers, Push-Pull Amplifying—
American Transformer Co. (Amertran)
Ferranti, Inc.
Samson Electric Co.
Thordarson Electric Mfg. Co.

Transformers, Speaker Coupling—
American Transformer Co. (Amertran)
Karas Electric Co.
Modern Electric Mfg. Co.
Thordarson Electric Mfg. Co.

Transformers, Transmission Filament Supply—
American Transformer Co. (Amertran)
Thordarson Electric Mfg. Co.

Transformers, Transmission Plate Supply—
American Transformer Co. (Amertran)
Thordarson Electric Mfg. Co.

Tubes (see Valves)—

Valves, AC—
Arcturus Radio Co.
C. E. Manufacturing Co. (CeCo)
E. T. Cunningham, Inc.
Donle-Bristol Corp.
Northern Mfg. Co. (Marathon)

Valves, Amplifying—
C. E. Manufacturing Co. (CeCo)
E. T. Cunningham, Inc.
Donle-Bristol Corp.
Zetka Laboratories

Valves, Detector—
C. E. Manufacturing Co. (CeCo)
E. T. Cunningham, Inc.
Donle-Bristol Corp.
Zetka Laboratories

Valves, Rectifier—
C. E. Manufacturing Co. (CeCo)
E. T. Cunningham, Inc.
Donle-Bristol

Voltmeters (see Instruments, Measuring)—

Wire—
Acme Wire Co. (Celatsite)
Cornish Wire Co.
Gavitt Mfg. Co.

What's the Most Important Thing that Goes Into a RADIO SET?

Without it no Receiver Can Give the Service You Expect — The Marti Electric Power Radio Has It.

YOU may be one of those thousands of laymen who know little or nothing about the "insides" or "parts" of a radio receiver. All the wires and things you see inside a radio set mean nothing to you.

It follows then that of all the things that go to make a complete radio set the most important of them all is honesty, manufacturing honesty—the will and determination of the manufacturer to eliminate all skimping both in the selection of the parts and in the construction of the receiver.

The Marti's Success

In its scientific design and honest construction lies the success of the Marti Electric Power Radio. The Marti engineers have established the most thorough and severe series of parts tests.

Not a single part goes into the Marti-Electric Power Radio until it passes these tests and measures up to the Marti standard for that part's particular function. These service-tested, super-quality parts are then assembled on the Marti chassis to function most efficiently, one with the other. The result is an outstanding piece of workmanship, and a quality of broadcast reception as superior to other radio receivers as the tone of a Steinway is to an ordinary piano.

MARTI
ELECTRIC POWER RADIO

Operates Directly From Your House Current Socket

NO [A Batteries, B Batteries, Chargers] NO [Liquids, Acids, Eliminators]

It Mirrors Tone

Judged by the five standards by which any radio set should be judged—tone quality, volume, selectivity, dependability and simplicity of operation—the Marti Electric Power Radio will win your decision. The Marti reproduces the broadcast program naturally and without distortion. It mirrors tone. Illuminated dials permit of hair line tuning and the construction of the Marti assures dependable performance and long service. Electric power from your house current eliminates all "A" and "B" batteries, chargers and other bothersome accessories. Just turn on the switch—that's simplicity of operation.

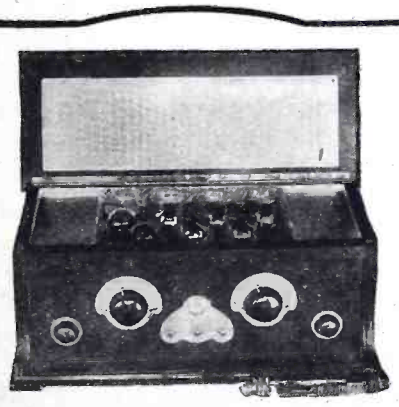
Hear the Marti at Your Dealer's.

Ask your dealer to let you hear the Marti Electric Power Radio. If he hasn't one in stock, write us for circular and address of nearest Marti dealer.

MARTI ELECTRIC RADIO CO., Inc.
WEST ORANGE, NEW JERSEY

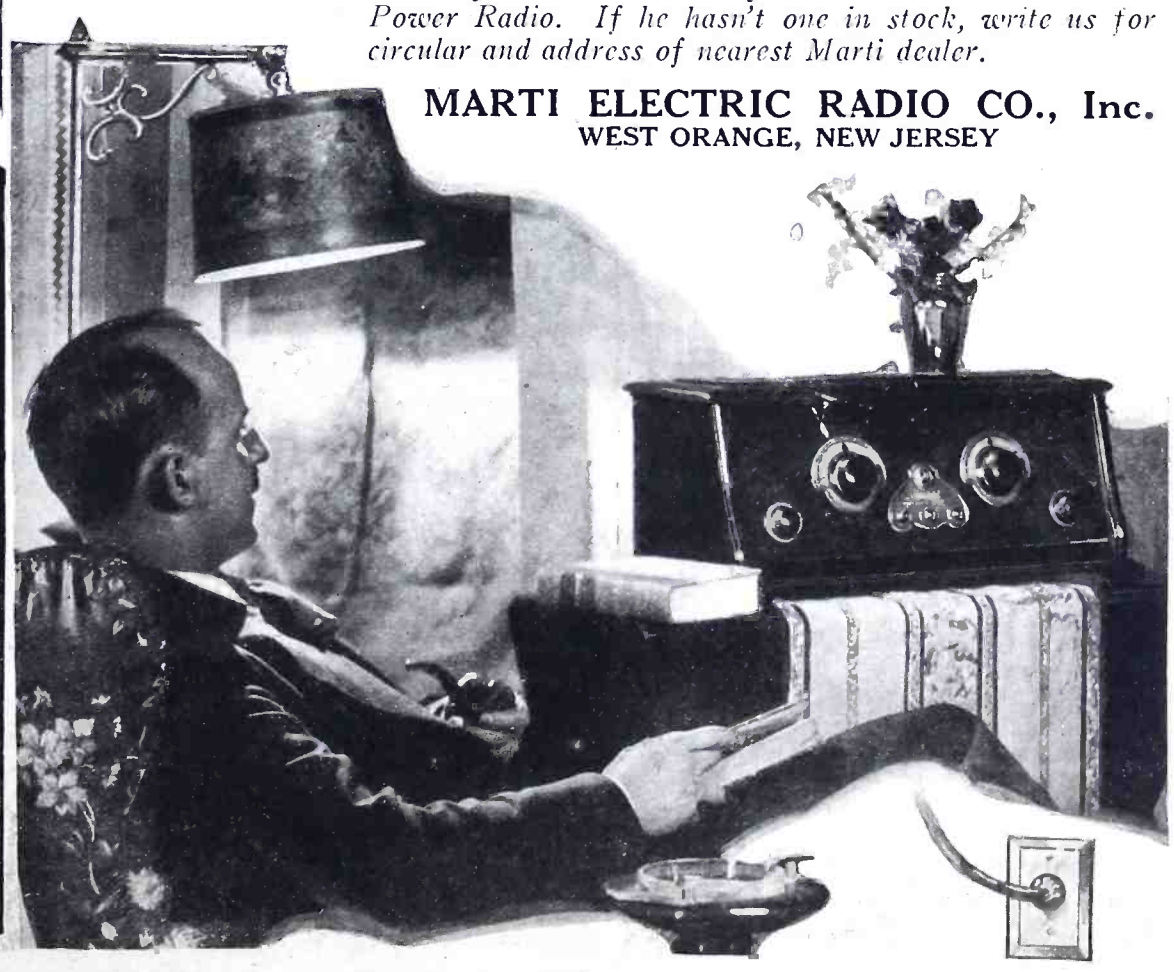
Important Note to the Trade

Heretofore the entire production of Marti Electric Power Radios has been taken by the Eastern market. We are now in a position to make an interesting proposition to high-class dealers and distributors in other parts of the country. Write or wire for complete particulars. See our exhibit at Radio Trade Show, Chicago, June 11-15.



The Marti Receiver is light and compact. Entirely self-contained—everything within genuine solid walnut cabinet. The two transparently illuminated dials—one for each hand—permit hair line tuning. And so highly selective is this Radio that you can tune in on any program that suits your fancy and be sure of perfect reception without interference.

Models up to $390.00
including all tubes



The Long and the Short of Aerials

(*Continued from page 317*)

In some instances long spikes driven through the pole and into a suitably placed chimney, together with a little wire reinforcement, is all that is necessary to hold the pole upright. In other instances a projecting pipe may give the necessary support. In the event that there is no available support at hand, it will be necessary to supply a small base which may consist of a plank about two feet long, a foot wide and an inch or more thick. A spike may be driven through the middle of this board into the bottom of the pole. The pole may then be raised and held in position by means of three iron guy wires. It will not be necessary to nail the plank support to the roof because of the pulling effect of the guy wires.

The position of the second pole having been previously determined, it may be securely fastened to some suitably strong projection from the roof, as before mentioned, or the guy wire and foot plank method previously described may be used for the second pole. It will be necessary to use an insulator with its attendant short piece of wire to fasten it to the top of the pole. With both the antenna masts erected, the free end of the antenna wire should be threaded through the free end of the insulator. With the free end of the antenna wire make several turns about the antenna wire proper, close up to the insulator, so as to prevent looseness of the antenna.

It will now be necessary to cut off the remaining antenna wire at a distance approximately four feet from the roof. To this free end of the antenna the lead-in wire should be attached. It is preferable that this connection be soldered. If soldering is inconvenient, a joint of approximately six inches in length should be made and this joint should be tightly wound with electric tape to a point extending an inch or two beyond the joint proper. One of the wall insulators should be fastened in the top of the coping at the edge of the building where the lead-in wire is going to be brought down the side of the building. If possible, it is advisable to utilize one of these wall insulators at a distance of about every twenty feet of the lead-in length. This is necessary because of the fact that in wet weather the brick wall makes a much better ground than in dry weather; and any slight swinging of the lead-in wire tends to change the capacity of the antenna, with a corresponding difference in the antenna tuning. This might produce a slight fading effect of signal strength in wet weather.

The method of bringing the antenna into the house will vary with the type of window used. In the event of metal casing, it will be necessary to utilize a lead-in strip. This consists of a flat piece of copper with a suitable attachment at each end and with the center of the strip insulated. The window may be closed upon this strip after the lead-in wire has been fastened to the outside terminal of the lead-in strip. The inside terminal of the terminal strip may be fastened to a suitable insulated wire running to the set. This wire should be led along the baseboard in the direction of the radio set with double tacks at two- or three-foot intervals to insure it staying in position. The ground wire may be fastened to the ground binding post on the radio set and then led around the baseboard in a manner similar to that used with the lead-in wire. In the event that these two wires go in the same direction for even a short distance, they should be separated about 6 inches from one another. One wire may be led along the top of the baseboard, while the other may be led along the baseboard next to the floor. The ground wire should be soldered to a ground clamp, which is a short piece of strip copper suitable for clamping around a radiator steam pipe or a water pipe.

Remember this: "A good antenna hitched to your set is like an extra stage of high-frequency amplification." You will get better distance and more reliable local reception if you do a good job in the beginning.

1928 Reproduction from a 1910 Phonograph

(*Continued from page 302*)

sion cord of the reproducer should be placed on opposite sides of the back of the cabinet to prevent hum.

When once installed all that is necessary is to place the vacuum valves in their respective sockets, as follows:

A CX-381 type rectifier valve is to be used in the high-power box. A CX-327 type valve is to be used in the first socket of the amplifier, and two CX-310 type power valves are used in the two last sockets of the amplifier. One socket on the amplifier is left unused.

Next turn "on" the switch on the front of the power box and after a period of a half minute the amplifier should begin to function. The complete job needs no batteries and runs completely from the AC lines.

It is best to install the reproducer on the opposite side of the room and for this purpose a Gavitt extension cord may be used between the phonograph and the Browning-Drake reproducer.

