Blueprint Section Every Month

Radio Age
The Magazine of the Hour

JULY 1925
25¢

In This Issue—
Ten Commandments for the Listener
A New Super-Heterodyne
Solving Tube Troubles
News of Radio Age’s Popularity Contest

MEET YOUR BROADCAST FAVORITES
A Perfected Super-Heterodyne

Again Silver-Marshall Engineering leads the field, just as it has since the first Silver Design was offered less than a year ago.

Not content with a seven-tube super-heterodyne, which has become the acknowledged standard of comparison with radio engineers and editors, McMurdo Silver, Assoc., I. R. E., has developed "The Super-Autodyne," a six-tube receiver that will outperform average seven and eight-tube sets.

Read the description of this remarkable radio achievement in this issue of "Radio Age." Plans and instructions describing this set in detail may be had for 50c.

Complete Parts

<table>
<thead>
<tr>
<th>Part Description</th>
<th>Each Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 S.M. 301A S.L.W Condensers</td>
<td>$1.00</td>
</tr>
<tr>
<td>1 S.M. 6 Ohm Rheostat</td>
<td>$1.00</td>
</tr>
<tr>
<td>1 S.M. 245 Ohm Potentiometer</td>
<td>$1.50</td>
</tr>
<tr>
<td>1 Carter Top Binding Posts</td>
<td>$0.50</td>
</tr>
<tr>
<td>1 Carter 101 Jack</td>
<td>$0.80</td>
</tr>
<tr>
<td>1 S.M. 211 Filter with Matched Tuning Capacity</td>
<td>$0.80</td>
</tr>
<tr>
<td>2 S.M. Charted Intermediate Transformers</td>
<td>$8.00</td>
</tr>
<tr>
<td>1 S.M. 101B Coupling Unit</td>
<td>$2.50</td>
</tr>
<tr>
<td>1 S.M. 6 Gang Socket shelf (S36-201A, S37-UV199)</td>
<td>$10.80</td>
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<tr>
<td>2 Thordarson 3 1-2-1 Transformers</td>
<td>$4.00</td>
</tr>
<tr>
<td>2 S.M. 202 Condensers</td>
<td>$0.40</td>
</tr>
<tr>
<td>2 S.M. 2035 Condensers</td>
<td>$0.75</td>
</tr>
<tr>
<td>2 2000925 Balancing Condensers</td>
<td>$1.00</td>
</tr>
<tr>
<td>1 S.M. 2 Meg. Leak</td>
<td>$0.50</td>
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<tr>
<td>1 S.M. 2 meg. Leak</td>
<td>$0.50</td>
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<tr>
<td>1 Carter No. 3 Jack Switch</td>
<td>$1.15</td>
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<tr>
<td>1 Benjamin 8650 Switch</td>
<td>$0.30</td>
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<tr>
<td>1 Belden Color cable</td>
<td>$0.85</td>
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<tr>
<td>2 Pair Benjamin 8529 Shelf Brackets</td>
<td>$0.70</td>
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<tr>
<td>1 Pair Benjamin 8529 Shelf Brackets</td>
<td>$0.70</td>
</tr>
<tr>
<td>1 Bakelite panel, 7&quot;x18&quot;x3-16&quot;, drilled, grained, and engraved</td>
<td>$6.00</td>
</tr>
<tr>
<td>1 Spaghetti, bus bar, lugs, screws, buts, etc.</td>
<td>$1.00</td>
</tr>
</tbody>
</table>

Send for “The WHY of the Super-Autodyne”—It’s Free; Dealers—Ask for Our New S-M Catalog

Silver-Marshall, 114 S. Wabash Avenue, Chicago, Illinois

* Tested and Approved by RADIO AGE *
Stations Don't "Bunch" On the Dials

Showing stations "Bunch-ed" as they are found on a 100 degree dial using any ordinary condenser.

The location of the same stations on the same dial using Ultra-LowLoss Condensers—"spread," simplifying tuning.

**Tuning Simplified Now!**

The day of tedious fumbling about for your stations is past—science has been brought into play. Now, with the Ultra-LowLoss Condenser you can instantly tune in on any station as easy as turning the hands of a clock to the hour.

With one station of known wave length located on the dial, all others can be found instantly. Each degree on a 100 degree dial represents approximately \(\frac{1}{10}\) meters difference in wave length. This applies to both high and low wave lengths. Other than 100 degree dials vary accordingly.

This simplification of tuning is made possible by the new Cutless Stator Plates to be found only in the Ultra-LowLoss Condensers. Every feature of the Ultra-LowLoss Condenser was developed with one predominating purpose—to overcome losses common in other condensers. Designed by R. E. Lacault, originator of the famous Ultradyne Receivers and Ultra-Vernier Tuning Controls.

At your dealer's, otherwise send purchase price and you will be supplied postpaid. Design of lowloss coils furnished with each condenser for amateur and broadcast wave lengths showing which will function most efficiently with the condenser.

**To Manufacturers Who Wish To Improve Their Sets**

Mr. Lacault will gladly consult with any manufacturer regarding the application of this condenser to his circuit for obtaining best possible efficiency.
A Chat With the Editor

YOU can count on the fingers of your two hands the basic radio receiver circuits from which all the many scores of hook-ups now existing may be developed. All those basic circuits are to appear in blueprint form in the August issue of this magazine. Our technical staff has selected the typical circuits which represent the various basic arrangements, most of which have appeared during 1924 and 1925 in RADIO AGE.

John B. Rathbun, the able draughtsman whose blueprints in this magazine have become standard in schools and in many thousands of radio homes, will have in this de luxe edition of RADIO AGE an exhibit of tested basic circuits which will make our August issue one of the most important radio contributions since broadcasting began. The blueprint section of the August number will itself be of almost the bulk of the regular magazine. With the addition of other standard RADIO AGE features the book will take on proportions that should delight the fan who wants his radio course from crystal to super, all under one cover.

Notwithstanding the unusual value offered in this big issue of our magazine the news-stand price will be the same as other issues; 25 cents. It is a matter of wide comment that RADIO AGE costs no more from month to month than other standard radio publications, although its blueprint section in each issue sets it apart from all other magazines. Now we are to offer you a complete collection of blue prints with complete constructional instruction in a single issue and for the regular price.

We would advise readers who wish to make sure of getting this remarkable August number that they tell their newsdealer to reserve their magazine for August NOW. If your dealer does not handle RADIO AGE write to us at 500 North Dearborn street, Chicago, enclosing 25 cents in stamps and we will mail you one on July 15, the day it goes on sale.

Frederick Smith
Editor of RADIO AGE
Get a good set—
and Evereadys

To enjoy radio for the rest of your life, get the best set you can afford. There are receivers at all prices, made by reputable manufacturers; it isn't necessary for anyone to get 'round-the-corner, unproved, unreliable merchandise at any price. That applies to batteries too. Eveready Radio Batteries are made in so many sizes and prices that there is a correct, long-lasting Eveready for every receiver and for every radio home, ship or commercial station. Specify Evereadys for your new radio set. It is false economy to buy nondescript batteries at any time. In the long run you'll find it most economical to buy either the large or extra large Evereadys. Always buy Evereadys and enjoy the knowledge that no one can get any more in batteries for the money than you. There is an Eveready dealer nearby.

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

EVEREADY
Radio Batteries
—they last longer.

* Tested and Approved by RADIO AGE • *

<table>
<thead>
<tr>
<th>Type</th>
<th>Price</th>
</tr>
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<tbody>
<tr>
<td>No. 766</td>
<td>215-volt Large Horizontal Price $2.00</td>
</tr>
<tr>
<td>No. 771</td>
<td>45-volt Large Vertical Price $3.25</td>
</tr>
</tbody>
</table>

Eveready Columbia Ignitor Dry Cell for all Radio Dry Cell Tubes 3½ volts

* No. 766 215-volt Large Horizontal Price $2.00
* No. 772 45-volt Large Vertical Price $3.25

Eveready Columbia Ignitor Dry Cell for all Radio Dry Cell Tubes 3½ volts
RADIO CORPORATION of America has completed its "proof" that in adopting the name RADIO AGE this magazine stepped on the cloven hoof of the corporation. The RCA contends that RADIO AGE, as a name, infringes on the name "Wireless Age," a publication owned by the Radio Corporation. Radio Corporation last fall brought formal action in the United States Patent Office at Washington opposing the application to have RADIO AGE registered as a trade mark.

The $33,000,000 group apparently held the fond notion that RADIO AGE would immediately yield its rights, rather than go into a legal battle with one of the Four Horsemen of Radio. On the contrary, RADIO AGE engaged the services of several of the best lawyers obtainable and we have seen the thing through. On May 5, in the Corporation offices in New York, the Corporation completed the taking of testimony of its own witnesses. The Corporation labored and brought forth a peanut tube.

It was an imposing array of witnesses and we regretted that Mr. Sarnoff, vice president and general manager of the RCA horse, was unable to be present. Mr. Sarnoff was busy preparing for a banquet. He is a banqueteer of parts. No hungry Cassius he.

At the last Hoover conference, Charles E. Erbstein faced the representatives there present in the interest of the Radio Corporation, Westinghouse, General Electric and American Telephone and Telegraph, and told them they were the Four Horsemen of Radio.

The name stuck. A few weeks later Mr. Sarnoff and Mr. Erbstein were present at a radio dinner in New York. Mr. Sarnoff approached Mr. Erbstein and asked in a gently sardonic tone:

"Tell me; which one of the Four Horsemen am I?"

"Pestilence!" responded Mr. Erbstein in a flash.

"Not famine?" inquired Mr. Sarnoff, somewhat taken back.

"You, Famine? Never!" murmured Mr. Erbstein.

So, on the occasion of the taking of depositions calculated to prove that RADIO AGE is guilty of unfair competition and is injuring the business of "Wireless Age," Mr. Sarnoff was preparing for another banquet.

It was necessary that the RCA witnesses swear to facts that would support the contention that the words "wireless" and "radio" mean the same thing. If this were proved, Radio Corporation might hope to get somewhere with its argument that in adopting the name, RADIO AGE, this magazine was appropriating, in effect, the name "Wireless Age," which does not belong to this magazine, but belongs to the New York monthly wireless publication, every share of stock in which is owned by Radio Corporation.

The witnesses then swore "wireless" and "radio" meant the same thing. No distinction whatever so far as the man on the street was concerned. But it developed, on cross examination, that all the witnesses were on the payroll of the Corporation and therefore could not well be criticized if their expert views on the significance of words partook of the same general tendency as the views of the kind and loving old Radio Corporation.

It also was necessary to prove that the use of the name RADIO AGE was causing injury to the business of Radio Corporation's magazine, which, they assure us, is called "Wireless Age." Therefore, a witness testified that newsdealers get the two magazines — that although one is published in New York and the other in Chicago, dealers often send unsold copies of RADIO AGE to "Wireless Age." The circulation manager of "Wireless Age" produced one letter in support of this contention. He said he had looked hard for other documentary evidence of the universal confusion between RADIO AGE and "Wireless Age" but the one letter was the best he could do.

Another Corporation employee swore that at the Pageant of Progress in 1922 he heard subscription solicitors in the RADIO AGE booth telling the gullible public that RADIO AGE was published by the Radio Corporation of America. This witness testified he immediately complained to the manager of the Pageant hotel. The RADIO AGE solicitor, Mr. Erbstein, was able to throw the solicitors out of the Pageant, and the RADIO AGE booth remained empty and free of guile from then on until the show closed. This witness admitted he never brought these matters to the attention of the officers of RADIO AGE, Inc., and that he didn't report the incident to "Wireless Age" until July, 1924 — almost two years later. A long time to carry such a pineapple around in one's craw.

Mr. Pierre Boucheron, general manager of the advertising and publicity departments of Radio Corporation and vice president and General manager of Wireless Press, Inc., which publishes "Wireless Age" for Radio Corporation, was easily the star witness for Radio Corporation. He, too, thought "wireless" and "radio" were identical in meaning. But on cross examination he admitted that since the action against RADIO AGE was begun, the name of the magazine which is claiming it is suffering great injury from competition by RADIO AGE changed its own name from "The Wireless Age" to "Wireless Age, The Radio Magazine." This change was officially announced in the corporation's magazine last November. It was explained in this announcement that the old title was being retained in part so that the magazine might be more easily identified by those who were more specially interested in wireless. Yet "wireless" and "radio" mean the same thing!

A man might be obviously right from start to finish in a controversy such as this and in the end might prove himself to be right. But he would have been compelled to finance his defense and, though he be right as a trivet, he could not obtain recourse against predatory interests who put him to all the trouble and expense. That's why a $33,000,000 band of patriots has a big advantage in opposing an individual of much more modest resources. Doesn't it seem to be quite all square with our fundamental ideals of equal opportunity and equal rights under the law, does it? We were warned three years ago that if RADIO AGE criticised certain radio interests those interests would step on us. Yet we criticised radio monopoly and we are going to keep it up. If we survive where others faint, it may be because our readers and newsdealers are not so confused as some folks hope they are.
Race is Still Neck and Neck
As Aldine Starts the Official Count of Last-Minute Ballots; Name of Winner to Be Revealed Next Month

By the time this issue of RADIO AGE appears on the news-stands, the RADIO AGE Popularity Contest will have ended, as only those votes received before midnight of June 15 will be credited to the total count of candidates.

As this review is being written (May 16), there still remain a full thirty days, during which period the winner will be definitely named, and judging from the heavy voting which has taken place during the past thirty days, no candidate is yet assured of the coveted position at the head of the list. At no time in the history of the contest have the three leading candidates been so closely bunched.

To further complicate matters, "Uncle John" Daggett, "way out on the Pacific Coast, has jumped from ninth to fourth place, where he stands menacingly, offering dangerous competition to the three popular leaders. By referring further to the "Standing to May 15" it will be found that Art Linick has also bettered his position by stepping one more round toward the top of the ladder, from eighth to seventh place.

On this page will be found an illustration of the shield which will be awarded the winner of the RADIO AGE Popularity Contest. From a background of artistic black will stand out in raised gold letters "The Winner's Name," and the inscription, "First Annual RADIO AGE Broadcast Entertainers' Popularity Contest—1924-25."

Surrounding this will be a plain gold border conforming to the shape of the shield. The gold plate will in turn be mounted on a dead black bevel-edged wooden plaque, to which is attached a chain for hanging. The size, overall, is six by eight inches.

While several ideas were offered for the design of the shield, the one accepted seemed to conform most to the principles of dignified simplicity, and was therefore the most forcible manner of declaring to the world the winner of the contest. Following is the standing of the candidates as they are lined up at present:

**WINNERS OF PRECEDING MONTHS**

<table>
<thead>
<tr>
<th>Month</th>
<th>Name and Classification</th>
<th>Where Heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>Duncan Sisters, KYW</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>Bill Hay, KFREX</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Karl Bonawitz, WIP</td>
<td></td>
</tr>
</tbody>
</table>

**STANDING TO MAY 15**

<table>
<thead>
<tr>
<th>Name and Classification</th>
<th>Where Heard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karl Bonawitz, Organist</td>
<td>WIP, Philadelphia</td>
</tr>
<tr>
<td>Bert Davis, Entertainer</td>
<td>WOJ, Chicago</td>
</tr>
<tr>
<td>Bill Hay, Announcer</td>
<td>KFREX, Hastings</td>
</tr>
<tr>
<td>John S. Daggett, Announcer</td>
<td>KHJ, Los Angeles</td>
</tr>
<tr>
<td>H. W. Arlin, Announcer</td>
<td>KDKA, Pittsburgh</td>
</tr>
<tr>
<td>Coon-Sanders' Nighthawks, Orchestra</td>
<td>KYW, Chi.</td>
</tr>
<tr>
<td>Jack Nelson, Announcer</td>
<td>WJJD, Mooseheart</td>
</tr>
<tr>
<td>Art Linick, Entertainer</td>
<td>KYW, Chicago</td>
</tr>
<tr>
<td>Harry M. Snodgrass, Entertainer</td>
<td>WOS, Jefferson City</td>
</tr>
<tr>
<td>Ford &amp; Glenn, Entertainers</td>
<td>WLS, Chicago</td>
</tr>
<tr>
<td>Duncan Sisters, Entertainers</td>
<td>KYW, Chicago</td>
</tr>
<tr>
<td>Lee Sims, Pianist</td>
<td>KWW, Chicago</td>
</tr>
<tr>
<td>Lambdin Kay, Announcer</td>
<td>WSB, Atlanta</td>
</tr>
<tr>
<td>J. Remington Welch, Organist</td>
<td>KFY, Chicago</td>
</tr>
<tr>
<td>Fred Smith, Announcer</td>
<td>WWJ, Detroit</td>
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<tr>
<td>Hired Hand, Announcer</td>
<td>WBAP, Fort Worth</td>
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<tr>
<td>&quot;Ben&quot; Kancy, Announcer</td>
<td>KFY, Chicago</td>
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<tr>
<td>Nick B. Harris, Entertainer</td>
<td>KFI, Los Angeles</td>
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<tr>
<td>Jerry Sullivan, Entertainer-Announcer</td>
<td>WQJ, Chi.</td>
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<tr>
<td>Edward H. Smith, Director-Player</td>
<td>WOJ, Schenectady</td>
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<td>Charles E. Erbstein, Announcer</td>
<td>WTAS, Elgin</td>
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<tr>
<td>Wendell Hall, Entertainer</td>
<td>KFWA, Kansas City</td>
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<td>Howard Miholland, Announcer</td>
<td>KGO, Oakland</td>
</tr>
<tr>
<td>Scottich Rite, Orchestra</td>
<td>KGO, Oakland</td>
</tr>
<tr>
<td>Banks Kennedy, Entertainer</td>
<td>WEDH, Chicago</td>
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<tr>
<td>S. Hastings, Announcer</td>
<td>KFY, Chicago</td>
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<tr>
<td>Robert Boniel, Announcer</td>
<td>WQJ, Chicago</td>
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<tr>
<td>Arion Trio, Instrumental</td>
<td>KGO, Oakland</td>
</tr>
<tr>
<td>Gold Dust Twins, Entertainers</td>
<td>WEAF, New York</td>
</tr>
</tbody>
</table>

At the left is the attractive shield which will be awarded the winner in the RADIO AGE Popularity Contest, which closed on June 15. Its size overall is six by eight inches, and a detailed description is contained in the article on this page by Mr. Aldine, the persevering Contest Editor for this magazine.
Mr. Manufacturer

Would you write 100 letters to 100 people to reach just two men?

Then, before you invest your advertising dollars—THINK!

An analysis shows that publications of general circulation, newspapers and magazines, devote less than 2% of their reading columns to Radio—proving that in the opinion of their own Editors less than 2% of their readers are interested in Radio. In fact, many general publications carry no Radio editorial matter. Therefore—98% of your investment is lost!

On the contrary, the Radio magazine offers 100% Radio editorial—attracts 100% potential buyers.

Spend your advertising appropriation in Radio Magazines. Be sure of the greatest possible return on your advertising dollar.

Radio Magazine Publishers' Association, Inc.

RADIO AGE is a member of the Radio Magazine Publishers Association, Inc.
What will Tomorrow Bring—

Four, Five or Six TUBES?

By ROSCOE BUNDY

Trend Seems To Be Toward Clear Music

T it was not so very long ago that the three tube regenerative receiver marked the height of affluence in the radio world and that the owner of such a super-set was enviously regarded by his fellow B. C. L.'s who were still getting their music via the single tube 'and the crystal set. In those days we could consistently get coast-to-coast reception or its equivalent on three tubes, and with the tubes retailling at $6.50 each and the receiver itself hovering around the $200 mark, the old three strunger was held in the same regard as the most elaborate five tube set of the present day. It tuned as broad as a barn, howled like a hound and mashed up the signals, but in her day the old three did her stuff, as the many DX records of 1921-1922 will testify.

Repeated refinements in the regenerative circuit, brought the three tube regenerative up to a high degree of efficiency in bringing in distance, but in the craze for distance we sacrificed selectivity and tonal quality. They were superlatively sensitive to weak signals, but as most of the old timers were of the single circuit type or were provided with the old inefficient vario-coupler, they were very broad-tuning and could not possibly cope with the present day congestion of radio traffic, even though they did have from five to ten tuning controls. There were more dials and less selectivity in 1922 than at any other time in radio history.

Just as a review on the subject of tuning controls let me list the dials and knobs that commonly appeared on the panels of the old time three tube three circuit regenerative:

1. Primary Variable Condenser Dial.
2. Rotor of Vario-Coupler Dial.
4. "Units" Tap Switch Knob.
5. Series-Parallel Switch (Sometimes)

in the way of improved performance. The radio frequency steps were coupled with primitive untuned radio frequency transformers that were little better than coupling condensers, and which peaked badly on some particular wavelength, generally on the wavelength of one of the local stations that you were trying to tune out.

At this stage of development the addition of tubes was a serious proposition for the tubes then drew anywhere from 0.75 to 1.0 amperes each, so that a four tube outfit would draw up to four amperes total, or four times as much "A" battery juice as the largest tubes of the present day.

You could easily run down a freshly charged battery in the course of one evening and then wait over for a day while you recharged your battery with some ineffective trickle charger, generally, of the buzzer type. Those were the days when the buzz of the charger was continuous in the land and when the battery spent as much time on the charger as on the receiver. You would feed it five amperes all day only to have the receiver drain out all of the profits by 12 o'clock p.m.

There is no doubt but what the 0.25 amperes tube of the 191A type made the multi-tube set a practical possibility, and that further increases in the number of tubes will also depend upon the development of tubes of the 199 type which will make dry cell operation practicable with five tubes or more.

The Reflex Enters

O wing to the necessity for battery conservation with the old tubes, the coming of the reflex circuit was heralded with joy and much of 1923 was devoted to the development of the reflex circuit by experimentally inclined amateurs. Partly for the reason that the radio frequency transformers of 1923 did not measure up to the standards demanded by the reflex, and partly for the reason that reflex principles were not well understood, the reflex did not attain the popularity that was expected by its sponsors, and there was a decided tendency toward falling back on the old reliable regenerative circuit, with which almost any beginner could expect to get some sort of results. These were the reflexes that gave phenomenal performance, but in the main, the radio public soon discovered that the reflex of that time was not an ideal circuit for the
novation could bring in a station without the
saturation with ease. For the first time we
the most powerful, local broadcastings
common is to cause a comment and
the longer per charge with the
tube regenerative receivers; hence we
against the 50 amperes formerly neces-
sity of tone, which aver-
flood of five-tube tuned frequency sets
each at that time
activity, and in gen-
selectivity, and distance with the
improved as well as
Tonal quality was
three tubes which
reach of the aver-
Again, this was the
fixed transformer.
ondition of the older
exclusivity in the radio fre-
quency stages, the
real advantage of the
neutrodyn, acc-
cording to my idea,
lay in the construc-
tional details such as
the tuned radio fre-
cy frequency trans-
meter and the aper-
iodynamic. By
these units we could
approach a degree of
selectivity hitherto
unknown, by
means of very
simple units; and
further, we could
peak our radio fre-
cy amplification
on the desired
wavelength instead of
adopting the com-
promise amplification
of the older
fixed transformer.
Again, this was the
first fairly high
power set within
reach of the aver-
age amateur and the
first practicable set
with more than
three tubes which
had appeared.
Tonal quality was
improved as well as
distance and select-
vity, and in gen-
ral it took the
radio world by
storm in spite of the
cost of the five
tubes, which aver-
gaged about $5.00
each at that time.
The rapid increase in the popularity
of the neutrodyn brought a perfect
flood of five-tube tuned frequency sets
on the market with all sorts of weird
methods of suppressing free oscillations.
The question of battery current consum-
cion could no longer be leveled against
these circuits, for the 21A tube gave a
total consumption of only 1.25 amperes
against the 3.0 amperes formerly neces-
sary with the old tubes in the three
tube regenerative receivers; hence we
could run longer per charge with the
new five tube combination than with the
old detector-and-two-stage outfit.
Under the new system, coast-to-coast
reception on the loud speaker was so
common as to cause no comment and
we could bring real distance through
the most powerful, local broadcasting
stations with ease. For the first time we
could bring in a station without the
accompaniment of the shrieks and wild
wailings that were prevalent in the
regenerative era and hear music and
voice without the background of hissing
and frying sounds that formerly
detracted so much from the enjoyment of a
program. The quality of tone, which was
nearly equal to the reflex at
its best, and the problem of perfect
reception was therefore put squarely to
the manufacturers of loud speakers.
It was now a question of developing a
horn that was a fit running mate for the
receiver.

New Twists Developed

In the meantime, we must not forget
that all this improvement also stimu-
lated experimental work on the regenera-
fixed primary coil. In fact, a modern
three-tube circuit with this sort of tuner
is fully the equal of an old four tube
receiver using the advent of the aper-
dic type coupler and tuned air core
radio frequency transformers, with the re-
result that the modern reflex much more
nearly approaches its theoretical advan-
tages. The radio frequency component
is now tuned by the same air core transformer
units employed in the tuned radio fre-
cy sets with greatly increased range
and stability. By the same means, ohmic
resistance is reduced, selectivity increas-
ed, and wonderful results are being
obtained with only a few tubes. Two
tube reflex sets with coast-to-coast re-
ception and loud speaker volume on 500
mile stations are not uncommon where
the improvement has been added.
Where fixed R.F. transformers are used
we now have true magnetic coupling
instead of the capacity coupling had in the
older types, and with modern untuned
transformers we have excellent perfor-
mance.

