Blueprint Section Every Month

RADIO AGE

The Magazine

January 1927

Full Data on World's Record Super 8

¶ Keeping Pace With Science

¶ Everyday Mechanics

25¢

SM Who Was Right?

Two said they were wrong—thousands use them with a degree of satisfaction not obtained with any other kind of audio amplifying device.

That is the story of S-M 220 audio transformers. Five months ago when 220's were about to be offered to the public, samples were sent to all important laboratories and magazine editors. Enthusiastically favorable comment came from all but two. Two editors condemned them because they were not "perfect" insofar as the construction and design of transformers alone is considered. But there lay the very cornerstone upon which the S-M 220's and 221's were developed—they were not intended to be "perfect" alone. The dominant thought at the outset was not to build a "perfect" transformer but rather one whose characteristics, together with all the other elements that had to be considered, would render perfect tones. Existing speakers had to be considered, the short comings of broadcasting had to be compensated for and consequently the 220 is not a "perfect" transformer when used alone, but a unit which when used with ordinary loud speakers for every day broadcast reception, produces, for the whole, almost perfect reproduction.

Who was right?

Now after five months, thousands of transformers have been sold. Each was bought with an unheard of guarantee—that it would give better reproduction than any other type of equipment. And only two have been returned for refund! Are we to believe the two who said the transformers have to be "perfect" or the unqualified endorsement of all but two of the thousands of users?

Two against thousands—who was right?

You, too, can buy S-M 220 audio and 221 output transformers with the same "better than anything else you've ever heard" guarantee. The price is but $6.00 each.

Do you know the secret of quality reproduction?

Have you your copy of "The Secret of Quality"? It tells you simply how to get the most out of your audio amplifier—how to get *real* quality. It explains just why a "perfect" amplifier is of no value—why "imperfect" speakers, transmitting stations, and compensating audio transformers, spell perfection for you.

It's free! Ask your dealer for a copy.

Prices 10% higher west of the Rockies.

SILVER-MARSHALL, Inc.

850 West Jackson Blvd. **Chicago, U. S. A.**

Interchangeable Inductances, made in many types and ranges, $2.50 each. Uniformly interchangeable coil socket, $1.00.

316-A and 316-B variable condensers, .00035 capacity, $4.50 each.

210 long wave transformers and 211 filter, $6.00 each.

340 Compensating condenser, $1.50.

Now Owns a Radio Store

"The Radio business is rushing just now. Building many Super Heterodynes, also doing installation and repairing. To your course I owe all my success in the Radio profession." A. J. Ommodt, Bowman, N. Dak.

Controls First Car by Radio

"I operate the portable broadcasting station in rear car, driving front car by Radio control. Will operate this car from New York to Frisco—13 months trip. Then we take the car around the world—a three years' tour. I owe it all to you." Leo Paul, New York City.

You Can Do What These Men Did!

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

Get into the great new Big-pay Industry—Radio. If you're earning a penny less than $50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at $25 or $35 or $45 a week, when you could earn $50 to $250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you? I'll train you just as I trained them—just as I trained the men whose letters you see on this page. I'll teach you quickly at home in your spare time to be a Radio Expert, and draw down big money for the easiest and most fascinating work in the world.

HERE'S WORK THAT IS ALMOST ROMANCE!

These Instruments Given FREE of Extra Cost

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

$50 to $250 a Week as a RADIO EXPERT

It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying $75, $100, $200 a week and up. Free book gives all the facts. Every day N.R.I. trained men are taking good places in the Radio field—men like you—men like those whose stories I show you here. You can prepare just as they did by new practical methods, learn right at home in your spare time. Lack of experience no drawback—common schooling all you need. Our tested clear methods make it easy for you. We guarantee to train you successfully. Big Free Book contains all the proof.

My Radio Training is the "Famous Course That Pays for Itself"

Make more money quick when you take up this practical course. I show you how to increase your earnings almost from the start of your course through practical pointers I give you.

Howard B. Luce of Friedens, Pa., made $320 in 7 weeks during his spare time. D. H. Suitt of Newport, Ark., writes "While taking the course I earned in spare time work approximately $900." Earl Wright of Omaha reports making $400 in a short time while taking his course—working at Radio in his spare time only! Sylvester Senso, 207 Elm St., Kaukana, Wis., made $500. These records not unusual—these men are a few of hundreds.

And when you graduate, my big Free Employment Department helps you get the job. You get just the same preparation and assistance toward success we gave C. C. Gielow, Chief Operator of the Great Lakes Radio Telegraph Co., E. W. Novy, Chief Operator of Station WRNY, Eric Chambers, Radio Engineer for Stewart-Warner, J. E. Fetzer, Chief Engineer of Station WEMC. The National Radio Institute, established 1914, today offers you the same opportunity these men had under a bond that guarantees you full satisfaction or money refunded. It's your big chance to get into the great Radio field—mail coupon TODAY for my big Free Book and proof!

Clip Coupon Now for FREE BOOK

Most amazing book on Radio ever written—full of facts and pictures—tells all about the great Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

J. E. Smith, Pres.
NATIONAL RADIO INSTITUTE
Dept. A-91
Washington, D. C.

$70 in one Day for T. M. Wilcox

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

Kimball With WMAQ Chicago

"Accepted a position with the Chicago Daily News Station WMAQ. My income practically doubled, thanks to your fine course. I handle all consultation also do operating." Keith Kimball, Station WMAQ, Chicago, Ill.

Promoted to Big Job

"Just been made Sales Manager of this Radio firm—received a very good increase in pay. Up to present have been getting salary which in 3 months enabled me to purchase a new car." R. Jones Bay City Mich.

Read the true stories printed in this border—of men who got out of the rut

Chief Engineer Station WEMC

"Please communicate with my two junior operators here who want to increase their knowledge of Radio. Being a graduate of your course I know they could do nothing better for themselves than study it for it is the way to success in this profession." John E. Fetzer, Chief Engineer, Station WEMC, Berrien Springs, Michigan.

Photo shows Graduate E. F. Spadoni in his own Radio store at Chicago, Ill. "Your course gets the credit," says Spadoni.

RADIO NEEDS TRAINED MEN!

Originators of Radio Home-Study Training

MAIL THIS NOW!

SEND THIS COUPON

J. E. Smith, President
NATIONAL RADIO INSTITUTE
Dept. A-91, Washington, D. C.

Dear Mr. Smith: Without obligating me in anyway, send me your free book "Rich Rewards in Radio" and all information about your practical, home-study Radio course.

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

Street Address.....

Town.....State.....

RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 6 *January, 1927* *Number 1*

CONTENTS

FOR JANUARY ISSUE

Cover Design by Gordon K. Martin

Radio Age is published monthly by RADIO AGE, Inc.
Member: Audit Bureau of Circulations.
Publication Office, Mount Morris, Ill.
404 North Wesley Ave.,
Address all communications to RADIO AGE, Inc.
Executive, Editorial and Advertising Offices
500 N. Dearborn Street, Chicago, Ill.

FREDERICK A. SMITH, *Editor*
F. A. HILL, *Associate Editor*
M. B. SMITH, *Business Manager*

Advertising Manager
HARRY A. ACKERBURG
500 N. Dearborn St., Chicago, Ill.

Eastern Representative
HEVEY & DURKEE, 15 West 44th St., New York, N. Y.

Pacific Coast Representative
CONGER & MOODY, Sharon Bldg., San Francisco, Calif.
CONGER & MOODY, Higgins Bldg., Los Angeles, Calif.

Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Vol. 6, No. 1, issued monthly. Subscription price $2.50 a year. January, 1927. Entered as second-class matter at post office at Mount Morris, Illinois, under the Act of March 3, 1879.

Chats With the Editor

SCANNING the pages of this issue our readers will find a wealth of construction material—from the simplest to the most complex receiver. One feature this month deserves special mention. On page 18 we are printing full constructional data on the superheterodyne originally described in the November issue. Flooded with requests from all parts of the country, and from abroad, it became almost imperative that further data be given to at least attempt to stem the tide of correspondence which this set evoked. So we trust we have done our duty well and that all our correspondents will find an answer to their every question.

Next month, due to the craving of the average home constructor for a beautiful thirty-six inch cone speaker, we are going to publish complete details that will enable any reader to make such a cone and get real enjoyment from the task, which, by the way, is not so difficult as it might seem.

Fans who have followed the description of the Henry-Lyford receiver will find another article by Mr. Lyford in this issue which will increase their stock of knowledge on that subject.

For the beginner in our next issue we will have a new article from the pen of Armstrong Perry showing a few of the possibilities of regeneration, while the seasoned builder will find described a well-known receiver with power amplifier installed in the same cabinet.

Be sure to read Robert J. Casey's humorous story of the vicissitudes of broadcasting—it will be found on page 11 of this number.

Frederick Smith

Editor of RADIO AGE.

APPROVED BY 18 MONTHS OF PUBLIC USE
NO OTHER BATTERY IS LIKE IT

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

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

Practical tests have shown this to be the most economical of "B" Batteries

In Daily use in the home, Eveready Layerbilt "B" Battery No. 486 has fulfilled the promises made for it in laboratory tests. More than a year's study of the performance of this battery in the hands of the public has shown that it is the most satisfactory and most economical "B" battery ever developed. All loud-speaker sets require Heavy-Duty batteries—and the Layerbilt has proved itself absolutely the best of them all.

If you are now using the smaller, Light-Duty batteries, the Eveready Layerbilts will give you twice the service though they do not cost anything like twice as much. If you are already using Heavy-Duties, the Layerbilt, the longest lasting Heavy-Duty ever built, will run your set at least 25% longer, and again you will save money. Unless Eveready Layerbilts now are connected to your set, you spend more on "B" batteries than you should, and you can have no idea how good a "B" battery can be. The Layerbilt holds a surprise in store for you.

Eveready Layerbilt's unequaled service is due to its unique construction. All other dry cell "B" batteries are made of cylindrical cells, with many soldered connections, and a great deal of space is wasted between the cells. The Layerbilt is built up of layers of *flat* current-producing elements, that make connection with each other automatically, and that fill all available space inside the battery case. It is every inch a battery. In it you get more active materials than in any other battery and the Layerbilt construction makes those materials much more efficient current producers.

Those are the convincing reasons why the Eveready Layerbilt has proved itself the longest lasting, most economical and reliable "B" battery ever built.

Just remember this about "B" batteries—Heavy-Duty batteries are more economical than the smaller Light-Duty batteries on all loud-speaker sets, and the patented exclusive Eveready Layerbilt No. 486 is the most economical of all.

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

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time, through the following stations:

WEAF—*New York*	WTAM—*Cleveland*
WJAR—*Providence*	WWJ—*Detroit*
WEEI—*Boston*	WGN—*Chicago*
WTAG—*Worcester*	WOC—*Davenport*
WFI—*Philadelphia*	WCCO—*Minneapolis, St. Paul*
WGR—*Buffalo*	KSD—*St. Louis*
WCAE—*Pittsburgh*	WMC—*Washington*
WSAI—*Cincinnati*	

RADIO EDITORIALS

IMPORTANT work is being done for radio broadcasting by the National Radio Co-ordinating Committee, which has been formed to push the passage of legislation that will regulate the number of stations, their wave lengths and their power. The committee realizes that it is going to be difficult to obtain definite action from the next congress but they are prepared to do their best to convince our national legislators that delay in passing a radio bill is sure to work hardship on a great industry and inflict an increasing annoyance upon twenty-five millions or more of broadcast listeners.

It is obvious to everybody that if the present unregulated rush for wave lengths continues the broadcast listener is going to suffer. The man who has invested considerable sums in receiving equipment will be discouraged by continued failure to tune in his favorite stations without interference from wave-jumpers. His attitude will be communicated to the man who is considering the question of buying a receiver. The facts are so plain they seem almost too obvious to be mentioned.

The owners of WGN recently obtained an injunction against WGES on the contention that in moving its wave length up to 316 it was trespassing upon the wave band used by WGN, whose wave length is 303. WGN alleged that in operating a station and causing upwards of 500,000 persons to take such interest in advance programs of the station that they would buy The Chicago Tribune to obtain the program information the station had established a property right to the air, or a band of the air. This contention was upheld by the court. The Tribune also was upheld in its argument that priority in operating on a wave-length further established the property right. Various stations have given warning that they will protect their wave length by injunction proceedings but WGN is the first to bring the matter to a definite issue. There will be a trial of the WGN-WGES controversy to determine whether the injunction will be permanent. There will be appeals and further litigation and none can say what may be the outcome.

It is clearly set out in the court's decision in the WGN-WGES suit that the court regards the regulation of wave lengths as one properly within the province and duties of congress. It is intimated that any decisions in present controversies will be supplanted and should be supplanted by federal legislation.

That is why every man interested in the progress of radio as a social factor should exert his influence toward prompt action by congress. In any case it should be remembered that it is not the interest of the broadcast station owner which is paramount in any settlement of the question of rights on the air. The prime object should be to care for the millions of radio listeners who are getting news, entertainment and instruction from the broadcast stations. If anybody doubts the immense interest of the public in radio broadcasting let them eliminate broadcasting for a week and then take note of the country-wide howl that would certainly be the first reaction. Radio demands a federal law which is applicable to radio as it functions today. All other means of regulation and control must necessarily break down.

* * * * *

QUEEN MARIE of Roumania afforded Americans an interesting example of the rather autocratic attitude of royalty toward the common herd. And Americans supplied the Queen with a demonstration of how the home folks in a free country regard even the appearance of slight on the part of distinguished visitors. The Queen was to have spoken from a New York station at a definitely scheduled time and announcements from the station had led hundreds of thousands of listeners to tune in for the Queen's talk. It appears that the Queen arrived at the studio in advance of the time she was scheduled to speak. She wanted to go on at once, explaining that she was in haste to keep another engagement, etc. The studio directors on their side explained that vast numbers of radio listeners expected to hear her at a given moment and that if the time were advanced most of them would be disappointed. The Queen and her entourage declined to wait and departed from the studio. The royal party must have received considerable proof of the general annoyance caused by this failure to carry out the announced program for the Queen's apologies and explanations were profuse on the following morning. The Queen found out two things about America. The people take their radio seriously and they are not Roumanian in their popular interpretation of the rules that govern the relations between royalty and home folks. The Queen was an indefatigable broadcast talker for the remainder of her tour.

* * * * *

THIS magazine enters its sixth year with the present issue. We take this opportunity of wishing a happy and prosperous 1927 for all those who have been our loyal friends since we established the magazine, back in the pioneering days of broadcasting, and to those new friends who are constantly appearing in our list of regular readers. We start the new year with two new departments which we believe will interest those who are radio experimenters as well as many who are not. Everyday mechanics and current developments of science are subjects of sufficient fascination to appeal to all classes of readers. To the readers of RADIO AGE, who, we assume, are inclined to be technically-minded, we believe the pages on mechanics and popularized science will be particularly welcome.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

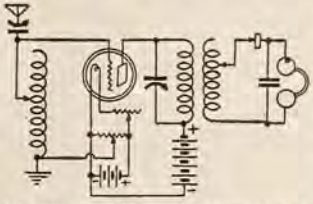
Radio Frequency Amplification *for the* Crystal Detector Set

By ARMSTRONG PERRY

ANYONE who took up radio in the natural way has a crystal detector set somewhere in the attic. Anyone with a family, or, even with neighbors, sees times when he would be glad to have a little set all to himself and clamp on a pair of phones to keep out extraneous noises while listening to broadcasts that do not enterest the entourage. The weak point of the crystal detector is its limited receiving range. That can be extended, inexpensively, by using a one-tube radio frequency amplifier. Very likely it will make the little receiver reach out five hundred miles, which is about twenty times the usual range of the simple crystal detector hookup and far enough to pull in an earful any time.

Go on—you can too make it yourself, if you know a screw driver from a pair of pliers. The circuit that includes the detector and phones can be left as it is. If it is a single circuit outfit, the antenna leads directly to the cat whisker that tickles the crystal. The crystal is connected to one tip of the phone cord and the other tip connects with the ground, via a wire or two and a binding post. One end of the inductance coil is hooked to the antenna and the other end to the ground. The tuning condenser usually is shunted around this coil, but may be in series at one end or the other. The coil may or may not be tapped. There may be a fixed condenser shunting the phones, to intensify the signals.

The two-circuit hook-up has two coils instead of one. One is connected to the antenna and ground just as the single coil in



One stage of radio frequency amplification coupled to a crystal detector through a variocoupler

the single-circuit outfit is. The other is close to this and the two form a coupler. The coil hooked to the antenna is the primary, because it is the first to receive the energy from the ether. The other coil is the secondary because it is the second to receive the energy. Just as in school, the incoming visitors go through the primary grade first and the secondary next.

The secondary circuit looks, when diagrammed, like the single circuit with the antenna and ground connections omitted. It includes the tuning condenser, the crystal detector and the phones. There may be a condenser in the primary circuit also. It may be in series between the antenna and the primary coil or between the coil and the ground connection, or attached to both ends of the coil in a shunt connection. The single circuit loses less energy and therefore may give louder signals, but selectivity is increased by two circuits connected through a coupler. A weak signal with less intereference may be better than a stronger one with more interference.

It is well to diagram the crystal detector outfit so that all details can be seen at a glance. Trying to carry too much information in the head is hard on the brains. Then the radio frequency amplifier should be diagrammed. The diagram may save the price of a tube, if you use it to check up your work just before you start to connect the filament with the wrong end of the "B" battery.

There are various ways of designing a radio frequency amplifier. None of them is too complicated even for a beginner. Following some other fellow's

design takes half the fun out of the job. Be original, and you will discover that some wise guy imitated your design years ago.

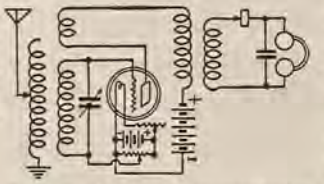
The radio frequency amplifier belongs between the detector and the antenna. Start at the antenna and work toward the detector. An expert will, of course, figure out the inductance and capacity of his antenna and design it to fit his set. If he does not forget the tin roofs, metal framed buildings, trees and other nearby objects that may absorb energy and cause capacity effects, he may secure better results than the common variety of radio bug. Roughly, the fundamental wavelength of the aerial is about three times its length. It is quite safe, for ordinary purposes, to run a wire from the garage to the house and trust the variable inductances and condensers to tune to the stations you want to hear.

Variable Condenser

YOU may place a variable condenser in series between the antenna and the inductance coil that comes next. It will help with the tuning. The inductance coil may be tapped or not. Some prefer a flexible unit, adaptable to wide bands of wavelengths, and others believe in covering a narrow band more efficiently and getting rid of effects caused by dead ends. A 50-turn honeycomb coil, or some other type of coil containing about the same value of inductance, and a .00025 or .0005 condenser work well together for broadcasting wavelengths. Either the coil or the condenser, or both should be variable.

The antenna, or the series condenser, if there is one in the antenna circuit, connects with the grid of the amplifier tube. If the rotor of the condenser, its movable part, is toward the ground, connect the grid to the stator. Changing the connections, so that the stator connects with the ground and grid, may make a difference. Try both ways and compare results on the same signal.

The filament circuit for the tube is the same as in most tube circuits. The directions that come with the tube may state that the positive terminal of the "A" battery should be connected with the rheostat that regulates the current. If the connections are not specified, try both ways. Any type of amplifier tube may be used except the new kind designed for the last stage of audio frequency amplification only. The correct voltages, as stated in the directions, should be applied to filament and plate. The manufacturers know more about these things than the local standing committee. As few constructors care to spend any large sum for adding an amplifier to a crystal set, dry-cell tubes are likely to be chosen.



One stage of radio frequency amplification, including regeneration, transformer-coupled to a crystal detector. Either a variocoupler or a radio-frequency amplifying transformer may be used in coupling the plate circuit of the tube to the crystal detector circuit

A potentiometer is a useful device in radio frequency amplification. It is known also as a stabilizer, for it helps to prevent the tube from oscillating. It resembles a rheostat in having a coil of resistance wire as its principal element, but instead of being connected in series it is shunted across the terminals of the "A" battery. There is a variable contact in the middle of the coil as well as the terminal contacts at the two ends. From this middle contact a wire leads to the grid, sometimes by way of the inductance coil. The result is that the grid is made positive and the grid circuit absorbs an appreciable amount of power. The effect is similar to that of a "C" battery used to place a biasing potential on the grid.

It may be difficult to find a potentiometer, unless you shop by mail. I asked three local radio dealers in my town for once and every one of them asked me what that thing was. A wire rheostat can be used by eliminating the connection between the tongue and the end of the coil and connecting the tongue with the grid. The ends of the coil are connected to the filament or "A" battery terminals.

The plate of the tube is connected to the primary coil of the coupler. If a single-circuit crystal set is used, the plate is connected, through a condenser, to the end of the single coil to which the detector is attached. The condenser prevents the "B" battery current from entering the detector, where it might fuse the cat whisker to the crystal. The positive terminal of the "B" battery is connected with the other end of the coil and the negative terminal is connected with the "A" battery. Either minus-to-plus or minus-to-minus connections may be tried. So long as the positive terminal of the "B" battery is kept away from the filament connections there is no danger of burning out the tube. A resistance is connected in series between the plate and the "B" battery.

The output resistance of a tube often is specified by the manufacturer and 11,000 to 15,000 ohms may be required for efficient operation. If a suitable resistance element is not at hand, an old-time amateur device may be tried. Draw a line on paper with a lead pencil or India ink. Place the paper on a little base of dry wood or bakelite where it will form a connection between two screws or binding posts that touch the ends of the line. Test the resistance and change it by erasing the line, or part of it, and making a new line that is thinner or fatter. A short, fat line probably will come nearer providing the proper resistance than a long, thin one.

Where coupled circuits are used, the variable tuning con-

denser may be shunted either around the primary or the secondary coil. Try it in both positions.

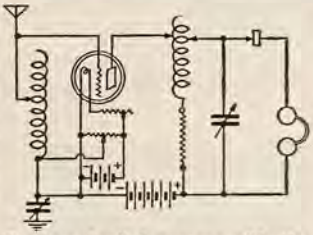
Transformer Coupling

CONNECTING the amplifier with the two-circuit crystal detector set, as described above, gives what is known as transformer coupling. The tuning coils can be placed in the antenna circuit and a radio frequency amplifying transformer used for coupling the amplifier to the detector circuit. It will give increased amplification. Connecting the amplifier with a single-circuit crystal set, as stated, gives resistance coupling. Each type of coupling has advantages and disadvantages.

Government experts have stated that resistance-coupled amplifiers seldom give full amplification below 1,000 meters. On the other hand, they save some troubles due to distortion. They require more "B" battery power than transformer-coupled amplifiers, so they are less desirable for use in portable sets.

One weakness of the radio-frequency transformer is that usually it covers a narrow band of wavelengths. The United States Bureau of Standards built several hundred of them, studied them exhaustively and produced a type that gave good amplification over a comparatively wide range. One of the men who worked on the problem resigned from the Bureau and manufactured transformers of this type, but the fact that he made them in plug-in form, so that one could be removed and another substituted easily, indicates that even the best do not give equal amplification over the entire broadcast-in range of wavelengths.

Some have found it difficult to understand how a radio frequency amplifier amplifies weak signals more in proportion than strong signals, while an audio frequency amplifier amplifies strong signals more than weak ones. The secret lies in the fact that the radio frequency amplifier amplifies the voltage applied to the detector and is not concerned with increasing the power output, while the audio frequency amplifier must amplify the power available to actuate the diaphragm of the phones or the loud speaker. Vibrating a diaphragm or cone and propagating sound waves



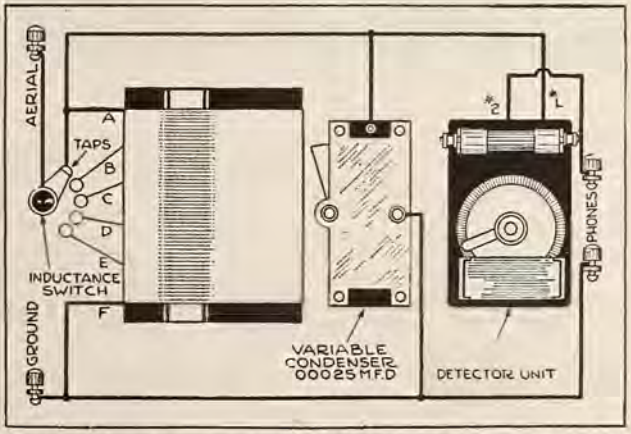
One stage of radio frequency amplification resistance-coupled to single-circuit crystal detector set

that must run through thousands of cubic feet of air and make themselves heard by many ears requires much more energy than it does to increase the grid potential of a tube. The small amount of energy used to produce the changes of grid voltage, or the voltage applied to the crystal detector, is used up in the tube and its circuits, while the energy in the plate circuit of the tube comes entirely from the "B" battery.

Grid Influences Plate

VARIATIONS in the grid voltage which, in the case of the single radio frequency amplifying tube, are caused by the very small amounts of power gathered from the radio waves, influence the plate current much more than changes in the plate voltage itself. With the plate voltage at 40, for example, an increase of grid voltage from .04 to 1. increases the plate current from 430 to 530 microamperes, or 167 microamps for each volt. Increasing the plate voltage of one volt increases the plate current only 21.6 microamps. The increase of grid voltage is eight times more effective, therefore, than a corresponding change of plate voltage.

This explains why the radio frequency amplifier can be used effectively with a crystal detector receiver, and give it twenty times as great a range, while the best an audio frequency transformer could do would be to increase the volume on such stations as probably could be heard, at least faintly, with the crystal detector without amplification.



In order to show the extreme simplicity of the crystal set, we are reprinting the diagram above which shows the coil, condenser and detector unit. Taps are shown on the coil, although they are not absolutely necessary—a honeycomb coil of 50 turns, or 50 turns of bell wire on a 3 inch form, will suffice. Full details of this simple crystal receiver appeared in the August issue of Radio Age (1926) page 17

Front panel view of the Microflex, showing the switch located at center of panel

Experimenter Has Choice *of* Four Receivers *in* One

A NOVEL combination of a tuned RF receiver, with a regenerative detector and two stages of audio, which can also be made into a straight regenerative and two of audio, RF, detector and one audio, and regenerative and one audio, is found in the Microflex which has been built around the Micro-coupler made by the Simplex Radio Devices Inc., of Newark, N. J.