Super-Simplified Receivers

(*Continued from page 310*)

a 250,000-ohm resistance, but as the current in the plate circuit is only a small fraction of that flowing through the filament circuit, the voltage drop will not be nearly so great, so we have the plate of the second valve positive with respect to its filament.

Turning now to the potential on the grid of the third valve, we find that this is slightly negative to the filament of the third valve, for although it is virtually connected to the mains on the positive side of the third valve filament, yet the voltage is dropped sufficiently through the 250,000-ohm resistance to make it actually negative with respect to the filament as a whole, so that we obtain the requisite degree of grid bias, if the values of the resistances have been rightly chosen.

In the same manner, the grid of the second valve is negative to the filament of that valve, for both the grid and the plate of the first valve are connected, through a choke, to a point on the negative side of the second valve filament. This point, however, is positive with respect to the filament of the first valve, so that the plate of the first valve gets its requisite positive potential. The grid of the second valve is really more negative than the point to which it is connected, owing to the voltage drop through the choke coil.

The valves used all take a filament current of .1 ampere, so that the voltage drop across each 400-ohm resistance is about 40 volts. The last valve has something like 100 volts on its plate, while provision for varying the bias on its grid is provided by the variable tapping on the third 400-ohm unit. The plate of the second valve gets something like 60 volts, while the first valve, which functions as a plate bend rectifier, gets about 40 volts.

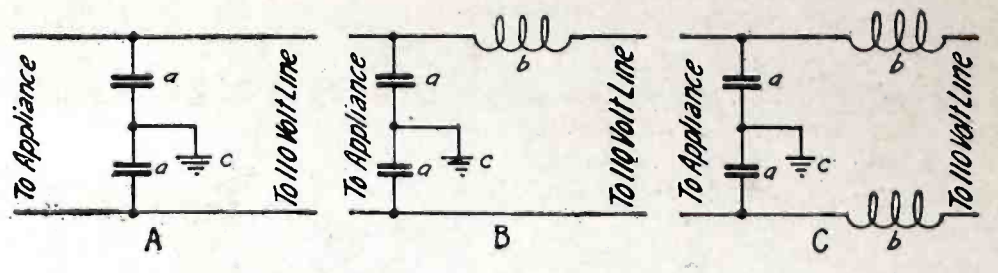
No ground connection is provided in this circuit, for most lighting circuits, if not already grounded, have at least a large capacity to ground.

Some care in the choice of valves for this circuit is necessary. In the case of the first valve, one must be chosen which will function well as a plate bend rectifier at a plate potential of 40 volts. A high amplification valve, such as is designed for resistance-capacity coupling purposes, should be placed in the second socket, and, a small power valve should be used in the third socket. These valves must all be of the .1 ampere filament current type, but may be of the 2, 4 or 6-volt class.

This unique circuit is perhaps hardly suitable for use with standard 110-volt AC circuits, but is of interest to the experimenter, as being a decidedly novel departure from orthodox practice, and those who have sufficiently high voltage lines available may like to try it out.

Running Down the Radio Criminal—Interference

(*Continued from page 315*)



HOW TO REMEDY A DEFECTIVE MOTOR

FIGURE 1: *The condenser method shown at the left is usually effective where motors are the cause of interference. Where the device is not remedied by this means, one or two chokes should be put in the circuit, as shown in the two diagrams at the right.*

is that it is easier for the ear to distinguish between zero and some degree of maximum volume than between various degrees of maximum volume.

Where the trouble is being caused by a motor-driven appliance of any type, it is usually due to defective brushes or commutator. If arcing at the brushes occurs, first see that the brushes are properly adjusted. If the commutator is dirty or grooved, it may be cleaned by sandpapering it with very fine sandpaper. Under no condition should emery cloth be used, since more harm will be done than good. Where the commutator is badly grooved, it should be turned down in a lathe. This is an operation which will require the services of an experienced electrician.

Another means of eliminating interference of this type is to use one of the methods shown diagrammatically in Figure 1. Usually most cases can be cleared up by using the method shown at "A." In more stubborn cases the methods shown at "B" or "C" will be necessary. There are several types of the filter units shown in these diagrams manufactured by well-known manufacturers, that are now available. These are properly designed and their use is recommended. If these are not obtainable condensers of suitable rating can be purchased and the choke coils can be constructed according to the data given below.

Choke Coil Data

For a single-layer, air-core solenoid whose length is considerably greater than its diameter, substitution of the proper values in the following approximate formula will give a two millihenry inductance:

$$\frac{a^2\ n^2}{b} = 20{,}000$$

where a is the radius of the coil in inches, n is the number of turns, and b is length of coil in inches.

For a multiple-layer coil of the same type, the following formula, also approximate, will serve:

$$\frac{an^2\ (a-1/3c)}{b} = 20{,}000$$

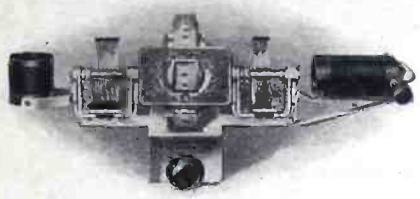
where a, n, and b are as before, and c is the depth of the winding in inches. A 200-turn coil wound on a 3-inch nonmetallic spool will give roughly two millihenries.

In vibrating types of appliances, such as battery chargers, a one-half or one microfarad condenser, connected across the contacts, will usually eliminate sparking and stop such interference.

It is essential in hunting trouble by volume indications that the same distance from the line be maintained at all times. Approaching closer to the line will naturally cause more volume at such points. Frequently the volume will drop, and no doubt the operator will find that instead of going away from the trouble as he suspects, the line has crossed from one side of the street to the other. Where lines change from overhead to underground, or at poles where ground wires lead down from pot heads or other equipment, volume will also be greater. Low service wiring or coupling to telephone cables, trolley tracks, etc., or any metal object will in most cases produce the same result. At street corners where branch wiring exists or places where there are more wires volume may also be greater. It is essential, therefore, that allowance be made for these conditions.

There is still another condition that is worth mentioning. Peaks in signal strength or "bumps," as they are called in the parlance of the linemen, will be noticed in following a line. These will usually occur in the center of a span and be equally spaced. If a careful check is made it will be noticed that they increase in volume as the source of interference is approached or decrease when going from the source of interference.

A survey of many thousands of complaints on the part of the power companies has brought to light another interesting fact. Most severe interference occurs in cold dry weather. In wet weather, contrary to general belief, trouble is far less bothersome; and in many cases severe interference will practically disappear.



The Official Browning-Drake Kit

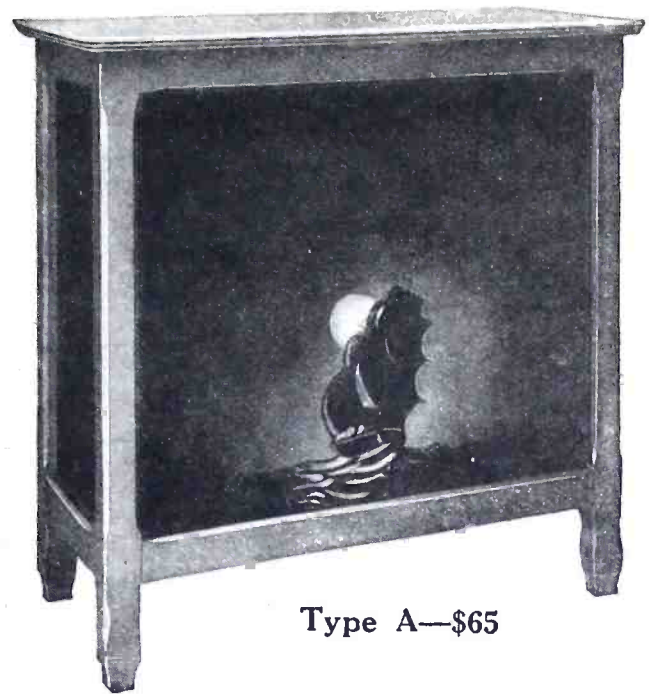
EVER since 1924 Browning-Drake has been the largest selling Kit each year. Those whose technical training permits complete investigation have long known the reason for its popularity. A real scientific advance formed the basis of its success, the importance of which is well shown by the fact that the industry has generally approached Browning-Drake transformer design.

The new Official Kit, pictured above, is the heart of any Browning-Drake set, A.C., D.C., or shield grid.

Your inquiry will bring full information on Kits and factory-built receivers.

A new constructional manual may be obtained either from your dealer or direct, for 25c.

A New Loud Speaker!



Type A—$65

The Browning-Drake Speaker

ENGINEERS of the Browning-Drake Corporation have recognized in this new speaker the nearest approach to fidelity in musical reproduction yet offered and feel privileged to place it on the market as a Browning-Drake product.

Several new principles of acoustics, developed by W. B. Whitmore and manufactured under Whitmore (Air-Chrome) patents pending, are embodied in this speaker.

Table Model A, illustrated above, is offered in either walnut or mahogany, Duco finish. Wall Model C, artistically designed for an out-of-the-way corner, will be ready April 1st. List price $38.00.

Dealers: A unique merchandising plan is offered in selling these speakers. Write to our nearest branch and get the details. Speakers in stock at branch offices.

The Browning-Drake Speaker Sales Co.
552 Massachusetts Ave., Cambridge, Mass.

NEWARK	PITTSBURGH	CHICAGO	SAN FRANCISCO
172 Emmet St.	910 Fulton Bldg.	53 W. Jackson Blvd., Monadnock Block	905 Mission St.

The Browning-Drake Corporation

110 Brookline Street **Cambridge, Mass.**

BROWNING-DRAKE RADIO

The Screen Grid LC-28

(*Continued from page 296*)

terminal at the top of the screen grid valve; this connection may be easily made in the form of a looped piece of bared hook-up wire soldered in a circle and slipped over the terminal cap at the top of the screen grid valve.

How to Install and Operate the Screen Grid LC-28

The receiver may be installed in its Corbett cabinet, as usual. Three CX-322 type screen grid valves should be placed in sockets P1, P2 and P3, with a standard Zetka ZD type detector valve in socket P4.

The valves recommended for the resistance-coupled amplifier are two CX-340 type high-mu valves in the first two stages, and one of the new CX-350 type super-power amplifier valves in the last power stage. A standard CX-381 rectifier valve is also recommended for use in this amplifier.

The proper connections from the National low-frequency amplifier to the LC-28 screen grid receiver are shown in photo-diagram in Figure 2. This shows all the connections between the Yaxley cable and the binding posts on the amplifier, as well as the connections to the Knapp "A" power-pack for supplying filament current for all valves except the rectifier and the power valves. These two latter valves will operate directly on alternating current of the proper voltages furnished in the amplifier.

It is very important that a reproducer capable of handling extraordinarily large volume be used with this combination, and the new Air-Chrome balanced-tension reproducer is recommended. It will have to be installed some distance from the receiver, since the volume is so great that it may vibrate the metal parts of the receiver and cause howling, if placed too close. A Gavitt extension cord is recommended for this use. This cord is made of twisted pairs and picks up no hum from the lighting circuits.

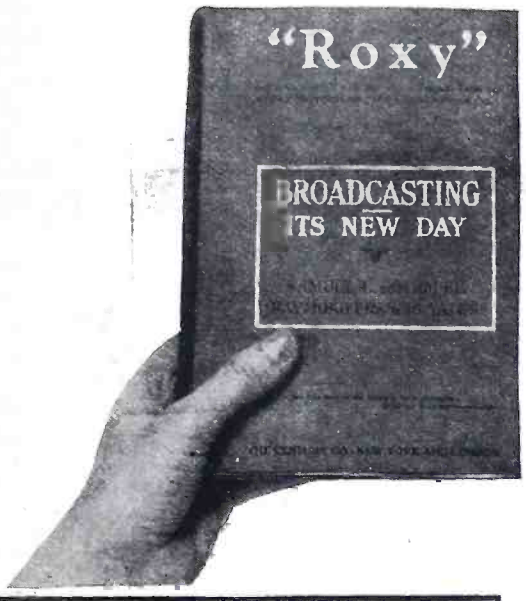
For the antenna, a short piece of wire of from four inches to ten or fifteen feet in length may be used for ordinary reception, according to the surrounding conditions in the location where the receiver is used. A light-socket antenna may be employed, if desired, with excellent results.