The Magazine of the Hour

RADIO AGE BALLOT
(How Many Tubes Do You Prefer?)

BALLOT EDITOR,
Radio Age, Inc.,
500 N. Dearborn St.,
Chicago, Ill.

On the following list I have checked off the radio receiver that best
fills my requirements, and have written my reasons in the blank space
following the specifications.

CLASS 1. THREE AND FOUR TUBES. (a) Three Tube regenera-
tive with transformer coupled audio stages, (b) Four Tube Regenerative
with resistance coupling, (c) Three Tube Reflex, (d) Four tube reflex
with loop, (e) Four tube regenerative with one stage of radio frequency.

CLASS 2. FIVE AND SIX TUBES. (a) Five Tubes, two stages of
radio, detector, and two stages of resistance coupled audio, (b) Five Tubes,
One stage of radio, regenerative, detector and three resistance coupled
stages, (c) Five Tube Reflex, with loop, (d) Five Tubes, Two stages radio, regenerative
detector and two stages of transformer coupled audio, (e) Six Tubes, Two stages of radio, regenerative detector, and
two stages of resistance coupled audio, (f) Six Tubes, two radio,
detector, three stages transformer coupled audio.

CLASS 3. SUPER-HETERODYNE. (a) Six Tube, (b) Seven tube
(c) Eight tube.

REASON FOR MY CHOICE

Name
Street or R. F. D.
City
State
NOTE: If you do not wish to tear this blank out of your book, send a brief note covering
the above points. It will do just as well.

NOTE: If you do not wish to tear this blank out of your book, send a brief note covering

The Magazine of the Hour
Three tube reflex circuits, using tuned radio frequency transformers throughout, give fully the results of a five tube straight radio frequency set when properly built, and have the advantage that they can be operated with dry cell "A" batteries with success. There are a number of "kit-sets" or complete sets of parts now on the market for building reflexes of this type, so that the construction of a reflex no longer is a problem for the advanced student of radio, but is entirely practicable for the rawest novice. This is in contrast to the conditions experienced in the old days when the builder of a reflex frequently had to buy enough material for two sets before he could find parts that would match up and function properly when hooked up in a reflex circuit.

In writing the above paragraph it brings to mind the great advantages enjoyed by the present day radio set builder compared with the trials and tribulations of the old-timer who had little to work with in the way of materials and still less data. In the old times, a smudgy illustration cut out of a newspaper with an exceedingly inaccurate description was considered a "find," and with a few yards of barb wire and other miscellaneous junk, a valiant attempt was made toward the construction of a workable receiver. Nowadays, the builder can obtain accurate apparatus put up in complete kits so that an hour's work with a screw driver and pliers is all that is necessary. Each wire is cut to length and a detailed series of picture diagrams gives all the data that anyone could possibly ask for. In one way, however, all this spoon-feeding is a bad proposition, for it is getting to such a point that the experimenter is now too dependent upon others and is rapidly losing his spirit of self-reliance. Here at RADIO AGE, we find that the slightest omission in a description or in a drawing is sufficient to throw him out all out of joint, and instead of trying a few simple experiments that could be performed in five minutes, he will write in and calmly wait for some one to work out his simplest problems for him.

The Super-Heterodyne

During the past year much work has been done on the development of the super-heterodyne principle and great progress has also been made along these lines. Properly designed, and with the proper materials, the super-het is the king of all receivers, but once again we warn the novice that he should obtain his apparatus in kit-set form to insure all of the parts being properly matched so that they will work together. To assemble a super-heterodyne out of a miscellaneous mass of unmatched parts of different makes requires considerable amount of skill and experience.

Continued experiment has resulted in the development of six and seven tube super-hets which give fully as good performance as the standard eight-tube type, and have the further advantage that they are more compact, cost less, and take less battery current. Unsatisfactory results are being had with six and seven super-hets which brings the set well down toward the limits of dry cell operation, and with such sets we obtain wonderful selectivity and loud speaker operation over great distances. Their tone value is of the best, and with a little experience they are easy to tune and handle. In fact, two condenser dials and a potentiometer are the only controls necessary.

Super-heterodynes are essentially a type designed for operation on a loop aerial, and for this reason they make a great appeal to those who have no chance to erect an effective outdoor aerial. Certain radio frequency and reflex receivers will also give results on a loop, but the super-het is particularly adapted for this kind of service, and to a great extent, its selectivity is due to the directional properties of the loop aerial with which it is used. Its only drawback is its cost, which is considerably greater than that of a corresponding grade of radio frequency or reflex receiver, and this item, of course, is sufficient to rule it out among many classes of radio fans.

When the DX fever was at its height, with every effort bent toward getting distance at any cost, very little attention was paid toward eliminating disagreeable noises or for improving the tone of the receiver. In fact, the noise in the early broadcast receivers, coupled with the crude loud speakers of that period, was very effective in holding back prospective customers who possessed the most elementary sense of tone. The field was entirely in the hands of the distance fanatics, and they continued to hold it until the coming of the tuned radio frequency sets, with their improved reception, made an appeal to another class of listeners. The latter formed the bulk of those who purchased radio during the past year; people who objected to listening to the mangled remains of a sonata, just so that they could boast of hearing some peanut station, 1,500 miles away. Better have good, clear, local reception on a crystal set for these prospects than a mushed up mess coming in from a distant station.

In addition to the inherent noises of the regenerative receiver, which were really not always so bad on the headphones, the early audio transformers were far from being perfect and added their din to the collection of noises annexed in the detector stage. High ratio audio transformers with their distortion, poor design and other factors made life miserable for the musician who was forced to hear the blasting and blare of the old horns or noise chutes. Improved transformer design, together with the use of low turn ratios, has greatly improved these conditions so that there is little distortion or noise within the receiver itself. Further, the introduction of resistance coupling in the audio stages made another step toward perfect tone.

I am thoroughly convinced that future improvements in radio apparatus will be along the lines of tonal improvement and that the buying public is more interested in tone quality than in the attainment of distance. A good, clear natural tone with moderate distance getting qualities; low current consumption so that dry batteries can be employed; stable performance without nerve racking shrieks and howls, and perfect selectivity are the characteristics of the salable radio receiver of the future. The experimenter and the DX hound have already been served, so that our next appeal is to that class of music lovers who have not yet seen fit to buy radio equipment.

The reproduction must be fully equal to that of the best modern phonograms.
admission, and according to my ideas, the subject of this article, after wandering around among the various types of radio receivers. What is your preference, or rather, what sort of a radio outfit would you buy if you were to purchase one tomorrow? With a limited amount of cash available, would you prefer a three tube regeneration with good distance getting qualities but only fair tone value, to a four tube set with slightly better distance and tone providing that the latter only cost a few dollars more? Would you prefer these sets to a three or four tube reflex with wonderful tone value, great volume, and moderate distance? I am omitting reference to the one and two tube sets which are really for the head-set and can only be used on the speaker with powerful local stations.

If you had more money to spend, would you spend it on the conventional five tube tuned radio frequency set with transformer audio stages, or would you like to add another tube for resistance coupling so that you would have the superlative in tone value for the R.F. class of receiver? How would a five tube reflex operating on a loop stripe you? Now for the third class, which costs quite a little more than any of the others. We speak of the super-hetodyne with its loop aerial, from six to eight tubes, and with its excellent tone and volume. Do you believe that these increased virtues compensate for the additional cost over those offered by the five and six tube sets of class two? That's what the manufacturer wishes to know, that is what we wish to know, and that is what will affect the market in which you are to buy your radio. There is only one way in which public demand can be determined and that is by asking the buying public to vote on their opinion or desires just as we are doing here. We have guessed until we are blue in the face, but as yet have come to no conclusion, and there are a whole lot more of you in the same boat with us.

In making your choice, please consider the many factors that enter into the proposition. The question of tone economy, compactness and portability, dry cell voltage, storage battery, first cost, distance, tone, volume, selectivity, loop aerial or outdoor aerial, and the cost of maintenance. Let us take one combination of these factors that will suit your conditions best and we wish to know what it is. We have divided the receivers into three classes according to price, for we believe that price is the determining factor in the majority of cases.
There are numerous characteristics of vacuum tubes used in radio reception and transmission that may be determined, but which have no value to the average radio fan. However, there are a few of vital importance to all users of vacuum tubes and it is the writer's intention to make clear such of these characteristics which are of importance to the fan so that he will be able to plot curves or charts and match his tubes as easily as he tunes his receiving set.

The equipment required for this work is a good vacuum tube test set, such as described in the May issue of RADIO AGE. An instrument such as this may be built at a nominal cost or one similar may be purchased ready made at a good range of prices, from the simple one-meter affair to those having a complete set of meters.

The One-Meter Tester

The one-meter tube testers are limited in their use, however, and outside of a plate current curve at a fixed grid bias, no other features may be determined. This type of test set will only give a fair idea of how a tube will act. They will sometimes show a good plate current curve, but fail to perform efficiently when in operation. Therefore, it is worth the difference in price to have a set that will show the filament current or voltage and the grid bias voltage in addition to the plate current.

For this article, the RADIO AGE test set was used. It consists of three meters; a filament voltmeter, a grid volt meter and a plate milliammeter with the necessary resistances to vary the filament and plate voltage and grid bias voltage as desired.

It was prepared for operation by connecting an "A" or filament battery of suitable voltage for the tube under test—to terminals (A BAT +) and (A BAT -).

A "B" or plate battery of ninety volts was connected across the binding posts (B-) and (B90) with taps at 22½ volts, connected to binding post (B22), 45 volts to binding post (B45), and 67½ volts to binding post (B67). Two 7½ volt "C" or grid batteries were connected to the "C" battery terminals. The negative terminal of one connected to binding post (C-) the positive terminal of this and the negative terminal of the second "C" battery connected to binding post (C+-) and the positive terminal of the second "C" battery to binding post (C+).

The filament rheostat (R) is moved to its off position, a tube placed in the socket (T) and the set is ready for operation. By moving the switch (BS) to point (—) and closing switch (GS) a negative grid bias voltage will be shown on the two-scale voltmeter (GM). This grid bias voltage may be varied at will from 0 volts to 7½ volts by moving the potentiometer (GP) until the meter shows the desired voltage. By moving the switch (BS) to the (+) point, a positive grid bias will be shown on the meter (GM) and will be varied as above.

The switch (PS) and the rheostat (BR) regulate the "B" or plate battery voltage. By moving the switch (PS) to terminal (1) and moving the rheostat (BR) a plate voltage range from...
The two-scale voltmeter, showing the grid bias voltage.

0 to 22½ volts is obtained, to point (2) from 22½ to 45 volts, to point (3) from 45 to 67½ volts and to point (4) from 67½ to 90 volts. This voltage is read on the meter (PF) by moving the transfer switch to position (4). The filament voltage will be read on the same meter (PF) by moving the transfer switch to position (3). The filament voltage is varied by the rheostat (R).

**Plate Current Curve**

For the first test, we will use a 3-4 volt 199 type of tube—placed in the socket (T) by use of an adapter. This is a high vacuum receiving tube with the filament normally operating at 3 volts and a filament current drain of .06 amperes or 60 milliamperes. This type of tube is most used in super-heterodyne receiving sets and is by far the most critical of everyday tubes.

A piece of cross section paper will be prepared by marking the plate voltage scale on the lower edge and the plate current scale on the left edge as in figure one. The filament voltage will be adjusted to a point just below 3 volts, say 2.8 volts, the grid will have a 0 volt negative reading on the meter (6m) and the plate voltage will be adjusted to 0 volts.

By moving the rheostat (BR) the plate voltage is increased. A reading will be taken from the milliammeter and a point corresponding to this reading and the reading of the plate voltmeter (PF) will be marked on the cross section paper, as in the chart (figure one). This reading—with 5 volts on the plate, showed a plate current of about .1 milliampere. At 10 volts it read practically the same, and so on, gradually until 20 volts was applied and read at .3 milliampere. At 25 volts the plate current was about .5 at 30 .7 and at 40 it was 1.2 milliamperes. It increased rapidly until 90 volts showed a plate current of about 4.3 milliamperes—which is average for a tube of this type.

When all of these points are marked they will be joined by a line running through each, and a completed plate current curve as in figure one will be made. Simple, isn't it? This performance may be repeated—on the same chart, at different grid bias voltage—say a 1 1-2 volt negative and a 1 1-2 volt positive bias, thus giving a complete plate current story of the tube at various operating conditions.

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**Grid Characteristic Curves**

To make a grid characteristic curve—figure 2, the plate voltage will be set at 40 volts—the grid bias voltage will be adjusted until the meter (GM) shows 0 with the switch on point (+). The reading of the milliammeter (MA) will be located on the chart as before—and readings for each fraction of a volt will be spotted—as in figure two. The 40 volt curve showed a plate current of 1.2 milliamperes and at 1 volt (+) it read 1.5 milliamperes and so on to 2 volts (+) it read 1.8 milliamperes. Going back to 0 volts and shifting the switch (BS) to a negative bias, the readings were taken the same as above, except they were inversely proportional to the grid voltage,

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Coupling is a broad term in its interpretation. It signifies the method by which energy is transferred from one radio circuit to another. Whether it be the energy from the antenna travelling to the detector tube, or energy being transferred between tubes of a radio frequency amplifier, or again audio energy passing between audio stages— coupling passes the energy across in each case.

Big Advantage in Having a Variable Coupling Scheme to Enable Adapting the Receiver to Different Aerials; Sutiting Coupling to Varied Wavelengths a Real Problem

By BRAINARD FOOTE

large aerial will increase broadness and a small aerial will reduce it. Slightly greater volume may be had with connection "B," however, so that many listeners prefer it even though it does upset the dial readings. In the case of a set like the neutrodyne, the three dials do not read the same, but the first one is lower than the other two.

It is of great advantage to have a variable coupling scheme to adapt the set to different aerials. With a long aerial, only 5 to 10 turns are needed in coil P, but with a very small aerial, as many as 15 or 20 may be used. The dotted line in "A" shows where the filament circuit is grounded, a measure ordinarily desirable because of its good effect upon inductive noises and upon hand capacity.

Antenna Wavelength

The aerial system has a "natural" wavelength of its own, which must be reckoned with. Users of tuned R. F. or even regenerative receivers with aerials having very long lead-ins have found certain "dead spots" on the dial. These are caused by absorption where attempt is made to tune the set to the natural of the antenna. This natural ought to be less than the shortest broadcast wavelength received, in order that it may not interfere seriously with short wave reception. To smooth out such a dead spot caused by a lengthy aerial system, either reduce the aerial's capacity or use a series condenser of .0005 or .0001 mfds. capacity. The simplest method of reducing the capacity of the antenna, if it is too long, is to shorten it. Simply shortening it, however, does only half the job. The greatest improvement comes by increasing its altitude. An antenna of 60 or 70 feet, raised 20 feet above a roof, is far superior for sensitivity to a 150 foot aerial only five feet above the roof. Not only does the passing radio wave induce more voltage in the wires because of their greater height, but the antenna's natural wavelength is reduced at the same time.

So much for antenna coupling. We now come to a more "ticklish" coupler—that which transfers energy from one R. F. amplifier tube to another one, or to the detector. (Turn the page)
In Fig. 2, "C" is shown such a coupler in circuit form. The secondary, of course, is of the proper size to cover the broadcast band in conjunction with the variable condenser that tunes it. The primary is as large as possible, but not so large that it passes sufficient energy back to the grid to cause oscillation of the tube. In practice, such an ideal transformer is out of the question, for it is perfectly efficient for only one wavelength or a very narrow band of wavelengths.

The average tuned R. F. transformer is of this type and is so constructed that its primary does not feed back enough energy to cause oscillation on the shorter wavelengths. For this reason, it is not quite as efficient as it might be on longer waves. This peculiarity accounts for the difficulty many R. F. receivers experience in getting volume from long wave stations like KYW, KSD and the like, whereas stations of much less power on the shorter waves can be received with enormous volume, by comparison.

**Variable Coupling**

OF COURSE, the obvious method for getting around this inequality of wavelength is to change the coupling, making it greater on longer wavelengths.

Shall this changing be accomplished by a moving coil whose angular relationship can be altered—like a tickler coil? Or shall we have a permanently set winding, with its number of turns controllable by a tap switch? The first method is better from the standpoint of uniformity and gradual movement, but it has a big disadvantage. The capacity coupling is changed too much and causes upsets in the secondary dial settings. Besides, there are too many turns on the coil for short wavelengths and the plate circuit is tuned so high that oscillation commences.

Hence the better plan is to provide a tap switch for cutting in or cutting out the primary turns. It is astonishing what an inapropriate for the last stage of the radio amplifier switch for cutting in or out the primary turns.

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In this, however, is efficient only over a moderate wave length and the plate circuit is tuned so high that oscillation commences. Besides, there are too many turns on the coil for short wavelengths and the plate circuit is tuned so high that oscillation commences.

In "D," Fig. 2, is shown the variable primary coupler. Here a tap switch is connected to change the coupling for long and short waves. Such a plan is of most value in sets having only one stage of tuned radio frequency and a detector, either crystal or tube. With the average coupling coil, a fixed primary of about 6 to 8 turns is adopted. Many tuned R. F. reflex sets are made up in this manner. If they are good for long waves, oscillations prevent good reception on short waves, and if excellent on short waves, the long wave stations come in poorly, although with no trace of oscillation.

**Amplifier and Detector**

Perhaps the easiest method of adopting the variable primary is to install a number of switch points and a switch knob and lever on the panel, where it is readily accessible from the R. F. transformer in the set. This, however, requires long connecting leads and is unsightly in view of modern receiver construction.

A superior method is indicated in Fig. 3. At "A," the coupler itself is pictured, "G" and "F" being the secondary terminals. The smaller winding is the primary and it consists of approximately 15 turns. With a crystal detector, it may be advisable to go as high as 20 turns, although no more than this are needed if the R. F. amplifier tubes are good ones.

For the average set used chiefly for local reception, the switch may have three taps and the entire primary have only twelve turns in all. A tap is taken at the 7th turn, at the 9th and at the 12th. In sets using two stages of radio, the primary may be smaller, even for DX work, some primary coils working well with a total of ten turns, tapped at the 5th and 8th and 10th. The number of turns in the primary must really be worked out by the individual set operator to fit his own conditions.

**Back-Panel**

THE switch points are laid out on a small piece of panel material, about 2 inches square. The switch lever may be of the regular style or be cut from spring brass or phosphor bronze. It is soldered to a 3/4-inch set collar. Good contact to the lever may be made by using a long set screw and attaching a nut to it for holding the end of a short piece of flexible wire. This forms the plate connection of "P," the transformer. The taps are laid out and so connected that a left-to-right movement of the panel knob brings an increase in coupling. The set collar is attached to a length of bakelite or brass rod, 3/4-inch diameter, which passes through a 3/4-inch hole in the sub-panel and also in the main panel. The assembly is given at "C" and at "B" the front panel is shown. Three small white dots indicate the position of the switch arm. These are made by filling with white wax crayon small depressions made with the twist drill.

In case there is special interest in DX reception, more taps are taken, thus giving a more gradual change in coupling.

The best way to determine how the primary should be wound is to make up an experimental primary coil of about 40 turns, with a tap at every second turn. The taps are merely bared places in the wire, twisted into loops. A spring clip is then used to connect to the taps in lieu of the switch arm and points.

In most cases, the final result will be a coil of about twelve turns, with taps at the 5th, 7th, 8th, 9th, 10th and 12th turns, or about six taps in all. The adjustments should be tested with good "B" batteries of at least 90 and preferably a little higher voltage, with good R. F. amplifier tubes and the coupling coils properly in place with about 1/4-inch separation between the primary and secondary.

(Turn to page 50)
A Big Step Toward Efficiency in Super-Heterodyne Design

A SIX TUBE ''SUPER-AUTODYNE'' RECEIVER

The Super-Het Reduced to Six Tubes, Yet Giving Results More Efficient Than Seven and Eight

By McMURDO SILVER

The receiving system to be described in this paper is the result of a very considerable amount of research and experiment put forth in an endeavor to produce a super-heterodyne that would give equal or better results than could be obtained with any existing type, yet which would employ a maximum of six tubes, for this number must certainly be considered the maximum allowable limit henceforth, if the word "efficiency" be used in connection with this system of reception.

In the past, there has been no question in the mind of even the most uninformed fan but that the super-heterodyne was the ideal radio receiver, and the ultimate desire of every enthusiast has been to be the proud owner of a set containing many more brightly lit tubes than any other set in his community. Yet this has been the real drawback of the super; the necessity of using from seven to ten tubes in order to obtain truly super-heterodyne results. Therefore, the aim of receiver designers has not been to improve results, for a super that really justifies the name will go down to the lowest noise-level—the limit of practical sensitivity; but rather, to reduce the number of tubes used and at the same time retain the sensitivity, selectivity and quality of reproduction obtainable with the best of sets.

Two Ways To Do It

To the mind of the engineer, there are but two practical methods of attacking this problem; either make the tubes used do more work, or raise the efficiency of each circuit of the receiver right up to the maximum limit, or do both simultaneously. The first method of attack may be considered an expedient, and boils down to reflexing, causing one or more tubes to perform various functions, such as radio and audio amplification simultaneously. This is not entirely practical, in view of the frequencies to be handled, except in one section—the frequency changer. Here, there is no reason why one tube may not be used for the first detector and oscillator, providing the separate tuning circuits may be satisfactorily isolated. Up to the present, this has been impossible, except by the second harmonic method, which will be considered later.

The next method, and the more straight-forward one, is to improve the efficiency of each section of the system so that fewer tubes will be required to give the same amplification that has hitherto been obtained. An example of such a receiver was described by the author in the March issue of RADIO AGE. This set incorporated a regenerative first detector, thus giving the greatest possible gain obtainable for both detector and oscillator has been that of isolating the loop or pickup circuit from the local oscillator circuit. It has been impossible to couple a tuned pickup circuit to a tuned oscillator when the two are to operate but fifty or sixty kilocycles apart throughout the broadcast wavelength range, and not have the tuning of one section react on that of the other.

Armstrong and Houck developed the expedient of the second harmonic system, whereby the oscillator, working at double the desired wave, did not react greatly upon the loop circuit. Then, a harmonic of the oscillator was used for heterodyning. This meant two waves were being produced by the oscillator of sufficient power to cause radiation, which necessitated the use of a muffer tube ahead of the detector-oscillator to prevent radiation. Thus, two tubes were still used, though the gain in signal strength was equal to or slightly better than that obtained with a good regenerative detector and oscillator. At best, the system is not entirely satisfactory for home assembly.

Then came the development by J. H. Pressley, a Signal Corps engineer, of the balanced autodyne circuit, which not only performs the required function with one tube, but does it much better than either the second harmonic autodyne, with its amplifying muffer, or what has hitherto been considered about the limit

THE next step was obviously to combine the detector and oscillator functions in one tube. The difficulty which has heretofore prevented the use of one tube for both detector and oscillator has been that of isolating the loop or pickup circuit from the local oscillator circuit. It has been impossible to couple a tuned pickup circuit to a tuned oscillator when the two are to operate but fifty or sixty kilocycles apart throughout the broadcast wavelength range, and not have the tuning of one section react on that of the other.

Armstrong and Houck developed the expedient of the second harmonic system, whereby the oscillator, working at double the desired wave, did not react greatly upon the loop circuit. Then, a harmonic of the oscillator was used for heterodyning. This meant two waves were being produced by the oscillator of sufficient power to cause radiation, which necessitated the use of a muffer tube ahead of the detector-oscillator to prevent radiation. Thus, two tubes were still used, though the gain in signal strength was equal to or slightly better than that obtained with a good regenerative detector and oscillator. At best, the system is not entirely satisfactory for home assembly.

Then came the development by J. H. Pressley, a Signal Corps engineer, of the balanced autodyne circuit, which not only performs the required function with one tube, but does it much better than either the second harmonic autodyne, with its amplifying muffer, or what has hitherto been considered about the limit.
amplification. The coil LI, coupled to of fact, considerably reinforced when L2, L3, causes the bridge circuit to the new component is finally fed to the potential may be used to cause rectification C2, B2, circuit, and vice versa. The bridge circuit can get into LI, C2, B2, since there are these points are neutral with respect to 3 and 6, no energy in the bridge circuit. Further, as these points are neutral with respect to 3 and 6, no energy in the bridge circuit can get into B1, C2, B2, since there is no potential difference across these points of the bridge. Therefore, the frequency adjustment of the bridge circuit cannot react upon that of the B1, C2, B2, circuit, and vice versa.

Since the signal is fed from the loop and its tuning condenser to the oscillator, it will divide equally across the bridge arms. If a tube detector is connected across one capacity CX, the drop in potential may be used to cause rectification. It would appear that some of the signal voltage is lost by this method, but actually it is not. It is, as a matter of fact, considerably reinforced when the new component is finally fed to the amplifier, probably due to regenerative amplification. The coil L1, coupled to L2, L3, causes the bridge circuit to oscillate at a frequency determined by these coils, CX, CX and C1, which is made variable for the purpose of tuning the oscillator circuit. As previously explained, this energy cannot get into the loop circuit, so radiation is confined to what may be experienced from the oscillator coil system itself—a negligible amount. By means of this circuit, which is surprisingly efficient when it is considered that one tube delivers a stronger signal than two tubes in the conventional circuit, and is consequently much more sensitive, it is possible to eliminate one tube from the receiver, and still obtain better results than with two.

