Blueprint Section Every Month

RADIO AGE

The Magazine *of the* Hour

January
1926

Blueprints of a "B" Battery Eliminator ¶ Taking Care of your Radio Set ¶ New data on the Photo-Electric Tubes ¶ How Rebroadcasting is Handled

25¢

Radio Age Model Receiver Type-H X

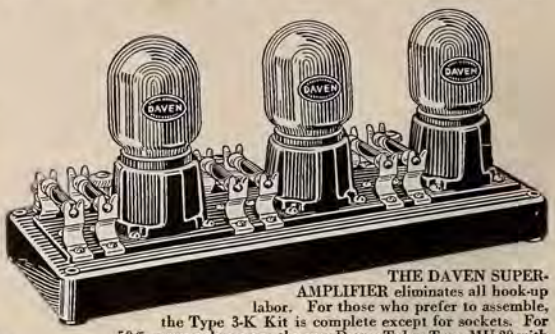
In this Issue

TK6540
R2

THE BIG LITTLE THINGS OF RADIO

* *Daven*

The DAVEN LEAKANDENSER—the new combination grid leak and grid condenser all in one! For any detector tube circuit.



THE DAVEN SUPER-AMPLIFIER eliminates all hook-up labor. For those who prefer to assemble, the Type 3-K Kit is complete except for sockets. For 50% more volume use the new Daven Tubes Type MU-20 with the Daven Super-Amplifiers. Daven Power Tube Type MU-6—for the last stage of any set.

The biggest of all the little things—THE DAVEN GRID LEAK. Made in 29 standard values from 2500 ohms to 10,000,000 ohms.

Volume *and* Quality

As an owner of a radio set you should demand two things: (1) Volume on the weakest signal, (2) Tone quality that makes criticism impossible and excuses or qualifications unnecessary. Why sacrifice one for the other? Demand both. Today it is a simple matter to have both.

It is easy to get volume but there is only one way to get both quality and volume. Use Resistance Coupled Amplification in the audio end of your set. We have made this very simple by developing the Daven Super-Amplifier. Or, if you prefer self-assembly, couple up Daven precision-built resistances and mountings as contained in the 3-K Kit. Then you will hear radio at its best.

Clip Mounting No. 50—suitable for single Resistor or Grid Leak.

Three new Daven Products were announced this Fall. The Daven Leakandenser is a Daven grid leak of permanent and constant value, combined with a grid condenser of fixed capacity, correct for all makes of detector tubes. Precision-built, simple, effective, uniform and very handsome. A pair of mounting clips included.

Resisto-Coupler No. 42, with special Daven Type "A" Coupling Condenser hidden in the base—the original and most popular resistance coupling unit.

The new Daven High MU Tube Type MU-20, used with the Daven Super-Amplifier, is designed to give 50% more volume—6 volt, ¼ ampere. The Daven Power Tube Type MU-6 is for use in the last or output stage of any set regardless of the method of amplification used—6 volt, ½ ampere.

Daven Ballast Resistors—for use with amplifying tubes in place of rheostats. There are five sizes, for one to five tubes. Sold with mounting only.

The new Daven Special Type "A" Condensers are the latest development of Daven Engineers. Their use in Resistance Coupled Amplifiers gives you 50% more volume than ordinary condensers.

The Resistor Manual is the "A.B.C." of Resistance Coupled Amplification—a complete handbook for designers and builders. Send for it.

New Daven Special Type "A" Coupling Condenser increases volume with Resistance Coupled Amplification. Sold separate, and also included in all Resisto-Couplers, Super-Amplifiers and Kits.

The Resistor Manual

A practical handbook on Resistance Coupled Amplification. At your dealer's 25c. By mail postpaid 30c. Dealers send for free sample.

DAVEN PRODUCTS ARE SOLD ONLY BY GOOD DEALERS

"The Sine of Merit"

DAVEN RADIO CORPORATION

Resistor Specialists

Newark Reg. U.S. Pat. Off. New Jersey

CLIP THIS COUPON

DAVEN RADIO CORPORATION, 157 Summit Street, Newark, New Jersey.
Please send me the following on Resistance Coupled Amplification:—

Check One

☐ Resistor Manual. 30c is enclosed. ☐ Complete Catalog (free).

Name .....

Address .....

To Dealers: May we have our nearest distributor communicate with you?

* *Tested and Approved by* RADIO AGE *

How I Earn $100.00 a Week as a Radio Expert

A year ago I was mighty blue and discouraged. It seemed to me that I would never be more than a low-paid bank clerk. Of course I had a small increase in salary every now and then, but I knew that pretty soon I would reach my limit and there would be no further advancement for me. What future had I to look forward to? Where would I be in five years? I became restless and discouraged and began to look around for some other opportunity.

It was then that I discovered that the demand is for *trained* men, that the opportunities are all for men who can do some one thing better than anything else. There were wonderful opportunities for men who were experts or specialists—but I was——a clerk. How I regretted then that I hadn't prepared myself for some definite career!

I Wanted to Marry

The thing that made me more restless at that time than anything else was the fact that Marian and I were—that is, we wanted to be married. But we both knew that we couldn't possibly get along on my small salary. If only there was something I could do that would bring me a larger salary!

It was just about the time that everyone became so interested in radio. Our whole town became radio-mad, and of course what was happening in our town was happening all over the country—all over the world. I managed to save up enough to buy a receiving set and I was never quite so happy as when I was trying to tune in on stations.

The thing fascinated me. Playing with air waves! Bringing melodies and messages out of the sky! I was never so interested in anything before.

Marian was the first to sense the great opportunity. "Why don't you become a radio expert?" she said. "You like it, and I am sure there must be a big demand for men who understand it. It's a new field and there's plenty of room for wide-awake men."

"But—but I'm not trained!" The thought excited me. To be a radio expert! To find my future in this fascinating new field! "I don't know anything about it, Marian," I said. "I wish I did, though."

"Well, why don't you find out about it," she retorted. "You can't learn about radio just by listening in to the concerts. Why don't you take a course?"

But we found out that most courses were expensive or that they would interfere with my other work. We were about discouraged when I discovered that through the National Radio Institute it is possible to become a radio expert by studying right at home in spare time. I told Marian about it and she was elated. "Send off for information, at once—today!" she exclaimed.

Advances Quickly to $100 a Week

I did, and the following day received an important booklet, "Rich Rewards in Radio" telling all about radio opportunities and how to become an expert in any particular phase of the work.

Here was my opportunity at last!

I began to study in all my spare time. It was the most interesting and absorbing study I had ever made. The secret of the radio revealed to me! Day by day I became more skilled and deft until I was able to take apart receiving sets and put them together again as though I were playing with a toy. It was fun! In a month I was able to take a position as lineman at a bigger salary than I was getting at the bank. This was wonderful experience for me, and I kept right on with my studies. It wasn't long before I qualified for a position as radio engineer at a salary of $100.00 a week! That is what I am earning now, though I expect to make more soon. It seems to me almost too good to be true, after all those years as a low-paid clerk in a bank. And Marian, who will soon be my bride, keeps saying, "I told you so!"

As a radio expert I can tell you that there is a tremendous demand for men who can build, sell and install radio sets, who can design, test, repair. Men are needed as engineers and executives, all over the world. The opportunities are limitless, and if you like radio there is no reason why you cannot qualify for one of these positions by studying in your spare time at home as I did.

The National Radio Institute offers an absolutely complete course which prepares you for the Government First Class Commercial License and for the bigger-paying jobs in Radio. The Director, E. R. Haas, will be glad to send you all details of their marvelous new method of practical instruction, including information concerning the Free Employment Service which secures positions for National Radio Institute graduates. Everyone interested should have this information. *It's free*, and this coupon will bring it to you. I advise you to send it off today. Radio is a new and interesting field, and it offers you more money than you probably ever dreamed possible!

Important

Those who mail the coupon *at once* will also receive details of Special Short Time Reduced Rate. Do it now.

National Radio Institute, Dept. AU3
Washington, D. C.

I am interested in radio and would like to find out whether or not I am suited for a radio career. Please send me, without the slightest obligation, your interesting free book called "Rich Rewards in Radio." Also full details concerning your special Short Time offer.

Name.....

Address.....

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

RADIO AGE

The Magazine of the Hour

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CONTENTS

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A Chat With the Editor

THERE is a significant lesson to be learned from the present wave-length situation. We remember that many owners of broadcasting stations, during the last four years, voluntarily have relinquished the licenses and wave-lengths which had been assigned to them by the Department of Commerce. They had lost interest in broadcasting and regarded their licenses as liabilities rather than assets. Distinguished leaders in the radio industry had solemnly assured us that the number of broadcasting stations eventually would be reduced to a half dozen and that this small group would be in the hands of two or three large corporations.

Today there are 578 broadcasting stations in the United States and 175 applications for licenses for additional stations are on file in Washington. Some of the most important individuals in the country have gone to Washington recently and vainly implored Secretary Hoover to give them a license and a wave-length. Several cities are now anxiously wondering whether stations they have built and equipped at great cost will have to be dismantled and forgotten. They cannot find a place on the air. One great newspaper which had been indifferent to the popular interest in radio for several years recently offered to permit a mid-west station owner to name his own price for his license. The station owner smilingly refused.

The lesson to be learned from all this is that we must maintain an open mind on all questions in controversy. The same sort of folks who laughed at the first steam locomotive, the first steam-boat and the first airplane, have been mirthfully waiting for the radio vogue to wane. It waneth not and the broadcast license today is worth as much as a Florida corner lot, than which, they tell us, nothing is more earnestly to be desired.

Frederick Smith

Editor of RADIO AGE

"These Eveready Batteries are the correct size for your set. With average use they will last you a year or longer"

"You have been one of the many who use 'B' batteries that are too small in capacity for their receivers. That is not economical. It makes you buy 'B' batteries twice as often as necessary. Fit the right size Evereadys to your set and add a 'C' battery,* if you haven't one, and you'll get the maximum of service at the minimum of cost."

The life of your Eveready "B" Battery depends on its capacity in relation to your set and how much you listen in. We know, through a careful investigation, that the average year-round use of a set is two hours a day. Taking that average we have proved over and over that on sets of one to three tubes the No. 772 Eveready "B" Battery used with a "C" battery will last a year or longer. On sets of four and five tubes the larger heavy duty Eveready batteries used with a "C" battery will last eight months or more.

The secret of "B" battery satisfaction and economy is: *With sets of from 1 to 3 tubes, use Eveready No. 772. With sets of 4 or more tubes, use either of the heavy duty batteries No. 770 or the longer-lived Eveready Layerbilt No. 486.*

We have prepared for your individual use a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. This booklet also tells about the proper battery equipment for use with the new power tubes.

Manufactured and guaranteed by

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

*NOTE: In addition to the increased life which an Eveready "C" Battery gives to your "B" batteries, it will add a quality of reception unobtainable without it.

* *Tested and Approved by* RADIO AGE *

EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.
Eastern Standard Time

For real radio enjoyment tune in the "Eveready Group." Broadcast through stations—

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

RADIO EDITORIALS

IT IS possible that a majority of broadcast listeners take little interest in the controversy over the terms under which copyright music may be put on the air. If the listeners are indifferent it is unfortunate. The National Association of Broadcasters, in session at Washington early in November, officially declared that broadcasting cannot go on unless some equitable arrangement can be made affecting copyrights. All negotiations between the broadcasters and the American Society of Authors, Composers and Publishers have come to naught and the next step is to be a more vigorous effort toward getting congressional action amending the present antique, if not obsolete, copyright laws.

All radio interests should get behind national agitation for legal relief from the present situation. The American Society of Authors et cetera is admirably organized. So should the broadcasters and broadcast listeners be organized. Radio manufacturers depend upon broadcasting to supply a basis for sales and therefore the manufacturers should take a willing hand in the matter.

It is admitted that the A. S. C. A. P. has a moral and legal right to protect its copyrights. The broadcasters are complaining that nobody has yet determined where those rights cease and the rights of the broadcasters begin. The fees required from broadcasters are not uniform, stable or permanent.

A broadcast station owner may pay a $600 fee to the A. S. C. A. P., this year for the use of using copyright music and songs controlled by the society but there is no assurance that the fee required next year will not be $6,000 or $60,000. There are many other flaws in the present attitude of the copyright people but they cannot even be outlined in the limited space of an editorial page.

What is required most of all is a campaign of education so that the public generally may intelligently judge the merits of the issue. We foresee that broadcasters will recognize that they have a powerful publicity weapon in their own hands—the microphone. If they work together they can stimulate a demand for proper legislation that will bring pressure upon the national congress from literally hundreds of thousands of homes.

All those interested in radio and its successful future should read the following resolutions adopted by the National Association of Broadcasters on November 8:

WHEREAS, There can be no continuation of broadcasting unless musical compositions are made available to broadcasters upon a fair, equitable and permanent basis, and

WHEREAS, an insistent demand from the public requires that music be made the principal part of broadcast entertainment, and

WHEREAS, practically all of this music is held by copyright proprietors and is not available to broadcasters except on prohibitive and unstable terms, and

WHEREAS, the broadcasters recognize the right of the copyright proprietors to compensation for the use of their compositions and are willing to pay a fair and equitable maximum fee for each broadcast rendition of each copyright musical number, and

WHEREAS, broadcasters believe that copyright owners should have the sole, complete and entire right to withhold their property from all broadcasting if they so desire; but that if a copyrighted number is released by the owner thereof to one or more broadcasters, then such number shall become available to all broadcasters, and

WHEREAS, the present conditions threaten the entire broadcasting structure and the continuation and permanence of broadcasting depends upon the solution of this problem, and

WHEREAS, all attempted solutions through negotiation between the parties have proved unavailing; now therefore

BE IT RESOLVED, that it is the sense of this Conference that the only possible solution lies in the enactment of suitable legislation based upon the above principles, and it is the recommendation of this Conference to the Secretary of Commerce that such legislation be suggested to Congress.

E. C. Mills is the leading spokesman for the authors, composers and publishers. We ask him whether the terms demanded of broadcasters at the present time are equitable and stable, or whether they are unstable and in some cases, prohibitive. It appears to us that if there is right on both sides of the argument and that heavy financial interests are involved it would be far better for the opposing factions to get together and make their own rules and regulations. But if they will not or cannot do this it is inevitable that this phase of radio transmission and reception must have recourse to the uncertain currents and tides of congress. Our impulse would be to keep radio problems as far away from the District of Columbia as possible. One of the blessed things about the new radio art in the United States has been its freedom from the usual multiplicity of federal restrictions.

Look for the next Radio Age Model.
Read about it in February Radio Age.

Send for this RADIO BOOK FREE

1926 Catalog of RADIO BARGAINS Save ⅓ to ½

The World's Largest Exclusive Radio Mail Order House Will Send You This Wonderful Book FREE!

64 illustrated pages containing thousands of bargains in radio sets, semi-finished sets and radio kits of all styles, sizes and approved circuits. 5-tube sets as low as $29.50. Beautiful models of the very latest designs and types. Elaborate console models with loud speakers built right in cabinets of genuine mahogany and walnut. **All sets guaranteed.** Coast to coast receiving range. Also contains everything in radio supplies, including batteries, chargers, loud speakers, transformers, condensers, rheostats and any other parts you may want for improving your set or building a new one. Guaranteed saving to you of ⅓ to ½.

The Biggest 5-Tube Value on the Market

Positively the world's greatest 5-tube radio bargain. **Regular $75.00 value.** Our large quantity production enables us to sell this set for **only $29.50,** fully built and wired in beautiful mahogany cabinet of latest design with sloping Bakelite panel of Satin finish, handsomely etched and engraved as illustrated. Constructed of the finest low-loss condensers, coils and sockets. Bakelite baseboard panel and dials. **Price for set only.....** **$29.50**
Transportation charges extra. Shipping weight 25 lbs.

This set with all Accessories, including the famous American Bell Loud Speaker with adjustable unit, 2-45 volt "B" batteries, one guaranteed 100 Ampere Hour storage "A" battery, cable for battery connection, 5-201A tubes, Aerial and ground equipment, and everything complete ready to set up and operate. Nothing else to buy. **Price.....** **$59.75**
Transportation charges extra. Shipping weight 100 lbs.

AMERICAN RADYNOLA 5 TUBE SET

$29.50

Order Direct From This Page! Save ⅓ to ½. Sets on this page are typical examples of bargains throughout our catalog. Our guarantee protects you. Money cheerfully refunded if you are not satisfied. Write your order and prices plainly. Send post office money order or bank draft for full amount to insure safety. Refer to any bank or commercial agency regarding our reliability.

Columbia Grand 5-Tube Console Set

$57.95

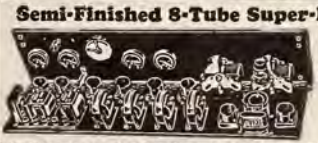
Console Radio with built-in loud speaker and adjustable unit. Has compartments for storage "A" and "B" batteries, battery charger, radio book of instructions, etc.

Beautiful Walnut Cabinet in two-toned effect. Two door panels inlaid with highest grade burl walnut. Cabinet is 39 inches high. Top measures 18x37 inches. Equipped with high-grade built-in loud speaker with adjustable unit. Large, roomy interior for holding all batteries, books, etc. The Columbia Grand is a 5-tube tuned radio frequency receiver. Coast to coast receiving range. Tune in stations desired—very selective. Has latest type, low-loss condensers, coils and sockets. Bakelite baseboard, sockets and dial knobs. Dials are beautifully etched in gold on walnut finish bakelite panel. **Price for set only, fully built and wired—$57.95.**

Transportation charges extra. Shipped by freight or express.

This set with all accessories, which include 2-45 volt "B" batteries, one guaranteed 100 ampere hour storage "A" battery, 5-201A tubes, multicolocord cable for easy battery connection, aerial and ground equipment, instructions for setting up and operating—**everything complete, nothing else to buy—$84.95**
Transportation charges extra. Shipped by freight or express.

Semi-Finished 8-Tube Super-Heterodyne



$43.75

World's Famous 8-tube Super-heterodyne. Fully mounted on panel and baseboard. Comes **Completely assembled** ready to wire and operate. We have testimonials from thousands of builders of this set. Some have received foreign stations on loop aerial. Unsurpassed in volume and tone quality. Low-loss straight line frequency condensers, vernier dials, finest quality rheostats. Matched Columbia long wave transformers. Requires only three screws for attaching panel and baseboard and set is ready to wire and operate. 7x30 panel. **Price of set only $43.75.**

Requires following accessories to complete this set: 7x30 cabinet, 8-201A tubes for storage battery operation or No. 199 tubes for dry cell operation, 100 Ampere hour storage battery, 2-45V "B" batteries, loud speaker, center tapped loop aerial. All these items are listed in our catalog, **at a tremendous saving.**

Our semi-finished sets come with all parts mounted on panel and baseboard ready for wiring. Do not fail to send for our catalog. Remember—we are the largest exclusive radio mail order dealers in the world and carry the best of everything in radio. We save you 1-3 to 1-2 on everything in radio. Detailed descriptions appear in our catalog.

Semi-Finished 5-Tube Radio Frequency Set

$18.75

This special offer is astounding the radio world. **Coast to coast reception on loud speaker.** Low-loss condensers and sockets. Highest quality transformers. Bakelite rheostats. All wiring concealed under Bakelite baseboard. 7x18 panel—fits into any standard 7x18 cabinet. Complete instructions for operating. **Guaranteed saving to you of $50.00. Price of set all mounted, $18.75.** Cabinet of same model as American Radynola pictured above **$5.65 extra.**

Our line is complete, includes all popular sets, such as Superheterodyne, Neutrodyne, Ultradyne, Reinartz, Regenerative, Radio Frequency, Browning-Drake, Super-Heterodyne Reflex and all other latest circuits. Kits, sets and parts by well-known manufacturers such as Frost, Howard, Baldwin, Brandes, Western Electric, Columbia and others.

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Complete parts for 8-Tube Ultradyne receiver, without cabinet, complete with blueprint, instructions and diagrams

$45.85

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Genuine Licensed Neutrodyne kit of parts come fully assembled on the panel and baseboard with complete instructions ready to wire

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COCKADAY

3-tube Cockaday kit of parts, fully assembled on panel and baseboard ready to wire

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REMLER 8-TUBE SUPER HETERODYNE

Complete parts for Best 45 Kilocycle Super-Heterodyne Genuine Remler parts

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ULTRA-AUDION

One-tube Ultra-Audion. Wizard of radio. Fully assembled and ready to wire, with instructions

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BROWNING DRAKE

4-tube complete low-loss parts

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HARKNESS

2-tube reflex kit of parts, fully assembled on panel and baseboard, ready to wire, complete instructions

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Catalog includes list of broadcasting stations, general radio information and facts about our free service division. Write for it today.

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For "Better Tuning" B-T

"The more you learn of Radio and the longer you use **B-T products,"** says a leading jobber, *"The more you appreciate that they are in a class entirely their own"*

The Season's Greatest Success

As the season grows it becomes more and more apparent that its *two greatest improvements* are the *B-T Counterphase* and the *B-T Euphonic Audio Transformer.*

No B-T product ever made such an instant nation-wide success as the *Euphonic* because no other Transformer, or system of Impedance, Resistance or other style of coupling gave the same unequalled satisfaction.

Like all B-T products the value is greater than the price.

2.2 to 1, $5.00 4.7 to 1, $5.75.

The Counterphase

These letters indicate what users think:

From Kansas City:

The Counterphase is in every particular by *far the most efficient receiving set* that I have owned or heard in operation. *One stage* of *audio* is quite sufficient for ample loud speaker reception in *five* rooms of *all* class B stations in the U. S., and many class A.

From Cincinnati:

Summarizing tests on Counterphase Set I can safely say it has *more volume, greater selectivity, greater sensitivity* and produces *higher quality of reproduction* than any receiving set I have ever heard.

Torostyle Transformers

3 Styles—Antenna, Intermediate and 4-Circuit

$4.00 Each

The latest
B-T Invention:

The "Silent Socket"

The *only remedy* we have ever found for Microphonic Noises

Price as shown $1.25

Read "Better Tuning" once—you'll read it always.

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* *Tested and Approved by* RADIO AGE *

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

JANUARY *Radio Age* MODEL *Has* SIMPLE TUNING *Control*

By Radio Age Technical Staff

IN PRESENTING to its readers the January model receiver, Radio Age's technical staff has somewhat simplified the tuning of the set as compared to the previous model and has made other improvements which will probably appeal to readers who follow the series. As time passes and each model is worked on there will undoubtedly be many refinements, all of which could not be included in one model simply on account of the lack of time and the fact that association of parts might not be susceptible to too much elimination of parts. Like anything else, radio may be improved to death, so after a while we would have a tubeless, coilless and capacityless set.

In building this set reference should first be made to the schematic diagram, Fig. 1 on page 9. This gives all of the electrical connections without regard to the placement of the apparatus.

Fig. 2 on page 10 gives you a view of all parts located on the baseboard but without any wires showing.

The isometric sketch Fig. 3 on page 11 gives you a pictorial view of the parts and their wiring, the isometric having photographic accuracy as regards the location of everything.

In Fig. 4 on page 12 is shown the same set, looking down upon it, but with all wires in place, while Fig. 5 on page 13 gives a front panel view of the assembled receiver.

Permit Variation

INASMUCH as the present receiver was not to be exhibited at a radio show too much attention has not been paid to "prettying up' the set, this being left more to the individual taste of the builder. Some of the wires in the set were made flexible so as to permit variation in connections during the time the set was undergoing tests on actual reception. These changes were made necessary on account of the fact we have seldom seen a receiver which on actual operation will follow all the hypothetical data written about it.

The same plan of putting in all the filament wiring first was adopted as was the case in the December model. The left hand filament terminal on all the sockets was attached to a piece of bus bar wire running from the left to the right of the baseboard and terminating at the yellow and green terminals on the Jones plug on the rear right part of the baseboard. Thus all of the sockets had a common connection with the negative A battery. The Kellogg soldering lugs were used in order to simplify soldering. If more time and trouble were taken the wire could be bent around the terminals, or flexible wire used, but we found the stiff assembly the best under these conditions.

Sockets

THE sockets are made by Pacent of isolantite and will take either the UX or UV prongs so in this respect the sockets may be termed universal. The sockets are affixed to the baseboard by two screws in each socket and placed with the grid and plate terminals away from the panel and the two filament connections toward the panel.

Diagrammatically in Fig. 1 all of the grid returns are shown returned to their respective filaments, but in actual practice it was found better for the leads that are to go to the negative (through the C battery which will be explained later) to be bunched and returned at the negative terminal of the first socket on the left end of the baseboard, instead of distributed over the length of the baseboard.

Although no mountings were supplied with the double-toroids made by the Radio Foundation, Inc., nevertheless we found the simplest way of mounting was to drill a small hole through the baseboard, countersink on the underside, and run up a long screw that engages the wooden core of the double-toroids. Thus they are firmly held to the baseboard, with the grid end down by the grid terminals of the sockets. Another method of mounting would be to use two small angle braces made out of copper or aluminum which would be affixed to the coils fore and aft by means of the screws at present holding the wooden core rod in place. In either case the coils should be mounted firmly enough so there is no possibility of their getting adrift if the set is to be carried about from place to place.

Audio Transformers

AUDIO transformers, both the 2 to 1 and the 3 to 1 are Thordarson's and should be mounted as shown in Fig. 2. On account of the spacing between the two audios grounding of the shields was not necessary, although if more than two stages of audio are used it would seem advisable. Frankly we do not believe anyone would ever want to put three stages of transformer coupled amplification on this set, although if it is desired to use resistance coupled amplification three stages may be properly used.

After putting in the negative filament line and hooking it up to its proper connections on the Jones plug, the Daven filament resistors for the quarter ampere tubes are inserted in each of the right hand filament terminals, and the positive wire run to the filament toggle switch, and thence to the positive terminal on the connection plug. This completes the filament wiring and after this much has been done all the balance of the connections may be made.

Drilling the Radion panel is quite simple and may be done after the panel has been affixed to the baseboard. For making the panel secure to the baseboard we drill five holes on a line about three-quarters of an inch from the bottom edge of the panel. The first hole is at the center of the 26-inch panel. Hence this hole would be at 13 inches. Halve this distance and make another hole to the left; halve the right 13 inches and make another hole. This gives three holes. The other two should be about two inches from the panel ends, one at the left two

(Turn the page)

inches from left edge, and the other at the right end two inches from the right edge. This gives five holes in all and should be enough to support any kind of a panel.

Condenser Holes

THE holes for the Amsco condenser may be drilled by means of the drilling template supplied with the condenser. After the holes are drilled and countersunk, the condenser should be mounted temporarily and the hole drilled for the holding screw on the Marco vernier dial, a small metal template being furnished by the Marco people for this purpose. This .00035 condenser should be at the left side of the panel and is used for tuning the secondary of the antenna coupler.

For the second condenser a Bremer-Tully tandem variable condenser, .00035 each section, was used. This condenser has a single hole mounting and another hole for the little trimmer capacity. A template is likewise furnished by the manufacturer for this purpose. The distance between the first condenser and the second one is about 7 inches. The hole for the first condenser is three inches in from the left edge, and on the 3½ inch line, (which is half the height of the panel) the hole for the second condenser is 10 inches from the left end.

After the tandem condenser, there is a single hole for the Centralab resistor (this is also a single hole mounting) the hole being 16 inches from the left edge. Four inches to the right of the resistor mounting is the hole for the Cutler-Hammer toggle filament switch, while two inches from the right end of the panel is the hole in which is placed a Yaxley single circuit jack. All controls are on a line on the panel and fairly evenly spaced.

Rest of Wiring

WITH the condensers, resistor, toggle switch and phone jack fastened on the panel, you may go ahead with the rest of your wiring. The rotors of the single and tandem condensers should be commoned by means of a piece of bus bar wire, all the grid returns of the three double-toroids being also fastened to this busbar. This wire in turn is arranged with a flexible wire by means of which it may be connected to different taps on a C battery, the positive of the C battery being tied to the negative filament line. Thus if it is desired to bias the r. f. tubes negatively it will be possible to do so at will by merely putting the flexible wire onto a different minus voltage on the C battery. Under some conditions it is advisable to bias the r. f. grids, especially where too much volume and broadness is apparent. With this in mind the ground lead on the set goes to the negative filament instead of going to the grid returns and the rotors of the condensers. Otherwise you would be grounding the bias battery instead of putting the desired negative bias on the grids of the radio frequency amplifiers.

By Shortest Route

LEADS from the grid taps of the r. f. coils should go direct and by the shortest path to the grid terminals on the three sockets, two r. f. and one detector. In the case of the latter the .00025 fixed Electrad grid condenser is inserted directly on the detector grid socket and the grid wire made fast to the other side of the grid condenser. This condenser has a clip into which is slipped an Allen-Bradley 1 megohm resistance; larger values may be used if desired. A connection is run from the stator of the single condenser (on the left) to the grid of the first r. f. tube. This will complete the grid circuit of the first tube. One wire from the grid of the second tube goes to one stator on the tandem condenser (preferably the one at the rear) while the other grid

List of Parts

1 Bremer-Tully tandem condenser, .00035 with trimmers
1 Amsco .00035 SLF variable condenser
3 Radio Foundation double-toroids
2 Thordarson audio transformers
1 Centralab variable resistor, 200,000 ohms
1 XL variodenser type N
5 Pacent isolantite universal sockets
5 Daven filament resistors for 1-4 ampere tubes, with mountings for same
1 Cutler-Hammer filament toggle switch
2 Marco clockwise vernier dials
1 Allen-Bradley 1 megohm grid leak
1 Electrad .00025 grid condenser and clip for leak
1 Dubilier 1 mfd by pass condenser
1 Muter .001 fixed condenser
1 Yaxley single circuit phone jack
1 Radion 7 by 26 by 3-16 panel
5 Magnatron quarter ampere tubes
1 Jones plug and cord
1 Burgess 7½ Volt C Battery.

(While the above parts were used in the January model receiver, any parts of equal merit may be used in the construction of such a receiver.)

connection on the side away from the detector socket goes to the stator of the second section of the tendem (the one on which the trimmer condenser's shaft extends out in front of the panel). These trimmers are used to take care of any variation in the inductances due to dissimilar winding, or any variation in capacities due to different tubes and wiring. In operation after the trimmers are once set they need not be used again. They are not to be used in tuning under any conditions.

From the plates of the two r. f. tubes one wire goes to each plate tap on the r. f. coils. The other end of the two plate coils goes to one terminal on the variable resistor supplied by Centralab. This resistor has a maximum value of 200,000 ohms and should be sufficient to take care of almost any plate voltage used on the r. f. amplifier tubes. The fact about twenty or thirty set manufacturers make use of such a resistor in their factory built sets would indicate this means of controllling undesired oscillations is pretty stable and effective. The other end of the resistor goes to the positive of the 90 volt B battery. A Dubilier 1 mfd by pass condenser is connected from the common connection of the two wires from the two double toroids to the common rotor, to the negative A filament line. In case you desire still more by passing another Dubilier 1 mfd. condenser may be placed across the plus and minus of the A battery lines. The principal place to look for trouble in r. f. currents is in the B battery where such a battery is common for all stages and it is always advisable to bypass, from the tap which the r. f. stages use, to the negative. Another bypass could be used on the 45 volt tap where it feeds into the audio transformer, and still another across the total voltage applied to the last audio stage. These capacities and their use rest mostly with the builder of the set. There can be no question as to the advisability of bypassing as much as possible to make a stable set.

C Battery

In making use of a C battery the 7 1-2 volt type made by Burgess may be used. This is variable in steps of 1 1-2 volts at a time. For the r. f. grids, if you use 90 volts on the r. f. tube plates, you will probably want to use from 1 1-2 to 3 volts negative bias, while for the audio with 120 volts you may use as high as 6 volts negative. The positive terminal of the C battery should be connected to the negative A battery line. The flexible wire from the common rotor connection and the returns of the r. f. coils is the one which should be tapped either on the 1 1-2 or 3 volt minus C terminal. If the signals are too broad and loud, biasing the r. f. grids will sharpen matters up a little.

The antenna coupler made by the Radio Foundation has three taps on it. Use the one with the least number of turns so as to get greatest selectivity consistent with fairly good volume. In calibrating the set leave the antenna tap at one place and make the run of the condenser scale from zero to one hundred. If you change antenna taps while calibrating the set the settings for some of the stations will be a little off.

Owing to the fact the Amsco single variable used in the grid circuit of the first stage of r. f. is of the type whose capacity increases when rotated in a counter-clockwise direction, the reading on the first Marco vernier dial will be opposite. To remedy this, make use of one counter-clockwise Marco and the other one clockwise. It would seem that eventually all manufacturers will adopt the system of capacity increases as the dial is turned to the right. When we remember the marvelous changes that condenser manufacturers have made in their products since the days of "mud" insulation, we can readily believe soon the makers of all instruments will get together and adopt a standard for their products.

Neutralization

While the X-L variodenser, type N, is

(Turn to page 10)

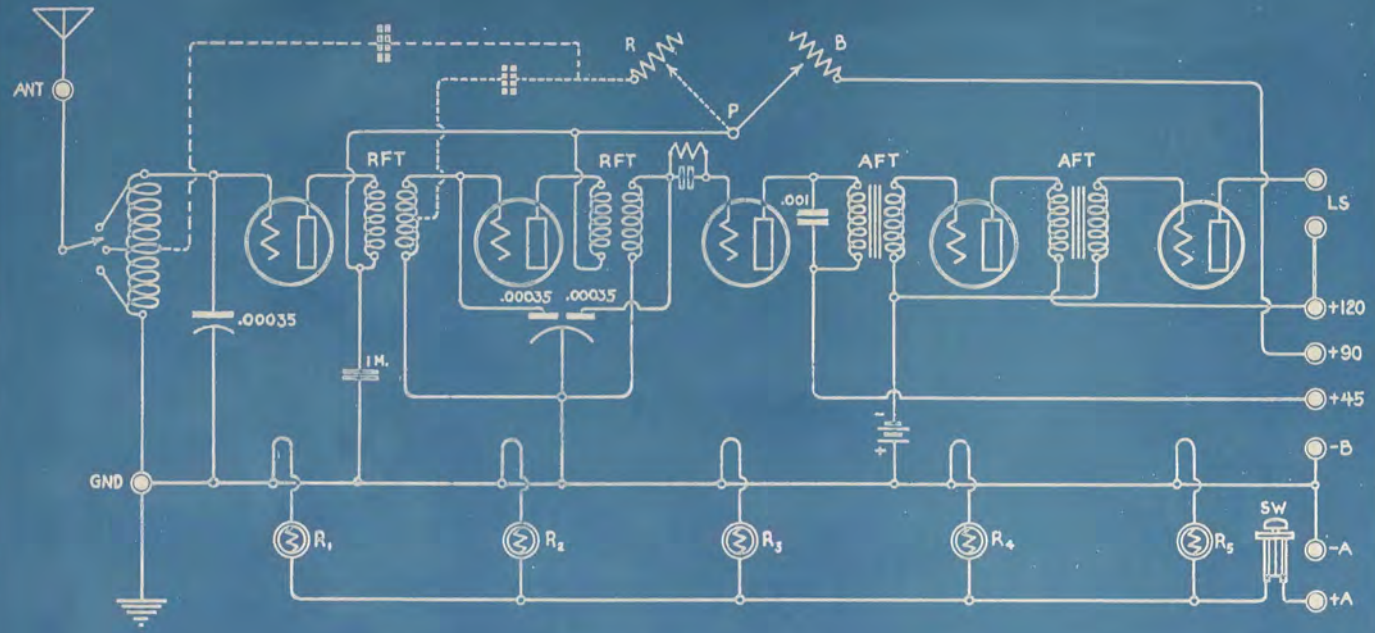


FIG. 1

RADIO AGE MODEL HX

TUNED R.F. RECEIVER

JANUARY

1926

W.T. GARLAND

shown in the list of parts, and is a handy thing to have around the experimental bench, its use in the set will be dependant upon the type of tubes used and the difficulty of preventing the first tube from oscillating. In using the series resistance in the plate circuit of the r. f. tubes a nice control of undesired oscillation may be obtained, but if any difficulty crops up it would be a good idea to make use of the type N for neutralizing the grids of the first two tubes. It is very difficult to lay out hard and fast rules for these things since there are so many variations in the application by the individual set builder. Better have a couple of the type N on hand anyway for use at odd-times.