Of course, a regular outdoor antenna should be used for extreme long-distance work. The receiver has plenty of selectivity even on a large outdoor antenna in a crowded metropolitan area.

The tuning in, the new screen grid model of the LC-28 remains exactly the same as for the original and earlier models, with the various controls operating for the same apparatus as described in earlier articles.

Do You Want A Free Copy of Roxy's Amazing New Radio Book?

Radio's greatest impresario, collaborating with Raymond F. Yates, Editor of POPULAR RADIO, gives his startling private views and predicts revolutionary changes in broadcasting.



CONTENTS

Broadcasting, Its New Day

By

S. L. ROTHAFEL (ROXY)

and

RAYMOND F. YATES

Hundreds of thousands of fans who listen to Roxy's weekly concerts have often wondered what he really thought of the big problems of broadcasting and the radio art in general. Now, for the first time, Roxy gives his answer to the big radio questions of the day in the most fascinating, edifying and readable book that has ever been published. In his extremely likable way, Roxy gives his impressions of broadcasting. He not only criticizes, but he suggests startling improvements and needed reforms in the presentation of programs. Roxy tells you what he thinks of radio as it effects the impresario, politics, religion, education and commerce. And he answers, once and for all time, that great question: "Where is broadcasting going, and how will it get there?" You will be surprised and amazed by Roxy's original thoughts on what is today the world's greatest form of entertainment.

The latter portion of the book is given over to a startling prediction of the technical future of the radio art; telling in a simple, readable way of the improvements in short-wave transmission, television, telephotography, receiving sets, tel-mechanics, and the transmission of power through the ether of space. The book is really a liberal education in radio, and treats not only its human side, but its technical side as well.

HOW TO OBTAIN YOUR COPY FREE

Thousands of people have been willing to pay $2.00 for this book. Now, for the first time, it is available to the readers of POPULAR RADIO who enter their subscription for a period of one year at $3.00 per annum. The book contains 316 pages and is liberally illustrated with heretofore unpublished photographs and simplified diagrams depicting the marvelous technical advancement that has taken place during the past five years. No intelligent person will want to remain ignorant of the great questions that BROADCASTING, ITS NEW DAY, answers.

ACT QUICKLY

Through a special arrangement with the publishers, POPULAR RADIO is able to offer only 2000 copies of this publication. Consequently, this offer can be held open only for a period of thirty days. Your copy is packed and ready for addressing. Act today to make sure that you do not miss this opportunity.

Popular Radio, Inc.
119 West 57th Street
New York, N. Y.

Dear Sirs:

I am enclosing $3.00 for a year's subscription to POPULAR RADIO, and it is understood that you will immediately send me, free of charge, one copy of BROADCASTING, ITS NEW DAY, by S. L. Rothafel and Raymond F. Yates.

Name.....

Street.....

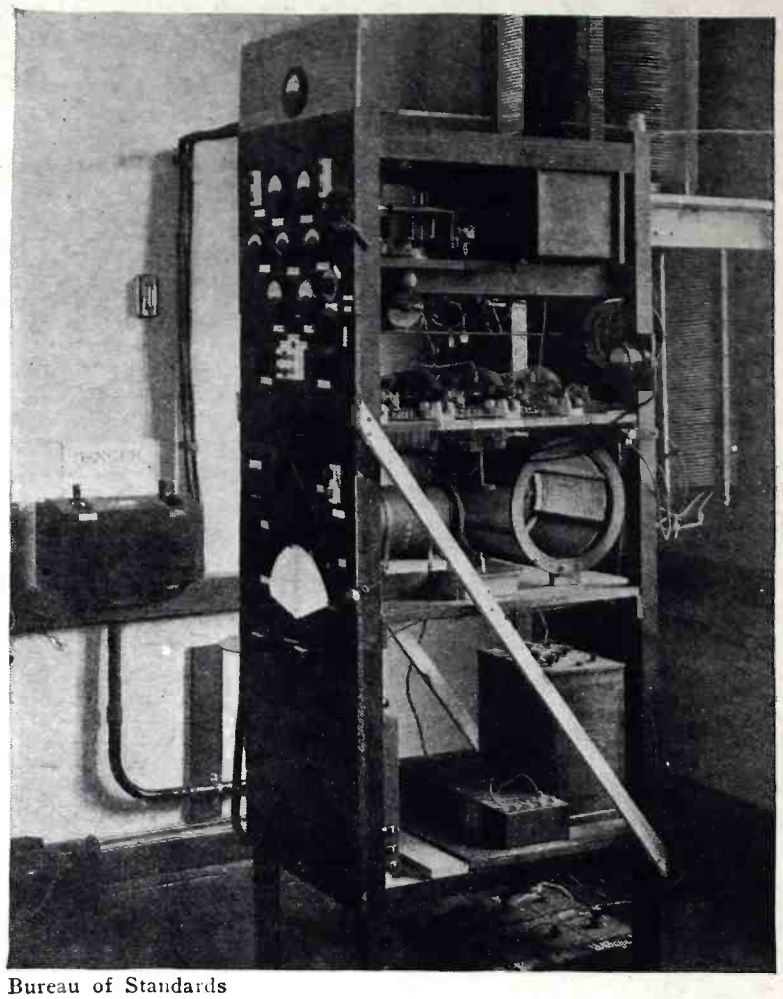
City.....

POPULAR RADIO, Inc.

119 West 57th St. **New York, N. Y.**

Finding the "Yardsticks" of Radio at the Bureau of Standards

(*Continued from page 291*)



Bureau of Standards

THE BROADCASTER'S FREQUENCY STANDARD

This 1-kilowatt transmitter is used by the Bureau of Standards for transmitting the constant frequency signals by which the broadcasters of the land calibrate their apparatus. Its frequency range is from 125 to 6,000 kilocycles.

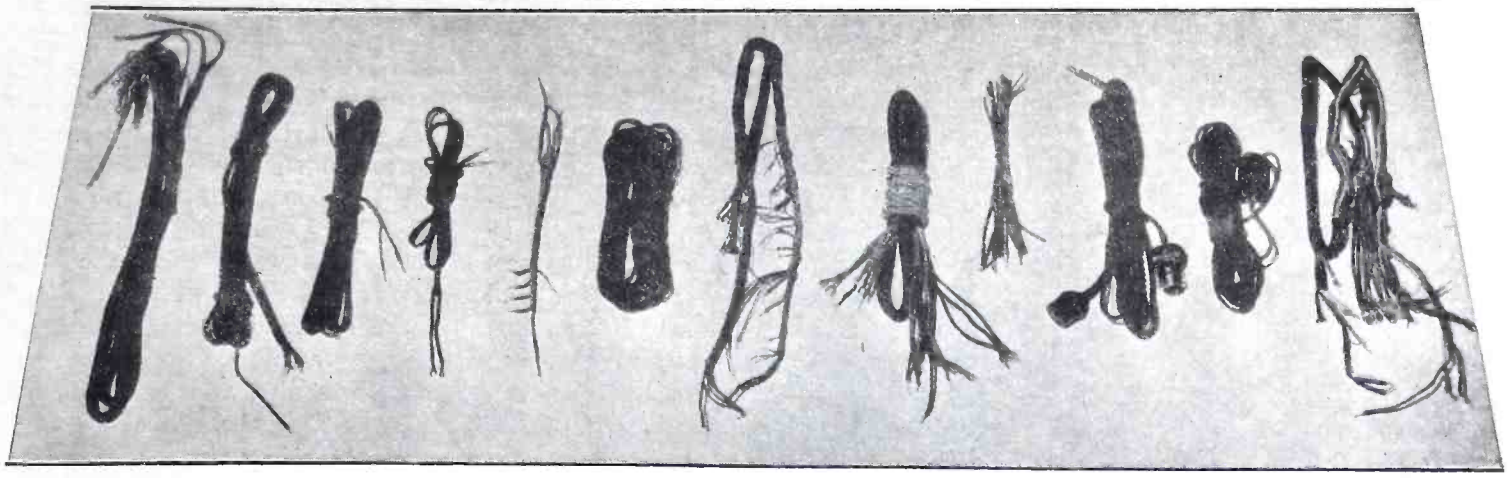
months, an experimental trial of daily broadcasting of market reports. The extensive market report system of today was established on the basis of the results of this trial. For a period of some months early in 1920, before any broadcast stations were established, the Bureau broadcast music experimentally on an announced schedule. Some of this music was taken from phonograph records directly by a microphone, no sound being produced; this principle has been applied commercially in the past two years in electrical phonographs.

Prior to the year 1923 not only did stations in general depart many per cent from their assigned frequencies, but even the wavemeters used as standards for frequency measurement and control by various laboratories and authorities throughout the country likewise differed by several per cent. It has been the privilege of the Bureau of Standards to contribute materially to improvements in frequency measurement which have made possible more precise station frequency assignments in all the various classes of radio service. This has helped to provide the maximum number of communication channels in the overcrowded ether.

As an aid in the maintenance of constant station frequencies, many of the broadcasting stations are using piezo oscillators or other forms of frequency indicators. Instruments for this purpose have been developed by the Bureau and have worked out very well in actual use at various stations. The use of a device of this kind is practically imperative to comply with the ruling of the Federal Radio Commission that broadcast frequencies be held within ½ kilocycle.

The Bureau disseminates accurate standards of frequency by regular transmissions of standard frequency signals. For several years it published monthly lists of the stations which it found to hold their frequencies with great constancy. This undoubtedly helped to mitigate the chaos of uncontrolled station operation in 1926.

Another illustration of the direct value to the public of the Bureau's scientific work is the radio beacon system. Certain of the Bureau's researches on antennas led to the development of a very simple and efficient radio direction finder. By rotating this direction finder, while listening to a radio mes-



Gavitt Wire Products for Every Radio Purpose

High Power Cords
Tinsel Speaker Cords
A. C. Supply Cords
Hook-up Wire
Battery Cables
Chassis and Panel Cables

for Manufacturers
for Professional Set Builders
for Amateur Set Builders

HIGH-POWER CORD—This speaker cord has been developed especially for high-power radio receivers having output voltages as high as 1500. Standard tinsel speaker cords are inadequate for use in modern high-powered sets. Our speaker cord is thoroughly insulated with rubber and twisted so as to minimize A. C. hum in the event the cord is laid parallel to lamp or fixture cords. Supplied in 20, 30, 50 and 100 foot lengths.

HOOK-UP WIRE—Professional and amateur set builders are supplied by the Gavitt Manufacturing Company with a full line of hook-up wire to be had in standard assortments with colored rubber insulation. All Gavitt hook-up wire is made up of No. 18 tinned stock. Each assortment contains five 5 foot lengths.

TINSEL SPEAKER CORDS—Gavitt tinsel speaker cords are strong, durable, and moisture-proof. Their braided coverings are woven tightly and are able to withstand more than normal abuse. Each cord comes with the standard tips. These speaker cords are supplied in 3, 5, and 6 foot lengths; special lengths made to order.

BATTERY CABLES—Gavitt battery cables are being manufactured in a wide variety of types, and they are being used by leading radio manufacturers throughout the United States. Standard types are always in stock and special colors may be made up at short notice. All battery cables are tightly woven and moisture proof and terminals carefully soldered.

A. C. SUPPLY CORDS—The Gavitt Manufacturing Company produces a variety of special cords for A. C. sets. These may be used on "B" eliminators, "A" eliminators, and come complete with special plugs for sockets. Such cords are made according to specification and in any length desired. These types of cords can also be had with polarity indicators or markers.

CHASSIS AND PANEL CABLES—For five years the Gavitt Manufacturing Company has been supplying the principal radio manufacturers of the United States with chassis cables made to suit their own individual requirements. All assembly, braiding and tinning is done at the Gavitt factory and the cables arrive ready for the soldering operation. Only the very best materials are used in these cables.