The intermediate amplifier is the only other unusual feature of the receiver. It employs but two stages and is on the order of those described by the writer in RADIO AGE for March, 1925. It differs, however, in that it employs special laboratory charted transformers which are a compromise between the extreme selectivity of properly designed air-core coils, and the great stability and amplification of good iron core transformers. But two core laminations are used in each transformer, of 7 mill silicon steel, one in the shape of an "F" and one an "L." The air gap formed, together with other recently developed features of the design, permits the realization of almost an ideal curve—extraordinarily high amplification over a 10,000 cycle band, with a sharp cutoff either side. The amplifier, employing two of these transformers, together with a sharply tuned filter which is provided with a laboratory adjusted tuning capacity, CS, gives tremendous amplification, for it also employs controlled regeneration, adjustable by means of R3.

**More Stages Unnecessary**

While more than two stages might be employed, two will go down to the best noise level, so that more are unnecessary. Further, there is a decided drop in amplification in adding more stages, which will react upon the preceding two, so that three stages give only slightly better results than two. This should really be written "slightly more noise," for two stages give more than enough gain.

Before going into a description of a receiver designed along the lines outlined, it might be well to justify the use of the name "super-autodyne." "Heterodyne" is generally considered to refer to a source of external power—a separate detector and oscillator tube. "Autodyne" refers commonly to a tube performing the functions of rectification and oscillation simultaneously, so it was considered logical to call the two tube receiver a "super-autodyne" and it certainly deserves the appellation, "super," for the results obtainable are surprising.

Below is a log representing one hour's work by an operator unfamiliar with the apparatus. The set was located 600 feet from WGN, one-half mile from KYW, and WMAQ, and many other Chicago locals were also operating. All stations were heard on the loud-speaker.

The reception was very pleasing on some of the unlisted low wave stations, due to the use of the straight-line-wavelength condensers. A comparison with a standard five-tube neutro-
The actual assembly of the receiver is extremely simple, providing a standard socket gang and a drilled panel are used. If this is not done, it will be necessary to drill up a sub-base and panel to take the instruments. The panel may be grained if desired by rubbing with fine sandpaper and oil until all traces of the original finish has been removed. Indicating marks for the condensers can be scratched with a scriber and filled with white.

If Figures 2 and 3 are carefully studied, no difficulty should be encountered in mounting all the parts, following the designations shown, which are also given in the parts list. As the parts are mounted, the wiring may be started and put in progressively on the base panel, then the two joined together and the final connections made. It is necessary to use a well-tinned soldering iron, with rosin core solder and some non-corrosive paste. The battery leads are brought out through a color cable, coded in accordance with the A. M. E. S. code, thus obviating binding posts and providing permanently attached connecting leads at one operation.

After the receiver has been wired, the necessary batteries should be wired to it, the rheostat just turned on, and the autodyne tube inserted in its socket. The phones must be connected to the set, the switch SI set at "L," C1 at 40, and C2 varied rapidly throughout its scale. A "plunk" will be heard, indicating an unbalanced bridge circuit. With one condenser CX set all in, turn the other CX slowly out, rotating C2, meanwhile. If the plunk does not disappear, reverse the operation, leaving the other balancing condenser all in to start with. Once the plunk has been balanced out for all settings of C1 and C2, condensers CX, CX should never be touched. If squealing or clicking is experienced at all, then the plunk was not eliminated at the right point. Turning C1, C2, and CX, CX should never be touched. If squealing or clicking is experienced at all, then the plunk was not eliminated at the right point. Turning C1, C2, and CX, CX should never be touched. If squealing or clicking is experienced at all, then the plunk was not eliminated at the right point. Turning C1, C2, and CX, CX should never be touched. If squealing or clicking is experienced at all, then the plunk was not eliminated at the right point. Turning C1, C2, and CX, CX should never be touched. If squealing or clicking is experienced at all, then the plunk was not eliminated at the right point.

**Portable or Permanent**

**Fig. 4.** The wiring diagram of the new super-autodyne receiver. Heretofore to obtain neutrodyne results on a loop aerial, seven and eight tubes were necessary. But in this receiver only six tubes are needed to achieve the same end.
Vacuum Tubes as

Distortion Devices

By DR. PETER I. WOLD

Some Interesting Sidelights on
The Repeating Function and
"Distorting" Function of Tubes

IN THESE days all of us have become so well acquainted with vacuum tubes, through actual use or through the countless articles on radio sets making use of them, that anything further might almost seem superfluous. On the other hand, there may be some who have only recently acquired an interest in radio, or it may be that the exceedingly versatile device very commonly but very poorly called a vacuum tube offers some point of view which may be new to many.

If you have followed the radio art for some time, you have heard of these tubes being used in a number of different ways, as for audio frequency amplification, radio frequency amplification, detection, regeneration, reflex regeneration, any or all of these occurring in your receiving sets; and if your interest carries over to the broadcasting station, you have heard of oscillation generators and modulation.

All of these terms may suggest a confusing variety of uses for the vacuum tube, but it may simplify matters if it is pointed out that this tube has two functions only, which are separate and distinct, and the various uses mentioned come under the one or the other.

These two functions may be spoken of as the repeating function and as the distorting function. The two are present in every tube in an amount depending on the design of the tube; i.e., the relative sizes and spacing of the elements in the tube.

By the way in which the tube is operated, and by the circuit with which it is associated, one of these functions may be emphasized.

What It All Means

BY the first of these functions, I mean that of repeating electrical variations impressed on the grid generally with amplification and, at least theoretically, faithfully, or without any distortion. By the second, I refer to that property of the tube by which electrical variations on the grid result in variations, generally amplified, which are substantially different. As an example of the first, we may take the repeating action as faithful as possible; i.e., to reduce distortion to a minimum. As an example of the second, we may take the detection of a radio message in which electrical oscillations or variations of perhaps a million cycles—and therefore quite inaudible—are so distorted or converted as to give oscillations of an audible frequency.

The repeating action of the tube and its circuit, with amplification, would probably be held to be the more important property, for it includes such applications as long distance telephony and all the actions in radio work mentioned above, except those of detection and modulation. On the other hand, its property as a distortion device is the more interesting, though not so generally understood.

Let me remind you for a moment of the essential elements of the standard vacuum tube. There is a filament which may be raised to a high temperature, whereupon it may give off electrons—those smallest particles of matter or electricity which we have come to recognize as playing so important a part in all our affairs. Then there is a plate kept at a positive potential by the battery, and which therefore attracts the electrons from the filament, thus giving rise to an electric current to the plate.

Finally, there is the grid placed between the two. When the grid is made more positive, a larger current flows to the plate and through its circuit, and when it becomes more negative a smaller current flows. It is possible thus to control a current by changing the potential of the grid; and the important point is that the energy for exercising this control may be very much less than the energy of the controlled current. It is for this reason that the device acts as an amplifier.

Getting Minimum Distortion

IF, starting with a small current to the plate, you draw a line showing how this current changes as the potential of the grid changes, you may draw a line showing how this current changes as the potential of the grid changes, you may draw a line showing how this current changes as the potential of the grid changes, as shown. The greatest precautions are taken to make the repeating action as faithful as possible, and the second is to reduce distortion to a minimum.
The Correct "B" Battery for your Portable

Success or Failure of the Vacation Radio Depends on the Condition of Your "B" Battery Outfit

The B battery is the power plant of your radio set and its failure means that the portable is temporarily useless. At home, batteries are not difficult to replace from the liberally stocked shelves of a nearby radio store, but in the wild and woolly haunts where many of us seek rest from the rigors of city life, B batteries are as rare as the proverbial dinosaur.

Hence, give this important element of your Summer radio set all of the consideration which it deserves. Take the same precautions that you would before starting on a motor trip across a hundred mile desert—make sure that your fuel supply will be sufficient to carry you to the next service station, with an ample margin to spare.

There are two kinds of service for which portable sets are designed and your B batteries should be selected with these in mind. First, there is the pack set, which can be carried on a hike, like other portable camp equipment; and second, there is the self-contained semi-portable, for temporary installation during vacation time, in camp or bungalow.

The Pack Set

In the pack set, everything must be sacrificed to secure light weight. Economical upkeep and long service without renewal of batteries must give way to the utmost portability. For this reason, the smallest and lightest B battery obtainable must be used, because the larger sizes are altogether too bulky and heavy to be carried for any great distance.

To meet these requirements, B battery manufacturers have placed tiny radio power plants on the market. These consist of an assemblage of very small cells, sealed in a small container. They represent the greatest possible amount of electrical energy which can be crowded into so small a space. But the output of any B battery, in milli-ampere hours, is proportional to the quantity of active chemicals within each cell. Only a certain amount of each essential chemical can be placed in a given space. Consequently, the size of the battery places definite limitations upon the output which may be expected from it. The smaller the battery, the shorter its life and its current output. B battery costs, per hour of operation, increase rapidly as the size of the battery becomes smaller.

Before starting on your trip with a portable set, be certain that you have a B battery power supply which will last over the period of your trip. Do not expect long life from tiny batteries called upon to deliver heavy currents for multi-tube sets. The smallest B battery, shown at the left of the illustration on this page, has all the capacity which can be incorporated in a battery of that size. It has a volume of 17.5 cubic inches. The next larger size, at the center, has a cubic content of 28.6 cubic inches, or 63% larger. The tall, slim battery at the right is 50.3 cubic inches or 186% larger than the smallest battery. Obviously, there is considerable advantage both in milliampere hour capacity and economy in

Liberal Supply at Start Will Insure Success

By Edgar H. Felix

This layout shows the various sizes of "B" batteries. It is advisable to spend liberally in equipping a portable set with "B" batteries, for a stingy investment at the start usually results in woe later on.
buying the largest possible battery which you can carry with you.

A pack set, intended for several weeks' use during vacation time, will give more satisfactory service if large batteries are used outside the set, while it is used at its semi-permanent location. When designing your portable, therefore, equip it with flexible battery leads so that, whenever possible, you can use larger batteries and so that you may limit the service on the small batteries to those occasions when convenience in portability compels their use. For instance, if you plan to take your set with you on a day-trip picnic, use the small portable batteries; but when you get back to the permanent camp at the shore of the lake, substitute the larger batteries for the smaller ones. Your two sets of batteries may then last you all through the summer season.

The Semi-Portable Set

The semi-portable set can give all of the satisfaction of the permanent installation, so far as battery upkeep is concerned. Thousands of motor campers who take good radio sets with them because they provide the finest kind of entertainment after the day's drive. Even if the battery compartments in the set do not provide sufficient space for larger batteries, leave the diminutive batteries home, and make space in your car for large or even extra large B batteries. If you have room for a radio set, you have room for the right kind of batteries to go with it. Nothing takes quite so much space as a radio set which is useless because its tiny inadequate B batteries have given out.

The realization that an adequately powered set is the only kind which gives satisfaction is gradually becoming general. Nevertheless, many sets on the market, including some intended for permanent installation, are equipped with compartments for small batteries, encouraging inadequate sources of power supply.

On any loud speaker set, the audio-frequency amplifier can be made very economical in its current requirements through the use of a C battery. A 4 volts negative bias on the grids of the audio-frequency amplifiers frequently reduces their current drain by one-half or two-thirds. Consequently, the little C battery is well worth its weight, even in a pack set. The current drain to which the C battery is subjected is so small that its serviceability is limited only by its shelf life.

The Magazine of the Hour

The illustration shows five sizes of B batteries in such a manner that you will be able to identify them when you purchase B batteries for your portable sets.

The smaller sizes, shown at the front of the illustration, should be used only when portability requires their selection. Their output in milli-ampere hours increases more than in proportion to their increase in size. Considering that the largest of these portable units—the tall battery at the right—has less than 25% of the electrical capacity of the battery shown at the left in the back, the greater lasting qualities of the larger batteries become obvious.

The large size, back of the small batteries at the left, has considerably greater lasting quality than the next preceding size. It is the middle ground between the utmost economy, as embodied in the extra large size, and the uneconomical small sizes. There are several makes of semi-portable sets equipped with battery compartments which will house these large batteries.

On the other hand, if it is possible to employ the heavy duty battery for a three or five tube set, as illustrated at the right, you attain the greatest economy possible in radio receiving power supply. These batteries will last much longer than the smaller sizes and they represent the best buy in radio power.

Selecting Strong Batteries

When selecting a storage battery, the owner of every owner of a receiving set desires one of sufficient capacity to make frequent recharging unnecessary, yet small enough to reduce the first cost to a minimum. Has ideas as to just what to specify, in order to obtain this highly desirable combination, may be somewhat hazy, but he is never in doubt as to the result he seeks.

Various types of storage battery selection charts have been developed in the past, which were intended to assist the owner of a receiving set in making a proper selection. Lately a chart has been developed which takes into consideration number, type and combinations of tubes in a way that makes selection of a satisfactory battery a simple matter.

Voltage of tubes, number of tubes, type of tubes, rated amphere drain and recharging intervals are treated in the chart in such a way that the receiving set owner has a choice of two recharging periods. For instance, for a set using one UV-200 and three UV-201A tubes, with a rated amphere drain of 11.5 amperes at one amper drain) will give 22 days of service without recharging when used for an average of three hours daily; while with the same tube combination, a battery of 80 amperes will have a recharging interval of 15 days. Similarly, for a set having three UV-201A tubes at 15 amper drain, a battery of 65 amperes insures 29 days' service while the smaller 47 amper battery gives 22 days service between recharging.

By calling attention to the types of tubes that are interchangeable, it will be noted that the accompanying chart gives practically every combination of 5-volt tubes in general use.
A Simplified Portable Super

By A. J. Haynes

Here is An Outfit Whose Cost Can Be Kept Well Below $130 by the Careful Home-Builder

A Popular Receiver That Will Give Dependable Loud Speaker Results in Summer Up to 1,000 Miles

For the past three years, portable radio sets have been built in great profusion—in Winter conversations. When the good old Summer time rolls around, however, rarely does a radio set accompany Dad in his jaunt to the Maine woods or the family on their annual flivver trip.

This lack of enthusiasm in the past can be attributed to a number of real reasons. There were only two or three broadcasting stations with sufficient power to make reception pleasant through static disturbances a year ago, many portable sets were "portable" only because the case was leather, and sometimes the batteries were enclosed, and finally, the cost of a good portable receiver was almost prohibitive for the average family.

This year these faults have been remedied to a great extent. Stations have increased their power until the "static level" has been pushed some hundreds of miles into the sticks. There are now a number of factory built portables which can be classed as real sets, and what is more important to most of us, the cost of both parts and accessories has moved downward in a very satisfactory manner during the last year.

The design of the set shown in this article has been thought out with complete portability, low cost and good performance as the primary considerations. The set is completely self-contained. Although the loop is built in the case cover, it will be found as efficient as the ordinary loop of approximately the same dimensions. The cost of the outfit can be kept below $130.00 for the complete units and this price includes all the necessary tubes and batteries. Even this comparatively low price can be cut considerably by judicious shopping.

Same Constants

If YOU substitute parts other than those shown in the material list, be sure that the new parts have constants exactly similar with those specified.

The circuit employed is a conventional "regenerative loop" affair. The only change which you might notice is the fact that the pickup coil is placed in the filament lead instead of in the grid lead of the first detector tube. This was done to reduce body capacity effects, which are often severe in supers using a grid pickup with regeneration.

The battery supply indicated is wholly adequate for the drain put on it. Our test set ran almost continually for two weeks while we were making tests and the batteries still have some of pep.

The "What will it do?" club is probably becoming quite anxious by now, and it is fair that they be answered. First, claims of the "coast-to-coast-on-the-loud-speaker-in-daylight" type are ruled out. The set will give dependable loud speaker results in the Summer time on stations up to a distance of 1,000 miles. This means results which you can enjoy and, if you are listening to music, dance to it without having to imagine half of the tune. On nights that are favorable to reception, you can make a very comfortable and thorough tour of the country via the loud speaker.

Most of the tests run on this set were made in Chicago, which is notorious for the difficult receiving conditions caused by the numerous and powerful stations there, and the results were highly satisfactory. The set was tried in the North, West and South sections of the city—each with its own particular set of problems, and in no test was the set unable to pull in fewer than fifteen out-of-town stations. These tests were all made while the local stations were broadcasting.

You can have the carrying case constructed by a local firm or a suitable
case may be purchased from one of a number of firms advertising them. Owing to the chance for confusion, it is best to cut the leads only as needed and to mark the drawing as they are used. In this way a double check is kept on the work as you go along.

Assembling and Wiring the Set

If the instructions given are followed carefully, particularly the order in which the leads are connected, the average fan should be able to complete the wiring of the set in three hours or less. The time required to complete the balance of the work depends on the cabinet. If you have purchased one ready-made, the set should be operating about four hours after you start work on it.

The only two leads which must be soldered in the set itself run to the jacks and, owing to their position, are easily attached.

Material List

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.005 mfd. Condenser</td>
<td>100 ft. Stranded Copper Wire</td>
</tr>
<tr>
<td>1.002 mfd. Condenser</td>
<td>3 ft. 5-conductor Battery Cable</td>
</tr>
<tr>
<td>2.00025 mfd. Cap.</td>
<td>12 6-32*1/2-40 Machine Screws</td>
</tr>
<tr>
<td>5 Megohm Grid Leaks</td>
<td>12 6-32*1/2 F H. Brass Machine Screws</td>
</tr>
<tr>
<td>1 1/80 Ya. Veneer Biweboanl</td>
<td>2 Brackets No. 1509 Rasco</td>
</tr>
<tr>
<td>1 Oscillator Coupler</td>
<td>1.005 mfd. Condenser</td>
</tr>
<tr>
<td>100 ft. Stranded Copper Wire</td>
<td>2 Brackets No. 1476</td>
</tr>
<tr>
<td>1 400 Ohm Potentiometer</td>
<td>12 6-32*1/2 F H. Brass Machine Screws</td>
</tr>
<tr>
<td>2 Jacks</td>
<td>40 6-32*1/2 F H. Brass Machine Screws</td>
</tr>
<tr>
<td>1 3 Mecohm Grid Leak</td>
<td>4 Lengths Uosin Core Solder</td>
</tr>
<tr>
<td>1 10 Megohm General Radio</td>
<td>4 Bakelite Loop Support Strips</td>
</tr>
<tr>
<td>1 5 Mecohm Grid Leak</td>
<td>10 Rubber Binding Posts</td>
</tr>
<tr>
<td>10 Gom. Type 201</td>
<td>40 6-32 Brass Nuts, 1/2&quot; Across Flats</td>
</tr>
<tr>
<td>Bakostat, General Radio</td>
<td>14 1/80 Ya. Veneer Biweboanl</td>
</tr>
</tbody>
</table>

When the panels have been drilled and countersunk, mount the proper parts on the panel and baseboard. Do not mount the oscillator coupler on the baseboard at this time, as there is some preliminary wiring on it which can be done more easily if it is not mounted. 6-32x 3/4" machine screws are used to secure the instruments to the board.

The Socket Strip

The assembly and partial wiring of the socket strip should now be undertaken. Where a bolt is used to attach only the socket to the strip, use 6-32x 3/4" machine screws. Where a bolt attaches both a socket and a condenser to the strip, use 6-32x 1/8" machine screws and cut off the extra length. Be sure to place a lug under each nut which locks both a socket and condenser in place. This is done at points A10, A11, and A12.

Before attaching the .00025G condenser in place, put a 6-32x 3/4" machine screw through the condenser at H5. Lead No. 35 is now cut to length and attached under the nut at L and the other end secured at L1, the Grid of the first detector tube.

Lead No. 1 is attached at the end of the 5° section to the first grid condenser at H5.

Leads are now partially completed to each of the by-pass condensers on the socket strip. Lead No. 25 is soldered to the .006 condenser at G4. Solder one end of lead No. 22 to the other .006 condenser at D6. One end of lead No. 26 is soldered to the .005 condenser at C4. At L2 of the .002 condenser solder lead No. 23 and attach the other end to the plate of the second detector tube.

The lugs which were left at points A10, A11 and A12 are now turned until they pass under the nuts at A6, A8 and A13. The negative filament lead is later attached to these points and the lugs form a very convenient method of making short leads.

Leads 8 and 9 are now cut from two pieces of round bus bar and form the two filament bus lines on the socket strip. Place a lug under each of the filament terminals on the sockets projecting at right angles to the socket strip, bend the tips to right angles, insert and solder the bus bar and finally bend the completed leads as close to the sockets as possible. No identifying letters have been placed on the diagram to show the position of these leads but as the sockets are marked, you should have no difficulty in doing the job correctly. These last operations complete for a moment the work on the socket strip and we shall turn to the wiring of the oscillator coupler.
The oscillator coupler consists of three separate windings: the pickup coil, the grid coil and the plate coil. In referring to the "inside" or "outside" connections to a section of the coil, the tap nearest the center or furthest from the center is meant respectively. Attach one end of lead No. 32 to the inside terminal of the pickup section at A7. Lead No. 3 is attached to the outside terminal at H3. Lead No. 19 is attached at J to the inside terminal of the plate section. Attach the lug at the end of the 10" section of lead No. 5 to the outside terminal of the plate section at C1. Fasten lead 11 with the tap at the end of the 10 1/2" section to the inside terminal of the grid coil at E1. The lug at the end of the 7 1/4" section of lead No. 13 to the outside terminal of the grid coil at K. This completes for the moment, the wiring on the oscillator coupler.

The battery cable should be prepared for use by cutting away the covering for a distance of 14". Whipping the covering at this point will prevent fraying of the covering from taking place. Use fairly heavy thread for this purpose. Measure the length of the battery leads from the point that the covering is cut. The C battery negative is lead No. 10. Filament negative, B battery negative is lead No. 14. B battery positive detector is lead No. 39. Lead No. 21 is the filament positive. B battery positive amplifier is lead No. 20.

Lettering used to designate battery circuits are based on the following list:

- A minus
- B minus
- C minus
- A plus
- B plus
- C plus
- B battery
- A battery
- Filament
- Detector
- Amplifier

(Turn to page 55)
Tricks of Summer Radio

Suppose a receiving station in Chicago receives both from New York and Los Angeles. A patch of radio fog might appear between New York and Chicago and weaken the New York signals, while the signals from Los Angeles remain unchanged. The map shows how we sometimes receive signals from the West better than those from the less distant East.

EVERYONE who has a radio receiving set knows that the atmospheric nuisance called "static." It comes in, especially during the warm months, and interferes with clear reception. A particularly pleasing musical number may be on, but that makes no difference to Old Man Static.

So many inquiries have been received at the General Electric station, WGY, at Schenectady, that A. F. Van Dyck, a radio engineer, has prepared the following paper, explaining some things that are known about static and what is being done to get rid of it. Mr. Van Dyck's explanation follows:

IN THE letters which WGY has received from listeners, certain questions have been asked by many different inquirers. Some of these questions involve radio phenomena which are not completely understood by scientists today, and the answers and explanations which we shall give should be understood to be the ones which are believed to be nearest the truth, although they are not subject to rigid proof.

First, let us consider what radio transmission is. We know that a radio sending station sends out from its antenna in all directions, a disturbance of electric forces. We cannot see or hear or otherwise observe with our senses just how this disturbance behaves, as we can with light waves and sound waves.

We consider it quite natural that a stone wall stops the light beam from a searchlight, or that a bugle call can be heard much farther over water than through a forest, or that under certain air conditions on a desert, the mirage phenomenon is observed; and to know what to expect in radio, we need only to remember that some things in space will stop, or reflect, or perhaps absorb the travelling radio waves, just as some other things in space stop or absorb or reflect light waves, or sound waves. We must not expect radio waves to travel out from a transmitting station, over some enormous distance to a receiving station, without encountering some obstacles somewhere in its path.

How Radio Pierces Walls

SUBSTANCES which are obstacles to light or sound waves are not necessarily such to radio waves. For example, we know that radio waves pass through the walls of a house with only slight loss. But there is some substance in the space around the earth which does have effect upon radio waves. This substance is not uniformly distributed through space, but is present here and there, and is continually changing location and magnitude, and consequently has very erratic effects on the passage of radio waves.

The condition is quite similar to the use of a searchlight in a fog, which might be varying rapidly in density or location, or both. This radio fog is commonly supposed to be made of ionized air; that is, air which by some influence has become a partial conductor of electricity. Of course, this radio fog never stands still and is changing from moment to moment under the influence of the complicated conditions of our atmosphere, and so the radio wave passing through space surely has an adventurous journey because it meets electrically charged clouds, patches of ionized air, and perhaps other obstacles of which we know nothing.

It is a fact often observed that it is possible to work radio communication over much greater distances at night than in the daytime. This may be explained by the effect of the sun upon the air, which causes ionization of it, and is most active in the daytime and practically absent at night. The sun seems to be responsible without question, in view of the fact that very erratic results in long distance reception are always noticed at sunrise and sunset.