In mounting the Thordarson audio transformers, the 2 to 1 is in the first stage and the 3 to 1 in the last stage. The electrical connections are shown in Fig. 1, the schematic. For the two filament connections on the audios a piece of bus bar wire may be run between the two binding posts and a piece of flexible wire attached to this bus wire, so it may reach upto the left front of the panel where the C battery is located. Tapping this flexible wire on different values of C battery will give the set maker an idea of the amount of C bias he wishes to apply to the grids of the audio stages. With 120 volts about 6 volts minus may be used. Lower B battery voltages will need a drop in C bias so as not to have the audio tubes drawing too little plate current with a consequent thinning out of the signal. Change the C battery bias until you get a full rich tone.

To secure control of oscillation by means of right hand rotation (clockwise) of the Centralab variable resistor it will be necessary to make the left hand resistor connection the B battery line, while the right hand one is the common wire from both the double-toroid r. f. primaries and one side of the Dubilier 1 mfd. by-pass condenser (whose other side goes to the negative filament). When the pointer is at the extreme left the total resistance of the unit will be in series with the plates of the r. f. tubes and no oscillation can occur. As the pointer is turned to the right the resistance will be decreased until a point where the higher B battery voltage will cause the tubes to go into oscillation. The point just before the tubes go into oscillation (accompanied by a howl) is the proper place for the set to be worked. The resistor will have to be changed slightly from wave change to wave change. The maximum resistance will be in during use on the extremely low waves while on the higher waves the resistance is decreased bit by bit until on KYW at 77 degrees on the second dial there will be no resistance in the circuit at all and the tubes will be securing the full value of the B battery voltage.

To Get Going

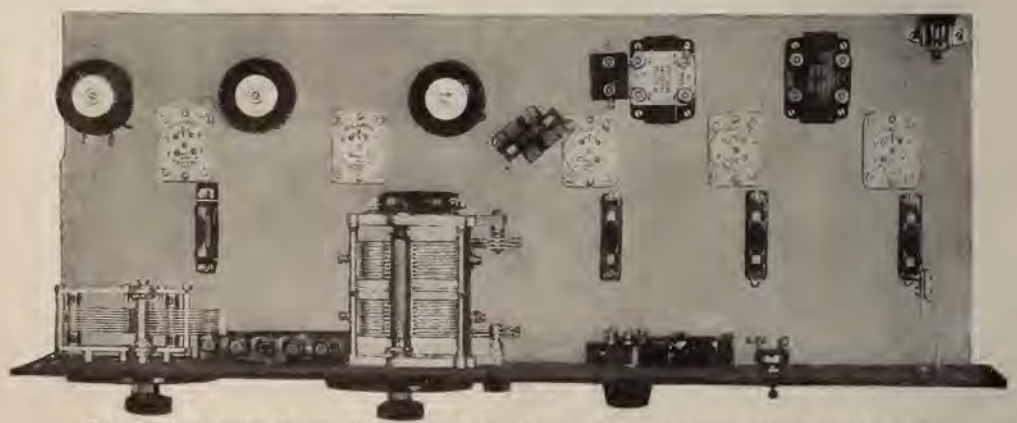
Assuming you have checked and double checked the wiring to make sure you have made no errors in the assembly of the apparatus, you are now ready to tune in stations. Insert your tubes one at a time and see they light properly. The Daven filament resistors take care of the quarter ampere tubes without any need for a rheostat and since we are not using a critical detector tube like the UV 200 it will not be necessary to have a rheostat for the detector tube. This means a saving in the form of one control at least and considerable peace of mind.

Put the antenna clip on the antenna tap nearest the top end of the double-toroid (see photographs Figs. 2 and 4) and the ground on the left hand filament connection of the first tube. Use the second condenser for finding your stations, the one on the left being not so critical as the tandem condenser used on the second r. f. and detector stage. The trimmer on the rear section of the Bremen-Tully tandem should be set at zero, that is, its plates should be disengaged. The front trimmer should be used to equalize the capacity discrepancy between the first ahd second sections due to any difference in tube capacities, wiring variations and other causes. Tune in a weak signal with the second condenser, setting the first one at approximately the same dial reading as the second one. Then rotate the front trimmer condenser on the tandem(which has a little knob on the front of the panel) until you have built up the signal to its maximum. During this operation to get the balance perfectly it will be necessary to do a little changing of the resistor in the plate circuit. When this is done it will be possible to get the signal strong and clearly defined on a single split-hair on the second dial. The first dial will be nearly the same reading, but its tuning will be slightly broader than the second one.

In our operation of the set on an admittedly poor attic antenna in one of the suburbs of Chicago, 226 meters came in at zero on the second dial. This wave is allocated to WBBM and WIBO. From this point all through the scale up to 77, within one hour, the stations shown in the box in this article were picked up with good volume, on some extraordinary volume all on loud speaker. However to get best selectivity we put the bias of the r.f. tubes at 1½ volts. The volume dropped some from that obtained when there was no bias on the tubes, but it permitted a little sharper tuning for stations in the local area which had a tendency to overshadow some of the out of town stations.

For the city dweller this type of a set would be better if it were to be thoroughly shielded with copper. The cabinet may be wood with copper sheet shielding. If you intend screening, do a good job and shield the shole thing. You might even (we would do it if living in the city) make use of a copper panel, mounting all apparatus on the panel with bushings where no contact is desired, and letting the parts like condenser rotors touch the panel. This would allow you to operate within the shadow of a number of the local boadcasting stations without interference from their transmitters. For those who live in the country and are

(Turn to page 12)



Top view of set showing all parts, but unwired. Refer to Fig. 1, schematic, for correct electrical wiring diagram. Tell them you read it in Radio Age

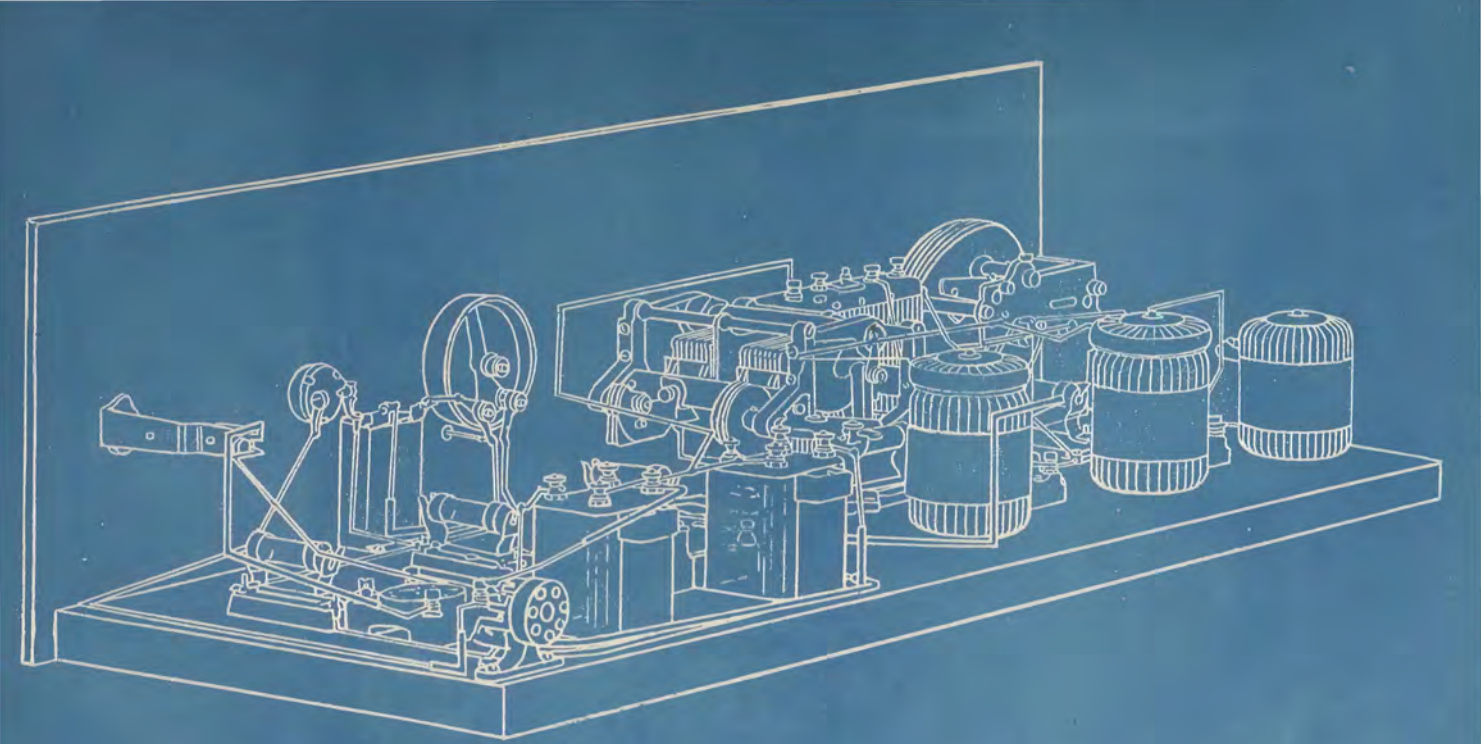


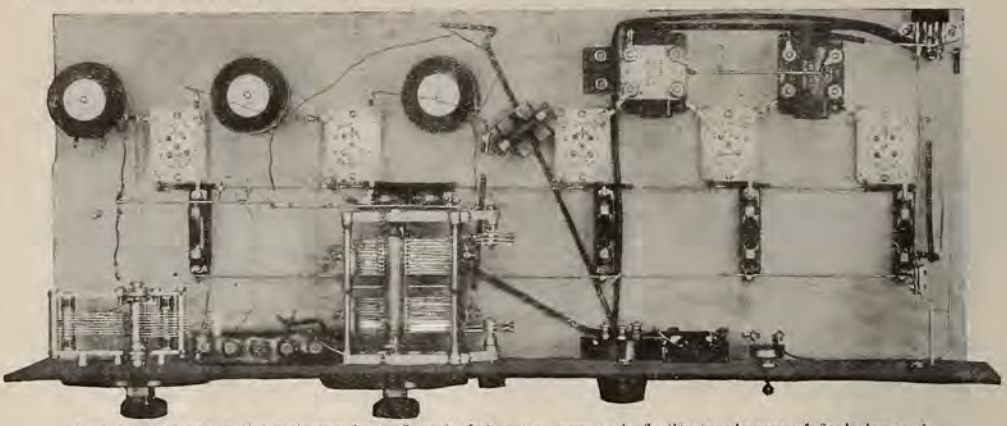
FIG. 3

RADIO AGE MODEL HX

TUNED R.F. RECEIVER

JANUARY

1926



In this photograph is shown the wired set. Several of the wires were made flexible to take care of final changes in the receiver. Flexible wire may be replaced by busbar.

removed from the influence of the modern high power transmitters the matter of shielding does not enter in to the matter at all.

The receiver was not tried on a Monday, or silent, night since it was felt such a receiver would not be suitable for use by the man or woman interested in long distance work. The best test of a set would be during normal operation with all of the city stations in full blast. Ability of a receiver to sidetrack the locals and bring in the distant signals should be the criterion of any receiver. The staff is working towards that criterion and feels in the presentation of the January model considerable progress has been made.

In closing this discussion we would call attention to the fact that while we specified and made use of a certain set of parts as shown elsewhere in these pages, any parts of equal merit may be used with success in such a receiver.

In the February issue we have another receiver which will be of interest to the cliff-dweller and which will take advantage of the directional qualities of a loop together with the use of tuned r. f. for amplification. The full details together with pictures, list of parts, blueprint schematic and the performance of the set may be expected in the February RADIO AGE which will be on the stands about January fifteenth.

1 Hour's Log

Right dial	Call	Wave
0	WBBM-WIBO	226
4	KSO	242
7½	WMBB	250
11	WBCN-WENR	266
15½	WSM	283
16	WKAR	285
17	WBAV	294
19	KPRC	297
20½	WLIB	303
21½	KDKA	309
24½	WGR-WSMB	319
25	KOA	322
26	WSAI	325
27	WBZ	333
28	WJAX	337
30	WLS-WCBD	345
32	WWJ	352
36	WGN-WEBH	370
40	WTAM	389
42½	WHAS-WHT	400
45	CNRM	411
46½	WCCO	416
48	WLW	423
49	WSB	428
50	CNRO	434
53	WOS	441
55	WQJ-WMAQ	448
61	WBAP-WFAA	476
63	WOC	484
77	KYW	536

Further Data On December Set

In the December model it was found more volume could be secured by eliminating the two neutralizing capacities shown in the pictures and the diagram. Probably with some other type of tubes such neutralizing capacities might be used, but with the set as pictured their use is not as desirable if full strength of signals is wanted. The addition of the grid bias to the r. f. tubes as detailed in the foregoing account of the January model also helped somewhat on the selectivity of the set.

When the larger value condensers (Silver-Marshall .0005) were used in the December model the higher range of the set was increased so as to embrace KYW and KSD without much of a sacrifice on the extremely low wave stations.

After these changes the three dials shown on the panel of the December model (Bremer-Tully vernier dials) ran practically true to form throughout the entire range.

By a little experimenting this model with its three controls could be reduced to one control, since the Silver-Marshall condensers have a little drum mounted on each of the condenser shafts by means of which they may be linked together with fish cord so as to give single dial operation.

The completed receiver ready to operate is shown in a front panel view.

Finishing Your Radio *Cabinet*

Method of Working the Wood, Applying Filler and Staining Detailed for Benefit of the Fan

By H. P. STRAND

IN THIS era of radio, where the fan likes to build his own, he usually selects some particular circuit or hookup, buys the parts, assembles them, makes some suitable box or cabinet, but what is it that gives his set that home-made look? It is the finish, or surface. It lacks that smooth satin appearance that usually distinguishes a factory made job from the homemade one.

Now the purpose of this article is to help you get a better finish on that set you are building by going at the treatment of the wood in the proper way. The cabinet is often given the least thought in the building of a radio, and that is usually because the builder is in ignorance of the methods used to properly finish woodwork.

Look at Surface

Let us first look carefully at the surface of the wood. How particular have you been to eliminate all dents and imperfections? Every one will show up later, unless we get rid of them at the start. We will talk of mahogany in this article as that is the stock usually used in radio cabinets. Clear mahogany is quite easy to work, but stock with pronounced grain effects, the wide dark bands so characteristic of this popular cabinet wood is a difficult thing to handle unless great care is taken. If a hand plane is used it will be found the plane will smooth one band but will tear up its neighbor, due to the direction of the grain reversing. The best plan is to have the stock run through a small thickness planer at the mill directing the operator to have the cutting blades sharp and to take very light cuts at a time. This can be followed up with No. 0 sandpaper on a block, being sure to use a back and forth motion with the grain only. If a circular or across the grain motion is attempted it will leave scratches that can never be removed. A scraper can now be used to put the finishing touches on the stock. A good scraper to use for this work is an old safety razor blade of the variety with the stiff back edge. This will take out the tiny sandpaper marks. Apply a pressure to the blade on the forward motion only, throwing one away when it gets dull and using another one. In this way we are going to get a good surface to start with and that is half the battle in wood finishing Make sure no planer marks remain.

Now For Filler

THERE is a filler on the market that comes in the form of a powder that when mixed with water makes an excellent paste to fill up any little places that can not be removed by the foregoing methods. This is allowed to dry and cleaned down with fine sandpaper. If you remember that mahogany is soft when you handle it around the bench, and take care to lay some papers down and keep bits of wood and the like, from getting under your work, you won't have much filling of this nature to do.

We next come to the question of staining, as the darker than natural effect is usually wanted. There are many varieties of stain on the market, so one should experience no difficulty in selecting one that will answer the purpose. A good stain will penetrate deeply into the wood, not raise the grain, or cover the grain, and its color will not fade. Those stains come put up in liquid form and in both red and brown shades. It is a good plan to get some of each and mix them until the desired color is obtained.

This is applied with a brush or a cloth and allowed to stand a few minutes and then the surplus is removed. A second application will produce a darker effect. It is a good idea to try some on a small piece of the same wood first to make sure of the shade.

The surface must next be filled with a suitable filler. This is purchased in paste form, and thinned out with turpentine, until it is about like molasses. Apply with a stiff brush and work well into the pores of the wood, brushing with the grain and across the grain. This will fill up all the little grain marks. Allow this filler to stand about ten minutes and then remove all the surplus with a rag. Make sure that you get it all off as any remaining will affect the drying of the varnish.

We next need a thin even coat of shellac. This also helps to fill the surface, as well as to make a binder for the varnish. Use orange shellac well thinned with alcohol. Apply with a brush, making quick even strokes.

Applying Varnish

THE first coat of varnish may now be applied. This should not be used as it comes in the can, as it is much too thick for the first coat. Dilute it with about 20% turpentine, that is, pour out in a small can enough for about the first two coats, and add about a fifth of that quantity of turpentine. Allow this to dry over night and then sand it lightly with No. 00 sandpaper. The surface should now appear with but a slight gloss and free from lumps.

Apply another coat the same as the first, and after it is dry, sand as before. Be sure to dust off well with a clean piece of cloth before attempting to put on the varnish.

We can now use the varnish as it came in the can. This next coat should be applied in a room where the temperature is not less than 70°. as the varnish will not flow properly and an uneven surface will result. Make sure that no dust is in the air, and none settled around on surrounding objects or the floor, that will be stirred up and settle on the work being done. You can not be too particular on this point as the job can not come out well if the room is not clean of dust and dirt. Stir the varnish well with a clean piece of wood and make sure that it is not chilled by being left in a cold place. If it does appear thick and cold, do not use it until after it has been placed in a warm room or near the stove or heater, and had a chance to warm up. Of course, the can should be well covered during the above warming up process to eliminate the chance of dust getting into the can

A good grade of bristle brush should be selected, preferably one that has been used before, as a new brush will loose its hairs until it has been broken in.

Do not use a small narrow brush on a surface that is quite wide, as too many strokes will be necessary to cover the work, and the varnish can not be applied smooth and even. A one and a half inch brush on small cabinets and a two inch on large ones will be found about right.

Apply this coat with long steady strokes, being sure to brush the varnish out well. Do not put it on too heavy, as several moderately thin coats are far better than one or two thick ones. Look out for "runs" and "sags," both results from thick applications of varnish and not being properly brushed out.

Ready to Rub

ALLOW work to dry at least 24 hours and then the first real rubbing job is ready. Procure from a piano supply house, a piece of felt, of the variety known as hammer felt, about 3x3 inches and an inch thick. This makes an excellent rubber. Thoroughly wet same in water and with a light sprinkling of powdered

(Turn to page 67)

Snap Shots *at* Chicago Radio Show

Lieut. Gov. Fred E. Sterling of Illinois officially opened the fourth annual Chicago Radio Show and also presented the trophies to the winners of the Miss Radio of the Middle West contest. He was assisted by Miss Rena Jane Frew of Beaver, Pa., America's Radio Diana, who is at the left of the governor. The prize winners are (left to right) Inez Weaver, Hebron, Ill., third prize; Flossie E. Erickson, Bloomington, Ill., first prize; Clarice Schmall, Chicago, fourth prize; Dorothy Goedecke, Chicago, second prize.

Commander Donald B. MacMillan (left), just back from his voyage of exploration in the northern polar regions, was the guest of honor at the fourth annual Chicago Radio Show, November 17-22. He is shown here with Lieut. Commander E. F. McDonald, Jr., who was second in command on the Arctic journey, and two of the Eskimo youngsters who were the pets of the thousands of visitors at the show.

The famous band of the Northwest Radio Trades Association, Minneapolis, Minn., which headed a delegation of seventy-five members of the association who attend the fourth annual Chicago Radio Show in a body

U. J. Herrmann, managing director of the fourth annual Chicago Radio Show.

G. Clayton Irwin, Jr., general manager of the fourth annual Chicago Radio Show.

Save money by

TAKING CARE OF YOUR RADIO

Neglect of both A and B batteries, antenna, ground and other connections, cuts down signals

By BRAINARD FOOTE

ALTHOUGH the initial cost of a radio receiver is usually regarded by the purchaser as the chief item of expense, in reality there are upkeep costs just as in the case of an automobile. As with the car, these extra expenses do not come at once and only after a period of six months to a year is there any appreciable expenditure necessary.

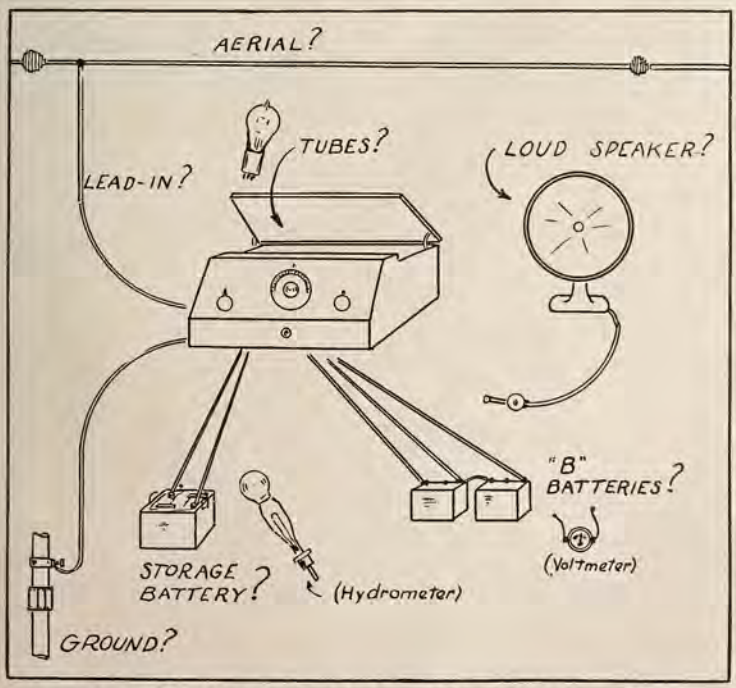
The radio set owner is interested, of course, in maintaining a high grade of home entertainment at a minimum outlay. He doesn't want to buy a new set of batteries every month, or invest in a new outfit of tubes any oftener than he must. Proper care of the set and its accessories will go far toward reducing the cost of keeping your receiver in steady working shape.

There are no radio outfits that do not require attention once in a while. The millennium will have arrived when such a condition exists! No, there are batteries to be recharged or to be replaced with new, worn-out tubes to be taken out and new ones inserted, aerials that break, corroded joints in aerial and ground wires that must be repaired, loud speaker and phone cords that become broken and others. As with anything human beings possess, prevention of trouble is better than cure.

Batteries

STORAGE batteries and dry batteries of the "A," "B" and "C" type are, taken together, the most troublesome items about the receiver. Hence let's consider these right away. If you have a storage battery, you have a source of power supply which is practically unfailing with proper care. It lasts for years if regularly attended to. Where do you put your battery? Some folks hide it away behind the piano where they can't get at it and never look at it unless the tubes fail to light and thus show that the battery is "dead."

You shouldn't wait so long before giving your battery a charge, however. Hence put the battery where you can find it easily. Stand it on a board or in a glass tray to protect the rugs or put it on a special shelf or table in the cellar, and run two heavy wires through the floor and cellar ceiling to connect to it. Always keep the top clean and dry, throwing away any rags you have used for the purpose at once. The battery can be washed with cooking soda and water and the top scrubbed with an old brush to clean it thoroughly. If green corrosion appears at the positive terminal, scrape it off cleanly and apply a coating of vaseline or automobile grease to prevent its recurrence. Always have clean and tight connections between the wires to the set and the battery terminals, as squeaky and scraping noises result from chemical action on loose joints.



Are you taking care of your set? Here are some of the accessories that call for your attention. You will save money and time, besides getting reliable service by radio, if you check up on these items. Read how and why.

Add Water

IF YOU have your charging done outside, select a reliable shop, where the place looks neat and clean and be sure the service man adds distilled water each time the battery is charged. If you do your own charging, get a good make of charger, have a quart or so of distilled water on hand (which you can buy at any garage or drug store) and a hydrometer of the syringe type for testing. You do not need a voltmeter for this purpose. Just before charging, add enough distilled water to cover the plates. If you can draw up a hydrometer-full of liquid from each cell, you have added enough. The added

(Turn the page)

Taking Care of Your Radio Set

(Continued from page 15)

water replaces that lost by evaporation during charging and while standing in use, but no acid evaporates. Hence do not add acid at any time.

The float in the hydrometer tells you the condition of the battery. When it floats to the highest mark, or about 1250 or 1275 the battery is completely charged and the active materials have been driven off the battery plates into the liquid by the charging current. If the float sinks to the bottom you have overdischarged the battery. It ought to go on charge when the float shows about 1150. Never attempt to get the last drop of juice from your battery, as it has the proper voltage for the set without altering the filament rheostats over the entire period. Be careful not to light matches around a battery on charge as there is gas given off which will explode.

Dry Cells

YOU should have a voltmeter to measure the "B" batteries. Otherwise, if reception becomes poor, you have no possible way of determining the trouble exactly. You may think it is the "B" batteries and go out and spend $6.00 for a new set uselessly. A fairly good voltmeter can be had for a dollar or more. Such a meter is not very accurate and it requires a good deal of current to operate it so that it should be connected to the battery for only a few seconds in measuring. However, with such a voltmeter, note the voltage of your "B" batteries when brand new and write it on the battery. Take each 45 volt or 22½ volt unit separately—don't measure the whole thing and let it go at that. Every time you have to charge the storage battery, make it a point to test the "B" batteries with the voltmeter. When the battery falls much below 40 volts a new one should be had. It is not always necessary to replace both the 45 volt units at once; sometimes one will last a month or two longer than the other. If you use a 22½ volt unit for the detector, it will outlast the other batteries. But if the detector is tapped to the first 45 volt unit, this unit will become discharged more quickly than the other because in addition to the current for the amplifier tubes it provides detector current, too.

Use Grid Bias

NEVER stand "B" batteries in a hot place, as the moisture is dried out. A dry and cool spot is best. So avoid locating your set too near the radiator. To make "B" batteries last long, always use a "C" battery in connection with audio amplifier tubes. This in itself costs little and lasts a long, long while. It biases the grid of the amplifier tube in such a way that the tube operates more clearly and with much less "B" battery current. The voltmeter can be used to measure the "C" battery, too and a new one should be installed when the old one drops the least bit, as noises begin when the "C" battery starts to decompose.

If you use dry cells instead of a storage battery, the voltmeter you buy should read plainly enough to indicate 1½ volts, or it should have a "low" scale for "A" battery measurement. Of course, if the set has a rheostat and you find you can increase its setting until the tubes fail to light brightly enough, well and good. But be extremely careful, if you DO use dry cells that are almost dead for lighting your tubes, that you turn off the tubes by the RHEOSTAT and not by the switch. The dry cells recuperate considerably and for a few seconds can deliver current at the normal value. Therefore, with the rheostat "ON" too far you might burn out or at least paralyze the tubes should you turn the set on by the switch. To avoid accidental short-circuits, use strong, heavy wire that has good thick insulation and scrape the insulation off for only a short space at the end, for contact.

Tubes Are Delicate

ALL radio tubes are delicate affairs. Don't unduly jar them, shake them or drop them. Moreover, don't apply too much strength in twisting them into the sockets as you may break the glass part loose from the base and break the inside wires. Jarring tubes often bends the elements inside and changes the tube's characteristics. It may then fail to act in your neutralized set. If you hear scratching sounds as you move the tube in its socket (with the set turned on) take it out and clean the prongs on the tube as well as the contact members of the socket. If the prong makes contact on its end, sandpaper the end of the prong. If it's a side-contact socket, wrap a narrow strip of sandpaper around the prong and clean it that way. To clean the socket contacts, wrap a length of sandpaper around a stick. Never insert a metallic object (like a pencil with metal end-piece) into the socket unless you first disconnect the batteries.

Tubes will last longest in the audio and detector sockets, but in a year or so may deteriorate sufficiently to cause them to function poorly in the R. F. sockets. It is always wise to have an extra tube on hand (or get a tube reviver) and to insert it once in a while in the R. F. socket to note any change in volume on a distant station or a weak local station. Often your set seems poor on DX, when the trouble is due to a worn-out tube. The filament will light but the tube is gradually going dead on account of the fact that the active material "thorium" has been "boiled out" of the filament wire. Never light the tube more brightly than necessary.

If your set has a loop antenna, don't read this part. The outside aerial doesn't need very much attention, but you should bear in mind that the loss of a little energy through leakage or capacity conduction will weaken or prevent a distant signal from affecting your set. Of course, for local stations, most any kind of installation will work, providing the joints are tightly soldered. But for weak stations and DX, inspect your aerial once in a while. Take off the insulators and wash them. They'll be sooty and dirty and when wet with snow or rain will cause lots of leakage. Clean the outside lightning arrestor. Black oxide of copper on the wire doesn't do any harm, but broken wires in a flexible aerial wire DO. Try to avoid unnecessary insulators outside and where you have to use them to turn corners, etc., use good radio insulators and not porcelain knobs with nails in them. Porcelain insulators are O. K. if glazed all over, but unglazed insulators absorb moisture. Glass insulators are good, as well as rubber composition.

Don't have the lead-in wire too close to the building as the loss then occurs via the little "condenser" formed by the capacity between the wire and the house wall. It's all right to have the ground wire run close, nailed to the floor or anything else, however. The ground should be made to the street side of the water meter on the water system, if possible. A longer wire run to this point, or as near it as can be, is preferable to a connection to the radiator. It sometimes helps to use both such connections for the ground however. Use a ground clamp, but thoroughly scrape the galvanizing and dirt off the pipe before putting it on. If possible don't have any soldered joints in the aerial or ground. One piece of wire from the end of the aerial to the set is best.

Reproducers

LOUD speakers and phones have delicate connecting cords. Tinsel wire is used in them and sudden pulls are likely to break part of the tinsel or to pull a connection at the end loose. The cord usually has a length of tape attached, which should be tied to the plug so that any strain is placed on the tape and not on the connecting cord tips. Should the cord become disconnected, it is always wise to try reversing the connections to obtain the loudest and clearest reception. In case the speaker has an adjustment for volume it is easy to find the correct polarity. Set the adjustment very close to the rattling point (where diaphragm touches magnets) and then reverse the connections. If the rattling stops, the first connection was right but if it increases and spoils the quality altogether the latter connection is right and the adjuster should be changed again.

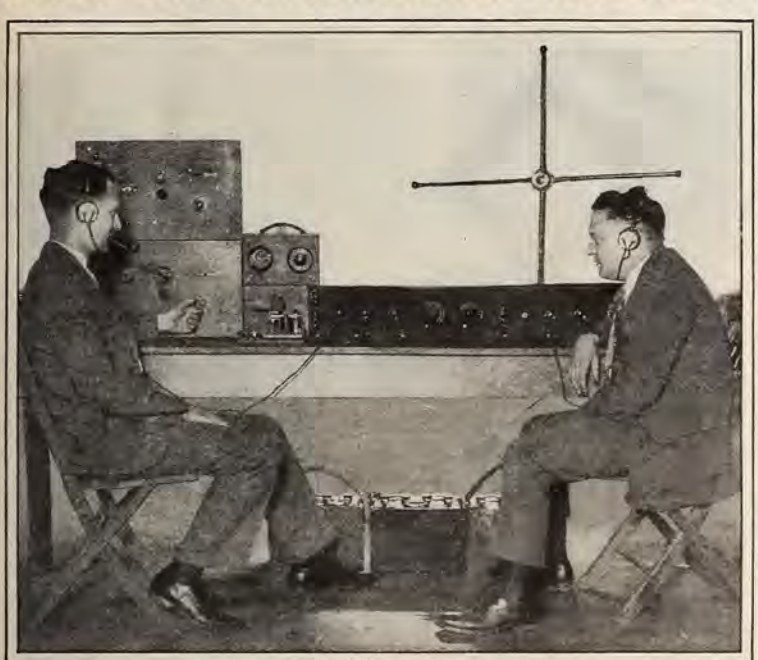
The set itself does not require much attention. It is best not to stand a fine radio cabinet too near a window or a radiator so that it will not be subject to sudden changes in temperature, nor will the sun's rays discolor the panel. Fingermarks should be wiped off and furniture polish may be used as with other woodwork. Keep the lid closed, to prevent dust from entering the cabinet and settling in delicate electrical parts where it may cause leakage and corresponding loss of volume.

Undiminished sensitivity and volume will reward you for the little time you spend in caring for your radio equipment and in addition, the average expense will be considerably reduced.

A tube restorer, which drives out thorium on partly exausted filaments, will also help to keep your tubes in good operation. Of course there is no remedy for a burned out filament, save another trip to the radio store.

Now you'll know

HOW RE-BROADCASTING IS HANDLED



In which a radio relay system covering half the continent is described by veteran engineer

THE receiving station for KYW's short wave pickup is shown in the above photograph with the author on the left tuning in KDKA's 61 meter signal for the edification of E. E Mattson, the Westinghouse press representative at Chicago. Since the installation of the uni-directional antenna the short wave signal from Pittsburgh is now heard uniformly enough to allow putting their dinner music out through KYW for the benefit of Chicagoans and residents of the Middle West.

By Walter C. Evans*

CHICAGO's first practical demonstration of the Westinghouse relay system was made through KYW during the World Series. That all seven games were successfully handled in this manner is amply attested by the listeners from Arkansas to Ontario who sent in enthusiastic reports, numbering well into the thousands.

Regular service has been established between 5:30 and 6 p. m. Chicago time when a dinner concert, originating in Pittsburgh and handled over the short wave relay system to KYW is daily broadcast.

How It is Done

The program is transmitted over twenty odd miles of telephone circuits from the concert hall in downtown Pittsburgh to the radio station located in the suburb of East Pittsburgh. Here the incoming line is connected to two transmitting sets, one 309 meter equipment known over the country as KDKA and the other, the short wave relay apparatus operating on 61 meters.

Many have been the problems worked out by the Westinghouse engineers before the relay system became sufficiently reliable to relay a regular scheduled program. Slight wave shifts, long and short fading, disruptions of tone quality which for a long time occurred without apparent reason, all had to be analyzed and a remedy applied. For nearly a year a recurring rumbling scarcely audible, increasing to a roar and then diminishing, for all the world like the surf on the beach, proved to be one of the worst stumbling blocks.

Crystal Wave Control

WITH the application of the piezo (named after Dr. Piez) crystal control which holds the wave length absolutely constant, removing the slight frequency shifts which were so troublesome, the operation became more stable and the quality cleared up.

The relay system calls for specially developed receiving equipment and an antenna. Use is made of two seventy foot poles carrying a copper pipe, split halfway up the pole giving a counterpoise and antenna. The distance between the two poles is calculated for the wave length of the one station to be received. The poles are connected together in such a manner that a uni-directional characteristic is obtained allowing the pick up of signals over only a small arc in the direction of the transmitter. Energy from stations or electrical disturbances in all other directions cause an opposed current between the two halves of this antenna system which cancel out.