Thus the experimenter is enabled to have four sets in one, the change-over being accomplished by a four pole double throw switch located in the center of the panel. This by its action makes the set either a straight regenerative, or a RF and regenerative combined. One of the coils is mounted on a micrometer action which permits minute inductive relationship changes, something heretofore lacking in the ordinary three circuit tuner on the market.

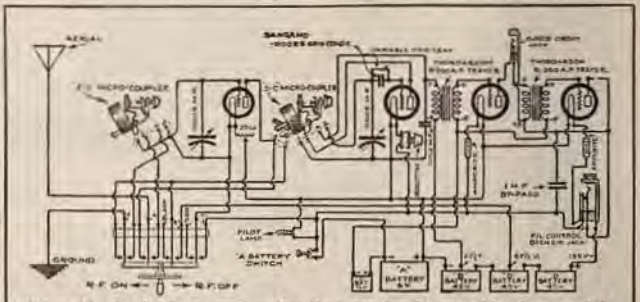
While for local work the set works best with just one stage of audio amplification (using Thordarson's R200 audio transformers),—for distant work,—and that is what most of the fans are interested in, the two stages should be used. The schematic circuit on this page shows the method of hooking up the set to give four receiver combinations.

For the change-over switch either a Yaxley, Carter, or Federal four pole, double throw panel switch may be used. The first two named are made in the single hole mounting type, while the Federal requires a cut-out of the panel for insertion.

Remler condensers are used for the tuning which obviate any possibility of body capacity due to the insulated stator and rotor. Because of the precise control of coupling afforded by the use of Micro-couplers, the over all efficiency of this receiver is greatly increased.

The receiver covers the conventional broadcast band from 200 to 550 meters, and should be able to provide any degree of selectivity desired by the builder.

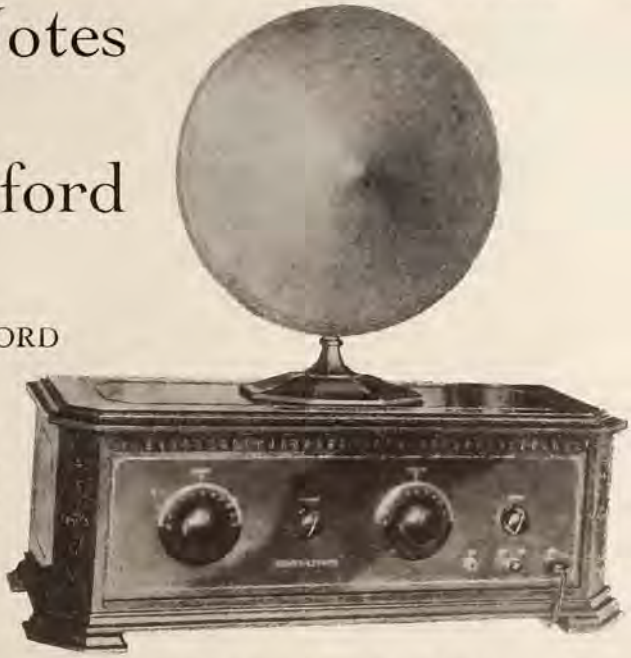
Rear panel view shows the two Micro-couplers, sockets, and all other parts used in this set



Schematic circuit of the receiver described showing four combinations possible

Further Notes on the Henry-Lyford

By
ELMORE B. LYFORD



IN THE previous article on the Henry-Lyford which appeared in this magazine, nearly all of the space was given to a description of the receiver and to constructional details, for those who wished to build one. Of necessity, much of interest to builders of this receiver had to be left out, and it is the purpose of this second article to provide additional information about this popular set.

It is necessary to use UX201A type tubes throughout in the Henry-Lyford with the exception of the second audio stage—the last tube. In this position a UX112 type power tube is necessary. With this arrangement of tubes, 135 volts of "B" battery will be required. The first two 45 volt blocks should be of the heavy duty type, for they supply current to all five tubes of the receiver. The third 45 volt battery may be one of the regular type, for it supplies current to the last tube only, and the drain on it is very light.

All of the "C" battery voltages, as was stated in the previous article, may be secured from one Burgess No. 5540 battery, which is a 7½ volt battery with a tap at every 1½ volt.

Of course, any good "B" eliminator may be used instead of batteries, if desired. Because of the use of sufficient by-pass condensers, the receiver is particularly adaptable to "B" eliminators, and any good one will give very satisfactory results.

A power tube of the UX171 type, may be used in the second audio stage without necessitating any changes in the wiring of the receiver. The only changes that are necessary to use this type of tube are those of the battery supplies. The "B" max. lead in the battery cable runs to B plus 180 volts instead of to B plus 135 volts, and the C minus max. lead runs to C minus 45 volts instead of to C minus 7½ volts.

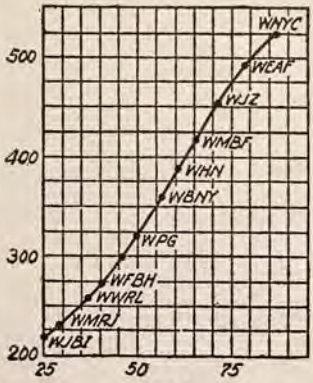


Figure 3

Isolate DC Component

WITH any type of power tube which requires a plate supply of more than 135 volts in this second audio stage, precautions should be taken to safeguard the loud speaker windings from too heavy a current through them. Under these conditions, the direct current supply to the plate of this last tube should not be allowed to pass directly through the speaker windings. One way to accomplish this is to use an output transformer between the plate circuit of the tube and the speaker, as shown in Fig. 1. Another equally good method is to use a choke coil and condenser combination, as pictured in Fig. 2. Here the choke coil should have an inductance of about 50 henries, and the condenser should be 2 or 4 mfd. filter type. One terminal of the loud speaker is connected to the blocking condenser, and the other side may be connected to either B minus or B plus, preferably B minus.

The use of a milliammeter in the plate supply lead of the last tube is a practical and convenient

way of checking up on the operation of this tube, and of determining when it is over-loaded. A 0-25 DC milliammeter inserted at X in Fig. 1 or Fig. 2, should show a steady reading when the receiver is in operation. If there is any fluctuation of this milliammeter needle, the tube is being overloaded, and the volume should be reduced. An overloaded audio tube is a prolific source of distortion, if nothing else.

Right here is a good place to say something about loud speakers. An audio amplifier capable of reproducing such a wide range of frequencies as does the one in the Henry-Lyford, deserves nothing less than the best of loud speakers. In no other way can the rich low tones of the receiver be appreciated. Some sort of a cone type loud speaker should be used and the Western Electric is recommended for best results, though there are others which are nearly as good. At any rate, an effort should be made to use the best one that is available.

Questions have been asked about the use of a loop antenna with this receiver. The answer is that this set was not designed for and is not suited to use with a loop. It will work on a short indoor antenna, however, with exceptionally good results. Almost any sort of an antenna which will work with any receiver will work with this one, as long as it is not too large. One of about 75 or 100 feet over-all length—including the leadin—is just about the right, wherever possible.

The use of the rotary coil on the antenna coupling transformer, was explained in the previous article. It allows greatly

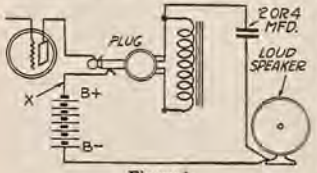


Figure 1

In the sketch above is shown the way to connect your loud speaker so as to isolate the DC component. The choke may be an old audio transformer secondary while the condenser is a 2 or 4 mfd condenser

different antennas to be used with equally good results. It will be found that there is one position of this coil which is best for general use, depending on the location and the antenna, and after this coil is once set, it need not again be changed.

It is convenient, and often very useful, to have on hand a tuning chart of your receiver, and one may easily be made. A typical tuning curve is shown in Fig. 3. This, as may be seen, is a curve of dial settings against wave-length. To make one, first log the settings of as many stations on different wavelengths as possible. These settings should then be plotted on a piece of squared paper, such as may be procured at any stationary store. After a sufficient number of points have been plotted, a smooth curve is drawn through them. The tuning curve for any Henry-Lyford, thus drawn, will correspond very closely to the one shown, both in appearance and position. In locating a station whose wavelength is known but which has not been logged, a reference to this curve will tell you, within a degree, where they should come in on the dials.

The curve of Fig. 3 shows very plainly the advantages of combination type condensers for tuning, such as are used in this receiver. There is no undue "crowding" of stations on either end of the dial, but all of the transmission channels are evenly spaced, making for easy tuning.

The tuning curve illustrated was made for the broadcast type coils, but curves made for the other two sets of plug-in coils for this receiver, for the lower wavelengths, will look the same. The range of these other coils is from 37 to 125 meters and from 75 to 225 meters, respectively, and the operation of the receiver is the same when using these coils as when using the broadcast type.

Shown originally in the blueprint section of the November Radio Age the Henry-Lyford circuit has been quite well received by our readers, both the fan and the experimenter type.

The use of a deliberately unbalanced circuit and a stage of untuned frequency amplification, makes this receiver very interesting to those who are constantly on the alert for something new or novel in radio. Using a stage of untuned radio permits having three stages of radio (two tuned) with only two dials and without necessity for using a tandem condenser.

Quality is one of the main features of the audio end of this set, two of the larger transformers being used. Results on a cone type speaker are certainly worth while.

—Editor.

IF you are building the Henry-Lyford particularly because of its exceptional distance-getting ability, the use of vernier dials on the tuning condensers is strongly recommended. When the fullest gain of the r. f. amplifier is used, the antenna dial particularly tunes very sharply, and it will be found difficult to tune the receiver properly with ordinary dials. For stations within the radius of 200 miles, tuning is easy, but for any distance work the vernier dials will be very helpful.

The panel size of the receiver is 7x24", and the depth is 9", so that the completed receiver fits readily into any standard cabinet, many styles of which are available. The panel layout of the receiver is simple and dignified, and graces any cabinet.

One final word, about the results which you may expect to obtain. The first hour's use of this receiver may be a little disappointing, as far as results on DX are concerned, but as soon as the proper use of the balancing condenser is learned, slight disappointment will turn to admiration. Radio receivers, like automobiles, are individual, and each one requires a little familiarity with it before the ultimate results are obtained.

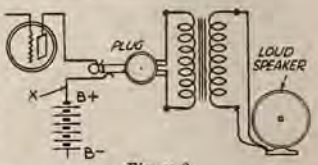


Figure 2

The loud speaker in this sketch is shown connected through an output transformer, several makes of which may be found on the market today

What's Wrong With Broadcasting?

By ROBERT J. CASEY

WHEN Thomas Edison sounded off some weeks ago on the subject of Radio and its manifold deficiencies, he stirred up more typographical conversation than could be found in the national output of alphabet soup.

"Radio," said Mr. Edison—interrupt me if I quote him incorrectly—"Radio has ceased to be a novelty and is now an affliction. It is consecrated to the dissemination of blah and symptoms of adenoids. I would much rather listen to a phonograph."

Mr. Edison must have known what he was getting into when he made this pronouncement. At any rate he got into it. Every official of every set factory in the country ignoring the publicity it might entail, took his stenographer in hand to answer Mr. Edison. Every soprano who ever got tuned out of a receiving set observed loudly but with becoming modesty that the sage of East Orange knew nothing at all about music. Every broadcaster in the country quit reading applause telegrams long enough to put Mr. Edison in his place and the great American indignation boiled and seethed for days and nights on end.

Of course Mr. Edison was wrong. It is true that the phonograph at its worst moments never brought one the current news. There never was a record built that would deliver at one winding the first sixty-five ballots of a democratic convention or the play-by-play account of a world's series baseball game. On the other hand the most skillful engineers in the phonograph business have failed utterly to reproduce in wax the overtones of a simple but lovely heterodyne whistle. Some of the sounds of radio are the peculiar property of radio and will remain an object of continuing wonder until the ears of the coming generation grow calloused and unappreciative.

If Mr. Edison were to ask what has been the agency most responsible for the rise of radio to its present high state of efficiency, any city dweller could tell him off-hand. The credit is due entirely to the broadcasters.

In England, where government control has put a curb bit on small town tenors, egg-beater salesmen, harmonica players, and surplus announcers, the benighted populace is still listening to stations a thousand miles away through aboriginal receivers such as the one-coupler-two-variometer thing that America discarded years ago. The ignorant broadcast listener thinks that a circuit is selective if it will separate stations a couple of hundred meters apart. And he has never given any thought or time to the solution

of the so-called "interference problem." The fact that he is totally unacquainted with interference is, of course, a minor point. The poor blighter probably never will know how badly off he is and that is most distressing.

In America, the land of the free hot air, development has been much more encouraging. Government invasion of public rights to the ether has been definitely stopped and at last we are beginning to get enough broadcasting stations to make things interesting. There is at least one station on every possible wave-length and generally two or three. What need to comment on the result?

If Joe Bozo, leading cold-in-the-head of the Hokeholm church choir, desires to make himself better known, he no longer has to journey to Europe for years of vocal culture or camp on the front steps of the impresarios of the Metropolitan opera company. Not Joe! He gets himself a brace of fifty-watt bottles and starts a broadcasting station. The station may not be large—but then there is always a chance that some gent with insomnia in New Zealand may hear him some night when conditions are favorable—and posibly thereafter commit suicide. The talent may not be so good, but on the other hand this deficiency is always compensated for by the modulation which isn't very good either. Joe cracks his merry quips into his microphone every night and so gets a lot of publicity within a radius of twenty-five miles at an expense far less than that which would have been entailed had he decided to reach the populace of the same territory by postal card.

HOKEHOLM gets to know Joe very well—so well indeed that when he is mysteriously murdered, which ought

to be any day now, he will be given a fifty word obituary on page 18 of the local Bugle. De Forest, Armstrong, Hertz, Faraday—all of them might find the culmination of their life work in Joe's nightly broadcast. Unfortunately some of them are dead and those who are alive will have to make some new and important discoveries during the coming year if Joe's radius of interference is to be extended another twelve miles.

If Theodore Goolash, the prominent real-estate broker, desires to peddle his lots in his most recently subdivided swamp his first thought is to create good will toward Theodore Goolash and all his works. Formerly such a campaign entailed much thought and quite an outlay of words in the public prints.

Now, thanks to the radio, his problem is simple. He finds a hotel that has not been finished more than twenty-four hours, he fights off the mob of would-be announcers who are jamming the lobby, and he arranges with the proprietor to put a couple of lightning rods on the roof. Then he looks through the book until he finds the wavelength of the neighborhood's most popular station and he refurbishes it with a new set of call letters. In a week or two he is proclaiming his message to the palpitant millions.

His task is even simpler than it used to be. In other days when the government was assuming a paternalistic and un-American attitude on the subject of air-rights the newcomer to the broadcasting station would be asigned a wave length and frequently it was a very inferior wavelength. Nowadays he has his choice of wavelengths and the trick of picking the frequency of a popular station immediately solves his problem of building up good will.

WHEN he begins to broadcast on such a wavelength he is sure that most of the town will be tuned in and waiting for him. Thousands of listeners who had hoped to hear some advertised program will be tickled stiff to learn that they can listen instead of Mr. Goolash and snappy lines about homes in the suburbs. A lot of the listeners will take steps to move into the suburbs at once—the farther the better and everybody will write letters to Mr. Goolash—letters that he can use as leads for such of his salesmen who survive when his office is bombed.

There was a time when one ukulele did not constitute an orchestra. But that was before five or six hundred one ukulele broadcasters felt themselves called upon to meet the popular demand for more radio stations.

With conditions as they are any fifty of the one-ukulele stations may be tuned in at one setting of the dial. Inasmuch as all of them will be emitting "Don't Steal My Daddy's Medal" or some song ending in "Yoo-hoo, Dear, Just Yoo-hoo," the result will be an ensemble beyond the wildest dreams of Philip Sousa.

Announcers, too, have been given their chance. Where in less enlightened times the town ass had to content himself with being just a town ass, he now finds himself in great demand. "This is station BLAH, Happy Willy Whoosis announcing. We have just received a telegram from Mr. Patrick Knockenschlocker of 4567 McApplesauce Boulevard asking 'Who was that lady I seen you with last night?' Hah! Hah! Mr. Knockenschlocker, that wasn't no lady, that was my wife."

Or "This is station GLUE, The Old Soak announcing. We are broadcasting a play by play account of the football game between * * Ding Ding! did you hear the fire engine going by just now. Hokus McPherson has just come into the stand. Hello Hokus. Did you bring anything with you? I'll turn the microphone and maybe you can hear the telegraph instruments. There are eleven men on the team representing—Fergus Fitzraspberry just interupted to ask if I ever tried to get a drink in Ishpeming. No Fergus, I never tried to get a drink in Ishpeming because I ain't never been to Ishpeming. . ."

BUT WHY go on with it? There is no particular object in writing about matters that are known intimately to every radio set owner in the country. There are now forty-six stations in Chicago alone, and since the air has been made permanently safe for adenoids it seems quite possible that ev-

(Please turn to page 39)

Try-out Hour for Radio Performers

By

GWEN WAGNER

The young lady in front of the microphone is being tried out at WHT. Gwen Wagner tells about it in this article. Al Carney at the piano and Pat Barnes near the organ

IT WAS an off hour in one of Chicago's largest radio stations. In the reception room sat a varied collection of human beings, ranging in age anywhere from 10 years up to 55. All wore expressions of rapt expectancy and all clutched satchels of some description or another.

In the studio beyond, a soprano was singing. Passionately and determinedly, but not too well she was caroling, "In the merry, merry muh-UNTH of May!"

Just then the studio director, whom I happened to know, appeared. I went up to him.

"Pardon me," I inquired, indicating the varied collection of human beings and also the soprano voice out in the offing, "but just what is going on around here?"

"Oh," replied the director with a harassed look, "this is try-out hour. They all want to get on the air you know."

I didn't, but no matter. I found out.

According to this particular director, half the people in the world want to go on the stage and the other half want to sing for radio.

"It doesn't make any difference how young or how old they are," he observed, "they're all determined to get on the air. Just let someone make some remark about what a grand voice they've got and they're off."

"Do you give them all a chance?" I queried.

"Oh, certainly!" retorted the director. "Occasionally we run across a find. For example, a bell boy from one of the hotels came up here one afternoon and wanted to sing for us. We tried him out and found he had a very good voice, exceptionally good for broadcasting. Now we use him regularly."

Finds Are Scarce

HOWEVER, according to various directors whom I later interviewed, "finds" are as scarce as hair ribbons on flappers. In fact, in one studio I was told that out of all the hordes that apply there, less than five per cent exhibit talent that would lend itself to broadcasting. Even this five per cent usually have to be coached in studio technique before they can be used.

These applicants have various reasons for wanting to get on the air. The main reason, according to practically every director I asked, is that they want their friends to hear them. Two others are: publicity and the desire to make money.

One man, however, had rather an unique reason. He came bolting into the studio and wanted to be put on the air instantly. He could sing, he said and that very well indeed. The director courteously suggested a tryout.

"Tryout?" repeated the gentleman "Tryout?"

"Yes," replied the director. "To see whether your voice is suitable for broadcasting you know."

The gentleman cast his eyes toward heaven. Between clenched teeth he muttered something in a foreign tongue. Then he brought his eyes down and his voice up—in English.

"But I don't want a tryout! I don't need a tryout! I am an operatic tenor. I can sing! But!" and here he appeared about to brandish something, probably the inevitable music satchel with which all applicants seem to be equipped. "They won't hear me! Can you believe that? They won't hear me! Just now I have come from a manager of an opera company. I have been to him many times. He says he will not hear me sing. He will not listen to me! But," and here the radio aspirant lowered his voice to a husky, confidential tone, "I want to sing on the radio and then he will have to listen to me! Understand? He will HAVE to listen to me!"

It might be said in passing, however, that the "manager" didn't.

Arrives now the little boy whose mother knows that if there

(Continued on page 50)

When Radio Turns Navigator

Radio Direction Finder Guides and Locates Vessels

"UNABLE to give position —last bearings taken three days ago—we're lost!" !

Thus reads the terse but dramatic message from a ship in distress. Out in the blackness of the night, pitching and tossing on waves stirred to a frenzy by the wintry gale, are fellow mariners and passengers, far off the traveled ocean lanes and all but lost save for the slender thread of radio communication.

"Keep sending us test signals," flashes back our operator. "Will locate by direction finder." And so the latest wonder of marine radio and the newest aid to modern navigation is brought into play.

Soon our operator is at the radio direction finder in the pilot house. A moment later he is wearing the headphones and manipulating the receiver dials. He begins turning the hand-wheel, which serves to swing the small loop frame on the deck above into the very teeth of the angry gale. The operator listens intently, the captain and others silently stand nearby; the swings of the hand-wheel become shorter and shorter. Here it is—the line of signals—the direction of their passage through space from the radiating point! But on which side of our ship—in what sense? Now the operator throws a switch, swings the hand-wheel again. The swings become shorter until they virtually stop. The operator now bends down as he peers through a magnifying glass, squinting an eye so as to line up the parallax lines which will give an accurate reading from the compass card below. Then he gives the reading to the pilot of the ship. A few moments later the course is changed, and the ship throbs to the command of full speed ahead in the face of a heavy sea.

View of radio compass loop mounted on upper deck of vessel. Rotation of the loop is controlled from inside the cabin beneath.

One hour, two hours, three hours—and our ship comes within searchlight range of the vessel in distress. A rescue is out of the question in such a rough sea, but we stand by, ready to act if absolutely necessary. The direction finder has completed well the task which radio began.

JUST as the dog turns his ears in determining the direction of sounds, so does the radio direction finder turn its loop to get a bearing on a given transmitter. This ingenious radio device operates on the principle that a given signal of maximum intensity will be received with a loop so placed that its plane is pointing at the radio station which is transmitting. If, on the other hand, the plane of the loop lies at right angles to the direction of the radio transmitter, no energy is picked up and nothing can be heard in the earphones. The position at which the signal drops out, or so-called minimum, is well defined and is employed in reading the direction of the transmitting station from the compass card that forms part of the apparatus.

The standard marine direction finder, as now installed on many ships, is entirely self-contained and occupies less than two square feet of floor space, in the pilot house or chart room. On the deck, above the pilot house or chart room, is the sturdy tripod frame supporting the loop which is encased in bakelite tubing with aluminum alloy fittings. The protective tubing of the loop measures 4½ inches in diameter, while the loop measures 30 inches on a side. A 2 to 1 reduction gear, operating by the vertical hand-wheel, serves to swing the loop in all directions, even in high gales, without backlash or interference or muscular exertion.

An eight-tube super-hetero-

(Continued on page 41)

Rotation control of the radio compass loop and the receiver used for picking up directional signals.

Washington Monument Does a Radio Shimmy

Radiates at Third Harmonic of NAA Transmitter

By S. R. WINTERS

TREES, bridges, enbankments, streams of water, trolley lines, valleys, large screens, water towers, and other surrounding objects are likely to exercise a distorting influence on radio waves. In effect, this means that if you are one of the millions of radio fans using a coil or loop of wire for radio reception, the directional properties of this pick-up system are effaced. Any one of the above-named objects, when interposed between the transmitting station and your radio receiving set, may cause the wave to deviate from its true course.

Such distortion, other than invalidating the use of a loop antenna in determining the direction of a particular transmitting station, does not operate to the detriment of broadcast listeners. However, when coils of wire are employed as radio direction-finders, the distorting effect of surrounding objects must be systematically avoided or the causes of such wave deviations taken cognizance of and included in direction-finding calculations. Instances of proof may be cited: The United States Navy, before establishing radio-compass stations, investigates any objects that might cause radio waves to swerve from their path of rectitude; similarly, the Navy must ascertain the distorting effect of metal in a hangar for a huge dirigible, like the *Los Angeles,* on which a radio compass is used.

The Radio Laboratory of the Bureau of Standards is called upon to make all kinds of tests to determine the twisting influence of radio waves as caused by objects interposed in their path. The Lighthouse Service, with its radio beacons and their far-reaching implication of service, may request of the Bureau of Standards assistance in determining suspected deviation of waves which would invalidate the effectiveness of direction-finders in taking bearings from radio beacons. Again, the United States Coast Guard, in its recent adaptation of radio direction-finders in trailing rum smugglers, may need to know if the shore line of a river or a concrete bridge is undermining the directional characteristics of these direction finders.

Study Distortion Influences

THESE suggested services, together with the ever-increasing applications of the radio direction-finder, as well as the loop antenna with our radio receiving sets, place added emphasis upon results of original investigations conducted by the Radio Laboratory of the Bureau of Standards entitled "A Study of the Surroundings Upon the Indications of a Radio Direction Finder." And, while these comprehensive investigations in the field were made some time ago, this writer is fortunate enough to be able to present exclusive information, photographs, and charts disclosing the interesting results. Francis W. Dunmore and Morris S. Strock negotiated this study for the Federal government, exploring into the secrets of trees, bridges, banks of rivers, valleys, and trolley lines.

Even the Washington monument, towering in silent majesty to a height of more than 500

Washington Monument whose fundamental is set into oscillation when NAA transmits

feet, did not escape the searching eye (magnified by a telescope) of these government scientists. And, stranger than fiction was the revelation coaxed from this enduring shaft of marble. It not only has a natural wave length—about 625 meters—but when NAA, the naval station at Arlington, is broadcasting on 2,500 meters, the Washington monument is, in effect, a secondary radio transmitting station. For, we have the words of Francis W. Dunmore, eminent radio engineer and physicist of the Bureau of Standards, as authority for this conclusion. He says: "In this connection it is interesting to note that when the Arlington station was transmitting on 2,500 meters, the signals could be heard on about 800

meters. Observations of direction at this time all showed that the monument was the source, thus indicating it was set in oscillation at the third harmonic of the Arlington wave and was thus radiating into the surrounding region."