Wave Power Varies

WITH the preceding statements in mind, it should be clear that when one is receiving over long distances—several hundreds of miles—it is natural for the waves to come through strong at one moment, and to fade away considerably the next moment, as some obstacle to radio waves comes between the transmitter and receiver. This explains, too, why one transmitting station, of two or more which are being heard, may get weaker, while the others do not. For example, suppose a receiving station in Chicago is receiving from New York and also from Los Angeles. A patch of radio fog might appear between Chicago and New York and weaken the New York signals, while the signals from Los Angeles remained unchanged. Whenever in reception over a considerable distance, one observes a variation in the intensity of the signals, it is most likely due to so-called "fading," caused by some obstruction to the traveling waves somewhere between the two stations, and not to any fault of the transmitting station itself. These effects are much more frequent in the Summer than in the Winter, presumably because of the greater influence of the sun on the earth and

(A Turn to page 60)
Gloria Swanson, who since her marriage to a dashing Frenchman is Marchioness Something-or-Other, made her first broadcasting appearance under her new name from WGN, located on the Drake Hotel, Chicago. Seated before the “Mike,” she answered several exceedingly personal questions put to her by Announcer Quin A. Ryan of WGN. The questions, by the way, had been sent in by inquisitive listeners who had been notified of the famous “Radio Interview” with Gloria as the Interviewee, who seemed willing to tell all her deep secrets for her radio and movie admirers.
Portable “Pick-up” Station for KDKA

TO TAKE care of the ever-increasing “pick-up” situation that has confronted Westinghouse station KDKA, at E. Pittsburgh, the Westinghouse engineering department detailed Engineer Carroll J. Burnside to construct a portable short wave sending station, to permit the immediate and practical broadcasting of various interesting and important events, as they take place in their vicinity, despite the fact that location may not permit telephone wire connection with KDKA.

A one-ton truck chassis was purchased and suitable house-body built, wherein the pick-up apparatus was constructed. The requirements of this transmitter were that it be absolutely dependable at all times, in any location, and make use of a low wavelength, which is free from interference. The equipment must be compact and its personnel small and upkeep low, to justify its use. The body of the truck is 5 ft. wide by 9 ft. long and is 6 ft. high inside, solidly built to withstand the jar of movement of the truck in motion. All equipment is cushioned to minimize the jarring of apparatus.

The transmitter is a quarter KW set, using 110V from lighting circuit where program is being broadcast, and a power transformer in the truck is used to step up to the high voltage required to operate the set. Power at this high voltage is passed through a vacuum tube rectifier using two quarter KW air-cooled rectifier tubes, which gives single phase full wave rectification. The output of the tubes is passed through a brute force filter of choke coils and condensers, which delivers 2000 volts DC power to the transmitter, which makes use of the standard Hartley oscillator circuit with Helsing modulation.

The equipment used in this portable set is capable of wavelengths varying from 20 to 100 meters, although the set will ordinarily be operated on about 53 meters—KDKA to pick up its broadcast and re-broadcast on their standard wavelength of 309 meters.

Because of a likelihood of broadcasting from some downtown section of the city, where it would not be practical to operate a regular antenna, a vertical oscillator type is used. A copper pole of three sections, of the telescoping type was constructed, which is folded and stored in the truck when not in use.

Iris Virginia Gruber has the distinction of broadcasting more than any artist in Philadelphia and is the winner of the Radio Cup presented for singing the greatest number of times during the concert season from January 1st to May 1st.

“Ford and Glenn” to Tour U. S.

FORD RUSH and Glenn Rowell, on the “Lullaby Boys,” whose songs and bedtime stories during “Lullaby Hour” and “Ford and Glenn Time” over WLS, the Sears-Roebuck station, Chicago, have endeared them to the hearts of kiddies and their parents throughout the nation, will start on a transcontinental tour of the United States June 2. The WLS favorites will broadcast their most popular features over nineteen of the principal radio stations clear to the Pacific Coast.

The journey from station to station will be made in their new sedans, in which they will carry complete camping outfits, which they will carry complete camping equipment, to permit the immediate and practical broadcasting of various interesting and important events, as they take place in their vicinity, despite the fact that location may not permit telephone wire connection with KDKA.

The committee rated the records upon the points which were decided upon at earlier meetings as those most desirable for radio announcing. They are as follows: (1) Average rate of speaking—175 words a minute. (2) Pitch of voice—low middle range. (3) Announcements should be made with variation of rate, pitch and stress. (4) Manner of announcer—formal but friendly. (5) Distinctness and enunciation.

A summary of the comments made by the committee during the course of the meeting has been arranged by Mr. Borden and Mr. Busse for public distribution.

McNamee of WEAF Chosen Best Announcer

GRAHAM McNAMEE of WEAF was selected as the best all-round local announcer by the Radio Voice Technique Committee of New York University at a meeting held recently, according to announcement made by the committee. McNamee nudged out Brockenbrough of WJZ by the small margin of four-tenths of a point, the scores being 87.3 for McNamee and 86.9 for Brockenbrough.

This committee meeting terminated the series of three which were held during the past four months under the direction of R. C. Borden and A. C. Busse, voice experts of New York University, to determine the ideal qualities to be looked for in radio announcers. The aim of the committee, which is composed of radio editors, dramatic critics and members of the faculty of New York University, is not to standardize the voice and art of broadcasting, but to point out faults to be avoided and to determine what the public prefers to hear.

Special phonograph records were made by Mr. Borden and Mr. Busse of representative announcers from the following nine New York stations:—WJZ, WEAF, WGCL, WHN, WEBJ, WOR, WAHG, WMCA and WBIR. Each announcer passed upon his own record and all those entered in the contest had been accepted by the makers as fairly representative of their work.

Ten men out of the number considered were chosen as the best local announcers. In addition to McNamee and Brockenbrough they are Barnett of WOR, Reed of WJZ, Carlin of WEAF, Squires of WMCA, Granland of WHN, Haupt of WEAF, Cross of WJZ and Morgan of WGBS.

Above is "Si" Berg, nationally known ukulele artist and songster, who has appeared all over the country before prominent microphones. He is now appearing consistently from WHT and KXW, Chicago, having contributed recently to the success of many RADIO AGE programs from the latter station.
Radio’s “Interview Lady” Scoops the World!

By MILTON LIEBERMAN

A WOMAN has brought the newspaper to the radio world. She has woven the two together and has brought shortcomings of one to be valuable features of the combination.

She is Terese Nagel, the “Interview” lady of WGBS, the Gimbel Brothers store, New York City. A newspaper woman of ten years experience, Miss Nagel, just a short time ago, brought that most famous of newspaper features, the interview, within reach and audibility of every radio fan.

The scheme is clever. Nearly everyone wants to become as nearly acquainted as possible with famous people, but it seemed a difficult matter to bring the celebrities to the public through radio. Those who could sing or play an instrument, of course, were immediately brought on the air, but it remained for Miss Nagel to bring those who conquered art in its more inaudible forms before the microphone in a satisfactory manner.

She Gets the Celebrities

ALMOST every person of importance in New York and visiting the city has spoken before the WGBS microphone through the efforts of Miss Nagel. She takes them there, and then, with her newspaper instinct and ability, draws forth their thoughts, their hopes and ambitions for all the world to hear. Fay King has called Miss Nagel the “newspaper woman of the air.”

She got a “scoop” the day that I visited her for an interview on her work. When I approached the beautiful studio on the seventh floor of Gimbel Brothers, having passed a group of people who were standing outside of the glass-windowed studio, I found that Miss Nagel was on the radio.

She finished her interview and dashed for the telephone. “A scoop,” she said, and I waited until she had finished her call.

“Just did a good piece of newspaper work,” she told me. “I was just interviewing Mrs. Anna Norton, who was chairman of the democratic party during their national convention, and found that she is going after a big political job here in New York. I rather think that she let it slip unintentionally, but I found out that she will run for the nomination for registrar of the city. It pays $12,000 a year. I just finished speaking to the city editor of the New York American, and he has congratulated me.

“That just goes to show,” she continued, “that the radio has unlimited possibilities. Just at present knowledge of who will run for registrar is very important, and the fact that a woman will do it makes the scoop valuable.”

How She Does It

She then told me about her job of interviewing celebrities, and how, by her clever questions, she draws information from them which they probably would never divulge in another way.

“I have interviewed hundreds of famous people. I can tell you some of them. There was Rube Goldberg, Miss Oliver Herriman, Jane Cowl, Tony Sarg, Victor Depeu, the cartoonist, Willem Van Hoogstratten, conductor of the New York philharmonic orchestra, Fay King, several actresses, including Miss Blanche Yurka and Miss Mary Melish. The Hamilton brothers, Cosmo Hamilton and Hamilton Gibbs, were very interesting. There was also Countess Caroli, whose husband was first president of the Hungarian Republic.

“It is very interesting, and I think I shall bring more newspaper features to the air. I plan to start a radio column and become the first radio columnist. The public will be asked for a name for the column and contributions like those used in newspapers will be accepted.”

Rosario Duprez is another favorite from WGBS. She is the “Perfume and Personality” lady who believes that perfume, properly used, will enhance the personality of any woman. Miss Duprez, unfortunately, cannot be seen on the radio. Unfortunate it is, for she is the essence of charm and personality. WGBS, however, has many other ambitions, besides linking newspaper work and perfume with radio.
By C. Clyde Cook, who Knows His Hollywood as Marconi Knows His Radio

A Station Broadcast Where They “Personality”

When Signor Marconi invented the Wireless Telegraph, little did he think that in the near future this same great invention would advance with such strides that Personality should some day be broadcast to the inhabitants of this universe.

Although it may sound like another Hollywood Press Agent’s stunt, this phenomenon has certainly been accomplished at station KHJ, The Los Angeles Times, Los Angeles, California, where none other than John S. Daggett, affectionately known to Radio fans as Uncle John, works this miracle with a resonant voice which, according to motion picture standards, registers “personality plus.”

Personality, some great philosopher has epitomized, is that intangible and indescribable force which, of necessity, must come from within. Which reduced to understanding English, only means that, to possess Personality in a marked degree, one must radiate that magnetic force or power from a most dynamic source—the heart! And that is the sole reason why Uncle John, directorial wizard of KHJ, has such a wonderful personality—he has a magnanimous heart, and his Radioland converts are becoming legion.

KHJ’s “Father”

This famous broadcasting station owes its existence, perhaps, to Uncle John’s genius, for it was he who dedicated KHJ to the horde of inhabitants of Radioland on April 13th, 1922. Like Aladdin’s magic lamp, Uncle John has wrought miracles with this magnificent broadcasting station. KHJ has brightened more homes of sorrow, brought more harmony and joy into homes of discord, than any other three stations combined. And this is because his attitude towards his duties as an announcer has been that of a minister of humanity, and his cheery voice has come to mean as much in the home as the teachings of the scripture.

Bringing to this position of announcer a splendid college education and the invaluable experiences of a successful newspaper man, there is little wonder that Uncle John’s name has virtually

Reel Joy Dispensers at KHJ Keep the Home Fires Burning in California

Three of KHJ’s scintillating stars are shown above, in their proper atmospheric setting. From left to right they are “The Sandman,” who lulls the children to sleepy land, “Uncle John” Daggett, the Good Samaritan of KHJ, and on his knee, the little Queen Titania, who is a fairy optimist for thousands of hard-working Californians.
become a household term in the Southwestern United States, and wherever the powerful KHJ broadcasting station can be heard. For Uncle John has seen fit to arrange programs which appeal to every member of the family, with a view to entertaining and enlightening his great following of Radio fans, for he has a penchant for broadcasting the best talent obtainable anywhere.

Thanks to KHJ and its progenitor, Uncle John, concerts of the highest type can be heard in one's home. KHJ is probably the only station which has on its staff an accomplished and famous musician. In the person of Claire Forbes Crane, Radio Editor of the Times, KHJ boasts a pianist who has been soloist with such large musical aggregations as the Boston Symphony Orchestra, the Los Angeles Philharmonic Orchestra, and others. With the technique acquired as associate artist of Madame Melba, Arthur Hackett and other renowned artists, she brings to Radioland a veritable 'Open Sesame' to shut-ins with musical longings. Under her artistic guidance the musical programs of KHJ have thrilled music lovers throughout the nation.

His Universal Appeal

But Uncle John's magical Radio wand is not confined to classical music. His musical programs are so arranged as to carry the universal appeal, running the gamut of musical emotions in the human heart. Just to prove how broad a scope and range these musical entertainments cover, permit me to quote verbatim the utterings of an affable-coated miner from the great open spaces: "Out on the Mojave Desert we get mighty lonesome; times we don't keer if we live or die, and along comes Uncle John with one of his side-bustin', gun-totin' musical tests which makes us plumb ashamed of ourselves for even thinkin' of kickin' off!"

And through all this good samaritan work of broadcasting cheer and entertainment runs that indescribable force — Personality. Why, the entertainers selected by Uncle John's inborn genius fairly exude it. So thoroughly saturated with it are these skilled entertainers and educators that they proceed to broadcast it without impairing the tastes of radio fans with astonishing results. You can feel the personality of various musicians, vocalists as well as pianists, in your very home. Most miraculous and yet a pleasant possibility in this day and time, with such a genuinely human announcer at the helm of the good ship Broadcast!

And not all of Uncle John's programs are solely entertainment. Professor Sylvester Hertzog lectures to the youngsters, in the language with which they are familiar, upon subjects which stimulate thought action, compelling them to think, to compare their own conceptions and quotations with which they thought impossible before.

This is conducted during the "Children's Hour," from 6:30 to 7:30 p.m., a time which all children in homes equipped with radio sets hold most sacred. They are also treated to special readings from the Bible by Uncle John, in that inimitable voice which children recognize as readily as they do their parents.

Another feature of KHJ, which has aided people in solving their daily problems, is the weekly lectures by Fred C. McNabb on the "Care of Gardens." In over fifty-two weeks of constant broadcasting, Mr. McNabb has done such creditable work that his bulky daily mail attests the results obtained. Then Harold Swartz, one of America's most promising sculptors, delivers a weekly lecture on "Art." "Care of the Body" talks are broadcast by Dr. Philip M. Lowell, a recognized authority on this subject, while Captain Salisbury and other well-known globe-trotters tell of their thrilling experiences in foreign countries.

Tales Easily Understood

Dr. Mars, Baumgardt, noted astronomer, delivered a lecture every Wednesday evening for over a year upon astronomical subjects, couched in such simple language that the layman could acquire a fairly working knowledge of the rather mysterious science of astronomy. The "Radio Philosopher," G. Allison Phelps, who has written and broadcast over thirty-six essays on momentous subjects, which are troubling people in the ordinary walk of life. Taking the smudgy commonplace of life, this wise philosopher animates them with his magic flow of metaphors and similes, so that grim bugbears and obstacles are soon converted into scintillating rays of sunshine.

Queen Titania

And last but not least of the legion of KHJ broadcasters is the famous Queen Titania, who broadcasts the innermost workings of Fairyland every Tuesday night. In conjunction with her father, The Sandman, who also writes and directs these unique sketches, Queen Titania and Uncle John broadcast the most instructive of juvenile programs, accompanied with the most melodious of music.

Hundreds of children, ranging from five years to fifty, throng the auditorium on these nights and are taken for a pleasant journey through the mystic realms of Fairyland, under the personal guidance of the diminutive Queen Titania.

During its brief existence KHJ has been responsible for more innovations, perhaps, than any other station on the Pacific Coast. In addition to the aforementioned features, Uncle John has inaugurated Saturday morning broadcasting classes. All persons are eligible, providing they register in advance. This novel Radio instruction is deemed by some as one of the greatest constructive influences toward a better understanding of radio.

While performers appear before the microphone, Uncle John stations himself down in the operating room the better to judge of the pupil's aptitude at broadcasting, and at its conclusion he lectures to the class upon their broadcasting from a radio point of view. This constructive criticism is also broadcast, making it possible for all members of radioland to learn the profound secrets of broadcasting.

When we radio converts shuffle off this mortal coil, we no doubt will consult the Recording Angel to ascertain the respective positions on the great list of those who served their Master well in radioland. If so, we no doubt will find that Uncle John's name, like Abou Ben Adhem, heads the list.

(Two going account

is the second of an interesting series of articles on California radio stations, which are known from coast to coast for their excellence. The first of this series appeared in the June RADIO AGE, and other equally interesting stories will be published in an early issue.)
Ten Commandments for the Broadcast Listener

While excellent radio reception is frequently possible during the warm months, the best long distance records come in the Winter. A reasonable attitude will help the listener here. He should remember that he cannot expect every act in even the best vaudeville performance to be tremendously amusing and just what he wants, nor can he expect the weather every day to be clear and pleasant.

Similarly he must not expect every day to be just right for long distance radio reception. Now and then a Summer storm may interfere with both radio and picnics. The listener should become acquainted with his local stations and enjoy them during the Summer, and be satisfied with the long distance records he has made, or will make, in the Winter. In other words, he should get the best there is in radio during all seasons, and above all he should be reasonable.

If the listener lives rather far away from all radio broadcasting stations which he wants to hear, there are several things he can do. He can lengthen his aerial wires and increase their height from the ground. Both of these measures make the signals louder as a general rule. He can add an audio frequency amplifier unless, of course, he already has this instrument. He can also increase the voltage of his "B" battery or plate battery up to 90 or even 112 volts (that is, to four or five of the usual 22½-volt units or blocks). He can use a more sensitive loud speaker, or content himself with head set operation. He should also tune more carefully so as to get the very loudest signal which his set is capable of giving. If there is a tickler adjustment on his set, he should learn how to use it so as to get full volume of signals. And he should remember that the good results he will then get are going to be even better results in the Winter.

If the listener is very near a powerful broadcasting station, he may get excessively loud signals from that station and have difficulty in picking up other stations when the nearby station is in operation. In extreme cases it is not possible to get the distant station at all under such circumstances any more than it is possible to hear a whisper from a distance when someone else is shouting nearby. Still a good deal can be accomplished.

There are ten good rules for broadcast listeners:

1. Don't try to hear Australia in mid-summer. Be satisfied to enjoy the nearer stations most of the time.
2. Don't be disappointed if an occasional storm interferes with your radio evening. There are many fine concerts coming. You can't expect to find a pearl in every oyster nor to receive a record-breaking concert every night.
3. If you want louder signals, use a longer aerial, more tubes, higher plate voltage, more sensitive loud speakers and more careful tickler and receiver adjustment.
4. A pleasant signal filling a moderate size room should be enough to give satisfaction. It is not worth while producing signals which deafen the neighbors. It is wasteful to insist on tremendous signals which are generally less pleasant than moderate signals.
5. If your local station comes in too loudly and drowns others out, a smaller aerial will help in tuning him out, with a smaller condenser connected between aerial and ground. And if all measures to get rid of the local station fail, why not enjoy his concerts? He is working hard for you and it is nobody's fault that you are so close to him that you are bound to hear him. Broadcast stations have to be closer to some people than to others.
6. For the new longer waves above 450 meters, use a condenser connected between the aerial and ground terminals of your set.
7. A little patience in learning to handle your receiver yields rich returns in satisfaction from fine signals. Remember that "Rome wasn't built in a day" and keep on getting more and more familiar with your set and how it works.
8. It is a good idea to read the radio column of a newspaper or a good radio magazine or two. It helps you to know how your set works and keeps you up-to-date in radio. Information of this sort is an aid in getting the concerts loud and clear.
9. Ask your radio dealer for advice; he can probably tell you what you want to know and will be glad to do so. The manufacturer of your set is also willing to help you get the desired results from its use.
10. Do not throw away the direction sheets or booklet that came with your set and with the tubes. Read all such material carefully now and then. If you have lost the direction sheets write to the dealer or manufacturer for another. These sheets answer most of the questions which have been puzzling you and preventing you from getting the best out of your set.

(Copyright, 1925, by Radio Age, Inc.)
PHILADELPHIA—One of the most unusual gatherings of famous stage and screen folk was held last month. Moving picture stars of the Metro-Goldwyn picture corporation, together with such famous men as Marcus Loew and noted stage stars, gathered around the microphones in the Studio of Station WIP, the radio broadcaster of the Gimbel store, to entertain the radio public and to answer all personal questions sent in to the station.

It was a real party—the stars sang, dined, danced to two orchestras; and the microphones did full duty all the while, Lillian Gish, Jackie Coogan, Barbara LaMarr, Johnny Hines, Mae Busch, Dorothy Mackaill, Marion Davies, Anita Stewart, Harry Morey, Dagmar Godowsky, Louise Glau, Frizzi Brunette, Ben Finney, Flora LaBreton and many more screen players.

Raymond Hitchcock, Eddie Cantor of “Kid Boots” fame, with Mary Eaton and her sisters, Doris and Pearl, Cecil Lean and Cleo Mayfield who made “No, No, Nanette” famous and the leading men and women of the two “Music Box Revue” shows represented the stage and Broadway. Nils T. Granlund, famous “N. T. G.” of Station WHN in New York City; Marcus Loew, president of the Metro-Goldwyn Picture Corporation and head of the Loew chain of theatres, and the great “Sir Joseph” Ginzburg, Broadway’s biggest “nut.”

Above, Jackie Coogan in a speculative mood before appearing before the WIP “mike” and telling his innermost secrets to a host of radio admirers. Mae Busch, popular leading lady, is the demure miss at the lower left. She was one of the principal speakers on this all-star movie program from the Philadelphia station.

Fans Get Real Insight Into Adventures of Famous Stars

ELI M. OROWITZ, the famous “Emo” whose weekly movie broadcasts from Station WIP have created a sensation all over the country, arranged the party and was the announcer for the evening. “Emo’s” witty remarks, aided by those of Johnny Hines, to say nothing of the other comedians present, made the radio sets bulge with laughter.

The party was strictly informal. Most of the stars spoke on the impulse of the moment. The movie fans who have seen their favorite screen star as many times as they possibly can, had the opportunity to hear their voices.

And if you wondered why Dorothy Mackaill bobbed her hair, or just what Barbara LaMarr thinks of vamps, or any of a thousand questions that run through movie fan’s heads, you found out if you heard this unique program.

This idea of having movie stars speak from big broadcasting stations is meeting with more and more favor every day. For instance, at WGN, Chicago, recently, according to dispatches received at WIP, Gloria Swanson, the prominent Hollywood resident and fashionably cinema actress, consented to be “interviewed” by the Announcer, the questions in the interview having been sent in by interested listeners. This is but one example of how movie stars are gaining wonderful publicity for themselves as well as providing more or less amusement.
IT IS somewhat noticeable that in spite of the sensational nature of the charges made against the Radio Corporation of America in the New Jersey Courts, comparatively few radio publications and newspapers gave publicity to the astonishing accusations made by the De Forest Radio Company. RADIO AGE is publishing these facts for the reason that both parties to the prosecution are key factors in the radio industry. We believe that it is due our readers to tell them the truth about this industrial scandal, not permitting the fact that the Radio Corporation of America is the biggest radio advertiser in the field to deter us from adhering to this principle of editorial responsibility.

Among publications which have given space to this situation are The New York Times, New York Herald-Tribune, Chicago Herald and Examiner, Radio Seller and Jobber, and Radio Guide. There are a few others, but the publications which have come to our hands and we know that their publications did not make room in their columns for a line of this publicity. While it may be extremely unpleasant to the Radio Corporation of America to have these court proceedings reported to the public, we believe that the Corporation will welcome full publicity in order that the charges and will be willing, as a Corporation admitting it was organized for patriotic purposes, to accept the judgment of the American public as to whether it has done wrong.

Briefly, the De Forest Radio Company, on May 1, 1925, obtained an injunction in Trenton, N. J., restraining the Radio Corporation of America from attempting to secure false information regarding the employees of the De Forest Radio Company. The injunction was granted after Vice-Chancellor Biddle ruled that the affidavits and other documents tendered to support the charge that the Radio Corporation of America had introduced spies into the plant and offices of the De Forest Radio Company and that the Radio Corporation's secret agents had, with bribes of money, seduced employees of the De Forest Radio Company into acts of treachery.

We publish the following from the New York Times of May 5, 1925:

The Radio Corporation of America maintained secret offices at 23 Beaver Street, where its special investigators, known only by code numbers, reported the results of their espionage on the De Forest Radio Company and other concerns, according to affidavits filed yesterday in the Chancery Court of New Jersey. The papers were filed to support the injunciticn suit of the De Forest Radio Company against the Radio Corporation of America, brought last week at Trenton.

The affidavits alleged that agents of the Radio Corporation of America in the De Forest Radio Company's plant farsod John S. Harley, chief special agent of the Radio Corporation, with valuable information by methods employed in the manufacture of radio apparatus, as well as the names and addresses of employees, the number of radio tubes produced, the names of persons and cooperating with the De Forest Company, noticed posted in the various departments, changes in the personnel, efforts made to purchase, etc., which was actually what took place in the power tube department.

The information alleged to have been passed on to the Radio Corporation of America also included drawings of machines and samples of products made by the De Forest Company.

Details of how Harley is alleged to have placed his agents in the De Forest establishment and of his employment of De Forest employees to furnish him with stolen information are also contained in the affidavits.

General Electric Accused

President Scott of the De Forest Radio Company, in an affidavit, alleges that the General Electric Company, with which he asserted the Radio Corporation was in connection, employed an agent to obtain the names and cooofices of persons and concerns dealing in information concerning secret methods of manufacture and production of radio apparatus furnished to the De Forest Company.

If the defendant and its associates, the General Electric Company, the Westinghouse Electric and Manufacturing Company, and the American Telephone and Telegraph Company, as alleged in the affidavit, were able to obtain such information, it could, of course, prevent information in secret files of its hands.

No statement was forthcoming yesterday from the Radio Corporation of America in connection with the filing of the typescript by James F. G. Harrod, President of the company, declining to comment. Vice President P. A. Johnson was out of town.

The charges of commercial espionage and theft of valuable business information are contained in great detail in the affidavits of R. W. Buckbee, cost accountant of the De Forest Company, employed by them between 1921 and 1933, who worked for the Radio Corporation of America in the early months of 1923 until April or May, 1924. Since Feb, 1923, 1925, he has again been employed by the De Forest Company.