QUOTATIONS ON SPECIAL CABLE PROBLEMS GLADLY GIVEN

The engineering department of the Gavitt Manufacturing Company stands ready at all times to submit data and prices on special cable problems. No order too small and no problem too difficult to receive prompt attention.

Send for literature and prices on our standard products
"RELIABLE" WIRE PRODUCTS

GAVITT MANUFACTURING CO.
BROOKFIELD, MASSACHUSETTS

sage, the direction of the transmitting station is indicated. A ship equipped with the device can steer to a ship which is sending out a distress call, or can locate its own position by the aid of radio signals from shore stations. The Bureau of Standards developed automatic radio transmitting apparatus to send out such signals from lighthouses. The Lighthouse Service has installed these radio beacons at fifty lighthouses, where they serve the same purpose as lights, but do it better because they work over greater distances and in fog. Radio has thus vanquished the terror of fog, the worst enemy of the navigator.

The radio beacon has also been found of service in air navigation. Special types of radio beacons have been developed to keep an aircraft on its course. The rapid growth of commercial aviation will depend heavily upon radio as an aid to navigation, for air navigation is subject to large errors due to wind drift. When fog makes the ground invisible, the aviator is in a serious plight. For this reason the Bureau is now devoting a large share of its effort in radio to perfecting methods to guide an aviator along his course and assist him in landing.

Another radio development for aircraft by the Bureau is a distant control device. This device, a direct product of fundamental research on electron valves, gives a means of navigating a pilotless airplane by radio. The same device has been found useful in operating a radio transmitting station from a distance and in other instances of remote control of machinery.

Some of the Bureau's research work is directed toward the study of wave transmission variations, fading, and atmospheric disturbances. These are seen as large problems, the ultimate solution of which requires much more extended knowledge of the actual behavior of the waves than now exists. This knowledge must come as the result of extended observations. The Bureau is engaged on methods and apparatus for such observations, and works in co-operation with other laboratories on these problems. An early program of such work done in co-operation with the amateurs led to the explanation of fading which was first published by the Bureau in 1921, which postulates that the waves travel at night along the Heaviside layer, or upper region of the earth's atmosphere, about 100 miles up. In daylight transmission the waves cannot reach the Heaviside layer because of the intervening ionized atmosphere, and hence in daytime the waves travel along the earth's surface, where they are subject to absorption. At night, on the other hand, when the air is much less ionized, the waves reach the Heaviside surface and travel along it. Variations in the Heaviside surfaces or masses of ionized air below it introduce the variable absorption which is evidenced as fading. This theory has been further substantiated by the results of later investigators.

A statistical study of interference to broadcast reception was conducted by the Bureau of Standards with the cooperation of about 200 observers located at distances up to 400 miles from two selected broadcasting stations. Interesting data on distance range and on various sources of interference were obtained. Subsequently, with the co-operation of a 50-kilowatt station, the Bureau determined the effects of high power on service area, blanketing interference, fading, etc.

The results of the Bureau of Standard's radio work are embodied either in publications, which are available to the public, or in reports for Government use.

While the Bureau makes as much as possible of its output available to the public through its publications, it is not, and could not possibly be, a radio question-and-answer bureau. With many evidences of the work of the Bureau of Standards appearing in publications and otherwise all over the country, and with the newspapers assiduously and commendably featuring the day-by-day results of scientific progress, many people have the impression that the Bureau can supply the answers to every conceivable question about electrical or mechanical apparatus. Now it is estimated that there are over 10,000,000 people in the United States using radio, and radio is so interesting that the average user has in his mind dozens of questions the correct answers to which would require a whole course of special training. The author need hardly say that one Government bureau could not supply individual training for this multitude, nor that it would be utterly unable to do its main work if it attempted to answer all the questions that come to it.

Coming—the LC-28 Junior

Just the set for the fan who wants LC-28 quality, but who cannot afford the big receiver—three stages of high-frequency, a crystal detector, AND a low-frequency amplifier, all mounted as a single unit. It will be waiting for you in the May issue.

Durham
Resistors for Every Power Purpose!

NOW, after three years of experiment and research, International Resistance Co. offers a complete line of resistances for all types of receivers, power amplifiers and accessory radio devices at new lost costs which represent important savings.

Durham Resistors are supplied in ranges from 500 Ohms to 10 Megohms, while Durham Powerohms range from 1 to 50 Watts and are supplied with every practical type of tip as illustrated. All are constructed upon the well-known Durham Metallized principle which has been approved in every type of service by the most important set and amplifier manufacturers in the country.

As for years past with Durham Resistors, these modern Powerohms are guaranteed for accuracy and absolute dependability.

Ask your dealer or jobber, or write us for complete illustrated literature.

1 *Durham Resistors—500 Ohms to 10 Megohms; standard brass end tip, mould or pigtail type.*
2 *Durham Grid Suppressors—250 Ohms to 3000 Ohms in steps of 100; standard brass end tip.*
3 *Durham Powerohm—1 Watt; 250 to 1,000,000 Ohms; standard brass end tip or pigtail type.*
4 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; standard brass end tip type.*
5 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; knife-end type.*
6 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; soldered end tapped type.*
7 *Durham Powerohm—2½ Watts; 500 to 250,000 Ohms; screw-end type.*
8 *Durham Powerohm—5 Watts; 250 to 250,000 Ohms; soldered end tapped or screw-end type.*
9 *Durham Powerohm—10 Watts; 250 to 250,000 Ohms; soldered end tapped and screw-end type.*
10 *Durham Powerohm—25 Watts; 250 to 250,000 Ohms; soldered and tapped.*
11 *Durham Powerohm—50 Watts; 250 to 250,000 Ohms; soldered and tapped.*
12 *Durham Mounting supplied in various lengths to carry any required number of Powerohms where quick change of resistance is necessary.*

INTERNATIONAL RESISTANCE COMPANY
2½ South 20th Street, Philadelphia, Pa.

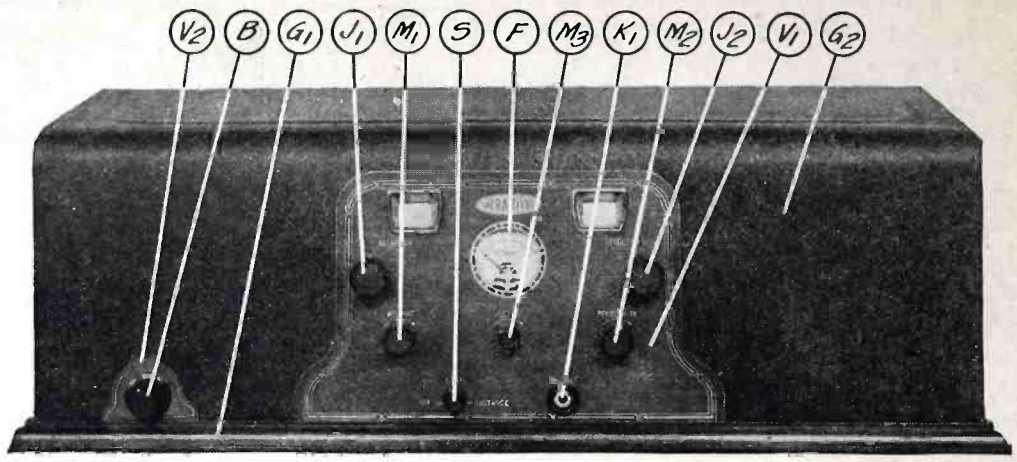
DURHAM METALLIZED RESISTORS & POWEROHMS

METALLIZED

METALLIZED

Plenty of New Ideas in the Remler Infradyne

(*Continued from page 289*)



THE PANEL CONTROLS

FIGURE 6: *Although the panel controls seem rather complicated for these days of simplified operation, it will be found that tuning in most stations requires only two controls. The other controls are for use in bringing in extreme distances.*

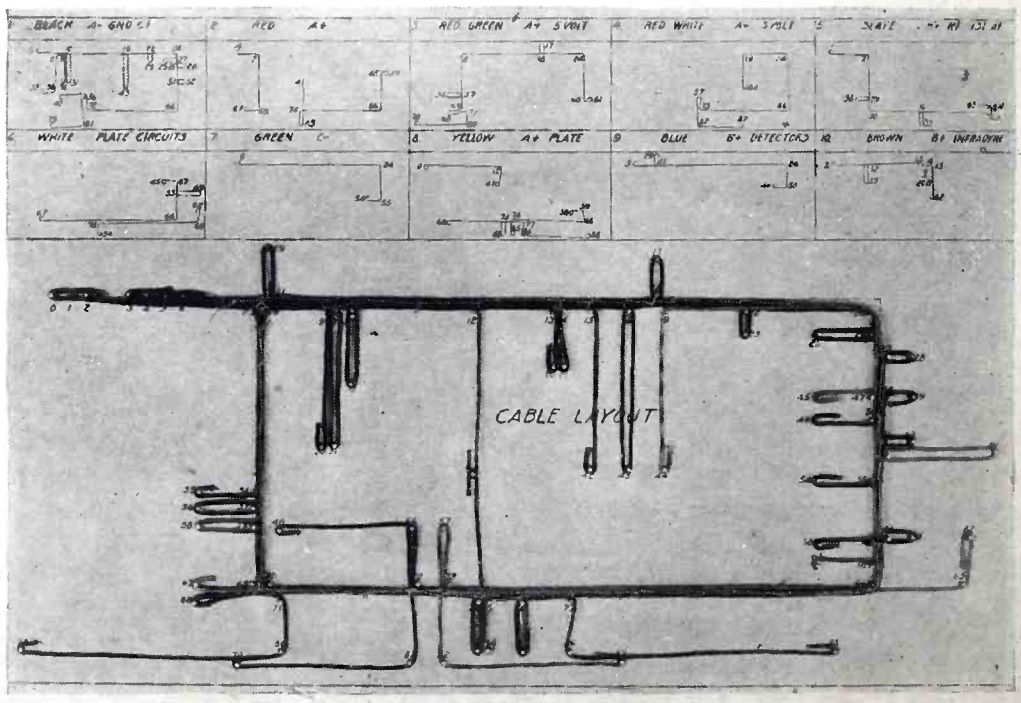
sockets U2 and U3, at the extreme right-hand end of the base. Place a CX-371 type valve in socket U4.

In connecting the batteries the red and black wires in the battery cable should be connected to the positive (+) and negative (—) terminals, respectively, of a 6-volt storage battery. Turn the switch, S, to the "local" position. All of the valves except those of the CX-299 type and the CX-301-a type valve at the extreme right-hand end of the base in socket U2 should light. The pilot light over the left-hand dial should also light. Now turn the switch to the "distance" position, and adjust the panel rheostat, M1, so that the voltmeter registers 3 volts; all of the valves in the set and both pilot lamps should now light.

Next connect up the "B" and "C" batteries, as shown in photo-diagram in Figure 5. Connect up the antenna and ground and plug in a pair of phones into the jack on the control panel. Set the inner part of the antenna compensator knob at "3" and adjust the outer part of the antenna compensator so that the moving coil makes an angle of about 45 degrees with the stationary coil. The left-hand tuning dial should read "zero" with the plates of the condenser in the high-frequency amplifier "wide open." Turn the volume control about 4/5 of the way "on" and rotate the left-hand dial slowly until a station on about 200 meters is picked up.

The balancing condenser connected across the antenna section of the gang condenser in the amplifier, A, should then be adjusted for the loudest signals. Fasten down the cover of this amplifier and the adjustment of the infradyne amplifier can be begun.

First see that the right-hand dial reads "100" when the plates of the con-



THE CABLE LAYOUT

FIGURE 7: *This picture is a reproduction of the paper template that comes with the foundation unit, with the cable properly laid out upon it by means of nails.*

denser are "wide open." Using the wooden wedge furnished with the amplifier turn the four infradyne amplifier tuning controls to "zero" and turn the infradyne amplifier "increase" screw abut 2/3 of the way "down," using the fingers instead of pliers. Then turn the switch on the front panel to the "distance" position and set the panel rheostat to exactly 3 volts. Set the left-hand dial for a station in about the middle range and set the "sensitivity" control to a point just beyond which a series of whistles is heard as the right-hand tuning dial is turned. The "increase" screw should be adjusted so that the whistles appear when the "sensitivity" control has been advanced about 1/3 of its range. Next rotate the right-hand dial until the station for which the left-hand dial is adjusted is brought in.