Uni-directional Antenna

THE receiving equipment for KYW is located at 18th Street and Prairie Avenue. This location was chosen because the old residences there are free from steel construction and there are no obstructions between the antenna poles and the lake. Sensitive though stable receivers having extremely low losses on the short wave are connected to the antenna poles. The signal is rectified through these and passed on to a multi-stage amplifier designed with special care in order that all the musical frequencies are amplified to their proper value. The output transformer of this amplifier matches the impedance of the three miles telephone line in to the KYW station on the Congress Hotel roof. The line is terminated in the station on a jack the same as the lines from the various studios and the broadcasting operator merely has to plug the circuit through to the 536 meter transmitter and it goes out on the "air" with the same volume and quality as the music from the Chicago studios.

All Remote Control

THE relay receivers in some of the Westinghouse stations are remotely controlled so it is not necessary to have an attendant adjust the tuners. The operator in the radio station has a dialing switch much like those on an automatic telephone. To vary the tuning dial or tickler on the receiver several miles away he has but to dial a two or a seven and the tuner handle jumps around two or seven degrees as the case may be. Relaying is done at KYW only from the Pittsburgh station so the tuners are accurately adjusted to the one wave length and are remotely started and stopped from the roof of the Congress.

* Engineer in charge, Westinghouse KYW, Chicago, Ill.

Noted Engineer Says:

"HOOK IT *to the* MINUS A"

Good engineering demands that negative B battery lead should go to negative A, thus establishing line of common polarity for measurements

By JOHN H. MILLER*

THE writer looks at a great many radio diagrams in the course of a week or two, and has noticed there does not seem to be any fixed point to connect the negative side of the "B" battery. It may be connected to the negative terminal of the "A" battery, the positive terminal of the "A" battery, some intermediate point, or to the arm of a potentiometer across the "A" battery.

The Old Days

In the good old days when soft detector tubes were so critical they could hardly be handled at all, it was almost necessary to provide a variable plate potential in order to get the most out of these tubes. An easy way to get this was to bring the B— terminal to the arm of a potentiometer connected across the "A" battery and by swinging from one side to the other a variation in plate potential of several volts was had.

But such tubes are no longer available, the ultra-sensitive detector with its need for extremely fussy adjustment having given way to tubes slightly less sensitive, but far more stable. There is no reason today for the adjustment of "B" battery potential in steps any finer than can be obtained on any ordinary "B" battery.

So we might as well connect the B— terminal directly to some point on the "A" battery, and it would seem that one of the "A" battery terminals would be best for this purpose.

Metering Purposes

NOW if we connect to the positive "A" battery terminal we add a few volts to the "B" battery voltage for the equivalent plate potential because of the voltage drop across the filament. But we make it exceedingly difficult to do some other things with our circuits because we have a positive terminal and a negative terminal tied together. We have no common terminal of like polarity for metering purposes and it is questionable as to which side of the "A" battery to ground.

But suppose we connect B— direct to A—, we then have a few volts less than in the previous case, but it is doubtful if one person in a hundred can even imagine the difference in output. And we do have a common lead of common polarity, which we can consider as a base or zero line for ground, making measurements and tying our circuits to.

Read Voltages

The use of instruments is growing quite widely on radio receiving sets and

The above meter will take care of three readings. It will measure A battery voltage, and two sections of B battery voltage. The meter case contains a three way switch which will save you the trouble of rigging up one of your own.

with a common negative terminal, connections are easily made to measure all voltages with a single instrument and with the use of the simplest kind of a switch, and if the rheostats are placed in the positive leads, filament voltage as well can be read, since the filaments are connected direct to the common negative bus.

In the interests of good engineering, it would seem that those who evolve new

In testing work, and also for your own information, a milliammeter is quite desirable to determine the total plate current being used. If your are swapping hookups and changing tubes all the time, all the more reason for having a milliammeter in series with the negative B lead so as to read total space current.

circuits and modifications of new circuits should consider the experimenter and make the diagrams as clear and generally adaptable as possible.

Burn Out Tubes

In the majority of tuned radio frequency sets either with or without neutralizing condensers or other means of stabilization, the grids of the radio frequency tubes are tied back to the negative side of the filament. If such a set has the B— terminal connected to the A+ terminal, a grid to plate short circuit in the tube will cause the "B" battery to be shorted across the filaments and several tubes will be burned out immediately. If the B— terminal were connected with the A— terminal, this rather common tube defect would short the "B" batteries, but the tubes would not be burned out.

Many sets on the market today have their various tuning elements shielded in metal cases and these metal cases are usually connected to the negative side of the filament. If the negative "B" battery return is brought to the positive side of the filament, one must be extremely careful with the positive "B" battery lead, since if it should touch any one of the metal boxes, all of the tube filaments will immediately become burned out. Therefore, tying the negative "B" battery terminal to the negative "A" battery and filament terminal will frequently prevent loss of tubes due to burn out, and seems to be a very logical scheme of connections.

A Milliammeter Too

IN the case of the experimenter who is continually testing out one hookup after another it would seem policy to have on hand a zero to fifty milliampere meter which may be placed in series with the negative lead of the B battery and by means of which the pull of each tube may be recorded. The use of a zero to ten milliammeter would be all right if the experimenter could provide a means for inserting the meter in the plate circuit of each tube so as to measure the plate current used, but this would be rather complicated. Instead the zero to fifty milliampere meter in series with the negative B lead would tell the story of all the tubes. Incidentally it will also go a long ways to convince the user of the necessity for a C battery to conserve plate battery current.

*Chief Engineer, Jewell Electrical Instrument Co., (Member I. R. E.)

The Received Signal

The Amplified Signal

Weak Signals Need

Enormous Amplification

Few Broadcast Listeners Realize Process Necessary to Strengthen Minute Currents Into Strong Ones for Radio Entertainment.

By
FRANK D. PEARNE

VERY few of the radio broadcast listeners of today have the slightest conception of what an infinitely small amount of energy is picked up by the receiving set, and to what proportions it must be amplified, or increased before it becomes audible to the human ear. The actual energy received upon the aerial is so little that it cannot be measured directly and the only way in which some basis may be arrived at, is to amplify it many thousands of times and then by knowing exactly what the value of the amplification happens to be, the actual strength of the signal may be roughly calculated. It has been estimated by some of our greatest scientists that the amount of energy picked up on a loop aerial in New York City from a broadcasting station in California, if allowed to pass continuously for thirty-five years, would represent the energy required for an ordinary fly to climb a distance of three feet up a straight wall. This statement may seem impossible for some of our readers to believe, but it was actually made and proven before one of the best known scientific societies in the United States and there were none present who could disprove it. Imagine then, if you can, dividing this time (thirty-five years) by the length of time required for a signal to be impressed upon the grid of a vacuum tube, and you may gain some idea as to the amount of energy which is picked up on the aerial of the receiving set.

Must Amplify Signal

WHILE this of course might be called an extreme case because of the great distance between the transmitting and receiving stations and the fact that a loop aerial was used, which naturally would not have as great an efficiency as an outside antenna, it serves the purpose of a comparison very nicely, and will demonstrate beyond a doubt that such a radio signal must be amplified many thousands of times in order that it may be heard distinctly with a loud speaker. Twenty years ago, if anyone had the audacity to suggest the possibility of such a thing, he would be a marked man for the rest of his life, but here it is. It is being done in thousands of homes every day and we think nothing more of it, than we do of the other more or less commonplace things of today. Do we ever stop to think, when something goes wrong with the set, what a wonderful thing it is to receive signals, music and speech over such great distances? No, we say that the set is no good and we do not appreciate what wonderful things the little set will accomplish with so little complicated apparatus and how easy it is to hear from all parts of the country in a few minutes' time. Perhaps a better understanding of these things will give us a reason for having more patience when some trivial thing interferes with our reception. In the first place let us consider what amount of power is sent out from the broadcasting station and why so little of this energy is received at some great distance from it. Supposing that a station in New York is impressing 1000 watts on the aerial. The watt is the unit of electrical power and 746 watts is equal to one electrical horse power. If all of this power so radiated could be picked up on the receiving aerial we could use it to furnish all the power required to light up an ordinary home with electric lights, but most of this power is lost in covering the distance between the stations. In the first place it leaves the transmitting station in the form of a wave of very high amplitude. As it passes through space the amplitude grows smaller and smaller until it seems to be flattened out into almost a straight line, and the amplitude of the wave determines the amount of power which is produced in the receiving aerial.

Lines of Force

A WAVE of high amplitude will carry more magnetic lines of force than one of low amplitude. It is for this reason that a receiving station located a short distance from the transmitting station will pick up a strong signal. The amplitude of the wave has not decreased to any great extent, consequently more magnetic lines are made to cut through the receiving aerial and more current is produced in it, but if the receiving station is a thousand miles away, the amplitude has been considerably reduced and fewer lines cut the aerial and this results in a much weaker signal. A receiving station which is so far away that the amplitude of the wave has been reduced to almost a straight line will have great difficulty in picking up the signal. Before the coming of the vacuum tube, reception

What Happens to Weak Signals

was limited to much shorter distances, as detection of the signal was accomplished by means of the crystal detector. The vacuum tube of the three element type made it possible to amplify the signal at the same time it was detected. From this, the amplifier was developed and now it is possible to pick up this minute amount of energy, which is too small to be measured and to increase it to such an extent that the signal may be heard at a distance of half a mile from the receiving station. In fact, were it not for this little three element tube, we might still be using the old time crystal detector without any form of amplification. The addition of the third element to the two element tube by Dr. Lee Deforest made it possible to amplify radio signals. This third element is called the grid and is located between the plate and filament of the tube. The hot filament throws out a stream of electrons which are attracted by the plate and form a conductive path between them. The positive terminal of a high voltage source of current is connected to the plate and the negative terminal is connected to the filament. As long as the filament is hot the stream of electrons pass from it to the plate and the current will flow from the high pressure source from the plate to the filament. A pair of phones, or a loud speaker connected in the circuit would produce no sound because the flow of current would be steady and would not change.

Grid Goes to Work

IF HOWEVER, any change takes place in the current flowing through the tube the diaphragms of the phones would be affected and a sound would result. This is where the third element, or grid does its work. This grid is between the plate and the filament and if a radio signal is impressed upon it, it varies the amount of electrons which reach the plate. In other words it attracts, or repels some of the electrons which are flying past it according to the charge which the signal may impress upon it. In fact, it has been called the trigger of the tube because even the smallest change in the signal which is too small to estimate, will greatly vary the resistance between the plate and filament and make enormous changes in the strength of the current flowing between them. This is often called the relay action of the tube, and by this method a signal which is entirely too weak to be measured, or recorded can be greatly increased in strength. This action takes place while the tube is also acting in the capacity of a rectifier, or detector of signals. After this, the rectified signal is passed through more stages of amplification which may be accomplished in several ways. Each additional tube which it passes through will multiply the volume from seven to ten times and if a high ratio transformer is used in each of these amplification stages the volume increases rapidly. A fairly strong signal from the detector may pass to the first stage with a tube amplification of eight to one, and then through a transformer which has a ratio of ten to one, which will bring the total amplification of this stage up to eight times ten, or eighty. The next stage then would raise it to eight times eighty, or six hundred and forty and the next transformer would multiply this by ten, or six thousand four hundred times that of the signal when it leaves the detector tube. Thus the weak little signal which at first was entirely too small to be heard is built up into an extremely powerful signal, which when passed through a loud speaker may be heard at great distances. In some cases the incoming signal is so weak that even with all of this amplification, it cannot be heard. The reason for this is the fact that not enough energy reaches the detector tube to cause it to operate with any degree of efficiency.

Need Plenty of Tubes

THIS is why many of the radio receiving sets which have only one or two tubes have so much difficulty in receiving signals from great distances. The incoming wave has grown smaller and smaller in amplitude and when the signal reaches the detector, it refuses to function at ordinary efficiency, and what little energy there is will not be enough to pass a signal to the amplifiers. Now if more tubes are used as amplifiers even this small amount of energy may be built up before it reaches the detector tube. This is accomplished by placing one or more amplifying stages ahead of the detector, which build up the signal before it is rectified, and to such an extent that when it does reach the detector, it has been brought up to the point where it is strong enough to have some effect upon it. This is called radio frequency amplification and in this process only the amplifying characteristics of the tubes are used. After passing through the detector the frequency is greatly reduced, hence the term "audio frequency amplification." The nature of the radio, or high frequency signals is such, that usually only the amplification of the tube is used. Transformers are employed of course, but the ratio of the transformer windings in this case are generally one to one which leaves only the tube amplification available. However, if three of such stages are used ahead of the detector we have eight times eight times eight, or an amplification at radio frequency which is five hundred and twelve times that of the original signal. Now if we multiply this by the previously mentioned audio frequency amplification we find that by the use of three stages of radio frequency amplification, a detector and two stages of audio frequency ampli-

(Continued on page 53)

In the picture above the reader may see the amount of apparatus involved in producing the primary current necessary for a station like KDKA at East Pittsburgh, Pa., to radiate from 10 to 50 kilowatts of energy from the antenna. This enormous current at the transmitter dwindles to a few millivolts by the time it has reached your receiving antenna and must be rejuvenated in order for you to hear the signals through a loud speaker. The startling difference in size between the transmitting and receiving sets also represents the difference in the cost of transmission and reception.

Piety has more

Data on Four Tube Tuned R. F. Set

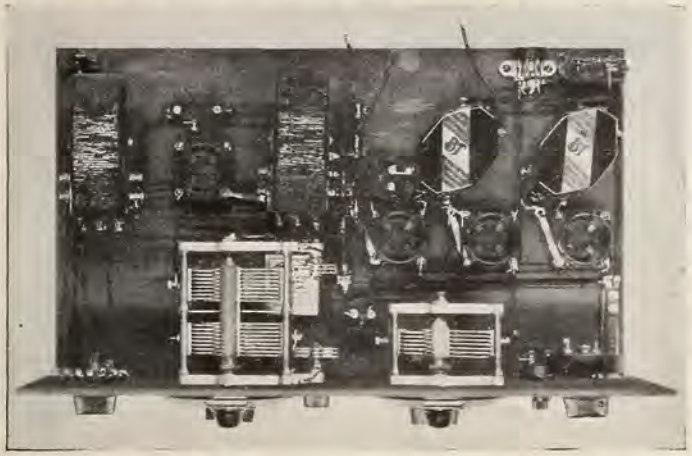


Fig. 1. Pictured here is the completed set mentioned by the author in the accompanying article. Close inspection of all details will help the constructor to get everything placed right in building this receiver.

By Ray G. Piety

Stable method of oscillation control; restricted field inductances and only two dials on this good performer

THE many favorable reports received regarding the operation of the four tube hookup described in the February number of Radio Age together with similar expressions of satisfaction that have come to the writer's attention leads me to believe another article embodying the more recent developments along the same line would be found interesting.

There are a great many who would be interested in constructing a set that will give at reasonably small expense a high degree of selectivity, good volume, as good tone quality as can be expected and one that is simple in adjustment and easy to tune.

Since radio frequency first became a possibility there has been no lack of articles in the various publications describing circuits designed to "add a stage of radio." It is not my purpose to go beyond the average reader's technical knowledge, nevertheless it will be agreed a somewhat more adequate analysis of the theory of operation of the four tube circuit will enable the set builder to get more out of his manufactured parts or assist him in making his own.

Fundamental Circuit

A NATURAL starting point from which to proceed is from a fundamental circuit, which, when properly constructed with good apparatus, has as many desirable features as can be combined in a steady-going reliable one-two- or three-tube set.

Unless some radically new and as yet unheard-of method of reception is discovered the next logical step is the addition to this detector circuit of a stage of radio amplification, of itself efficiently designed, without setting up such action between the two tubes as will decrease the efficiency of either. It will be seen that if this can be accomplished we should have a four-tube set that will show unusual results.

The circuit shown in Fig. 2 is agreed by all to possess a high degree of amplification when properly designed parts are used. You will note there is a tube with an ordinary transformer coupled input together with a coil in the output to transfer the amplified signal to the detector. The primary, which in the simple circuit is between antenna and ground, is here placed between the plate and B battery where it supplies amplified energy to the same detector tube.

Adding R. F. Stage

THIS is simple and easy. All that has to be done is to place a tube ahead of the original detector to amplify the signal, and so give greater signal strength, but the results are true only if the action is as definite and efficient as explained. Before we can assert that this action, and no other takes place, there are a few other considerations which must be taken into account. It is these other considerations which require a receiver of this type to be designed, rather than simply built.

The result of placing a telephone receiver in front of the transmitter is familiar to many. A continuous whistling sound is set up. The explanation of this action is that some original impulse is picked up by the transmitter; actuates the receiver, which in turn re-excites the transmitter and so the original impulse keeps swinging around from transmitter to receiver to transmitter indefinitely. This action is called oscillation and takes place because the amplified output of a system is so coupled back to its input, that it can re-excite it with sufficient strength to sustain a continuous interaction. It should be noted this is not in the nature of perpetual motion as the output must be amplified, and further this amplification must be sufficient to overcome all energy losses in the oscillatory circuit. Analysis of the fundamental regenerative circuit will show the action is very similar to that of the telephone.

Feedback Action

By means of the tickler there is a transfer of some of the amplified energy back to the input, where it is again amplified. However, if too much energy is sent back the tube will oscillate and prevent satisfactory reception of broadcast signals. It is apparent then, that best results will be obtained when the largest amount of energy possible is fed back but yet not enough to cause oscillation.

BUT it will be found when an efficiently designed stage of radio frequency amplification is added in the manner just described there will be an excess of energy fed back from the output of the radio frequency tube to the input from

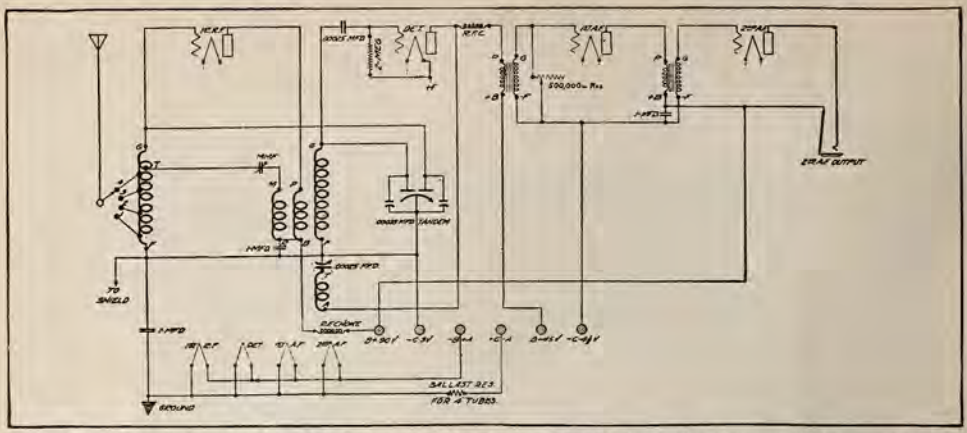


Fig. 2. The schematic diagram, by which the set should be wired is shown in Fig. 2. For placement of the parts the reader should refer to the photograph at the beginning of the article.

the very beginning. Instead of requiring a special tickler to secure oscillation, the feedback due to coupling between coils and through the internal capacity of the tube with a tuned plate circuit is sufficient to cause oscillation and prevent satisfactory reception.

Methods of preventing this will be found in the telephone analogy. The amplification may be decreased to a point where it cannot overcome the losses in the circuit, the feed back may be decreased, or the losses in the circuit increased.

Defeat Our Purpose

Altho the latter method is commonly used it will be seen at once that if we have to put fixed losses back into the circuit we are defeating our purpose, as we planned to combine the two parts in such way as to retain the full effects of both.

What we want is not a fixed reduction of amplification, or a "damming" process by insertion of resistance, but a means of securing that *balance* which will keep the circuit just below the point of oscillation. When we test the final circuit as shown in Fig. 2 we find a greater resultant output than by any of the other methods, so the theory must be correct.

THE method used is covered by the Bremer patents. A coil is coupled to the primary in such manner as to transfer "counter" potential; that is, energy in a reverse direction to that which would cause oscillation, the action therefore being almost exactly opposite to the so called regenerative principle. The proper amount of counter potential necessary to balance out the objectionable feedback is controlled by a small condenser connected to T on the antenna coil and so adjusted that the energy going in one direction (which would cause oscillation) is just equal to that going in the other (to stop oscillation).

When this condenser is set correctly the inter-action between the detector and r.f. tube will be so slight that the tickler coil of the detector tube may be set at its best point without having the detector cause the r.f. tube to go into oscillation.

You will note the absence of this condenser would create a condition where the detector quite frequently could not be operated at its best point, as the r.f. tube would be thrown into oscillation before that point had been reached in the detector circuit.

To prevent such condition arising is the advantage of using the "Counter-phase" method of control of the radio frequency stage.

SINCE the B battery circuit is common to all tubes a choke coil and a 1 microfarad condenser are inserted to prevent coupling between tubes thru the battery circuit.

By means of these changes we have "added a stage of radio" without impairing the efficiency of either circuit as would have happened had we just added on the extra tube, and the writer is fully convinced the resulting circuit is one that has no equal in a 4-tube outfit either for operating efficiency or smoothness and simplicity of operation.

List of Parts

1 .00035 Mfd. tandem condenser.
1 .00025 Mfd. variable condenser
1 Four-Circuit coil.
1 Antenna Coupler.
3 1 Mfd. fixed condenser.
2 R. F. choke coils.
1 Low ratio audio transformer.
1 High ratio audio transformer.
4 Sockets.
1 Ballast resistance for four tubes in parallel.
1 Set of binding posts or multiple plug connector.
1 Filament Switch.
1 Baseboard 10" x 17".
1 Panel 7" x 18".
2 Vernier dials.
1 Two circuit jack.
1 Grid leak (2 meg.) and condenser (.00025).
1 Inductance switch (Four or eight points).
1 Balancing condenser (about 30 MMF).
1 500,000 ohm variable resistance.

But the advantages mentioned are by no means all. We have still another improvement which is also in direct keeping with present demands. By proper design of the two inductances and the use of a tandem condenser with a small "clean-up" adjustment on each unit it was found possible to bring both stages to exact resonance by a single adjustment. In other words, the detector and r.f. units may be so balanced it is possible to tune them both with but one dial.

The regeneration and tuning controls are entirely independent of each other; the great advantage of which is immediately apparent, as the tickler coil of the detector does not detune the detector input, and therefore it is not necessary to adjust the small "trimmer" condenser on the tandem with every station as would otherwise be the case.

HERE, then, is a highly practical and efficient four-tube set with really only one tuning control, yet with the "trimmer" adjustment available whenever the final touch is required on weak or distant stations.

The second condenser, as well as the resistance across the audio transformer, are volume controls and do not in any way impair either selectivity or sensitivity.

The set is just about as good a combination of desirable qualities as can be combined in one instrument. The sensitivity will please the distance hound, while the ease of tuning and clarity and range of tone unite to charm the less expert manipulator.

The use of a variable tap on the antenna coil makes it possible to balance the

required selectivity against the volume desired and thereby obtain the best adjustment possible for any individual antenna and receiving conditions.

Use Good Parts

GOOD apparatus should be used. To be sure perfect resonance may be obtained on all wave lengths, it is necessary to employ a tandem condenser with a small clean-up capacity on each stage. One of these capacities is variable and controlled from the panel. It is doubtful whether it is possible to construct a set that will tune to perfect resonance with the same capacity on both stages due to individual variation in tubes, wiring and other apparatus except by using a small clean-up capacity to compensate for this variation. Properly constructed toroid coils have the advantage of cutting down coupling between stages and were used for this reason. They also may be shielded with good effect as noted later.

By carefully following the wiring diagram in Fig. 2 and making all leads short and direct no assembly trouble should be experienced.

Connect leads to every other tap only on the antenna switch. This avoids the possibility of the contact arm connecting two taps at once and short-circuiting the turns between taps on the antenna coil.

Shield the Set

IF LOCATED within less than a mile of a strong local station it is advisable to completely shield any set. The cabinet and panel should be completely lined with thin copper. Partial shielding is of no particular value.

The condenser may be left in contact with the shield but it is necessary to insulate the jack, selectivity switch and volume control. Shielding prevents the wiring in the set from picking up the signal and feeding it in direct before going through the tuned circuits. The advantage is less pronounced the further your location from the station. It will be noticed no rheostat is used, a fixed resistance giving the proper filament adjustment on all tubes. Many operators use a rheostat as a volume control, which is wrong. When the volume is sufficient to overload the tubes turning them down only overloads them more and although the volume is decreased the clarity is impaired.

Volume Control

A volume control is provided in the form of a variable resistance across the first audio transformer which has the advantage of actually increasing the clarity as the volume is cut down.

After the wiring is completed,—and it is so simple that it needs no explanation, all that remains is the adjustment of the balancing condenser.

The batteries and antenna should be connected to the set and some station on the lower wave lengths tuned in.

Finding the Stations

Set the single condenser at zero, in order to prevent the detector tube from oscillating, and turn the rear trimmer condenser about three-fourths of the way in. Adjust the small balancing condenser to the minimum capacity (pointer at the highest point). If wiring is correct and the proper apparatus has been used the radio tube should now be in an oscillating condition.

TUNE in a weak signal at about 300 meters. When the tuning dial is rotated back and forth across this signal a beat note or possibly a whistle will be heard. Increase the capacity of the Mikro-mike condenser until this beat disappears when the tuning dial is turned back and forth across the signal. Watch carefully for the point where the beat disappears and then turn the small condenser from one-eighth to one-quarter turn beyond this point. When making this adjustment it is best to operate on a weak signal in order you may be sure both tuned circuits are in resonance. If necessary disconnect the antenna. If the rear trimmer condenser is set at the right point, the front or panel trimmer will show best results at about its middle point, and no further adjustments are necessary.

Use 201-A Tubes

IT IS generally best to use about 45 volts on the detector tube, although a lower voltage may be more satisfactory with certain individual tubes. The circuit is designed for the 201-A type of tube throughout, but small or dry-cell tubes may be used if desired, with some sacrifice in volume.

If your work has been well done and the instructions carefully followed you will be more than pleased with the ease of tuning and the smoothness of operation.

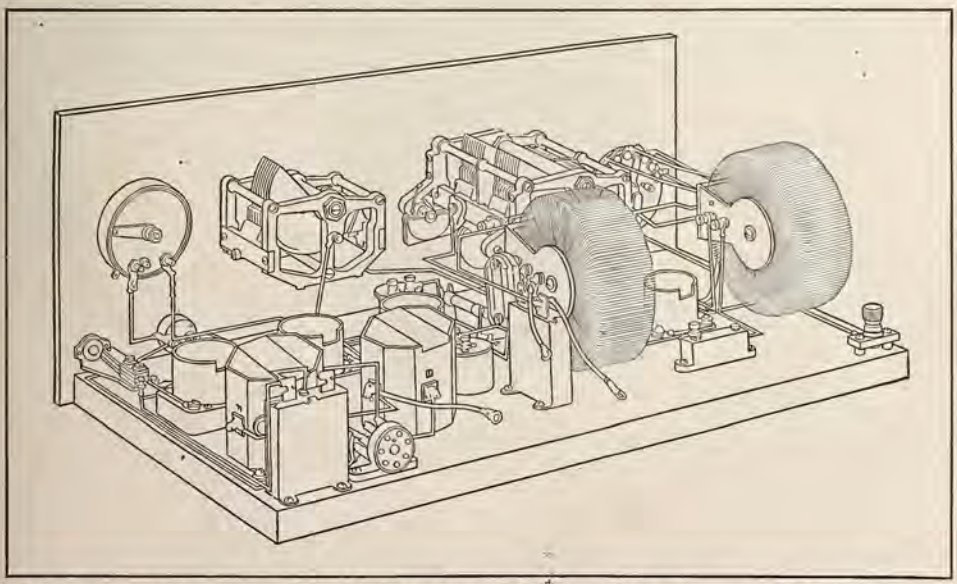


Fig. 3. Here is an isometric view of the set looking at it from the left rear. The three connection wires with clips are for B battery connections.

It won't be long before

YOU'LL SEE WITH YOUR RADIO TUBES

Interesting developments on the thermionic photo-electric cell detailed by Engineer

By V. K. Zworykn*

IN LATE years photo-cells are taking a more and more important place in aboratories as most precise and sensitive apparatus. With the increase in application of photo-cells the methods of using them are improving or, vice versa, the improvement of methods increases the usefulness of cells.

After the development of methods of amplification of phot-electric impulses by means of thermionic tubes, the application of cells extends far beyond the laboratories. We know now, after the works of G. de Prell (Ann. der Physik No. 3, 1923); G. Ferrie (Compes. Rendus November 5, 1923) and others how to amplify the photo-electric impulses as high as a million times by means of a single thermionic tube. These methods are particularly adaptable for amplification of very weak impulses an require carefull insulation and evenspecial thermionic tubes for best results. In order to simplify the installation and adapt the photo-electric cell for use of untrained operators, the following device was developed, having in view the output sufficient to operate directly the average mechanical relays.

Photo-Sensitive Tube

This device is the combination of thermionic tube with a photo-sensitive control electrode. It consists of filmanent of oxide coated type inside of open mesh grid enveloped completely by another grid of fine mesh. This second grid is in electrical contact with metallic coating of inside wall of glass container. The fourth electrode of cylindrical shape is around the second grid. These last three electrodes are coaxial. The inside of the cell is coated with photo-emitting substance, for instance alkali metal, and treated in the usual way. Great care should be taken to prevent the alkali metal from condensing appreciably on insulatng parts of the cell.

In order to prevent the light from the filament falling on sensitive film, the part of second grid is closed by metal shields and the filament is operated at the temperature below visual emission.

Several connections are possible with this cell, depending on requirement of the output. The simplest connection is to let the second grid float and first grid connected to plus side of the filament and positive potential applied to the cylinder in respect to the filament.

How it is Used

The cell is now operating as three electrode tubes, as the first grid acts only for reduction of impedance of the tube and can even be omitted.

(*Research Department, Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa.)

YOU can truly say now that vacuum tubes have eyes, at least electrically. The tube shown above is the thermionic photo-electric tube which is adaptable to transmission of photos either by wire or radio. Much experimental work is being done on this phase of transmission and the story by Mr. Zworykn should be of interest to photo-transmission fans.

The second grid acquies the negative charge from the electronic flow and blocks the current between the filament and anode. If the light will fall now on the sensitive film, it will discharge by photo-electrons the second grid, the latter being connected with the film. The blocking action will be reduced and part or the whole available thermionic current will flow to the anode, depending on the rate of discharge of film or intensity of the light. With such arrangement, the output of the order of milliampere was obtained, the cell being preferably of hard type. When larger output is desire without going to the higher potentials and without sacrificing the sensitiveness, the other circuit is preferable.

The first grid is used as an anode with low potential (order of 30 volts) due to the close spacing between this grid and filament. The second grid is connected through the high resistance to a negative potential with respect to the filament. The cylinder can be connected to the first grid directly or, preferably, have possible potential in respect to it.

Can Block Current

The second grid is now working as outside control electrode and with sufficient negative potential can completely block the current between filament and first grid. If this potential will be adjustable without light falling into the cell, no current will flow between the electrodes and no voltage drop across the resistance. While illuminated the film and second grid will discharge the photo-electrons to the cylinder and this current will produce the voltage drop across the resistance. The potential of the second grid will be lowered and the current start to flow from filament to the first grid. The amount of current depends upon rate of discharge of photo-electrons, i. e. illumination, and charge of second grid through the resistance.

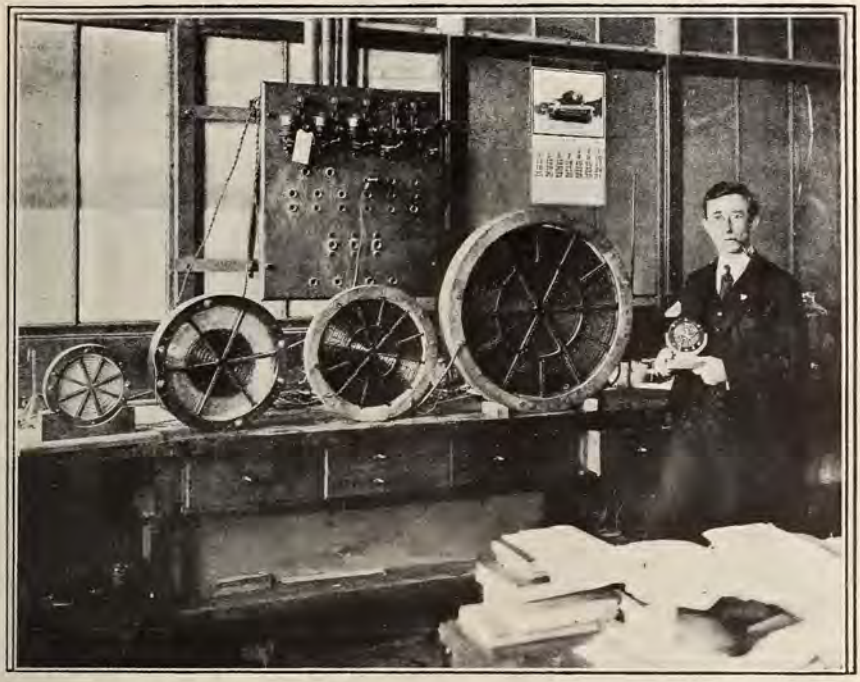
By proper choosing of spacing and mesh of second grid and adjusting the resistance, it is possible to obtain good relation between the intensity of the light and the output within certain limits. The cell in the arrangement, of course, has the time lag which is proportional to the capacity of second grid and the value of the outside resistance.

Ine one tube, made as described above, the time lag with this circuit was calculated to be of the order of 1–10000 of a second and this has been verified experimentally up to a frequency of 3,000 cycles. This value can be considerably reduced by diminishing the capacity of the second grid and increasing its voltage factor on the first grid. The continuous output obtained was of the order of five milliamperes. This limit was due to the heat developed inside of the cell, which distills the alkali metal on the transparent and insulating parts. Of course by proper construction this also can be improved.

For this connection the cell, of both soft

(Turn to page 54)

Hornless Wonder of Schenectady Uses New Diaphram Principle



Dr. C. W. Hewlett, inventor of the loud speaker bearing his name, which is described in the article below, is shown with a few of the models he has developed in the research laboratories of the General Electric at Schenectady. The largest one shown on the right is probably big enough to blow a person out of a medium sized room with the volume of tone emitted. Over a hundred and fifty thousand people who visited the Coliseum in Chicago during the recent radio show had an opportunity of seeing and hearing this loudspeaker which was connected up so as to amplify the broadcasts going on inside the model studio maintained by the show authorities.

AUTOMOBILE tourists who visit the camping ground at Schenectady will be furnished radio entertainment by the municipality.

A giant, hornless loud speaker that emits signals equally from both sides has been installed near the camp ground, and listeners within 500 feet of the apparatus may enjoy music and speech of great volume and free from distortion. It is known as induction loud speaker, and was developed in the Research laboratory of the General Electric Company.

Induction Principle

The induction loud speaker is quite different in every respect from the household variety of loud speaker using a horn. Dr. C. W. Hewlett, physicist, is the inventor of the device, which until its installation in the Schenectady park, has had only limited use in public.