Buckbee's employment by the Radio Corporation of America was discussed in the affidavit, and prior to leaving the De Forest concern he was employed by his fiancee. Mildred, a co-employee, that a man who gave the name of "Jameson," who claimed to have met her at a radio dinner, had telephoned her for an appointment. Buckbee met "Jameson" at his fiancee's home. Her sister Madeline was present.

"Jameson" said he knew nothing about the details of the radio business but was devoting himself to the merger of various radio companies. He told Buckbee he and a certain other person, with whom he was acquainted, had been employed by the Radio Corporation of America to obtain the names of the employees of the De Forest Company. He had been unable to get employment with the De Forest Company and, to obtain the names of persons or offices from which the knowledge would be useful to him, he desired. Two weeks later he met Thies in Room 301, 302 and 303, at 25 Beaver Street. Buckbee was employed as special investigator under the direction of the De Forest Company. He had been asked by an employee of the Radio Corporation of America, calling himself "Hurley," for information regarding instruments made by the De Forest Company.

"Hurley" threatened to do so. and Harley said he was particularly interested in obtaining the names of the employees in the tube department, and of the high frequency departments. He wished to have a diagram of the layout of the tube department, giving the names and locations of all the machines.

"He asked me to take a position with the De Forest Radio Company as a means of getting this information, but, at the same time, of the employ of the Radio Corporation of America."

Continuing, Buckbee said the De Forest Company's office in Dearborn, Michigan, was that a former De Forest employee might be able to assist him. Harley directed him to employ Tides for that purpose, and Buckbee, as alleged in the affidavit, was employed by the De Forest Company.

Buckbee was employed by the Radio Corporation of America to obtain employment with the De Forest Company. Harley directed him to employ Tides for that purpose, and Buckbee, as alleged in the affidavit, was employed by the De Forest Company. Harley directed him to employ Tides for that purpose, and Buckbee, as alleged in the affidavit, was employed by the De Forest Company. Tides had just been employed by the Radio Corporation of America, and the police were accustomed to go when Tides had been employed.

Buckbee's description of "Hurley" called attention to the Radio Age. By Fred A. Smith, Editor, Radio Age

Known as "G-I"

While I was employed by the Radio Corporation of America, I was designated as "G-I." and made all reports under that designation. I never signed my own name to any reports. I telephoned to Harley, and from Harley to the Radio Corporation of America, I knew her as "G-I." She was doing investigations for the company. I never knew her by that designation, never by any name, I know, of any of the employees working under Harley went by initials letters and numbers, as I would meet them in the room where their reports were being made out and recognized them by their designations and I would see those designations in the reports which they were preparing.

The Radio Corporation of America, I frequently met Cecilia Lambert at Harvard. I knew her as "C." She was working at the Radio Corporation of America. I have on several occasions worked under that designation. Since my recent employment by the De Forest Company I have on several occasions worked under that designation.
How the Alert Jack Nelson is
Making Us CHILDREN Again

RADIO SHOULDN'T BE TOO SOLEMN, IS HIS DOCTRINE

Jack Nelson is a great favorite among the kiddies. His best claim to fame in that line lies in the fact that he has lived among thousands of orphan boys and girls at Mooseheart, Ill., the city founded by the Loyal Order of Moose to care for children of deceased members. In his capacity of director of the Mooseheart radio station, WJJD, Jack came in contact daily with these children, who formed a large part of the station's daily programs—and still do. Consequently he knows whereof he speaks in the juvenile line.

After several years of broadcasting experience, Mr. Nelson is prepared to announce that radio listeners, whether young or old, like to be reminded they were children once. They prefer this reminder more than they do solemn speeches, sad music and uninteresting programs, according to Jack. He is an ardent believer in the policy that anything light-hearted and juvenile will "go over" with a radio audience much better than any other form of entertainment.

By this Jack does not advocate a continual round of bedtime stories, for he has never featured that sort of broadcasting. He does, however, believe in keeping people young—anywhere from 12 to 20, he says, and in the attainment of that ideal he has mapped out some wonderful programs that have won an instantaneous response among fans all over the country who have learned to listen regularly for the programs from WJJD every night after 10:30 o'clock, on a wavelength of 302 meters.

For example, the Moline sisters, popular vaudeville artists, come attired as little girls when they enter Jack's studio in the Palmer House, Chicago. Not that the listeners can see them, but Jack describes them picturesquely and then lets them "do their stuff." They cut up for all they're worth, and the radio waves virtually ripple with laughter. The girls don't exactly act foolishly kiddish, but they are funny and light-hearted, and that's the kind of spirit Jack wants to send out from WJJD on his popular programs.

At other times the children themselves broadcast from Mooseheart, and sometimes little kiddies of 7 years of age make the announcements. All this makes a tremendous "hit" with the listeners, and no doubt in the near future WJJD will probably mean "Watch Jack's Joy Diggers."
Radio Age Institute

Manufacturers' Testing Service

MEMBERS of the staff of RADIO AGE will be pleased to test devices and materials for radio manufacturers with the object of determining their efficiency and worth. All apparatus which meets with the approval of various tests imposed by members of the technical staff of RADIO AGE will be awarded our endorsement, and the seal shown to the right will be furnished free of charge. Materials for testing should be sent to:

RADIO AGE INSTITUTE
504 N. Dearborn Street,
Chicago, Ill.

DEVICES
displaying this seal have been tested and approved by the RADIO AGE INSTITUTE.

Apparatus illustrated and described below has successfully passed our tests for July, 1925.

Test No. 70. WET "B" BATTERIES, submitted by the Kelman Electric Co., Rochester, N. Y. Consists of twelve cells in glass jars, set in a wooden frame. Tops are provided with vents for filling with distilled water. There is a sufficient plate area to allow a generous milliamperc capacity for use in receiving batteries, which arrived in good condition as a result of good packing. Tested and approved by RADIO AGE Institute.

Test No. 71. KELLOGG SHIELDED TRANSFORMERS. Codes 503 and 504 were tested, having been submitted by the makers, the Kellogg Switchboard and Supply Company, 1006 W. Adams St., Chicago, Ill. These unshielded types of audio transformers are of 4:1 to 1 and 3:1 ratio respectively, and over a period of strenuous tests were found to produce a radio distortion of less than 2 per cent, consistently. The design is exceedingly simple, very high in efficiency, and is thoroughly padded on three sides with piano felt, there being a resonance chamber below the horn, and a bezel of colored glass serving as a warning that filaments are lighted. Tested and approved by RADIO AGE Institute.

Test No. 72. REMOTE CONTROL LIGHT. Also submitted by the makers, the Kellogg Switchboard and Supply Company, 1006 W. Adams St., Chicago, Ill. This device consists of a single hole mounting brace and socket for miniature light, for use at a point other than right on the battery switch. It is known as a remote control light. It also serves as a warning that filaments are lighted. Tested and approved by the RADIO AGE Institute.

Test No. 73. JEWETT SUPERSPEAKER CONSOLE. Submitted by the manufacturers, the Remo Corporation, of Meriden, Conn. This device consists of a single hole mounting brace and socket for miniature light, for use at a point other than right on the battery switch. It is known as a remote control light. It also serves as a warning that filaments are lighted. Tested and approved by the RADIO AGE Institute.

Test No. 74. FILAMENT WARNING SWITCH. Sample submitted by The Yaxley Mfg. Co., 1107 W. Monroe St., Chicago, Ill. Consists of a single hole mounting filament switch and socket for a miniature light, the light in parallel across the A battery through the switch so that, while current is on the light is illuminated, giving warning current is being used. This light sits back of the panel and a bezel of colored glass permits the set-owner to see it. It serves as a warning to the radio fan who gets ready to turn in after a strenuous DX chase that his filament are still lit and should be extinguished in the interest of battery economy. Tested and approved by RADIO AGE Institute.

Test No. 75. JUNIOR CONDENSER. Submitted by Gardner and Hepburn, Inc., 2100 Washington Ave., Philadelphia, Pa. Consists of a two gang variable condenser, well made and suitable where tuning of two inductances simultaneously is desired. Or it can be used with the two halves in series to decrease the capacity of the condenser. Tested and approved by RADIO AGE Institute.

Test No. 76. STRAIGHT-LINE WAVELENGTH CONDENSER. Submitted by the manufacturers, Silver-Marshall, Inc., of 119 S. Washington Ave., Chicago, Ill. This condenser is a new low loss condenser designed for perfect S-L-W tuning. It is of the single bearing type, equipped with a long cone brass bearing, adjustable, and tension adjustment mounted on, but independent of, the bearing. All plates are of heavily hardened and flattened brass, entirely silver-plated, as are all current-carrying surfaces. This feature, in conjunction with the use of a minimum of high-grade insulation well out of the electro-static field, results in this condenser having even lower losses than many laboratory standards. The single end-plate, as well as the shape of the plates, is responsible for the very low minimum capacity and the exceptionally high capacity ratio. Instead of separating by wavelengths, with this new S-L-W condenser it is possible to separate stations by kilocycles, thus insuring greater selectivity and more separation of stations. Complies latest design in low loss construction. Tested and approved by RADIO AGE Institute.

Test No. 77. CONTINENTAL 3-GANG CONDENSER. Submitted by Gardner and Hepburn, Inc., 2100 Washington Ave., Philadelphia, Pa. Consists of a two gang variable condenser, well made and suitable where tuning of two inductances simultaneously is desired. Or it can be used with the two halves in series to decrease the capacity of the condenser. Tested and approved by RADIO AGE Institute.

Test No. 78. CONTINENTAL LOW LOSS AND JUNIOR CONDENSER. Submitted by Gardner and Hepburn, Philadelphia, Pa. It is known as the Continental lo-loss condenser, with the vernier arrangement consisting of the Junior condenser shown at the bottom of the above illustration. It can be used separately or in parallel with the lo-loss as a means of fine tuning. Tested and approved by RADIO AGE Institute.

A ROUNDUP OF HOOKUPS—Something you've never seen before in the August RADIO AGE
How to Understand All Radio Symbols; Giving the Crystal Its Merited Attention

By JOHN B. RATHBUN

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CONVENTIONAL radio circuit diagrams, the short-hand of radio, have always proved a stickler for the tyro in this science, and it is certain that many a prospective builder has contracted a bad case of cold feet and quit the game when he was brought face to face with the curly-cues and zig-zag lines of the technical diagram. Not being very familiar with the apparatus itself, it is no wonder that the prospect of learning still more of the technique filled him with dismay. However, when these symbols are once understood, they are more easily read and understood than the picture diagrams for they show the functioning and general principles of the circuits far more clearly to the experienced eye than pictures of the apparatus. You can see the course taken by the current in the different branches of the circuit at a glance, and can immediately classify the circuit with little chance of error; something that I have never yet been able to do with the picture type. However, the picture diagram has its place in the scheme of things where the reader is not interested in theory, but simply in building something that will bring in the voice and music with the least delay and study.

For the benefit of those who have not yet become familiar with the standard conventional symbols used in radio circuit diagrams, I have prepared the accompanying two pages of blueprints in which the more common symbols and abbreviations have been defined. In addition to the listing of the symbols, I have taken up a short description of the various parts used in the receiving circuits so that the subject will be more easily followed.

Circuit Symbols (Sheet No. 1)

1. INDUCTANCE (Air Core Type). The hollow coil of wire or other inductance coil with an air core is shown by a continuous scroll or helix as in Item No. 1. Its purpose, to choke off or impede the flow of radio frequency current or for tuning radio circuits to the wavelength of the transmitting station. The abbreviation is (L) and its magnitude is generally expressed in millihenries, or by the number of turns of wire.

2. VARIVOLT (Vary Voltage). This consists of a great many turns of wire wound around a core of soft steel wire on the tube, which is called "laminations." It is used when a greater retardation must be had than is convenient with an air core choke, and can choke audio as well as radio frequency currents. Values in henries or millihenries.

3. TRANSFORMER-COUPLED (Air Core Type). This transformer for radio frequency currents consists of two coils of wire called respectively the PRIMARY (PRI.) and the SECONDARY (SEC.) coils. Radio frequency currents passing through the primary induce similar currents in the secondary coil, thus affording a means of "coupling" two circuits together magnetically.

In our diagrams the primary coil (PRI) is shown with fewer turns than the secondary and is shown on the end opposite to the grid connection (G). The other connections are the filament (F), the plate connection (P), the positive "B" battery connection (B) and the neutral tap (N) used for certain neutralized circuits. The abbreviation is (RFT), and it may be tuned or untuned, the former by a variable condenser.

4. VARIOMETER. This is a form of variable inductance used in place of the air core choke, and consists of a movable member (The Rotor) which turns inside of a stationary coil called the "Stator." The stator plates are shown by the short straight line. The abbreviation is (VAR). By this means the inductive or choke effect can be varied through a wide range without condensers and the device is frequently used for tuning a circuit inductively. It may be tapped at the mid-point as shown at (Q).

5. ANTELLANA GROUND ARRESTOR. At the right is shown the symbol for the antenna or plate connection (GND), and at the right is the symbol for a ground connection (B). In the center is the symbol for a ground connection (GND) and at the right is the symbol for a lightning arrestor (LA).

6. OUTPUT - PHONES - SPEAKER. The symbol for the headset or phones is shown at the right, which may indicate the output of any radio receiver circuit. Abbreviation may be marked by (+) or minus as shown, or this may be omitted altogether. The positive connection of the phone cords is colored red and this red strand should be connected to the (+) connection of the circuit.

7. CONDENSERS. A "fixed" condenser consists of alternate sheets of tinfoil and paper or mica compressed into a compact pile, and adds "capacity" to the circuit, an effect opposite to that of an inductance coil. The symbol for a fixed condenser is at the left where the abbreviation is shown as (K) and where the capacity in microfarads is also added where advisable. A VARIABLE CONDENSER used for tuning inductances is shown at the right, where the rotor plates are indicated by the curved line and the stationary or stator plates are shown by the short straight line. The stator (straight line) should go to the grid of a tube, while the rotor is connected to the ground connection (B). This condenser is also rated in millifarads (m. f.).

8. RESISTANCES - RHEOSTATS. A fixed or unvarying resistance is shown by the zig-zag line which distinguishes it from an inductance. For low resistances used for controlling the filaments of the tubes, its magnitude is given in terms of ohms. For very high resistances, as for grid leaks, the resistance is given in terms of MEGOHMS, abbreviated (MEG).

A RHEOSTAT or variable resistance is shown at the right and is usually employed for controlling the current of tubes. The letter (P) is used for a rheostat, or resistance.

9. BATTERIES. An "A" or filament battery or a "C" battery is shown by the symbol at the left which consists of alternate short heavy lines and longer light lines. The short heavy lines indicate the negative (—) plate while the long lines are the positive plates (+). Each pair of these lines represents one cell, and it is the best practice to mark the voltage below it as at (6v.) and the letter (A), (B), or (C) above it to designate the type of battery.

An "A" battery is at the right where the dotted line indicates a number of omitted cells, there being too many cells in a "B" battery to draw them complete. When the battery is tapped at some low point, as at (+22), the voltage of the tap is marked in this way.

10. POTENTIOMETER. This is a device which looks much like a rheostat used for the accurate control of voltages, generally the biasing voltages applied to the grid of a vacuum tube. It consists of a fixed resistance of from 200 to 400 ohms connected in series in the plate of a vacuum tube, which taps off the drop of potential at any point of the resistance. The polarity of the slider also changes.

Blueprints of Conventional Radio Symbols and Typical Crystal Receivers on pages 36, 37, 40 and 41.
(Continued from page 35)  

\section*{Radiophone Designers' Manual}  

\author{T. R. Stimson}  

\title{The Crystal Detector Circuit}  

\section{Circuit Design}  

\subsection{Components}  

The choice of components is largely determined by the requirements of the particular circuit. The components should be selected with care, and it is advisable to use high-quality components wherever possible.

\subsection{Construction}  

The construction of the circuit is a matter of great importance. It should be as simple as possible, and as free from variable elements as possible. The wiring should be done with care, and the connections should be as secure as possible.

\subsection{Adjustment}  

The adjustment of the circuit is a matter of great importance. It should be done with care, and the connections should be as secure as possible.

\subsection{Operation}  

The operation of the circuit is a matter of great importance. It should be done with care, and the connections should be as secure as possible.

\subsection{Maintenance}  

The maintenance of the circuit is a matter of great importance. It should be done with care, and the connections should be as secure as possible.
While the complete theory of contact rectification is not yet well understood, I will explain the functioning and purpose of the crystal in a general way so that the beginner will have a working knowledge of its properties when installed in the receiving set. Mechanically it is very simple, consisting of a contact or catwhisker wire, the crystal itself, and a thin wire making light contact with the crystal at a sensitive spot. In some cases, a contact may be between two crystals instead of between the wire and crystal, but in any event the radio frequency current must pass through a high-resistance material before passing through the phone, so that the audio or "hearsable" portion of only a few that a great saving is developed.

Owing to the rapidity with which the radio wave oscillates back and forth, the diagrams of the phones cannot follow the radio frequency currents in the receiver directly and nothing will be heard in the phones if some sort of rectifier or "detector" is not inserted into the circuit. These waves are "alternating," that is, they flow first in one direction and then in the other, and before we hear the signals these waves must be made "unidirectional" or forced in one direction through the phones but with an intensity that varies according to the sounds sent out by the broadcasting station. The crystal detector with its contacting "catwhisker" wire acts as such a rectifier and permits the passage of only one set of waves that are flowing in the same direction.

With the radio frequency current rectified, the "audio frequency" waves are developed so that the diaphragms of the phones follow the slower voice frequency pulsations, thus producing sound. Our station waves therefore consist of two components, the high frequency radio carrier waves oscillating at the rate of about 1,000,000 vibrations per second; and the audio frequency waves impressed on them that will range from a few hundred to an upper limit of about 15,000 vibrations per second. All the latter waves are produced by varying the intensity of the radio waves by "modulation," and are not actually an independence set of signals.

There are a great number of minerals that will act as detectors to some extent, but only a few that are effective enough to be used in the practical crystal set.

A ROUNDOF-UP OF HOOK-UPS
in the Deluxe AUGUST ISSUE OF RADIO AGE.

Never before have you seen such a galaxy of hookups, from the simplest crystal to the most recent simplified super-heterodyne receivers. Radio from its humble beginning to its present peaks of achievement in the Special Summer Number of RADIO AGE.

All basic Hookups.

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The Magazine of the Hour

Galena, silicon, carborundum, cerussite, pyrophyllite, peredite, radiated calcite, are among the most commonly used simple minerals, and in addition to these are the multitude of trade names. A good galena crystal is probably one of the most sensitive crystals, but it is not stable and must be kept in a dry place. The carborundum do not require so frequent adjustment and are quite sensitive if carefully selected and mounted. The synthetic crystals are in most cases stable and sensitive, and have the advantage of having a greater effective area or more "hearsable" portion of the wave than that of certain crystals, so that it is not so difficult to adjust them. For the catwhisker wire, we require a metal that will not corrode under ordinary atmospheric conditions and one that will maintain a bright metallic contact area at the point where it rests on the crystal. A copper wire will work well with most crystals, but a silver or gold wire is better, as it does not corrode or get dull as rapidly. With the exception of the carborundum and crystal, the catwhisker wire should make very light contact with the crystal, working best when only just barely touching the surface. With the carborundum detector a very heavy pressure is required, which is in order to make effective contact of the crystal, as the heavy pressure prevents the displacement of the contact when subjected to vibration.

There has been considerable argument for and against the fixed crystal detector with the immovable catwhisker, but the belief that a variable detector will prove best in the long run for the beginner, at least, as it avoids the necessity of constant readjustment and the detuning effect of the motion of the contact area. It will perhaps be of interest to know that the crystal has a great deal of effect in the tuning of the circuit and very often we can tune a station in and out by means of the crystal adjustment alone. For the experienced crystal set operator, the adjustable crystal is therefore often an advantage, as it is an aid to selectivity and tuning, particularly where there are a great number of strong, local stations and other interferences.

It is a good plan to get a number of crystals and then select the best crystal by actual test, and then by the degree of variation among crystals even of the same make, and the only way that you can be sure of the quality of the crystals is to select the best crystal from a number of samples.

The Hook-Up or Circuit

THERE are about a thousand different crystal detector hook-ups from which to choose a choice and perhaps to them have their adherents, who believe that they have the only circuit worth using. Some employ variometers for tuning inductances, others use varistors, variable air and fixed air condensers, honeycomb coils and straight solenoid coils in all sorts of combinations, but as a matter of fact, a close examination will show that most of these circuits can be boiled down to six distinct classes. The various forms of inductances will not change the characteristics of a circuit, it simply adds or detracts from its efficiency by the sharpness of its tuning curves and the amount of interferences within the coil. A variometer may show better results than a simple tuning coil, simply for the reason that it can be more closely adjusted to work with a particular crystal, but not because it is a variometer. An inductance is an inductance no matter what form it may be used.

(Turn to page 42)
Fig. 1. Below

(A) RELATIVE AUDIBILITY = 55

(B) RELATIVE AUDIBILITY = 85

(C) RELATIVE AUDIBILITY = 45

(D) RELATIVE AUDIBILITY = 10

(E) RELATIVE AUDIBILITY = 40

(F) RELATIVE AUDIBILITY = 15

Fig. 2
COMPLETE CRYSTAL DETECTOR CIRCUIT WITH ANT. COUPLER.
Fig. 3
Plan View of Crystal Set

Fig. 4
Installation Drawing
a good degree of selectivity by other means and without so much loss in signal strength; hence, this type or circuit can be neglected for the time being.

Circuit With Coupler

For the sake of selectivity we will connect our aerial and ground to the detector circuit by means of an aperiodic or semi-periodic couple of the type so commonly use in tube sets. For the detector circuit we will adopt the circuit shown in Diagram (B) to obtain the greatest signal strength and will depend entirely upon the coupling construction for our selectivity. This particular combination will probably give us the best all-round combination for signal strength, selectivity, and is simple to build and tune.

In Fig. 2 we have the schematic diagram of the complete circuit. The coupler consists of the primary coil (L1) connected at one end to the aerial and to the ground at the other end. The radio impulses that are transmuted to the secondary coil (L2) which is identical with the coil (L) in Diagram (B). A variable condenser (C1) is connected across this secondary coil and it can be tuned to wavelength. The fixed condenser (K) connected across the crystal detector is of necessity of a smaller condenser than already described. The phones (Ph) are in series with the crystal detector.

By means of the inductively coupled coils (L1) and (L2) we may obtain much better selectivity than with the aerial and ground connected directly to the detector circuit and selectivity depends largely upon the distance between these two coils. The greater the distance the greater will be the tuning qualities where there is a ground effect of the aerial. Properly adjusted, it is possible to tune in and out on a difference of five meters wavelength, but with comparatively little loss in signal strength. With the aerial and ground connected directly to the detector circuit, it is probable that a near station will come in all around the dial, no matter how it may be turned.

In regard to a crystal detector, it may be said that it is comparatively easy to get selectivity with a crystal than with a tube receiver and that greater care will be required in the adjustment. The crystal and stationary plate of the detector are always in opposition to each other, being connected to a steam pipe. For the present, this method of connection to the aerial and ground is also shown in this view, the ground being a connection to a water or steam pipe.

The aerial should not be less than 60 feet in length, but the higher the better. A 150 foot wire is the most desirable where the necessary room can be obtained. With a crystal detector set, the aerial wire that we hang up, the better will be 150 feet long. A 150 foot length (L) can be used up to 150 feet.

With two wires placed side by side, 150 feet long, the aerial and with the set located in an open country, quite long distances can be covered. However, with a 60 foot aerial in a good locality, we can get good reception with fair distance, providing that the aerial line is not screened by steel structures such as steel factory and office buildings, bridges, etc.

Higher Power Licensed

To Beat Static

The Department of Commerce has announced that favorable consideration will be given to applications from owners of Class B broadcasting stations for permission to transmit at the demand, without requiring the increases to be made in steps of 500 watts as has been the past procedure, provided the stations are situated outside of congested receiving centers.

In taking this action the Department is acting in response to the demand of broadcast listeners that the use of increased power be permitted in order to overcome the existing static conditions which are making reception difficult.
If the filaments of your vacuum tubes begin acting as you feel during the summer, it is not necessarily an indication that their span of life has been bridged, for rejuvenation of tubes seems to be as welcome to inanimate thoriated filaments as it is to those who have sought the fountain of eternal youth.

Tube manufacturers have cautioned their customers, via the literature accompanying the tubes in the cartons, that a paralyzed tube may be restored to its pristine activity by leaving it lighted in the set for ten minutes with the "B" battery shut off, this process apparently bringing the thorium from the filament center and giving the tube new life.

One of our prominent manufacturers has come forward with a tube rejuvenator on which radio fandom's interest seems to have centered. It consists primarily of a small step-down transformer, similar to the toy transformers used for running toy railroad trains, etc., being made in two types, one for 110-20 volt primary with four, sixteen and eight volt secondary sections, and the other for the 220-230 volt circuits with the same secondary outputs. This, together with a socket for each size of tube, comprises the layout, to which the owner adds his timepiece.

For the UV 199 tubes the tube is placed in the socket after the transformer has been plugged into the lighting mains. It is given ten volts on the filament for 30 seconds, then the voltage is cut to four volts and the tube is allowed to remain for ten minutes. The first voltage is known as the shocking charge and serves to drive the thorium from the filament center. The ten minute lighting of the filament at four volts is known as the baking charge and serves to solidify the thorium on the filament so its electronic emission is again at a maximum.