Consider the infradyne amplifier tuning controls reading from left to right as numbers 1, 2, 3 and 4. Leave No. 2 set at "zero." Adjust No. 3 for maximum signal strength, while rotating the right-hand tuning dial slowly back and forth past the station setting. Next rotate knob No. 1 for maximum signal strength and then adjust knob No. 4, coming back to knob No. 2 for a final adjustment. As the proper settings are found the amplifier will probably go into oscillation and a whistle will be heard as the station setting is passed. If this happens, turn the "sensitivity" control back until it ceases.

In operating the infradyne several pointers should be kept in mind. When the switch is in the "local" position only the left-hand tuning dial and "volume" control should be used. With the switch in the "distance" position the "sensitivity" control and both tuning dials will be used, in addition to the "volume" control. The voltmeter should always indicate 3 volts.

The two tuning dials should read nearly alike over the entire range.

When all of the adjustments have been made we are ready to put in place the metal cabinet, G1.

We now have a receiver which needs no further adjustment and is amply selective to cope with any local broadcast conditions.

By turning the switch to "local" the economy of operation is greatly increased, and by turning it to "distance" the man who wants "DX" will find all he wants in the way of sensitivity in fishing after far away stations.

Home-made Static

"WHAT part does Jenkins sing in your glee club?"

"I can't quite figure out, but I am about convinced he just adds the static to make it sound as if our selections were coming in over the radio."

—CINCINNATI ENQUIRER

Use the PR Converter for Television Wavelengths

(Continued from page 309)

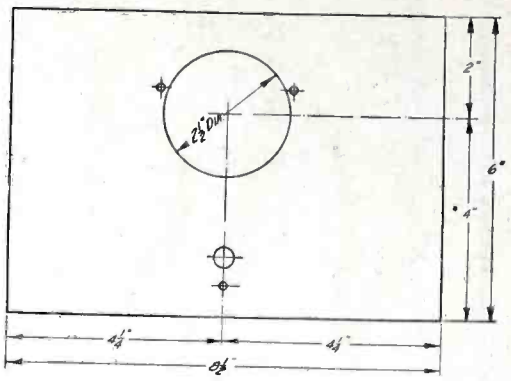


FIGURE 4: THE DRILLING PLAN FOR PANEL I1.

of the aluminum shield for mounting the drum dial, D, as shown in Figures 2 and 4. The direction sheet and template packed in the carton with this dial should be followed out in mounting this tuning dial.

Next drill the top panel, I2, as shown in Figures 2 and 5, for mounting the coil frame, the socket, E, and the choke coil, B. Also drill the four holes for passing through the necessary connections from the coil frame to the instruments mounted within the box shield. The coil frame is fastened to this panel by means of two machine screws and nuts. Looking at the front of the top panel, the machine screw on the right-hand end of this coil frame should be passed through to the socket, E. This one screw is used for fastening both instruments. The other side of the socket, E, is attached to the top panel by means of a machine screw and nut.

Next fasten the choke coil, B, to the top panel with the mounting bolt and nuts provided with this instrument.

Now drill the side shield, I3, for mounting the neutralizing condenser, H. A hole about ⅜ inch in diameter should be drilled in the upper left-hand corner of this panel for passing through the twisted leads of the connector plug. The neutralizing condenser, H, is fastened to this side panel by means of two machine screws and corresponding nuts. Two spacing washers approximately ¼ inch thick should be inserted between this instrument and the panel.

Next fasten the grid condenser, F, that is equipped with grid-leak clips, to the grid terminal of the socket, E.

The tuning condenser, C, is attached to the drum dial, D, by means of the special bracket furnished with the dial.

How to Wire the Short-Wave Converter

The picture wiring diagram in Figure 2 shows the instruments in their correct positions. The instruments mounted within the box shielding are outlined in solid black lines, while the coil assembly, A, which is mounted on top of the box shield, is shown in dotted lines.

The same holds true of the wiring. The heavy red wires are the connections to the instruments within the box shield and the dotted lines are the connections to the coil assembly, A.

The connector plug may be made from the base of a burnt-out UX type of valve. Remove the glass and other matter from the base and solder the two filament leads and the plate lead of the connector plug to their respective prongs. To avoid mistakes, check these instructions against the detail drawing in Figure 2.

When the wiring has been completed, the grid-leak, G, should be inserted in the grid-leak clips and the sides of the box shield should be inserted into the of the aluminum shield for mounting fastened with the aluminum screws.

How to Install and Operate the Short-Wave Converter

The antenna and ground connections are taken off the Hammarlund-Lynch "5" receiver, or any standard broadcast received with which this unit is to be used, and applied to the antenna and ground posts of the converter. Next insert the connector plug of the short-wave converter into the detector socket of the broadcast receiver. For details of connection, refer to Figure 3.

The vacuum valves recommended for the short-wave converter and the Hammarlund-Lynch "5" receiver are as follows: A Zetka ZD valve in the valve socket of the converter; two CeCo Himu valves in the first and second low-frequency stages and a CeCo type valve in the last low-frequency stage in the Hammarlund-Lynch "5" receiver.

The filament voltage of the valve in the short-wave converter is controlled from the filament voltage source used in the broadcast receiver.

The primary of the coil assembly, A, should be loosely coupled to the grid coil. All tuning is done with the variable condenser, C. Regeneration is controlled by the neutralizing condenser, H. This regeneration control should be adjusted for most satisfactory reception at each particular wavelength received.

The various short-wave ranges may be covered by interchanging the coils. It is recommended that a log be kept of the dial setting and coil used on each station received.

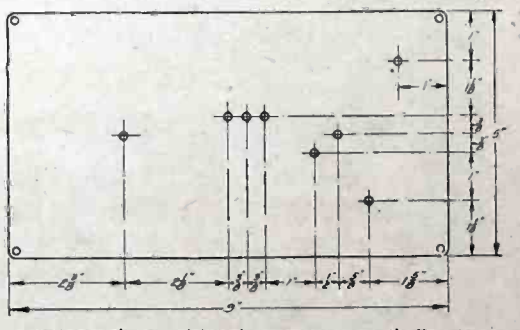


FIGURE 5: THE DRILLING PLAN FOR PANEL I2.

An "Air Road" Test With the Marti Electric

(Continued from page 316)

ter of fact, POPULAR RADIO did a great deal to inspire the work that eventually led to its perfection; for it will be recalled that as far back as 1924 POPULAR RADIO was quick to grasp the engineering possibilities of the AC valves of the heater type. Mr. Charles Marti, an alert young engineer and follower of POPULAR RADIO, having read of the experiments of the technical staff with these new valves, had sufficient courage and faith to proceed with the design of an all-electric receiver. As a result of his forethought, the Marti All-Electric is now conceded to be among the best receivers of this type.

The receiver makes use of two stages of high-frequency amplification. It is tuned by two illuminated dials, one connected to a single condenser and one to a double. Three stages of low-frequency amplification of the resistance-coupled type are used. Thus, with the detector included, the receiver has six valves. The last stage uses a CX-310 type amplifier valve, which supplies very great volume. This volume is controlled by a knob on the right-hand side of the receiver.

The power unit, that is, the "B" current supply and the filament heater transformer, is incorporated in the cabinet. A switch to accommodate low or high line voltages is also incorporated, together with a provision for using the AC line as an antenna if the user does not wish to go to the trouble of installing an outside wire.

Among the many unusual features of the Marti receiver is the possibility of interchanging the valves. Although the Marti is originally supplied with AC valves having separate heater terminals at the top, in every stage except the last, which uses a 310, any one of the five valves may be immediately replaced with a five-prong heater type valve.

The power unit which supplies the "B" voltage for the 310 and other valves makes use of a CX-381 rectifier valve.

In operating the receiver, it is necessary to know the meaning of the four controls on the panel. As previously explained, two of these are controls for the tuned-high-frequency stages. One is a volume control and the other a switch used for local and long distance reception—really, a high and low gear. This high and low gear, local and long distance switch on the Marti is an innovation which varies the impedance of the plate circuit in one of the high-frequency valves. For local reception sufficient volume will be had with higher impedance, but with distance better results can be obtained with lower values of impedance.

This "air-road" test of the Marti receiver proved to be unusually interesting and somewhat amazing in the matter of results achieved. In tuning, the receiver was found exceptionally sharp; so sharp, indeed, that oftentimes the accuracy of a hair's breadth was necessary to separate the stations in the lower and more confused portion of the radio spectrum. In tuning the Marti, the dial on the right is used first to bring the signal in at maximum loudness, keeping the two dial settings approximately even. The second dial is used to "trim up" and to bring the first tuned circuit in resonance with the other two tuned circuits.

With the control knob on the long distance tap and the volume control abut three-quarters of the way round, the Marti provided not only exceptional quality, but very great sensitivity. Even with the increased output of the two high-frequency valves, there seemed to be no indication of undue regeneration or other circuit noises. The AC current hum was conspicuous by its entire absence.

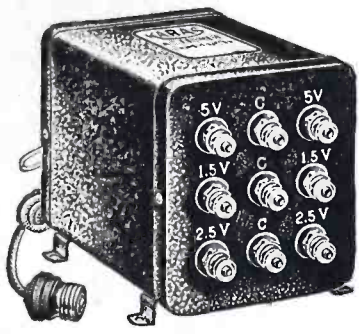
Beginning at 8.15 p.m., the "driver" of this air road test skipped from one side of the country to the other during the course of the evening. In the early part of the evening (New York was the operating center) the following stations were logged:

WJAR, WJAX, WEEI, WFI, KYW, WEAF, WJZ, WOR, WAAN, WGL, WGY, WGR, WICC, WTIC, WQAM, WMAK, WHAN, KDKA, WSM, WWJ, WLS, WEBH, WQJ, WGN, WLIB, WBAL, WBZ, WTAG, WWRL, WLWL, WABC, WFBL.

Later on in the evening and during the early morning KOA and KFI were logged under atmospheric conditions that could by no means be considered ideal.

A careful examination of the mechanical details of the Marti All-Electric will convince even the most discriminating engineer that extremely good judgment has been used in producing this receiver. The shielding is of aluminum, with a mottled finish and provided with a ventilating system which carries away the excess heat developed by the 310 and 381 valves. There is an admirable compactness about the whole unit, fixed condensers, resistances, and other necessary appurtenances being very carefully concealed by the shielding. Special flexible spring connectors are used to make contact with the heater elements of the Kellogg valves used. The various condensers and resistances, as well as the high-frequency coils of the Marti, are easily accessible by simply taking the valves out of the receiver and turning the set upside down. Removing the perforated cover exposes the parts and permits easy access to them for repair.

KARAS stands for QUALITY in the "CUSTOM-BUILT" FIELD!



TYPE I2

Supplies up to 8-226, 2-227, 2-171 tubes.

$8.75 List

THE KARAS A-C-FORMER

Converts battery sets to AC operation Delivers absolutely correct voltage. Needs no separate device for center tap. Has plug-in connection to "B" eliminator, and wire to panel switch. No re-wiring necessary. Operates with Carter, Eby or other cable harness.

KARAS MICROMETRIC VERNIER DIALS

Smooth, velvety action—no back-lash. Vernier ratio—63 to 1; tunes to 1-1000th of an inch. 0-100; 100-0 and 3608.

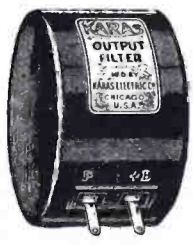
List $3.50

THE NEW KARAS S. F. L. CONDENSER

The finest product of years of experience. Removable shaft allows for subpanel, baseboard or single hole mounting from either side, permitting use of 0-100 or 100-0 dials.