This disclosure would seem to imply that the memory of George Washington may, in the future, be held accountable for some of the ills which beset radio reception. Broadcast listeners who complain to Secretary of Commerce Herbert Hoover about radiating regenerative sets, interference from the Annapolis arc station and code from the Arlington naval station, may protest against a radiating Washington monument! Those that would besmirch the name of the Father of Our Country by referring to his beer recipe and his fondness for the feminine gender may contend that radio interference from the Washington monument is a haunting memory or proof of the adage that "the evil that men do lives after them!" Jesting aside, the scientific investigation into the influence of this shaft in distorting radio waves produced interesting and valuable information.

Natural Wavelength

TESTS in proximity to the Washington monument indicated that the greatest distortion of the wave front was at 625 meters, which observation led to the conclusion that this is the natural wave length of the marble shaft. Signals were sent from a specially installed transmitting station, located at the Soldiers' Home, on a series of wave lengths, ranging from 400 to 1,000 meters. The direction-finder was stationed, successively, at each of six positions at increasing distances from the monument. Observations were made of the horizontal angle through which the direction-finder must be turned in order to obtain a minimum signal. Some of the observations were productive of peculiar twists of the radio waves; this phenomenon leading the investigators to conclude that these strange distortions were traceable to an underground cable line extending in a southeasterly direction.

With a portable direction-finding outfit, the representatives of the Bureau of Standards invaded a valley, through which coursed a brook, 25 feet wide. Alfred Tennyson, in writing his poem, "The Brook," was not equipped with such modern instruments, and neither were these fact-searching scientists provided with a poetic license. They are content in informing a radio-interested world that a small body of water causes little distortion to radio waves. The direction-finder was carried from point to point along this leisurely-moving brook, and only in one instance did the invisible wave swerve to any appreciable degree. At this particular point a tree, only six feet away, was held responsible for the radio wave wandering from its path of rectitude.

The tentative conclusion that trees cause deviation of wave fronts prompted the Bureau of Standards to focus its direction finder around a tree in an open field. While the transmitting set, located a number of miles away, at the Soldiers' Home, was sending on wave lengths of 400 and 1,400 meters, respectively, there was a negligible amount of distortion, either directly in front or behind the tree. However, when the coil antenna and receiving set were placed to the right or left of the tree the intercepted radio wave deviated as much as five degrees. The tree involved in this test was only 40 feet high; which factor prompts the Government investigators to assume that greater distortion would be caused by proportionately larger trees. Radio experimenters might pursue this line of investigation with interesting results.

If broadcast listeners reside in the vicinity of a water tower, this form of structure may prove to be the source of radiation of radio waves—a sort of secondary broadcasting station, if you please! Distortion tests were conducted in proximity to a 150-foot water tower and an electric-power line nearby. The waves swerved considerably but, we are told, that "Observations on the longer wavelength —1,400 meters—indicated that a large part of the distortion may be due to the power wires near which the observations were taken. On the shorter waves the distortion is in such a direction that radiation from the tower is indicated, though the observations on 625 meters make it uncertain whether this is the entire cause!"

Banks and shore lines of rivers may be disconcerting to the otherwise unimpeded progress of all-embracing radio waves. Thus, if you are camping and fishing this coming Summer, with a radio receiving set and loop as a pick-up system, the waves from your favorite broadcasting station may be slightly distorted and your coil antenna, in effect, may lose some of its otherwise sharp directional properties. However, tests behind a 20-foot bank afforded proof of relatively little deviation of radio waves. Furthermore, we are informed that a wave speeding over one-half mile of *fresh* water, approaching the shore line at an angle of 500 degrees, is not distorted appreciably.

A concrete bridge, if it contains iron reinforcements, is apt to bend radio waves considerably—that is, cause a relatively wide deviation. The Radio Laboratory of the Bureau of Standards placed its portable radio direction—finding equipment on a 150-foot reinforced concrete bridge. Curves plotted as a result of this test showed large angles of distortion, which are attributed to the iron reinforcements of the bridge. In another test, in a small valley—a cut of 500 feet long and 50 feet deep—which was spanned by a small frame bridge, the direction-finder failed to disclose any appreciable distorting affect of the speeding invisible waves. A telephone line crossed this valley, parallel to the bridge.

Distortion measurements were

made near a 100-foot wire, supported five feet above the ground, at an angle 45 degrees with the line to the transmitting station. This elevated antenna was tuned to the wave length of this experimental broadcasting station, with the result that a slight distortion of the wave front was recorded. Experiments with the coil aerial, an integral unit of a radio direction-finder, directly under a 100-foot 3-wire antenna, 75 feet overhead, failed to produce any distortion, when the antenna was tuned or untuned. This antenna was stretched at an angle of 15 degrees with the line to the transmitting station. However, when the direction-finder was placed near the lead-in wire the incoming radio wave evidenced a marked deviation. "Very little, if any distortion existed with the antenna untuned," observed Francis W. Dunmore of the Bureau of Standards. "This shows," he emphasizes, "The importance of keeping the direction-finder at a considerable distance (100 feet or more) from any such tuned circuit."

Explore Three Channels

THIS comprehensive investigation into the reaction of radio waves when they collide with objects in their mad race through the ether involved the design of special equipment for this purpose. For instance, the direction-finder consisted of a coil of wire wound on a frame four feet square. This design made provision for the use of three wave lengths—400, 625 and 1,400 meters. The frame of this aerial was mounted with its plane vertical on a tripod three feet from the ground. The frame was rotated on a vertical axis by the observer, who was located eight feet away and he manipulated two heavy pieces of cord which were attached to the frame. The detector circuit and batteries were placed on a stool three feet high.

The scale on the direction-finder read from zero to 180 degrees, and it could be clamped at any position on the tripod. A pointer on the coil frame turned with the latter and served as an index by which to read the position of the direction-finder. Visual observations were made in determining the direction of the transmitting station, a telescope being mounted upon the coil frame for that purpose. The position of the telescope on the frame was determined by observation made in a large open field, where it was presumed that no distortion existed. The direction-finder was turned to such a position that the signals were inaudible. The telescope was then put in place on the shelf in the middle of the frame so that the image of the transmitting station could be seen on the cross hairs. The telescope was then secured firmly in position.

The radio receiving set or detector circuit for the reception consisted of one vacuum tube, of the non-oscillating type. A small air-core transformer was employed, the particular advantage of which was the reduction of the change in direction with reversal of coil leads to about two degrees. The observer, engaged in making distortion observations, would listen to the radio signals received by this detector circuit, turning the frame of the coil antenna until a minimum signal is heard. The scale reading on the direction-finder is then recorded. The leads to the detector circuit are reversed by means of a switch, and the observation repeated. The mean or average of these two readings is the basis for plotting the charts showing the distorting effect of radio waves when striking different objects.

The transmitting station, established especially for these tests, was located on the grounds of the Soldiers' Home, three and one-half miles from the Bureau of Standards. The transmitting antenna was supported between an elevated water tank and the tower of a building. The commanding location of the Soldiers' Home, situated on one of the highest points of the District of Columbia, was a natural advantage favoring these observations. The magnetic compass was discarded as a means of determining the direction of the transmitting station when taking bearings because of its possible effect upon the deviation of the indications on the scale of the direction-finder. The telescope afforded visual means of sighting directly on the transmitting station, located as it was on a commanding hill. Con-

(Please turn to page 40)

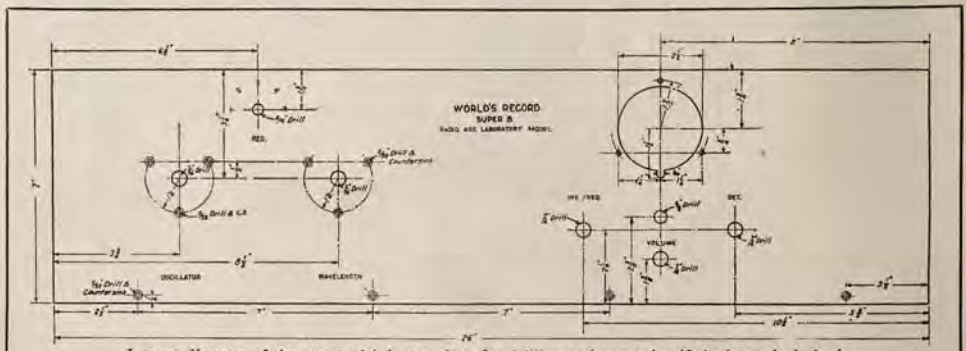
Transmitter used in the tests to determine field distortion

Full Data on Building World's Record Super 8

Encased in its cabinet with loop and loud speaker the Radio Age laboratory model of the World's Record Super 8 presents an unusually attractive appearance

UNPRECEDENTED interest in the type of superheterodyne described on pages 38, 39 and 40 of the November issue of this magazine, coupled with insistent demands from our readers for further and complete building data on the laboratory model which we constructed, prompts the staff to present in the following article all the details of this excellent receiver so that even the novice may duplicate the set.

In the November issue the schematic was shown for the more advanced fans. Pictures were also published. However, in this presentation practically all of the details are shown in pictorial form with the exception of the photograph of the completed receiver equipped with loop and loud speaker, which is shown at the heading of this page. In this manner we hope that all our readers who have bombarded us with questions on this receiver will find their hopes realized when scanning these pages.



Layout diagram of the panel with instructions for drilling and engraving if the latter is desired

Detail of Coupler

A GREAT many of the requests received in this office were for the details of the coupling unit on which in this issue, on page 19, are given the number of turns for the plate, grid and pickup windings. The wire used is No. 26, DCC, and the stator form is 3 inches in diameter, with the rotor being 2½ inches in diameter. The connections are shown in detail at the left of the coupler sketch, while the proper method of wiring them in is shown in the pictorial representation on page 21.

For the more advanced experimenters we are again showing the schematic circuit of the receiver, with slight changes made in it since its first appearance in November. One departure from the original one is the insertion of a C battery in series with the center tap of the loop which will have a tendency to further sharpen up that circuit. This is only suggested for those living under the shadow of a broadcasting station in some of the metropolitan areas.

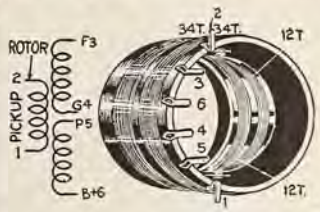
Tendency of the intermediates to oscillate is suppressed by means of the C battery tap going to the filament terminal of all of the RF transformers, and the first audio. Grid bias is given the last audio where a UX112 is used, this bias being the full voltage of the C battery, 7½ volts.

Two ten ohm rheostats are provided, one for the filament control of three of the intermediate stages while the second one is used for the filament control of the first and second detectors. The tubes to be used are noted in the pictorial representation and this scheme should be followed for best results.

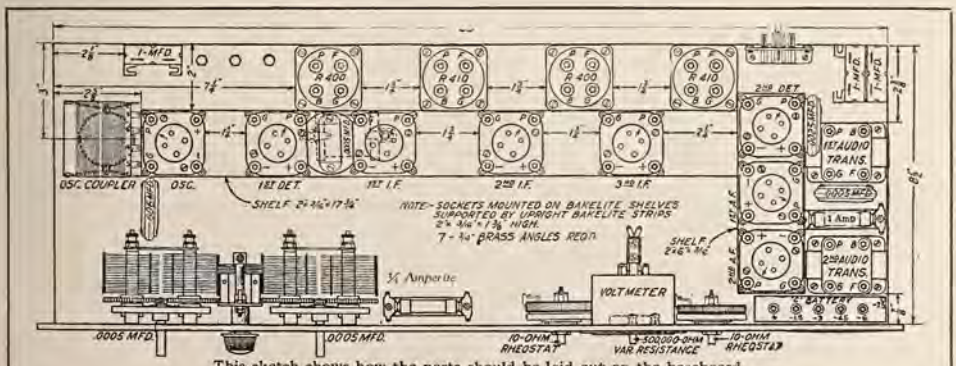
While the midget condenser used for balancing the loop is placed on the panel where it may be easily reached, in actual practice it has been found possible to place it back of the panel and once adjusted for a certain tube in the first detector stage, it can be left alone. Perhaps the average set builder will like it on the panel so it is shown in that position. By means of it the loop may be made either sharp or broad. Switching around the two outside loop terminals may make a difference on the tuning of this midget condenser, and it is rec-

EVERY NIGHT LOG

Kc	Stn.	Loop	Osc.
1010	KPRC	61	60
1000	WPG	62	62
990	WGN	64	63
980	KOIL	65	64
970	KDKA	66	65
960	KSBA	67	66
950	WGES	69	68
940	WSMB	70	69
930	KOA	71	70
920	KWKH	73	72
910	WJAZ	74	73
900	WBZ	75	74
890	WJAX	77	75
880	KFAB	78	76
870	WCBD	79	79
860	WEEI	81	80
850	WWJ	83	81
840	KRLV	85	84
830	WPAP	86	85
820	WDAF	88	87
810	WEBH	90	88
800	KTHS	92	90
790	WGY	93	91
780	CKY	94	93
770	WTAM	95	93
760	WOAI	98	96
750	WHT	100	98
740	KMMJ	103	101
730	None heard		
720	WCCO	106	104
710	WLW	109	107
700	WSB	111	109
690	None heard		
680	WOS	113	112
670	WQJ	117	115
660	WJZ	120	118
650	KMA	121	120
640	KFI	124	123
630	WBAP	126	124
620	WOC	131	129
610	WCFL	136	134
600	KFRU	139	137
590	WIP	141	140
580	WCX	143	141
570	WHO	151	149
560	KYW	158	156
550	KSD	163	160



Detail of the oscillator coupler No. 26 DCC wire is used in all windings. The turns are shown in sketch



This sketch shows how the parts should be laid out on the baseboard

ommended that connections be switched until best results are secured. It is also advisable to try more than one position of the rotor coil inside the coupling unit. With the rotor at right angles to the grid and plate windings on this unit there will be least transfer of energy from the oscillator to the grid of the first detector. In this case there is no tendency of the first tube to block under strong signals. However if the inductive relationship of the pickup rotor and the stator coils is such that maximum energy is picked up from the oscillator there is a possibility of overloading the first detector grid and introducing considerable distortion. Tune in a signal of medium strength and then adjust the pickup coil for best results. Also switch the outside terminals of the loop and see if different results are obtained.

IN OPERATION we found the simplest method of tuning was to set the oscillator condenser, at the right, to a given point and swing the loop condenser, left, back and forth until a gentle hissing sound is heard. This shows that the loop circuit is then resonant at the frequency for which the oscillator is set. A variation of the rheostat controlling the filaments of three of the intermediate stages will result in changing the volume of the signal.

If properly built this receiver will surprise its owner with its ability to pick up long distance signals. The audio quality is good with the type of audio transformers shown, although those who are finicky on the subject of quality may find it more to their liking to make use of the larger transformers made by the same manufacturer, such as the R200.

For those who like to be relieved of any trouble in the operation of a set, we used this receiver with an Abox filter for the filament supply and a Majestic B eliminator for the plate potential. Thus all we had to do was to turn on a snap switch and the filament and plate power was on. What could be simpler?

Power for the Abox filter is supplied by a five ampere charger, bulb type. This insures sufficient filament voltage to run the Super 8 even if a UX 210 is used in the last stage. Even on extreme distance when the set is working to its utmost there is no hum of an electrical nature, such as modulation. All bulb chargers have a slight mechanical hum, but this does not affect reception.

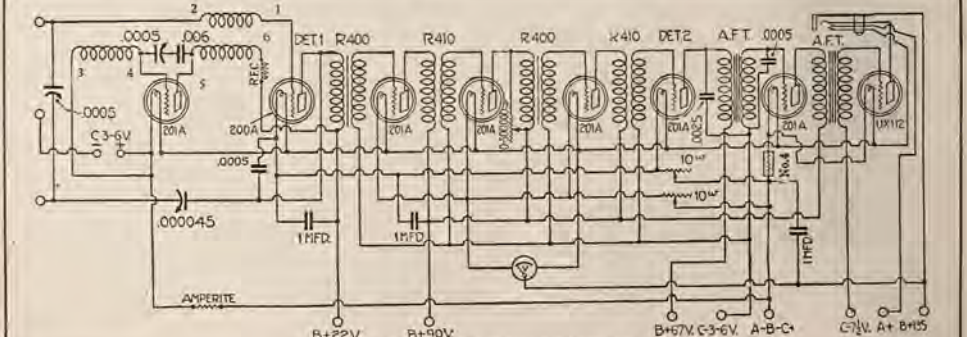
A few final words. Be sure to solder all connections well. Go over the set twice to make sure that all connections are in accord with the pictorial layout on page 21. When satisfied that all is well, hook up the set to the A and B source and prepare to entertain yourself to your heart's content.

To make the loop and oscillator settings track as nearly as possible, the Quali-tone loop was used since it seems best designed for this particular set.

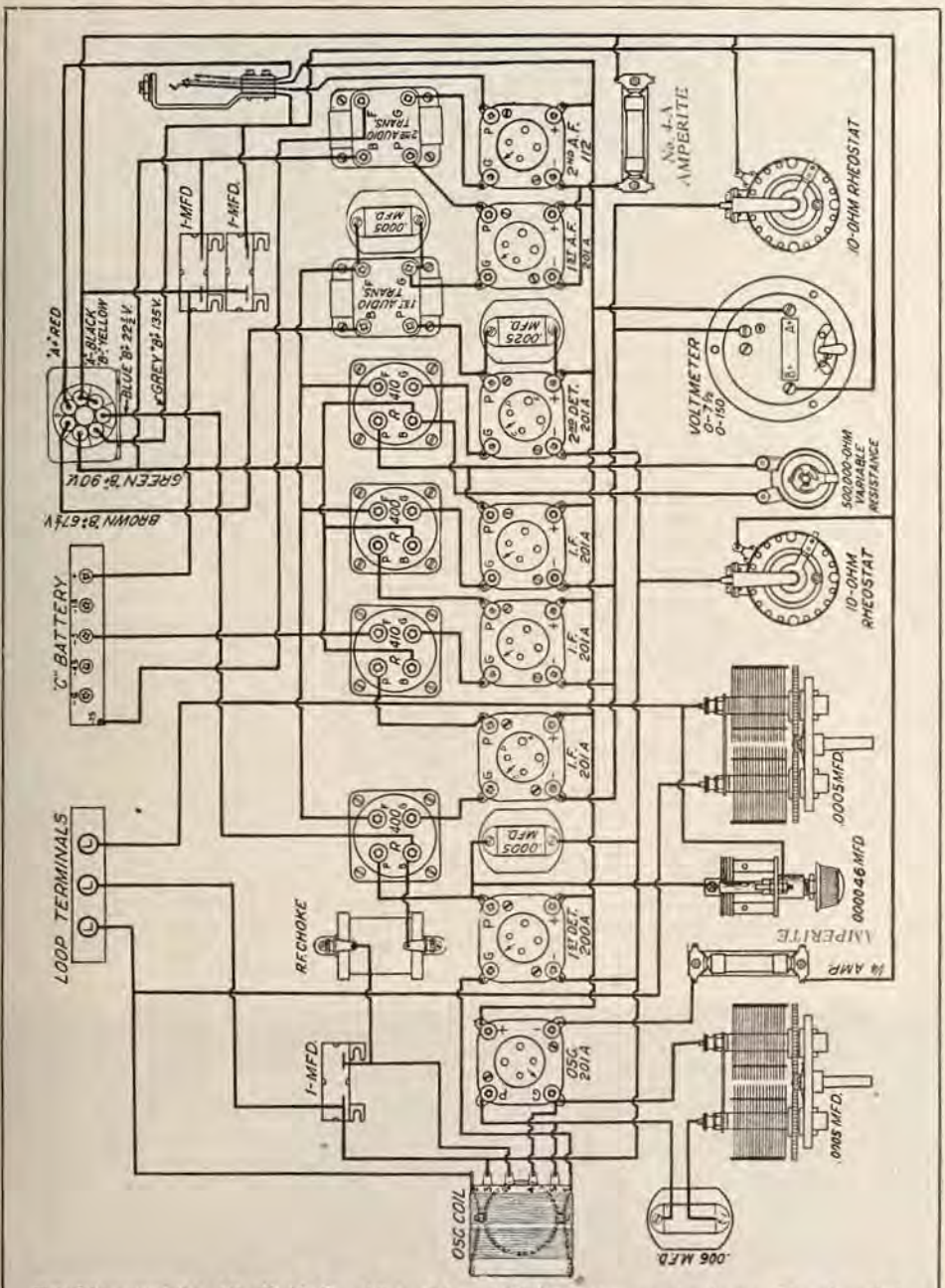
Set builders may expect a slight deviation from the published loggings, due to a difference in tubes, loop and the amount of C battery applied to the center tap. However the log shown will serve as a guide for the experimenter who should be able to log his own set in the same manner.

LIST OF PARTS

8 Benjamin UX cushion sockets
2 Selectone 410 RF transformers
2 Selectone 400 RF transformers
1 Thor RF coupling unit
2 Remler .0005 mfd variable condensers
2 Yaxley 10 ohm rheostats
1 Jewell dual range voltmeter 0-7½-0-150
1 Carter 500,000 ohm resistance, variable
1 Hammarlund .000046 mfd midget condenser
1 Sangamo .006 mfd condenser
2 Sangamo .0005 mfd condensers
1 Samson 125 mh rf choke
3 Sangamo 1 mfd bypass condensers
1 Yaxley base mounting plug
2 Thordarson audio transformers 2-1; 3-1
1 Yaxley filament control jack
1 Radiall ¼ Amperite
1 Radiall 4-A Amperite
2 National vernier dials
3 X-L Pushposts
1 Quali-tone loop
1 Quali-tone drum speaker
1 Burgess 7½ volt C battery
1 Frost phone plug
1 Formica 7x26x3-16 panel
1 Abox filter
1 Majestic "Super" B eliminator
1 Rectigon 5 amp. charger



Schematic circuit of the receiver described



Pictorial representation of the World's Record Super 8 from which the novice may wire the set. The schematic is shown elsewhere in this article for the more advanced fans

Dual Impedance Receiver Has Excellent Tone Quality

RF and Regeneration Make Ideal DX Set

TONAL quality has always been an aim of the experimenter. In the receiver shown on these pages this objective has been gained by a combination of one stage of audio amplification followed by two stages of impedance coupling. For the distance enthusiast the set has been arranged for one stage of neutralized RF amplification and a regenerative detector. This combination has been tested thoroughly in the laboratory of this magazine and has performed very satisfactorily in all respects, including that of selectivity. This being under the control of the operator, any degree of selectivity may be secured merely by altering the inductive relationship of the RF primary rotor.

As will be noted from the schematic on page 23 the dual impedances (Samson) are a compromise between transformer and impedance coupling. These give good quality reproduction and are mounted and connected in the same manner as ordinary audio transformers, the condensers being already placed inside of the cases.

In the photograph on page 22, the condenser on the left is for wavelength tuning, the upper knob on the RF coupler in the center of the panel is for the regenerative rotor, while the lower rotor is for the RF plate rotor which permits either fine or broad tuning. The right hand condenser governs the secondary wavelength. The antenna winding on the coupler at the left is fixed. This coupler is arranged horizontally whereas the double rotor coupler is arranged vertically, this eliminating any possibility of inter-action between inductances.

For neutralization of the first RF tube and to prevent this tube from slipping into oscillation and radiating in the antenna circuit, (even though feebly) the 85 mh choke spanned by a .0001 mfd. fixed condenser is placed in series with the grid return of the first tube and goes to the negative of the first tube. The neutralizing condenser is placed between the plate of the first tube and the grid end of the 85 mh choke. The connection is shown clearly in the schematic circuit printed in this article.

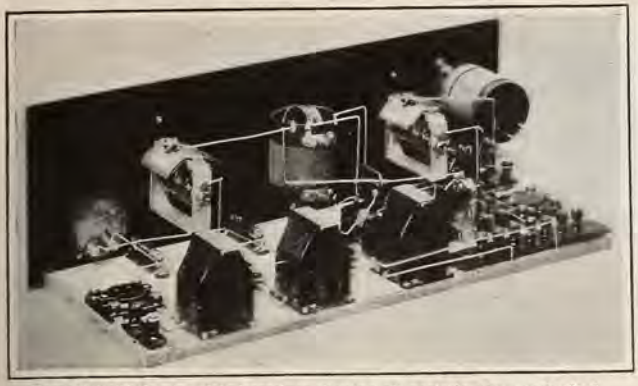
In the regenerative circuit another 85 mh choke is placed in series with the regenerative rotor between the rotor and the primary of the 2 to 1 audio transformer. It prevents RF energy from going through the primary of the audio transformer and being passed on to the next tube, resulting in distortion. This choke is spanned by a .001 mfd condenser which serves to bypass the RF energy to the filament positive terminal which is common with the ground.

Aside from the features mentioned above the set is a standard, good, radio frequency amplifier with regenerative detector, one straight audio and two impedance stages. The cost of the parts is not excessive and their assembly is simplicity itself.

Pictorial Layout

THOSE who are not accustomed to wiring a receiver from the schematic circuit should consult the pictorial representation of this receiver as shown on page 24. The parts may first be laid out upon the baseboard and the panel as shown in the drawings and the photographs. Then the filament wiring of all the sockets, together with the Am-

Front panel view of the receiver described in this article



Rear view of the completed receiver showing all parts in place and wired

perites, should be placed in before the other wiring is done.

In mounting the double rotor coupler attention should be paid to the fact that upper control is the regenerative one. This winding is larger, in turns, than the primary of the RF circuit, and the coupler should be mounted with the regenerative rotor at the top of the panel and the RF primary at the bottom. All connections of the two couplers are brought out to soldering lugs which makes assembly quite easy. A strip for the binding posts at the rear of the baseboard may be made from a piece of bakelite 7 inches long and about an inch wide. Another smaller strip 2 inches by 1 inch can support the two binding posts for the loud speaker, while another strip of the same size can be used for holding the two binding posts for the antenna and ground.