For the UV201-A type the shocking voltage is sixteen volts for a period of 30 seconds, and a baking charge at eight volts which lasts for ten minutes. The same action takes place as with the 199.

One Need Remains

As a result the owner of emaciated tubes need no longer worry about a means of bringing back their life. However, neither the tube manufacturer's method of restoring life by allowing the tubes to remain lighted without the B battery on, nor the transformer method.

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<td>Kenosha, Wis.</td>
</tr>
<tr>
<td>Henry W. Werner, Jr.</td>
<td>Box 419</td>
<td>Valhalla, N. Y.</td>
</tr>
<tr>
<td>W. Manning, Jr</td>
<td>619 Princess St</td>
<td>Woodstock, Can.</td>
</tr>
<tr>
<td>Robert B. Otto</td>
<td>85 Lowell St</td>
<td>Mathews, Mass.</td>
</tr>
<tr>
<td>Edward Nolan</td>
<td>657 Tent Ave</td>
<td>New York, N. Y.</td>
</tr>
<tr>
<td>Allan S. Wilson</td>
<td>244 Kenwood Ave</td>
<td>Dayton, Ohio</td>
</tr>
<tr>
<td>Harold W. Fairley</td>
<td>121 Gilmour Ave</td>
<td>Toronto, Canada</td>
</tr>
<tr>
<td>Robert W. Barnhill</td>
<td>116 East 9th Ave</td>
<td>Bristow, Okla.</td>
</tr>
<tr>
<td>Harold A. Reynolds</td>
<td>229 North Montello St</td>
<td>Brockton, Mass.</td>
</tr>
<tr>
<td>Wallace Butxon</td>
<td>4166 Emerald Ave</td>
<td>Oakland, Calif.</td>
</tr>
<tr>
<td>George A. Winkle</td>
<td>902 South 15th St</td>
<td>Birmingham, Ala.</td>
</tr>
<tr>
<td>J. A. Myers, Jr</td>
<td>944 West Capitol St</td>
<td>Jackson, Miss.</td>
</tr>
<tr>
<td>M. E. Walter</td>
<td>117 Lafayette St</td>
<td>Niles, Ohio</td>
</tr>
<tr>
<td>Fred Braunton</td>
<td></td>
<td>Anaconda, Mont.</td>
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<tr>
<td>Cecil Carrigg</td>
<td>215 21st Ave</td>
<td>San Francisco, Calif.</td>
</tr>
<tr>
<td>William Heinrichowitz</td>
<td>133 Johnson Ave</td>
<td>Newark, N. J.</td>
</tr>
<tr>
<td>George D. Hillstrom</td>
<td>10135 Lafayette Ave</td>
<td>Chicago, Ill.</td>
</tr>
<tr>
<td>D. Gabelhouse</td>
<td></td>
<td>Vegreville, Alta., Canada</td>
</tr>
</tbody>
</table>
mentioned before, will restore a filament from which the spark of life has departed due to a breakage. When someone invents a filament restorer for burned out filaments he will be kissed on the brow by all the broadcast listeners, the amateurs and the owners of broadcasting stations, although doubtless the tube manufacturers would chase him into the wilds of Patagonia with a sawed off shotgun.

An old reliable crystal circuit, one of the early types used in the U. S. and still popular with those who do not care for the expense of a tube set for short distance reception on headphones.

At the last moment in our June issue we were able to get together interesting data on the binocular and toroid coils which are designed to eliminate the necessity for neutralization in radio frequency amplifiers. The Pickups Editor will be glad to hear from readers of RADIO AGE of the success encountered with these new types of fieldless inductances.

Here's a fan who is even willing that shoes should be shied at him, but he has the courage of his convictions and writes us as follows:

"An interested observer may be intimidated many times before making his debut into a certain field; but there comes a time when he can restrain himself no longer, and makes a headlong dash by giving his views on a subject. His suggestions may be of little benefit and then again they might open up a way for something better. It is with the latter in view I write this.

"Possibly you have meant the Pickups and Hookups Department to be what it is —no more, but personally I believe that you gave this section of your magazine to the experimenter for a means of radio development. If so, then it is up to the contributor to use it and use it widely.

Dx Lists?

"DX lists do not occupy a seat of honor in my household simply because I do not invite them, or to put it in the words of an amateur, 'I didn't get the Pacific Coast because I was not fishing.' To me the logging of numerous stations merely for a long list is a waste of time. The logging of twenty-nine stations in so many minutes as given by one of the contributors is laughable. May I ask how many of us today would know anything of radio and its possibilities if the early experimenters spent all their time at such foolish toying? Wouldn't it be of more interest and of more educational value if the contributors to this department gave discussions of different circuits, as many are doing, effect of weather conditions, code interference and most of all, receiver interference?

"You will also notice that this section contains hookups, nine-tenths of which are of the regenerative, one-tube type. "Fine, I say, in the hands of one who knows how to use them without spelling half a dozen neighbors' good names. But how few of us there are who are ideal.
Figure 2, and sent in by Walter E. Fee, of 115 Beecher St., Atlanta, Ga., is the single circuit Armstrong, noted for its ability to squeal, and one of the oldest regenerative sets known to experimenters. L 2 is inductively placed against L 1 for feedback.

In Atlanta this circuit works out quite nicely (though we hardly dare think what the neighbors have to say on this subject when the tube is oscillating). It tunes in the long distance stuff while WSB is batting out flies, and for a change Mr. Fee hooks it on a loop and goes fishing for distance, with results as follows: WSB, WOC, WEAF, WCCO, KDKA, KSD, WOAW and WQJ. Of course, this is used on head phones only. It is one of the tried and true types of receivers, although not recommended for congested areas where your neighbor might have one too.

Here’s another one familiar to the fellows who have been following the game for longer than a couple of years. The circuit sent in by Carl Wininger, 20 William St., St. Catherine’s, Ont., Canada, was originally published by Weagant shortly after Armstrong gave the world his regenerative circuit. Later Weagant’s circuit was taken up and popularized by Reinartz. It has masqueraded under a thousand different names, but, the circuit fundamentally is the same which is the point in which most experimenters are interested.

Instead of using a variable regenerative coil for control of oscillation, the Weagant circuit, alias Reinartz, alias et al, uses a variable capacity in series with an inductance, the two paralleling the plate and filament. The control of oscillations seems easier with this type of receiver than with the straight variable plate coil.

The receiver shown in Fig. 3 happens to be the single circuit Weagant, which can be made up with honeycombs, spiderwebs, straight winding on a tube, or any other form of inductance. While it is good for excellent work on distant stations, for the sake of other listeners it would be best to loose couple it, by having an untuned primary in inductive relation to L 1. The condensers in the circuit shown are .0005 mfd. Reinartz found that oscillations could be better controlled by inserting a small choke in series with the phone lead at the point marked X in the diagram.

In the inductively coupled receiver the condenser C1 spans L1, while the antenna comes down through a fifteen turn coil to ground. The secondary is then removed from direct contact with the aerial and if the receiver does feed back into the aerial it will be with lessened energy.

L1 can be approximately fifty to seventy-five turns, while L2 can be somewhere between thirty-five and fifty turns. The condenser C2 making it unnecessary for the exact number of turns to be found for the inductance L2.

Another popular type of receiver in which regenerative control is by a variable capacity in series with an inductance paralleling the plate and filament. Known years ago as the Weagant circuit, later popularized by Reinartz and others. Better build it loose coupled for the sake of the neighbors, unless you happen to live out in the exact geographical center of the Gobi desert.
gested districts. His coils are wound as follows: L2 52 turns 1R or 20 DSC on a three or three and a half inch form. Around center of winding one layer three quarters inch cambric. Stick 8 pieces of hard rubber 3-4 by 3-16 by 1-4 placed equidistant around the piece of cambric, fastened with collodion. Coil L1 is wound on these blocks and consists of 3 to 10 turns of the same wire. An ordinary plate variometer is used for L3. C1 is .0005 and C2 .001 mfd. This circuit is inductive and even if oscillating would not cause the same amount of annoyance which a single circuit would. He submits a list of DX stuff that certainly entitles him to the DT button.

Another circuit which has proved very popular with those who wished to economize on tubes and material, is the reflex circuit, originally attributed to Latour, the Frenchman, who gave it to the Allied communication authorities during the early part of the war and which was immediately pounced upon by everyone on this side of the water as an excellent circuit from an economical standpoint. It has been rearranged countless times and additions and deletions made to the original.

This circuit, Fig. V, is sent in by Francis Davis of Cushing, Okla., who tells us L1 is wound on a 3 inch tube with 15 turns of No. 22; L2 same size tube with 50 turns; L3 is the same as L1 and L4 is the same as L3. The variables C1 and C2 are .0005 mfd. C3 is .00025 and C4 is .001 mfd.

Davis' list of DX stations also gets him the DT button.

Looks like the ladies are not to be prevented from having equal rights in radio as well as economics, for in this week's mail come two letters from feminine fans, the first from Floid Omond, 16 Alsace Ave., Buffalo, N. Y., who finds RADIO AGE interesting in every way, and specially the Pickups and Hookups. She has built a one tube and a three tube set and has received fine DX stuff with these. So we will send her a button, but regret we haven't a little wisp of ribbon to send along with it; we used up the last piece in winding a coil.

The other feminine ether chaser is Mrs. Eva A. Taylor, 69 Murdock St., Youngstown, Ohio, who reads RADIO AGE with a great deal of interest, especially since she ran across one of the Youngstownian names in the magazine. She has qualified for the button by sending in a list of stations she has received on a manufactured four tube set with built in loud-speaker. She wonders if there is anybody in Chicago who does not own a broadcasting station, as her experience on the air seems to show that nearly everybody in Chicago is broadcasting.

We got quite a laugh out of a letter from Albert C. McTee, 2306 Seminary Ave., Chicago, Ill., who says his set is in a second edition of "Hell's Kitchen" where he has to contend with regenerative squeals and howls. In his letter he tells of making a crystal detector out of an old mouse trap but fails to tell whether he was bothered with squeaks, on account of this fact. He

(Turn to page 48)
Radio Age
The Magazine of the Hour

Offers to Its Readers the First Feature of Its Kind Ever Published in a Radio Magazine

A Round-up of Hook-ups

ALL Basic Circuits from which ALL Radio Hook-ups are Developed Described and Illustrated with

62-Page Blueprint Section

For the first time in any radio magazine, RADIO AGE is publishing in its August, 1925, issue, an array of radio hookups that will impress and delight every lover of technical radio information and accuracy.

In this big number, which is to be our “Deluxe August issue,” RADIO AGE will prove its superiority in the technical field by giving its readers, at no additional cost for the magazine, many pages of hookups, from the early diagrams to the very latest developments in multi-tube design.

Because of the inevitable popularity of this number, and the demand its publication will cause, readers are asked to order copies in advance.

Order Your Copy of This Wonder Issue In Advance!

25 CENTS A COPY, $2.50 A YEAR

RADIO AGE, Inc., 500 N. DEARBORN ST., CHICAGO

THIS unusual number will sell for the usual price of 25c a copy. Of the pages in this number, fully 50 pages will contain actual constructional articles, of which THIRTY OR MORE pages will be typical RADIO AGE blueprints, which have made the “Magazine of the Hour” distinctively famous the world over.

From the simplest crystal set, the articles in this number will enable the reader to travel by an orderly process to the super-heterodyne; taking in every popular type of receiver introduced since the advent of the radio science.

Where improvements have been made, the latest technical explanations will be given. Everything will be strictly up-to-the-minute, and written so clearly and simply that either the rawest novice or the most seasoned technical expert will understand the articles almost at a glance.
How are Your DX Lists Coming This Summer? Let the "Pickups and Hookups" Readers Know About Them!

Charles Markarian, 110 Summer St., Worcester, Mass., gets fine results with the reflexed neutralode described by Mr. Hopkins in the January issue of RADIO AGE.

T. L. Kent, 721 North Ave., Waukegan, Ill., formerly GUS, is now out of the "ham" and into the BCL game, which he likes very much.

John Hogle, of 321 Selma Ave., Kenosha, Wis., says he is bothered by only one station, that being Zion. He asks for a wave trap that will obliterate that station. He has made up his set from RADIO AGE blueprints. He gets excellent results from his three circuit regenerative. A wave trap might be used on Zion with good results. Make it on a cardboard form about three inches in diameter, winding it with about fifty turns of No. 18 bell wire (also known as annunciator wire), spanning it with one of the Kemler condensers he uses. Insert in series with the aerial lead of your normal primary and tune to Zion's wave, leaving it there while you chase off in quest of other signals.

Roy R. Winder, Pedro Miguel, Canal Zone, sends word of his luck with radio in the land of static down around "Pete-Mike" on the Panama Canal. The first station he has a chance to pick up is PWX, Havana, about 900 miles to the northward. He is a regular reader of RADIO AGE, considering it one of the most valuable assets of radio.

Another fourteen-year-old radio fan is E. N. Girard, 715 South 58th St., Philadelphia, Pa., who uses RADIO AGE hookups as his guide. He gets out of town stuff without trouble from the locals and sends in a dandy DX list.

Kendall McNeil, of Ottawa, who neglects to send his address, writes interestingly of his excellent results with the improved three tube Reinartz described in the May RADIO AGE by Mr. Piety. He gets all the stations in the U. S. and also nabbed two or three of the Continentals, namely London, Newcastle and Aberdeen, all of which he has confirmed.

D. C. Atkinson, 788 Hohman St., Hammond, Ind., one day used his downspout on the eave-troughs of the house instead of an antenna, getting stronger signals. He used this on a crystal set, but says he has not tried it on a tube set yet. Let's hope his experience will not start an epidemic of down-spouting or else all the landlords in the country will be faced with the necessity of installing tinned copper downspouts with binding post connections for each experimenter. Many tin roofs have worse 

P. E. Chapman, 805 North Preston St., West Philadelphia, Pa., thinks RADIO AGE is the best on the market and reads it with great interest. He thinks our invitation to readers and experimenters to forward their results to the amateur and a great help to all who are interested in radio. He is still using the four-tube circuit published by RADIO AGE in September, 1924, and with it has logged 167 stations; three Europeans, two Cubans, five Canadians, six Pacific coast and one Alaskan.

P. French, 1209 Franklin St., Beaumont, Texas, took us at our word as to Spring cleaning referred to in the May RADIO AGE. He reports that Spring cleaning from aerial to ground clamps...
DAVEN
SUPER AMPLIFIER

It is a recognized fact, that only a Resistance Coupled Amplifier delivers perfect amplification. With the SUPER AMPLIFIER you are assured of ample volume, lower "B" Battery consumption, minimum of assembly labor, unimpeachable quality—an amplifier which makes any good set better.

Obtain from your Dealer the Resistor Manual a complete handbook on Resistance Coupled Amplification. Price 25 cents or postpaid 35 cents.

The Difference—
When Using AMPERITE
Amperite the "self-adjusting rheostat", automatically controls the flow of current, and makes hand controlled rheostats obsolete.

For perfect results you must use AMPERITE for filament control.
Price $1.10 everywhere.

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Dept. R.A.7, 50 Franklin Street, New York City

Write for FREE
Hook-ups

AMPERITE
"means right amperes"

Sales Distributor Wanted
to start now in the fastest growing business the world ever knew—Three Million radio sets were sold last year—22 Million will be sold in the U. S. A.

THE MUSIC BOX RADIO RECEIVER
is the peerless seller of them all. Think! Only two orders weekly means $600 per month. Four orders $1200 per month. The Set with the Marvelous Tone and Volume Supreme, the Distance getter of them all. Write now, today, for our liberal 15-day trial offer and protected territory.

THIELEN, Manufacturer
1207 North Shore Ave., Chicago,

Geared
80 to 1

Another important development in ACCURATUNE construction—the use of a full brass gear train, built exceptionally rugged and designed for Accurate Tuning. "Absolutely essential for sensitive sets."

At your dealers, otherwise send price ($3.50) and you will be supplied postpaid

MYDAR RADIO CO., S-K Campbell St., Newark, N. J

"The Roundup of Hookups!"—112 pages of every conceivable kind of radio hookups—will be the big feature of the "Deluxe" Edition of the August RADIO AGE. On the stands July 15, but order your copy in advance if you want to get this wonder issue. More than thirty pages of blueprints and scores of hookups! 25 cents a copy.

* Tested and Approved by RADIO AGE *
The Broadcast of Plays  
Written for Radio

By E. E. Mattson  
Westinghouse K Y W

Since the advent of radio, its progress has been marked by many improvements, some of them expected and some not looked for. However, improvements from a technical point of view have not been the only goal sought in radio. From the beginning radio was popular because of its newness, its mysteries and seeming intangibility. A person bit by the radio bug soon became almost diabolical in his lust to grope into the distance, and spared no effort to purchase or build a set that brought him clear and distinct sound. Those were fascinations that led him on.

With the advance of radio activity, and the many angles taught its leaders by experience and study, it became apparent that the mere broadcasting of vocal or instrumental numbers accompanied by conventional announcing would not suffice. Some of them expected and some not. Other things were essential—balancing of the act. These, and many beautiful. The artist was taught to imagine. What the stage artist did by pantomime, the artist was taught to do by the microphone in the studio. So far this has brought many improvements, especially in the Summer-time. Wilson Ames, his life long friend. The entire personnel of the act.

The announcer, the artists, the station, who have been coached in rehearsal until the effect intended has been brought out to a high degree.

Summer Radio Conditions To Be Surveyed

By F R ANK Hopkins and Harvey T. Kelley, Assot., I. R. E., and well known radio engineers, plan to leave Chicago some time during August on an extended trip throughout the Western and Southwestern portion of the United States, to carry on an intensive survey of broadcasting conditions in so-called "dead spots." Because radio reception is so difficult in the Summer-time, under most conditions, the two experts will endeavor to trace the causes for them for public use. Their findings will be sent for publication in RADIO AGE as the trip progresses.

A 100-watt broadcasting station will be part of the equipment carried on this trip, and arrangements have been made to carry on tests in Colorado, Utah, Arizona, New Mexico, Southern California, and where static conditions at this time of the year are unusual. Under the influence of adverse conditions, an attempt will be made to determine just what kind of radio circuit performs the best. Several small parts will be taken on the trip and tested under varying atmospheric and geographic conditions. Communication with Eastern and Pacific broadcasting stations will be maintained throughout the long trek, which will be made by automobile.

Several stations have expressed a desire to broadcast the findings of the experts, to guide them in reaching districts and listeners in isolated parts of the world who at present encounter difficulty in maintaining consistent touch with radio stations throughout the year, and especially in the Summer-time.

Mr. Hopkins and Mr. Kelley intend to devise several new types of radio apparatus to meet the difficulties they expect will confront them. These varied types of apparatus, which will be designed after thorough tests, will be described to readers of RADIO AGE. This Fall, thereby being of great value to those fans who live far from strong stations and who are bothered by static, fading and other unaccountable disturbances.

Both Mr. Hopkins and Mr. Kelley have long been identified in radio circles, both doing research and development work. Both are past masters in the transmitting and receiving art.
The Radio Spies

(Continued from page 32)

occasions seen this same Cecilia Lambart at the
De Forest plant in Jersey City. I was likewise told
by another employe who was working under Harley,
whose name I do not recall, that there was at that
time a young lady he met Harley, at the lat-ter's sugges-
tion. With Harley was Miss Johnson, whom Buck-
bee asserts, told him that Miss Johnson was
position with the De Forest Radio Company, as
stenographer, and that he wanted her, after having
(Turn to page 60)

Through the Locals—
ALL-AMAX Reaches Out

Every ALL-AMAX Set, wherever it may be, brings to
its owner his choice of all the beauties in the air.
Every day come more and more letters to our office,
telling of the long distance reception, almost unbeliev-
able on a three-tube set, which has rewarded the
owners of ALL-AMAX.

Remember, too, that ALL-AMAX is completelymounted
on panel and baseboard. You can wire it in one delightful
evening, following simple photographic instructions.

* ALL-AMAX SENIOR, three tubes and detector . . . Price, $42.00
* ALL-AMAX JUNIOR, one tube and detector . . . Price, $22.00

ALL-AMERICAN RADIO CORPORATION

E. N. RAULAND, President

2680 Coyne Street

Chicago

ALL-AMERICAN

Institute Correction

Through an error, the illus-
trations of Tests No. 47 and 49
in the RADIO
AGE Institute
for May, 1925,
were reversed. The Quam
Con-
denser test was
illustrated by an engraving of
the Duplex
Condenser, and vice versa.

We are reprinting
views of the two
condensers with
their proper identi-
fications. The view here-
with shows the Quam
condenser, and the
cut at the bottom
is a Duplex
Matched Condenser.
Standard Radio Receivers

Recently RADIO AGE inaugurated a new department called "Know Before You Buy," to serve as a guide to the prospective radio purchaser in deciding on the receiver best suited to his individual needs. Fans throughout the country have shown an instantaneous response to this new feature, and accordingly it is continued and will be a feature of all forthcoming numbers of RADIO AGE. Readers are invited to write us concerning the sets in which they are interested, and manufacturers also are asked to send us material describing their sets.

Selectivity Paramount in Chelsea Sets

The Chelsea Three and Five Tube receivers have been designed with virtually one end in view: that of attaining the ultimate in selectivity. The Chelsea Super Five, just announced, is a five tube receiver embodying this selectivity with unusual volume. Distortion is minimized so it is unnoticeable, as is any annoying squealing.

The Chelsea Five has all the principles of the perfected non-regenerative set, including remarkable distance. The cabinet, of the sloping type, is finished in rich mahogany with shielded Bakelite. The retail price is now $50.

The Three Tube Chelsea

Clear volume on the loud speaker, with ability to bring in distant stations within reasonable range, is the feature of the Three-Tube Chelsea, Model 122. This set has been on the market for some time and has gained a reputation for its consistently remarkable performance. One station is received at a time, proving it is also selective.

The Chelsea 3-Tube Set is of the triple circuit type, controlled by a single tuner. No knowledge of radio is necessary to operate this simple receiver. The cabinet is slightly sloping, as in the Chelsea Super Five. It is of attractive finish. The price is now $40.00.

The Eaglet Receiver a "Prince of the Air"

The Eaglet, a three tube dry cell neutrodyne, has been "weighed in the balance" of engineer’s tests, and has proved that it possesses selectivity, volume as well as simplicity, distance and tone volume. These qualities, coupled with good workmanship, finish and guarantee, constitute the last word in radio.

The Eaglet embodies the Eagle Balanced Neutrodyne circuit, using one step of tuned radio frequency amplification, vacuum tube detector and two steps of audio amplification. The first tube is reflexed; that is, it amplifies radio and audio frequency at the same time; making the Eaglet virtually a four tube receiver.

It gives reception equivalent to a four tube dry cell set, using only the current required by three tubes. The Eaglet is portable in the sense that it is light of weight, can be conveniently carried about the house and can be hooked up to different antennas, taken out in an auto, used on camping trips, Summer homes and hospitals.

For its operation it requires three No. 6 dry cell A batteries 1½ volt, and four No. 231½ B intermediate size or one 4½ volt unit C. The tubes are UV 190 vacuum tubes or their equivalent. The instrument can be operated with ear phones or loud speaker. The installation is the same as the Eagle model B; namely, approximately 100 feet antenna. Two antenna leads are provided, one for long and one for short aerial.

The receiver is a delicate, scientific instrument, and should not be tampered with by inexperienced people. The Eaglet has been welcomed both by the trade and the consumers and has already endeared itself to thousands of owners. Families spending the hot months in camps, mountains, or sea shore will find the Eaglet a source of great joy and will be able to keep in touch with the wonderful open air orchestra programs that are always broadcast during vacation time from the country’s best stations. The water enthusiast can listen in and have a whale of a time with his Eaglet installed on yacht or motor boat, on account of its compact design and light weight. The price is $75.00.

"Tone Modulator" in Resas Receiver

The perfected Resas Tone-A-Dyne receiver embodies every advantageous feature claimed for any five tube set, plus the Tone Modulator, a feature that is to be had only with the TONE-A-DYNE.

As its name implies, the Tone Modulator controls the tone and volume at all times and under all operating conditions. There is nothing complicated or difficult about it. Simply a turn of the knob and the musical or vocal selection assumes its most pleasant volume.

The Tone-A-Dyne is non-radiating. Annoyance from squeals and howls is eliminated.

The selectivity of the Tone-A-Dyne is unusually satisfactory. With local stations broadcasting on a wavelength only 5 meters away, station WHAS (Louisville) has been readily tuned in without interference on a short indoor aerial.

The Tone-A-Dyne is so designed that it can be operated by anyone without previous experience. The three tuning dials are accurately calibrated and matched so that their settings practically correspond. There is only one filament control, and this can be set at the best operating point on reception of the first station. A snap switch controls all tubes. Clearly marked binding posts are provided in the rear for all connections.

The price is $78.00. (Turn to page 54)
Learning the Various Tube Characteristics

(Continued from page 12)

operation. This condition usually comes suddenly on air and spread out over the life of the tube as would be expected. It is sometimes caused by applying excessive voltage to the filament of an otherwise good tube. If such is the case, it is possible to restore the tube to normal by the rejuvenation process, or by applying the rated voltage to the filament with the plate voltage cut off, for about a half hour.