TYPES

11	.00025 mfd.	$5.00
17	.00037 mfd.	5.25
23	.0005 mfd.	5.50



KARAS OUTPUT FILTER

Improves reception. Eliminates chattering of speaker. Sweetens and clarifies tone qualities—prevents demagnetization. List $8.00

KARAS TYPE 28

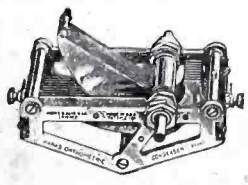
The world's greatest transformer—perfect reproduction of low and high notes plus tremendous volume! Scientifically impregnated—in a steel-clad spun-sealed case to safeguard its marvelous amplifying qualities. List $8.00

KARAS HARMONIK

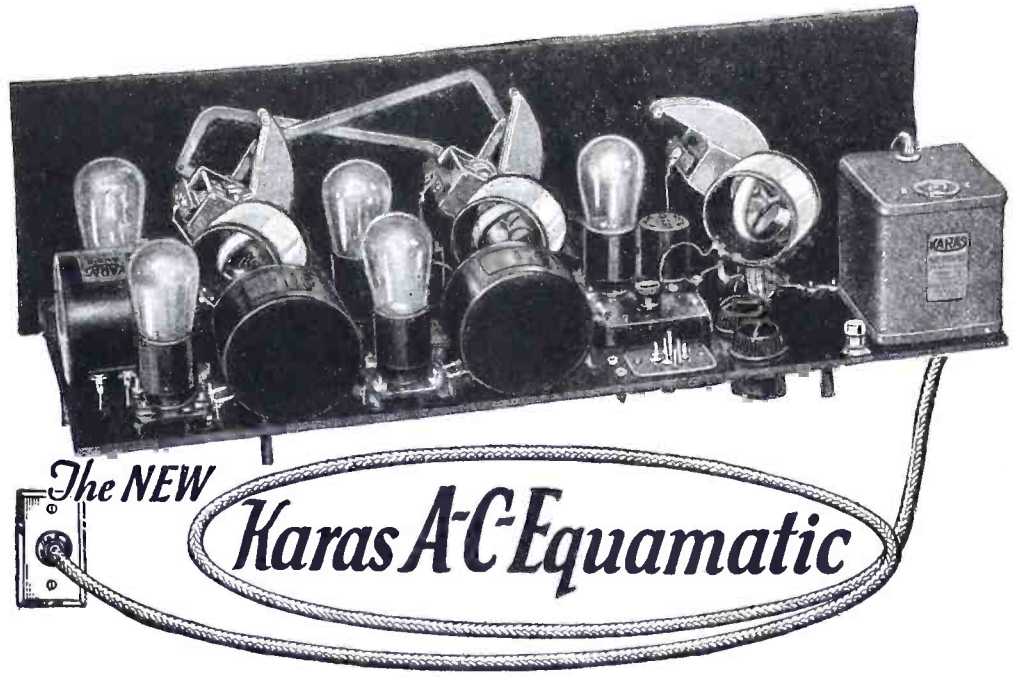
This audio-frequency amplifying transformer delivers most beautiful reception—amplifies with great volume, clarity and purity. List $5.00

KARAS ORTHOMETRIC CONDENSERS

Separates adjoining wavelengths by equal distances on the dial.



5 plates—.0001 mfd. capacity	$6.50
7 plates—.00014 mfd. capacity	6.50
11 plates—.00025 mfd. capacity	6.50
17 plates—.00037 mfd. capacity	6.75
23 plates—.0005 mfd. capacity	7.00
17 plates—extended shaft .00037 mfd. capacity	7.00



The NEW **Karas A-C Equamatic**

Operates from any 110 v. light-socket!

A pleasure to build—and a joy to operate—the Karas 2-Dial Equamatic! The only completely balanced and perfectly neutralized 5-tube A. C. Kit. Uses standard 226 and 227 A. C. Tubes. The A filament supply is furnished by the new and sensational Karas A-C-Former. Build the set that is famous for its distance-getting ability, superb tone volume and amazing selectivity—and then just plug it into any 110-volt A. C. light socket! You can get the complete kit from any dealer or arrange to have it built through your dealer or set builder! The cost is far less than a commercial set of similar quality!

ASSOCIATE MANUFACTURERS

CARTER YAXLEY HAMMARLUND
BENJAMIN SAMSON ELECTRAD DURHAM

Buy or Specify Karas Parts

Karas parts have long been famous for their scientific construction with quality materials! Whether you build yourself, or through your dealer or set builder, be certain to specify Karas parts. You will be pleased and delighted with the extraordinary performance of every part in the Karas line.

Dealers and Set Builders!

Line up with the Karas line! It is accepted by set builders and consumers throughout the country. Karas circuits have met with unqualified success and recommendation, and Karas parts have maintained a high reputation for scientific accuracy and precision! The Karas Transformer line will be unusually complete this year—which is highly important to every dealer!

WRITE FOR CATALOG, FULL INFORMATION, ETC.

KARAS ELECTRIC CO.

4029 D-N. Rockwell Street, Chicago.

33 years manufacturing precision electrical apparatus!

In the Professional Set Builder's Shop

(*Continued from page 318*)

A New Power Valve

A STILL larger and more powerful amplifier valve has recently been announced by valve manufacturers. It is designated as the 250 power amplifier and is capable of delivering over three times as much undistorted energy as the UX-210, long the favorite power amplifier valve for maximum volume and tone quality in home reception.

The 250 is considerably larger in size than the 210, although its base is identical. The filament of the new power amplifier is of the improved coated ribbon type, which insures great mechanical strength and operating life.

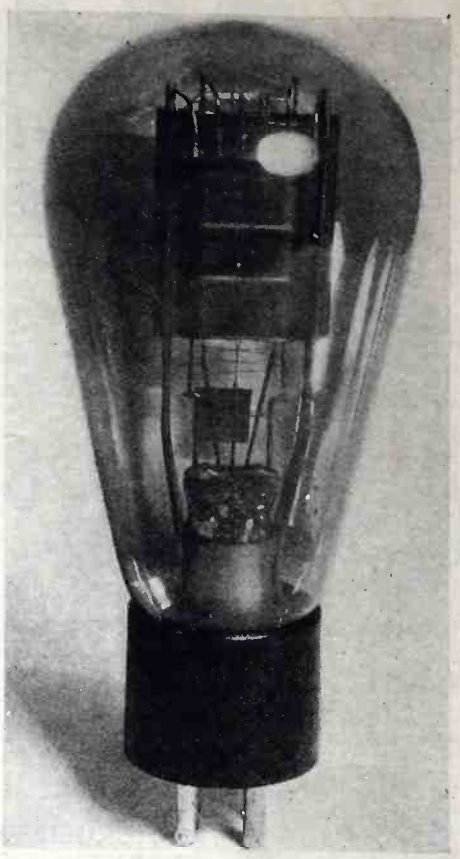
This new valve will provide a far greater output volume, without distortion, than has heretofore been possible, especially in conjunction with auditorium reproducers and in the operation of a number of reproducers from a common amplifier, as in hospital and exposition work. It is interesting to note that while the plate voltage has not been materially increased over that of the 210, the required plate current is three times as great as for the 210.

The characteristics of the 250 are given in the accompanying chart.

When used as a transmitting valve the UX-250 is rated at 25 watts as against the 7½-watt rating of the 210. As a power amplifier (receiving) valve the maximum undistorted output of the 250 is 4,650 milliwatts (4.65 watts) as against 1,540 milliwatts (1.54 watts) for the 210, 700 milliwatts for the 171, 195 millwatts for the 112-A, and 110 milliwatts for the 120 power valve.

As with other large power amplifier valves, the output of the 250 cannot be led directly to the ordinary reproducer. Instead, it is necessary to utilize some form of reproducer coupling system, either in the form of an output transformer or a choke and by-pass filter.

With the addition of the 250, it now appears that every conceivable radio requirement is filled, from the small dry-battery operated receiver to the large auditorium amplifier that entertains large audiences with the radio.



THE 250 POWER VALVE

Occasional Testing Keeps Valves Fit

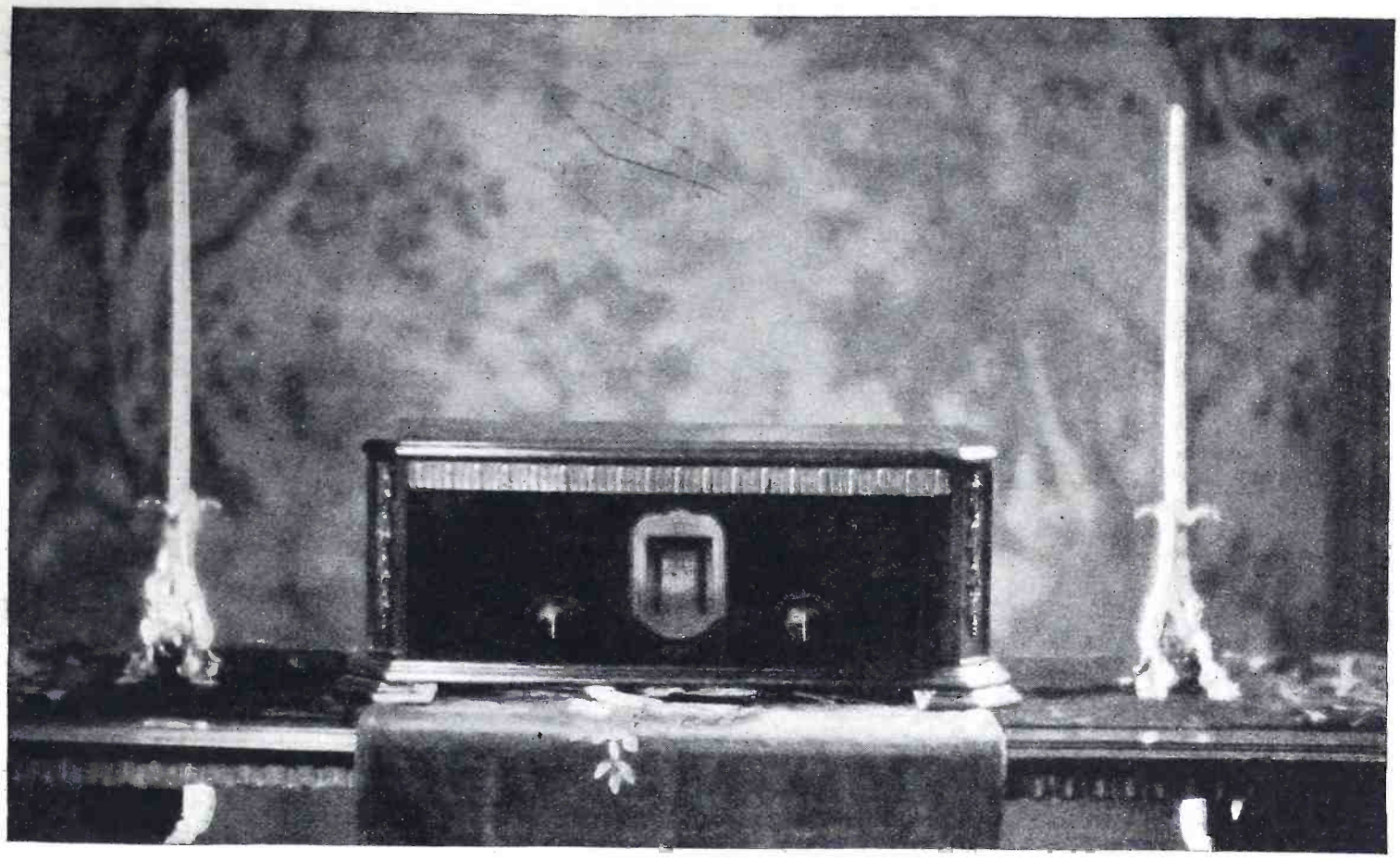
IT is a good plan to have the valves in a receiver tested after every three or four hundred hours of service. If a receiver is in use an average of three hours per day, for instance, it will be worth while to have a service man test the valves about once every four months, and to replace any that are found to be wearing out. This is particularly important where the receiver makes use of rheostats for the adjustment of the valve filament supply, because if a single valve starts to wear out there will be a tendency to make up the decreasing volume by turning the other filaments up higher, and the usual result is that several valves are prematurely worn out, whereas replacement of the one poor valve would have saved the others.