The speech amplifier has been made in many different sizes, but the type used to entertain tourists and residents of Schenectady, measures forty-two inches in diameter. The working diameter of the diaphragm is thirty-six inches. The device consists essentially of two large flat coils of wire mounted close to one another in a frame which holds a thin aluminum diaphragm between the coils These coils carry direct current which produces a radial field in the space occupied by the diaphragm and these same coils carry the amplified voice currents and induce in the diaphragm corresponding currents which, by their interaction with the radial magnetic field, cause the diaphragm to vibrate and give off sound waves.

New Features

Briefly the features of the new amplifier are:

It has no iron in it and does not depend on permanent magnets. No horn is necessary as is the case with the ordinary loud speaker. Sound is thrown out equally from both sides. The diaphragm is acted on at all points of its surface so it vibrates as a whole rather than being allowed to break up in partial vibrations.

The large size of the diaphragm enables it to emit efficiently the low components of the tones in speech and music. This results in much more natural reproduction that can be obtained from ordinary types of loud speakers. This is particularly noticeable in the reproduction of piano music. The induction loud speaker is very substantial in construction. It is practically impossible to damage it or get it out of order. When occasion calls for it, a speaker may deliver large volumes of sound, as when addressing a large audience.

(Turn to page 56)

There is need for

ACCURACY *in* RECEIVER *Operation*

Antenna, inductances, capacities and all allied apparatus yield better results with fine control

By
ARMSTRONG PERRY

IF a radio fan gets more than fifty per cent of the efficiency that is in his receiver, he is getting more than a good many of us. We humans, in our "higher" development, seem to care more for ease and convenience than for the opportunity to make our efforts completely effective. One of the best radio devices ever invented was criticized on the ground it required six full turns of the knob to cover the voltage range over which filaments show their greatest efficiency. One turn was all the public would stand for. That is all a latch key requires, and see what that lets you into—sometimes!

Fish Are Efficient

The electric light, which is generally considered as a rather effective modern device, is said to be only from 6% to 8% efficient, dissipating most of its energy in the form of heat. Deep sea luminescent fishes, on the other hand, are 100% efficient, according to Beebe of the *Arcturus*. He says, even while dying they emit a light so strong a photographic plate exposed to it becomes overexposed in a fraction of a second. He shows photographs to prove it. Since man-made devices are so inefficient at best, the radio fan should try to bring out the most there is in them. In fact, it might be well to emulate the polygamist, who tries to get more out of life than there is in it.

TO begin at the top and work downward, how many of us know just what there is in our aerials? The inductance and capacity of an aerial can be calculated, roughly at least, by following directions found in all well-regulated radio text-books. Most manufacturers and dealers are willing to divulge the secret if approached by a good customer. The aerial can be adapted to the receiver, or the receiver to the aerial. No one who has noted even the effect of cleaning the insulators and brightening the connections can doubt that efficiency can be increased to a remarkable degree if the characteristics of the aerial are studied.

The aerial connects, more or less directly, with inductance coils. The variocoupler and variometer are forms of variable inductance. Either of these devices, properly designed, constructed and installed, is capable of almost infinite accuracy of control. A hair's breadth in the adjustment of the rotating coil may make a difference of a thousand miles in the receiving range of the receiver at the moment. But the knowledge that so many users grow impatient over the slightest extra effort keeps some manufacturers from using fine controls on even their best and highest priced sets. They leave it up to such users as are willing to try for maximum efficiency to install knobs and dials that make fine adjustment possible.

Condenser Control

The control of condensers is as important as the control of inductances. The connecting of two or more condensers to one controlling knob probably is due to the desire of the manufacturer to make his set appear more simple, rather than to any idea that the possible efficiency can be increased by that practice. It is possible to pass stations without hearing them, even when condensers are separately controlled by knobs on the ends of the shafts of the movable plates and when the operator is listening with phones and exercising ordinary care. Inevitably, many stations are lost when efficiency is sacrificed to ease, and when the operator brags that he has no use for phones but gets 'em all on the loud speaker.

There are experts who tell us the modern tubes are not critical as to filament voltage and, therefore, the rheostat made of coiled wire with a sliding tongue that hops from turn to turn is accurate enough in its control. Laymen should not try to argue down experts, but anyone who has used a filament control that provides smooth and continuous variations of voltage knows, if the fine control of the detector filament does not bring in the hard-to-get stations, something else does it while he is working the rheostat.

WHAT we do not know about our batteries would fill a large sheet from the memo. pad. Not long ago I visited a Broadway restaurant in New York which had dismissed its orchestra and installed a radio set, and a loud speaker more perfect than any I have ever heard except a later one invented by the same man. This radio outfit had become more popular than the orchestra. It gave volume at least equal to that of the orchestra, and better quality and variety of programs. Business depended upon it. For two days it had not been working well. It stuttered and stammered. At times it seemed to need the stimulation of the stuff the boss kept hid under his desk. An expert was called in. The manager told him that the wet batteries were charged regularly every night and that the new dry batteries had been purchased only a few days before. The expert picked up a voltmeter that was lying beside the batteries, applied it to the "B" battery, and found that the latter was delivering about one-half of its rated voltage.

About Batteries

The date of purchase has no more relation to the age of a battery than it has to the age of a fish or an egg; a battery smells about the same regardless of age, so it is easier to sell a rotten one, that's all. Wet batteries can be tested with a hydrometer. They can be charged from the house lighting system, and closely controlled. Dry cells are not wholly subject to the control of the users, but the potential of the plate can be regulated by keeping watch of the voltage available at the various taps and connecting at the proper place or adding batteries. The test for wet operators and their control does not enter into this discussion.

The ground connection needs controlling also. High resistance there may affect or offset efficiency elsewhere. A good-sized ground wire, making actual connection with wet earth, and electrically tight connections are all that are necessary for ordinary purposes. The resistance can be measured.

NO severe criticism need be aimed at careless radio users if they accept the responsibility for the results of their own carelessness. None, unless they use radiating receivers or turn on their loud speakers and leave them yowling at the whole neighborhood. Close control of a receiver for a long period of time is tiresome. The t.b.m. whose Maggie keeps him from the plumbers' ball or the front row at the Follies is justified in plugging in and letting the nearest, loudest station provide a soothing atmosphere while he enjoys his pipe and his paper. But when the itch for distance is active—the thirst for adventure and achievement—it is only just what we should avoid placing all the responsibility upon the inventor, designer and manufacturer. We should use such intelligence as we possess in our efforts to produce something besides imaginary performances to brag about tomorrow at the office.

Mutiny Aboard Pirate Ship WBCN

THE murderous ruffians pictured above are none other than the redoubtable crew of the pirate ship WBCN which sails the ethereal sea every Tuesday from midnight until about 3 a. m. when even bold pirates should be abed.

"Bloody Bill," the skipper, is William H. McDonnell, co-owner and director of the station; Edward H. Dougherty, the business manager of Foster and McDonnell, officiates as "Iron Knuckle," the first mate. "Terrible Terry" is Merle Yagle, musical director and chief accompanist. "One Eyed," the boatswain, has as many good eyes as any other person, despite the title. He is Harry A. Zook, Jr., chief announcer and assistant director. The Pirate Ship is Harry's brain child.

Malicious McDonald is Frank H. McDonald, president of the Broadcast Listeners' Association of America, well known for his fight to secure a real silent night for Chicago fans.

Altogether, this crew present an excellent nocturnal aerial feature; some of the scenes via radio are quite realistic, while the rollicking good humor quickly spreads to the listeners at distant points. Keep it up, Harry!

What the Broadcasters are Doing

Public's Taste For Good Music Increases

Is musical taste and appreciation being uplifted and are radio listeners swinging over to the classics?

"Yes!" is the emphatic answer of Percy A. Scholes, widely known music critic of the British Broadcasting company, with headquarters in London, who is on a tour of America.

"For example," he observed, "we read in musical history that Beethoven was born in 1770, but for thousands he was only born in 1900 or 1910 when phonographs or reproducing pianos came into our homes. And for millions more, Beethoven was only born in 1921, 1923 or perhaps as late as 1925 when many of us first acquired radio receiving sets."

Substantiating the expericne of staff members at KOA, General Electric broadcasting station of Denver, he pointed out that marked changes in the public attitude toward music of a higher standard, have taken place within recent months.

"Introduction of broadcasting was the greatest event in the history of the art of music," he continued. "That America should have developed such manifold broadcasting activities is matter for congratulations. Our British experience is sure to be the American experience—give listeners plenty of fine music and they will learn to like it."

As music critic for the British broadcasting organization, Mr. Scholes' duties consist principally of a fortnightly review of the leading musical events of London. This is broadcast from the London station, linked with all other stations of the country and requires approximately fifteen minutes. In addition, critics of books, dramas and films are heard at regular intervals.

WSUI to Have College Scenes on the Air

Making use of radio to strengthen the allegiance of the alumni to their school, and to interest outsiders in their institution, the Alumni Association of Cornell College, Mount Vernon, Iowa, is broadcasting a series of episodes typical of campus life from Station WSUI, Iowa City, Iowa.

A rambling trip through the college—glimpse of the chapel exercises; a few words from a professor's lecture, and a glance at the more frivolous of campus activities are being planned for this program by Prof. and Mrs. Clyde C. Tull. Both faculty and student talent will be utilized.

JENNINGS PIERCE, who signs "JP" (maybe it's Jupiter Pluvius) is one of the announcing staff at KGO, the General Electric's Pacific Coast broadcasting station at Oakland, Calif. Many Eastern fans would give their right ear to hear him, but the Mid-Westerners are well acquainted with his voice.

WCAD Makes Air Relay of WGY Signals

WCAD, "The Voice of the North Country" on 263 meters, operated by students of St. Lawrence University, has solved the problem of program features. WCAD gets them out of the air. By tuning to the 1560 meter wave of the developmental transmitter of the General Electric Company, near Schenectady, they get programs that originate in New York, Washington, Poughkeepsie, Albany and Schenectady.

Canton, the home of St. Lawrence University, is the county seat of St. Lawrence. It lies within sight of the northern foothills of the Adirondacks and only eighteen miles south of St. Lawrence River. Its slogan, "The Voice of the North Country" is a tribute to a prominent St. Lawrence alumnus, Irving Bacheller, who immortalized this region in fiction as "the North Country."

WCAD grew from the need of the inhabitants of Canton and vicinity for radio entertainment and for information on agricultural topics. The larger stations were available to those who had selective sets, but not all who would appreciate broadcast programs could afford the type of set needed to pick up "distance."

Several weeks ago WCAD began experimenting with radio relay from WGY at Schenectady. Efforts were made to rebroadcast the 41.88, 109, 379.5 and 1560 meter waves, and of all these it was found that the 1560 was most reliable and most generally free from fading or static.

Resume Homemakers' Hour

Homemakers' Hour, which experienced quite a vogue over WLS the Sears-Roebuck Agricultural Foundation Station last winter, was resumed November 18, conducted under the direction of Ellen Rose Dickey, Home Advisor of the Foundation, assisted by Martha Meier.

Tell them you read it in Radio Age

Looks Like Jazz Is Due For a Fall

King Jazz is slipping—

Classical music, via loudspeakers and earphones, is favored by the masses—

This trend, said to be completely contrary to all expectations, was revealed by a widely heralded poll which was conducted by KOA, Denver broadcasting station of the General Electric chain. Voting was heavily stimulated by a spectacular musical competition between jazz and the classical school, staged as a program novelty by the Rocky Mountain broadcasting station. Leading artists and representative compositions of both factions were featured.

Broadcast listeners, representing all walks of life and sitting virtually as an international musical jury, voted three to two that jazz is falling behind in popular favor and therefore will never replace the works of conventional composers.

As judges of this studio clash, listeners were invited to vote jazz, classical or for a combination of both types of music. On the face of virtually complete returns from listeners, the classical camp won three of every five votes cast in the race with jazz. Of the total votes cast, more than 50 per cent favored the classical school, the remainder being split between proponents of jazz and those who lean to a combination of both racy tempos and conventional numbers.

Must Broadcast to Hold Your Wave

With the radio public and, in fact, most of the radio industry desirous of weeding out a large number of the 571 broadcasters now licensed, the Department of Commerce is seeing to it that every station licensed is actually operating. Wave lengths not being used regularly may be recalled and issued to prospective stations awaiting air channels.

Some owners are apparently of the opinion that they can renew their broadcasting licenses once a month without keeping on the air. This is far from the fact. A license to operate a broadcasting station is given with the understanding that the owners actually broadcast—at least once a week—and may be recalled if this requirement is not met. Just as with traction companies or public carriers, radio broadcasting, as a public service, must function, or the charters will be revoked in broadcasting, a renewal of the license refused.

Union College Professor Makes Electron Sing

The possibility of creating a new musical instrument by utilizing the photo-electric effect was recently brought out by Dr. Peter I. Wold, professor of physics at Union College.

A photo-electric cell was connected to WGY's broadcast circuit and a disc with many rows of perforations was placed between the cell and a light source. The photo-electric cell is coated on its inside surface with metal potassium which is very sensitive to light. At the center of the cell is a plate of tungsten. A battery of 135 volts has its negative terminal connected to the potassium coating and its positive terminal to the tungsten plate. When light falls on the potassium coating electrons are given off and travel to the tungsten plate, thus constituting a current. By means of a motor the disc with circular rows of holes was rotated between the light and the cell. When the disc was revolved slowly a low pitched note was given off, rising gradually as the speed of the disc increased.

In Prof. Wold's demonstration the disc contained four rows of holes, the outer row with 48 holes, the next row with 36, the third with 30 and the inside row with 24 holes. By covering one row or another he secured different notes.

Even a Scientist Has Sense of Humor

EVEN a scientist with his head in the clouds can show evidences of dry humor as is shown in the title of a recent publication from the Government Printing Office.

"The Vacuum—There's Something in it," by Dr. W. R. Whitney, Director Research Laboratory, General Electric Co., is a brief description of the types of vacua known to science at present. It is known as Publication 2799 from the Smithsonian Report for 1924, and may be secured from the Government Printing Office at Washington.

Prof. R. A. Millikan, winner of the $40,000 Nobel peace prize for the measurement of the electron, has an interesting report on "The Physicist's Conception of an Atom," known as Publication No. 2798 and obtainable from the same source as above.

"The Electrical Structure of Matter" is covered in Publication No. 2797, by Sir Ernest Rutherford, F. R. S.

Good Relay Work

L. G. Windom, owner and operator of amateur radio station 8GZ, of Columbus, Ohio, is making some excellent records in speedy communication between this country and New Zealand. Acting as an intermediate for East Coast stations, Windom has on several occasions taken messages which are relayed to Ivan O'Meara of Gisbourne, New Zealand. Other New Zealand amateurs, to whom these messages are consigned, are able to answer through O'Meara's station, z2AC. Windom has succeeded in getting replies to the originating stations in the course of a twenty-four hour period.

WFLA to be On Air by January 1

The recent edict of Secretary Hoover that there would be no new stations allowed to start, will not in any way affect the station the Mizner Development Corporation is building at Boca Raton, according to a recent statement.

The company expects to have WFLA in full operation by the first of January.

Lamdin Kay, WSB's chief announcer, will open the new station at Boca Raton it is stated.

Little Miss Phyllis Stepler, of Chicago, twelve-year old dramatic artiste and danseuse who has just returned from a three months' tour of the Pacific Coast during which time she appeared before the microphone of most of the western broadcasting stations, where her rare charm and personality was vividly conveyed to the listeners. During the 1921-1922 season Miss Stepler was the official child actress of the Chicago Grand Opera company.

She is the daughter of Mr. and Mrs. R. R. Stepler, 1125 Farwell Ave., Chicago.

If They Can't Sing They Can Talk

If the directors of the Chicago Civic Opera will not permit the broadcast of opera performances, at least the public will have an opportunity to listen to a number of its brightest stars discuss the intriguing background of grand opera from station WHT.

Arrangements made with the opera company call for the appearance of an opera star before the WHT microphones each Monday, Wednesday and Friday at 11:15 A. M. during the current season.

These musical celebrities will tell the radio audience what goes on behind the scenes in a great opera house as well as their own experiences.

Another feature of these special broadcasts will be the establishment of a radio question box on opera subjects, and inquiries will be answered on the microphone as well as by mail.

Tell them you read it in Radio Age

Here's Chance to Brush Up on Spanish

From the icy sweeps of the Arctic circle to Mexico and Central America, radio listeners of all ages and nationalities are to be invited shortly to study Spanish over KOA, Rocky Mountain broadcasting station of the General Electric company at Denver.

Manuals already have been obtained to accommodate a class of 5,000 persons, and it was predicted today that this number would be increased materially before the expiration of the course, an all-winter feature.

Instruction, in charge of Prof. Benicia Batione, head of the Spanish departments at the University of Denver, will be based upon the Galeno natural method, as prepared by Prof. Oscar Galeno, formerly of the University of Chili and more recently the University of California.

KOA's classes will meet via loudspeakers and earphones regularly every Monday evening at 8 o'clock, commencing November 30 and will be in session approximately one hour, it was said.

Cousin John Gets In On Woman's Hour

STATION KYW established a precedent November 16, when a man appeared on the women's hour program in the morning from the Hearst studio. John C. Cutting, known as KYW's "kitchen aid," was the lucky fellow. He gives a ten minute talk each Monday and Friday morning at 11:15 o'clock. Mr. Cutting, who has been broadcasting each week for the last six months from the Edison studio on KYW's program, tells the ladies what to do with a stew, how to hemstitch hamburger, crochet steaks, etc. For more than two years Mr. Cutting was the only man appearing on the woman's program of Station WJZ, the Radio Corporation of America. Mr. Cutting has discontinued his title of "kitchen aid," because of the confusion in the minds of some women that he is to be classed with the pots and pans. His new title will be "Cousin John."

Broadcast Service Area is Mapped Out

One of the interesting features disclosed by Secretary Hoover in his address before the Fourth National Radio Conference at Washington, was the compilation of a service area chart made up by the Bureau of Standards which tends to show the average range of broadcasting stations for crystal receivers.

The radius of the circle served by a 500 watt station under adverse weather conditions, day and night, throughout the year, would about cover an area of ten miles. A 5,000 watt station would cover an area of 30 miles while the 50,000 watt station would not exceed an area of 100 miles. Of course good weather conditions and better receiving sets would increase the individual ranges.

Basis of Radio to be SERVICE *to the* AMERICAN PUBLIC

Secretary Hoover outlines phases of situation and tells how problems were handled at Washington conference.

FOLLOWING is the text of Secretary Hoover's recent radio address, delivered at the conclusion of the Fourth National Radio Conference, and broadcast from Washington. In it the fans may find interesting phases of the broadcast situation touched upon by Secretary Hoover.

WE HAVE just completed the Fourth National Radio Conference in Washington. As chairman of that conference I have been requested to report the results of the conference to the radio listeners, for you are the people most vitally concerned in its conclusions.

"The conference included representatives of all phases of radio, both civilian and governmental.

Interference

"The major subject of this whole three-day conference was interference. In the practical terms of the listener, interference is the different howls, noises, and whistles that come along with your programs. We know from the experience of the last few years in this new art that many of these noises can be done away with, but the doing away with them takes us into a dozen varied difficult fields. It involves questions of legislation by Congress to further control the traffic in the ether; treaties with foreign governments to eliminate interference of code signals from their ships at sea and to coordinate the broadcasting in foreign countries with our own. It involves many complicated and complex questions in the operation of broadcasting stations; cooperation from the electric light and power companies, that electric currents will not go astray. It involves cooperation of the listeners themselves that they shall keep their own receiving sets so they do not occasionally turn them into sending sets and thereby disturb their neighbors.

"All radio listeners know that messages over the radio are carried on a specific wave length. They also know there is only a certain band of these wave lengths from about 200 to 550 meters which can be used for telephone broadcasting. Many of you perhaps do not realize the enormous amount of commercial and other radio work that is carried on outside of the broadcasting band.

Limited Channels

"But in the broadcasting band there are only a certain number of paths over which broadcast messages can travel from the station to the ears of the listener, and only one of these paths can be used by one station at one time, unless they are a long ways apart. Some of these paths are used by our neighbors in Canada for Canadian stations, and ours have come to be an integral part of a single network. To speak in actual figures, for all the broadcasting in the United States there are practically 88 wave lengths which can be used at the present development of the art, and we now have nearly 600 broadcasting stations clamoring for their use.

"The air to-day is over crowded. And even worse, we are faced with the desires and demands of nearly 200 new broadcasters who wish to erect stations and to force their way into the air.

"This was the primary problem with which the conference had to deal. It is the cause of major interference. It faced it boldly. The conference declared the

HERBERT HOOVER

public interest, as represented by service to the listener, should be the basis for every broadcasting privilege.

"I think therefore if I were asked what are the two outstanding results of the conference, I would say they lie first, in the recognition of the listeners' dominant interests in radio, and second, as a correlary, in the determination that the amount of interference must be reduced. That means fewer stations and better ones, or at least no increase in numbers, and it must result in more efficient service and better programs.

Freedom of Air?

"It may be we shall hear a great deal about freedom of the air from some of the people who want to broadcast and who will not be able to show that their desires accord with your interests. But there are two parties to freedom of the air, and to freedom of speech for that matter. There is the speech maker and the listener. Certainly in radio I believe in freedom for the listener. He has much less option upon what he can reject, for the other fellow is occupying his receiving set. The listener's only option is to abandon his right to use his receiver. Freedom cannot mean a license to every person or corporation who wishes to broadcast his name or his wares and thus monopolize the listener's set.

"It was suggested that we might make room for more stations if we widen the broadcasting band. Your instruments would not cover new stations outside the present band, and if this suggestion were adopted it would mean that we should have to invade the band which has been assigned to amateurs, of whom there are thousands. The Conference agreed with me that radio has a useful contribution to the fine development of the American boy. None of us wish to minimize his position in growing American life and therefore the conferences confirmed here his province.

Need Legislation

"While the recommendations of the conference should ultimately result in tremendous betterment to broadcasting, we must not expect radical improvement too soon. The conference was merely an advisory body. It had no final power. It expressed the views of every one interested in radio. Before most of its recommendations can become effective, they must be enacted into law by the Congress of the United States. I hope that this legislation will be given us by Congress at its next session.

"The problems of those radio listeners isolated from the city communities were especially considered in the conference. Methods were recommended by which we can secure an extension and improvement of the service to our farmers.

"The Navy must have wave lengths by which they communicate with their ships at sea. They must have wave lengths by which they communicate with their aeroplanes in the air. The Army must have wave lengths by which they communicate with forces in the field and with their aeroplanes. We must have wave lengths assigned for international telegraph, for we are now in daily radio communication by code with every important country in the world. One of the greatest services radio has performed is communication between ships and shore and between ships at sea. Radio has enormously reduced the loss of human life at sea and we must provide full facilities for that at all times. There has been a very wonderful invention called "the radio compass" which takes the place of the old magnetic compass by

(Turn to Page 58)

Street Railway Company GOES *on the* AIR *with* WEBJ

Employes of New York's Third Avenue Line Construct and Operate 500-Watt Transmitter

THE first powerfully equipped radio broadcasting station to be owned and operated by a street railway company was opened on September 9 in New York and assigned the call WEBJ. It is the station of the Third Avenue Railway System of New York City, operating on 500 watts and on the air with a 273 meter wave length.

An interesting thing about this new station is that it was entirely constructed by members of the company's electrical staff under the supervision of Walter J. Quinn, chief electrical engineer of the railway system. It is located on the roof of the executive offices and trolley barns at 130th Street and Third Avenue, Manhattan.

Radio engineers are agreed this is a fortunate location as the station is not surrounded by tall steel buildings or other structures which might tend to absorb the output. It is expected relatively long distances will be reached, although this was not the purpose of the company in building a station of this size and power. On the contrary, the management intend to present entertaining programs which will thus easily reach Greater New York and other sections in which their street cars operate.

The Antenna System

The construction of the station took two months. The antenna towers are sixty feet above the roof and the antenna itself is of the T type and a counterpoise system is used. There are 145 feet of phosphor bronze wire in the flat top and the length of the lead is 48 feet. The direction of the antenna is approximately north and south.

The operating room is also on the roof and is made of steel and hollow tile. A winding metal staircase leads below to the fourth floor and the studio which is approximately 50 feet from the operating room. The studio is 15x25 feet and the walls, ceiling and floor are soundproof in accord with the most modern practice. The hangings on the walls and ceiling are made of lined druid cloth and the floor is heavily carpeted on felt. It is furnished simply but tastefully. Deeply upholstered mahogany furniture and a special system of electric lighting together with a Duo-Art grand piano help to make this studio one of the most comfortable and efficient in the city.

THE Executive Director of the station is Garrow T. Geer, who is also Secretary of the Third Avenue Railway Company. The Program Director and Chief Announcer is H. A. Bruno; the Assistant Director and Announcer is R. R. Blythe, and the Operator is F. O. Speicer.

In a recent interview Mr. Bruno said: "We intend to present the very best programs obtainable, bearing in mind the radio audience is always interested in hearing something new. In addition to the general public we are also reaching many of our three thousand employees and their families.

"The preliminary programs we have already given have been a carefully balanced admixture of vocal and instrumental music and interesting talks. They were presented in an endeavor to determine just what our particular radio audience wanted and from the letters received we seem to have struck the right note.

"Our transmitter is tuned for a wave length of 273 meters, which is considerably lower than some of the other local stations. Consequently tuning is much sharper."

Has Some Innovations

Station WEBJ has already inaugurated one or two new features. A radio airplane travelogue is presented every Tuesday and Friday between the hours of seven and nine o'clock. The correct time is also announced every fifteen minutes during the programs. There is also a review of the current photoplays at the first run Broadway houses by Blybrun, and on Fridays he will also review the week's new plays.

High spots of the weekly program are to be posted on a bulletin which will be placed in every street-car of the Third Avenue System in Manhattan, Bronx and Westchester. In this way the management hopes to spread the news about the new station to more than a million street car passengers daily.

Mr. Bruno also stated that no paid advertising talks would be broadcast from this station. Later he hoped to include talks of general interest to the public, instructing them how to prevent accidents.

It is interesting to note WEBJ has already drawn some of the best radio artists to its programs. In addition, the names of several new artists also appear in the weekly schedule. Some of the Broadway movie houses will co-operate in arranging the programs. Some of the artists who appear at these theatres go on the air at WEBJ between shows. They are rushed by car to 130th Street and Third Avenue, and returned in time to make their next appearance on the stage.

S. W. Huff, President of the Third Avenue Railway System, is an enthusiastic radio fan and listens in to each program at his country home in Westchester.

OPERATION of this station is being closely watched by officials of street railway companies throughout the country. The fact it is the first and that its programs have been well received, has created considerable comment. The employes of the company are also enthusiastic about their station and are quick to offer comment and suggestion.

Aerial photographs of the station were taken recently, and Mr. Bruno, who is an aviator in his spare time, directed the taking of these air views from an observation seat in an accompanying airplane. They are to be used to show the location of the station and will also be given to artists as souvenirs of their visit to "the car barns."

During the winter months some of the entertainment will be furnished by employees of the company, and so we may soon expect to hear the Motormen's Quartette and the Conductor's Band coming over the ether. Anyway, from the programs WEBJ has been presenting up to this time it seems as if a welcome addition has been made to the already large number of broadcasting stations in Manhattan, and future programs will undoubtedly be watched with interest by the radio audience.

Here We Have

High Lights *at* RADIO CONFERENCE

Service to Radio Public was keynote; cut down number of transmitters; bar advertising

By CARL. H. BUTMAN

WITH the conclusion of the Fourth National Radio Conference at Washington the radio public heaved a sigh of relief at the action taken and the recommendations made to Secretary of Commerce in their behalf and in the interest of the industry in general.

All Phases of Radio

No more broadcasting stations will go on the air until such time as there are suitable channels released; no more stations will be forced to divide time or wave lengths; the broadcasting band was left as it has been between 202 and 545 meters; and efforts to eliminate all forms of interference were advocated—in resolutions adopted, almost unanimously, by a conference representing every phase of the industry.

This conference, cited as the largest and the most satisfactory of all, ended with the adoption of a resolution thanking Secretary Hoover for his interest, and promising him the support and cooperation of all branches of radio and its allied interests. In reply, Secretary Hoover thanked the conferees in turn for their close cooperation, which, he said, showed that this industry was the first to administer to its own needs through practically "self government"—setting an example for other industries.

Certain of the recommendations, when worked out into regulations by the Department and laid down in legislation by Congress, it is believed, are indicative of far smoother sailing for the many radio craft on the etherial seas in the future.

Salient Points

Among the salient points touched upon —some of them felt to be drastic, are the following:

If, in the opinion of the Secretary, there be no public need for additional broadcasting stations on the air, he will not license any more, even if stations are now complete and awaiting a channel. This position may be taken pending action of Congress. It will be considered a hardship by some desirous of entering broadcasting but is held a benefit to listeners.

Throughout the whole conference the key note was "service to the radio public". The manufacture and sale of radiating receivers was opposed by the Conference, it being pointed out that although control of some types of oscillating receivers was possible and that education was needed, the committee on interference was anxious at some early date to prevent the further manufacture and use of this type of listening device. Spark sets, partly used by amateurs were discouraged, as well as those in marine use, in an effort to further clear the air. Arc apparatus, it was held, might be further improved and the use of high-power only when necessary was advocated

Ask Congress to Act

WHILE no attempt to draw up a radio bill was made, a number of salient features were outlined and will be presented to Congress through Chairman White of the House radio sub-committee. These recommendations covered licensing of stations, opposed a monopoly in radio communication, and suggested an appeal over the Secretary of Commerce decisions, although vesting in him the power of administration in radio matters. Five years was proposed as the time of duration of stations' licenses, and established fees ranging from $25. to $2,000. per station, were advocated. Any form of government censorship was objected to, and, as radio broadcasting is not felt a public utility, the question of rates and fees was not considered a matter for legislation.

Secretary Hoover registered himself as opposed to the granting of so much power upon a secretary, or rather an official of the government, without having some form of appeal from his decisions, which suggestion will undoubtedly be incorporated in any legislation.

No Band Changes

Contrary to the general opinion the allocating committee accepted the present broadcast bands without change but urged that special consideration be given the various government departments in the dissemination of their particular news.

In dealing with the complicated problem of advertising by radio the conference expressed itself as unqualifiedly opposed to direct methods of advertising and called upon the members themselves to keep radio as free from this practice in the future as it had in the past. It was decided that the burden of keeping the air free of direct advertising should fall upon the broadcasters rather than upon the government and that no legislation was necessary at this time.

It was recommended that inasmuch as the distinction between class A and B stations is purely artificial that this terminology should be discontinued. The licensing and classification committee also suggested that a permit for the construction of a station should be necessary before the building operation was commenced in order that the owner might be assured of a wave length when the station was complete.

Cut Number of Stations

THE Department of Commerce was urged to decrease the number of stations by refusing to grant any more wave lengths and likewise refusing any more operating permits until such time as the mortality of stations had created a demand. This resolution was passed in different forms by several of the committees and accepted unamimously by the convention.

Wavelength Speculation

A blow was dealt the rebroadcasting of programs without the specific consent of the originating station and a warning sounded against the practice of speculation in wave lengths. It was urged that the Department scrutinize the sale of broadcasting stations in the future to discourage any attempt to speculate in wave lengths which are becoming more and more valuable now that the number of stations is to be limited.

In dealing with the marine radio situation it was recommended users of radio transmitters be encouraged to install transmitters of less broad emission. This was assured by the steamship authorities, who were replacing the spark equipment with apparatus having less broad emission, it was explained.

Amateurs Unchanged

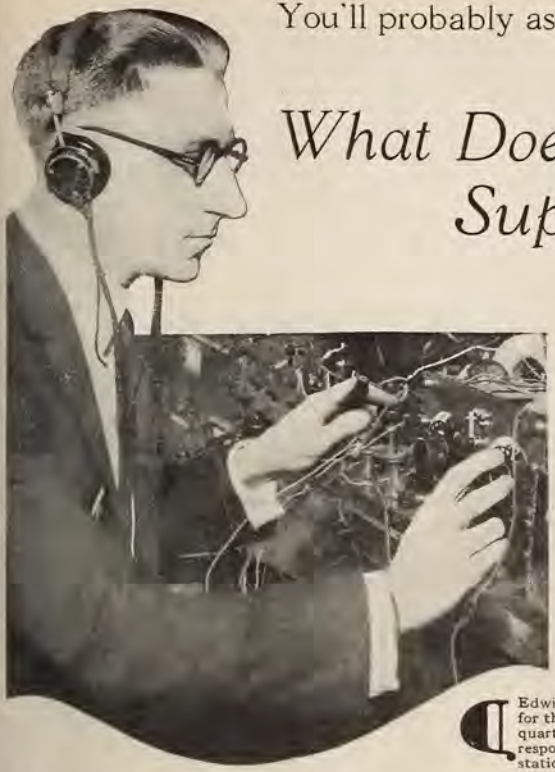
MATTERS dealing with the amateurs were not changed to any extent. They were urged to observe the silent hours but were otherwise left to govern themselves on their present wave assignments.

It was felt the matter of interference from radiating receiving sets should take the form of persuasion rather than coercion and that such interference could better be eliminated by giving publicity to methods of operating these receivers in such a manner that they would not radiate. Publicity of this kind had accomplished much during the past year but this, it was felt must now be more emphatic to accomplish the desired result. This objectionable feature to radio had been greatly reduced in Canada, the committee pointed out, by the circulation of pamphlets to all the receiving set owners. The committee urged the press to publish such articles as would help to educate the public in the use of radiating receivers and the proper manipulation of sets which through changes made in factory-made equipment might be made to radiate. *(Turn to page 60)*

You'll probably ask

What Does a Radio Supervisor Dream About?

Department of Commerce's Chicago representative leads a hectic life compared to the old days



Edwin A. Beane, Radio supervisor for the Ninth Radio District with headquarters in Chicago, who is the man responsible for holding all broadcasting stations in this zone in line.

WHILE there has been a great deal written about the marvelous changes wrought in the radio industry since its inception in 1898 or so, little has been told of the development of the Department of Commerce in general from an organization with governmental powers over wireless on shipping vessels in United States waters to the highly specialized and trained corps of engineers and administrators who today handle from Washington and nine inspection regions in the United States the destinies of the vessels, the amateurs and the broadcasting stations.

Perhaps a few words about the supervisor of radio for the ninth district would not be amiss at this time when the fourth national radio conference at Washington has passed into history with a vast number of suggestions made to Mr. Hoover for the proper regulation of the industry.

Broad Waves

UNDER the 1912 law authorizing the Department of Commerce to administer wireless regulations covering American shipping, there were a number of inspection districts designed to make a complete blanket of the country. At that time the amateurs were working with wave lengths anywhere from zero to infinity and considerable interference with commercial traffic on 600 meters was occasioned. Those were the days of the open spark, the carborundum detector, and the straight coupled antenna which had possibilities for a wonderfully disturbing fracture of the ether.

With the 1912 law in effect regulations were passed to bring about inductive coupling for spark transmitters and the use of a decrement which would prevent undue interference in communication between stations. Vessels' transmitters and those of the amateurs were regularly inspected and licensed. At that time the worries of the radio inspector, as he was then called, were not so bad, for there was a limit to these shipping in the United States and even the amateurs had not reached into the thousands.

Today the Ninth district over which E. A. Beane presides as radio supervisor of the Department of Commerce, comprises the upper Michigan peninsula and the states of Wisconsin, Illinois, Indiana, Kentucky, Kansas, Colorado, Missouri, Iowa, Minnesota North and South Dakota and Nebraska. Headquarters are located in the Federal building at Chicago.