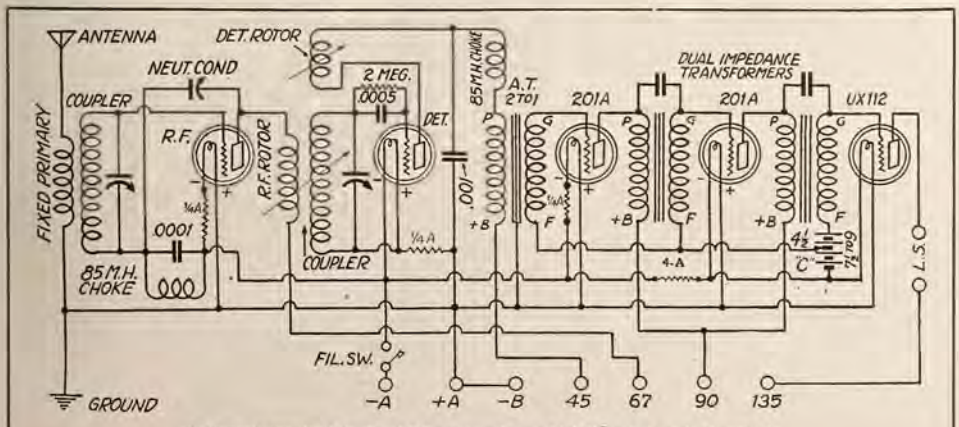
As shown in the photograph the grid condenser may be mounted directly upon the grid terminal of the socket. This will conserve space. The 0-500,000 ohm variable resistance which is used as a volume control is mounted on the panel at the extreme right, and is connected in the circuit across the grid and bias connections of the first audio transformer. It is not shown in the schematic drawing, but is in the pictorial. Another means of cutting the volume of the receiver lies in the manipulation of the RF plate rotor so that its winding is at right angles to that of the secondary. Which of the two is preferable remains for the individual set user to determine.

Neutralization of the first tube is not difficult, the knob permitting any value of capacity within the range of the neutralizer to be used.

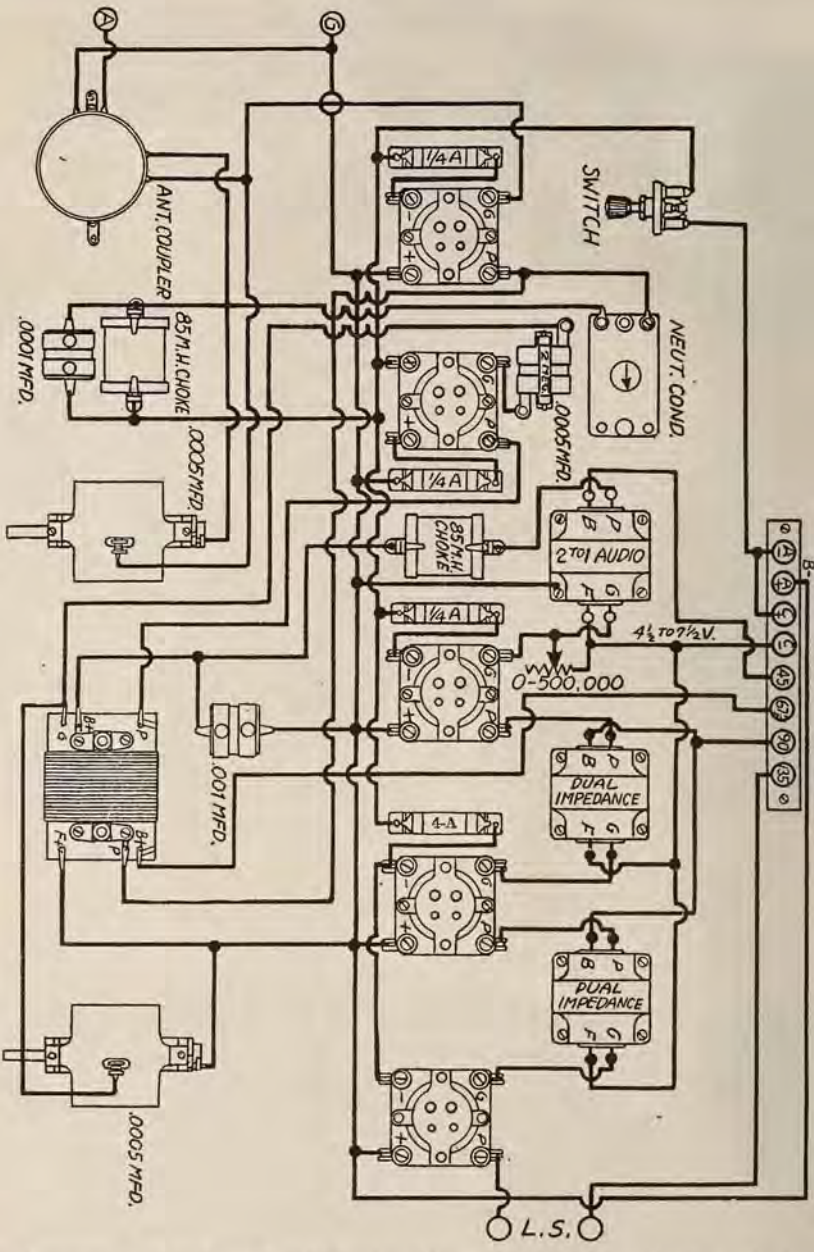
This receiver has been used with A and B batteries and with A and B elimination, performing satisfactorily in either case. For congested areas like Chicago and other metropolitan centers, it should appeal to fans who have had difficulty in tuning out interfering stations.

LIST OF PARTS

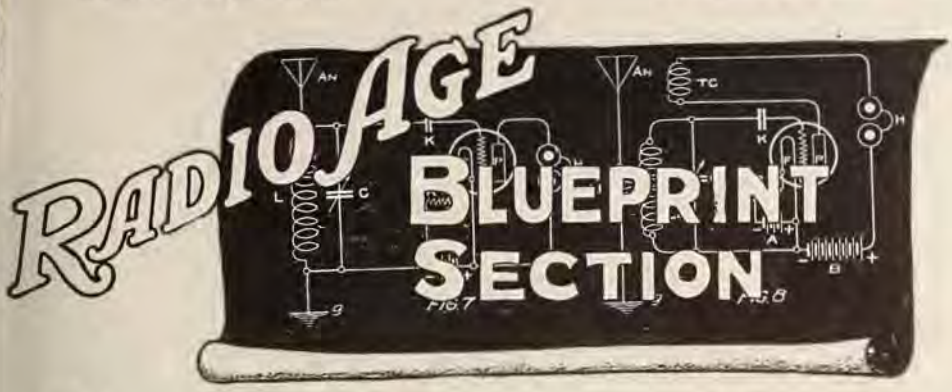
1 Samson antenna coupler
1 Samson double rotor coupler
2 Samson .0005 mfd. variable condensers
1 Samson 2-1 audio transformer
2 Samson dual impedances
2 Samson 85 mh chokes
1 Samson neutralizing condenser
2 Samson vernier dials
5 Eby UX cushion sockets
10 Eby engraved binding posts
3 Radiall ¼ Amperites
1 Radiall 4-A Amperite
1 Sangamo .001 mfd. condenser
1 Sangamo .0001 mfd. condenser
1 Sangamo .0005 mfd. condenser
1 Durham 2 megohm grid leak
1 Carter "Imp" battery switch
1 Centralab 0-500,000 ohm variable resistor
1 7x26x3-16 panel
1 8½x25x½ baseboard



Schematic circuit of the Dual TC receiver from which the set may also be wired



Pictorial representation of the Samson Dual TC Receiver which may also be used as a wiring diagram by those who are not accustomed to schematic sketches



Clough 7 Tube Super Result of Much Research

Several Novel Features Make it Highly Desirable

By F. A. HILL
(Associate Editor)

CONSIDERABLE research work has been done in the past few years on the superheterodyne, principally by independent engineers who have seen in this type of receiver the culmination of all ideas concerning distant reception, freedom from interference and, lately, excellent audio quality in the loud speaker.

With this in mind we take pleasure in announcing a recent design by Kendall Clough, of the Research Laboratories of Chicago, of a seven tube superheterodyne in an exceedingly compact form which has given, under RADIO AGE laboratory tests, perhaps the highest account of itself of any of the types of similar receivers of the same number of tubes. In addition the quality of the audio end of the receiver is excellent, and surpasses anything we have yet tested.

These remarks may seem rather radical for a magazine of conservative tendency, but the facts speak for themselves. We are always on the lookout for something better than the ordinary for our readers and in this case we believe we have found it.

Inspection of the schematic circuit of this set will not disclose any trick stunts. Instead the reader will observe that it is the conventional superheterodyne with a shielded first detector, a shielded oscillator, and antenna coupling instead of a loop. These features (the first two), make for decreased local pickup of stray energy, while the latter permits the use of the receiver in a congested locality where a loop's directional propensities would be set at naught due to the construction of the building in which the receiver was located. It also permits using a very small energy collector, an antenna of from 4 to 25 feet in length.

However the feature to which most importance should be attached is the method of feeding the oscillator a positive grid bias to a point where the plate circuit of the oscillator will take the same space current with the tube oscillating as it does with the tube *not* oscillating. When this point is reached (as will be explained further in this article) the even harmonics of the oscillator will have been eliminated, leaving only the odd ones which will be greatly robbed of their energy.

Peaking the Filters

ANOTHER point to be considered in this particular superheterodyne is the fact that a great deal of work was expended on the intermediate stages by Mr. Clough who had felt there was much to be desired in peaking long wave filter circuits and who set about designing a new method of doing this work. Beside the accuracy of peaking in the intermediate stages, the question of field intensity of the transformers themselves was fully investigated with a view to finding the effects of coupling between the intermediate transformers; the presence of shielding; the effect of non-uniform tube capacities and a host of other problems with which the

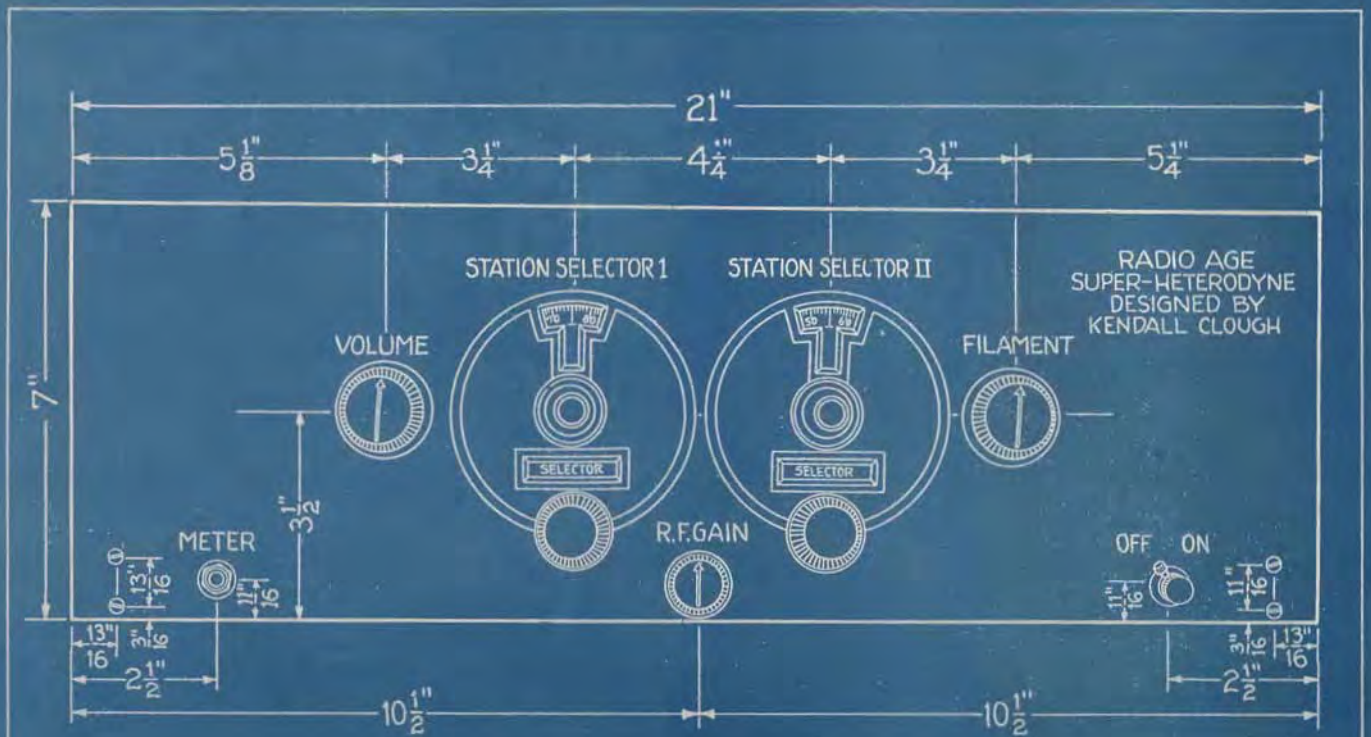


FIG. 1 FRONT VIEW
RADIO AGE SUPER-HETERODYNE
DESIGNED BY KENDALL CLOUGH

RADIO AGE INC.

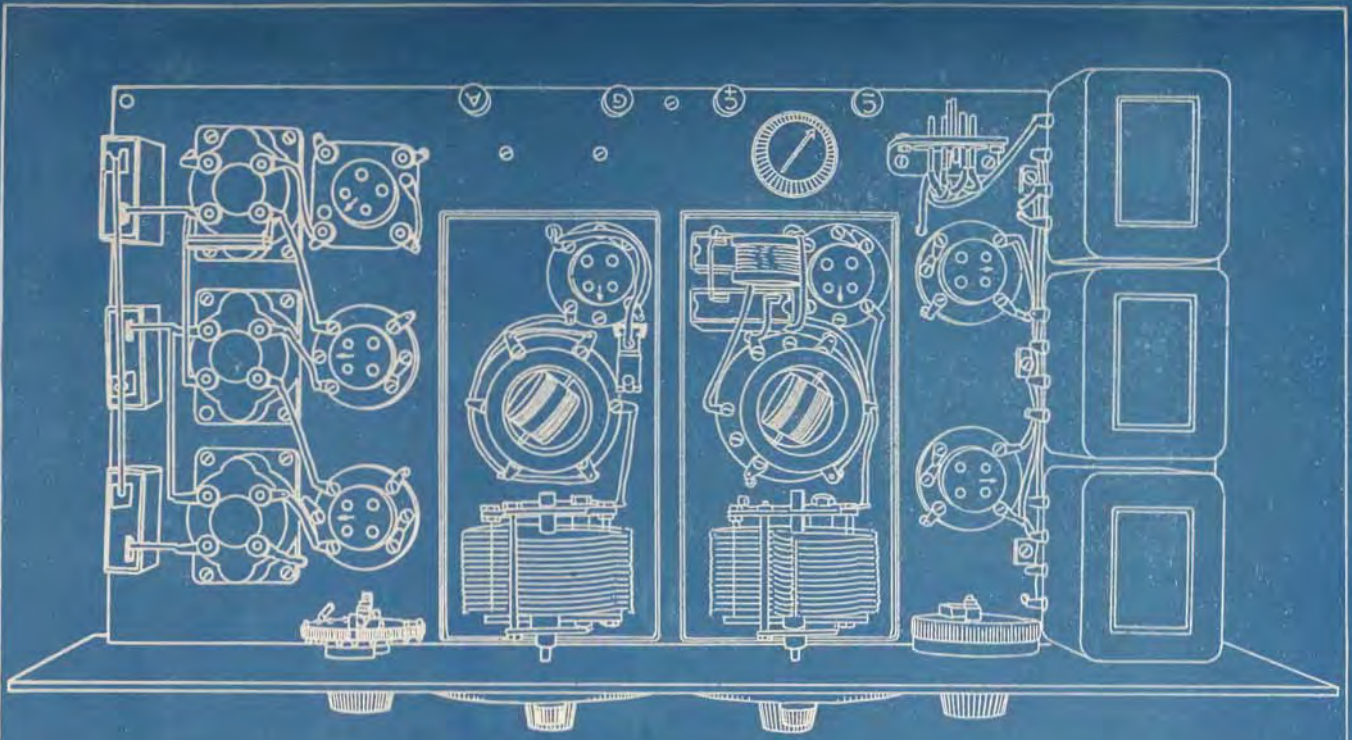


FIG. 2 TOP VIEW
RADIO AGE SUPER-HETERODYNE
DESIGNED BY KENDALL CLOUGH

RADIO AGE INC.

average experimenter is not prepared to cope.

As a result of months of work this especial design has been found to be an ideal one both for the experimenter and the listener. By means of the oscillator biasing system there are only two points on the oscillator dial where a station appears, this being a normal function of this kind of receiver. In some localities this feature is highly necessary to permit reception of a distant station either on the higher or the lower beat of the oscillator. In some cases where interference is encountered in the upper beat, the lower one will bring the desired station through without a trace of interference. With the even harmonics eliminated much of the short results. Then carefully begin fishing for the distant stations. Do not make too great capacity changes in the oscillator circuit when hunting DX for on many occasions you will entirely pass over the desired long distance signal. The midget capacity shown as RF gain will help in making the set sensitive to signals. If the potentiometer (volume control), on the panel is thrown all the way over to the negative it will throw the intermediate stages into oscillation. This control should be operated at a point just below that where the intermediates go into oscillation.

Elsewhere in these columns there will be found a log of the performance of this receiver *on nights other than Monday*—this particular night being "silent" in Chicago and not a good evening to test a receiver against the local barrage.

In a forthcoming issue of Radio Age we hope to have more data of an operative nature on this receiver. Those of our readers who build this set will confer a favor on us by reporting their results for the benefit of other experimenters.

In the audio end the plate circuit of the second detector is supplied with a 276 rf choke which serves to keep out any rf from the audio primary. This coil is spanned, from plate to negative filament, with a .002 mfd condenser. The grid return on the first audio is to negative filament, whereas the grid return of the second audio is to the 6-7½ volt tap on the C battery. The output transformer is shown, 221, this serving to completely isolate the dc component from the loud speaker.

LIST OF PARTS

2 S-M type 11-A plug in coils
2 S-M type 515 coil sockets
1 S-M type 275 rf choke
1 S-M type 276 rf choke
2 S-M type 316 variable condensdensers
2 S-M type 801 vernier dials
1 S-M type 340 midget condenser
7 S-M type 511 tube sockets
2 S-M type 210 long wave transformers
1 S-M type 211 air core transformer
2 S-M type 220 audio transformers
1 S-M type 221 output transformer
2 S-M type 631 stage shields

1 Yaxley closed circuit phone jack
1 Yaxley plug and cable
1 Yaxley 3 ohm filament rheostat
2 Yaxley 200 ohm potentiometers
2 Yaxley lmp jacks for speaker
5 Polymet I mfd bypass condensers
1 Dubilier .002 mfd condenser
1 Dubilier .0005 mfd condenser
1 Durham 2 megohm leak and mounting
1 Bakelite panel 7 by 21 by 3-16
1 Bakelite sub panel 10 by 21 by 3-16
2 Benjamin brackets
4 Eby binding posts
1 Yaxley filament switch

Use Good Tubes

HAVING gone over the component parts of this super, which is clearly shown in the schematic, we will go into its operation. First of all, regardless of the expense entailed, get six standard Radiotron or Cunningham 201-A tubes, and one UX112. Since the intermediate stages and the filter are designed to work with tubes having minimum tube capacity, it is imperative that 201-A tubes of the type mentioned be used. We had a couple of trick tubes in the set and nearly lost all of our religion wondering what was wrong. If you are going to the trouble of making up a good job like the Clough super by all means use the best tubes it is possible to secure.

Take a fresh 7½ volt C battery and insert at the terminals shown Osc+C and Osc—C. This is a separate C battery from the one used for biasing the audio and the second detector. On account of the positive bias applied to the oscillator this battery will not last as long as the other since it draws about one milliampere. After connecting in the oscillator C battery (having put in all tubes, hooked up the antenna and ground and plugged in the loud speaker) take a voltmeter or milliammeter (any low reading one will suffice since it is also a milliammeter) and plug it into the jack marked "meter." Then take a short length of wire with a clip at each end, and *short out terminals 3 and 4 of the oscillator coil.* While doing this watch the meter. If the reading of the meter goes down as you short terminals 3 and 4 change the potentiometer knob on the subpanel to add more C bias. If the reading on shorting terminals 3 and 4 goes up, then less C bias should be supplied. The simplest way to do is to attach one clip on terminal 4 of the oscillator and then with other end tap on terminal 3. Alter the potentiometer value as you tap until you reach a point where the meter needle remains steady regardless of whether the terminals are shorted or not. In this condition the oscillator takes just as much space current when the grid circuit is shorted and the tube stops oscillating, as it does when the tube is fully oscillating. Here the even harmonics will have been eliminated and the odd ones greatly reduced in strength. If the 7½ volt C battery is not sufficient, hook another one in series with the first one.

Get Proper Voltages.

ANOTHER word might not be amiss. The voltages shown in the diagram, namely, 45, 9(

and 135, should be assured. If using a B eliminator, test your voltages to see the proper values are secured. In using dry batteries be sure to use the heavy duty type, since the receiver when using a power tube, takes from 30 to 50 milliamperes. In actual operation and with everything going full blast our test set ran 35 milliamperes.

Inside of the 111-A coils there will be found small rotors. These rotors govern the pickup from the antenna, and the pick-up from the oscillator. It would be a good idea for the set builder to experiment with different inductive relationships of these rotors. The rotor in the antenna coupler should be varied until a good signal strength is secured with a given length of antenna, while the oscillator rotor may also be varied until the best results are secured.

Tune in a local station first and get the set adjusted for best wave transmission which might ordinarily be heard on the super, is likewise done away with. In the audio end with the falling characteristic of these transformers many of the shrill whistles heard on another set are cut off to a point where they are not noticeable. In the lower register we found tones from the well known "oompah" of the Sousaphone, the throbbing cello and a number of the pedal notes of an organ that we did not believe were in existence before. One of our radio wags suggested the audio transformers used in this receiver should be sold to a great many of the broadcasting stations for line transformers.

In another portion of this story we will give the results of our tests. At present we will confine ourselves to a description of the circuit, section by section.

The Description

FIGURE 1 of the blueprints shows the front view of the panel, which is 7 by 21. On it are located the jack for the meter, volume control, selector one, RF gain control, selector two, filament control, and the filament switch. The drawing gives the detailed dimensions.

In the second blueprint, Figure 2, are shown, reading from left to right, the three intermediate stages, the shielded first detector, the shielded oscillator, and the two stages of audio with output transformer. The stage shields are available so that any one can duplicate this feature of the design.

Figure 3 shows the under side of the subpanel on which a majority of the connections are made, most of these connections being run together across the bottom of the subpanel.

Schematically the Clough superheterodyne is shown in Figure 4, which is the diagram from which the set should be studied and wired. All markings are shown on the diagram so that even a novice should not hesitate to make up a set.

Referring to the schematic circuit, we will dissect it for our readers. The first detector circuit is located inside the stage shield. It comprises the coil socket, 515, the plug-in coil, 111-A, the tube socket 511, the variable condenser 316, the grid condenser and grid leak. Ground is common with the stage shield, the negative filament terminal 4 of the coil, the rotor of the variable condenser, the rotor of the midget condenser (.000025 mfd) and one side of the bypass capacity which is across the 45 volt lead.

The oscillator circuit is likewise shielded with a stage shield, which is common with the negative connection of the potentiometer, the negative of the filament. A strap is shown below the ground connection which serves to join the two stage shields and place them at ground potential, thus limiting

Photograph of the completed Clough superheterodyne with the stage shields removed from the first detector and oscillator

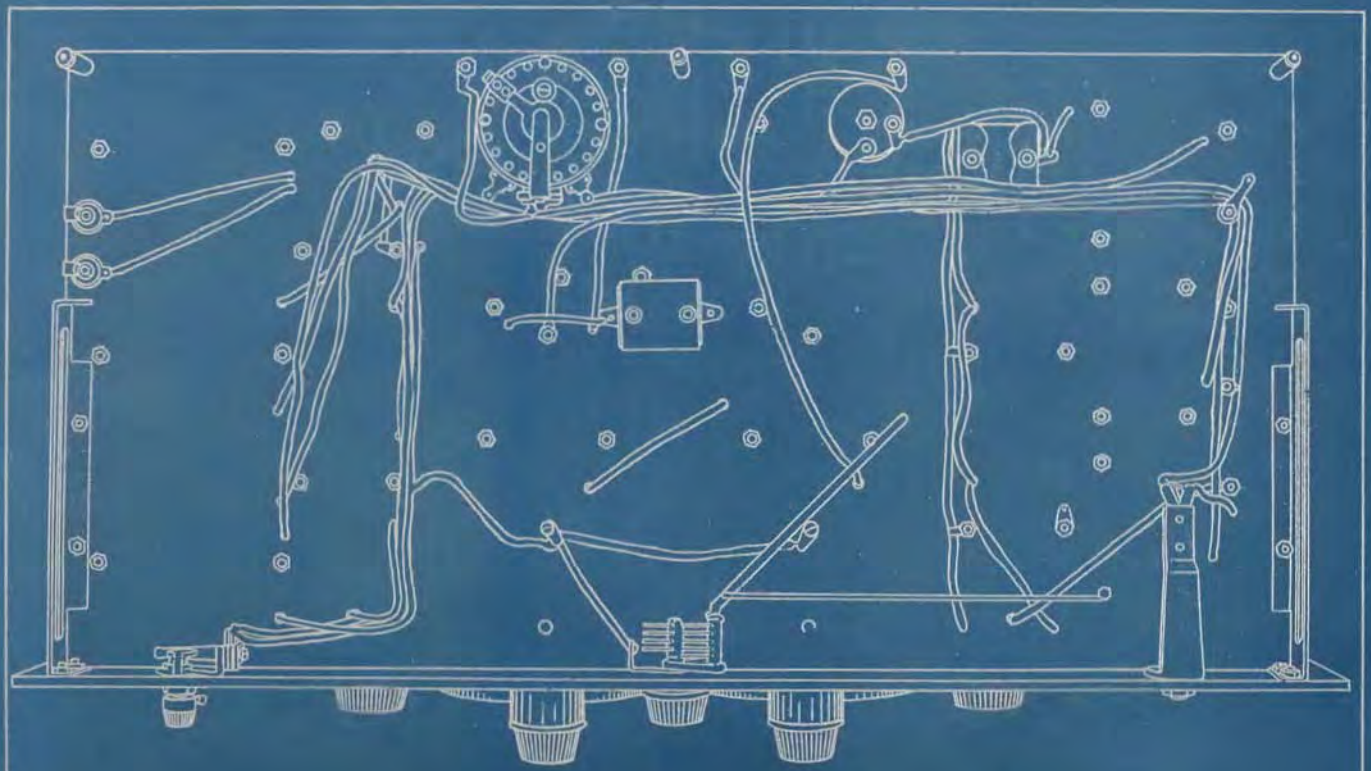


FIG. 3 BOTTOM VIEW
RADIO AGE SUPER-HETERODYNE
DESIGNED BY KENDALL CLOUGH

RADIO AGE INC.