—OGDEN ALBERSON

CHARACTERISTICS OF THE 250 POWER VALVE

	Recommended			Maximum	
Plate voltage (volts)	250	300	350	400	450
Negative Grid Bias (volts)	45	54	63	70	84
Plate Current (millamperes)	28	35	45	55	55
Plate Resistance (a-c) (ohms)	2100	2000	1900	1800	1800
Mutual Conductance (micromhos)	1800	1900	2000	2100	2100
Voltage Amplification Factor	3.8	3.8	3.8	3.8	3.8
Max. Undistorted Output (milliwatts)	900	1500	2350	3250	4650

Filament	7.5 Volts	1.25 Amperes
Max. Overall Size	Height 6¼"	Diameter 2 11/16"
Base	Standard UX	



The New Improved Hi-Q Six—the creation of ten foremost American Radio Engineers — a receiving instrument that is far in advance of its time.

Exclusively CUSTOM-BUILT

By Yourself at Home . . . from our Simple Instructions . . . and at Great Savings!

No ordinary standards can be applied to this latest improved Hammarlund-Roberts Receiver, for it is the result of a determination to produce America's very finest instrument—absolutely regardless of cost!

Every modern constructional feature has been incorporated. Each part is the most efficient known to radio science, and the entire group has been purposely selected for perfect synchronization.

Complete isolation of four tuned circuits plus Automatic Variable Coupling effects maximum and uniform amplification over the entire wave band. Distortion is totally eliminated. Oscillation is utterly absent. Symphonic transformers and a power tube faithfully reproduce the full musical scale. Selectivity, even in crowded areas, is something to marvel at. And tonal quality simply MUST be heard to be appreciated!

Completely drilled panel and sub-panel are foundation for easy building.

Such a set, factory made, and sold through usual channels, would possibly cost around $300.00, but, through following our simple instructions, you can purchase all parts for only $95.80 and build this supreme receiver yourself —a CUSTOM BUILT set which gives you CUSTOM BUILT results at a saving of $100 to $150.

Get the complete Hi-Q Instruction Book from your dealer—or write us direct. Price 25 cents.

Hammarlund ROBERTS Hi-Q* SIX

HAMMARLUND-ROBERTS INC. 1182 Broadway, Dept. B New York City

Associate Manufacturers

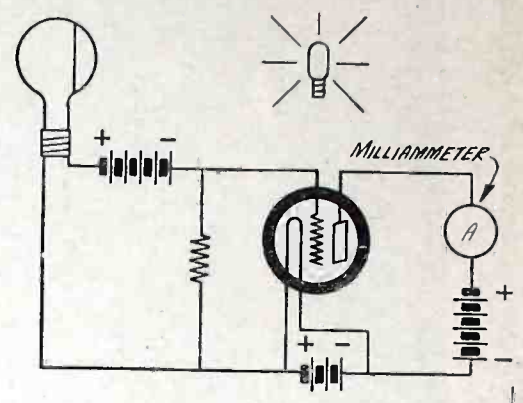
The "Eye" of Television

(*Continued from page 300*)

proportional to the intensity of the light falling upon it. However, this statement requires a little modification. It is true, provided the color of the light is not changed, but it is not true that equal intensities of blue and red light will produce the same response in the cell.

In this respect the cell resembles the human eye, in that it is not equally sensitive to all colors. Figure 4 shows the visual sensitivity curve of the average human eye. The ordinates represent the relative effect produced on the eye by equal amounts of light energy of different colors. The maximum occurs in the yellow-green portion of the spectrum for the average person. Of course, for a color-blind person the curve would be different. Now, if we investigate a photo-electric cell of, let us say, potassium in the same fashion, by exposing the cell to equal amounts of energy of light in different parts of the spectrum and observe the current which passes through the cell we will obtain the curve shown in Figure 5. This curve, like the visual sensitivity curve, passes through a maximum, but the maximum for potassium occurs near the ultra-violet part of the spectrum and the curve is very low in the red part of the spectrum. This means that a potassium cell does not see colors the same way that we do, as it is far more sensitive to blue and less sensitive to red light. The shape of this curve and the wavelength for maximum sensitivity differs for different substances. No two elements see colors in just the same way.

One application in which color sensitivity plays a very important rôle is in the photometry of lamps. Instead of measuring the candlepower of lamps by means of a visual photometer, a number of methods have been devised for doing the same thing with photo-electric cells. Now suppose that two lamps, one gas-filled and one a vacuum-type lamp, have been compared with a visual photometer and found to be of the same candlepower. If these two lamps are now compared on a photo-electric cell photometer, the results will not agree with the visual measurements. The gas-filled lamp operates at a higher temperature than the vacuum lamp and so emits a larger proportion of its radiation in the blue portion of the spectrum. The photo-cell is particularly sensitive to blue radiation and will give a larger current for a given amount of blue than for the same amount of red light. Consequently, to the cell, the gas-filled lamp will appear the brighter, although to the eye both lamps appear the same. This defect is overcome by correcting the cells by means of suitable color filters before the cell window.



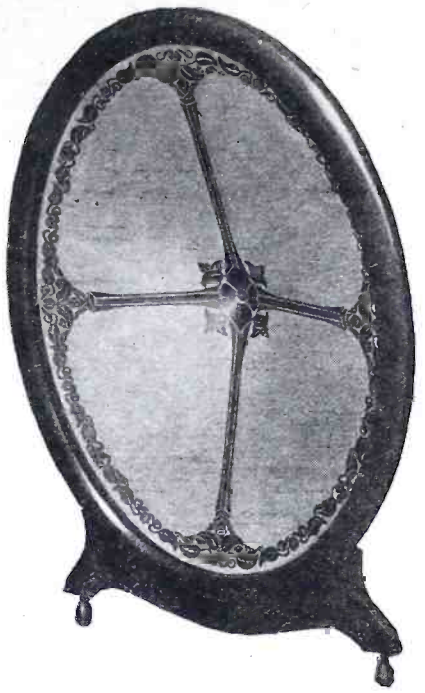
AMPLIFYING THE OUTPUT OF A CELL

FIGURE 6: *This diagram shows how the output of a cell may be amplified by means of a stage of resistance-coupled amplification somewhat similar to those employed in many present-day receivers.*

In cases where it is desired to use ultra-violet instead of visible light, the cell are made somewhat differently. Instead of the alkali metals, substances such as zinc, magnesium and cadmium are used. These metals are sensitive to ultra-violet light, but not to visible light. Ordinary glass is nearly opaque to ultra-violet, so the bulbs are made of quartz.

The output current of the photo-electric cell is small, so that for most practical applications it must be amplified. This can be done with ease by using vacuum valve amplifiers in circuits well known to all radio men. One of the simplest of these circuits is shown in Figure 6. A grid-leak resistance of several megohms is connected in series with the photo-electric cell and the ends of the resistance are connected to the amplifier valve filament and grid, respectively. Any changes in cell current produce similar changes in the potential drop across the resistance, which results in large changes in current in the plate circuit of the radio valve. Of course, this is nothing but resistance-coupled amplification.

Now as to possible uses of the photo-electric cell. New applications for it are arising every day. Two of the most spectacular ones are television and the talking movies. There are a number of systems of television, all of them fairly complicated, but the essential feature in all of them is the photo-electric cell. A beam of light travels across the object to be viewed and is then reflected back into a photo-electric cell. The amount of light falling upon the cell will depend upon the object, the white parts sending a strong beam of light into the cell and the dark parts a weaker beam. These will produce respectively large and small currents in the cell. Thus the shading of the object is translated into an electric current of varying magnitude.



Height over all—44 inches
Width—30½ inches
Depth of base—11½ inches

SOUND
REPRODUCING
DEVICES

Announcing

The S-P-N Speaker

an entirely DIFFERENT Speaker that gives you True Tone without Distortion! and here are the reasons:

FREEDOM FROM EXCESSIVE VIBRATION—Distortion in loud speakers, as in radio sets, is due to "resonance"—excessive vibration at particular frequencies. These vibrations cause harshness when in the high frequencies, and "drumminess" when in the low frequencies, and in all cases a hang-over effect, running one note into another, and so destroying sharpness of definition. To overcome this in the S-P-N speaker, a principle unique and important has been introduced; a suspension designed to neutralize the vibrations reflected at the edge of the cone. It makes use of the relative phase-shift occurring at free and fixed boundaries, an effect which is independent of frequency, and which does not cause the loss of energy which occurs when damping devices are used.

SINGLE CONE TYPE—Resonance or reverberation found in horn or double cone types due to wholly or partially confined air-spaces is avoided.

DRIVING UNIT—Balanced armature type of very heavy construction employing four large permanent magnets, ENABLING IT TO CARRY HIGH POWER AT LOW FREQUENCIES.

PAPER—Carefully selected after thorough testing to give proper relation between reproduction of high frequencies when only part of the area is effective, and reproduction of low frequencies when the whole of the area acts in producing sound waves.

FLOOR OR WALL TYPE—Can be used either as a floor model or by removing four screws can be converted into a wall type.

FINISH—Frame and pedestal are high-grade cabinet finish, the whole constituting a handsome piece of furniture of restrained type, harmonizing with any surroundings.

ENGINEERING STAFF—This speaker was developed after four years of research work by H. H. Newell, B.S., A.M.I.R.E., A.I.E.E., and S. J. Plimpton, B.A., Ph.D., of the staff of one of the country's leading technical schools, and R. Bruce Sturrup, Radio Engineer. The standing of these men is a guarantee of the thoroughness of the work.

PRICE $65.00 F. O. B. Worcester.

STURRUP-PLIMPTON-NEWELL CO.

P. O. BOX 152, STATION A WORCESTER, MASS.

"—in all DC sets where the amplification per stage in the radio frequency is low, they can be used to great advantage."

Increased Amplification by simple change in valves

This new 6-volt amplifying valve is the latest production of Harold P. Donle, inventor of the already-famous sodion detector valve.

The Donle-Bristol DA-2 has a new type of oxide-coated filament, producing a much higher emission. It is used successfully in the high frequency amplifier of any standard DC set, *with no changes of any kind in the circuit.*

Each valve used increases the amplification from 30 to 50%—a gain at least equal to that which would be secured by an additional radio stage.

Le Clair's Radio Shop of Peekskill, New York, writes on March 9, 1928:

"We are in receipt of four Donle-Bristol DA-2 amplifier tubes. We have made many different tests and find that the tube is all that is claimed for it.

"The only objection we could find is that due to the great amplification the local interference is much more noticeable. However, in all sets where the amplification per stage in the radio frequency is low, they can be used to great advantage. The increase in volume in some circuits is even greater than half."—Le Clair's.