The War Ban

DURING the war by presidential edict all wireless stations, both receiving and sending, save government transmitters were squelched and the Navy department took over control of the air. With the cessation of hostilities the ban on transmission and reception was lifted. Then the radio supervisors' difficulties began to accumulate.

With the experience gained in the war in using telephone transmitters it was not long before Frank Conrad, now assistant chief engineer of the Westinghouse company at Pittsburgh, fostered in part by H. P. Davis, vice-president of the same organization, began broadcasting phonograph music from his amateur experimental transmitter, radio 8XK, then his personal transmitter but now assigned to the Westinghouse experimental station at Pittsburgh. Then modulation was atrocious and the music of the canned variety, but the scheme took a strong grip on American imagination. About the same time the Western Electric conducted some tests with their experimental station at Deal Beach; also Grebe, of Richmond Hill, Long Island, used a transmitter, followed by the General Electric interests.

Fever Grips U. S.

WITH the radio fever thoroughly enmeshing the American public

(Turn to page 62)

WJJD *has an* IDEAL *Arrangement for a* RADIO STUDIO

By Bob Ellsworth

WHEN the first section of the new $40,000,000 Palmer House, Chicago, was formally opened in the latter part of December, what is claimed to be the ideal radio studio arrangement was put into operation.

This hotel, when the second section is completed next year, will be the world's largest hotel with 3,000 guest rooms. It stands on the site of the historic old Palmer House, which has been so prominent in the history of Chicago.

Up In the Air

The eight room radio suite located on the twenty-fourth floor (the highest studio in Chicago) is the first radio studio to be incorporated in the original plans of a large building so all modern arrangements and conveniences were put into the plans and nothing was overlooked to make it ideal in all respects.

It is the Chicago Studio of WJJD, the Moose Station at Mooseheart, Ill., the station named in honor of Secretary of Labor James J. Davis, the Director-General of the Loyal Order of Moose and the Founder of Mooseheart, the City of Childhood, which now has over 1,200 boys and girls from all over the country. It is maintained in cooperation with the Garod Corporation and the Palmer House.

Has Movie Booth

BECAUSE it was included in the original plans, it has been possible to include in the layout of this radio suite all the conveniences for artists and guests and at the same time to include all the latest improvements for better programs.

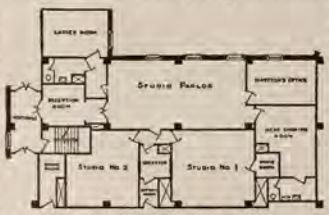
Some of the features of this ideal radio suite are as follows:

It is the first radio studio to have a movie booth. The floor plan reproduced herewith will show it is located adjoining and almost a part of the larger studio (No. 1) with a door entering into that studio. Jack Nelson, the director of WJJD, who with the architects, Holabird and Roche, is responsible for the plans, explains this feature by saying: "There have been many occasions when motion pictures have been taken in studios in which I have been working. Many of the motion picture News Weeklies have requested permission to take movies of celebrities who have come to the studio to broadcast talks and entertainment. If the celebrity is willing, of course, we are, and then enters the problem of getting the proper electric current to operate the powerful Klieg lights. In some cases it has been necessary to run heavy wires from the basement of the hotel up to the studio. This means a lot of inconvenience to the guests of the hotel as well as being a great bother to the people in the studio and the hotel electricians. So in our movie booth we will have direct leads from the main switchboard of the hotel in the basement heavy enough to carry the load for the lights. In the movie booth also, we will store the lights and camera so when we want movies, all we need to do is call in our camera man from Moosehart, who will be available at all times. The movie booth is so located that, except for the lights, a guest will hardly know a reel is being taken because the door will be a divided one enabling the camera man to actually shoot from the booth. It is true, of course, this will only be used occasionally, but when it is, it will be a great convenience to us."

Eight room suite in new Palmer House devoted to activities of Mooseheart broadcasting station.

Twin Studios

ALTHOUGH the studio has eight rooms, it is the equivalent in floor space of twelve guest rooms. No dimensions are given on the plan printed here but the size can be best estimated by telling you the larger studio is twenty-two feet square. The advantage of two studios has been proven at other stations and is obvious. A trio, small orchestra, or even a band can be placed in one studio, and while they are performing on the air, a soloist and his accompanist can be in the other engaging in a brief rehearsal so that the accompanist is accustomed to the piano and the tempo desired by the singer, who can warm up a bit and get into the swing of the song before actually broadcasting. It also saves all the confusion of removing music stands, changing accompanists, arranging music, while the announcer is talking or while he waits for the number to be started. Thus the biggest advantage of two studios is that there are no waits between numbers and a smooth running program on the air results.



The above diagram illustrates the manner in which the studios, parlors and offices are arranged in the new studio of WJJD, located on the twenty-fourth floor of the Palmer House.

So that both studios will be under the control of the operator, an elaborate yet practical signal light system is installed. The volume of singer and accompanist, and the soloist's distance from the microphone are controlled by signs which light up electrically actuated by the pressing of a pushbutton on the control operator's desk in his room between the two studios. These are in addition to the signal lights required by government regulation.

Well Furnished

FOR the comfort of artists and guests, not only is the studio parlor furnished in excellent taste to remind one of a living room, but a rest room for the ladies and a smoking room for men are part of the suite. In fact, nothing has been spared for the comfort of those who are in the radio suite. For instance, over $10,000 alone was spent for proper ventilation of all the rooms.

To avoid the inconvenience of mike stands or pedestals, the microphones are suspended in each studio at the end of an eight foot arm, which can be adjusted to any height or position. Microphone wires from the mike stand to a wall socket in the ordinary studio are a bother and a source of trouble. Unless they are securely anchored, somebody is constantly but unwittingly kicking the cable and pulling the plug from the wall socket. Then, too, the cable lying loosely on the floor is not decorative to say the least, and there is always the bother of moving a microphone stand to get the proper distance for each artist. This can seldom be done without a noise on the air, but with the suspended microphone on the adjustable wrought iron

New Palmer House and Jack Nelson (inset) Director of WJJD

arm in the new WJJD suite, all this is eliminated. The arm itself harmonizes with the furnishings of the studio, it can be moved with no trouble or noise, and the microphone cord is hidden at all times.

Loud speakers have been placed in the studio parlor, each of the rest rooms and in the director's office so the program on the air can be followed from any place in the suite.

Performers Like It

IT was mentioned above the studio parlor has been furnished in the style and comfort of a home parlor or living room. Roomy chairs, divans, sofas and

(Turn to page 59)

ANNOUNCEMENT

The 1926 Radio Age Annual Will Be Ready Early in January

TO MOST RADIO FANS the Radio Age Annual needs no introduction. Thousands of fans from all over the world have been waiting for this announcement of our 1926 ANNUAL, and we have a great treat in store for them.

Many pages of blueprints of the most successful hook-ups of the year, along with complete descriptions of these sets. Technical articles on every phase of radio written by unbiased radio experts. Photographs and illustrations by the score. A complete list of broadcasting stations with a log you can easily fill. These are just a few of the things that will make the RADIO AGE ANNUAL for 1926 the most talked of and widely read book about radio.

The price of this book will be $1.00. If after receiving your copy you are not completely satisfied, return the Annual and we will refund your dollar. For the past two years our Annuals have been sold on a money-back-if-not-satisfied guarantee. Out of the many thousands of copies sold only one came back! (You can't please everyone.)

The number of copies available is limited. Use the coupon below and be sure of getting the 1926 RADIO AGE ANNUAL as soon as it is off the press!

To those fans who have never before been the proud owners of a RADIO AGE ANNUAL we are making a special offer. For only $2.50 we will send the 1926 ANNUAL, and include also a copy of the 1925 ANNUAL and a copy of the 1924 ANNUAL. A complete library of three years activity in set building and technical writing. Don't miss this opportunity to add to your knowledge of radio. Use the Coupon below.

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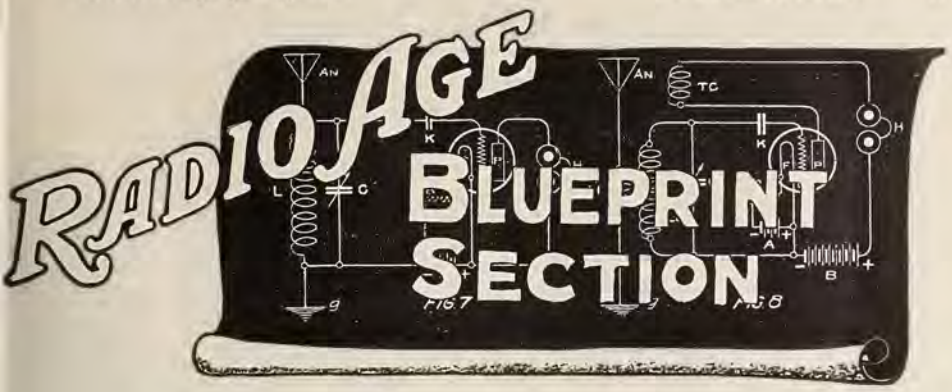

How To MAKE A Simple

Power Supply Device

By JOHN B. RATHBUN

Plentiful B Battery Power in Your Home Electric Light Socket

USING the electric light socket as a source of high voltage plate current has always proved a very attractive proposition, particularly with radio receiving sets employing four or more tubes at loud speaker volume. Properly designed, such devices supply an unfailing current at a constant potential indefinitely without attention or replacement regardless of the number of hours in operation or the condition of the receiving set. It is simply a matter of turning on the switch when the receiver is started and turning it off when through with the set.

Loud speaker operation makes a heavy demand for current on the ordinary type of "B" batteries with the accompaniment of trouble due to exhausted batteries such as reduced volume and battery noises, to say nothing of the trouble and expense caused by replacements of the dry cell type or the recharging of the storage type "B." Further, the voltage of a battery drops off when there is a heavy demand for current so that there is always a certain amount of distortion taking place on crescendos when music is being received or a blurring of speech when the speaker's voice exceeds a certain pitch. These troubles increase rapidly when the batteries approach exhaustion because of the rapidly increasing internal resistance of the cells. For a five tube set, the source of plate current should be capable of supplying at least 25 milliamperes without drop of voltage or 50 milliamperes with the eight and ten tube receivers.

True, there are certain "B" eliminators new on the market which will not maintain a constant voltage when a current in excess of 20 milliamperes is drawn, and which produce a strong 60 cycle hum, but this is a question of incorrect design and by no means proves that the principle is at fault. It is the old, old proposition of placing a device on the market before it is properly perfected. On the other hand, there are a number of well designed units that maintain a constant voltage at above 60 milliamperes and in which a perfected filter system entirely eliminates all hum even on the headset. With the latter devices, the improvement in reception is remarkable. The set has a much greater "kick" owing to the constant high voltage on the plate, and there are no rasping crackles, diminishing volume or irregularities in reproduction due to the resistance of dried-up cells.

Principles of the Eliminator

In general, all "B" battery eliminators are divided broadly into the alternating current (A.C.) or the direct current (D.C.) type according to the nature of the lighting current to which they are to be connected. For use on a D. C. current supply, only a filtering system is necessary by which current variations are smoothed out together with the noises they cause. When used on an A.C. current circuit the eliminator must be supplied with a transformer and rectifier by which the alternating current is converted into a unidirectional current. After rectification, the usual filter system is connected to smooth out the current ripples and fluctuations in voltage. The employment of a rectifier marks the difference between eliminators used for A. C. and D. C. currents.

There is always a rapid and regular variation in D. C. current due to the commutator used on the generator, and while this is a very small percentage of the total voltage generated, yet it is sufficient to cause a disagreeable humming noise known as "commutator hum" unless it is properly filtered out by the eliminator. If it were not for this minute vibration, the D.C. voltage could be used directly on the plates of the tube without further treatment just as the set is connected to a "B" battery. As a matter of fact it is usually more difficult to eliminate the commutator hum than to filter out a rectified alternating current wave.

Rectification of the alternating current supply is accomplished by electron tubes or by an electrolytic rectifier. In either case, these devices permit the current to flow through the receiver circuit in only one direction by entirely stopping or reversing the alternate waves, and after the waves are made unidirectional a filter system of inductances and capacities smooths out the gaps by providing sufficient electrical inertia to maintain a flow of direct current to the set at the time when the A.C. waves are zero. In many respects, the filter is like the flywheel of an engine for in both cases a uniform flow of power is maintained when the impelling forces are above, below or are at zero in regard to the output. The engine flywheel carries the load at the time when the piston is on dead center. The filter system continues to supply current when the supply momentarily ceases.

A. C. Rectification

An alternating current, such as taken from an alternating current lighting system, is a current which periodically reverses its direction of flow, first in one

(Turn to Page 39)

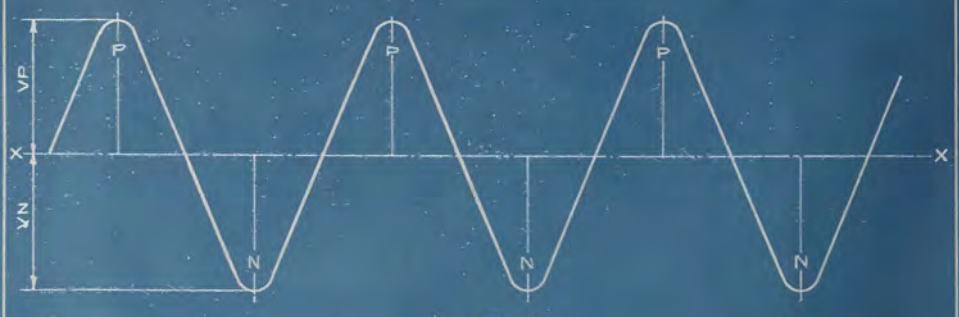

FIG. 1

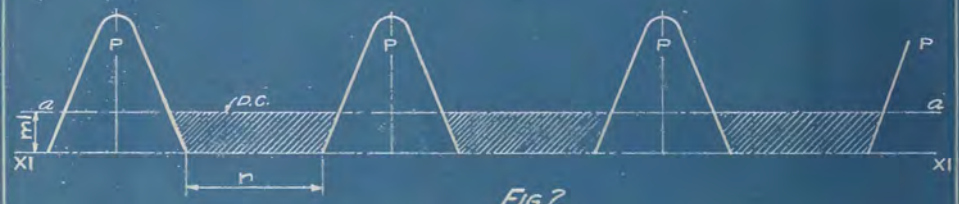

FIG. 2

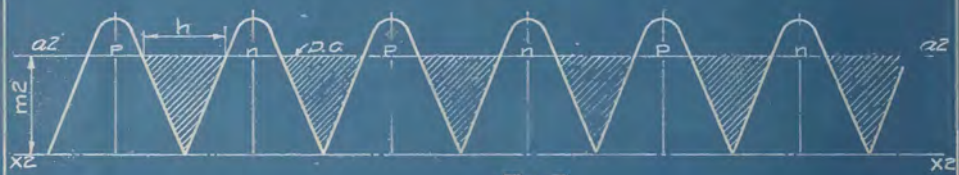

FIG. 3

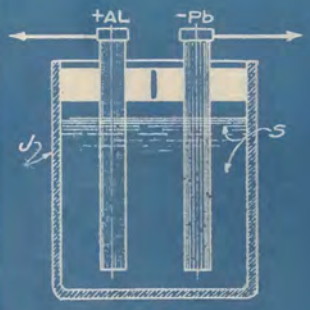

FIG. 4

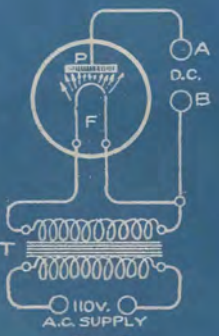

FIG. 5

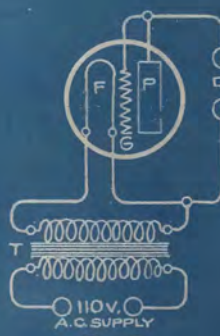

FIG. 6

J.B. RATHBUN
BE-200E

direction and then in the other without intermission. In Fig. 1 is a graphical representation of an alternating current showing the violent periodic changes that take place. All of the loops (P) above the reference line (X-X) are considered "positive" in direction, while the loops (N) below the line are "negative" and flow oppositely to the loops (P). The height (VP) above the reference line (X-X) indicates the maximum voltage or "amplitude" of the positive waves and (VN) is the voltage of the negative system, both sets of waves being equal, but occurring at different times. As the positive and negative waves are equal and opposite it is evident that their sum is zero.

In "single wave" rectification all waves of a given polarity or direction are entirely suppressed leaving only half the waves effective. Thus, in Fig. 2 the negative waves (N) are stopped with only the positive waves (P) remaining. These are spaced widely apart by the full width (n) of the missing negative waves so that the impulses are intermittent and jerky. The average voltage is now only equal to the height (n) which is far below the value of the A.C. current, with the line (a-a) indicating the average D.C. output. The shaded portions between the waves (P) indicate the energy that must be supplied by the electrical inertia of the filter to maintain the voltage over the spaces (n) at which the supply voltage is zero. If it were not for the flywheel effect of the filter, the line (a-a) would also drop to zero at every point (n) and then cause a periodic humming in the receiver.

Full-wave or "Two wave" rectification is shown in Fig. 3. In this case the positive waves (P) are allowed to pass freely through the rectifier as before, but instead of suppresing the negative waves they are turned up by an independent rectifier and made positive waves. The converted negative waves (n-n-n) are then inserted between the positive waves so that we now have twice the energy that we had in the half-wave system, and further, the application of the energy is more uniform with correspondingly less demand on the filter system. With an equal amount of filter inertia, indicated by the shaded areas, the mean or average D.C. voltage is increased to (m2) which means a greater effect than with the half-wave system, and the rectified voltage (a2-a2) is more nearly equal to the input voltage. For maximum results, full-wave rectification must be employed.

Classes of Rectifiers

Probably the simplest form of rectifier is the electrolytic cell rectifier shown in Fig. 4. This consists of a lead rod or negative electrode (Pb) and a positive electrode (A1) consisting of an aluminum rod. Both rods are immersed in a solution of borax or similar solution which will maintain a film of oxide on the surface of the aluminum rod. When the aluminum plate is formed, current will pass through the cell in only one direction as indicated. The single cell performs half-way rectification but when two cells, or cells in multiples of two are connected up, full wave rectification can be had. This is identical with the rectifier used in charging storage "B" batteries.

An electron tube, a common example of which is the Tungar bulb, is very commonly used as a rectifier. In this device a heated filament throws off electrons within an exhausted vessel and current is conveyed only in one direction in the electron stream. In Fig. 5 is a two element rectifying tube similar to a Tungar bulb. The filament (F) is heated to the point where electrons are freely emitted and the electrons form a path from the filament to the plate (P). A transformer (T) connected to the 110 volt A.C. lighting circuit supplies current for heating the filament and the two connections (A) and (B) are the terminals from which the half-wave rectified current is drawn.

An ordinary three element radio receiving tube, such as a 201A, can also be used as a rectifier tube by connecting it according to the diagram in Fig. 6. The grid and plate are connected together to form a single electrode while the remaining connection is brought out from the filament transformer as before. Such an arrangement also functions as a half-wave rectifier, but its output is limited to a few milliamperes and hence is not desirable for use as a rectifying medium in a "B" eliminator. For proper operation, a special rectifying tube should be used from which 50 to 60 milliamperes can be drawn without over-taxing the tube. Such tubes are now on the market but they have a filament which is subject to deterioration. Further, the tube types shown are of the half-wave type and for full rectification two tubes must be connected together. By the use of two independent filaments in one bulb full rectification can be obtained but there is only one tube of this type now on the market and that tube is difficult to obtain.

The Raytheon tube, a full-wave rectifier, is one of the most interesting and efficient rectifying devices yet devised, and while it has the external appearance of an ordinary tube, yet it has no filament and takes no heating current in the ordinary sense of the word. Owing to the absence of a filament, the life of the Raytheon is indefinite, thousands of hours of operation being recorded during which there was no appreciable drop in the output. The action is rather peculiar and rather difficult to describe within this limited space so that our readers must be content for the time being with a description of its practical workings and application to the "B" eliminator.

A general view of the Raytheon assembly is shown by Fig. 7. The elements are enclosed in the usual type of pear shaped glass tube which contains a highly exhausted atmosphere of helium gas, and at the bottom is the usual four prong socket which fits into a standard tube socket. On closer examination we see the elements are very different from those in a filament heated tube. There are two very small anode wires (e1) and (e2) which are imbedded in the lava block (L) so only the ends are exposed, and above the anodes is the cap shaped cathode (C) which forms the abutting element. We therefore have the three elements necessary for full-wave rectification, the two anodes and the cathode, and these are connected to the prongs in the base of the tube.

The discharge takes place between the anodes and the cathodes by a process of ionization of the residual helium gas, and

(Turn to Page 42)

Figure 1. The completed power supply device, looking from the rear.

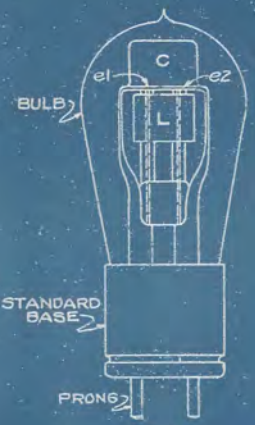

FIG. 7

FIG. 8

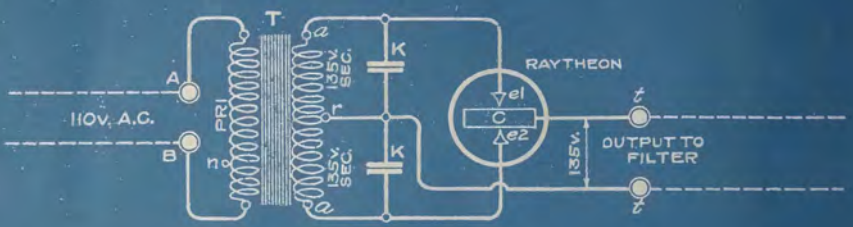

FIG. 9
RECTIFIER CIRCUIT

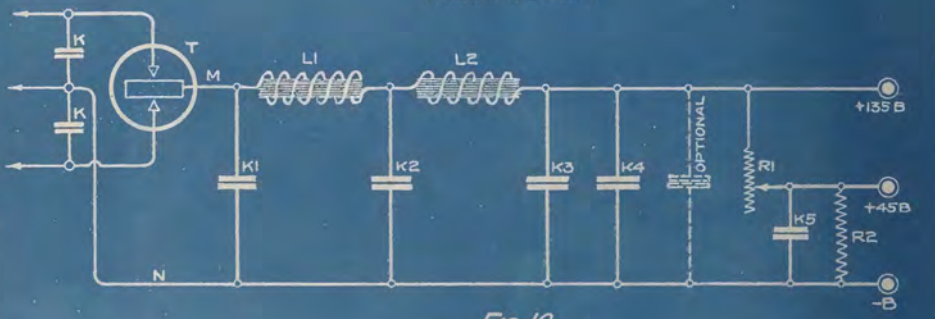

FIG. 10
FILTER CIRCUIT

J.B. RATHBUN
BE-200E

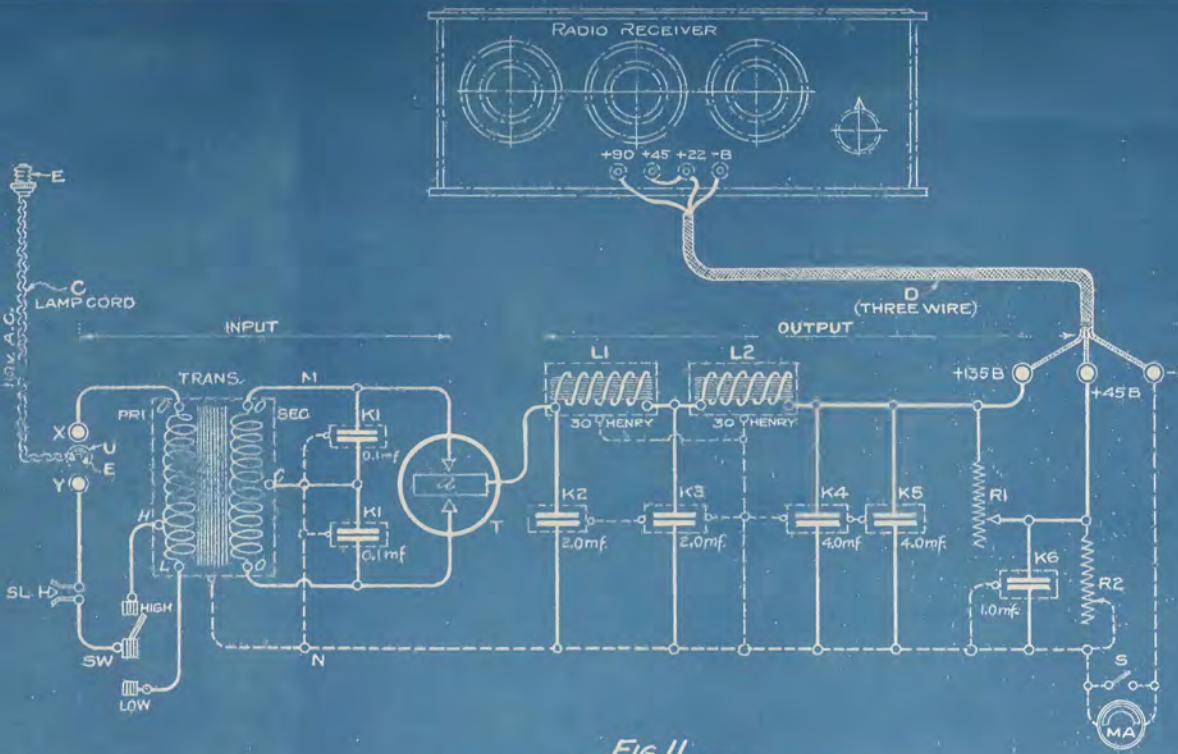

FIG. 11

CIRCUIT DIAGRAM OF "B" ELIMINATOR

THIS SCHEMATIC DIAGRAM IS LETTERED TO CORRESPOND TO THE FOLLOWING PICTURE LAYOUT AND WIRING DIAGRAM FOR WHICH FULL SPECIFICATIONS ARE GIVEN IN THE TEXT. AT "T" IS THE RAYTHEON TUBE USED FOR RECTIFYING.

J.B. RATHBUN
BE-200-E

because of the extremely small end area of the wires (e1) and (e2) exposed to the gas, there is very little "back current" or reverse flow in the circuit. Flow reversal takes place to some extent at certain portions of the cycle with all filament and electrolytic rectifiers, this action making filtration a difficult problem, but with the Raytheon this trouble is reduced to a minimum with practically no reversal in the output.

When placed in a standard tube socket, as in Fig. 8, the grid post (G) and the plate post (P) are connected together to form the terminal (1) while the filament posts are the two anode posts running from the filament (F) posts of the socket. This completes the connections for full-wave rectification.

A schematic diagram, Fig. 9, shows the connections to the tube up to the filter. Alternating house current at 110 volts is supplied to the terminals (A) and (B) of the transformer primary (T), and by the required turn ratio twice the required plate voltage is established at the ends of the secondary coil (a-a). The ends of the transformer then lead to the tube anodes (e1) and (e2) so alternate half-waves are impressed on the cathode (C). By the use of two anodes each half-wave is rectified and passed on to line (t) giving a total or full wave rectification at the output.

By a mid-tap (r) in the transformer secondary and by the two fixed balancing-condensers (K), half the transformer voltage, or 135 volts in this case is established in the output line (u) so the rectified output has a potential of 135 volts across (t-u). The primary tap (n) permits of a still higher voltage when desired by increasing the ratio between the turns in the primary and secondary coils. This is a special transformer now easily available on the open market and no doubt will soon be made by a number of firms as well as by the pioneers—the Acme Radio Apparatus Company.

Intermediate voltage as may be required for the detector tube and radio frequency amplifying tubes are attained by a resistance balance system connected to the filter output and has no direct connection with the rectifier.

Filtering systems consist of iron core inductances and fixed capacities connected into circuit with the coils. It is the inductances or "chokes" that provide the necessary electrical inertia, retarding the flow of current until the voltage or potential is established. The condensers have the reverse effect and are for the purpose of modifying the action of the chokes, the condensers being connected across the output of the tube while the inductances are in series with the circuit. This materially smooths out the rectified current, and while not new in transmitting circuits has only recently been applied to broacast receivers.

A detail of the filter circuit is shown by Fig. 10, the outline of the Raytheon tube being shown at (T) on the left so the relation of the tube to the filter circuit can be more easily followed. The anode of the tube is the (+B) source of D.C. current so the plate of the tube is connected directly to the choke coils (L1) and (L2) and thence straight through to the +135B output post which goes to the audio amplifying circuit of the receiving set. Very large fixed condensers are connected between the chokes and the (−B) line as shown so that a condenser comes before and after each choke. When the current is being dammed back at the left of choke (L1), for example, a portion of this stored energy or reserve energy is dissipated by allowing it to escape to the opposite side of the line through the condenser (K1). In the same way, current that is held back at the left of choke (L2) escapes (partly) to the oposite side of the line.

The A. C. current going from the positive side of the line through the condensers is opposite in phase to the current in the negative lead, hence these oscillations oppose each other and damp out the vibrations that tend to cause humming. The condensers are very much larger than those used in radio receivers for the condensers (K1-K2) have a capacity of 2.0 microfarads and condensers (K3-K4) are the 4.0 microfarad size. The chokes (L2) consist of thousands of turns of very fine insulated wire wound around a laminated iron core, much like the core of the common audio transformer. The total inductance of the windings, however, is considerably greater than that of either the transformer primary or secondary, and should be rated at 30 henries. The iron core chokes have only two binding posts instead of four and in this way may be easily distinguished.

This arrangement gives us a potential of 135 volts across the main lines (M) and (N) with the proper transformer ratio, a voltage suitable only for the audio amplifying stages. A considerably lower voltage is desirable for both the detector tube and the radio frequency stages (45 volts), so we must be able to draw both 135 and 45 volts from our "B" eliminator for the usual type of radio frequency receiver.

This is accomplished by a sort of special potentiometer arrangement connected across the main lines (M) and (N). One element is a high fixed resistance (R2) and a high variable resistance (R1) by which the value of the detector voltage can be varied to suit conditions. Thus the (+45) post corresponds to the sliding arm of a potentiometer, the resistance of which is connected across the main line. Instead of sliding this connection back and forth to obtain varying voltages, the resistance (R1) is varied. A smaller condenser (0.5 to 1.0 microfarad) is a bypass to the fixed resistance (R2). This completes the elements of the rectifier and filter system and we will now pass on to a description of the complete practicable instrument.

Conventional Circuit Diagram

Fig. 11 is the complete conventional diagram of the "B" eliminator circuit which is actually an assembly of the elements already described together with a few additional controls which are of assistance in handling the device. The completed circuit is suitable for connecting to a 110 volt circuit and delivers direct current up to 180 volts for the audio amplifier with a tap for the lower detector and radio frequency amplifier tubes. It should be particularly noted that this "B" eliminator in its present state is suitable only for use on 110 volt alternating current circuits, and that it will be injured if connected to a direct current main. Special provision must be made for direct currents which are not given here as alternating current is the prevailing system for the distribution of light and power

(Turn to page 44)

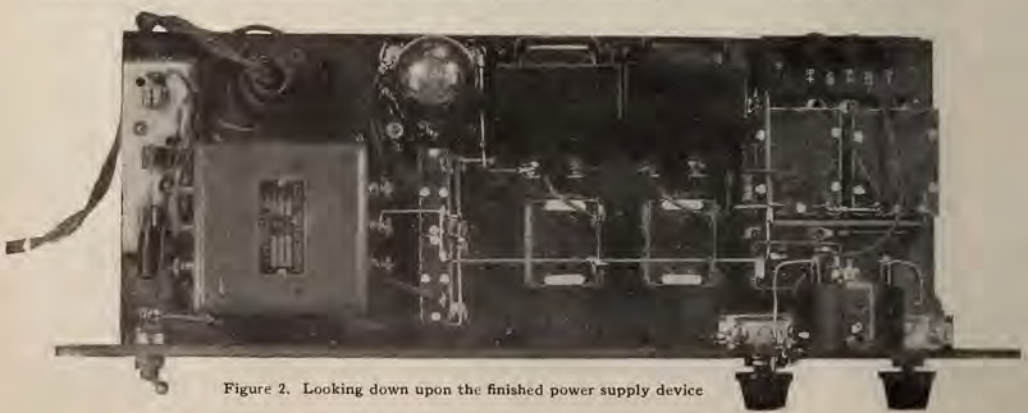

Figure 2. Looking down upon the finished power supply device

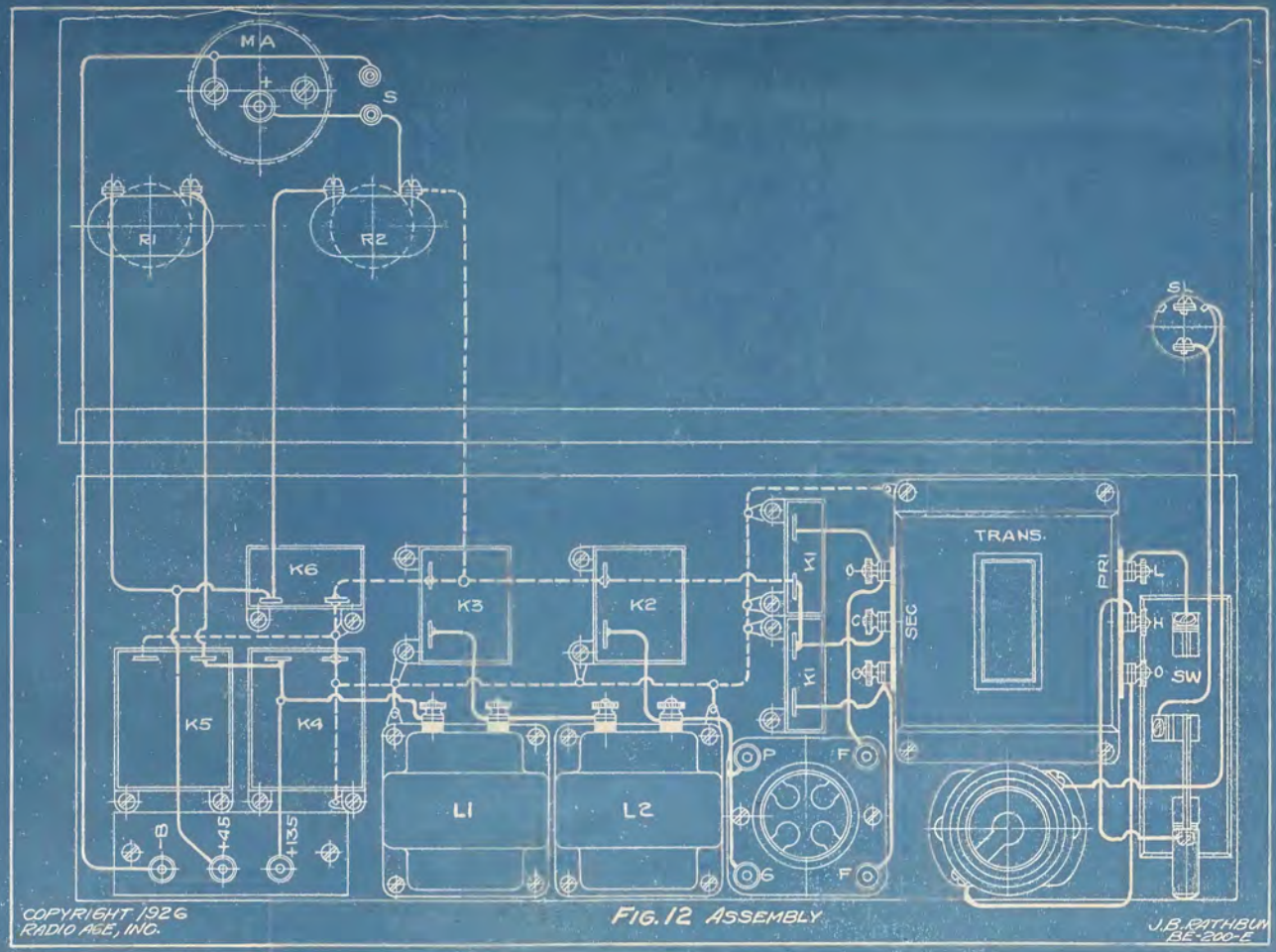

FIG. 12 ASSEMBLY

J.B. RATHBUN
BE-200-E

in the vast majority of installations. At the left of the diagram we have the special Acme Type B-4 transformer suited for this sort of service, and this transformer was used in the experimental eliminator with excellent results. It consists of the primary coil (PRI) and the secondary (SEC) wound on the same iron core, and the lettering of the transformer terminals is the same as that marked on the Acme transformer. Alternating current at 110 volts enters the circuit at the terminals (X) and (Y), this being first connected to the single pole double throw switch (SW) by which the output voltage can be varied. Throwing the switch to the upper contact connects the current to the primary tap and gives the "high" voltage. Throwing the switch over to the lower contact includes all of the primary turns and thereby reduces the voltage.