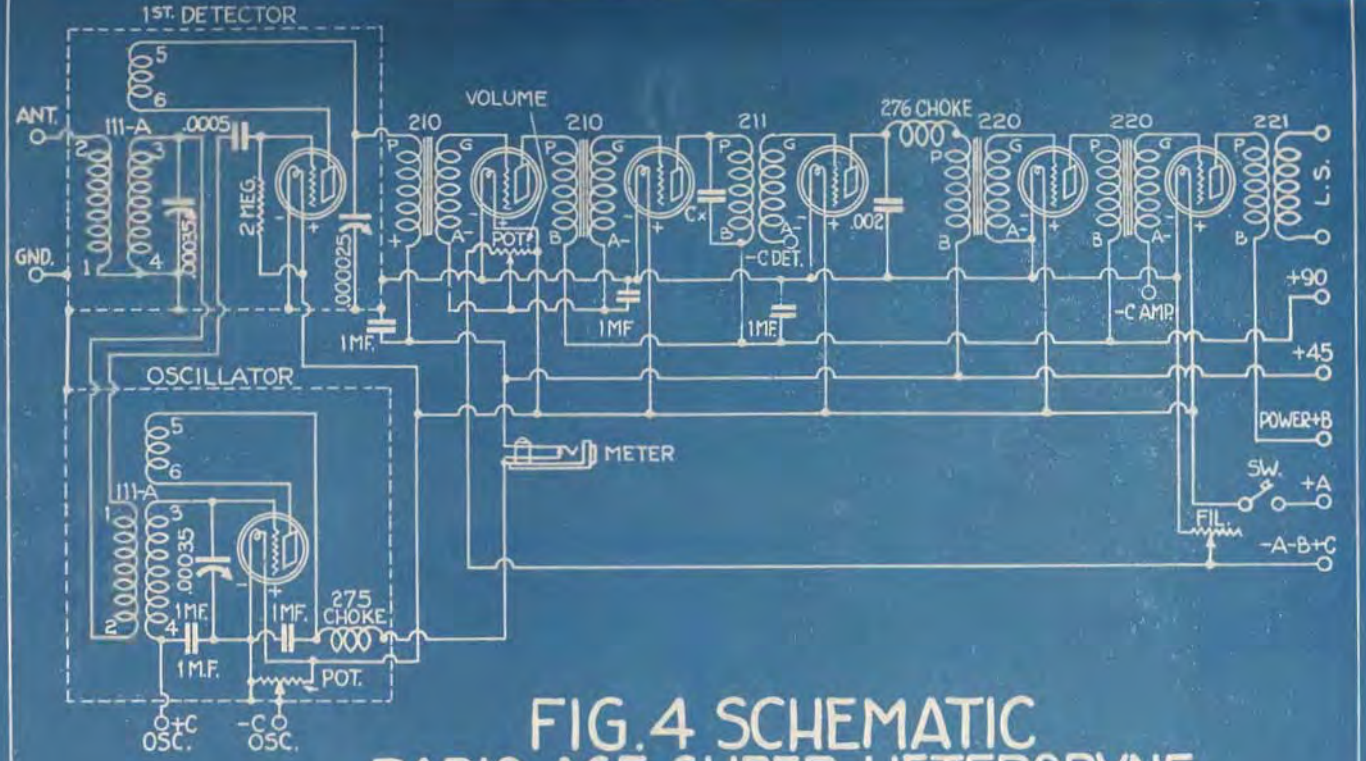


FIG. 4 SCHEMATIC
RADIO AGE SUPER-HETERODYNE
DESIGNED BY KENDALL CLOUGH

RADIO AGE INC.

considerably the local pickup of the circuits. A one mfd bypass is shown between terminal 5 and the negative filament, the 275 choke being in series with the plate section of the coil, the meter jack and the 45 volt line.

The intermediate, or long wave section, of the circuit is self explanatory. Two long wave, iron core transformers are used, the first one using 45 volt plate potential, and the second one 90 volt potential. A potentiometer is placed across the positive socket terminal and the negative of the filament battery, its center arm going to the two grid returns of the iron core transformers. The air core filter coil, 211, has 90 volts applied to the plate, while the grid return goes to the 1½ or 3 volt negative terminal of a C battery. The capacity Cx placed across the primary of the air core transformer, peaks this transformer at the desired frequency—in this case 55 kilocycles. The condenser is supplied with the transformer.

OBSERVING the log shown as a result of tests on the Clough super, readers will note a slight deviation from a uniform curve for both the oscillator and antenna settings. These, we believe, are due to the changes we made during the logging, of the antenna and oscillator rotor inside of the plug-in coils. Where greatest interference from local splash was encountered, it was necessary to alter the inductive relationship of the antenna rotor to bring back sharpness. In such a case a slight irregularity shows up in the plotting of the condenser settings. The same holds true for alteration of the oscillator pickup rotor, and a difference in the positive bias applied to the oscillator will likewise bring a slightly different oscillator condenser setting. It is suggested before a permanent log is made of the receiver, all possible combinations of rotor settings be tried, especially in the vicinity of stations like WQJ against WJZ. If the rotor adjustments are made on the WQJ-WJZ band (separated by 10 kilocycles), and the degree of selectivity fixed, this degree will remain true for the balance of the broadcast channels. It is not advisable to be constantly changing the antenna settings since it would entail considerable bother in making up a standard set of logging figures.

Particular attention should be paid to the filament setting of the tubes. With a voltmeter, adjust the filament circuit until the reading is exactly 5 volts. From this point all other adjustments may be made. However if the filament voltage is constantly shifted there will be a slight deviation in the oscillator readings.

LOG OF CLOUGH SUPER

KC	Stn	Ant	Osc
1010	KPRC	34	38
1000	WPG	35	39
990	WGN	36	40
980	KOIL	37	41
970	KDKA	38	42
960	KSBA	39	43
950	WGES	40	44
940	WSMB	42	46
930	KOA	43	47
920	KWKH	44	48
910	WJAZ	45	49
900	KTNT	46	50
890	WJAX	47	51
880	KFAB	48	52
870	WCBD	49	53
860	WEEI	50	54
850	WJAD	52	55
840	KRLV	53	56
830	WPAP	54	58
820	WHB	55	59
810	WEBH	56	60
800	KTHS	57	61
790	WGY	58	63
780	CNRM	59	64
770	WTAM	60	65
760	WOAI	61	66
750	WHT	62	67
740	KMMJ	63	69
730	WCRW	64	70
720	WCCO	65	72
710	WLW	66	73
700	WSB	67	75
690	KFKB	69	77
680	WOS	70	79
670	WQJ	72	82
660	WJZ	74	83
650	WCAE	75	86
640	KFI	77	87
630	WBAP	78	90
620	WOC	81	93
610	WCFL	83	96
600	WMC	85	98
590	KFQB	88	75*
580	WCX	90	77*
570	WOAW	92	79*
560	KYW	96	82*
550	KSD	100	85*

*Lower beat used instead of upper.

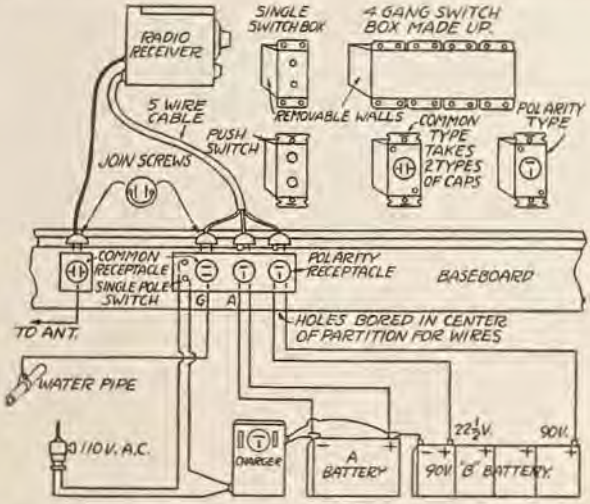
Pick-ups and Hook-ups by our Readers

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

WHEN Miss Elizabeth Zandonini of Washington, D. C., received a radiogram from a friend in Italy recently she was somewhat surprised to note that the message had been filed in Italy only an hour before she had received it in this country. A checkup on the routing showed that an Italian amateur had sent it on short waves direct to an American amateur in Philadelphia, who in turn passed it on immediately to an amateur in Washington, the latter completing the fast delivery by telephoning to Miss Zandonini's residence.

JAMES W. WIGGINTON, watchmaker and jeweler at Larkspur, Calif., has a homespun single tube regenerative set with which he prowls the ether lanes in search of DX. Mr. Wigginton is located at the brow of Mt. Tamalpais, 8 miles northwest of San Francisco. In our dreamy moments we pine for such a location for our pet set.

Permanent Attachment Place For Radio



FOR those fans who want the best in their radio installation, there is nothing better than a row of plugging in places in the baseboard, where connections to everything can be conveniently made and just as easily disconnected. The sketch shows how this can be accomplished in a simple way.

At the left is the antenna receptacle, which is only an ordinary electric light receptacle. In connecting this one, only one of the contact screws are used, and in the cap both of the screws are jumped with a piece of wire as shown, so it will make proper connection, whichever way it is inserted. The group of four fittings consists of a push button switch to start and stop the charger when desired, and the others represent three more receptacles, the first is the same type as the antenna uses, and the other two are "polarity" type, which mean that they can only be inserted one way, which insures the right battery polarity. This whole assembly gives connection to antenna, ground, charger switch, "A" battery, "B" battery 22v. and 90v., all brought up through the cellar directly underneath, a location being selected where the partition can be easily entered by boring holes up from the cellar to admit the wires.

The usual switch box is used, cut in flush with the baseboard, to encase the receptacles and the switch. For the group of four, the boxes are joined together into one, by removing the side walls as required and the screws provided, will clamp them all together. The single brass finishing plate is easy to purchase anywhere, but the four "gang," may have to be made for you, out of a piece of ⅛" brass.

In operation, the charger switch is left "off." When it is desired to charge the battery, you simply push the switch "on," making sure all the rheostats on the set are off to avoid possible injury to the tubes, leaving it charging until it is desired to operate the set again, if necessary. This being all located in the baseboard, it makes tramping to the cellar unnecessary, and all unsightly batteries out of sight.

—H. P. STROUD.

ONE of our readers, whom we take to be a telegraph operator (from his signature), tells this department of his scheme for using a telephone as an aerial. J. N. Bacon, at Oshkosh, Wis., writes as follows:—

"I am located on a corner with street cars on west and south sides of me, power line carrying 8 wires (power to car barns) 60 feet west of and parallel to my antenna, high power line carrying 66,000 volts 300 feet east of and parallel to my antenna and all approximately at same height. Reception spoiled by incessant crackling and when street cars are passing reception is entirely drowned out.

"It was inconvenient to change the antenna to right angle to these power lines, and the results would have been doubtful even then, so I tried the stunt of using the telephone as a "pick up" with the result of an apparent increase of signal intensity, reducing the crackling to almost abs lute quiet, and unless I am looking for the street cars, would not know they were passing, except when forcing the tubes, then I get a slight crackling, but when the R. F. and detector tubes are being worked on the correct amount of filament battery, no noise is noticed. Am using a Browning-Drake hook-up, and while I have *only had both coasts*, the *Gulf* and *Canadian* station, as well as anything intermediate so far, with this new 'pick up,' I am in hopes that I may possibly get a little farther later on.

"While the wife was not looking, I 'acquired' an aluminum pie pan from the kitchen cupboard and attached a wire to it for a lead-in to the antenna post on the set, cutting off the outside antenna entirely. I then placed the pan on the one desk and placed the phone upon the pan.

"*Do not attach the wire to the phone*, nor allow it to come in contact with the metal part of the phone or the trouble shooter will be trying to locate trouble on your lines.

"If it broadens your tuning, as it did mine, cut a .0005 fixed condenser in series in the lead-in. This will bring it back to very sharp tuning again.

"If you think this would help out some one who might be similarly situated, pass it along. There is no interference from the phone, whether it is working or not, neither does the ringing of the phone interfere, only a slight 'click' of the make or break, as the receiver is lifted off or replaced on the hook."

BUILDING his own sets from prints in this magazine, Z. T. Wheeler, 112 Russell St., Nashville, Tenn., writes to enroll in the DT fraternity. Mr. Wheeler seems to have a penchant for three tube sets and says he has made up nearly every possible combination of three tubers, getting good results from all of them.

Trees as Sources of Radio Inductive Interference

By JAMES MONTAGNES

IN some sections of the country radio inductive interference is the bugbear of radio fans. Electrical appliances and electric lines are the cause of this, and it takes radio inspectors and supervisors much time to hunt the trouble in order that the broadcast listener may be rid of this pest.

The little town of Orillia in Ontario at the head of Lake Simcoe, recently sent in a complaint to the Toronto radio inspector that terrific radio interference was making radio reception almost impossible. The radio interference car was quickly prepared and Inspector S. J. Ellis with his assistant left for Orillia, about eighty miles north of Toronto.

On coming within view of the town, Mr. Ellis was greatly impressed with the vast number of trees in and about the community. In fact Mr. Ellis fervently believes that there isn't another town with such a distinguishing entry. The trees proved to be more than that.

Usually inspection for this sort of interference is done on foot; where a long road has to be investigated the car is used. A receiver, loop aerial and phones are carried by the hunter, the receiver being slung over the shoulder by means of a strap and the loop carried in the hand. Then as a noise is heard in the phones it is tuned in and hunted till it is loudest. This vicinity is then thoroughly searched and the source of the trouble quickly found in this manner.

Following this system Mr. Ellis began hunting for inductive interference on reaching Orillia. He did not have far to go. Coming under some of the trees a faint sizzling was heard in the earphones. Without the aid of radio this was also to be heard, although very faintly. On investigating it was discovered that in a number of places throughout the town high voltage lines carrying 2,200 volts for the electrical consumption of Orillia were touching the trees in various places. As soon as the wires were separated from these branches the trouble ceased. As a result wherever this phenomena was found branches were sawn off. Typical examples of these charred limbs are shown in the accompanying photograph. Today Orillia is still a town of trees but radio reception is excellent.

Section of tree trunk, indentation showing where wood was burned away by high power line grounding to tree

Keeping Pace With Science

European Scientists Study Ghostly Temperature Drop

SCIENTIFIC circles in Europe are experiencing a distinct revival of interest in the supposed phenomena produced by mediums and in other so-called psychic manifestations. Most scientific men have been disinclined to investigate these phenomena seriously on the ground that many mediums are known to be frauds and that fraud is probable in the whole realm of the psychic. Outstanding exceptions to this view have been Sir Oliver Lodge, in England, and Dr. Charles Richet, in Paris. These pioneers are now beginning to have imitators among other scientific men. Few of these scientists share the spiritualistic beliefs. They prefer the idea that if any of the phenomena are real these are to be explained by new forces of nature which we do not yet understand. The most important single experiment yet reported in the field of actual scientific investigations of mediumistic phenomena appears to be one in which the temperature of the seance room dropped suddenly while a seance was in progress.

This Ship Swallows the Whale

Wide World Photo

The whale may have swallowed Jonah, but in 1926 here is what swallows the whale. In the strange blunt prow of this modern whaling vessel, is a waterproof door which is opened when a whale is caught, and in goes the whale, where the try-work scannery and full equipment for using every bit of the big sea beast is located. The ship shown here is the C. A. Larsen, one of the biggest whalers afloat

Mother of Airplanes at Sea

Wide World Photo

The airplane carrier "Langley" off San Diego during recent maneuvers of the Pacific fleet. The ship, under the command of Captain John Reeves and in charge of the aircraft squadrons, has been in operation since 1924 and naval aviators have landed their planes 2500 times without a single major accident. One thousand seven hundred of these landings have taken place since last November and all have been made at sea while the Langley was engaged in tactical maneuvers with the fleet or in training of the pilots. The arresting gear on board the Langley, which permits the plane to come to a full stop within the length of the deck, is one of the few jealously guarded secrets of the American Navy

Keeping Pace with Science

Eyes and Ears of the U. S. Coast Artillery

Wide World Photo

In the foreground is shown the huge new two-billion candle power Sperry searchlight, capable of casting a ray of light 40 miles, exhibited for the first time at the 1926 Electrical and Industrial Exposition at Grand Central Palace. In the background of the picture may be seen the listening machine used by the Army to detect the approach of enemy airplanes

First Plane Catapulted From Turret of U. S. Battleship By Powder Explosion

The U. S. Navy added another chapter to the history of aeronautics when a 5,100 pound amphibian plane was shot from the top of a turret of the U. S. S. West Virginia in Los Angeles harbor. A charge of powder equivalent to that used in an 8 inch shell was exploded. Lieut. D. S. Fahrney piloted the plane in the experimental take-off which is the first time it has ever been done.

Wide World Photo

Cosmic Rays Have Been Traced to Milky Way

TWO discoveries have been announced concerning the remarkable cosmic rays which continually bombard the earth from outer space. One announcement comes from the American physicist, Dr. R. A. Millikan, who detected these rays last year by sinking his apparatus deep in the water of a snow-fed lake high up on the California mountains. Dr. Millikan has now repeated these tests in the water of another mountain lake on top of the Andes Mountains in South America. The results are the same. The reality of the cosmic rays can no longer be doubted. The other announcement comes from Dr. Werner Kolhoerster, of Berlin, a German scientist who has been studying these rays for several years. Assisted by Dr. Gubert von Salis, he tested the intensity of cosmic rays on the top of one of the mountains in Switzerland. This intensity was found to vary from hour to hour, depending upon what part of the sky was overhead. More of the rays appear to come from the Milky Way than from other parts of the sky, with two other apparent sources perceptible; one in the neighborhood of the great Andromeda nebula and the other in the constellation Hercules. What produces these cosmic rays is unknown. Many scientists think that it is some transformation of the atoms of matter. The rays resemble X-rays but are much more penetrating. If they can be identified as coming from some particular class of celestial objects that may yield a clue to their origin and thence to how they can be produced and studied here on earth.

Everyday Mechanics

Experiment Confirms the Electric Nature of Matter

CREATING electric currents by shaking the electrons inside a bar of copper, as peas might be shaken inside a baby's rattle, is the striking scientific experiment recently accomplished by Dr. Richard C. Tolman and L. M. Mott-Smith at the California Institute of Technology, at Pasadena. The new experiment concludes and strengthens a series of similar tests begun by Dr. Tolman nearly ten years ago. Its result confirms the modern idea that both electricity and matter are fundamentally the same. The electrons with which Dr. Tolman's experiment dealt are the tiny electric particles which operate the vacuum tubes of a radio set and which constitute electric sparks and electric currents. These same electrons are believed to form parts of the atoms of matter. A bar of metal contains millions of them. Ordinarily these electrons are tightly held inside the metal, escaping only under the action of intense heat or of electric forces. Nine years ago Dr. Tolman was able, however, to shake a few of them out of a moving copper rod by stopping it quickly, in the same way in which one shakes pills out of a bottle to which they adhere. Now he has used the different method of making his cylinder of metallic copper twist back and forth on a spring. This sets the electrons inside the metal to swinging.

Germ Personalities

THAT even the tiniest germs possess personalities and individualities is the conclusion reached by a German biologist, Dr. F. M. Lehmann, from long-continued studies of a variety of microscopic, one-celled animal called the Paramecium. Creatures of this kind are plentiful all over the world and may usually be seen under the microscope in a drop of water from any stagnant ditch or pond. Dr. Lehmann has studied the effects of such things as temperature, food, fresh water and so on on individual creatures of this species. He finds them to differ almost as markedly among themselves as human individuals would do under parallel circumstances.

Skill With Knife Wins Scholarship

Wide World Photo

Alfred Bird, 16 years old, of Somerville, Mass., makes models of famous old ships with his trusty jack-knife as his only tool. Professors at the Mass. Institute of Technology thought so much of his work that he has been offered a scholarship in Marine Engineering. He is shown here holding a model of the famous "Flying Cloud" which he built from an accurate blueprint of the original ship

May Fly Like Angels

Wide World Photo

The least angelic of men will soon be flying about with a set of substantial mechanical wings, according to M. Anton Lutsch, Austrian engineer, who has invented an apparatus to be worn by an individual with an extremely light motor furnishing the motive power for a set of wings. The first model, shown here, weighs only eighty pounds, and has already risen several yards above the ground and for quite a distance in any given direction. The model has been bought with all rights by a Swiss consortium and transported to Switzerland where further improvements and experiments will be made. Photos show a front and rear view of the unique apparatus worn on a man's back

Smoke-Eating Apparatus

Wide World Photo

C. W. Ringer, chief engineer of the Minneapolis Fire Department, demonstrating his new apparatus for sucking out of burning buildings clouds of suffocating smoke which impede the efforts of firemen

Coach Using Electric Drive

Recently Chicagoans witnessed demonstrations of the Versare coach which utilizes electricity for its motive power, the current being furnished by a generator driven by a gasoline motor. The coach is equipped with a 125 hp., six cylinder engine recently developed by the Versare and Waukesha companies. The engine is connected to a 40 kw Westinghouse generator by means of a disc type coupling. Two Westinghouse 28 hp., motors take current from the generator for driving. Braking is accomplished by air brake, electric resistance braking and the conventional hand brake. Speed determined by the electric controller, there being no gear shifts. A number of these coaches are now in operation, one similar to the coach shown above being used by the Alton Transportation Co.

General Electric Has 15 Transmitter Licenses

FIFTEEN radio licenses have been issued to the General Electric Company by the Department of Commerce, to assist engineers of that company in their comprehensive inquiry into the mysteries of radio transmission.

To the average listener fifteen radio licenses sound like a lot of interference and there might be some atmospheric difficulties in the vicinity of Schenectady if all the transmitters represented by the fifteen licenses were on the air at the same time with voice and code. This is not the case however, as rarely more than six transmitters are working at once and these are so widely spaced that there is no chance of one transmitter encroaching on the air lane of another. Furthermore all of the Schenectady transmitters, no matter in what stage of development they may be, are controlled by crystal quartz which holds them on the desired frequency.

The licenses issued to the General Electric Company and the wavelengths for which they are issued are: 2XAW, 3 to 20 meters; 2XO, 2XAF and 2XAD, 10 to 50 meters; 2XH, 2XK and 2XAC, 50 to 150 meters; 2XAK and 2XAZ, 100 to 200 meters; 2XAG (50 kilowatts), 380 meters; 2XAH, 1000 to 4000 meters; 2XI, general experimental license; 2XAM, 110 meters. The fifteenth license is for broadcasting purposes and is for WGY, licensed for 379.5 meters.

Station 2XAF is now being used on 32.79 meters and it was this transmitter which carried the signals of WGY across the Atlantic and the Pacific, early this spring.

2XAD is now being used for transmission on 20 and 26 meters, and 2XK, heard previously on 109,100 and 65 meters is now operated periodically on 140 meters. 2XAH, at one time operated on 1360 meters, later on 1480, is now transmitting signals on 1400 meters for rebroadcasting by WCAD of St. Lawrence University, at Canton, N. Y. 2XAM and 2XAE are used by the General Engineering laboratory of the General Electric Company for communication between the main laboratory and the standardizing laboratory in the town of Glenville, about eleven miles away.

Power Under Water

Wide World Photo.

San Francisco is the richer for 15,000 horse power of electricity being generated in the mountains of California, brought down and under San Francisco Bay by cable. The length of cable laid across the bay was 8½ miles, valued at $225,000 and represented the culmination of 8 months of toil. The cable measured 4½ inches in diameter. Contained within its outside insulation of wrapped wire there were three insulated groups of heavy copper wire to carry the 11,000 volts needed to meet the demands in San Francisco. The coils of cables were 41,000 foot lengths and were spliced together. The cable barge is shown dropping the last coil of cable into the Bay.

What's Wrong With Broadcasting

(Continued from page 12)

ery city which supports more than a thousand inhabitants will have that many before the snow flies.

When programs and licenses were considered a part of the equipment of a broadcasting station many a voice was stilled despite the knowledge of its owner that millions of people wanted to hear it. Now neither programs nor licenses are required and most of the birds who used to build receivers are now building transmitters. It seems quite likely that within the next two or three months nobody—that includes Mr. Edison—will be left to listen to the broadcasting stations. And what of it?

All in all Mr. Edison's preference for the phonograph seems to prove just one thing: He may be afflicted with insomnia but his ears are all right.

Washington Monument Does a Radio Shimmy

(Continued from page 17)

tinuous waves were transmitted, these being chopped by a commutator connected in the filament center tap.

"As a result of these observations," summarizes Mr. Dunmore of the Radio Laboratory of the Bureau of Standards, "it appears that there is induction or radiation from most metallic objects so that a radio direction-finder placed in the immediate vicinity gives an erroneous indication of the direction of the transmitting station. The magnitude of this distortion depends greatly upon the wave length.

"For this reason, it is always advisable to detune or open circuit any antennae which are in the immediate neighborhood of a direction-finding station. It also seems doubtful whether burying wires near the receiving station is sufficient to avoid all distortion.

"In general, the distortion decreases to a negligible amount at a distance away from the disturbing object about equal to its largest dimension.