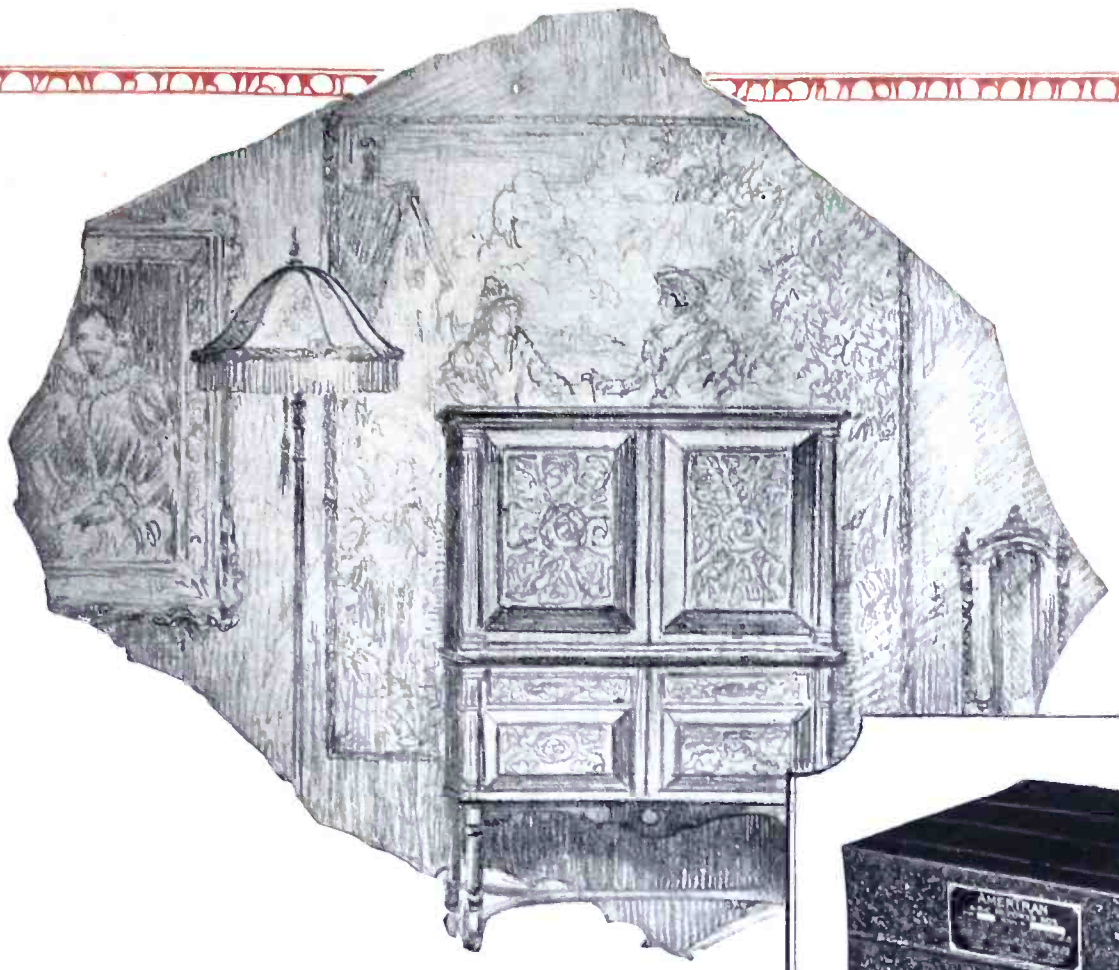
Complete characteristics will be mailed upon request, and if your dealer has not yet secured his stock, mail orders will be promptly filled by the manufacturers.

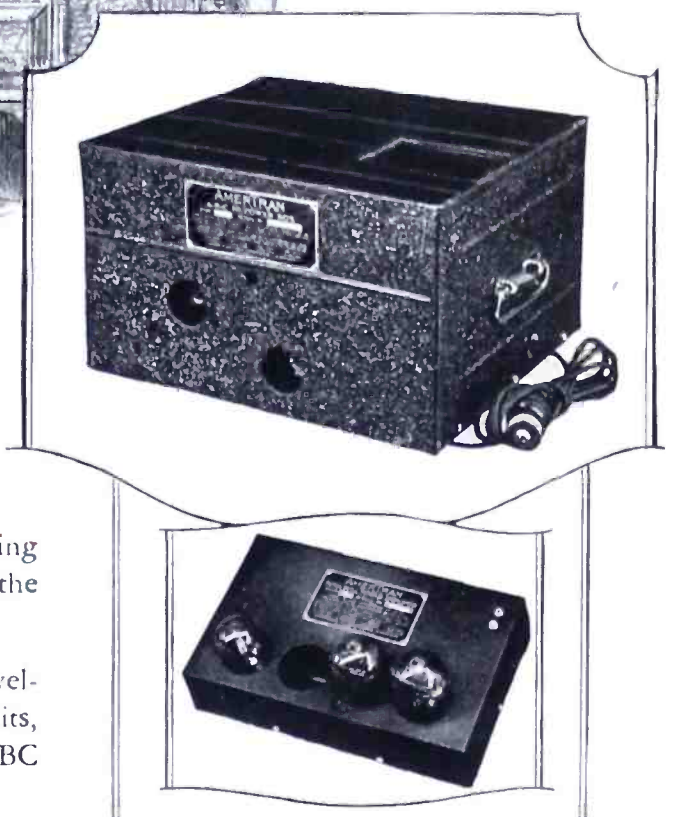
Exact size photograph of the new Donle-Bristol DA-2 Amplifying Valve.
Price $3.00 each

THE DONLE-BRISTOL CORPORATION

MERIDEN, CONNECTICUT

We are also manufacturers of high quality special-duty tubes and valves of all types and shall be glad to quote on your requirements





Link Your Tuner to Natural Reproduction

THERE are thousands of hours of good operation left in your tuning circuit. In the last three years there has been no progress made in the development of better commercial tuners.

But the Audio! Three years have brought new refinements, new developments which have culminated in the new AmerTran companion units, the AmerTran Push-Pull Power Amplifier and the AmerTran ABC Hi-Power Box—the Power House of Radio Sets.

Link your tuner to Natural Reproduction—transform your old set to one that will astonish even your most critical musical friends. Your imagination cannot exaggerate the difference this combination will make in your set. Low notes of course, but the lows with no loss in the upper range so necessary to brilliance in musical reproduction.

Never, in all your experience, have you heard its equal—hear it at your favorite dealer's store. Send us the coupon, we'll arrange the demonstration for you, no obligation of course. Your radio experience is incomplete until you have heard this, the crowning accomplishment of AmerTran.

AMERICAN TRANSFORMER COMPANY

Transformer Manufacturers for 28 Years

110 Emmet Street, Newark, N J.

AMERTRAN

TRADE MARK REG. U.S. PAT. OFF.

Both Units are extremely flexible. The Push-Pull amplifier consists of a first stage AmerTran DeLuxe and second stage AmerTran Push-Pull for two power tubes. Two types — one for UX-171 tubes, one for UX-210 tubes. Choice of UX-201A or UX-227AC for first stage for DC or AC operation.

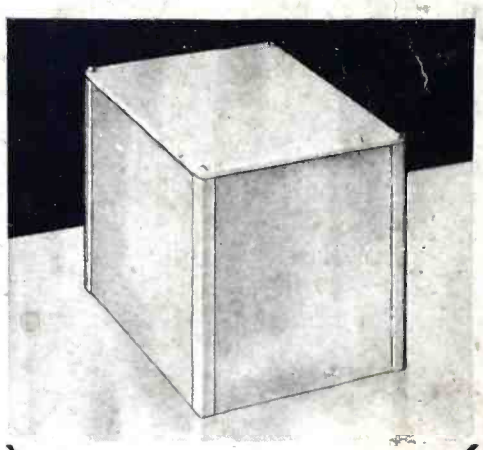
The ABC Hi-Power Box is a 500 volt DC plate supply (lower tap voltages, of course) plate current to 110 ma; AC filament current for a 281 rectifier, two 210 Power tubes and sufficient 226 and 227 AC tubes to take care of any set. Adjustable negative bias voltages for all tubes. May be used with AC sets, or to convert DC sets to modern AC receivers.

Both units are licensed under patents owned or controlled by the RCA and may be bought complete with RCA or Cunningham tubes.

Prices: Push-Pull Amplifier . . 60.00
ABC Hi-Power Box . . 95.00
East of Rocky Mts. Both without tubes.

AMERICAN TRANSFORMER CO.
110 Emmet St., Newark, N. J.

☐ Kindly send complete information on the AmerTran Push-Pull Amplifier and ABC Hi-Power Box.
☐ Please arrange for demonstration at my dealer's.
Dealer's Name .....
Address .....
Name .....
Address .....
City ..... State .....



Junior Aluminum Box Shields

Four of these shields on an aluminum sub-panel are used in the L. C. 28 Set

For greater selectivity, finer appearance, longer life, lighter weight, use Aluminum Box Shields in the set you build—and look for Aluminum Shielding in the set you buy.

Designers agree on the superiority of Aluminum for shielding. It has become an established factor in radio design—recognized alike by advanced amateur set builders and engineers responsible for commercial production.

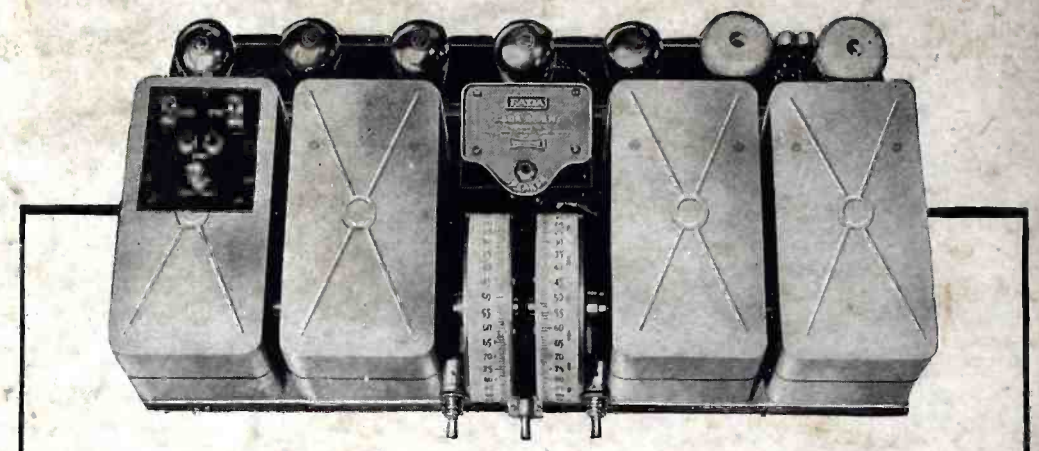
Aluminum Company of America's Junior Box Shields, designed especially for amateur sets, are made of heavy Alcoa Aluminum with satin-dip finish, size 4½ in. x 4½ in. x 5 in. high. (Made also in standard size, 5 in. x 9 in. x 6 in. high.) They require no soldering.

Four of these Junior Aluminum box shields (no bottoms required) together with an Aluminum sub-panel are supplied for Cockaday's L. C. 28 Receiver, which is being featured in this magazine.

If your dealer cannot supply you with Junior Aluminum Box Shields send us your order and we will have an authorized dealer ship them promptly at $8.00 per set of four. (Standard size at $3.50 each.) You simply pay the postman.

ALUMINUM COMPANY OF AMERICA

2461 Oliver Bldg. Pittsburgh, Pa.



F. A. D. Andrea, Inc., uses Alcoa Aluminum for Shielding and other parts of "Fada" receiving sets.

Expect Better Results When You See *This* Metal in Radio

WHEN you look at radio receivers using aluminum shielding or condenser blades; aluminum castings, front panels, chasses or sub-panels you will know that the manufacturer has chosen the *one* metal that most efficiently meets *all* the widely differing conditions encountered in radio design.

MR. L. M. CLEMENT
Chief Engineer of F. A. D. Andrea, Inc., commenting on shielding says, "In a radio receiver aluminum, because of its electrical conductivity, makes a more efficient shield than any other of equal weight. The material can be easily drawn into the desired shape and its finish is permanent and pleasing to the eye."

Such famous makers as Atwater Kent, Crosley, Fada, Freed-Eisemann, Grebe, Howard, R-C-A, Stewart-Warner, Stromberg-Carlson, Zenith and a host of others employ parts of Alcoa Aluminum so that the purchasers of their receivers may enjoy the *best of radio reception*.

These makers recognize the superiority of Alcoa Aluminum. They appreciate its ideal combination of high electrical conductivity, lightness, strength, and beauty. Look for Aluminum in the set you buy—when you find it you may expect the *best* results that the *best* radio engineers have yet achieved. Send for a copy of our new booklet, "Aluminum for Radio." It is free.

ALUMINUM COMPANY OF AMERICA

2461 Oliver Building Pittsburgh, Pa.

ALUMINUM

The mark of Quality in Radio

QUADRI-COLOR CO., JAMAICA, N.Y.C.