From the secondary posts (O-C-O), the secondary coil is connected to the Raytheon tube (T) already described, and it will be seen from the extension arrow above this part of the circuit that this is known as the "input." A dotted line around the parts of the transformer indicates the outer shell or casing which must be invariably "grounded" by connecting it to the (–B) line marked (N). By this we do not mean that the shell is actually to be connected to earth, but that it must be connected to the (–B) line so that it will not transmit humming to the output through capacity transference. If the casings of the chokes, transformers and filter connections are not connected to (–B) there will certainly be a hum no matter what other provisions we may make in the circuit.

The Tobe Deutschmann condensers (K1) connected across the tube have a capacity of 0.1 m. f. and as shown, their casings are also thoroughly grounded to (–B). A tap taken to the mid-point (C) of the transformer secondary forms the line (N) or the (–B). Anode connection (a) now goes to the first iron core choke coil (L1), and is bypassed by the 2.0 m. f. fixed condenser (K2). Choke (L2) is in series with the first choke (L2) and is bypassed by the 2.0 m. f. fixed condenser (K3). The casings of both condensers (K2) and (K3) are grounded to (–B). The capacity of the chokes is 30 henries.

After the last Thordarson choke coil comes the final output fixed condensers 4.0 m. f. The casings of these condensers are also grounded to (–B). All of the fixed condensers shown must withstand a considerable voltage without breaking (K4) and (K5), each with a capacity of down, much higher than ordinarily met with in a receiving set bypass and should be tested to at least 1,000 volts before they are accepted. The Tobe Deutschmann condensers used in the experimental set are well adapted for this purpose.

At (R1) is the variable resistance used for the control of the detector tube voltage, the movable member of which is connected to the (+45) post. The variable resistance actually used at this point was a "Bradleyohm" which gave a very smooth and continuous variation of from 25,000 to 250,000 ohms and excellent control of the plate voltage. This is known as the No. 25 Bradleyohm. At (R2) we can use a 10,000 ohm fixed resistance such as the Bradleyunit, but for our purpose it was found the use of a No. 10 Variable Bradleyohm was a better lead as it permitted advantageous adjustment. Once adjusted, it requires little further attention.

At (K6) is a 1.0 m. f. Tobe bypass condenser connected across the resistance (R2), for the purpose of cutting down the last ripples on the detector tap. It is of particular importance that the current is steady in the detector circuit and the combination of (K6) and (R2) assures maximum damping at this point.

A 0-100 scale milliammeter (MA) is very convenient but is not absolutely essential. The milliameter used in the experimental set was a Jewell instrument which proved its value on many occasions. and were we to build another "B" eliminator it is certain that a similar meter would be installed. It is an index to the condition of the tubes, the volume, modulation, and many other similar factors. A small panel controlled switch (S) is for the purpose of short-circuiting the meter when not in use. It is not desirable to leave it in circuit continuously.

In general, that portion of the circuit marked "input" should be kept well away from the "output" portion to avoid inductive disturbances and possible humming through capacity coupling. While the casings are all grounded together, yet is it always safest to separate the input and output sections.

A "picture" diagram of the completed "B" elminator is shown by Fig. 12. Here all of the parts are shown as they actually appear and this is of great assistance to the novice in wiring and laying out the parts. The upper view is a rear view of the panel which is connected to the lower plan view by the wiring so that the connection between the baseboard parts and panel parts can be clearly followed. The parts bear the same reference letter in both Figs. 11 and 12 so it will be an easy matter to trace back and forth between the two diagrams.

A standard 7"x18"x$\frac{3}{16}$" Dilecto panel forms a support for the instruments and resistances. This is fastened in the usual way to a wood baseboard measuring 7"x17$\frac{1}{2}$x$\frac{1}{2}$", although the board may be deeper if the cabinet will permit. In these dimensions the eliminator can be installed very nicely without undue crowding and yet with a compactness not often noted in apparatus of this sort. Before starting out on a description of the arrangement, it will be well to list the materials used in the test set and which are highly recommended. We warn the beginner against the use of audio frequency transformers in the place of the iron core chokes, for this is often recommended by those who have not had actual experience in the construction.

Connection with the electric light current is made through the receptacle (U) into which a plug on the end of the flexible lamp cord is screwed. When the eliminator is to be moved, the plug can be unscrewed without fussing with any high tension wires. In the upper right hand corner of the plan view will be seen the terminal connection strip (F) with its three binding posts used for the connection between the eliminator and the receiving set. The three wire cable is used at this point and three separate wires must not be used in place of it. Twisting the three wires in the cable very materially cuts down the remaining ripples because of the close proximity of the wires and this effect would not be obtained with wires widely spaced.

It is not a good idea to place the eliminator very close to the receiver. It should be at least two feet away or in the lower battery compartment of the console if a console is used. There is practically

(Turn to page 48)

Figure 3. Front panel view of the B battery eliminator

Pick-ups and Hook-ups by our Readers

Conducted by Fred Hill

CONTRIBUTORS		
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Robert S. Smith		Bangor, Pa.
Geo. H. Holtham	1716 Nicollet Ave.	Minneapolis, Minn.
G. L. Luers	122 East Capital St.	Washington, D. C.
DIAL TWISTERS		
Donald C. Smith	7 Erskine St.	Dartmouth, N. S., Canada
Joseph O'Brien	2625 Harway Ave.	Brooklyn, N. Y.
Felix Fredericksen		Delmar, Iowa
Harold Young	400 North Harold St.	Ft. William, Ont., Can.
Owen E. McGillicudy	4 Algonquin Ave.	Toronto, Canada
Jack T. Parr	861 Post St.	San Francisco, Calif.
W. W. McCune	728 Porter St.	Glendale, Calif.

ROBERT S. Smith, of Bangor, Pa., favors us with the following sketch as the result of divers experiences in eliminating interference, which might be of interest to many of the radio fans who have labored along similar lines:—

"Static eliminators are the bunk!

"When high frequency waves are slipping from the aerial to the set to the loud speaker and upon being transformed into sound waves, manifest themselves by a continuous squak-squak of a leaky insulator or a vibrator charger or an electric refrigerator in company with some perfectly good music—

"Well, don't buy a static eliminator. Both the music and noise are high frequency waves and, being of the same nature, one cannot be obliterated without destroying the other. Nine times out of ten the noise (or more frequently, noises) which we hear are high frequency electric waves and cannot be gotten rid of by use of chokes and filter coils in the radio set. The tenth time, you migth have an induced AC low cycle hum you can eliminate and still hold your music.

"Not so many years ago, all automobile manufacturers were vying with each other trying to eliminate the bumps in the road by fixing the springs on their machines. But even today, with balloon tires and practically perfect springs, the real, honest-to-goodness country road with lots of ruts and bumps defy any man-made machine to run over it without feeling the bumps. Finally the people came to their senses and, instead of trying to conquer the bumps in the road by working on the machine, they fixed the road.

"Why not come to our senses and really get to work on the source of the trouble? We know that most of our noise is due to man made machinery. It isn't in the radio set. Why not start a general house-cleaning campaign by getting some dope on filters and chokes and putting them where they do good—*not* in the radio set, but across the armatures of the vibrator chargers, motors, generators, etc. Get the trouble at its source. We could eliminate at least ninety-five per cent of our noises by

"1. Putting all electric wires underground.

"2. Having generators and motors in our local power plant properly efficient and by using a couple of filters and chokes.

"3. Putting condensers and chokes across the armatures of noisy vibrator chargers, electric refrigerators and other sparking electric equipment.

"The first of these is an expensive proposition but it is an end to work for. It would really save thousands and thousands of dollars for the electric company both in repair and leakage. Wherever there is a spark in a power line there is a loss and that loss does two things: It costs the electric company money and causes us great annoyance.

"Let's work for better roads for radio."

A contribution on the subject of variable condensers is received, this time from G. L. Luers, 122 East Capitol St., Washington, D. C. In the sketch sent in by Mr. Luers is shown the rotor plates of a condenser, especially the vernier plate, with holes bored in it so as to give it somewhat of the s.l.f. tendency. The holes should be bored in the rotor near the point where the rotor meshes with the stator, which would be the point where the lower bands are found. The holes may be bored on one or more plates depending upon the amount of capacity reduction that is desired. Do not drill both rotor and stator. Either drill the rotor or the stator. The sketch sent in by Mr. Luers shows the manner of doing the work. While this department is always in favor of showing as many kinks as possible yet it believes for those who can afford it the best practice is to get a good s.l.f condenser and use a vernier dial which combination will repay the investment.

Some of the little things in radio sets are being improved constantly, and no one better realizes this fact than the chap who is forever building sets and tearing them apart, as many of the readers of this column are in the habit of doing.

Take, for instance, the matter of resistors for the grid circuits. We all remember when the pencil mark was the grid leak and the mark had to be rubbed off and reapplied several times before the proper value was reached. Then came carbon paper-like substances on which a coating of graphite had been applied. The unions at the ends of the resistance material generally loosened so we had a noisy grid leak and immediately blamed it on static or the house cat. Then small coated rods began appearing, each enclosed in a glass tube. Each six months or year has seen advances in design in which the manufacturer tries his level best to put out a quality product that will stand the gaff of radio usage. Today we have a fairly uniform set of resistances for our grid condensers.

The same thing applies in the resistors for filament control. First the rheostat that used to burn up when handling the ampere of current on the old type tubes. Later a better model. Then the quarter ampere tube; still better rheostats. Then the ballast resistance to eliminate the rheostat control, and now we have the tube made with sufficient resistance in its filament to float on the six volt "A" battery line without external resistances. Probably the next step will be the 110 volt tube in which the heating element will be separated from the electron emitting surface, and after that—we can't even guess.

We note with amusement the Weagant variant, born somewhere around 1916-1917, is again being discovered and developed by some of our latter day radio experts and doubtless Mr. Weagant feels quite elated over the recent original research; if we believed all we read King Tut is running for President.

Between power line troubles and lake boat interference Harold Young, 400 North Harold St., Ft. William, Ont., Canada, is making the best of it and sends in a good list of DX. The chap who sticks to it despite the interference is certainly most deserving of the button.

Frederick Fredericksen, Delmar, Iowa, favors us with a sketch of a Danish 5 tube tuned r.f. receiver which lack of space at this time prevens our reproducing. The set utilizes the well known honeycomb coils for the r.f.t.'s. To stop oscillations the grid returns of the r.f.t.'s are connected to the center arm of a potentiometer, one of the many methods of preventing oscillations.

George H. Holtham, 1716 Nicollet Ave., Minneapolis, Minn., sends in his conception of a three tube 199 set making use of a crystal detector. The wiring is made up of No. 18 bell wire which probably helps considerable compared to some of the much smaller sizes. Mr. Holtham says he is not bothered by the locals in his home town.

Joseph O'Brien, 2626 Harway Ave., Ave., Brooklyn, N. Y. must spend his young life bent over a radio set judging from the list of stations he recently forwarded this magazine. We don't see how the world can sit up all night with a set and still work the next day. How do you do it?

Youth is no protection against the bite of the radio bug. Here we have Donald C. Smith, 14 year old radio fan, of 7 Erskine St., Dartmouth, N. S., Canada, who has been at it for two years, progressing from the crystal to the tube set and hanging up a good list of stations on the single circuit single tuber he is now using.

George Wistow, 95 Leslie St., Toronto, Ont., Canada, who has already been initiated into the DT fraternity, writes us asking that we extend the honor to Mr. McGillicudy, 4 Algonquin, Ave., Toronto, Canada, who conducts a listening post on radio for the Toronto Daily Star. It seems that Mr. Wistow recently had Mr. McGillicudy over to the Wistow homestead and as a result the Star reporter had a column and a half of good dope heard on Mr. Wistow's set.

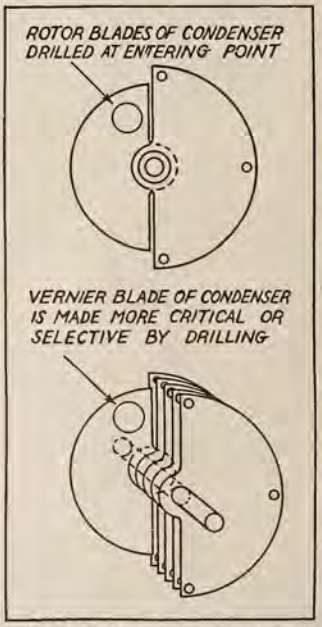
Despite KPO about ten blocks away from him and using 1,000 watts, Jack T. Parr, 861 Post St., San Francisco, Calif., manages to break down the barrier and get the Eastern stations uniformly, although it entails staying up late at night to do it.

A. P. Secor, 228 Laurel Ave., Bridgeport, Conn., uses a three megohm grid leak in series with the grid terminal of the third audio transformer to improve quality and allow the use of three stages of audio amplification without distortion and howling. The last stage is biased as usual either through the negative return or a separate C battery. Lack of space prevents showing this in a sketch.

How would you like to have a loud speaker whose diaphragm was 42 inches in diameter?

The General Electric people who have been doing a good deal of research on the cone speaker have developed what is known as the Hewlett loud speaker. We do not believe it is on the market and may not be for some time, but it is interestingly described in Publication No. 2799, obtainable from the Government Printing Office at Washington.

No horn is used on account of the large size of the diaphragm. The absence of the horn and the distributed exciting coil make reproduction possible with a high degree of faithfulness. We understand one of these loud speakers is a part of the equipment of KOA at Denver.



The sketch shown above explains pictorially the manner in which Mr. Luers makes capacity changes in his condensers so as to get the s. l. f. characteristic without buying a condenser of that type. If you contemplate drilling the rotor, do not drill the stator. In other words only one of the elements should be drilled, either the stator or the rotor.

Radio fans in Wilmington, N. C., have progressed to the stage where they find it beneficial to have a radio club and as a consequence such an organization has been formed. The president is Raymond Hunt, Vice-president, A. B. Blake, and Secretary, H. H. Hunt. The members have informal discussions of various problems. The idea is good and should be applied all over the country.

W. W. McCune, 728 Porter St., Glendale, Calif., reports good luck with a single tube set made from descriptions appearing in the Radio Age, Pittsburgh, Calgary and Cincinnati are his best Eastern stations through the local barrage.

One of the most popular methods of controlling regeneration in a tuned r. f. set nowadays seems to be the 200,000 ohm variable resistance in series with the plate circuit of the radio frequency tubes. We believe there are about twenty or thirty manufacturers making use of this device in their factory built sets. It works on the voltage loss principle. In addition many set makers are using the variable resistance, something about 500,000 ohms, across the grid and filament of the second r. f. tube to control its tendency to oscillate. These are two of the thirty two methods of presenting oscillation, all of which has been previously detailed in the pages of Radio Age. Try and find a new one!

Judging from appearances, although the super het is still the king pin on weak and distant signals, the tuned r. f. sets using tandem control of capacities and restricted field inductances, is going to be represented in a large number of the sets made for the coming year. The plug-in type of inductances meet with some favor under certain circumstances but for the general public this method of covering more than one band seems a little involved. For the amateur waves the plug-in system is about the only means of hopping around in search of the signals on the various bands which Uncle Sam has assigned the brass pounders.

We would be very glad to hear from the readers of this department as to their opinions, favorable or otherwise, on the Model Receiver appearing in the December Radio Age and also the one in this number.

YOU'RE RIGHT!

"Leaving out the usual applesauce about your having the best magazine, etc., I will say instead that it is different enough to get the monthly quarter . . . . One thing I notice is the reference to the Weagant variant appearing more frequently than in other magazines . . . . I hooked up this circuit some time back and found it a wow for volume, selectivity and a full, rich, round tone."

The above from a N. S. G. W. named William J. MacKenzie, 220 Pierce St., San Francisco, Calif., who in addition to rooting for the Golden West includes Radio Age-in his cheers.

Recently in the lab. we stumbled upon a great combination for making inductance tests without having to tear up everything in sight every time we wanted to swap inductances. The Kurz-Kasch people sent us one of their demonstrator panels on which are mounted three USL condensers geared together with a rack and set of gears. The center dial, which is the master, controls the left and right hand condensers. Each of the condensers has an E-Z Toon vernier by means of which capacity discrepancies may be compensated in connection with the use of inductances which are not exactly of the same period. This panel we mounted on a baseboard with sockets and everything made fast permanently. To further conserve time and energy we made use of the Allan-Bradley resistance coupled amplifier unit which we also attached to the baseboard. Thus we had the condensers, sockets and the audio amplifying sections fixed up in permanent form. Then to compare different sets of inductances all we had to do was to remove one type and substitute the other, without in any way disturbing the balance of the test set. All of which saves a great deal of wear and tear on the nerves.

CATCH CRIMINALS BY RADIO
By M. L. Jenkins

The radio is beginning to take its place as a factor in the prevention of crime. The results of a message broadcast by a Nebraska sheriff recently no doubt caused Nebraska and Kansas criminals to wonder just where they would be able to hide.

When the Hastings, Nebr., sheriff broadcast the description of a stolen car, a Bird City, Kans., radio fan thought it was a car he had bought from J. B. Freeman of Hebron. It was. Investigation resulted in the recovery of fourteen stolen Nebraska and Kansas cars, and the arrest and conviction of three Nebraska men.

Radio possibilities in the detection of crime are unbounded. It is probable that every county seat town and all cities will soon have broadcasting stations and that when a crime is committed, details will be sent out in every direction.

Not so long ago the automobile was reckoned as a big factor in the increase of crime. It provided a quick getaway and so many cars look alike, it provided a superior method of concealment. But now the radio. It more than offsets the auto, and may be developed very effectively in dealing with crime.

Definite Hour Is Set For International Tests

Final arrangements have been made for the International broadcasting tests which take place during the week of January 24.

All American broadcasting stations will remain silent between the hours of ten and eleven o'clock, at night, Central standard time.

This will mean that radio fans will have sixty minutes in which to angle for European signals on waves which extend from 300 to 2600 meters.

European stations will broadcast their special programs for the listeners on the North American continent from 4 to 5 a. m., G. M. T., which means anything from a five to an eight hour differential for residents of various sections of the United States.

The table below will give you an idea as to the proper time for your particular geographical section of the United States:—

The European program runs from 4 to 5 a. m., January 25.

New Yorkers on Eastern Standard time will find their time 11 to 12 o'clock the night of January 24.

Chicagoans and Middle Westerners on Central Standard time will start up their trans-Atlantic signal quest from 10 to 11 o'clock, the night of January 24.

Residents of the Mountain Standard time should twirl their dials between 9 and 10 o'clock the night of January 24.

Californians and residents of the Pacific Standard time region will be on the alert for their European signals from 8 to 9 p. m., on January 24.

In reckoning time the fan may make use of the fact that Greenwich mean time (generally abbreviated G. M. T.), is considered the starting time; every fifteen degrees of longitude west counts one hour earlier, while every fifteen degrees of longitude east counts one hour later.

Thus New York is in the 75th meridian so five hours are subtracted from the G. M. T. time; Chicago is in the 90th so its time interval is six hours earlier; Denver in the 105th and its time differential is seven hours while San Francisco is in the 120th meridian and its time difference is eight hours.

In this week of international tests the owner of a tuned r. f. set will still be at the mercy of the gentleman who owns a regenerative set and has not learned to properly handle it. Despite this fact, however, it is confidently expected the tuned r. f. group of receivers (together with the super) will carry off the laurels. The straight regenerative in the hands of an experienced operator will give a good account of itself.

Location of the receiver, surrounding structures, power wires, trolleys and other absorbing structures will make their influence felt when the listener is straining for every millivolt from a distant transmitter's signals. The fans located in the wide open spaces will have the advantage of their city cousins, but the city dweller may outdo his competitor at least in the number of tubes in operation.

Tell them you read it in Radio Age

(Continued from page 44)

no limit to the distance between the two parts and it is often very convenient to put the eliminator in a cabinet and install it in the basement where it will be out of the way. When run in a damp place it will be a good idea to use a three wire cable with an outer rubber cover in addition to the braid so that internal leakage will not develope.

As previously explained, it is advisable to keep the apparatus in the output circuit, such as the chokes and large fixed condensers, at the opposite end of the baseboard from the input portion of the circuit as shown. If the parts are rearranged so the condensers come close to the transformer you may be almost sure of a persistent hum which will be almost impossible to eradicate. For the same reason, do not locate the eliminator so that the three wire cable passes close to the transformer end on its way to the receiver. If it does, it is almost certain to pick up some hum.

In Fig. 12 the outlines of the apparatus are shown in light continuous lines, the main wires by heavy full lines and the "ground wires" to the case by dotted-lines. All of the wires electrically connected to the (–B) post are considered as being ground wires although not necessarily connected to earth, while the wires going to the positive amplifier and detec-

Bill of Materials

Index	No. of Pieces	Name
K1	2	0.1 m.f. Tobe Deutschmann Fixed Condensers.
K2-K3	2	2.0 m.f. Tobe Deutschmann Fixed Condensers.
K4-K5	2	4.0 m.f. Tobe Deutschmann Fixed Condensers.
K6	1	1.0 m.f. Tobe Deutschmann Fixed Condensers.
L1-L2	2	30 Henry Thordarson Iron Core Choke Coils.
MA	1	0-100 Scale, Jewell Milliammeter.
R1	1	No. 25, 25,000 to 250,000 ohm. Bradley ohm.
R2	1	No. 10, 10,000 Fixed Bradleyunit Resistance, or No. 10, 10,000 to 100,000 ohm. Bradleyohm. The latter is shown and is best.
S	1	Small Panel Switch, Nickled Knife Type.
SL	1	Cutler-Hammer Toggle Switch.
SW	1	D. S. P. S. T. Baby Knife Switch. Porcelain Base Type.
T	1	Raytheon Tube.
TRANS	1	Acme B-4 "B" Eliminator Transformer.
TS	1	Standard Tube Socket.
U	1	Standard Molded Receptacle used in electric lighting work.
A	1	7"x18"x3/16" Dilecto Panel.
B	1	7"x17½"x½" Wood Baseboard.
C	1	Standard Flexible Lamp Cord, No. 18. Length depends on distance of eliminator from lighting socket.
D	8'	Three Conductor Belden Cable with three rubber-covered conductors in a heavy braid.
E	2	Electric Light Socket Plugs.
F	1	1¼"x3½"x3/16" Dilecto Terminal Connection Strip.
G	3	Eby Binding Posts.
H	2	Brass Corner Brackets for stiffening panel.
I	60	Solder Lugs.
J	15'	Rubber covered Flexible Wire. Strand used for wiring sets.
K	10'	Busbar, Tinned Copper.
L	1	Roll of Solder.
M	60	Assorted Wood Screws.

(Turn to page 55)

Plenty of WGY Waves For Fans to Pick Up

Those who grope among the air channels at night have found an increasing number of radio stations signing "General Electric Company, Schenectady." There are now nine transmitters applying electrical impulses on nine different wavelengths from Schenectady, and during some periods seven transmitters may be on the air at the same time. Not all however broadcasting, some are transmitting code—but each is on its own wavelength and each is applied to its apportioned task.

Schenectady, in the past eight months, has become the great world center of radio transmitter experimentation. Within three miles of the city the General Electric Company has constructed a gigantic transmitter developmental station. On the plot of many acres eight transmitters have been erected. Each transmitter has its independent antenna system and these systems, as well as the transmitters, are constantly undergoing changes as information on operation and reception accumulates. All transmitters are constructed on wooden frames and may be quickly dismantled or altered as defects are discovered and new methods are devised.

The men at the transmitters are doing only part of the work, for development would be impossible without reports on reception of the output of these stations. The entire country, as a result, becomes a laboratory and the interested radio experimenter is invited to become a volunteer co-worker. The General Electric Company is greatly indebted to these listeners who have thus far reported on the various tests, notably the 50 kilowatt broadcast tests and the programs broadcast alternately from vertical and horizontal antennas on super-power.

Reports from volunteer listeners are supplemented by observations made by a corps of field engineers who are detailed to various parts of the country. For example engineers are traveling about with trucks equipped with measuring instruments by means of which the characteristics of the radiated energy may be accurately set forth.

Investigations at the South Schenectady station include the short and long wavelengths, code and broadcast signals, with various degrees of power input and a side variety of antenna structures. Engineers are painstakingly recording data on transmission during daylight and dark, in rain, snow or fog, during the daylight and at dark.

At the present time the following stations may be heard on the air with broadcast programs from the studio of WGY: 2XAG, 379.5 meters, 2XK, 109 meters; 2XAF, 41.88 meters. Telegraph or continuous wave signals are put out from: 2XAZ, 214 meters; 2XAC, 80 meters; 2XAD, 21 meters; 2XAW, 15 meters. 2XAH operation on 1560 meters is now undergoing changes in design, but has been on the air for weeks and will be hear adgain in a short time.

WITH THE MANUFACTURERS

Electricity and Music Unite in Panatrope

Before a distinguished audience of scientists, musicians, and men and women prominent in society, the Panatrope, a new musical reproducing instrument which for the first time utilizes the electrical principle for the reproduction of sound, was presented at Aeolian Hall recently.

The panatrope has been perfected by scientists of the Radio Corporation of America, the General Electric Company, the Westinghouse Electric and Manufacturing Company and the Brunswick-Balke-Collender Company.

The program consisted of introductory remarks by P. L. Deutsch, Vice President of the Brunswick-Balke-Collender Company, selections by the assisting artists, Mario Chamlee of the Metropolitan Opera Company and the Elsbuco Trio, a speech by Dr. Alfred N. Goldsmith, Chief Broadcast Engineer of the Radio Corporation of America, who talked over the radio from Washington through the panatrope, and selections on the panatrope itself.

The panatrope is a new musical reproducing instrument involving new inventions and entirely new principles. The phonograph cannot faithfully reproduce all the delicate vibrations of the electrically recorded records. It remained for the panatrope, based as it is on electrical recording and electrical reproduction, to complete that union of electricity with music which has marked a milestone in scientific and musical fields.

Through the panatrope it is possible to take an original sound, cause it to be changed to light waves and electrical waves and finally reproduce it again with a loss and distortion which is infinitesimal.

Zenith Dividend

At a meeting of the Board of Directors of the Zenith Radio Corporation held November 4, the regular annual dividend of six per cent was declared, plus an extra of four per cent, payable January 2, 1926, to stockholders of record December 1, 1925.

The above action is the result of the report of operations for the year just closed. Net profits for the year exceeded those of the preceding year by 175%, it is stated.

Radio Trade Meeting Set for New York

The fifth annual convention of the National Radio Trade Association will be held at the Hotel Ambassador, Atlantic City, the week of May 10, 1926, according to announcement by F. E. Potter, Chicago radio manufacturer, chairman of the committee on annual meetings.

Retailers, jobbers and manufacturers will attend from every section of the United States, according to early reports from the membership of this organization which is the largest exclusively radio trade body in the country.

NEW COIL FORMER

A DEVICE which will help materially in the winding of spiderweb, low loss and other types of coils, has been put on the market by the Franklin Coil Winder Co., and is shown in the accompanying picture.

Although the device would be more appropriately called a "coil former" it will help many an experimenter to make clean-cut and business-like coils. It consists of a set of spokes and metal blocks which may be fitted together into a variety of patterns covering the construction of many types of inductances.

Taper Thickness of Plates In New Condenser

A NEW variable condenser of the grounded rotor type in which s. l. f. tuning is accomplished not by the eccentric shape of the rotor or stator, but by a tapering thickness of rotor and stator plates, is announced by the Allan D. Cardwell Co.

This condenser secures straight line tuning by using plates whose thickness is tapered so as the plates are revolved they tend to dovetail more closely due to the variable thickness of both stator and rotor.

The new type, known as the type E, are said to be more rugged than the original Cardwell on account of the extra thickness of the plates.

Tell them you read it in Radio Age

Bureau of Standards Does Not O. K. Claims

The attention of the Bureau of Standards has again been called to the frequent misuse of its name in connection with the sale of dry batteries for radio receiving sets. Claims have been made by some dealers and factory representatives, that the superiority of their particular brands of dry batteries has been shown by tests made at the Bureau of Standards. Tests of batteries, including the dry-cell "A" and "B" batteries for radio use, are made at the Bureau in accordance with government specifications.

These tests are made to aid the departments of the government in the purchase of batteries and to help each manufacturer to improve his product. The Bureau does not publish the results of its tests, nor does it inform any manufacturer of the results of its tests on other manufacturers' batteries. Therefore, statements that any make or brand of battery is superior as shown by tests made at the Bureau of Standards are unwarranted.

China Radio Reproducer Attracts Attention

One of the points of interest at Cleveland's recent Radio Show was the "Kirk" vitreous china radio reproducer manufactured by the Cambridge Sanitary Manufacturing Company.

This product represents quite a deviation from former reproducers in both material and construction. The design is patterned after the sound shells of famous orchestras, having many important advantages, principally the large, vibrationless base and the rim construction, in which the rim forms a part of the base, eliminating vibration at both points

Moves Offices

Ernest Walker Sawyer has moved his offices from the Chapman Building to 1915 Santa Fe Avenue, Los Angeles.

Mr. Sawyer represents the Silver-Marshall, Amsco, Radiotive and several other well known lines in the West.

Company Incorported

R. C. Blume Company, with offices at 1650 Monadnock Bldg., Chicago, has been recently incorporated for the purpose of handling a complete line of electrical and radio specialties on a distributors basis.

Radio Game Grows into a Lusty Infant

As evidence of the tremendous hold which radio has taken upon the public, the Chas. Freshman Company, Inc., of New York and Chicago, manufacturers of the line of Freshman Masterpiece Receiving Sets, announced the following figures of business done during the past few months:

The net sales of the Company for September, 1925, were $676,442.69, as against net sales for September, 1924, of $161,583.73; an increase of more than 300%—and yet—one month later, the net sales were almost twice those of September. For October, 1925, net sales were $1,290,174.65, as against $366,417.83 for the same month in 1924. As a matter of comparison, the sales for the entire year of 1924 were $2,122,315.92, showing conclusively that sales for the one month of October, 1925, approximated 60% of the entire amount of business done in the year of 1924.

Other companies report excellent volume of business.

Pole Piece Winder Runs at 10,000 r.p.m.

An automatic coil winding machine for winding pole pieces on telephone and loud speaker units has been announced by the Radio Production Machinery Co.

The winding machine turns the spools at a rate of 10,000 r.p.m., the wire traveling at 60 miles an hour. Wire up to No. 44 enamel may be run. The device is also made in multiple spindle to take care of different types of jobs.

Charges Your B Battery From Your A Battery

A novel B battery which can be charged from the A battery by the simple expedient of placing all of the cells in parallel for charging and series for discharging, has been placed on the market by the Orotone Battery Co. This unit was exhibited at the Radio Show held at the Furnite Mart in Chicago and attracted considerable attention.

The battery, which is a 96 volt one, is cut up into 24 four volt sections which are charged in parallel by placing of a conducting bar into a line of unit switches. The battery may be charged in fifteen minutes with enough current to last the evening, while the charge for an exhausted battery is about four hours. The scheme outlined above does away with the necessity for a special charger for the 96 volt type.

Group Control for Neutrodyne Receivers

Neutrodyne owners and those who are constantly trying out different circuits will welcome a recent product marketed by the Kurz-Kasch Co., which consists of a gear rack and a set of gear which may be attached to any three condensers so as to secure group tuning control.

The center condenser is the master control and has in addition an E-Z Toon vernier, as have the left and right hand condensers pictured in the illustration herewith. With the center knob the operator moves all variables simultaneously over the wave band. Slight discrepancies in the different sized antennas and the inductances may be ironed out by means of the verniers attached to the group control.

What appealed to the Radio Age staff mostly was the fact this unit which the Kurz-Kasch Co. supplied us mounted up in a demonstrator panel, can be attached to a baseboard and used as a means of testing any number of different inductances without having to tear down the test set every time. The condensers used in the group control demonstrator were made by the U. S. Laboratories. The device may be readily attached to any set using three dials.

As a means for simplifying the neutrodyne control the E-Z Toon group control should be especially acceptable to all. In our laboratory tests on a set of three inductances it was a very simple matter to compensate with the verniers so when the center master dial is revolved station after station comes in Only a slight variation on one of the verniers was necessary to build up a signal to maximum,—after that the control was operated from the center knob.

Self-Aligning Bearings

A set of bearings, for use with variometers, variocouplers and other tuning devices requiring a variable inductive relation, has been made by Edward Board, a designer of special machinery. The bearings are self-aligning and assure positive electrical contact.

Pressure Ground Clamp

Under the name of "Snap-tite" the Snap-Tite Clamp Co., is marketing a ground clamp which requires no soldering and which holds the wire tight against the pipe or other metallic rod used. The clamp is made in three sizes to take care of various types of metallic conductors.

Tell them you read it in Radio Age

Gold Watch Prize for Most Miles Per Watt

A 21 jewel watch with solid white gold hand engraved case and a Lord Elgin movement has been selected as the 1926 prize offered by the Jewell Electrical Instrument Co., in their "most miles per watt" contest which is open to all American and Canadian licensed transmitting amateurs.

The contest closes on June 1, 1926. The winner will be the one who has submitted documentary proof of havnig transmitted by wireless telegraphy the most miles per watt over a distance of three hundred or more miles.

The input wattage in the contest shall be taken as the sum of the watts in the filament and plate circuits of the tube. In order to simplify matters the watts will be taken as the product of volts and amperes.

The contest is attracting considerable attention among members of the brass-pounding fraternity in this country as well as Canada.

Inventor of Tirrill Voltage Regulator Is Dead

Allen A. Tirrill, 52 years old, an inventor and consulting engineer of the Westinghouse Electric and Manufacturing Company died recently. Mr. Tirrill was the inventor of a voltage regulator bearing his name.

For many years he was associated with the General Electric Company. Schenectady, N. Y., and in 1910 became an engineer at the Westinghouse Company. He left the company in 1916, since that time being one of its consulting engineers.

The new flat cell "B" battery recently announced by the National Carbon Company makers of Eveready batteries, utilizes the new principle of patented battery construction by substitution of flat cells for cylindrical cells.