White Paint Cooler

THE Bureau of Standards, Department of Commerce, was recently requested to devise a method for preventing the excessive heating of gas balloons in sunlight, it has been announced. Previously, it was pointed out, the Bureau had conducted tests showing that radiators in homes radiated more heat when painted with certain kinds of paint and, conversely, tents painted with different kinds of paint would bar heat from the interior.

The information gained from these early tests, stated the Bureau, was an aid in solving the problem of devising a method for preventing the super-heating of gas balloons. The outer surface of the top and sides of the balloon, should be painted white.

When Radio Turns Navigator

(Continued from page 14)

dyne receiver is employed in connection with the radio direction finder, neatly installed in the metal cabinet which forms the base of the equipment. The tuning controls, exposed to view by a drop cover, consist of two station selectors, a volume control, a filament control, and a switch for obtaining "Line" and "Sense" readings. The batteries are also in the base of the equipment, and are connected with a trickle charger.

SO IMPORTANT is the direction finder in navigation that radio beacons, like lighthouses and lightships, have come into existence along our coasts as infallible guides to coastwise and transoceanic and lake navigators. These radio beacons, operated by the U. S. Lighthouse Service, now extend up and down the Atlantic and Pacific coasts, along the Gulf of Mexico, and on the Great Lakes, as well as in Alaska and Hawaii.

Operated on regular schedule, the radio beacons are also pressed into service when weather conditions warrant steady operation. They are likewise started on request. Operating on 1,000 meters wavelength assigned for such radio transmission by international regulation, the ICW or interrupted-continuous-wave transmitters employed send out signals that vary in note and in character, so that each beacon may be readily identified. Heretofore, all radio beacons have been operated at the same time, causing considerable and troublesome interference because of the unified wavelength. This interference has been eliminated, however.

"Invariably, navigators are enthusiastic in their praise of the direction finder, which, in many cases, has taken precedence over the time-honored sextant in determining a ship's position, even when ideal weather prevailed," according to T. M. Stevens of the Radio Corporation of America. "In foggy and cloudy weather, of course, the radio direction finder serves to solve what has hitherto been a serious predicament. Where sounding are impractical along steep coasts, because of great depths a short distance off shore, navigators have used the radio direction finder and their known speed in guiding their ships along. Delays on account of fog can now be practically eliminated.

Steam Fire Boat Is Passing Out

"DIESEL electric fire boats are fire fighters of the future," said Daniel H. Cox, one of America's foremost authorities on fire boats, at the 15th Annual Convention of the American Association of Port Authorities, recently in session at Norfolk, Va.

"With nearly every community motorizing their fire equipment for the reason that the old horse-drawn apparatus stood idle 90 per cent of its time and the horses stood in their stalls eating their heads off, it is for the same reason that cities owning waterfront property to protect are replacing the out-of-date steam fire boat with the modern and efficient Diesel electric fire fighter.

"It might interest you to know," continued Mr. Cox, "that the *Port Houston*, the first electric fire boat built, which was built for the Harris County Houston Ship Channel Navigation District Commission with the electrical equipment furnished and installed by the Westinghouse Electric in responding to its first fire, which was at a coal dock, a distance of approximately two miles from its station, within twelve minutes from the time the alarm was turned in, the vessel was in position alongside the wharf with its full force of water playing on the fire.

"Some of the outstanding features in favor of the Diesel electric over the steam fire boat are that despite the slightly increased capital investment, the operating cost is greatly reduced," said Mr. Cox. "For instance there is no boiler-room force on the Diesel electric tug, therefore the expense for crew is greatly reduced.

RADIO WORLDS RECORD RADIO'S

Parts Used and Recommended by Radio Age Magazine for its Worlds Record Super 8

BENJAMIN CLE-RA-TONE

Shock-Absorbing Spring Suspended Radio Sockets

are featured in the Radio Age Worlds Record Super 8. They were chosen because they stop tube noises. Greatest aid to smooth flawless operation. Also included in other leading circuits.

Cle-Ra-Tone Socket 75c Each

At your Dealer's or remit with his name to us and we will see that you are supplied.

Benjamin Electric Manufacturing Co.

120-128 S. SANGAMON ST. CHICAGO

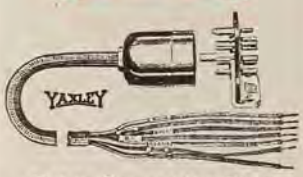
247 W. 17th St. New York: 448 Bryant St. San Francisco:

THOR COUPLER

This coupler has a balanced winding given an even output from 200 to 500 meters. List Price $3.50

THOR MANUFACTURING CO.
35 S. Dearborn St. Chicago

YAXLEY



Cable Connector Plug

The Plug Proper—Phosphor bronze double contact springs, mounted in Bakelite. Cannot work loose. Shorting impossible. Plug cannot be inserted incorrectly.

The Cable—Extra quality, seven strand (RMA standard colors) cable furnished. Six extra markers packed with each plug. Wire ends tinned. Cable length 5 feet.

The Yaxley Cable Connector Plug is entirely different and distinctive. The polished Bakelite base and nickel plated parts give it a rich appearance. Electrically and mechanically the plug is correct. Easily installed, the Yaxley Cable Connector Plug makes the hooking up of batteries safe and simple.

No. 660 Cable Connector Plug—Complete as described.....$3.50

Yaxley Air-Cooled Rheostat

The large number of turns of special nonrusting resistance wire gives this rheostat a vernier adjustment without vernier attachment, feeding current slowly and evenly. Smooth as silk in operation. The resistance unit is suspended in air to permit radiation. No steel is used in the construction of this rheostat. Mounts in single 7-16" panel hole. Furnished complete with Bakelite Knob. Black Knob standard. Mahogany 5c extra. **Rheostat complete with Knob, No. 110K—10 Ohms**.....$1.35

THORDARSON R-200 AMPLIFYING TRANSFORMER

The choice of the Thordarson R-200 amplifying transformer for the Radio Age Worlds Record Super 8 is significant. Among amplifying transformers the R-200 is supreme in musical performance, and is now standard equipment on such quality receivers as Zenith, Howard, and Kennedy. Ideally adapted for use with cone type speakers.

Price Each.....$8.00

SELECTONE TRANSFORMERS

R-400
SELECTONE Untuned Transformer—R400—has specially designed closed iron core, which limits interstage coupling and is impregnated in a vacuum so that all characteristics of coil remain constant. The coil design gives an extremely high amplification. Can be used in any circuit requiring a long wave transformer.

PRICE $6.00

R-410
SELECTONE Tuned Stage Transformer—R410—is air core. Each transformer is matched to within one turn before sealing in case. The matching of these filters is so perfect that where extreme selectivity is desired, two can be used and are guaranteed to match perfectly.

PRICE $6.00

Scott Transformer Co.
7620 Eastlake Terrace Chicago

6,000 to 8,000 Miles Consistent Reception on a Loop!

AGE SUPER EIGHT
GREATEST RECEIVER

Parts Used and Recommended by Radio Age Magazine for its Worlds Record Super 8

For Better Radio
Hammarlund
PRECISION
PRODUCTS

Hammarlund, Jr.
(Midget)

A high ratio, shielded midget condenser with all the distinctive earmarks of Hammarlund design and workmanship. Many uses are shown in circulars packed with each condenser. Made in four sizes: 16, 32, 50 and 75 mmfd. Price, $1.80 to $2.00.

Among the other new kits of this Season for which Hammarlund Precision Products are specified are: Cockaday's "LC-27"; Lacault's "LR4" St. James Super; the new Harkness; "Henry-Lyford", Morrison's "Varion"; Victoreen Superheterodyne; Loftin & White; Pacent "Ultimax"; Browning-Drake; Popular Science Monthly "Powerful"; Hammarlund-Roberts "Hi-Q."

Hammarlund Mfg. Co.
424-438 West 33rd St., New York City

REMLER

Variable Condenser
.0005 mfd.

Twin Rotor Construction. 360 degree rotation of dial gives extremely fine adjustment. Both sections of condenser insulated from shaft—therefore no body capacity whatever.

630	.00035	SLW with dial	$5.00
631	.0005	SLW with dial	$5.00
638	.00035	SLW less dial	4.50
639	.0005	SLW less dial	4.50
648	.00035	SLF less dial	4.50
649	.0005	SLF less dial	4.50
659	.0001	SLF less dial	4.50

The "SELF-ADJUSTING" Rheostat

Insures Perfect Automatic Tube-Control Because AMPERITE—

1—Eliminates Hand Rheostats, thereby simplifying control.
2—Permits use of the latest types of tubes or any combination of tubes.
3—Simplifies and reduces set-wiring, thereby making for greater compactness and avoids losses.
4—No moving parts, hence no grinding noises; clear and full tones.
5—Prolongs tube-life by keeping filaments at a constant temperature.
6—No filament meters needed.
7—Brings the most out of each individual tube — automatically —no guessing.
8—Makes every set-owner a master operator, no knobs to turn.

LIST PRICE $1.10

Manufactured by
RADIALL COMPANY
50-52 Franklin Street New York

ANYONE can build an exact duplicate of the Radio Age Worlds Record Super Easily and Successfully

With the parts here listed, anyone can build an exact duplicate of this remarkable Worlds Record Super with a screw driver, pliers and soldering iron. Building instructions make it almost impossible to err in construction and if followed carefully, assure the builder of a receiver that will duplicate the tremendous performance of the original model. Build the Worlds Record Receiver and you will have at small cost the finest Radio Set obtainable today.

SEE
List of Parts and Diagrams in the Construction article in this issue

6,000 to 8,000 Miles Consistent Reception on a Loop!

THE RADIO AGE

WORLDS RECORD SUPER 8

RADIO'S GREATEST RECEIVER

6,000 to 8,000 Miles Consistent Reception on a Loop!

Accessories Recommended by Radio Age For Its Worlds Record Super 8

Quali-Tone

THE LOOP WITH THE WORLDS RECORDS

NOTE ADJUSTMENT!

$10.00

Patented

The Quali-Tone Loop was used exclusively on the Worlds Record Super and was in great part responsible for the marvelous records that remarkable receiver established. Note adjustment feature that keeps wires taut always. Get the QUALI-TONE for better reception.

See and hear Quali-Tone's new Drum Type Speaker—

The Troubadour, $30

SEND for literature describing Quali-Tone's complete line, which includes the Junior Speaker—$7.50, Quali-Tone No. 2 Speaker—$10. Quali-Tone No. 3—$15. Quali-Tone No. 4—$25 and Quali-Tone Radio Units at $6 and $7.50.

Duro Metal Products Co.

2653 North Kildare Avenue Chicago

MAJESTIC "B" Current Supply

Delivers pure direct current from your light socket

Majestic Super-B

Recommended for the Worlds Record Super 8

Capacity one to twelve tubes, including the use of power tubes. 45 mills at 150 volts **$35.00**

West of Rocky Mts., $37.50 (As illustrated)

No Hum—Superior to Any Source of Power

The voltage can always be accurately adjusted to meet the varying conditions of *every* city and on *any* set. Economical—costs a fraction of a cent per hour. No acid or liquids; Uses Raytheon Tube; No filament to burn out.

See your dealer today.

Grigsby-Grunow-Hinds Co.

4584 Armitage Avenue Chicago, Ill.

THE ABOX FILTER

Real "A" elimination at last. Filters current direct from charger to radio set. It is the first device of its kind ever offered to the public

Price

$19.50

East of the Rockies

The Abox Filter contains no batteries. It is a filter circuit consisting of a choke coil and two of the new Andrews electrolytic condensers which operate on a new principle and permit enormous capacity with small space, cost and weight.

The Abox Filter handles as much as five amperes and renders the current absolutely smooth and suitable for proper operation of the tubes. It is always ready for immediate use, even after long idleness. It cannot run down or wear out.

The Abox Company

215 N. Michigan Ave. Chicago

Read—

Construction article in this issue for complete data on The Radio Age Worlds Record Super 8—Radio's Greatest Receiver. For full verification of Worlds Records write: Mr. E. H. Scott, 7620 Eastlake Terrace, Chicago.

One Dial LONG DISTANCE 5 TUBE RADIO

$25.00

EVERYBODY, including experienced radio engineers said — it cannot be done. But we did it—produced a high grade, long distance single dial control radio to operate a loud speaker to retail for $25.00—and yet allow liberal discount to agents.

This marvelous instrument is the result of five years hard work by an organization of trained radio engineers. It is no experiment —thousands are in use—the results speak for themselves.

There Will Be a Radio In Every Home

Thousands have been waiting for just such a radio —a real long distance, powerful instrument but—at a price they can afford.

It is here, and live wide awake salesmen will recognize their opportunity immediately—they won't lose a single minute writing for full information.

Just as there are 100 Fords to one high priced car, just so will there be 100 Vikings to every $75.00 and $100.00 radio—think what this means to men who get in on the ground floor right now.

A $25 Radio Which Will Equal a $75 Radio

Put a Model 599 Viking which retails for $25.00 alongside any radio retailing for $75.00 and even more. Compare them for ease of tuning—only one dial to tune on the Viking—distance received, volume and tone. The results will make any man say, "I'll save that $50.00."

Radio is today the biggest and quickest selling line—thousands are being sold—salesmen have made unheard of profits. But here is a far greater, a far more interesting radio proposition than anyone ever dreamed of.

You Should Make $100.00 a Week Easily

You can't help it—many will make more. Some will control a county—others will control many counties. We have the liviest radio selling plan of today—instruments of all prices—a radio price to fit every pocketbook.

Any man who will follow our teaching cannot help but add big money to his present income and start to do it immediately. If you want more money here is your chance but you'll have to act quick—others will jump at this chance.

Agents Wanted Make $100.00 a Week

Sell Radio in Your Spare Time—Evenings

You don't even have to give up your present position. The only time radio can be sold is in the evenings—by demonstration. So here is a chance to add to your present income. During the past five years we have trained 4364 men in this very profitable business.

You'll be the first one with a real low priced long distance radio—your price will startle everybody—the results will be even far more startling. Once you demonstrate you're sure of a sale. No one can think of investing $75.00 to $100.00 in a radio when this instrument will get the same results and your retail price is only $25.00. Just think of the advantage you have. Sell a radio for only $25.00, and yet make a handsome commission.

A Regular Radio at a Price Unheard Of

Uses five No. 199 tubes, operates on three ordinary dry cells. Only one dial to tune—a feature generally only found in the highest priced instruments. Any child can tune the Model 599 VIKING—simply turn the dial. Cabinet is extremely attractive, 12 inches long, 8 inches high and 6 inches deep. The wood is covered with Keratol, embossed in a very attractive design. On the front are two very odd gold colored, colonial designs inserted in two panels. The base and ends are finished in a rough gold and black colored finish which together with the rich seal brown Keratol of the balance makes a cabinet that would be an ornament in any home.

The tuning is arranged so that it is accomplished by the use of one special low loss condenser and a basket weave coil. Sockets, rheostat, potentiometer and base board are all of bakelite. Three transformers give an abundance of volume for loud speaker. Parts will equal the average $75.00 or $100.00 radio instrument—only enormous production could possibly bring about this low price.

Territory is Going Fast— Better Write Today

Someone is going to get the big profit on the sales of these instruments in your community —is that someone going to be you? Write today for our 100 page book which fully describes not only this wonderful instrument but also a full line of radio at all prices. It's FREE for the asking.

Use This Coupon

H. B. Fischer,
120 W. Austin Ave., B
Chicago, Illinois.

I am interested in selling your 5 tube set in this territory. Please send me your 100 page radio book, FREE.

Name.....

Address.....

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

SEND FOR 100 PAGE FREE BOOK

Hypodermic to Trail Cell's Life Secrets

NEW facts about the chemical conditions inside the tiny living cells which compose the bodies of men and of all other animals were disclosed by Dr. Robert Chambers, of Cornell University Medical College, in a recent address to the New York Academy of Medicine.

Although many of these living cells are so tiny that they cannot be seen at all except by the help of a good microscope, Dr. Chambers has been able to inject much tinier drops of chemicals into them without killing them, much as a physician injects drugs into his human patients by means of the hypodermic needle. Inside each living cell is a central portion which scientists call the nucleus. This is supposed to be the seat of the most active phenomena of life. By injecting colored chemicals into this inmost seat of the life forces, Dr. Chambers has been able to see changes in the color of the injected material. These changes prove that the tiny living granules in the nucleus are different from the surrounding portion of the cell, being much less acid.

$12.50

COMPLETE
Nothing else to buy. Replaces "B" Batteries. Operates direct from Electric Light Socket on 110-120 volt A. C. Lighting Circuit. Delivers up to 100 volts.

$17.50

New High Voltage Model
Complete: Delivers up to 180 Volts

Not only the most reasonable

but proved by 40,000 users to be also the most convenient, unfailing and satisfactory "B" Eliminator

New High Voltage Model

for extremely large sets, or sets using power tubes, now perfected. Delivers up to 180 volts. One control adjusts voltages on all taps.

Equal to any "B" Eliminator regardless of price—not only in operation, but in workmanship, quality, durability and appearance

They Want YOU to Know

Montreal, Canada
I am pleased to s ate that the Ferbend "B" Eliminator purchased from you is a wonder and is giving results far beyond my expectations. The tone and volume would satisfy the most critical.
James Stroud,
Electrical Engineer.

Youngstown, Ohio
Your Eliminator is the best buy I have made in a long time. It has already more than paid for itself in saving on "B" batteries.
E. L. Welsh.

Sprinerville, N. Y.
Having had perfect results with the seven Eliminators recently purchased you may send me six more by express at once.
Leonard J. Cooper.

Burbank, Calif.
I am more than pleased with your Eliminator. I am getting several Eastern stations through about 15 locals using the Eliminator.
Jean Barnard.

St. Petersburg, Fla.
I used your Eliminator all last winter, and it was as good, if not better than several I tried of much higher price. I am more than satisfied.
Ben M. Pyatt.

Trenton, N. J.
I have used your Eliminator for several months and unhesitatingly recommend it. It has added 25 per cent to the volume of my set and always has full voltage.
J. M. Staeger

New Orleans, La.
The "B" Eliminator which I purchased from you some three or four months ago has given entire satisfaction and I am well pleased with its performance.
C. J. Murphy

Wilmington, N. C.
I am well pleased with the Eliminator I purchased some time ago. It is all you claim and more. It brings in signal i loud er and clearer than any set of dry batteries I ever used.
T. E. Lyon.

Amsterdam, N. Y.
I have connected your Eliminator with other makes and it cannot be beat. My reception has really increased 50 per cent. It gives me much better results than I was ever able to get with dry batteries. William Davis.

Wheeling, W. Va.
The Eliminator purchased some time ago is giving remarkable results.
William A. Raper, Jr.

Des Moines, Ia.
Your Eliminator is fine.
Rev. F. A. Case.

Louisville, Ky.
Your Eliminator is all you claim it to be. Am very much pleased with it.
Ahmee G. Smith.

Oil City, La.
Your Eliminator has given me good service for over a year.
George May.

St. Louis, Mo.
After giving your "B" Eliminator a thorough trial wish to state that I am thoroughly satisfied. It's perfection to perfect—absolutely no hum whatever.
Frank Kolar.

Mattapan, Mass.
I have used your Eliminator for six months and am satisfied with it in every way. It has increased the volume of my 5-tube Neutrodyne fully 50 per cent and there is absolutely no hum from the 60-cycle line.
John W. Fursedi, Jr.

Second Successful Year

Money Back Guarantee

Stop paying out money for costly, unreliable battery service and repairs. Permanent excellence ***can*** be built into economical "B" service. 40,000 users of the good Ferbend "B" Eliminator agree. That is why during the slack summer season we worked at full capacity to meet orders. That is why hundreds of unsolicited testimonials prove beyond the shadow of a doubt its splendid, enduring performance.

Ask Your Dealer—or Send Direct

Shipment made direct on receipt of price, or C. O. D. if preferred. Use for 10 days to convince yourself—if unsatisfactory write us within that time and purchase price will be refunded. Use Coupon NOW.

Makers of the original and genuine FERBEND Wave Trap

FERBEND ELECTRIC COMPANY
431 W. Superior St., Chicago, Ill.

FERBEND ELECTRIC CO.
431 W. Superior St., Chicago, Ill.

☐ Send $12.50 model. ☐ Send $17.50 model.
☐ Send at once. Payment enclosed.
☐ Send C. O. D. ☐ Send literature.

Name .....

Address .....

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

FERBEND "B" ELIMINATOR

Approved and passed by the rigid Laboratory Tests of the two foremost Radio Laboratories in America —Radio News and Popular Radio

Try Out Hour for Radio Performers

(Continued from page 13)

ever was a gift to radio, her offspring is it.

"I want you to try Johnnie's voice on the air," she wheedles. "He has such a lovely voice. All the neighbors say they never heard anything like it. He's not the least bit afraid either. Shake hands with the gentleman, Johnnie! Yes, indeed, I was just saying to my husband last night, 'I MUST take Johnnie up and let him sing for XZY. They have SUCH a good station.' I wouldn't take Johnnie any place else."

The long-suffering director or whoever happens to be trying out the talent, agrees to listen to Johnnie's phenomenal voice. Usually the poor little soul has adenoids or enlarged tonsils or an advanced case of toothlessness and could never be used under any circumstances, even on a children's program. As gently as possible mamma is told that Johnnie's voice is not suitable for broadcasting.

Mamma Gets Peeved

WHAT! Not suitable for broadcasting!" Mamma usually retorts in righteous indignation. "Why I heard a little boy sing from your station last week and his voice didn't begin to compare with Johnnie's! It didn't compare! Of course if you WON'T use him here, I'll be OBLIGED to take him to some other station."

And she sails out of the studio while the director is left to curse Mr. Volstead and all his cohorts.

I might as well insert, right here, the method used by most directors for disposing of the applicant and still keep him in a good humor. The old inevitable standby is: "Give me your name and address and we'll call you when we need you."

This does not mean that when a director tells an applicant that, the applicant is hopelessly lost. In some cases, applicants are called but they are rare, oh very rare!

I know one girl, pianist in a big studio, who tries out talent and who, when she began, used to tell the truth. She is a German girl of very frail and saintly appearance and it was her beautiful, innate sincerity that caused her to tell the applicant, simply but accurately, just what was what.

After the tryout was over and the applicant would prove unworthy, this little German girl, who speaks with an engaging accent, would say sorrowfully (and incidentally she is always sorry when someone's hopes are dashed), "It is too bad but you are not good. I am so sorry. You go home and practice for a good long time. Then when you think you are good enough, you come back and we will see what we can do."

Scheme Worked For While

THIS formula worked beautifully for several weeks while directors and studio attaches stood aghast at hearing the truth told in such a sincere, straightforward manner. But one day this little German girl's honest sincerity was betrayed. She told the plain and rather painful truth to a young man who had reached the no-hat, wide pants stage. He listened to her to the end and then smiled pityingly.

"Of course," he remarked, sweeping her small person with his eyes, "you haven't the slightest idea of what you are talking about."

And walked out of the studio.

Since that, the little German girl uses the age-old formula of Give-me-your-name-and-address-and-we-will-call-you. I think it's rather too bad.

I believe I must have, by this time, given the impression that all of the people who apply for tryouts want to sing. That isn't true. Most of them want to sing but a few of them want to do other things. There are pianists and violinists and other musicians who make application and, in rare instances, prove good enough to use. One studio reports on an applicant who came to the station equipped with everything but the kitchen stove. He had a French harp in his mouth, a violin in his hands, cymbals between his knees, sleigh bells around his ankles and

such a varied collection of other gimcracks and do-dads that the astounded studio director just naturally couldn't keep track of 'em. I believe the gentleman called himself a "one-man band."

In weeding out radio talent, I am told there is one system that is absolutely sure-fire and one in which the applicant does not have to make a display of his talents. That system is this: When they say they don't know whether they're good or not, they usually are. But! When they admit they're good, it's a safe bet they're terrible.

Said I to a radio director after he had told me all he could about tryouts, "What would your advice be to anyone who wanted to get on the air?"

His answer was this: "Listen to the different radio stations to find out their standards. Visit the studio and learn, by observation, how singers or musicians broadcast. Take your talents to the station whose standard you think you suit. Then, for heaven's sake, be willing to take advice from those in the studio."

American Electric Now Combined with Monarch

THE radio trade will be interested in the recent incorporation of the American Electric Company of Chicago who for some time have been engaged extensively in the manufacture of Burns radio apparatus.

The extensive manufacturing facilities and engineering experiences of this company have now been combined with the like resources of the Monarch Telephone & Manufacturing Company, also of Chicago.

The organization will be known as the "American Electric Company, Inc.," and will continue at their plant at 64th and State Streets, Chicago. An extensive manufacturing and advertising program has been planned.

With the added resources and increased engineering and sales force they will be in a position to give their trade whatever is required in service and the best possible in equipment.

Scientist Proposes Big Rockets to Attract Lightning

AN interesting modification of Benjamin Franklin's celebrated experiment of drawing down lightning on a kite string has been proposed by Dr. C. V. Boys, famous English physicist now living in well-earned retirement after a lifetime of distinguised service as a teacher. Dr. Boys proposes that rockets be sent up into a thunder cloud to see whether a flash of lightning will then follow the track of the rocket, either downward to the earth or upward from the earth to the cloud. Experts on lightning are disagreed about what starts the flashes and about what determines the path of a flash. The track of a rocket contains, Dr. Boys points out, a multitude of electrified atoms, discharged as the explosive burns and drives the rocket upward. Knowledge of whether or not lightning would instantly follow the electrified channel thus created through the air might tell us much, Dr. Boys believes, about the nature of lightning. To touch off such a rocket-borne invitation to a lightning flash might not be, Dr. Boys admits, the safest occupation in the world. He suggests a long string attached to the fuse of the rocket and pulled by a person lying flat on the ground at some distance from the point where the lightning would be likely to strike.

Theories of How Prehistoric Man Discovered Fire

CONFLICTING theories of how prehistoric men first learned about fire are affected by an investigation made for a quite different purpose by the United States Forest Service and just reported in the Monthly Weather Review by H. T. Gisborne. Some students of prehistoric man assume that the first knowledge of fire came from volcanoes; others ascribe it to forest fires started by lightning. The volcano advocates have urged that lightning-ignited forest fires are too few to have served as such a general cause.