From the above it will be seen how an old or defective tube will cause the aging of the other tubes in a circuit. This condition is readily noted by the necessity of increased "A" battery voltage—but most fans just turn the rheostats on and let it go at that—paralyzing or otherwise decreasing the efficiency of all of the tubes, which is a rather expensive performance in the end.

Amplification Factor

To determine the amplification factor of a vacuum tube experimentally, a high frequency current of about 1,000 cycles is necessary—along with a hot wire galvanometer and other associated equipment. However, it is possible to determine this factor by use of the plate current values of the tube under test, substituting approximate values for functions of the various voltages in the tube. Thus, $-1 - a (E_b + E_o + e)^3$ in which $E_b$ equals the Thermionic current in millamperes, $E_o$ equals the potential (voltage) difference between the plate and filament, $E_t$ equals the potential (voltage) of the grid and $e$ is an arbitrary quantity representing the small differences of potential (voltage) existing in the tube under various conditions. $a$ is a structural constant.

The quantity $\gamma$ in this equation is as explained in volume 47—1918—"Physical Review" by Van der Bijl—"That for equivalent values of $E_b$ and $E_t$, a change in the grid (plate) voltage $E_o$ produces $\gamma$ times as great a change in the current to the grid as an equal change in the grid voltage $E_o$—or non-technically—a change in voltage on the plate would have to be $\gamma$ times as great as the voltage change on the grid that would be required to produce a given change in the plate current. The voltage amplification factor $\mu$ is the reciprocal of this quantity or $\mu = 1/\gamma$.

This is shown graphically in figure 2—where the grid and plate curves are drawn to the same scale on the same chart, indicating that a much smaller change in grid voltage will produce a greater change in plate current than a like change in plate voltage will produce.

The ratio of the two voltages required to produce a given change in plate current is the amplification factor ($\mu$) on the chart; the ratio of the slopes of the straight portions of these curves is the amplification factor.

The amplification factor of the tube plotted on this chart will be between 6 and 6.25 or an average of 6.125. With this average factor we have $\gamma = 1/6.125$

(Continued from page 56)
Standard Radio Receivers; The Atwater Kent

(Continued from page 52)

Atwater Kent Carefully Designed

THE careful construction of Atwater Kent Radio is apparent to the most casual observer—the easy movement of the tuning dial; the absence of intricate wiring; the sturdiness and rigidity of the various parts, are but a few of its features. Other structural details worthy of particular note are:

Diaphragms: special alloy metal, unusually large in diameter, assuring great volume without distortion.

Magnets: special Atwater Kent, requiring no extra batteries.

Many types of radio receiving sets deliver a sufficient volume of sound from distant broadcasting stations, but they are not selective—that is, they cannot separate two stations, both broadcasting at the same time on waves of nearly the same wavelength.

Atwater Kent Receiving Sets overcome these difficulties to a marked degree, so that two or more stations broadcasting at the same time can be separated and the desired station tuned in clearly, and without troublesome interference.

One of the most pleasing features of Atwater Kent receiving sets is their assurance of securing a desired broadcasting station.

A printed list is supplied with each set which gives the approximate dial setting of many of the well-known broadcasting stations. With this key list in hand, the owner of an Atwater Kent can tune in a series of desired stations, or stations operating on similar wavelengths.

By writing down the dial readings opposite the names of the stations, make up a list or "log."

Model 20 is a powerful receiver capable of operating a loud speaker under all conditions where broadcasting is at all practicable—hence ear phones are unnecessary. It comprises two stages of tuned radio frequency amplification, a detector and two stages of audio frequency amplification with three tuning dials. It is non-radiating and non-squealing.

Dimensions: Height, 8 1/2 in.; length, 26 in.; depth, 8 3/4 in. Number of tubes required, 5.

Part No. 4640, Model 20 Cabinet Receiving Set, $100.00.

Open receiver, same as Model 20 but without cabinet—$85.00.

New Studios Ready for WCCO

Work has started on the new Saint Paul studios of the Gold Medal Station, Saint Paul-Minneapolis, WCCO. These studios will be among the most uniquely located in the world. They are being built in Saint Paul's new Union Depot, used by nine railroads. The studios, reception room, and executive offices, will be at the left of the concourse through which all persons pass going to and from the trains.
A Simplified Portable Super-Het

(Continued from page 23)

Lead No. 14 of the battery cable is attached to A1 on the battery switch. Attach the lug at the end of the 2 3-4 inch section of Lead No. 17 to the potentiometer at A2. The tap is attached to the battery switch at A3 and the last lug is attached to the rheostat at A4. Lead No. 27 is now run between the rheostat at A5 and the negative filament line at A6.

Lead No. 18 runs from the potentiometer at B2 to the positive filament line at B3.

The lug at the end of the 8 3-4 inch section of lead No. 12 is attached to the center of the potentiometer at G. The other taps of this lead are attached to the terminals marked “F” on the third, second, and first intermediate frequency transformers. These are points G1, G2, and G3 respectively.

Attach the lug at the 4 1-4 inch section of lead No. 2 to the rotor plates of the loop tuning condenser at H1. The tap on this same lead connects to the stator plates of the balancing condenser at H2. The other end of this lead connects to one side of the loop.

Attach the lug at the end of the 7 1-4 inch section of lead No. 15 to the rotor plate of the balancing condenser at J1. The tap in this lead connects to the plate of the first detector tube at J2 and the remaining lug connects to the “Plus” terminal of the first intermediate frequency transformer at J3.

The lug at the end of the 7 1-2 inch section of lead No. 6 attaches to the lower jack at D1. The next tap connects to the B Positive terminal on the second audio frequency transformer at D2. The remaining lugs attach to the “Plus” terminals on the fourth (or filter transformer), the third and second intermediate transformers respectively. These connections are made at points D3, D4, and D5.

The oscillator coupling should now be bolted to the sub base. Use 6-32x5-16 inch machine screws for this purpose.

Before attaching the socket strip be sure that all of the wires which you have attached so far are as close to the base board as possible. This is one of the few “don’ts” in these instructions and should be observed.

The socket strip is attached by means of 6-32x1 3-4 inch machine screws. Run the bolt through the base board, place a brass washer under a 6-32 3-8 inch nut and secure it firmly. Then run another 3-8 inch nut down the bolt about three quarters of the way. The socket strip is now placed in position and the loose nuts on the underside of the strip run up to the correct point. Fasten the strip firmly in place by nuts screwed on from the top and you are ready to resume wiring.

Lead No. 25 is now completed from G4 on the 0.006 to G1, the Filament terminal of the third intermediate frequency transformer.

Lead No. 22 is completed by connecting from D6 on the other 0.006 condenser to the “Plus” terminal on the fourth or filter transformer, D3.

Connect lead No. 26 from C4 on the 0.005 condenser to the B plus terminal on the first audio frequency transformer, C2.

Complete lead No. 32 from A7, the inside terminal of the pickup coil to the negative filament line of the socket strip at A8.

(Rurn to page 56)
The Magazine of the Hour

Simplicity of Construction is Vital in Portable

(Continued from page 55)

Lead No. 19 is completed from J, the inside terminal of the plate section to the plate of the oscillator tube, J1.

Lead No. 5 by running from the outside terminal of the plate section C1 to the "Plus" terminal on the first audio transformer, C2, and to the "Plus" terminal of the first intermediate transformer.

Lead No. 11 is completed from the inside terminal of the grid section, E1, to the filament terminal on the first audio transformer, E3, and to the filament terminal on the second audio transformer, E7.

From the outside terminal of the grid section, K run lead No. 13 to the grid of the oscillator tube, K1, and to the stator plates of the oscillator condenser at K2.

Attach the battery cable to the filament terminal of the first audio transformer at E3. This is the C battery negative connection.

Lead No. 21 is the positive filament wire in the battery cable and attaches to the positive filament terminal on the socket.

The second socket from the left can be used for this purpose.

The B battery positive and detector line of the battery cable, lead No. 39, may now be attached to the "Plus" terminal on the first intermediate frequency transformer at C3.

Lead No. 20 is the B battery positive amplifier of the battery cable and attaches to the "Plus" terminal of the second intermediate frequency transformer at D5.

The tap on lead No. 1 is now attached from the first grid condenser at H5 to the stator plates of the loop tuning condenser at H6.

Lead No. 24 runs from the rotor plates of the oscillator condenser, E1, to the filament terminal of the first audio transformer, E3.

Lead No. 16 is connected by the bug at the end of the 4 inch section to the upper Jack, V. The tap connects to the plate of the first audio tube, V1, and the remaining tap is connected to the grid terminal of the second audio frequency transformer, V2.

Lead No. 36 runs from the grid of the first intermediate frequency tube, X, to the grid terminal on the first intermediate frequency transformer, M1.

Lead No. 37 runs from the grid of the second intermediate frequency tube, O, to the grid terminal on the second intermediate frequency transformer, O1.

Lead No. 38 connects the grid of the third intermediate frequency tube, Q, to the grid terminal of the third intermediate frequency transformer, Q1.

Lead No. 29 connects the plate of the first intermediate frequency tube, N, with the plate terminal on the second intermediate frequency transformer, N1.

Lead No. 30 attaches to the plate terminal of the first audio transformer at L1 and runs to the plate of the second detector tube, L2.

Lead No. 34 connects the grid of the first audio frequency tube, U, with the grid terminal of the first audio frequency transformer, U1.

Lead No. 42 runs from the grid of the second audio frequency tube, W, to the grid terminal of the second audio frequency transformer, W1.

The grid condenser for the second detector tube is now mounted on the transformer as shown in the diagram and photograph. The easiest way to do this is to remove the regular nut from the second intermediate frequency transformer, C1, and screw down tightly a small 6-32 nut. The regular nut is now replaced and as a sufficient amount of thread is now exposed, the condenser can be fastened securely by a 6-32 machine screw which has been cut or filed to the correct length. An alignment of 41 is then made for the condenser at S1 and to the grid of the second detector tube at S.

Lead No. 4 is then attached to the plate of the second detector tube and the wiring is completed in the set itself.

Lead No. 7 shown on the diagram is later used to connect the loud speaker terminals with the B battery positive amplifier and can be left aside until it is needed.

Three 22-1/2 volt B Batteries, six ordinary dry cells, and a C Battery are the battery supply.

When the set is completed, plug the battery cable into the battery partition and cut the covering of the cable until leads of sufficient length are exposed. The layout shown in the sketch leaves everything snug but there are several combination you might try. Lead No. 7 now comes in for a useful career as the connection from one loud speaker terminal to the B Battery positive amplifier. Leads No. 31 and No. 33 are now connected to the outside terminals of the loop windings and Lead No. 3 connects with the center tap terminal of the loop.

When all the tubes are in the set, the batteries hooked up and the loud speaker connected, pull the filament switch and adjust the rheostat to a point about three quarters of the way on. This is probably a little too high but a few minutes of exposure won't hurt the tubes particularly and we are at least certain of having enough. Set the balancing condenser at its minimum capacity and advance the volume control until it is brought up to a soft roar. Now, when a station is tuned in, it may be brought to maximum volume by continuing to advance the balancing...
condenser and the potentiometer until the circuit "spills over." Selectivity in this circuit is governed chiefly by the amount of regeneration present in the first detector circuit and by the position of the potentiometer. The more regeneration in these circuits, the sharper the set becomes. Excess regeneration in the first detector circuit will be recognized by the "mushy" quality of the received signal and by the fact that the oscillator dial becomes very broad in tuning. As the detector is then combining the functions of both a detector and oscillator.

The grid leaks recommended are 3 megohms in the first detector circuit and 5 megohms in the second detector circuit. If the circuit tunes too sharply or if volume is less than expected on local signals, substitute a lower value in the first detector circuit. If the circuit tunes too sharply or if volume is less than expected on local signals, substitute a lower value bypass condenser.

Body capacity should not be present on any of the controls except the small balancing condenser. Even here it will not be particularly noticeable except on distant signals. If body capacity exists on any of the other controls, look over all connections, particularly those of the bypass condensers.

5KW Power for Cincinnati

WLW and WSAI, two broadcasters located near Cincinnati, have been authorized to use power as high as 5000 watts. This information may come as a shock to some skeptical fans who have feared any great increase in power, for they are the first two 5K\V stations. The new licenses catalogue the power as "500 to 5000 watts." It is requested that they use discretion, observing suggestions of the district radio supervisor if interference is created by the increased power.

The main factor, which influenced the Department of Commerce to grant these licenses, was the fact that they are both located outside the crowded urban districts.

WEAF, the A. T. & T. Co., station in New York, has been authorized to increase its power to 2500 watts, being now the next highest powered station.

RADIO AGE for July, 1925

The Magazine of the Hour
It does not seem so long ago that we were listening to the now almost forgotten spark signals with the simple little crystal set, which at that time was considered one of the wonders of the age.

Interest in this, however, was confined to a few amateurs who studied the code and enjoyed an evening's chat with their friends. Then came the radio telephone, by means of which voice and music could be heard with these rudely constructed and inefficient sets. Two broadcasting stations began to send out musical programs and the amateur began to be popular. People began to call at his little station and marvel at this new scientific toy, to ask his advice as to how they, too, might build a set and enjoy this pleasure, not because of any particular desire to learn the principles of radio communication, but because they wanted to hear this music coming from the air and to entertain their friends with this newly found amusement.

More broadcasting stations began to operate and the fever spread until at the present time radio has grown to be one of the greatest industries in the world. In the beginning, it was difficult to construct even the simple crystal set, the parts having to be constructed by the operator himself. We hadn't a radio store on every corner as we now have. It was real work.

Improvement Arrives

With the opening up of more broadcasting stations and the increase in the number of fans, came the demand for something better in the way of a receiving set. Vacuum tubes began to replace the crystal, because by their use the signals were not only detected as they were with the crystal, but they were amplified also, this being made possible by the addition of the third element in the tube, called the grid, which was produced by the inventive genius of Dr. Lee De Forest. These vacuum tubes, however, were expensive in the old days and only those who could afford luxuries were lucky enough to possess them.

Today they may be had for the price of one dollar and up, and the simple little crystal has lost its prestige. With the advent of the vacuum tube more of these amateurs became interested in the actual science and as a result of their uniring efforts, we now have radio as it is today. They created the demand for better apparatus and improved upon the few basic circuits until we now have hundreds of circuits in use, with more coming all the time.

But what of these circuits? As a matter of fact, there are only a few of these basic circuits, most of the new arrangements being only improvements which are bound to come from this vast army of experimenters. Before the World War, Major Armstrong announced his regenerative circuit, which was a basic idea, but since that time the only distinctive new circuit which has appeared is the reflex, the production of which is generally attributed to Prof. Marius Latour of France, and Armstrong's Superheterodyne.

Today there are hundreds of sets advertised, all of which are merely modifications and additions to these five or six basic circuits. Among these are the single-circuit regenerative, three circuit regenerative, superregenerative, and other forms of regenerative or radio frequency amplification. From this list many combinations have been made, radio frequency amplification has been added and hundreds of little kinks here and there have been incorporated, but a close analysis will reveal the fact that no radical changes in the old basic principles have been made. There are many people at the present time who want to purchase sets and who are holding off and waiting in the fear that some new thing is shortly going to develop which will make their selection obsolete.

A Foolish Idea

This is a foolish idea which is not borne out by the past. It is true, perhaps, and very probable that many new sets will appear on the market in the next year, but it is not at all probable that any radical change will take place. There is, of course, a possibility that the wave band of the broadcasting stations may be slightly increased, due to the fact that so many applications for licenses are being received by the Government that they find the present wave band too narrow to accommodate all of them and keep the proper separation. But one may rest assured that nothing will be done to make the present type of receiving set obsolete.

Experiments have shown that it is possible to broadcast on wavelengths as low as 100 meters, but it will probably be a long time before the wave band will be broadened to this point. The fact that so many stations are now in operation has made the question of selectivity one of vital importance. In the old days, when only a few stations were sending their programs, it made little difference whether or not the set was selective, but today things are changed. Selectivity is the watchword. The question of distant reception has been well taken care of, and the present day receiver will pick up programs from coast to coast and from Alaska to South America, but if the set is not selective, this great range is of no particular value.

Regeneration and radio frequency amplification have made distant reception possible. Here, again, we find that we are back to the old basic circuits. Radio frequency amplification is not new but the method of tuning it, the construction of the transformers, neutralizing the feed-back, and many other improvements are to be found in these improved circuits.

The one bad feature of radio frequency amplification has always been the tendency of one stage to feed back energy to another, thus setting up undesirable oscillations with the resultant howling and squealing. Different methods of overcoming this are found in many of the standard sets now in use. The neutralizer, for example, overcomes this difficulty, by neutralizing the inherent capacity of the tube. By this means all the advantages of radio frequency amplification are realized and distant reception is easily obtained.

Importance of Selectivity

On the other hand, this radio frequency amplification of the neutralizer would be of little value if the set were not selective. The regenerative receiver, however, makes use of the feed-back method to gain amplification. It has the bad feature of radiation, which is one of the greatest troubles the broadcast listener has to contend with. Radiation from a nearby set will sometimes completely detune a receiver which is tuned to a distant station and will cause enough shrieks and howls to spoil a good program. This is not the fault of the regenerative set, but rather the carelessness of the person operating it, for it is quite possible to so adjust it that no radiation takes place.

Amplification by regeneration is caused by feeding back some of the amplified signal in the plate circuit to the grid. This builds up the strength of the signal and is really a method of amplification. When a signal strikes the grid, it is rectified and amplified in the usual way. A tuned plate circuit is employed and when part of the varying current in the plate circuit is fed back to the grid, the plate current is again varied. This in turn again increases the plate circuit current, which is again fed back to the grid. This process continues until the signal becomes stabilized and has the effect of prolonging and building up the signal. The time required for all of this building up is so short that it does not in any way distort the signal.

There are many types of regenerative circuits on the market today, but they all work on the same basic principle.
But many of them are better than others, due to the fact that different types of inductances are used, and varying methods of coupling the circuits. A loose coupling between the primary and secondary circuits will always give much better selectivity than a tight one. A fair example of this is seen in the audion receiver. Here there are many variations. Sometimes the tuning inductance consists of a variometer which is connected in series with a variable condenser. Both the inductance and the condenser are variable. The same circuit is often used with a fixed inductance and a variable condenser. Either of these work very well, but naturally a closer adjustment may be made if both the inductance and the capacity are adjustable.

**Loses Its Selectivity**

This type of receiver is known to have a long range, but because of the direct coupling between the primary and secondary circuits, it loses much of its selectivity. By using a single inductance in the aerial circuit, and placing it near the variometer so as to afford an inductive coupling, it still retains its long range and the selectivity is greatly increased.

The super-heterodyne is well known for long range and selectivity. In this arrangement another bad feature of radio frequency amplification is overcome. This is the tendency of such transformers to work at their greatest efficiency at one certain frequency and the dropping off of this efficiency as the frequency varies from their natural frequency. In this set, a local oscillator is used, which sets up oscillations of nearly the same frequency as that of the incoming wave, causing a beat frequency which is the result of the two, to pass through the radio frequency transformers. As the local oscillator is under the control of the operator, this beat frequency may be made the same in any case, regardless of the frequency of the incoming wave, making it possible to always work the transformers at their natural frequency, regardless of what the frequency of the incoming wave may be. Thus the set is always working at its greatest efficiency and even the most feeble wave may be picked up and amplified to great volume.

The reflex set is peculiar in that it will produce more amplification with less tubes. This is done by making some of the tubes do double duty. After the radio frequency tubes have amplified the signal and it has passed through the detector and reduced to audio frequency, it is again passed through the radio frequency tubes at audio frequency, thus operating them at both radio and audio frequency. This is not only a saving in the original cost of installation, but less battery is also required to operate the filaments than would be necessary in other types of receivers. Many different reflex circuits have been devised, but while they differ in the apparatus used, they all come back to the same basic principle.

Because of the many deviations from these basic circuits, there are hundreds of different sets for sale and it is no wonder that the uninitiated beginner has a hard time to decide on which one to purchase.

In the August issue of the RADIO AGE, all of the basic circuits will be shown in blueprint form, which has been made this magazine so popular with the fans. In this issue, which is to be a deluxe number, approximately eighty pages will be given over to this subject. Aside from the blueprints of original circuits, many modifications and methods of amplification will be shown, making it possible for one to trace the history of almost any set in existence. A careful study of these circuits will in a measure give an idea of just what changes they have gone through in the last few years.

* Tested and Approved by RADIO AGE *

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It's the season when aggravating radio imps seriously interfere with smooth reception on most sets—but there's a way to make your set behave better. Jefferson Transformers will bring in summer programs with almost cold-weather clearness. Extra care in manufacture and the benefit of greater experience by the world's largest manufacturers of small transformers give Jefferson Transformers the lead in audio tone amplification. They will give remarkable results for you this summer. You'll find them at the best radio dealers.

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(7-25)

Some of the Tricks Summer Static Plays (Continued from page 24)

its atmosphere during that season. Unfortunately, no way of avoiding this difficulty is known today. The trans-oceanic radio stations have to be equipped with high power apparatus in order to work through the bad periods of the day and year, although at certain times of the year and day less power may be used, as evidenced by the successful trans-atlantic transmission by low power amateur stations.

For the sake of clearness, we have so far described the cause of fading signals as due to obstructions in the path of the radio waves. Actually, the radio clouds sometimes reflect the waves, much as a mirror does a light wave, and so very peculiar reception effects are sometimes noticed. Sometimes the signals are made stronger instead of weaker, sometimes they may be lost altogether, as the several effects of reflection and absorption combine.

And now, let us consider that arch enemy of radio—Old Man Static. When Marconi first began to receive messages over distances of a few miles, he noted, besides the signals he was listening for, noises which had nothing to do with the signals, and every receiving operator since that time has heard those same disturbing and interfering noises. These noises have been called strays, or atmospherics, or static, and the elimination of them is the most important problem in radio communication today. There are at least two or three kinds of static, but the most troublesome kind is the one which is due to stray electric waves, in nature just like radio waves, and caused by electrical disturbances somewhere in space.

A LIGHTNING flash produces a traveling electric wave, much like a radio wave, and if we can assume that lightning flashes, large and small, are occurring continuously somewhere, we have a reasonable explanation of static.

We know that static is worse in the Summer when the disturbances in the atmosphere are greater and more frequent. Also, it is often observed in the Winter-time that the formation of snow causes static.

Without knowing definitely the origin of this disturbance, it seems safe to assume that the actions which take place in our atmosphere, due to the air, the sun, sunspots, water vapor, etc., are responsible for the creation of these irregular, irresponsible and very troublesome waves which we call static. Since they are so much like the radio waves in nature, no way has yet been found of eliminating them completely.

Progress has been made in the last few years, however, and the trans-oceanic stations are much more free of this interference than formerly. The problem of complete elimination of static is the most difficult one in radio, and if solved, we shall have a new epoch in radio because the power of transmitting stations can be greatly reduced and the reliability of communication increased.

Vacuum Tubes and How They Distort (Continued from page 18)

grid increases, you will find that the line is not straight, but becomes steeper over quite a range, there being a definite curvature (See Fig. 1). Such a line or curve is spoken of as the plate current-grid voltage characteristic of the tube and circuit. The more nearly straight it is, the more faithfully does it repeat the impulses put on the grid; i.e., the less distortion does it introduce. This is a condition to be desired, then. However, the tube is to be used as an amplifier.

The curvature of the characteristic depends on the design of the tube, and in any given tube may be emphasized by the circuit with which it is associated.

Suppose we have a tube circuit which has curvature and we impress on the grid two electric currents of different frequencies. It can then be shown theoretically and is found experimentally that there are present in the plate current currents of the original frequencies and also currents of frequencies equal to the sum and equal to the difference of these frequencies. In other words, the
resultant current is not a faithful reproduction of the original impulses, but shows some distortion.

This is a very useful thing, as may be seen if we apply the principle to a broadcasting station. Suppose, for example, that we combine in a tube circuit the radio frequency of one million cycles with a musical frequency of one hundred and one. Then, in accordance with what was said above, we would have set up in the plate circuit the original frequencies and the sum and difference frequencies; i.e., we would have in the plate circuit frequencies of 1000; 1,000,000 plus 1000 and 1,000,000 minus 1000. The first of these is of too low frequency to affect the radiating antenna of the station, but the other three, being of suitable high frequency, would be radiated. It is these three waves of slightly different frequency which would travel out to your receiving set.

The middle one of these, one thousand, is called the carrier wave and the others may be called the upper and the lower side waves. The three together constitute the modulated wave; i.e., the wave on which has been impressed the message which is to be transmitted. The side waves or frequencies are the important ones, and it should be noted that they were not originally present, but were brought in only by the distorting effect of the tube. The mixture of the original frequencies is a very intimate one. It is more than a mere addition of the two, but a scrambling of the two. If we apply the principle to a broadcasting station, suppose, for example, three frequencies, each at one thousand, is called the carrier wave and the others may be called the upper and the lower side waves. The three together constitute the modulated wave; i.e., the wave on which has been impressed the message which is to be transmitted. The side waves or frequencies are the important ones, and it should be noted that they were not originally present, but were brought in only by the distorting effect of the tube. The mixture of the original frequencies is a very intimate one. It is more than a mere addition of the two, but a scrambling of the two.