There is about 30 per cent more active electricity-producing material than in the Heavy Duty Battery No. 770 of identical external dimensions. About fifty per cent longer life is given by use of the layer construction.

Pioneer Announcer Leaves KDKA's Microphone

One of the best known voices in the world will become silent, as far as the radio audience is concerned, this month when Harold W. Arlin, pioneer announcer of the world and chief announcer of Westinghouse Station KDKA since its beginning, severs his connection with the station to take a position in the commercial world that will necessitate ending his residence in Pittsburgh.

Mr. Arlin remains with the Westinghouse Company, however, as he has been appointed manager of personnel for the Westinghouse Electric Products Company, at Mansfield, Ohio, and with his removal to the Ohio city has resigned his position as Chief Announcer of KDKA.

H. W. ARLIN

Mr. Arlin was connected with the Westinghouse organization when the company instituted broadcasting by establishing the world's pioneer station in 1920, and became an announcer. No one in those days had any very clear idea of the qualifications of radio announcer, but it quickly became apparent that Mr. Arlin had qualifications that made him a valuable asset to the station; his virile, resonant voice, his exceedingly clear enunciation, his tact in handling people under the peculiar nervous strain of broadcasting, his coolness and good judgment under trying circumstances, his wide knowledge of music, sports and other matters most commonly broadcast, his amiable disposition reflected in his voice, soon endeared him to the rapidly growing radio audience.

Thousands of Letters

The hold Mr. Arlin has on the radio audience is evidenced by the thousands of letters he has received from every section of the United States and from nearly every civilized country in the world, friendly personal letters from people who have never seen him, in most

(Continued on page 53)

Tell them you read it in Radio Age

Pioneer Announcer Leaves KDKA's Microphone

(Continued from page 52)

cases, but who write to him as they would to a warm and highly esteemed personal friend of long standing. The best known American voice in Europe, the London Times editorially calls him. "Young 'Arry W.'", Johannesburg, South Africa, affectionately dubs him. Among the radio fans in Australia, South Africa and the British Isles, especially, his name is almost a household word and his photograph is familiar. In the outside world, as well as among the officials of the company itself, his work as announcer has received commendation.

Marshall Foch and Lloyd George are among the international celebreties Mr. Arlin has introduced to the radio audience. Other notables whose appearance in the air he has announced are Theodore Roosevelt, Jr., Governor Pinchot, Fritz Kreisler, Manager "Bill" McKechnie of the world's champion Pittsburgh Pirates; Babe Ruth, Hughey Jennings, Lillian Gish, Priscilla Dean, and a host of other stage and movie stars.

Mr. Arlin is one of the incorporators and the first vice president of the National Association, Radio Announcers of America. He has made addresses before Rotary and Exchange clubs in various cities, and has appeared as guest announcer from stations in Chicago, New York, Boston, Providence, Rochester, Syracuse and other cities.

Handling Concerts

One of the highlights of Mr. Arlin's radio activities was the handling of the concerts from Wanamakers in New York and Philadelphia which were transmitted to England by Westinghouse International Short Wave Relay System.

In his position Mr. Arlin will be in charge of employment, the educational activities, relief, safety, and all factors pertaining to the personnel of the Mansfield works.

"Radio announcing has been a fascinating thing for me, with its opportunities for studying the character and eccentricities of people and its peculiar possibilities for making friends," Mr. Arlin said. Due to my position as KDKA announcer, I have been able to make friends and acquaintances in numbers exceeded by few people, including politicians who are supposed to know everybody. I can go into any city and feel that I am among friends, instead of in a strange land, and hosts of people will instantly connect me with the station upon hearing my name."

Enormous Amplification Needed

(Continued from page 20)

fication, all of which will require six tubes, this weak little signal from the distant station has been amplified three million, two hundred seventy-six thousand, eight hundred times by the time it reaches the loud speaker. Here then, is the secret which makes it possible to take these infinitely weak signals which are so far out of the range of the human senses and bring them out with enormous volume.

You'll See with Your Radio Tubes

(Continued from page 24)

and hard type, can be used. If the reverse order of action of the cell is desired, i. e. if it is desirable to have the current flow while the cell is not illuminated, the circuit can be changed as follows: The second grid is left floating and the cylinder is made negative with respect to the filament. The first grid will again be the main anode. The results with this arrangement are almost as good as obtained with the second circuit.

By means of this cell it was possible to operate from reflected daylight or small lamp, the ordinary 150 ohms. telegraph relay which in turn operated the circuit of power line with several amperes. Its uses are more and more appreciated by the radio and electrical worlds.

Radio Production to be Heard From WHT

The establishment of a radio production department with a theatrical personnel directed by John Clark, nationally known scenario writer, is a departure by station WHT to influence a new type of radio program.

The WHT production department will prepare a series of radio novelty presentations with all star casts scheduled twice weekly. The members of the production company are on the payroll of the station and subject to rehearsal call. All rehearsals are supervised by George Junkin, Chicago manager of the Drama League of America. To lend theatrical atmosphere to the presentations all casts will be costumed.

Radio novelties written and produced over WHT by Production Manager Clark are "The Listeners," Kipling's "Road To Mandalay," "West Of The Golden Gate," "North Of Montreal," "In The Land Of Cotton," "A Trip To The Far East."

KDKA Singer

WINIFRED PERRY, contralto, is a graduate of the Overlin Conservatory of Music and has studied with Oscar Sanger and William S. Brady, in New York City.

Mrs. Perry's accomplishments on the American stage and her appearance at KDKA as soloist of the Dutch Master Half Hour of Music programs, have won for her a place in the hearts of music lovers.

(Continued from page 48)

tor are the high tension wires and are all of a positive polarity. The (–B) ground wires for the most part can be plain tinned square section copper busbar such as used in wiring sets, but the high tension wiring should be rubber covered flexible wire to avoid the possibility of short circuits and shocks. At certain points the difference of potential between wires may reach 280 volts or more, and at all points except one, the potential is 135 volts. With this voltage one can get a very good healthy shock, and the power behind the apparatus makes good wire insulation imperative if we are to avoid burn outs and similar troubles.

Where ground connections are made to the cases of the instruments, the paint should be carefully scraped off around the point of contact so a bright metal surface shows. The wood screws used for attaching the parts to the baseboard are then run through soldering lugs so that the lugs are brought down forceably in contact with the cleaned contact surfaces, and the ground wires are then soldered to the lugs. Good strong soldered joints and rigidity in the general construction are important points that must be observed. Weak connections, loose and jangling parts cause noise which must be avoided.

When thrown in one position, the main two-way switch (SW) gives the highest voltage, and the switch is shown in this position. In the other position of the switch blade the voltage is reduced. With the blade in the center so that it does not make contact with the other side, the power is cut off. As a rule, this switch need not be touched frequently and when through with the receiver the line current is cut off by the Cutler-Hammer snap panel switch (SL). Either switch can be used however.

At (R1) and (R2) on the panel are the high resistance Bradleyohms. The variable resistance (R1) is used for controlling the detector plate voltage which in some receiving sets may be a fairly critical quantity. The other variable resistance (R2) generally requires adjustment only once, but re-adjustment may be necessary at long intervals in special cases. Some detectors and radio frequency stage tubes work better on from 22.5 to 30 volts than others while in other receivers it may be necessary to use 45 volts or even 67.5 volts to get the best results. This is the purpose of (R1).

Careful attention should be paid to the markings on the transformer and the wires that run to these posts, and the transformer should be placed so the primary binding post strip is at the left and the secondary posts at the right of the transformer where these posts feed into the Raytheon tube. Also note the Raytheon tube is mounted in a standard tube socket, and the grid and plate posts (G) and (P) of this socket are connected together to form one terminal of the tube output. This is entirely different than the connections made to the socket for a receiving tube.

This rectifier and filter will carry a continuous load of 65 milliamperes without materially reducing the voltage or volume.

Hornless Wonder of Schenectady Uses New Diaphram

(Continued from page 25)

The amplifier on Schenectady's camping ground is erected in a small building which may be thrown open on both sides. In a neighboring building is a motor generator set which supplies three kilowatts of direct current power to polarize the loud speaker. The amplifier for supplying the voice current is divided into two parts, a voltage amplifier and a power amplifier. The voltage amplifier consists of two stages of 201 A Pliotrons and one 210 Pliotron coupled in cascade by resistance and capacity. The power amplifier consists of a one kilowatt low impedance Pliotron. The plate current for all these tubes is supplied by a 2,000 volt, full-wave kenetron rectifier which is operated from the alternating current lighting mains. Filament current for the tubes is furnished by transformers.

The radio programs of WGY, the General Electric Station which is located only four miles from the park, are picked up by means of a loop about fifteen inches in diameter.

U. S. Tool Moves Into Larger Quarters

The U. S. Tool Company, Inc., whose factory is located on the edge of the residential part of that section of Newark, New Jersey, known as Ampere, has made extensive additions and improvements in its plant. The present company was formed in 1919 and started with about 2000 square feet on one floor of 51 Lawrence Street. As the business grew, larger quarters were taken at 117 Mechanic Street with additional space at 78 and 117 Mechanic Street, where they used two floors. In December, 1924, the present buildings were purchased from the General Electric Company, which had erected it with a view to using it as a tube testing laboratory.

From its inception the company has prospered and its officers are: E. M. Squarey, president and treasurer; Fred Koch, A. E. Borton, A. B. Bergen, vice presidents: W. P. Powers, secretary, P. A. Prior, chairman board of directors. The engineers are W. P. Powers, who is a graduate of the University of Pittsburgh, Pa., and was assistant to Professor Hazeltine at the Stevens Institute and Ernest Ross, formerly of the General Electric Company Laboratory at Schenectady, N. Y.

Set Winner

Miss Jean Waggett, 7753 Saginaw Ave., Chicago, Ill., who won the December Model H radio set given away by the Radio Age at the Fourth Annual Chicago Radio Show held in November.

Runners-up in the contest were: Bert Fisher, 310 Burlington Ave., La Grange, Ill., and George Nikodem, 2547 South Harding Ave., Chicago, Ill.

Important New Metal Useful in Radio

As a result of a search by chemists over a period of one hundred years all over the world, a new metal of immediate value and vast possibilities has been added to the world's technical resources, in the form of pure metallic ductile thorium which has been prepared for the first time by the research laboratories of the Westinghouse Lamp Company, according to a statement by Dr. H. C. Rentschler, head of the research department, and Dr. J. W. Marden.

Thorium is of particular interest to the radio enthusiasts because it is the active constituent of practically all radio tube filaments. The present method of making radio tube filaments consists of compounding thorium oxide in the tungsten wire, as thorium has the ability to throw off electrons with great ease and at a very low temperature. As the tube is heated, the thorium oxide comes to the surface of the wire in the form of minute quantities of thorium metal, which gradually oxide off through the emmission of electrons. As the thorium on the surface of the tungsten is used up, more of the thorium oxide in the filament comes to the surface, the life of the tube ending when the thorium is all used up. Through the use of the new method, thorium can now be produced commercially in filamentary form as contrasted with the minute admixture with tungsten used at present.

In addition to its use in radio tubes, this metal is of extreme importance to the medical profession as a target material for X-Ray tubes, being much more efficient than the tungsten now in use.

Service to the American Public

(Continued from page 30)

which ships have been navigated for centuries. We must provide wave lengths for use on the ships.

Agency Established

"We must bear in mind that radio broadcasting is the birth of the last five years and that our previous conferences have been largely concerned with trying to get the service established; to create an effective service that could reach every home. The agency is now established. When I called the first conference only 30 people were present. There were then only 2 or 3 broadcasting stations and only a few hundred thousands listeners. Today there are nearly 600 stations and about 25,000,000 listeners. The problems of the present conference were to perfect that service.

"In general the Conference, representing every phase of this question, was unanimous that there must be new legislation to give more control in the protection of public interest and in the perfection of the service."

Inexpensive Tube Tester Issued by Jewell

Individual set owners may now secure an inexpensive tube tester which will determine the worth of their tubes, through the recent issue by the Jewell Electrical Instrument Co., of a Junior tube tester known as No. 108.

Checking tubes is a simple process since the tester is supplied with a plug and cord. Readings are shown on a milliameter.

Another of the Jewell issues is the portable voltmeter de luxe, furnished in a mounting somewhat similar to clock mountings and which adds a decorative effect to the radio set. The meter will read either A or B batteries. Many of the newer model sets are having provision made for plug in method of reading A and B voltage.

Music To Go With Technical Talks

"Something New in Radio," is the title of a novelty talk to be broadcast every Sunday night from Station WMCA (Hotel McAlpin), New York City, by Bernays Johnson, who has just returned from an extensive tour of the leading radio stations of the European nations.

Mr. Johnson is sponsored in these talks and enabled to make them through the courtesy of the Daven Radio Corporation and is assisted by the Daven Orchestra at these various demonstrations.

This is the first time radio technical talks with the aid of an orchestra have been used in this country and this half hour period, 10:30 to 11:00 o'clock, Sunday nights, should prove an interesting innovation on the air.

Goes to 25 Kilowatts

Station HDO, Hilversum, Holland is to try out 25 kilowatts soon according to reports from Europe. Its present power is 1000 watts and it operates on 1050 meters.

WJJD's Ideal Studio Arrangement

(Continued from page 35)

lounges are scattered about with tables, lamps, etc., so that it will be homey in appearance and comfort. This, it is claimed, is a step forward in so-called audience rooms, which have been put into some of the latest studios.

The reason for this is that benches which resemble pews are not satisfactory from the guest's standpoint, and with a crowd of people staring through a plate glass window at him, certainly not from the artist's standpoint. Performers have said that such arrangements resemble aquariums and are distracting. In the Palmer House radio suite by means of drapes and lights it is possible for all the guests in their comfortable chairs in the studio parlor to see and hear the artists, but the artists cannot see through the gauze curtains into the studio parlor and thus be distracted because after all, the effect on the air is the important thing.

Public Address System

What is called a public address system has been installed in the hotel, which means that music or speeches can be broadcast through WJJD no matter whether they originate in the hotel, or the radio program upstairs or any outside station can be received by loudspeakers in all parts of the hotel. The many orchestras now playing in the Palmer House, both concert and dance orchestras, almost continuous from noon until one A. M., will be broadcast by WJJD, and the public address system makes it not only possible but convenient to pick the music from these orchestras from any part of any of the big dining rooms and banquet halls, or even from any of the private dining rooms, the hotel lobby, or the hotel foyer.

Atwater Kent Booklet

"A trip through a modern radio factory" is the title of a little booklet issued by the Atwater Kent Mfg. Co., and sent to radio fans who write in their comments on the series of Atwater Kent Sunday evening broadcasts.

Hydrometer Receptacle

The Elwood Mfg. and Specialty Co., are now putting on the market a holder for hydrometers known as the Ecloid hydrometer receptacle. It solves the question as to where to put the hydrometer after testing the specific gravity of a storage battery. The receptacle hangs on the wall like a thermometer and is provided with a glass drip cup.

More Canadian Licenses

Canadian fans numbering 64,682 secured receiver's licenses during the first 9 months of 1925, an increase of 7,823 over the corresponding period of 1924, Consul Hickerson, reports to the Department of Commerce. Licenses issued during this period to fans in Ontario totaled 32,833; in Quebec, 9,062; and Saskatchewan 7,729, followed by Manitoba, British Columbia, Alberta and Nova Scotia in order.

Here We Have High Lights at Radio Conference

(Continued from page 32)

Stick to Wave

The Committee on Interference also endeavored to help the listener by urging the broadcasters to adhere strictly to their wave lengths, stating those who had not equipped themselves with machinery to constantly check their frequency, should immediately do so. The committee pointed out that harmonics, so objectionable to the listener-in, might be avoided partly by having the operators refrain from using more power than was necessary. This fault should be removed by management—through a closer supervision it was pointed out.

Power Interference

THE interference committee expressed the hope that cooperation between the broadcasting stations and the power companies would continue to the end that the interference caused by these companies would be eliminated. Some of these cases were possible of detection locally without the assistance of the department and the broadcasters were urged to assist the inspectors in those instances. It was also believed by the committee that many of the interference problems could be solved by the formation of listeners clubs throughout the country and it was urged that these be formed and encouraged. This committee also opposed the further issuance of licenses at this time when the congestion is so acute.

The legislative committee pointed out that the existing federal statutes are not adequate to permit proper administration of radio communication activities and urged Congress to pass the necessary legislation as quickly as possible, which it is understood the Commerce Department plans to do.

In the three-day discussions of the copyright committee headed by Representative Wallace White, Maine, which attempted to reach an agreement between the Society of Authors, Publishers and Composers and the broadcasters, the members were unable to dispose of this vexatious problem. After the committee had recommended to the conference that legislation be enacted to settle the question, Secretary Hoover advised that the matter be left as it now stood until a further effort has been made at conciliation. The recommendation of the Secretary was accepted, and the report tabled.

The copyright sessions were hectic and revealed the inside features of a long fight which may still continue.

A Human "S. O. S."

When New York officials recently apprehended a foreign vagrant whose speech they could not understand, despite the aid of several linguists, they located some of his countrymen by permitting him to broadcast a personal "SOS". Several of his native brethren, who proved to be Laplanders, came to his rescue and he was released.

Carrier Telephony Used On Railroad Train

Further reports on applications of radio and wired wireless to railroading by the American Railway Association, reveal that a new carrier current, or wired-radio, system has been developed for communication between the front and rear cars of long freight trains on electrified roads. Either code signals or voice may be used satisfactorily; the latter however, only when the train is standing still. Wave lengths of 100 to 140 meters were used in recent tests with about 50 watts power, over a line three miles in length.

The most interesting tests was made on the electrified section of the Norfolk & Western Railroad. Duplicate sets were mounted in two locomotives, one pulling and one pushing a train which was fully half a mile long. By means of carrier-current signal in the rails the train was started and stopped most satisfactorily, both engineers working together. The train was started up and its speed increased to 14 miles per hour in less than a minute, whereas it usually required a longer time to start a long, two-engined train. Stopping was readily accomplished without the accustomed jarring and bumping. Voice transmission from cab to cab was found clear and easily understood when the train was not in motion.

Further demonstrations indicated that this system would operate satisfactorily when the two engines were separated a distance of six miles. This equipment is to be tried out by a large southwestern road before representatives of the Railway Association's radio committee.

Tube's Light Not a Guide to Sensitivity

Many radio fans are under the impression that the amount of light a radio tube gives off is an indication of its sensitiveness or general condition, and some are even inclined to regard with suspicion tubes that appear to glow only dimly. The fallacy of this idea is explained by Clifford M. Norberg, a research engineer.

The fact a radio bulb does emit light is entirely an incidental feature of its operation, says Mr. Norberg. What is desired in a tube is a flow of little particles of electricity called "electrons," and the easiest way to obtain it is to burn certain kinds of wires in glass bulbs from which the air has been exhausted. The temperature must be quite high in order to make the flow copious, and most wires must be heated white hot by the current from the "A" battery for proper operation. Of course the incandescent wire, or "filament", as it is correctly called, emits considerable light, but this phenomenom has absolutely no connection with the functioning of the tube from the radio standpoint.

What Does a Radio Supervisor Dream About?

(Continued from page 33)

there began a scramble for apparatus. Tubes were scarce, tuners hard to find and loud speakers unknown. Little by little manufacturers began making stuff with which the public could hear music. Thus far the radio inspectors had only a few problems to conquer, but when actual broadcast transmitters began cropping out over night with a demand for wave bands it seemed while life was hard it was still livable because there was space on the air for a number of stations.

But when the demand for stations reached the point where five or six hundred broadcasters desired stations on a band which probably does not accommodate more than ninety channels, the problems loomed larger and larger. Much trouble was saved by the institution of the radio conferences called by Mr. Hoover, but still it has not entirely relieved the radio supervisors of a good deal of trouble.

Today the most popular song in the Department of Commerce is, "Yes, we have no frequencies." To list the multitudinous duties of Supervisor Beane at Chicago would entail considerably more space than we have at our command in this issue, but you can rest assured he has little time for rest. The chap who vows a station is off its frequency (despite the fact the station's frequency meter shows it is on frequency) has to be placated. The individual who believes there is serious heterodyning going on because a regenerative set next door is operated as a transmitter instead of a receiver, also has to be told the matter will be looked into and things straightened out. The party that rails at an amateur in the next block on account of interference, has to be shown the cause of his trouble is leaky power lines in his alley.

Another form of trouble is that reported by Radio Supervisor Beane, constituting interference in the broadcasting band and which may require a reallocation of channels. When two high-powered broadcasting stations, using either modulated or unmodulated waves, are operated simultaneously on widely separated frequencies, they produce a third frequency in the air, which is quite sharply defined. They actually heterodyne each other, Mr. Beane points out. This, of course, interferes with any stations on the wave produced and broadcast by the two operating stations.

Produces Third Frequency

Explaining the phenomena to the Interference Committee at the conference, Mr. Beane said: "The principle of heterodynation is quite well known, of course. For instance, an oscillator functioning on a given frequency can 'beat' with another oscillator, located in close proximity to it, which produces a third frequency. This frequency is the difference between the frequencies at which the two oscillators are functioning.

(Turn to page 64)

Suit to Stop Radio Livestock Quotations

A court action of national interest to broadcasters which may establish a legal ruling effecting the manner and method of dissemenating information by radio has been instituted in the Circuit Court at Chicago by John P. Bowles, cattle broker, against the Chicago Live Stock Exchange which seeks to prevent the broker from broadcasting live stock quotations over WHT.

The Chicago Live Stock Exchange passed a resolution effective December first which prohibits any member of the exchange from broadcasting live stock quotations and information or furnishing such information to broadcasting stations. The John P. Bowles Company, one of the largest commission houses at the Chicago Stock Yards, has for the past six months been broadcasting the current market quotations by remote control direct from the yards through station WHT.

The court action is predicated on the right of the plaintiff to use radio as an advertising medium in the same manner and for the same intent and purpose as he would employ newspapers or magazines.

ASTERISKS placed in advertising space denotes manufacturers have submitted samples of their products to Radio Age Institute and these products have passed the Institute tests.

Tell them you read it in Radio Age

What Does a Radio Supervisor Dream About?

(Continued from page 62)

Another frequency equal to their sum is also created. Similarly, a radio station operating on 560 kilocycles and another station operating on a frequency of 1200 kilocycles will actually heterodyne at radio frequencies and produce a third frequency of 640 kilocycles in the air. As this third frequency created by the two stations, may already be assigned to a third, or a continuous wave broadcaster, modulated or unmodulated, a so-called 'beat note' is produced ruining transmission of a third station operating on 640 kilocycles."

The reassignment of new waves or frequencies should be so arranged, according to Mr. Beane, that this phenomena will not take place. It is actually taking place he has ascertained, between broadcasting stations. Fortunately, he states, the field strength of the third wave or frequency created by the two stations on their proper frequencies, is considerably less than the strengths of the original frequencies, so the use of frequencies which may cause such interference need only be considered within a small radius of two stations which may produce a third frequency. The third frequency created by two 500 watt transmitters is reported as only objectionable for a distance of about five miles. Two 5000 watt stations, however, cause this difficulty over a radius of approximately 20 miles. If practical and logical assignment of frequencies in the future is to be made, it is believed absolutely necessary that the results of radio frequencies heterodyning each other must be considered.

The Navy's Scheme

Officers of the Navy point out they have taken this phenomena into consideration for some time and use frequencies ending in 5; any new frequency created by beat notes, is therefore, not an assigned frequency and cannot interfere with regular channels; since their sum or difference would necessarily be a frequency ending in zero. A reassignment by the Department of Commerce to prevent this form of interference, may be undertaken on this basis—that is, increasing all assignments by five kilocycles, or reducing them that much.

Mr. Beane's tests in Chicago included several stations, among them KYW on 560 kilocycles, and WGY and WOR on 1200 kilocycles; they produced a frequency of 640 kilocycles, which was unassigned, yet Chicago listeners got the beat note created. Tuning below and above this frequency showed the adjacent stations in the band were on their proper assignments and were not involved in the interference reported.

New Italian Station

The projected station at Milan, Italy will be similar to 2LO at London, equipped to broadcast with 12 kilowatts on 384 meters. It is owned and erected by the Union Radiofinica Italiana.

DeForest Cuts Price on Receiving Tubes

Retail price reductions on all lines of the DeForest radio receiving tubes, as a result of specialized manufacturing processes, increased production, and greater sales, were announced on December 1.

The lines affected are the newly standardized DV-2 detector, the specialized DV-5 for radio and audio frequency amplification, and the DV-3 and DV-3A for dry cell battery circuits.

H. L. Lanphear, an executive of the DeForest Company, in announcing the new schedule made public the following statement: "Our recently inaugurated policy of developing and producing a new and complete line of highly specialized receiving tubes has resulted in such increased sales throughout the country that we are now in the fortunate position of being able to announce forthwith a sweeping price reduction on all lines of our receiving tubes.

"With the addition of the DV-5 the Company has at last realized the ambition long held by the DeForest tube engineering staff, namely, to supply specialist tubes for each step in radio reception.

"This tube development by DeForest Engineers has resulted in several points of tube superiority, one the use of an isolantite base by which the electrical losses have been reduced from one-eighth to one-fiftieth.

Tell them you read it in Radio Age

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDPM	Westinghouse Electric & Mfg. Co.	Cleveland, Ohio	250
KDYL	Newhouse Hotel	Salt Lake City, Utah	246
KDZB	Frank E. Seifert	Bakersfield, Calif.	210
KDZI	Electric Supply Co.	Wenatchee, Wash.	360
KFAB	Nebraska Buick Auto Co.	Lincoln, Nebr.	341
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAJ	University of Colorado	Boulder, Colo.	261
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. K. Azbill	San Diego, Calif.	224
KFBG	First Presbyterian Church	Tacoma, Wash.	250
KFBK	Kimball-Upson Co.	Sacramento, Calif.	248
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	Bishop N. S. Thomas	Laramie, Wyo.	270
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCF	Frank A. Moore	Walla Walla, Wash.	256
KFDD	St. Michaels Cathedral	Boise, Idaho	278
KFDJ	Oregon Agricultural College	Corvallis, Oreg.	280
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	250
KFDY	South Dakota State College	Brookings, S. Dak.	273
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Oreg.	243
KFEK	Augsburg Seminary	Minneapolis, Minn.	261
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Nebr.	268
KFFP	First Baptist Church	Moberly, Mo.	242
KFEY	Bunker Hill & Sullivan Mining and Concentrating Co.	Kellogg, Idaho	235
KFGB	Heidbreder Radio Supply Co.	Utica, Neb.	224
KFGC	Louisiana State University	Baton Rouge, La.	268
KFGD	Chickasha Radio & Electric Co.	Chickasha, Okla.	248
KFGH	Leland Stanford University	Stanford University, Calif.	270
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colorado	Gunnison, Colo.	252
KFHH	Ambrose A. McCue	Neah Bay, Wash.	261
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	469
KFIF	Benson Polytechnic Institute	Portland, Oreg.	248
KFIO	North Central High School	Spokane, Wash.	266
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Daily Commonwealth	Fond du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	R. B. Fegan (Episcopal Church)	Junction City, Kans.	219
KFJF	National Radio Manufacturing Co.	Oklahoma City, Okla.	261
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Oreg.	246
KFJL	Hardsacg Manufacturing Co.	Ottumwa, Iowa	242
KFJM	University of North Dakota	Grand Forks, N. Dak.	278
KFJR	Ashley C. Dixon & Son	Portland, Oreg.	263
KFJX	Iowa State Teachers' College	Cedar Falls, Iowa	258
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	Southwest Baptist Theological Seminary	Fort Worth, Texas	254
KFKA	Colorado State Teachers College	Greeley, Colo.	273
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Electric & Manufacturing Co.	Hastings, Nebr.	288
KFKZ	F. M. Henry	Kirksville, Mo.	226
KFLD	Paul E. Greenlaw	Franklinton, La.	234
KFLP	Everett M. Foster	Cedar Rapids, Ia.	256
KFLR	University of New Mexico	Albuquerque, New Mexico	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelical Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFLZ	Atlantic Automobile Co.	Anita, Ia.	273
KFMB	Christian Churches	Little Rock, Ark.	254
KFMQ	University of Arkansas	Fayetteville, Ark.	300
KFMR	Morningside College	Sioux City, Iowa	261
KFMW	M. G. Sateren	Houghton, Mich.	263
KFMX	Carleton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	266
KFNG	Wooten's Radio Shop	Coldwater, Miss.	254
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	Chamber of Commerce	Burlingame, Calif.	226
KFOJ	Moberly High School	Moberly, Mo.	242
KFON	Echophone Radio Shop	Long Beach, Calif.	233
KFOO	Latter Day Saints' University	Salt Lake City, Utah	236
KFOP	Rohrer Elec. Co.	Marshfield, Ore.	240
KFOR	David City Tire & Electric Co.	David City, Nebr.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Board of Education, Technical High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul, Minn.	252
KFPG	Garretson and Dennis	Los Angeles, Calif.	238
KFPL	C. C. Baxter	Dublin, Texas	252
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPT	Cope & Johnson	Salt Lake City, Utah	286
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	266
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co.	Fort Worth, Texas	263
KFQH	Radio Service Co.	Burlingame, Calif.	231
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. Riker	Holy City, Calif.	217
KFQW	C. F. Knierim	North Bend, Wash.	216
KFQZ	Taft Products Co.	Hollywood, Calif.	226
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRM	James P. Boland	Ft. Sill, Okla.	242
KFRU	Stephens College	Columbia, Mo.	500
KFRW	United Churches of Olympia	Olympia, Wash.	219
KFRY	College of Ag. & Mechanic Arts	State College, N. Mex.	266
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUJ	Hoppert Plumbing and Heating Co.	Breckenridge, Minn.	242
KFUL	Thomas Groggan & Bros. Music Co.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	242
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUQ	Julius Brunton and Sons Co.	San Francisco, Calif.	234
KFUR	Peery Bldg. Co.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	261
KFUU	Colburn Radio Labs.	San Leandro, Calif.	224
KFUW	Airfan Radio Corp.	San Diego, Calif.	246
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	205
KFVE	Film Corporation of America	St. Louis, Mo.	240
KFVF	Clarence B. Juneau	Hollywood, Calif.	208
KFVG	First M. E. Church	Independence, Kans.	236
KFVH	Whan Radio Shop	Manhattan, Kans.	219
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Welcome, Minn.	227
KFVO	F. M. Henry	Kirksville, Mo.	226
KFVR	Moonlight Ranch	Route 6, Denver, Colo.	244
KFVS	Cape Girardeau Battery Station	Cape Girardeau, Mo.	224
KFVU	Standard Publishing Co.	Eureka, Calif.	216
KFVW	Airfan Radio Corp.	San Diego, Calif.	246
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFVZ	Glad Tidings Tabernacle	San Francisco, Calif.	234
KFWA	Browning Bros. Co.	Ogden, Utah	261
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWC	L. E. Wall	Upland, Calif.	211
KFWF	St. Louis Truth Center	St. Louis, Mo.	215
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	254
KFWI	Radio Entertainments, Inc.	South San Francisco, Calif.	226
KFWM	Oakland Educational Society	Oakland, Calif.	207
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWP	Rio Grande Radio Supply House	Brownsville, Texas	214
KFWU	Louisiana College	Pineville, La.	238
KFWV	Wilbur Jerman	Portland, Oreg.	213
KFXB	Bertram O. Heller	Big Bear Lake, Calif.	203
KFXC	Santa Maria Valley Railroad Co.	Santa Maria, Calif.	210
KFXD	L. H. Strong	Logan, Utah	205
KFXE	Electrical Research & Mfg. Co.	Waterloo, Iowa	236
KFXF	Pike's Peak Broadcasting Co.	Colorado Springs, Colo.	250
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	Mountain States Radio Distributors, Inc. (Port. sta.)	Denver, Colo.	216
KFXM	Neches Electric Co.	Beaumont, Texas	227
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Mary M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	205
KFYJ	Chronicle Publishing Co.	Houston, Texas	238
KFYR	Hoskens-Meyer, Inc.	Bismarck, N. Dak.	248
KGB	Tacoma Daily Ledger	Tacoma, Wash.	250
KGO	General Electric Co.	Oakland, Calif.	361
KGTT	Glad Tidings Tabernacle	San Francisco, Calif.	234
KGU	Marion A. Mulrony	Honolulu, Hawaii, Waikiki Beach	270
KGW	Portland Morning Oregonian	Portland, Oreg.	491
KGY	St. Martins College	Lacy, Wash.	246
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Seattle, Wash.	273
KJBS	J. Brunton & Sons	San Francisco, Calif.	220
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KJS	Bible Institute of Los Angeles, Inc.	Los Angeles, Calif.	293
KLDS	Reorganized Church of Jesus Christ of Latter Day Saints	Independence, Mo.	441
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	266
KMA	May Seed & Nursery Co.	Shenandoah, Iowa	252
KMJ	Fresno Bee	Fresno, Calif.	234
KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KNRC	C. B. Juneau	Los Angeles, Calif.	208
KNX	Los Angeles Evening Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322
KOB	New Mexico College of Ag. & Mechanic Arts	State College, N. Mex.	349
KOCH	Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Monarch Manufacturing Co.	Council Bluffs, Iowa	278
KPO	Hale Bros.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Post-Dispatch	Houston, Texas	297
KPSN	Star-News Publishing Co.	Pasadena, Calif.	316
KQP	H. B. Read	Portland, Oreg.	213
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KQW	Charles D. Herrold	San Jose, Calif.	231
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Printing Co.	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	300
KSO	A. A. Berry Seed Co.	Clarinda, Iowa	242
KTAB	Tenth Ave. Baptist Church	Oakland, Calif.	333
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	Brown's Radio Shop	Portland, Ore.	263
KTCL	American Radio Telephone Co., Inc.	Seattle, Wash.	306
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	275
KTNT	N. Baker	Muscatine, Iowa	256
KTW	First Presbyterian Church	Seattle, Wash.	454
KUO	Examiner Printing Co.	San Francisco, Calif.	250
KUOM	State University of Montana	Missoula, Mont.	244
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	231
KVOO	The Voice of Oklahoma	Bristow, Okla.	375
KWG	Portable Wireless Telephone Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWKH	W. G. Patterson	Kennonwood, La.	261
KWSC	State College	Pullman, Wash.	349
KWUC	Western Union College	LeMars, Iowa	252
KWWG	City of Brownsville	Brownsville, Texas	278
KYO	Electric Shop	Honolulu, Hawaii	270
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	240
WAAB	Valdemar Jensen	New Orleans, La.	268
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAM	I. R. Nelson Co.	Newark, N. J.	263
WAAW	Omaha Grain Exchange	Omaha, Nebr.	278
WABC	Asheville Battery Co., Inc.	Asheville, N. C.	254
WABI	1st Universalist Church	Bangor, Me.	240
WABL	Connecticut Agricultural College	Storrs, Conn.	283
WABO	Lake Avenue Baptist Church	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	Coliseum Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	238
WAFD	Albert B. Parfet Co.	Port Huron, Mich.	275
WAHG	A. H. Grebe & Co.	Richmond Hill, N. Y.	316
WAIT	A. H. White Co.	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Hubbard & Co.	Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	248
WARC	American Radio & Research Corp.	Medford, Mass.	261
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAC	Clemson Agric. College	Clemson College, S. C.	331
WBAH	The Dayton Co.	Minneapolis, Minn.	417
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAO	James Millikan University	Decatur, Ill.	270
WBAL	Consolidated Gas & Elec. Co.	Baltimore, Md.	375
WBAP	Wortham-Carter Publishing (Star Telegram)	Fort Worth, Texas	476
WBAV	Erner & Hopkins Co.	Columbus, Ohio	292
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBAY	Western Electric Co.	New York, N. Y.	492
WBBA	Plymouth Congregational Church	Newark, Ohio	226
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment Co.	Chicago, Ill.	226
WBBN	Blake, A. B.	Wilmington, N. C.	275
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc.	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBX	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Infantry Co. "B" 118th Inf.	Charleston, S. C.	268
WBCN	Foster & McDonnell	Chicago, Ill.	266
WBDC	Baxter Laundry Co.	Grand Rapids, Mich.	256
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBGA	Jones Elec. & Radio Mfg. Co.	Baltimore, Md.	254
WBNY	Shirley Katz	New York, N. Y.	210
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBR	Pennsylvania State Police	Butler, Pa.	286
WBRC	Bell Radio Corporation	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Electric & Mfg. Co.	Springfield, Mass.	333
WBZA	Westinghouse Electric & Mfg. Co.	Boston, Mass.	242
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275

Finishing Your Radio Cabinet

(Continued from page 13)

pumice of a fine grade, on the surface of the cabinet, a light back and forth motion may be attempted. Do not make the downward pressure any thing but light as you will find that you have rubbed through the varnish if you are not careful. Do not make any circular motion or go across the grain as we found in sandpapering, scratches will result that will show up later. Examine the progress of the rubbing frequently by wiping the surface clean and where the varnish appears to be rough or still retains its gloss, the rubbing operation should be centered more than where it seems to be finished. Look out for rubbing the edges and the corners through white. It is about the easiest thing to do. If that condition does present itself, a little of the original stain applied with a small pointed brush will restore the color. Keep the felt wet.