Mr. Gisborne and his assistants are charged with the duty of watching for forest fires in a portion of the northern Rocky Mountains. So far from being a rare occurrence, they find that during 1924 lightning started 51 per cent of the forest fires and in 1925, 81 per cent. Lightning constitutes, therefore, the greatest single danger to the forest. Actual records of lightning fires confirm, therefore, the contention of those who have maintained that primitive man must have been continually familiar with such fires, and thus in position to observe the habits of fire and to learn, by the accidental cooking of animals in the burning forest.

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	E. Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDYL	Intermountain Bdestg Corp.	Salt Lake City, Utah	246
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	Electrical Equipment Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. Z. Azbill	San Diego, Cal.	380
KFBK	Kimball-Upson Co.	Sacramento, Calif.	535
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	St. Matthews Cathedral	Laramie, Wyo.	375
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFDD	St. Michael Cathedral	Boise, Idaho	275
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	236
KFDY	South Dakota State College	Brookings, S. D.	300
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank	Portland, Ore.	252
KFEL	Eugene P. O'Fallon, Inc.	Denver, Colo.	254
KFEQ	Scroggin & Co.	Oak, Neb.	268
KFEY	Bunker Hill & Sullivan	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	242
KFGO	Crary Hardware Co.	Boone, Iowa	226
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colo.	Gunnison, Colo.	252
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	467
KFIF	Benson Polytechnic Institute	Portland, Ore.	248
KFIO	North Central High School	Spokane, Wash.	272
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Commonwealth Reporter	Fond du Lac, Wis.	273
KFJB	Marshall Electric Co.	Marshalltown, Iowa	248
KFJF	National Radio Mfg. Co.	Oklahoma City, Okla.	261
KFJI	E. E. Marsh	Astoria, Ore.	246
KFJM	University of North Dakota	Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son	Portland, Ore.	263
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	W. E. Branch	Ft. Worth, Tex.	254
KFKA	Colo. State Teachers College	Greeley, Colo.	273
KFKB	J. R. Brinkley	Milford, Kan.	431
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
KFKZ	Chamber of Commerce	Kirksville, Mo.	225
KFLR	University of New Mexico	Albuquerque, N. M.	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelist Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFMR	Morningside College	Sioux City, Iowa	261
KFMX	Carlton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Ia.	461
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	KFOB, Inc.	Burlingame, Calif.	225
KFON	Nichols & Warriner, Inc.	Long Beach, Calif.	233
KFOO	Latter Day Saints' Union	Salt Lake City, Utah	236
KFOR	Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul, Minn.	252
KFPL	C. C. Baxter	Dublin, Texas	252
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Cal.	231
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	273
KFQA	The Principia	St. Louis, Mo.	261
KFQB	Lone Star Bdcast Co.	Fort Worth, Texas	508
KFQD	Anchorage Radio Club	Anchorage, Alaska	300
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. E. Riker	Holy City, Calif.	231
KFQW	C. F. Knierim	Seattle, Wash.	216
KFQZ	Taft Products Co.	Hollywood, Calif.	226
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	Don Lee, Inc.	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFRW	Western Broadcasting Co.	Olympia, Wash.	219
KFSD	Airfan Radio Corp.	San Diego, Calif.	246
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	240
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUR	Peery Bldg. Co., Inc.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	263
KFUU	H. C. Colburn & E. L. Mathewson,	Oakland, Calif.	220
KFVD	Chas. & W. J. McWhinnie	Venice, Calif.	205
KFVE	Benson Broadcasting Corp.	St. Louis, Mo.	240
KFVG	First M. E. Church	Independence, Kans.	236
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Fairmont, Minn.	227
KFVR	Moonlight Ranch	Denver, Colo.	244
KFVS	Cape Girardeau Battery Sta.,	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWB	Warner Bros. Pictures	Hollywood, Calif.	252
KFWC	L. E. Wall	San Bernardino, Calif.	291
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Eureka, Calif.	254
KFWI	Radio Entertainments, Inc.	San Francisco, Calif.	250
KFWM	Oakland Educational Society	Oakland, Calif.	326
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	KFWV Studios	Portland, Ore.	213
KFXB	Bertram C. Heller	Big Bear Lake, Calif.	203
KFXD	Service Radio Co.	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Denver, Colo.	430
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	R. G. Howell	near Edgewater, Colo.	216
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Harry M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	214
KFYJ	Houston Chronicle Pub. Co. (Portable)	Houston, Tex.	238
KFYO	Buchanan-Vaughan Co.	Texarkana, Tex.	210
KFYR	Hoskins-Meyer, Inc.	Bismarck, N. Dak.	248
KGAR	Tucson Citizen	Tucson, Ariz.	244
KGBS	A. C. Dailey	Seattle, Wash.	227
KGBU	Alaska Radio Co.	Ketchikan, Alaska	229
KGBW	Martin Brotherson	Joplin, Mo.	283
KGBX	Foster Hall Tire Co.	St. Joseph, Mo.	348
KGBY	Albert C. Dunning	Shelby, Nebr.	203
KGBZ	Federal Livestock Remedy Co.	York, Nebr.	333
KGCA	C. W. Greenley	Decorah, Iowa	280
KGCB	Wallace Radio Institute	Oklahoma, Okla.	331
KGCG	Moore Motor Co.	Newark, Ark.	240
KGCH	Wayne Hospital	Wayne, Nebr.	434
KGCI	S. M. Rhodes	San Antonio, Texas	240
KGCL	Louis Wasmer	Seattle, Washington	230
KGCM	Robert B. Bridge	San Antonio, Texas	263
KGCN	Alva E. Smith	Concordia, Kansas	210
KGCR	Cutler's Broadcasting Service	Brookings, S. D.	252
KGCX	First State Bank	Vida, Mont.	240
KGDA	Home Auto Co.	Dell Rapids, S. D.	254
KGDE	Jaren Drug Co.	Barrett, Minn.	232
KGDI	Northwest Radio Service Co.	Seattle, Wash.	416
KGDJ	R. Rathert	Cresco, Iowa	203
KGDM	V. G. Coping	Stockton, Calif.	217
KGO	General Electric Co.	Oakland, Calif.	361
KGRS	Gish Radio Service	Amarillo, Tex.	234
KGTT	Glad Tidings Tabernacle, Inc.	San Francisco, Cal.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii	270
KGW	Oregonian Publishing Co.	Portland, Ore.	492
KGY	St. Martins College	Lacey, Wash.	278
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Spokane, Wash.	395
KICK	Atlantic Automobile Co.	Anita, Ia.	273
KJBS	J. Brunton & Sons Co.	San Francisco, Calif.	234
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KLDS	Reorganized Church of Jesus Christ,	Independence, Mo.	441
KLS	Warner Brothers	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	265
KMA	May Seed & Nursery	Shenandoah, Iowa	461
KMJ	Fresno Bee	Fresno, Calif.	234

New Comet Will Not Hit Our Earth

THREE comets are now visiting the neighborhood of the earth. Two are old friends, having been with us before on their periodic returns to the central part of the solar system. The third is apparently new, no comet of similar orbit having been detected before and none having been expected exactly in the position of this one. It was discovered on Nov. 6 by Professor Comas Sola of the Astronomical Observatory of Barcelona, Spain, which discovery has since been verified by a score or more of observatories both in Europe and America. According to preliminary computations of the comet's orbit made by the Copenhagen Observatory, it will be with us for several months, reaching its nearest point to the sun on May 14, 1927. As yet the comet is very faint, being visible only in large telescopes. Comets are believed to be clouds of solid particles with some gas surrounding them. There is no probability the new comet will come especially close to the earth, but even if it hit us it probably would do no harm. Our air would protect us from the flying particles of the comet, causing them to burn up just as do the meteors or "shooting stars," thousands of which hit the earth's atmosphere each day.

KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KMOX	Voice of St. Louis	St. Louis, Mo.	280
KMTR	Echophone Mfg. Co.	Los Angeles, Calif.	372
KNRC	C. B. Juneau	Santa Monica, Calif.	238
KNX	Los Angeles Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322
KOAC	Oregon Agriculture College	Corvallis, Oreg.	280
KOB	N. Mex. College of Agric.	State College, M. Nex.	349
KOCH	Omaha Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Mona Motor Oil Co.	Council Bluffs, Iowa	306
KOIN	KOIN, Inc.	Portland, Ore.	319
KOMO	Birt F. Fisher	Seattle, Wash.	306
KOWW	Frank A. Moore	Walla Walla, Wash.	285
KPJM	Wilburn Radio Service	Prescott, Ariz.	215
KPO	Hale Bros., Inc.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Printing Co.	Houston, Texas	297
KPSN	Star-News	Pasadena, Calif.	316
KQW	First Baptist Church	San Jose, Calif.	333
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KRAC	Caddo Radio Club	Shreveport, La.	220
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KRLD	Dallas Radio Laboratories	Dallas, Tex.	357
KRSC	Radio Sales Corp.	Seattle, Wash.	500
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Publishing Co.	St. Louis, Mo.	545
KSEI	Broadcasting Association	Pocatello, Idaho	261
KSL	Radio Service Corp.	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad	Santa Maria, Calif.	283
KSO	Berry Seed Co.	Clarinda, Iowa	405
KSOO	Sioux Falls Bdcst. Ass'n.	Sioux Falls, S. D.	360
KTAB	Associated Broadcasters	Oakland, Calif.	303
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	M. E. Brown	Portland, Ore.	263
KTHS	New Arlington Hotel	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa.	333
KTUE	Uhalt Electric	Houston, Texas	263
KTW	First Presbyterian Church.	Seattle, Wash.	454
KUOA	University of Arkansas	Fayetteville, Ark.	300
KUOM	University of Montana	Missoula, Mont.	244
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	231
KVI	Puget Sound Broadcasting Co.	Tacoma, Wash.	242
KVOO	Southwestern Sales Corp.	Bristow, Okla.	375
KWGR	H. F. Parr.	Cedar Rapids, Iowa	296
KWG	Portable Wireless Telegraph Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWKH	W. G. Patterson	Kennonwood, La.	312
KWSC	State College of Washington	Pullman, Wash.	349
KWTC	J. W. Hancock	Santa Ana, Calif.	261
KWUC	Western Union College	Le Mars, Iowa	252
KWWG	City of Brownsville	Brownsville, Texas	278
KXRO	Brott Laboratories	Seattle, Wash.	240
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	240
WAAD	Ohio Mechanical Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAM	Isaiah R. Nelson	Newark, N. J.	263
WAAT	F. V. Bremer	Jersey City, N. J.	235
WAAW	Omaha Grain Exchange	Omaha, Nebr.	384
WABB	Harrisburg Radio Co.	Harrisburg, Pa.	204
WABC	Asheville Battery Co.	Asheville, N. C.	254
WABI	1st Universalist Church	Bangor, Me.	240
WABO	Hickson Elec. Co., Inc.	Rochester, N. Y.	278
WABQ	Haverford College Radio Club	Haverford, Pa.	261
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt. Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Colis Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons	Akron, Ohio	258
WAFD	Albert P. Parfet	Port Huron, Mich.	275
WAGN	R. L. Miller	Royal Oak, Mich.	275
WAGS	Willow Garage, Inc.	Sommerville, Mass.	250
WAHG	A. H. Grebe	Richmond, Hill N. Y.	316
WAIT	A. H. Waite & Co.	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Raddison Radio Corp.	Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	461
WARC	American Radio & Research	Medford, Mass.	261
WARS	Amateur Radio Specialty Co.	Brooklyn, N. Y.	295
WASH	Baxter Laundry Co.	Grand Rapids, Mich.	256
WATT	Edison Elec. Illum. (Portable)	Boston, Mass.	244
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAC	James Milliken University	Decatur, Ill.	270
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAL	Consolidated Gas & Power Co.	Baltimore, Md.	246
WBAP	Carter Publication, Inc.	Ft. Worth, Tex.	476
WBAW	Braid Elec. Co. & Waldrum Drug Co.	Nashville, Tenn.	236
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBBC	P. J. Testan	Brooklyn, N. Y.	250
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment	Chicago, Ill.	226
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc.	Rossville, N. Y.	416
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf.	Charleston, S. C.	268
WBBZ	C. L. Carrell	(Portable), Chicago, Ill.	216
WBCN	Foster & MacDonnell	Chicago, Ill.	266
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBKN	Arthur Faske	Brooklyn, New York	291
WBMS	G. J. Schowerer	North Bergen, N. J.	224
WBNY	Baruschrome Corp.	New York, N. Y.	322
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBRC	Birmingham Broadcasting Co.	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBRL	Booth Radio Laboratories	Tilton, N. H.	365
WBRS	Universal Radio Mfg. Co.	Brooklyn, N. Y.	394
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Elect. & Mfg. Co.	Springfield, Mass.	333
WBZA	Westinghouse Elect. & Mfg. Co.	Boston, Mass.	333
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufman & Baer Co.	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Pl., Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAM	City of Camden	Camden, N. J	337
WCAO	Monumental Radio Inc.	Baltimore, Md.	275
WCAR	Southern Radio Corp.	San Antonio, Texas	263
WCAT	School of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur Glenn Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Hotel Chateau	Baltimore, Md.	229
WCBR	C. H. Messter	Providence, R. I.	234
WCBS	H. L. Dewing, Portable	Boston, Mass.	242
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCFL	Chicago Fed. of Labor	Chicago, Ill.	492
WCFT	Knights of Pythias Home	Tullahoma, Tenn.	252
WCGU	C. G. Under	Lakewood, N. J.	351
WCLO	C. E. Whitmore	Camp Lake, Wis.	231
WCLS	WCLS Inc.	Joliet, Ill.	214
WCMA	Culver Military Academy	Culver, Ind	258
WCOA	City of Pensacola	Pensacola, Fla.	222
WCRW	Clinton R. White	Chicago, Ill.	416
WCSH	Henry R. Rines	Portland, Maine	500
WCSO	Wittenberg College	Springfield, Ohio	248
WCWK	Chester W. Keen	Fort Wayne, Ind.	234
WCWS	Chas. W. Selene (Portable)	Bridgeport, Conn.	232
WCX	Detroit Free Press	Pontiac, Mich.	517
WDAD	Dad's Auto Accessories, Inc.	Nashville, Tenn.	226
WDAE	Tampa Daily Times	Tampa, Fla.	273
WDAF	Kansas City Star	Kansas City, Mo.	366
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	268
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	261
WDBE	Gilham Electric Co., Inc.	Atlanta, Ga.	270
WDBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio	227
WDBO	Rollins College	Winter Park, Fla.	240
WDBZ	Kingston Radio Club	Kingston, N. Y.	233
WDEL	Wilmington Elec. Specialty Co.	Wilmington, Del.	266

Winsdor Wall or Table Type Cone Speaker Amazes Radio World

Model 210
(Pat. Applied For)

The latest model Windsor Cone Loudspeaker has astonished the world of radio. In convenience, quality of reception, and extremely low price, it far surpasses anything yet offered. The cone is 22 inches in diameter and is mounted on a sounding board which, in turn, is supported by an easel back. It can be hung up on the wall, as in the picture above, or stood upon any flat surface as shown in the picture below. It contains the famous Windsor loudspeaker unit noted for the extreme clarity and fidelity of reproduction.

Model 210
22-inch Cone Loudspeaker with sounding board and easel back.
$15.00
(West of Rockies $18)
(Pat. Applied For)

Model 302 (Shown below)
With Moulded Composition Horn Loudspeaker and 18-inch Cone Loudspeaker.

(Pat. Applied For)

In this Windsor Console is combined both the Windsor Moulded Composition Horn Loudspeaker and the 18-in. Windsor Cone Loudspeaker. The top is 30 in. x 17 in. and stands 29 in. high. Plenty of battery and equipment space is provided by large shelf in rear. Price, finished in Mahogany or Walnut **$48.00**
(West of Rockies, $55)

Rear view at left shows large compartment with ample space for batteries, battery charger, or battery eliminator, which are entirely concealed from view. Back is open for ventilation of batteries.

At right is shown the Cone Loudspeaker, with its sounding board, which is quickly and easily removable, allowing instant access to all batteries, battery charger, battery eliminator or other equipment and wiring.

(Pat. Applied For)

Model 200—with 22-inch Cone Loudspeaker

This Windsor Cone Loudspeaker Console is equipped with a 22-inch Windsor Cone Loudspeaker. Its top is 30" x 17" and is 29" high. The battery shelf provides ample space for batteries, charger, battery eliminator and other equipment. Beautifully finished in either Mahogany or Walnut.

Model 200
$29
Console with Cone Loudspeaker Ready for Set and Batteries
(West of Rockies, $35)

This is the Fastest Selling Line of *Loudspeakers and Loudspeaker Consoles* in the Radio World Today

The quality of radio reception made possible by Windsor Cone and Horn Loudspeakers and Loudspeaker Consoles so far surpasses anything heard heretofore that it amazes and delights every radio enthusiast. The Windsor Line is so complete that everyone can find in it a loudspeaker, loudspeaker table, or loudspeaker console exactly to fit their particular needs.

Model 100
with Moulded Composition Horn Loudspeaker or 16-inch Cone Loudspeaker
(Pat. Nov. 18, 1924)

Above is shown a beautiful Windsor Loudspeaker Console, finished in either Walnut or Mahogany, which provides ample space on top for any radio set. The battery shelf beneath will accommodate all necessary equipment. Equipped with either Moulded Composition Horn or 16-inch Cone Loudspeaker. Size: 38 in. x 18 in., and 29 in. high. Price . . . **$40.00**
(West of Rockies, $42.50)

To the right is shown the newest Windsor Loudspeaker Console. It is equipped with a 22-inch Cone Loudspeaker and cabinet suitable for 7-inch radio panels up to 26 inches in length. Battery shelf provides ample space for all equipment. Beautifully finished in either Walnut or Mahogany. Price (without receiving set) . . **$44.00**
(West of Rockies, $52.00)

(Pat. Applied For)
Model 1000
with 22-inch Cone Loudspeaker

Note to Dealers: Write or wire today for details of the highly profitable Windsor line.

Electrical Department

WINDSOR FURNITURE COMPANY

1416 Carroll Avenue • CHICAGO, ILLINOIS
Los Angeles Branch—917 Maple Avenue

WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDRC	Doolittle Radio Corp.	New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDWM	Radio Industries Broadcast Co.	Newark, N. J.	280
WDXL	DXL Radio Corp.	Detroit, Mich.	297
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	National Broadcasting Co.	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
WEAN	The Shepard Co.	Providence, R. I.	367
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Willard Storage Battery Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBH	Edgewater Beach Hotel	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBL	R. C. A. Show (Portable)	New York, N. Y.	226
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	226
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBW	Beloit College	Beloit, Wis.	268
WEBZ	Savannah Radio Corp.	Savannah, Ga.	263
WEDC	E. Denemark Station	Chicago, Ill.	250
WEEI	The Edison Elec. Illuminating Co.	Boston, Mass.	349
WEHS	Oliver G. Fordham	Evanston, Ill.	203
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	316
WENR	All-American Radio Corp.	Chicago, Ill.	266
WEPS	R. G. Matheson	Gloucester, Mass.	295
WEW	St. Louis University	St. Louis, Mo.	360
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	270
WFBG	First Baptist Church	Knoxville, Tenn.	255
WFBE	Garfield Place Hotel Co.	Cincinnati, Ohio	232
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	278
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	The Onondaga Co.	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
WFBR	Fifth Infantry National Guard	Baltimore, Md.	254
WFBZ	Knox College	Galesburg, Ill.	254
WFCI	Frank Crook, Inc.	Pawtucket, R. I.	229
WFDF	F. D. Fallain	Flint, Mich.	234
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	Vesta Battery Corp.	Chicago, Ill.	217
WFRL	Flatbush Radio Labs.	Brooklyn, N. Y.	330
WGAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	248
WGBB	H. H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBL	Scranton Broadcasters, Inc.	Scranton, Pa.	240
WGBR	G. S. Ives	Marshfield, Wis.	229
WGBS	Gimbel Brothers	Astoria, L. I., N. Y.	316
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Fla.	278
WGBX	University of Maine	Orono, Me.	234
WGCP	May Radio Broadcast Corp.	Newark, N. J.	252
WGES	Oak Leaves Broadcasting Corp.	Chicago, Ill.	316
WGHB	Fort Harrison Hotel	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGM	Verne and Elton Spencer	Jeanette, Pa.	269
WGMU	A. H. Grebe & Co. (Portable)	New York	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School of Technology	Atlanta, Ga.	270
WGWB	Radiocast Corporation	Milwaukee, Wis.	384
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University	Milwaukee, Wis.	275
WHAM	Eastman School of Music	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	New York, N. Y.	431
WHAR	F. D. Cooks Sons	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chamber of Commerce	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBL	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBM	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHFC	Hotel Flanders	Chicago, Ill.	258
WHK	The Radio Air Service Corp.	Cleveland, Ohio	273
WHN	George Schubel	New York, N. Y.	361
WHO	Banker's Life Co.	Des Moines, Ia.	526
WHOG	Huntington Bdcstrs. Assn.	Huntington, Ind.	242
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	238
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAS	Home Electric Co.	Burlington, Iowa	254
WIBA	Capital Times-Strand Theatre	Madison, Wis.	236
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WIBI	Frederick B. Zittell, Jr.	Flushing, L. I., N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	Billy Maine (Portable)	Chicago, Ill.	216
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBR	Thurman A. Owings	Weirton, W. Va.	246
WIBS	T. F. Hunter	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	WIBX, Inc.	Utica, N. Y.	234
WIBZ	A. D. Trum	Montgomery, Ala.	231
WICC	Bridgeport Bdcst. Stations	Bridgeport, Conn.	285
WIL	Benson Radio Co.	St. Louis, Mo.	258
WIOD	Earl G. Fisher Co.	Miami, Fla.	248
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAD	Jackson's Radio Eng. Laboratories	Wcao, Texas.	353
WJAF	J. S. Fenberg	Ferndale, Mich.	407
WJAG	Norfolk Daily News	Norfolk, Neb.	270
WJAK	Kokomo Tribune	Kokomo, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co.	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAZ	American Bdcast Corp.	Mt. Prospect, Ill.	329
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	Financial Journal	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
WJBO	Valdemar Jensen	New Orleans, La.	268
WJBR	Omro Drug Stores	Omro, Wis.	227
WJBT	John S. Boyd	Chicago, Ill.	468
WJBU	Bucknell University	Lewisburg, Pa.	211
WJBV	Union Course Laboratories	Woodhaven, N. Y.	288
WJBW	C. Carlson, Jr.	New Orleans, La.	270
WJBY	Electric Construction Co.	Gadsden, Ala.	260
WJBZ	Roland G. Palmer	Chicago Heights, Ill.	420
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WJR	Jewett Radio & Phonograph Co.	Pontiac, Mich.	517
WJUG	U. B. Ross	New York, N. Y.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	Bound Brook, N. J.	454
WKAF	WKAF Broadcasting Co.	Milwaukee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	286
WKAV	Laconia Radio Club	Laconia, N. H.	422
WKBA	Arrow Battery Co.	Chicago, Ill.	210
WKBB	Sanders Bros.	Joliet, Ill.	283
WKBC	H. L. Ansley	Birmingham, Ala.	225
WKBE	K. & D. Electric Co.	Webster, Mass.	270
WKBF	N. D. Watson	Indianapolis, Ind.	244
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKBH	Callaway Music Co.	LaCrosse, Wis.	250
WKBI	F. L. Schoenwolf	Chicago, Ill.	220
WKBJ	Gospel Tabernacle Inc.	St. Petersburg, Fla.	280
WKBL	Monrona Radio Mfg. Co.	Monroe, Mich.	252
WKBM	J. W. Jones	Newburgh, N. Y.	215
WKBO	Camith Corporation	Jersey City, N. J.	309
WKBP	Enquirer and News	Battle Creek, Mich.	265

Atmosphere of Mars Believed Dust-Filled

RECENT studies of the planet Mars have led to no recent pronouncements of importance. Several observers report further changes in the appearance of dark or bright areas on the planet's surface but such changes have been observed often before and yield no new information. There has been published in Germany, however, a new paper discussing photographs made of Mars two years ago. Dr. B. G. Fessenkoff, the Russian scientist who made this study, believes the Martian atmosphere to be extremely dusty, probably as much so as the air of a terrestrial desert during a sand storm. This is the most probable explanation, he believes, of the different appearance of the planet as photographed by red light and by violet light. Continual dust storms on Mars probably would not interfere with the existence of life there, although it would make things rather uncomfortable for creatures organized as we are; which the Martians, if they exist at all, probably are not. The two planets reached their closest approach for many years on October 27 and are now slowly drawing apart.

Jinks: "Come on in and hear the radio. They're broadcasting a church service."

Binks (of Scotch descent) "Have they taken up the collection yet?"

WKBQ	Starlight Amusement Park	New York, N. Y.	285
WKBR	C. J. Heiser	Auburn, N. Y.	225
WKBS	P. M. Nelson	Galesburg, Ill.	361
WKBT	First Baptist Church	New Orleans, La.	252
WKBV	Knox Battery and Electric Co.	Brookville, Ind.	236
WKBW	Churchill Evang. Ass'n	Buffalo, N. Y.	362
WKBY	Fernwood Wuick (portable)	Danville, Pa.	220
WKBZ	K. L. Ashbacker	Ludington, Mich.	256
WKDR	Edward A. Dato	Kenosha, Wis.	428
WKJC	Kirk Johnson & Co.	Lancaster, Pa.	258
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	422
WKY	Hull and Richards	Oklahoma City, Okla.	275
WLAC	Life & Casualty Ins. Co.	Nashville, Tenn.	226
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBC	D. A. Burton	Muncie, Ind.	224
WLBE	J. H. Fruitman	Brooklyn, N. Y.	231
WLBF	E. L. Dillard	Kansas City, Mo.	211
WLBL	Wisconsin Dept. of Markets	Stevens Point, Wis.	278
WLIB	Liberty Weekly, Inc.	Elgin, Ill.	303
WLIT	Lit Bros.	Philadelphia, Pa.	394
WLS	Sears Roebuck & Co.	Crete, Ill.	345
WLSL	Lincoln Studios	Cranston, R. I.	441
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Radio Corp.	Harrison, Ohio	422
WLWL	Paulist Fathers	New York, N. Y.	384
WMAC	C. B. Meredith	Casenovia, N. Y.	275
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	441
WMAK	Norton Laboratories	Lockport, N. Y.	266
WMAL	M. A. Leese	Washington, D. C.	294
WMAN	Haskett Radio Station	Columbus, Ohio	278
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Mercer University	Macon, Ga.	261
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	250
WMBC	Michigan Broadcasting Co., Inc.	Detroit, Mich.	256
WMBF	Fleetwood Hotel Corp.	Miami Beach, Fla.	384
WMBI	Moody Bible Institute	Chicago, Ill.	288
WMC	Commercial Pub. Co.	Memphis, Tenn.	500
WMCA	Greely Sq. Hotel Co.	Hoboken, N. J.	341
WMRJ	Peter J. Prinz	Jamaica, N. Y.	227
WMSG	Madison Sq. Gard. Bdcast. Corp.	New York, N. Y.	302
WNAB	Shepard Stores	Boston, Mass.	280
WNAC	Shepard Stores	Boston, Mass.	430
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Brothers Co.	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNJ	Herman Lubinsky	Newark, N. J.	350
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plants & Structures	New York, N. Y.	526
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOAN	J. D. Vaughn	Lawrenceburg, Tenn.	283
WOAW	Woodman of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOBB	Longacre Eng. & Const. Co.	Chicago, Ill.	555
WOCB	Orlando Broadcasting Co.	Orlando, Fla.	294
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	A. D. Newton	Jamestown, N. Y.	275
WODA	O'Dea Temple of Music	Paterson, N. J.	391
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Harold E. Smith	Peekskill, N. Y.	232
WOMT	Mikado Theater	Manitowoc, Wis.	254
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Grand Rapids Radio Co.	Fernwood, Mich.	242
WOQ	Unity School	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAK	N. D. Ag. College	Agricultural College, N. D.	275
WPAP	(See WQAO)	Cliffside, N. J.	361
WPCC	North Shore Cong. Church	Chicago, Ill.	258
WPCH	Concourse Radio Corp.	New York, N. Y.	273
WPDQ	H. L. Turner	Buffalo, N. Y.	205
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	385
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	Cliffside, N. J.	361
WQJ	Calument Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAH	S. N. Read	Providence, R. I.	235
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Avenue Radio & Electric Shop	Reading, Pa.	238
WRAX	Beracah Church, Inc.	Philadelphia, Pa.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wayne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio Shop	Coldwater, Miss.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRES	H. L. Sawyer	Woloaston, Mass.	300
WRHF	Wash. Radio Hospital Fund	Washington, D. C.	256
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc.	Motor Yacht "MU-1"	236
WRNY	Experimenter Publishing Co.	Coyetsville, N. Y.	374
WRR	City of Dallas	Dallas, Tex.	246
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publishing Co. Inc.	Allentown, Pa.	229
WSAR	Daughy & Welch Electrical Co.	Fall River, Mass.	254
WSAV	Clifford W. Vick	Houston, Tex.	248
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	288
WSBF	Stix Baer & Fuller	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	315
WSDA	Seventh Day Adventist Church	New York, N. Y.	263
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283

Speed of Light Is Now Accurately Determined

AT THE meeting of the National Academy of Sciences, at Philadelphia, November 8, Professor Albert A. Michelson, recognized dean of American physicists and professor at the University of Chicago, announced the most accurate figure ever obtained for the speed of light through space or in a vacuum. The figure previously accepted by scientists for this speed was 186,326 miles per second. As the result of a three-year investigation carried out on top of two mountains in California, Professor Michelson has corrected this figure slightly. The new figure for the speed of light is 186,284 miles per second.

The final measurement of this value was accomplished by means of a rapidly-revolving sixteen-sided block having mirrors on each of its sixteen sides. A ray of light from a powerful arc lamp was focused on this revolving mirror-sided block, so that the succession of light flashes reflected as each mirror passed by was sent out of the laboratory on Mount Wilson and off toward another mountain top twenty-two miles away. On this other mountain top was a stationary mirror which reflected these light flashes back again to their original sources.

While the light was on its journey to the distant mountain-top and return, the revolving set of mirrors at the source moved slightly, due to the rotation of the mirror-sided block. Accordingly the light flash returning from the distant mountain was not received on the same mirror-face from which it departed, but on the next face; this next face having been brought into line by the rotation of the mirror-faced block. The speed of rotation of this block could be altered by means of a throttle controlling the compressed air turbine which drove the block. By adjusting this speed so that the second mirror-face came to occupy for the returning light ray exactly the same position that the preceding mirror-face had occupied when the ray departed, it was possible for Professor Michelson to calculate the length of time (a little less than one four-thousandths of a second) that the light-flash had been on the way to the distant mountain-top and return. In order to make this calculation, the speed of rotation of the mirror-faced block was measured accurately. Also, the United States Government engineers carried out a special and extremely accurate survey to determine the exact distance between the laboratory on Mount Wilson and the distant mirror.

TO the layman, and even to some scientists, it may seem remarkable that so much labor and money should be expended on a single scientific experiment, especially when the only result expected from that experiment was the attaining of a slightly greater precision for a figure already known with a considerable accuracy. That the experiment was considered worth doing and important is due to the fact that the speed of light in space is felt by physicists to be the most fundamental of all of the constants of nature. This speed enters importantly into the calculations of the Einstein theory as well as into practically all modern theories of the nature of matter, of energy and of the universe.

WSMB	Saenger Amuse. Co. & Maison B. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wis.	246
WSRO	Harry W. Fahrlander	Hamilton, Ohio	252
WSSH	Tremont Temple Bap. Church	Boston, Mass.	261
WSUI	State University of Iowa	Iowa City, Iowa	484
WSVS	Seneca Vocational School	Buffalo, N. Y.	219
WSWS	Richmond Harris & Co.	Batavia, Ill.	275
WSYR	Clive B. Meredith	Syracuse, N. Y.	353
WTAB	Fall River Herald-News	Fall River, Mass.	266
WTAD	Robt E. Compton	Carthage, Ill.	236
WTAG	Worcester Telegram	Worcester, Mass.	545
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	389
WTAQ	C. S. Van Gordon	Eau Claire, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAW	Agricultural & Mech. Col. of Texas	College Sta., Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WTRC	20th Dist. Republican Club	New York, N. Y.	240
WWAE	Electric Park	Plainfield, Ill.	384
WWJ	Evening News Assn. (Detroit News)	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275
WWRL	Woodside Radio Labs.	Woodside, N. Y.	258

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg. Co., (Ltd.) Ca.	Mont., Que.	411
CFCH	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	329
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCL	Dominion Battery Co.	Toronto	357
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co. (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co. (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	312
CNRC	Canadian National Railways	Calgary, Alta.	436
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	435
CNRR	Canadian National Railways	Regina, Sask.	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	384

Republic of Mexico

CYB	Mexico City	380	CYL	Mexico City	400	CZE	Mexico City	350

Republic of Cuba

PWX	Cuban Telephone Co. Havana	400	5DW	R. S. Calderon Matanzas	200	6KW	F. H. Jones Tuinucu	272
2BY	F. W. Borton Havana	260	6VY	Jose Ganduxe Cienfuegos	260	7SR	S. Rionda Central Elia	350
20K	M. G. Velez Havana	360	6JK	F. H. Jones Tuinucu	340	8BY	A. Ravelo Santiago de Cuba	250
20L	Oscar Collado Havana	257						

Great Britain

2LO	London	365	5XX	Daventry	1600	2ZY	Manchester	378
5IT	Birmingham	479	2RN	Dublin	390	5NO	Newcastle	404
5WA	Cardiff	353	6BN	Bournemouth	386	5SC	Glasgow	422
2BE	Belfast	440				2BD	Aberdeen	495

France

Lyons		550	Paris (Eiffel Tower)		2,650	Paris		1,780	Paris		458

Short Wave Phone Broadcasting

		K.C.	Meters			K.C.	Meters
2XK	Schenectady, N. Y.*	4600	65.16	KDKA	Pittsburgh, Pa.*	5100	58.79
KDKA	Pittsburgh, Pa.*	4760	63.00	2XAF	Schenectady, N. Y.*	9143	32.79

*Crystal Control

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE'S classified advertisements.

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All classified ads for the February issue must be sent in by December 25.

AGENTS WANTED

WANTED, AN ACTIVE MAN TO TAKE ORDERS for Hardy fruit trees, berry bushes, evergreens, flowering shrubs and roses. Liberal commission. Free replacement. Sales instruction and outfit free. Sherman Nursery Company, attention Mr. Smith, Charles City, Iowa.

Gold Wave Aerial. Greatest Side Line out. Guaranteed to bring in more stations—gives greater distance and selectivity. Reduces static to a minimum. Sells all dealers handling radio. Unlimited field. Big commissions and re-orders. Luxem and Davis Mfg. Co., 6231 Broadway, Dept. 61, Chicago.

MAN in each town to plate auto parts, reflectors, bath fixtures, silver mirrors, refinish beds, chandeliers by new method; $10 daily; no capital or experience required; outfits furnished; write today. Gunmetal Company, Avenue J, Decatur, Illinois.

SELLS for $9.75. Prints ad on wrapping paper, envelopes, etc. $1.00 commission. Send 10c for sample work. Automatic Ad-Stamper, Joplin, Mo.

AUTOMOBILE ACCESSORIES

FREE CIRCULAR—INSTANT COLD WEATHER starting for Ford, Chevrolet and Star owners—P. O. Box 1523-E, Denver, Colorado.

BOOKS AND MAGAZINES

What could be better than magazine subscriptions for gifts. Send stamp for our special list of subscription bargains. Midland Products, Dept. R. A., 524 Courtland Ave., Park Ridge, Illinois.

Twentieth Century Book of Receipts, Formulas and processes, an 807 cloth bound book containing 10,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Sent prepaid upon receipt of $4.00. Send stamp for our 48 page catalog of latest and best practical, scientific mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Ill.

BUSINESS OPPORTUNITIES

PECAN-Orange-Fig Groves "On the Gulf". Monthly payments. Guaranteed care. Big quick returns. Suburban Orchards, Dept. R, Biloxi, Mississippi.

LAND FREE if planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,500 profit annually. Reliable Companies will cultivate and market your bananas for 1-3. Bananas ripen every day and you get your check every 30 days. For particulars address National Development Company, Empire Building, Block 135, Pittsburgh, Pennsylvania.

CODE

DO YOU WANT TO MEMORIZE THE WIRELESS TELEGRAPH CODE? THE CORYDON SNYDER CODE METHOD IS EASIEST. QUICKEST. PATENTED. Send 10c coin for complete method to Corydon Snyder, 1243 Rosemont Avenue, Chicago, Illinois.

COLLECTIONS

Three Collection Letters That Actually Collect: Product, 23 years' experience, $1.75. Address J. A. Hillman, Lynchburg, Virginia.

DOGS

BEAUTIFUL REGISTERED BOSTON PUPS $15. Bulldogs, 501 Rockwood, Dallas, Texas.

MISCELLANEOUS

FOR SALE: WATCHMAKER'S LATHE at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Missouri.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our lady club. Particulars free. Eva Moore, Box 998, Jacksonville, Florida.

RHEUMATISM, NEURITIS—WHY SUFFER? Guaranteed complete treatment mailed, postpaid $1.50. Personal Pronounced incurable should try. This Remedy gets you results or money refunded. Square dealing. Write PROF. GUHA, BOX R-166, HUNTINGTON, IND.

RADIO

Build the Quadraformer Super VI. A real five tube set. Genuine Essential Kit, $17.50 including instructions. Booklet 25c. Literature on request. R. P. Tomamichel, 2244 Seminary Avenue, Chicago, Illinois.

TROUBLE-SHOOTING. Do you know the key to the knowledge of any electrical circuit? You can find correct answer in a booklet written by nationally known authorities on Radio and Electricity. Ask your radio dealer for "Practical Guide for Every Radio Builder and Owner", or Send 10c to-day to Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, Ill. Sold at all news stands in the city of Chicago.

Buyers Service for Readers of Radio Age. I will buy for you standard radio merchandise if you cannot obtain same in your locality. Remit list price of article wanted, and if same are not obtainable by me I will make refund. R. P. Tomamichel, 2244 Seminary Ave., Chicago, Illinois.

EXPERIMENTERS. Complete Chemical Apparatus and Radio Catalog. 1000 Illustrations. Price 25c; refunded on $5.00 order. Laboratory Materials Company, 646 East 71st Street, Chicago.

Guaranteed tubes. 199 and 201A types $1.00 each. $7.50 units to make a loud speaker of your Phonograph only $2.49. $4.00 list head phones going at $1.69. This is real value, a standard make 3 tube set with long range and lots of volume for $8.95, less accessories, while they last. $12.00 loud speakers with genuine Bakelite Bell at $6.95. Write for our prices before you buy your radio parts. Outlet Sales, 112 Calvert Ave., Detroit, Michigan.

Do you want to build a real radio set at low cost? The circuit of the Web Wonder Four is just out, send stamp for full particulars, Web Radio Co., Box 849, Chicago, Ill. Dept. B. P.

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

IVORY RADIO PANEL beats them all. Write for FREE Sample. Ivorylite Radio Panel Co., 3222 Ave. F, Fort Worth, Texas.

A new circuit just out, something different. Send 2 cent stamp for information how to build your own set. Web Radio Company, Box 849, Chicago, Ill.

Want to dispose of my Kennedy Universal Receiver type 110 and two stage Amplifier type 525. Excellent condition guaranteed. No reasonable offer refused. K. F. Oerlein, 2843 Cambridge St., Philadelphia, Pa.

ATTENTION SET BUILDERS. Increase efficiency and selectivity by installing set of binocular type radio frequency coils. Set Builders use extensively. Set of three $6.45. Money-saving price list mailed upon request. All articles sold on money back guarantee. Midwest Radio Supply, Dept. C., Box 222, Racine, Wisconsin.

Radio Book—Construction of a modern Super Heterodyne Type Receiver including Testing and Operation $1.00; Henley's 222 Radio Circuit Designs, 267 pages, $1.00; The ABC of Vacuum Tubes used in Radio Reception 132 pages, 25 cents; Henley's Workable Radio Receivers 196 pages $1.00; Experimental Wireless Stations 392 pages $2.00; Wireless Telegraphy and Telephony Simply Explained 154 pages $1.00. Sent prepaid on receipt of price. Send stamp for our 48 page catalog of latest and best practical, scientific, mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Illinois.

SILICON Transformer Steel cut to order .012". 10 lbs. 25 cents, 5 lbs. 30 cents, less than 5 lbs. 33 cents per lb., 4 cubic inches to the lb. .007" for radio frequency transformers, 50c cubic inch, postage extra. At least ½ cash with order—balance C. O. D. Geo. Schutz, Calumet, Michigan.

99.7% Pure aluminum for Rectifiers, B Eliminators, Trickle chargers and transmitters. ½" round, ¼"x1" rectangular 5c inch, ½"x½" 4c inch. ⅜" round lead elements 3½" long 15c, 7 for $1.00 all with brass terminals, prepaid to 3 zone. No order less than $1.00. Geo. Schutz, Calumet, Michigan.

PURE ALUMINUM and lead rectifier elements, holes drilled, with brass screws and nuts per pair 1-16"x4", 13c, 1x6, 15c, 1½x6, 17c, 1½x6, 19c, sin ½ elements half price. Sheet aluminum 1-16", $1.00, 1-8" $1.90. Lead $1.00 square foot all prepaid. Geo. Schutz, Calumet, Michigan.

CONDENSERS. 800 VOLT FILTER, .1 mid 45c, .25 51c, .5 60c, 1. 75c, 2. $1.20, 3. $1.80, 4. $2.40, 1500 VOLT FILTER, .1 51c, .25 60c, .5 75c, 1. $1.05, 2. $1.85, 3. $2.70, 4. $3.60. ELIMINATOR BLOCKS, 2, 2, and 8 $3.70, 2, 2, 8 and 1 $6.15, 2, 2, 8, 1 and 1 $6.60. .1 and .1 in series 90c. Many other capacities. Arma transformers and chokes. THE RADIO CLUB, INC., La Porte, Ind.

3 element Rectifier jars for B eliminators, B battery chargers and transmitters, 1 jar takes the place of 2 ordinary jars, ½"x½"x½" 99.7% pure aluminum, rubber covers binding posts 3/4" inside diameter $1.00 each, 4 for $3.00, prepaid to 5th zone, ½ cash with order balance C. O. D. Satisfaction or money back, George Schutz, Calumet, Mich.

Tubes all kinds, including latest power tubes at cut prices and special discount, send 2 cent stamp for prices and particulars. Web Radio Company, Box 849, Chicago, Ill., Dept. TE.

Eliminator parts 50H choke $2.00, 30H choke $1.75, 20H choke $1.00. Write for list of parts including condensers and transformers. Postage prepaid. Radio Parts Sales Company, Box 24, Orange, N. J.

EUROPEAN broadcast on two tubes. Simple and cheap to construct. Blue prints 50c. Triangle Drafting Service, 5124 Sheridan Road, Chicago, Illinois.

Save up to 50% on Nationally Advertised Radio parts. Send for our new price list of Radio Kits, "B" eliminators, Radio Receivers and Parts. NATIONAL RADIO-PRINT CO., Room 404, 200 Broadway, New York.

Radio Panel Lamp. Rests on top cabinet. Lights dials. Uses battery current. Complete with bulb $1.25, postpaid. Satisfactory or money back. Robert Stevenson, Lancaster, Ohio.

SAVE MONEY on radio sets and parts. List free. All merchandise guaranteed. GEMRAD COMPANY, 631 E. Okmulgee, Muskogee, Okla.

SALESMEN WANTED

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

WANTED TO BUY

Full value paid for old GOLD jewelry, silver or platinum. Packages returned if our offer not satisfactory. Elaine Specialty Company, 3121 Avenue G, Fort Worth, Texas.

Radio Age Classified Ads Bring Results

An Index to the Best in Radio Hookups!

HOW long have you postponed making that favorite hookup of yours because you couldn't find reliable and clear diagrams? We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

November, 1924
—Blueprints of a Single Tube Loop Set and a Capacity Feed-back Receiver.
—A 3-Tube Low Loss Regenerator.
—Mastering the 3-Circuit Tuner.

January, 1925
—A Six-Tube Super-Het.
—An Efficient Portable Set.
—A Tuned Plate Regenerator.
—Making a Station-Finder.

February, 1925
—A Three Circuit Regenerator.
—A Real Low Loss Set.
—Blueprints of a 3-tube Reflex.

March, 1925
—A 5-Tube R. F. Receiver.
—How to Wind Low Loss Coils.
—A Short Wave Receiver.
—Blueprints of a Two-Tube Ultra Audion and a Regenerative Reflex.

April, 1925
—A 3-Tube Portable Set.
—"B" Voltage from the A. C. Socket.
—An Amplifier for the 3-Circuit Tuner.
—Blueprints of a Five-Tube Radio Frequency Receiver.

May, 1925
—A "Quiet" Regenerator.
—How to Make a Tube-Tester.
—A Unique Super-Het and an Improved Reinarts.
—A Six-Tube Portable Receiver Illustrated with Blueprints.

June, 1925
—Reducing Static Disturbances.
—A Seven-Tube Super-Heterodyne.
—Browning-Drake Receiver.
—Overcoming Oscillations in the Roberts Receiver.

July, 1925
—Learning Tube Characteristics.
—How Much Coupling?
—Blueprints of Conventional Radio.
—Symbols and Crystal Detector Circuit.

August, 1925—50c per copy
—How to Attain Smooth Tuning.
—Alternating Current Tubes.
—Deciding on a Portable Super.
—And a big 60-page blueprint section.

September, 1925
—Thirty-one ways to prevent self-oscillation.
—Tuning efficiency with two controls.
—Ideal Audio AmplifierCi rcuits.
—Blueprint section.

October, 1925
—Auto-Transformer Coupling.
—Some Facts about Quality.
—An Improved Slide-Wire Bridge.
—Blueprints of Circuits Using Single and Dual Controls.

November, 1925
—A Good Audio Oscillator.
—An Efficient Short-Wave Transmitter.
—Blueprints—Adding R. F. Stages.

December, 1925
—Tuned R. F. and Regeneration.
—Radio Age Model Receiver.
—Inductive Gang-Control Receiver.
—Tuning with Chart Curves.

January, 1926
—Radio Age January Model Set.
—A Four-Tube Toroid Set.
—Power Supply Device—Blueprint Feature.
—Finishing Your Radio Cabinet.

February, 1926
—February Radio Age Mode. Set.
—Plug-in Coil Receiver.
—Universal Testboard—Blueprint.
—Eliminating Audio Distortion.

March, 1926
—Improving the Browning-Drake.
—Rheostatless Tubes in a Set.
—Which Type Intermediate?
—How to Make a Wavemeter—Blueprint.

April, 1926
—Shielding Your Receiver.
—Home Testing Your Tubes.
—Balanced Capacity Receiver.
—Several Sets on One Antenna.

May, 1926
—Short Wave Transmitter—Blueprint.
—Simplifying Battery Charging.
—List of European Broadcasters.
—Protecting your Inventions.

June, 1926
—Antenna Design.
—Simple Crystal Set.
—Improving the Neutrodyne.
—Golden Rule Receiver—Blueprints.

July, 1926
—Compact Portable Super.
—Short Wave Receiver.
—Shielded Golden Rule Set.

August, 1926
—Receiver, Transmitter and Wavemeter.
—Beginners 200 mile Crystal Set.
—History of Amateurs.
—Changing to Single Control.

September, 1926
—How to Make a Grid Meter Driver
—Short Wave Wavemeter
—Power Amplifier for Quality (Blueprint)

October, 1926
—Crystal Control Low Power Transmitter (Blueprint)
—Raytheon Design for A B C Elimination
—What Type Loud Speaker to Use
—Nine Tube Super Brings Back Faith

November, 1926
—Blueprints of the Henry-Lyford.
—World's Record Super With Large Tubes.
—How to Use a Power Tube in Your Set.
—Illuminated Controls on 4 Tube Receiver.

December, 1926
—Starting Radio with Crystal Set.
—Six Tube Shielded Receiver.
—Types of Rectifiers Discussed.

Radio Age, Inc., 500-510 N. Dearborn St., Chicago

1-27

Supreme in MUSICAL PERFORMANCE!

Tschaikowsky, Beethoven, Brahms — would you listen with rapture to the rendition of their masterpieces by the "hungry six" corner band? You would not!

Then why distort the masterful programs of the better broadcasting stations to the "hungry six" type of reception when Thordarson transformers are available at every dealer's?

Thordarson transformers are found in the majority of quality receivers, where musical performance is the first consideration—A conclusive proof of the musical supremacy of Thordarson amplification.

THORDARSON
RADIO TRANSFORMERS

R-200
Amplifying Transformer

The transformer for the musical epicure. Has unusually faithful reproductive powers. Specified on such quality receivers as Zenith, Kennedy and Howard... $8.00

Standard Amplifying Transformer

A good reproducing transformer suitable for the requirements of the average ear.

2 to 1 ratio.....$5.00
3½ to 1 ratio..... 4.00
6 to 1 ratio..... 4.50

Autoformer All Frequency Impedence Amplifier

Amplifies every note in the musical scale. An impedance with a step-up ratio, giving the even amplification of the impedance with the amplification increase of the transformer..... $5.00

R-210
Power Compact

A complete foundation unit for power amplification and B-supply. Contains a power supply transformer and two chokes for power amplifier using UX-210 power tube..... $20.00

R-171
Power Compact

Similar to the R-210 type but designed for UX-171 power tube and Raytheon rectifier. Contains buffer condensers as well as power supply transformer and chokes..... $15.00

R-197
Power Supply Transformer

A Power Supply Transformer designed for B-supply using the R. C. A. UX-213 type full wave rectifying tube. Will supply up to 180 volts B..... $7.00

R-196
30 Henry Choke

Designed either as a filter or an output choke. Completely shielded. Current carrying capacity 80 MA. Inductance 30 henries. D. C. resistance 280 ohms..... $5.00

R-76
Speaker Coupling Transformer

An output transformer designed as a protective device to keep the high direct current voltage of power amplification out of the speaker unit..... $6.00

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.

Swifter, finer tuning action— *Illuminated*

Striking beauty, as well as micrometer accuracy, distinguishes the receiver equipped with MAR-CO controls.

Actual Size

Responsive— to your lightest touch

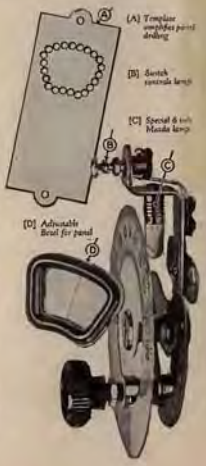
ORDINARY dials seem clumsier than ever . . still more inadequate to meet modern conditions . . after one experience with the new MAR-CO control.

Nothing approaches its swift, searching response except the celebrated MAR-CO vernier dial itself, 500,000 of which have replaced old type dials. But the new control develops the "friction-drive" principle to the utmost, banishing any suggestion of "backlash" or play And when you switch on the light, a soft radiance illuminates the moving numerals, adding swifter readability to the scale . . . and fascinating beauty to the panel.

MAR-CO controls fit all condensers. Scales read 0 to 100, or 100 to 0, as preferred. The template supplied reduces panel mounting to a simple 10-minutes' diversion, whether you are building a new set, or remodelling an old one. The special Mazda lamp runs on your regular "A" battery or on a separate "C" battery. Send for Booklet. Martin Copeland Company, Providence, R. I.

* * *

MAR-CO illuminated Controls, $3.50 each
MAR-CO 4 in. vernier dials
(fit any set) nickel plated, $2.50
Gold plated, $2.75
New MAR-CO rheostat dial . . . 75c



MAR-CO *Illuminated* Controls