When you think that the surface is rubbed about enough, wash off with water and thoroughly dry. Now it will take several coats, applied just this same way, and each one rubbed down, before a good surface can be had. I suggest that at least three coats be used and more if you want the best job. When you consider that a piano with its fine polished finish often has fifteen or twenty coats of varnish, you can better understand why. A good deal of success in rubbing is generally due to a fine grade of varnish, the good patience of the worker, allowing the varnish to be very dry before rubbing, and the degree of skill attained by the worker as he goes along. Some shops use a semi-flat or velvet finish varnish, as they call it. This drys with a surface that resembles a rubbed one. A little rubbing to smooth off the lumps and specks that accumulate somehow while the work is drying, will produce a job that looks as well as the one using the regular varnish. Some say it is not as durable as the other, but the makers claim it is.

When finishing up on the rubbing it is a good plan to wash the felt off and rub the surface with just the wet felt, as this will remove the tiny scratches and leave a better looking finish. Be sure to get all the pumice off between coats, by thoroughly washing, or the next coat will appear lumpy.

It is after the last touch has been done that the care or carelessness of your early work shows up. If you left any dents or rough places in the surface of the wood, they will remind you of it. The rubbing felt will not go down to the bottom of these places and a shiny unfinished spot will remain.

Much time spent on the preparation of the wood is time well spent, if you want a perfect job.

*** Asterisks ***
placed in advertising space denotes manufacturers have submitted samples of their products to Radio Age Institute and these products have passed the Institute tests.

WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufmann & Baer Co. and The Pittsburgh Press	Pittsburgh, Pa.	461
WCAH	Entrekin Electric Co.	Columbus, Ohio	266
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAO	A. A. and A. S. Brager	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Telephone Co.	Washington, D. C.	468
WCAR	Southern Radio Corp. of Texas	San Antonio, Texas	263
WCAS	W. H. Dunwoody Industrial Institute	Minneapolis, Minn.	280
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur C. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBF	Paul J. Miller	Pittsburgh, Pa.	236
WCBG	Howard S. Williams (Portable)	Pascagoula, Miss.	268
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Charles Swarz	Baltimore, Md.	229
WCBN	James P. Boland	Ft. Benj. Harrison, Ind.	266
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Messter	Providence, R. I.	205
WCBX	Radio Shop of Newark (Herman Lubinsky)	Newark, N. J.	233
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCEE	Liberty Weekly	Elgin, Ill.	275
WCLO	C. E. Whitmore	Camp Lake, Wisc.	231
WCLS	H. M. Couch	Joliet, Ill.	214
WCSH	Henry P. Rines	Portland, Maine	256
WCSO	Wittenberg College	Springfield, Ohio	248
WCUW	Clark University	Worcester, Mass.	238
WCWS	Chas. W. Selene (Portable)	Providence, R. I.	210
WCX	Free Press and Jewett Radio & Phonograph Co.	Detroit, 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
WDAR	Lit Brothers	Philadelphia, Pa.	393
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	261
WDBA	Plymouth Cong. Church	Newark, Ohio	226
WDBB	A. H. Waite & Co., Inc.	Taunton, Mass.	229
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
WDBD	Herman Edwin Burns	Martinsburg, W. Va.	268
WDBE	Gilham-Schoen Elec. Co.	Atlanta, Ga.	270
WDBJ	Richardson Wayland Electric Corp.	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio	227
WDBN	Electric Light & Power Co.	Bangor, Me.	252
WDBO	Rollins College, Inc.	Winter Park, Fla.	240
WDBR	Tremont Temple Baptist Church	Boston, Mass.	261
WDBV	The Strand Theatre	Fort Wayne, Ind.	258
WDBZ	Boy Scouts, City Hall	Kingston, N. Y.	233
WDCH	Dartmouth College	Hanover, N. H.	256
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
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	American Telephone & Telegraph Co.	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield (W. Gibson Buttfield)	North Plainfield, N. J.	261
WEAN	Shepard Co.	Providence, R. I.	270
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEB	Benwood Co.	St. Louis, Mo.	273
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBD	Electrical Equipment and Service Co.	Anderson, Ind.	246
WEBE	Roy W. Waller	Cambridge, Ohio	234
WEBH	Edgewater Beach Hotel and Herald Examiner	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBK	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
WEBL	Radio Corp. of America (Portable)	New York, N. Y.	226
WEBM	Radio Corp. of America (Portable)	New York, N. Y.	226
WEBP	E. B. Pedlcord	New Orleans, La.	280
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	226
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBT	The Dayton Coop. Industrial High School	Dayton, Ohio	256
WEBW	Beloit College	Beloit, Wis.	268
WEBZ	Savannah Radio Corp.	Savannah, Ga.	263
WEEI	The Edison Electric Illuminating Co.	Boston, Mass.	476
WEHS	Robert E. Hughes	Evanston, Ill.	203
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	285
WENR	All-American Radio Corporation	Chicago, Ill.	266
WEW	St. Louis University	St. Louis, Mo.	248
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
WFBE	John Van De Walle	Seymour, Ind.	226
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	278
WFBH	Concourse Radio Corporation	New York, N. Y.	273
WFBI	Galvin Radio Supply Co.	Camden, N. J.	236
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	Onondaga Hotel Co.	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
WFBQ	Wynne Radio Co.	Raleigh, N. C.	255
WFBR	Fifth Inf. Md. Nat'l Guard	Baltimore, Md.	254
WFBW	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	309
WFBZ	Knox College	Galesburg, Ill.	254
WFDF	F. D. Fallain	Flint, Mich.	234
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	F. K. Bridgman	Chicago, Ill.	217
WFRL	Robert Morrisson Lacey	Brooklyn, N. Y.	205
WFUV	G. Pearson Ward	Springfield, Mo.	252
WFUW	Earl William Lewis	Moberly, Mo.	233
WGAL	Lancaster Electric Supply & Construction Co.	Lancaster, Pa.	248
WGAQ	Youree Hotel	Shreveport, La.	252
WGAZ	South Bend Tribune	South Bend, Ind.	360
WGBB	Harry H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBI	Frank S. Megargee	Scranton, Pa.	240
WGBK	Lawrence Campbell	Johnstown, Pa.	248
WGBM	Theodore N. Saaty	Providence, R. I.	234
WGBQ	Stout Institute	Menominee, Wis.	234
WGBR	George S. Ives	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	316
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Florida	278
WGBX	University of Maine	Orono, Me.	252
WGCP	D. W. May, Inc.	Newark, N. J.	252
WGHB	G. H. Bowles Developments	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGI	American R. & R. Co.	Medford Hillside, Mass.	261
WGMU	A. H. Grebe & Co., Inc., Portable	Richmond Hill, N. Y.	236
WGN	The Tribune	Chicago, Ill.	370
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School Technology	Atlanta, Ga.	270
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University and Milwaukee Journal	Milwaukee, Wis.	275
WHAG	University of Cincinnati	Cincinnati, Ohio	233
WHAH	Hafer Supply Co.	Joplin, Mo.	283
WHAM	University of Rochester (Eastman School of Music)	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAT	Dr. George W. Young	Minneapolis, Minn.	263
WHAV	Wilmington Electrical Specialty Co.	Wilmington, Del.	266
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBB	The Copps Co.	Stevens Point, Wis.	240
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chas. W. Howard	Bellfontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co.	Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Inc.	Ellsworth, Me.	231
WHBL	James H. Slusser	Logansport, Ind.	216
WHBM	C. L. Carrell, Portable Station	Chicago, Ill.	233
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256
WHBR	Scientific Electric & Mfg. Co., 3664 Vine St.	Cincinnati, Ohio	216
WHBU	Riviera Theatre and 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 Ind. Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHK	The Radio Air Service Corp.	Cleveland, Ohio	273
WHN	George Schubert	New York, N. Y.	361
WHO	Bankers' Life Co.	Des Moines, Ia.	526
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	238
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	400
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAD	Chronicle Publishing Co.	Marion, Ind.	226
WIAS	Home Electric Co.	Burlington, Iowa	254
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBC	L. M. Tate Post, No. 29, Vet. of Foreign Wars	St. Petersburg, Fla.	222
WIBG	St. Paul's Protestant Episcopal Church	Elkins Park, Pa.	222
WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WIBI	Frederick B. Zitteli, Jr.	Flushing, 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	Werton W. Va.	246
WIBS	New Jersey Nat'l Guard Hdqs. Co.	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Grid-Leak, Inc.	Utica, N. Y.	205
WIBZ	Powell Electric Company	Montgomery, Ala.	231
WIL	Benson Radio & The Star	St. Louis, Mo.	273
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAB	American Electric Co.	Lincoln, Nebr.	229
WJAD	Jackson's Radio Engineering Laboratories	Waco, Texas	353
WJAG	Norfolk Daily News	Norfolk, Nebr.	270
WJAK	Clifford L. White	Greentown, Iowa	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAZ	Zenith Radio Co.	Mt. Prospect, Ill.	322
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	L. W. McClung	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBG	Interstate Radio, Inc.	Charlotte, N. C.	224
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
WJBN	St. Johns Ev. Luth. Church	Sycamore, Ill.	256
WJBP	Seneca Vocational School	Buffalo, N. Y.	218
WJBQ	Bucknell University	Lewisburg, Pa.	211
WJD	Denison University	Granville, Ohio	217
WJJD	Supreme Lodge, Loyal Order of Moose	Mooseheart, Ill.	303
WJR	Jewett Radio & Phonograph Co. and Detroit Free Press	Pontiac, Mich.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	New York, N. Y.	454
WKAA	H. F. Paar	Cedar Rapids, Iowa	278
WKAD	Chas. Looff (Crescent Park)	East Providence, R. I.	240
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.	285
WKAV	Laconia Radio Club	Laconia, N. H.	224
WKBB	Sanders Bros.	Joliet, Ill.	214
WKBE	K. & B. Electric Co.	Webster, Mass.	231
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKBK	Miss Shirley Katz	New York, N. Y.	210
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	326
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	422
WKY	Wky Radio Shop	Oklahoma City, Okla.	275
WLAG	Cutting & Washington Radio Corp.	Minneapolis, Minn.	417
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLAX	Community Broadcasting Station	Greencastle, Ind.	231
WLB	University of Minnesota	Minneapolis, Minn.	278
WLIB	Liberty Magazine	Chicago, Ill.	303
WLIT	Lit Bros.	Philadelphia, Pa.	394
WLS	Sears Roebuck & Co.	Crete, Ill.	345
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Mfg. Co.	Cincinnati, Ohio	422
WLWL	Missionary Society of St. Paul the Apostle	New York, N. Y.	288
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. Lesse Optical Co.	Washington, D. C.	213
WMAN	First Baptist Church	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.	Detroit, Mich.	256
WMBF	Miami Beach Hotel	Miami Beach, Fla.	384
WMC	Commercial Appeal	Memphis, Ten.	500
WMCA	Hotel McAlpin (Greeley Square Hotel Co.)	New York City	341
WMH	Ainsworth-Gates Radio Co.	Cincinnati, Ohio	321
WNAB	Shepard Stores	Boston, Mass.	250
WNAC	Shepard Stores	Boston, Mass.	280
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lennig Brothers Co. (Frederick Lennig)	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNJ	Radio Shop	Newark, N. J.	252
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNYC	Dept. of Plant and Structures	New York, N. Y.	526
WOAC	Page Organ Co.	Lima, Ohio	261
WOAE	Midland College	Fremont, Nebr.	280
WOAG	Apollo Theatre (Belvidere Amusement Co.)	Belvidere, Ill.	274
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOAN	Vaughn Con. of Music (James D. Vaughn)	Lawrenceburg, Tenn.	283
WOAO	Lyradion Mfg. Co.	Mishawaka, Ind.	369
WOAR	Lundskow, Henry P.	Kenosha, Wis.	225
WOAT	Boyd M. Hamp	Wilmington, Del.	360
WOAV	Pennsylvania Nat. Guard, 2d Bat., 112th Inf.	Erie, Pa.	242
WOAW	Woodman of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCG	Triple Alliance Radio Station	Sycamore, Ill.	205
WOCL	Hotel Jamestown, Inc.	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, N. J.	224
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Otto Baur	New York, N. Y.	233
WOO	John Wanamaker	Philadelphia, Pa.	508
WOQ	Unity School of Christianity	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Marketing Bureau	Jefferson City, Mo.	441
WOWL	Owl Battery Company	New Orleans, La.	270

Guide for Fans Who Want Free Radio Books

Folder listing types of radio tubes, Cleartron Vacuum Tube Co., 28 West 44th St., New York, N. Y.

Data on resistances, Crescent Radio Supply Co., 5 Liberty St., Jamaica, N. Y.

General catalog of parts, sets, broadcasting stations, Randolph Radio Corporation, Dept. 224, 159 N. Union St., Chicago, Ill.

Literature on consoles, tables and enclosures, Detroit Woodcraft Corp., 2262-4 Hendrie St., Detroit, Mich.

General catalog and log, Economy Radio Sales Co., Dept. C, 288 6th Ave., New York, N. Y.

Literature on audio transformers, Flint Radio Co., 1862 Wilson Ave., Chicago, Ill.

Circular covering development of set, Scott Radio Laboratories, 35 South Dearborn St., Chicago, Ill.

Data on radio products, Acorn Radio Products Co., 712 W. Madison St., Chicago, Ill.

Folder describing sets, W. K. Electric Co., Kenosha, Wis.

Literature on resistance coupled amplifier, Allen-Bradley Co., 289 Greenfield Ave., Milwaukee, Wis.

Special circular No. 776 and 15-B catalog covering indicating instruments, Jewell Electrical Instrument Co., 1650 Walnut St., Chicago, Ill.

Literature on condensers, Heath Radio and Electric Co., 206 First St., Newark, N. J.

Book describing radio courses and opportunities, National Radio Institute, Dept. AU3, Washington, D. C.

Radio hookups, Radiall Co., Dept. RA-1, 50 Franklin St., New York, N. Y.

Descriptive folder covering kits and sets, Telephone Maintenance Co., Dept. C, 20 South Wells St., Chicago, Ill.

Catalog of radio products, Daven Radio Corporation, 157 Summit St., Newark, N. J.

Booklet describing inductances, Aero Products Inc., 217 N. Desplaines St., Chicago, Ill.

Circular describing consoles, Raulf Radio Console Mfg. Co., 562 Vedder St., Chicago, Ill.

Fans Like Minstrel Shows Over Radio

Officials at KOA recently expressed belief they had found the champion program for radio broadcasting—Nineteenth century minstrel shows. This deduction was made following three minstrel performances which were arranged as a test feature.

Following each program, a spectacular increase was noted, it was said, in the number of responses from the audience. A check of these communications pointed to growing popularity for negro melodies, jokes and impersonations.

Asserting jazz has defeated itself, a North Dakota fan insists "the time is ripe for an early revival of minstrels."

From the standpoint of studio directors, minstrel shows, it was explained, are easily suited to broadcasting because of an absence of stage settings including effects and also, because a wide variety of musical numbers and humorous sketches may be used.

WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAC	Donaldson Radio Co.	Okmulgee, Okla.	360
WPAJ	Doolittle Radio Corp.	New Haven, Conn.	268
WPAK	North Dakota Agricultural College	Agricultural College, N. Dak.	275
WPAL	Superior Radio & Telephone Equipment Co.	Columbus, Ohio	286
WPCC	North Shore Cong. Church	Chicago, Ill.	258
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.	263
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	New York, N. Y.	361
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAQ	St. Louis Radio Service Co.	St. Louis, Mo.	* 263
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Horace D. Good	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wynne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio & Electric Co.	Coldwater, Miss.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRL	Union College	Schenectady, N. Y.	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., Motor Yacht "MU-1"	New York, N. Y.	236
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WRW	Tarrytown Radio Res. Labs	Tarrytown, N. Y.	273
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publishing Co.	Allentown, Pa.	229
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
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.	1219 S. Wabash Ave., Chicago, Ill.	210
WSBF	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	275
WSOA	Seventh Day Adventist Church	New York, N. Y.	263
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSM	Nashville Life and Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amusement Co. & Maison Blanche 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	Radio Company	Hamilton, Ohio	252
WSTA	Camp Marienfeld	Chesham, N. H.	229
WSUI	State University of Iowa	Iowa City, Iowa	484
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	266
WTAC	Penn Traffic Co.	Johnstown, Pa.	268
WTAD	Robt. E. Compton	Carthage, Ill.	236
WTAG	Telegram Pub. Co.	Worcester, Mass.	268
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Williard Storage Battery Co.	Cleveland, Ohio	389
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	S. H. Van Gordon & Son	Osseo, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAT	Edison Electric Illuminating Co.	Boston, Mass.	244
WTAW	Agricultural & Mechanical College of Texas	College Station, Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTG	Kansas State Agricultural College	Manhattan, Kans.	273
WTIC	Travelers Insurance Co.	Hartford, Conn.	349
WTX	H. G. Saal Co.	Chicago, Ill.	268
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	250
WWAE	Electric Park	Plainfield, Ill.	242
WWAO	Michigan College of Mines	Houghton, Mich.	263
WWGL	Radio Engineering Corp.	Richmond Hill, N. Y.	213
WWI	Ford Motor Co.	Dearborn, Mich.	266
WWJ	Detroit News	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg. Co., (Ltd.) Canada	Montreal, 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.	321
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
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.	434
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.	356
CNRV	Canadian National Railways	Vancouver, B. C.	411
CNRW	Canadian National Railways	Winnipeg, Man.	384

Republic of Mexico

CYB	Mexico City	360
CYL	Mexico City	510
CZE	Mexico City	345

Republic of Cuba

PWX	Cuban Telephone Co.	Habana	400
2BY	Frederick W. Borton	Habana	260
2CX	Frederick W. Borton	Habana	320
2OW	Pedro Zayas	Habana	300
2EV	Westinghouse Elec. Co.	Habana	220
2HC	Heraldo de Cuba	Habana	275
2HS	Julio Power	Habana	180
2JD	Raul Perez Falcon	Habana	105
2K	Alvara Daza	Habana	200
2KO	E. Sanchez de Fuentes	Habana	350
2LC	Luis Casas	Habana	250
2MG	Manuel G. Salas	Habana	280
2MN	Fausto Simon	Habana	270
2OL	Oscar Collado	Habana	290
2TW	Roberto E. Ramires	Habana	230
2WW	Amadeo Saenz	Habana	210
5EV	Leopoldo E. Figueroa	Colon	360
6BY	Jose Ganduxe	Cienfuegos	300
6CX	Antonio T. Figueroa	Cienfuegos	170
6DW	Eduardo Terry	Cienfuegos	225
6KJ	Frank H. Jones	Tuinucu	275
6KW	Frank H. Jones	Tuinucu	338
8BY	Alberto Ravelo	Stgo. de Cuba	250
8OW	Pedro C. Anduz	Stgo. de Cuba	275
8FU	Andres Vinnet	Stgo. de Cuba	225
12AB	Alberto S. de Bustamante	Habana	240
16AZ	Valentin Ullivarri	Cienfuegos	200
20K	Mario Garcia Velez	Habana	360

Great Britain

2LO	London	365
5IT	Birmingham	475
5WA	Cardiff	350
6BM	Bournemouth	385
2ZY	Manchester	375
5NO	Newcastle	400
5SC	Glasgow	420
2BD	Aberdeen	492
6SL	Sheffield (relay station)	303

France

YN	Lyons	740
FL	Paris (Eiffel Tower)	2,6[illegible]
8AJ	Paris	1,870
ESP	Paris	—

Why the Model Sets are Being Built

For some time past Radio Age has been deluged with correspondence from readers asking why we do not show a number of sets made up of commercially manufactured and easily secured material, the idea being that perhaps a number of fans have on hand radio parts of good quality which they might utilize in a standard circuit without having to buy all parts of the same general type.

The Radio Age model series was begun in December with a list of parts easily secured from any good radio dealer. Any parts of equal merit to those shown in the list might also be used. Further if the experimenter desired to wind his own inductances he would be able to do so and make use of them in the same hookup. For example, honeycomb coils may be used for inductances in either the December or January models; in fact any kind of inductance may be used by the builder. Our technical staff on account of the greater convenience and the fact commercial apparatus is generally more accurate than the home made, grouped together a number of representative units and made them into a receiver. The same policy will be adhered to in the future so the interested experimenter may easily see how the various parts may be utilized. At the same time readers may witness the process of simplified set-building described in a step-by-step manner, all of which makes very interesting reading for those who have a genuine interest in the art.

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook the value of RADIO AGE'S classified advertisements. Many such messages have paved the way to independent incomes.

The classified advertising rates are but ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, of five, fifteen and thirty per cent respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less than ten words will be accepted.

All classified ads for the February issue must be sent in by January 1.

ADVERTISING SERVICE

QUEX Sales Letters Get More Business. Write him today. Quex, 4418 Michigan Ave., Chicago.

AGENTS WANTED

FORDS, 60 miles on one gallon of Gas. It has been proven such mileage can be made. AIRLOCK guarantees to increase gas mileage; also prevents radiator boiling in summer or freezing in winter. Cools, Fuels, Decarbonizes the Ford motor. Splendid territory open. AIRLOCK PRODUCTS, Box 703C, Willow Street, Long Beach, Calif.

RADIO—Join our sales organization and make big money. We want a man in every county to sell well advertised sets and parts made by the leading manufacturers. Widener of Kansas City makes $150.00 weekly. You can do as well or better. Write today for catalog, and discounts. Name your county. Waveland Radio Company, Div. 52, 1027 No. State St., Chicago, Ill.

MANUFACTURER'S AGENT calling on Radio-Electrical Jobbers, Chicago and vicinity, has opening for 3 additional lines carrying volume business, as we cater to large jobbers. Edelstein, 1804 McCormick Bld., Chicago.

Man wanted for this territory to sell wonderful value men's, women's, Children's shoes direct, saving consumer over 40%. Experience unnecessary. Samples supplied. Big weekly permanent income. Write today Tanners Mfg. Co., 1334C. St., Boston, Mass.

RADIO SALESMEN and SET BUILDERS in every county write Grenzer Radio, 1479 Hodiamont, St. Louis, Mo.

AGENTS

AGENTS: 100% PROFIT: WONDERFUL LITTLE article. Something new; sells like wildfire. Carry in pocket. Write at once for free sample offer. ALBERT MILLS, Manager, 5794 American Bldg., Cincinnati, Ohio.

"B" BATTERIES

100 VOLT EDISON TYPE "B" BATTERY, knocked down. Parts and plans—complete, $12.50. Lane Mfg. 2937 W. Lake, Chicago.

BATTERIES FOR SALE—Four 24-volt "Main" Storage "B" Batteries, never used, shipped and ready to wire for $38.00. First order gets the batteries. Address Box B, Radio Age, 500 N. Dearborn St., Chicago, Ill.

BUSINESS OPPORTUNITIES

$100 weekly up. We want experienced Radio men to operate branch assembling plants. Part or whole time. Barfield Radio Co., 13 Tillery Street, Dept. A R, Brooklyn, New York.

CRYSTALS

Supersensitive Galena Crystals: Pound 75c prepaid. ALKEMITE. All sensitive Crystals 50c. Buskett, Geologist, Joplin, Missouri.

Classified ad. copy for the February RADIO AGE must be sent in by January 1, 1925.

DOGS

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

HELP WANTED

RADIO SALESMEN and SET BUILDERS—We need you and you need us. If you are reliable and well known in your community, we will appoint you our representative and furnish you with standard well advertised sets and parts at prices that will enable you to sell at a handsome profit. Write at once for catalog and sales plan. Waveland Radio Co., Div. 53, 1027 N. State St., Chicago, Ill.

MEN wanting forest ranger, railway clerk and other government positions, write for free particulars of exams. Makane, Dept. B-33. Denver, Colo.

MEN WISHING TO ENTER DINING, SLEEPING CAR SERVICE AS CONDUCTORS, PORTERS, WAITERS, WRITE 123 RAILWAY EXCHANGE, KANSAS CITY.

INVENTIONS

NEW IDEAS WANTED—Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and saleable. Address: Mr. R. F. Devine, Room 3101, 116 West 32nd St., New York, N. Y.

PATENTS

FOR SALE: U. S. and Canadian Patent on an Attachment for Phonographs; is the most beautiful invention of the age. Address Chas. F. Smith, Huff, N. Dak.

RADIO

Sixty cents monthly subscribes four Radio magazines List Free. Spencer-Shields Agencies, West Los Angeles California.

A PRACTICAL TUBE RECEIVING SET FOR $10. Postpaid. Jess phones and tube. Complete with phones, tube and battery, $18.00. J. B. RATHBUN, 1067 Winona St., Chicago, Ill.

Standard solderless radio Jacks. Binding post attachments. Double circuit. One dollar bill. Postpaid. Clinton Seward, Jr., New Paltz, New York, N. Y.

Three Cosmopolitan Phusiformers, each $5.50, book of instructions included. F. A. Mall, Tripoli, Iowa.

15 to 25 per cent discount on nationally advertised sets and parts. Every item guaranteed. Tell us your needs. IMPERIAL RADIO COMPANY, Delaware, Ohio.

RADIO SETS. Our prices save you money. Lists free. The Radio Shoppe, Box 645, East Liverpool, Ohio.

AT LAST! The Radco Static Eliminator. Eliminates 50 to 90% Static. Many satisfied users. Write for particulars. Radio Specialties Company, Sioux Falls, South Dakota.

$1.00 For Your Old Tubes
regardless of make or condition towards the purchase of each new Standard $2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. Order today. Luxem & Davis Mfg. Co., 6229 Broadway, Chicago, Ill.

RADIO CIRCUITS

SPECIAL FOR JANUARY
The Rainarts Radio Booklet, by Frank D. Pearns, fully illustrated, and RADIO AGE, for $2.50. Price of Booklet alone is 50c. Send check, currency or money order to RADIO AGE, 500 N. Dearborn Street, Chicago.

RADIO DEALERS

DEALERS—Write for our illustrated catalog of reliable Radio Merchandise. Transmitter Corporation, Dept. D, 1836 Wilson Ave., Chicago, Ill.

RADIO SUPPLIES

HAVE YOU SEEN THE NEW DIALITE, THE UNIQUE lamp that lights up your panel and adds a decorative touch to any radio set? Retails at $2.75, complete. Send for folder and dealer's proposition on this fast moving article. Also, we are distributors for the famous Knurled Walnut Cabinets, the most beautiful cabinets made. American-Universal Radio Co., 6255 Broadway, Chicago, Ill., Box 11.

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 $355 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 126 F Austin Ave., Chicago.

66 MILES ON 1 GALLON—SCIENTIFIC GAS SAVER. All autos. 1 free to introduce. Critchlow, A-90, Wheaton, Illinois.

MANUFACTURERS OF NEW AND IMPROVED STATION finder and vernier tuning-dial want live salesmen to call on radio trade. Excellent side-line; good commissions; exclusive territories. Westerland Corporation, Dobbs Ferry, New York.

STAMPS

STAMPS, 50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc., 10c. 50 different U. S., 25c; 1,000 mixed, 40c; 1,000 hinges, 10c. List free. C. Stegman, 5950 Cote Brilliante, St. Louis, Missouri.

WANTED

WANTED—To complete my set RADIO AGE need August, September, October, November, 1923, issues, bound or unbound. Advise price. Lloyd C. Henning, Hollbrook, Arizona.

WIRELESS

WANT TO MEMORIZE THE WIRELESS CODE? The Coryden Snyder Code Method. Patented, is quickest. Send 50c coin, stamps or M. O. to C. G. Snyder, 1423 Elmdale Ave., Chicago, Ill.

TELEGRAPHY—Morse and Wireless—taught at home in half usual time and at trifling cost. Omnigraph Automatic Transmitter will send, on Sounder or Buzzer, unlimited messages, any speed, just as expert operator would. Adopted by U. S. Govt. and used by leading Universities, Colleges, Technical and Telegraph Schools throughout U. S. Catalog free. Omnigraph Mfg. Co., 13 F Hudson St., New York.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Eva Moore, Box 908, Jacksonville, Florida. Enclose stamp.

Look! You Radio Bugs! Join Radio Correspondence Club. Entirely new. Broaden your acquaintance, exchange ideas. Membership open to LADY BUGS also. Dime stamp brings pamphlet and Radio Novelty Cards. Radio Rose, Box 662, Cleveland, Ohio.

Radio Age Classified Ads Bring Results

Tell them you read it in Radio Age

Radio Dianas

Mayor William E. Dever of Chicago officially welcomed Miss Rena Jane Frew of Beaver, Pa., America's Radio Diana, (left) and Flossie E. Erickson of Bloomington, Ill., Miss Radio of the Middle West, to the fourth annual Chicago Radio Show, Nov. 17 to 22. The Mayor also spoke at the formal opening of the show.

Elect Officers for National Radio Trade Association

Henry M. Shaw, president of the Shaw Insulator Company of Newark, N. J., and prominent radio figure was re-elected head of the National Radio Trade Association for the coming year, according to announcement by George Lewis, teller at the recent election.

Other officers elected were: C. B. Cooper, New York, treasurer; L. A. Nixon, secretary; and Walter A. Schilling, members of the board of directors at large. Eight vice presidents were elected as heads of various committees directing the activities of the organization, including Powel Crosley, Jr., H. B. Richmond, Geo. C. Furness, Frank Reichman, Lawrence Mott, D. MacGregor, R. W. DeMott, and Burt B. Barsook.

Directors elected to represent specific sections of the country were as follows: Paul B. Lamius, Denver; Arthur Halloran, San Francisco; C. J. Zamoiski, Baltimore; J. L. Willinbrink, Louisville; C. P. Belden, Chicago; Royal Stemm, Chicago; Chas. G. Taylor, Newport, Vt.; A. Ullman, Boston; Alex Eiseman, Brooklyn; O. B. Carson, New York; M. W. Kunkel, Pittsburgh; A. R. Wildauer, Detroit; Herman Rose, Newark and F. M. Rosenfeld, Newark, N. J.

These officers will serve until after the fifth annual convention of the association to be held in May at Atlantic City, their successors being elected shortly after the convention and taking office in the summer of 1926. The membership of this organization, according to announcement, makes it the largest in the Radio industry, taking in every branch of the trade and art.

Asterisks placed in advertising space denotes manufacturers have submitted samples of their products to Radio Age Institute and these products have passed the Institute tests.

Easy to Build this 5 Tube Receiver

Send For This Book

Contains step-by-step instructions on the assembly, wiring and operation of the Hammarlund-Roberts. Fully illustrated; most complete "How to Build It" radio book ever published.

25c

THE unusual simplicity in design of the Hammarlund-Roberts is one of the many stirring features that have made this receiver the talk of the country.

The creative genius that conceived the idea of this masterly five-tube receiver, and the engineering skill that brought the idea to reality, kept always in mind the limited mechanical ability of the inexperienced builder. The result is a plan of assembly so complete, so detailed, that anyone, following the step-by-step directions in the instruction book may construct the Hammarlund-Roberts in the course of an evening.

And, to the proud owner, his completed work becomes at once the measure of efficient receiver design. At a fraction of the cost of a ready-made receiver of nearly equal efficiency, he has an "engineered" radio set—a scientifically perfect mechanism in which every part synchronizes with the others.

The masterpiece of ten leading engineers—equal in performance to a standard eight-tube set—backed by the best known parts manufacturers in the radio field—this is the Hammarlund-Roberts. Today it is the one radio receiver desired above all others.

Parts Complete, less Cabinet, $62.30

Associate Manufacturers

All-American Radio Corp.
Alden Mfg. Co.
Radiall Company (Amperites)
Carter Radio Co.
Union Radio Corp.
International Resistance Co., Inc. (Durham Resistors)
Westinghouse Micarta
Hammarlund Mfg. Co., Inc.

HAMMARLUND-ROBERTS, 1182-D Broadway, New York City

Hammarlund Roberts

Rauland-Lyric ALL-AMERICAN TRANSFORMER

This famous instrument and other parts shown are some of the quality units used in the Hammarlund-Roberts.

AMPERITE

DURHAM UNION

Hammarlund

Carter Switches and Rheostats

NA-ALO Dials, Sockets

* *Tested and Approved by* RADIO AGE *

Zenith Super-DeLuxe English Model

Ten Tubes!

in DeLuxe Art Model Cabinets from $500 to $2,000.

Super-Zeniths priced from $240 to $355

Other Zenith Sets $100 and $175

Zenith Super-DeLuxe Colonial Model

Ten Tubes—with but a Single Dial!

If you would really know the wonder of fine radio reception—listen to the ten-tube Zenith Super-DeLuxe!

Imagine a tone, for example, so clear and mellow that each instrument in a big orchestra can be readily identified.

Imagine a control so perfectly synchronized that the turning of a single dial gives you a complete *procession* of programs, each coming in the instant the dial touches its proper mark, each vanishing less than two points beyond.

To make the statement that one has discovered "the best in radio" without having listened to the ten-tube Zenith Super-DeLuxe is like calling a violinist the greatest in the world without ever having listened to Kreisler.

See Zenith—listen in your own home to the instrument which MacMillan chose exclusively for his Arctic Expeditions. Then—hear all the other sets you like. We will abide by your decision.

Your nearest Zenith dealer will be glad to demonstrate a Zenith Super-DeLuxe, any night you say. Write for his name, together with complete descriptive literature.

ZENITH RADIO CORPORATION
Straus Bldg., 310 S. Michigan Ave., Chicago, Ill.

Super-Zenith Model VIII

Same as VII except—built with mahogany legs of well proportioned, appropriate design, converting model into console type.

Super-Zenith VII

Six tubes—2 stages tuned frequency amplification—detector and 3 stages audio frequency amplification. Installed in a beautifully finished cabinet of solid mahogany—44¼ inches long, 16½ inches wide, 10¾ inches high. Compartments at either end for dry batteries.

Why did Commander MacMillan take Zenith to the Arctic?

Because—on his previous expedition, Zenith kept him in touch with civilization. Naturally he again chose it because of first hand knowledge of its absolute dependability.

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