Let us now go to the receiving set where these waves are picked up. They finally reach a vacuum tube. If this tube shows no curvature or distortion, it will merely repeat the high frequency waves which arrived, but these, in that form, are of no use, for they are intangible. What is desired is a message of the same as the original frequency; i.e., one thousand. Obviously it is going to take something radical to get this from three frequencies, each at or in the neighborhood of one million. Suppose in the tube the circuit has distortion then by the same principle as given before; there will appear in the plate circuit currents which are the same as the three high frequencies and in addition there will be all the possible combinations of sum and difference frequencies. If you will set these down yourself, as can be easily done, you will find quite an array; in fact, there will be twelve of them in the simplest case. Most of these will not be of use, but you will find two which are of the frequency 1000, the original signal frequency. They represent the difference between the carrier of 1,000,000 and the side waves of 1,000,000 plus 1000 and 1,000,000 minus 1000.

Thus we see that it is as a result of its distorting characteristic that a tube can first modulate a carrier frequency with a message frequency; i.e., "scramble" the two together so that one carries the other, and then at the receiving station "unscramble" them and give us the original message.

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Complete description in this month's "Radio Age"

This new Super-Heterodyne has been made completely portable without the least sacrifice in operating efficiency. The entire equipment, set, batteries, loop aerial and loud speaker is contained within a strong carrying case 20 3/4" x 17 3/8" x 8 3/4".

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Wherein One of Horatio Alger’s Plots Comes True

By R. H. Hopkins

The proper way to tell about McMurdo Silver would no doubt be to say “Once Upon a Time,” or, to become somewhat more modern, we might head the dissertation “From Nothing to Something,” or one might even resort to the time-honored, and (we hope) buried, style of Horatian epics.

But none of these styles seems to fit properly, so we will confine ourselves not to the regal, as the editorial ‘we’ to a plain statement of facts concerning the not altogether unforeseen life of a young man badly bitten with the radio bug, who at the age of 22 is the president of a prominent radio company and whose name is more than well known to many thousands of radio fans.

Born in a small college town in western New York, the son of a college professor, his early years were spent uneventfully in causing his fond parents just a little bit more than the usual amount of consternation, for at a very early age his thoughts turned to things mechanical. The result was no more than could be expected. Many peculiar and supposedly original con¬trivances made their appearance, most of them designed to provide a hearty and stimulating welcome for the college students who called upon his father in search of wisdom.

Frequently the searchers were discouraged, but it is interesting to the casual observer of later years to perceive that these and other arrangements most frequently resulted in the acquisition of wisdom.

Radio first entered McMurdo Silver’s consciousness early in 1912. Someone, desiring to keep the young hopeful’s mind well abreast of the times, read him an account of “Wireless Telegraphy” and how it enabled ships at sea to keep in unbroken touch with the world while they were out upon the bosom of the bounding brine.

Radio first entered McMurdo Silver’s consciousness early in 1912. Someone, desiring to keep the young hopeful’s mind well abreast of the times, read him an account of “Wireless Telegraphy” and how it enabled ships at sea to keep in unbroken touch with the world while they were out upon the bosom of the bounding brine. At the same time an account was also read, with true relevance, of the Mexican Rurales, a troop of mounted police, recruited from criminals by the simple and masterly expedient of catching one, putting a rope around his neck, placing him upon a horse all ready to be gently stroked with a whip, and asking the individual so situated if he wished to become a Rurale, or if he preferred to dismount from his steed post-haste and remain in the unenviable position of hanging by his neck to a nice tree limb, separated from it by several feet of rope, and from the ground by several more feet. The answer, unless choked off by the culprit’s emotion, or the executioner’s desire for a negative reply, was invariably “yes.”

Practice Makes Perfect

Strange as it may seem, these two bits of instruction stuck firmly in the young man’s mind. The next day the cook, called to the back yard of the family residence by uneasily yells, beheld a strange sight. Sitting astride a sawhorse was a young Mexican boy hurriedly conscripted for the part of the convict. His hands were tightly tied, and a very heavy rope, almost thicker than his pudgy arms, connected his unwilling neck with the limb of a small tree directly above him. He was calling loudly upon all the saints known to him in a somewhat unintelligible imitation of Spanish. Next to him stood one of the “Silver Gang,” asking loudly and repeatedly whether he “joined or died.” The executioner, in anticipation of the reply, held the nozzle of a length of garden hose in his hand.

Some distance away, in the wash-boiler, stood the instigator of this new game, holding the other end of the hose, while in the other was another piece of hose which reached back to the gibbet and terminated in the grimy grip of the assistant executioner. As the victim’s cries were uttered, the executioner shouted them into one hose, through which they were presumably transmitted to the ship at sea, simulated by the wash-boiler. From there, through the other hose, the verdict was again shouted in a high falsetto to the assistant executioner, who in turn put the all-important question to the prisoner, in this way, wisdom was assimilated by the analytical mind of the young; communication with ships could only be through rubber hose since one couldn’t shout several thousand miles. And to use "wireless telegraphy" one had to have a reason, which was opportunely provided by the recalcitrant son of a Mexican village, who might even yet be reclaimed to the cause of the law by strong-roped methods and the marvels of radio.

Thus was the youth of this young man spent, alternating between the heights of the Sierras and the ordered calm of a college town, the main street of which was shaded by towering elms almost as much as is the village itself. But this was not for long, and the association of garden hose and radio having been dismantled along with other illusions, the big city claimed our subject. There, more strenuous pastimes being taboo, radio was taken up with renewed vigor, and a pos-

(Turn to page 72)
Underground Radio from Coast to Coast

By JAMES E. SMITH
President of National Radio Institute

Dr. Samuel W. Stagg, whose achievements with underground transmission are far famed, has climax all his tests by sending radio waves from Hyattsville, Md., to Los Angeles, Calif., a distance of 3,000 miles. Signals at Los Angeles, according to the report, "were coming in freely with little fading."

This record eclipses all previous underground records (these also having been set by Dr. Rogers' experiments), and opens the way, according to many leading scientists, to an immeasurable development and improvement in methods of radio transmission.

This achievement of coast to coast transmission through the ground crowns with success an undertaking which was first brought forward and attempted by Dr. Rogers in 1908. It overthrows the dicta of men no less eminent than Marconi, who scoffed at the proposal to radiate wave energy through the earth's crust.

As a direct result of Dr. Rogers' latest accomplishment, it is now possible that the experimental exploratory aerial extending sometimes 400 to 600 feet in the air, may become in the near future as obsolete and unnecessary as cable connections between stations. The "aerial" will simply be taken out and buried.

The "aerial" which Dr. Rogers uses consists simply of 4 copper cables fifty feet long, extending toward the four points of the compass. Copper tubing, 3/4" in diameter, is buried 3 feet deep and surrounded by inch terra cotta pipe, insulated and supported throughout by glass rods. The pipe is buried from the underground station outside the Rogers Research Laboratory at Hyattsville.

Through it the waves are radiated into the crust of the earth, and carried through the ground—without atmospheric disturbance, without diminishing in strength through the 24 hours of the day.

The earth's crust is the most efficient medium for radio waves, Dr. Rogers claims, and he believes his experiments now have disproved the Heaviside theory. "Radio waves transmitted through the atmosphere," he says, "obey the laws of light—that is, travel in a straight direction—and these atmospheric waves are not dissipated, but being reflected by the Heaviside mirror. The earth crust to a much greater extent retains the waves, and less power is required to transmit great distances."

During the war Dr. Rogers developed and placed at the service of the Government, applications of his theories which made possible communication not only between submarine and submarine, but also between submarine and shore. His private station at Hyattsville, using his own "underground," was pressed into secret service by the officials of the Government, and received messages clearly and strongly when the great station at Arlington was hopelessly deafened by static.

Should the day ever come when a few hundred feet of buried wire will supplant and replace the towering and costly aerials which now identify the radio station, all the "aerials" will be on the brow of this modest, indefatigable man of science, of whose sixty-odd patents surely none can be more far-reaching in importance than this discovery which brings the signals "in finely, at 4 in the afternoon"—across the continent!

-DUPLEX MATCHED CONDENSERS-

Know the satisfaction and ease of tuning that comes when all dials read alike or eliminate logging and dial by wavelengths. Use DUPLEX Matched Condensers. Made in strict accordance with Bureau of Standards specifications. Used in the famous Thermodyne. Tested, matched, packed and sealed, to remain unopened until used. Ask your dealer.

Interest in illustrated folders sent free on request.

DUPLEX CONDENSER & RADIO CORP.
42 Flatbush Avenue Extension, Brooklyn, N. Y.
### Corrected List of Broadcasting Stations

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<th>City, State</th>
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<td>San Francisco, Calif.</td>
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Another Broadcasting Boom Opens

Instead of quieting down for the summer months, interest in radio broadcasting is reported as increasing by many exponents of this art. At least prospective broadcasting station owners are showing more activity than ever before. Department of Commerce records indicate. Although there are 566 stations on the air today, utilizing every available broadcast wavelength, there are at least twenty applicants for class B broadcast privileges and about a hundred individuals or organizations are said to be seeking licenses for class A operation. Not all these stations have made formal application to the Department of Commerce, however. This is not a requirement and is seldom the usual method of procedure. Ordinarily, a prospective broadcaster first leases a site, then buys expensive equipment and sets it up before he asks the Department if there is a vacant air channel for him. No shipping company would buy its boats and equipment before it found out if it could get a route and a license to do business: neither would an auto bus line, but in this new game of broadcasting, some of the more practical essentials and necessary requirements seem to be neglected to the cost of the would-be radio-phone station operators.

Some citizens now seem to realize that there is no more room for Class B, high-power, stations, but the congestion among the smaller class A stations, in consequence of the few channels assigned to them, is worse. There are 468 stations now, 54 of them operating on 500 watts, the maximum power allowed to this class and there are dozens of them on the same wavelength. As the power increases, and there is rumor that many A's will be permitted to go up in power this summer in an effort to overcome static, the situation becomes worse from a reception point of view. With increased power, they cover more territory and therefore interfere with more stations, just as the higher-powered B stations do, even when there are but two or three over the figure on March 1st. In the low A wavelength, where a wave band of 226 meters for example, there are sixteen stations now operating.

There is no record kept of proposed stations until formal applications are filed with the district radio supervisor, but from one western supervisor comes the statement that there are 32 stations in California alone planning to ask for broadcasting licenses as soon as their stations are completed. This official can not possibly satisfy more than ten or a dozen of his prospective customers, many of whom are understood to have already bought or ordered equipment, despite the reiterated statement that the air each night to to answer requests. WIBO is located at 6310 Broadway, Chicago, the studio and reception room on the second floor, and the operating room on the third floor. The studio is equipped with Colotex walls, designed in rather a unique manner, handsomely furnished, with perfect acoustics for broadcasting. The eighty-foot towers are completed and Philip L. Latin, Chief Engineer, is working every effort to assure the public of successful broadcasting from this station.

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RADIO AGE for July, 1925

STATION WIBO came on the air last month, in Chicago. Harry Geise, Director and Announcer, promises the radio audience several new and novel surprises and features, and with the assistance of Dan Russo and Ted Fiorito, who have already gained a multitude of radio friends, will endeavor to please the radio audience with the best programs obtainable.

Dan and Ted, co-conductors of the Oriole Orchestra, formerly playing at the Edgewater Beach Hotel, and Harry Geise, known as the "How-Do-You-Do Man," are on the air each night to to answer requests. WIBO is located at 6310 Broadway, Chicago, the studio and reception room on the second floor, and the operating room on the third floor. The studio is equipped with Colotex walls, designed in rather a unique manner, handsomely furnished, with perfect acoustics for broadcasting. The eighty-foot towers are completed and Philip L. Latin, Chief Engineer, is working every effort to assure the public of successful broadcasting from this station.

Get Cuba or Mexico City

While Big Local Stations Are Broadcasting, The New York Evening World got 46 stations in One Evening including Dallas, Los Angeles, and Porto Rico; while testing the wonderful sensitivity of the New in Principle—New in Design

WERNER Radio Frequency TRANSFORMERS For All Circuits

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* Insulated condensers give lasting satisfaction. Write for booklet 11.

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Chicago Office: 636 West 22d Street

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Sold Direct on Free Trial and Easy Terms

Marshall Radio Products, Inc.
Dept B, 636 Marshall Blvd. & 19th St., Chicago
WASHINGTON—That advertising is insidiously creeping into broadcast programs and that radio “entertainment” will eventually become “thinly veiled publicity,” is charged by some of the leading exponents of radio and advertising.

We have all heard what are virtually publicity talks on coffee, candy, flour, chewing gum and other commodities, through the air, and also enjoyed entertainment by playing-card quartettes, automobile-tire orchestras, safety razor and grocery store musicians. The butcher, the baker, the candlestick maker and the whole of industry has been broadcasting of late. What is it coming to?

The question “whether advertisers should pay for broadcasting” is causing concern among the broadcasters and national advertisers, as well as the radio industry itself, but since it will be up to the fans to decide eventually, a brief of a survey recently made by Albert E. Haase follows:

Radio and Business

“The radio industry is discovering that good broadcasting means good business, and extraordinary broadcasting, extraordinary business,” Mr. Haase points out. Conversely, poor broadcasting means poor business. Many who are in the industry realze that if the mad rush to get the advertisers’ dollar for the support of radio continues, radio itself will suffer.

Today, advertising agencies are offered 15% commission by a number of broadcasting stations for business. One salesman has secured the advertising rights from fifteen stations.

On the other hand, stations which do not sell space on the air are besieged by publicity men who seek to talk on certain business and collect from the manufacturers.

“Overdoing advertising, will kill radio and at the same time hurt advertising, a representative of the Colgate Co., is quoted as saying. The whole problem of radio advertising is being studied by the Association of Advertising Agencies, which already has decided that the present methods of radio advertising are not agreeable nor desirable to fans, and that the nuisance use of radio advertising will be bad for all advertising.”

So far the American Tel. & Tel. Co., through WEA and a chain of interconnected stations, appears to be the main channel for radio advertising. The charges according to Mr. Haase, vary from $25 a minute for talks, and $250 a half hour for entertainment, from one station, up to $1,000 an hour for entertainment distributed through seven stations. The advertisers, of course, furnish all the talent. Circulation is part of sales talks, but figures are naturally only estimates. These rates are not guaranteed as fixed, but may be increased, unless the Interstate Commerce Commission should take a hand, claiming that telephone lines are a public utility or that connecting lines are between states.

Statements from a number of the representative manufacturers show that there is no unanimity of opinion against paid radio advertising, but they all believe in good broadcasting.

Lee DeForest believes that as more concerns take up radio advertising, their programs become less interesting to the public, that advertising is insidious and becoming more flagrant; and he asserts that he has actually become prejudiced against several of the broadcasters’ products. He looks forward to a time when the great majority of programs will be for “thinly veiled advertising purposes.”

Secretary Hoover is opposed to censorship, but through the radio conferences it has been made known that “indirect advertising” only is permitted via broadcast by The Department of Commerce. However, Mr. Haase sees possible governmental intervention and ultimately a decision from receiving set owners.

Views of concerns which have tried paid advertising are interesting. The Eveready entertainers, considered unique by many, actually pay the National Carbon Co., in good will. One day 3,000 letters came in, according to J. R. Crawford of that company. But he does not think radio advertising, even indirect, would pay all types of manufacturers, except experimentally.

As a contrast, Stuart Peabody of the Borden Milk Co., claims that two broadcasting trials failed to bring adequate responses. The Macy Co. failed to derive substantial benefits from broadcasting. But Nat Lewis, owner of two gift and haberdashery shops, found fashion talks via radio, which he calls “publicity,” better than any other forms of advertising. He received 5,000 letters following one talk.

Officials of the United Retail Candy Stores, backers of the “Happiness Boys,” say after fifteen months of broadcasting entertainment stunts that they feel it is “publicity” rather than “advertising,” which they use simultaneously.

The Fisher Co., Astor Coffee manufacturers, continue radio programs after fifteen months’ trial, having received over 100,000 communications from all parts of the country.

Through co-operation with the A. T. & T. Co., the Victor Talking Machine Co. is said not to pay for space, when its stars sing—when it is studying the results, however, and will soon report on broadcasting. Advertising experts feel that radio has a time limit and that its circulation is uncertain, compared to other mediums; they believe it is probably an accessory.

* Tested and Approved by RADIO AGE *
WITH THE MANUFACTURERS

Dry Cell Tests Held for First Time

ON May 10, from the Great Lakes Naval Training Station, Great Lakes, III., the first tests in history were made from an airplane in flight, using the new 37 meter radio transmitter and receiver operated by dry cells only.

Heretofore, all airplane radio equipment has had its source of power from a small generator which was driven through a fan-shaped propeller by the force of the wind. In other words, when the engine and the airplane were out of commission—so was the radio. This new transmitter, which is being tested is the first of its kind and is one of the transmitters which will be used by the MacMillan Expedition which sails from Boston, Bunker Hill Day, June 17, under the auspices of the National Geographic Society.

The value of this type of equipment can be immediately realized when it is remembered that the airplanes that are to accompany the MacMillan Expedition manned by U. S. Navy personnel, under the command of Commander R. E. Byrd, U. S. N., will fly over that great unexplored area lying between Point Barrow and the North Pole, in quest of new lands. Should a landing be forced, this type of equipment will make possible a quick call for help from the planes held in reserve back at the advance base of Axel Heiberg Land.

The Zenith Radio Laboratory announced that the tests made at Great Lakes Naval Training Station on 37 meters were not satisfactory, as the greatest distances at which they were heard were Newton, Iowa, and Minneapolis. Failure to reach greater distances is attributed to the fact that the amateurs and the set is especially suited to opera-

Campaign for Jewel

E. H. WILKINSON and T. F. W. Meyer, General Manager and General Sales Manager, respectively, for the Jewel Radio and Phonograph Co., Pontiac, Michigan, have returned to the factory after an extended trip through the East putting the finishing touches on the new distributor, and dealers' franchise plan in that territory which has been under way for several months.

The Jewel slogan, "Fair prices, rigidly maintained" must be very strictly adhered to under this new system, because every dealer handling Jewel products throughout the country must come well recommended as to their stability by a Jewel Distributor, or one of the factory district representatives in the field, it is announced.

The dealer will be benefited in this same respect by knowing that his customer cannot buy a Jewel product from any but another authorized dealer who is holding to the standard Jewel prices.

Stewart-Warner Radio, Model 305

The Stewart-Warner Speedometer Corporation, 1826 Diversey Parkway, Chicago has placed on the market a complete ensemble of matched radio units. This ensemble consists of the line of Stewart-Warner Radio Instruments; the Stewart-Warner Reproducer especially built to give perfect harmony with Stewart-Warner Radio Frequency Set, designed to give beautiful tone quality; Batteries, Aerial and Ground Equipment.

The Stewart-Warner Instrument shown is Model 305—a five tube set in which is incorporated the U. S. Navy Circuit. There are three tuning controls, mounted on a sloping front panel. The cabinet is finished in dark walnut. In this instrument, the special Navy tuned radio frequency circuit has been developed to a high stage of perfection, and the set is especially suited to opera-

Freshman Announces New Sales Policy

The Chas. Freshman Co., Inc. of New York has just announced its sales policy for the coming season. This concern, manufacturers of the line of Freshman Masterpiece Receiving Sets, has decided to eliminate the jobber and distributor in the sale of its product. Freshman Masterpiece Sets will be sold to Authorized Freshman Masterpiece Dealers, care-fully selected, and granted an exclusive franchise in their territory. In towns of approximately 25,000 and under, one representative dealer will be appointed to exclusively handle the line, and in larger cities, additional dealers will be granted franchises in the population and trading area. A staff of salesmen is now at work signing up dealers to the Freshman Masterpiece Contract, which assures dealers of absolute protection, as far as stability of prices is concerned; also, all business from each individual dealer's territory will be credited to him. In this way, the appointed dealers will be practically direct factory representatives of Freshman Co.

The Freshman Company enjoyed remarkable success with their one model, the original Freshman Masterpiece, during the last year. The fact that with one model, priced at $60.00, over 125,000 sets were sold from July 1924 until February 1925, speaks highly for the tre-

New "Hercules" Masts

S. W. HULL & Company, 2048 East 79th St., Cleveland, Ohio, announce a new series of "Hercules" Aerial Mast. These masts are made in three standard lengths, 20 ft., 40 ft., and 60 ft., all steel construction. All masts are made of a special angle construction that gives great strength and light weight, thus making a rugged mast easily erected, at the same time presenting a pleasing appearance by its graceful lines.

(Turn to page 72)
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 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 August issue must be sent in by July 1.
Tination of business and engineering

THUS, in the early summer of 1924, Chicago saw the retail store of silver-Marshall, Inc., with the erstwhile vigor of its president as its head. Events followed each other with a rapidity characteristic of the radio industry, and by fall the young concern marketed a line of products designed by Mr. Silver which met with instant favor. The old story was repeated—production could not catch up with demand, and winter saw Silver and his partner working shoulder to shoulder with the ever increasing force of the new growing concern. By spring the partners saw the rewards of their labors in the ever-extending business they had built up.

Mr. Silver is probably best known to the radio public as the designer of many pieces of radio equipment and a number of receiving circuits of exceptional design, several of which have been described in this publication. In addition to his combination of business and engineering ability, his capacity for describing radio apparatus involving complex circuits in a manner so simple that the average layman can easily comprehend, is one seldom met with. His articles have appeared in practically every important radio publication and newspaper in this country.

Desiring to see the genius home in his lair, we called upon Mr. Silver one day. We were ushered into the presence of a mere stripling seated at an unimposing desk, who, when he arose, proved to be over six feet. In the course of our getting several words in edgewise, telegrams flew out, apparently important matters were settled, and ideas evolved and rushed to the laboratory for immediate experiment.

From a shelf he selected one of a number of receivers, handed it to an assistant, and in a instant a volume of sound poured out of the loud speaker that was amazing, yet with perfect quality.

"What is it?" we asked. After a moment the answer came, briefly: "Just a six-tube super-heterodyne, because it uses an autodyne frequency changer.

"Autodyne frequency changer" not being in our vocabulary, we left after a few minutes conversation, impressed primarily with the sudden transition of the man from the capacity of radio engineer and back again, and the sincerity, certainty and energy that seemed to pour forth with every word he uttered, either as president or engineer.

A RADIO statistician recently conducted a research among radio merchants and learned that approximately 53% of the public are buying radio receivers indicate a preference for loop sets.

William H. Priess, a well known engineer and president of the Priess Radio Corporation, whose work for a number of years has been exclusively identified with loop reception, is naturally one of its strongest proponents. The percentage of favor toward the loop which the statistician's research showed did not surprise him. "A loop set has a number of advantages," he said. "The set can be installed quickly and moved to various locations without entailing the services of a steeple-jack. It is the ideal set to take in the car on a day's outing or to the country on a week-end. It can be installed in places where the connection of antennae is forbidden or impossible."

"In addition to its inherent mobility, the loop receiver has the remarkable property of directional reception and freedom from certain types of 'static' disturbance. Two interfering signals of approximately the same strength and wavelength but coming from different directions cannot be separated by the ordinary antenna set. With the loop receiver, however, this separation can be made complete by turning the loop to one of the stations disappears, and tuning in sharply on the other station.

"With the right set and the right loop, satisfaction over the antenna set is certain."
Is The **‘ANNUAL’** on your Summer List?

If you intend to take a trip this summer, you’re surely going to keep in touch with Radio, either by bringing a set along or building one during the dull afternoons, from parts you can take with you.

And how are you going to build this set or study up on radio for the big season that is bound to come in September?

The answer is simple. All you have to do is to invest **ONE DOLLAR** in a **RADIO AGE ANNUAL** for 1925, the world’s most complete and authoritative hookup book, and take it with you, whether you go to Eagle River or the River of Doubt.

Let the ANNUAL for 1925 be your Radio Companion this summer! It will tell you whatever you want to know in the radio line—from troubleshooting of the little faults that may develop far from home—to the actual construction of simple portable sets or elaborate multi-tubers.

Get the ANNUAL now—and then go on your vacation! It will be your radio safeguard.

$1.00 a Copy

**RADIO AGE ANNUAL FOR 1925**

Some of the Features

- How to read and understand hookups.
- How to understand radio phenomena.
- How to select the right receiver.
- How to amplify any kind of set.
- How to substitute a tube for a crystal—building the first tube set.
- How to make a reflex set.
- Building your first Reinartz set.
- The renowned Baby Heterodyne No. 1.
- Adding audio and radio stages to the Baby Heterodyne.
- Adding audio and radio stages to the Baby Met.
- Building your first reflex set.
- The Baby Met No. 2, a Wonder Super-Het, and others.
- How to make an amplifying unit.
- How to make a battery charger.
- How to amplify any kind of set.
- How to make a loud speaker.
- RADIO AGE ANNUAL BLUEPRINT SECTION with such popular hookups as the aperiodic variometer, loop sets, feed-back receivers, neutralizers, reflex hookups, Baby Met No. 1, a Wonder Super-Het, and others.
- A three-tube long distance regenerator.
- A 3-tube set that easily receives KGO on the loud speaker from Ohio.
- Improving the ever popular Reinartz.
- And many other up-to-the-minute hookups and articles.

RADIO AGE ANNUAL COUPON

RADIO AGE, INC.
500 North Dearborn St., Chicago, Ill.

Gentlemen: I want to be one of the first to get the **RADIO AGE ANNUAL FOR 1925**. Enclosed find $1.00. If I am not satisfied with the ANNUAL I will return it within five days and you will refund my dollar.

Name...........................................
Address.......................................
City...........................................
State...........................................

7-25
While MacMillan Charts the Arctic
Zenith Broadcasts to the World!

Between Alaska and the North Pole stretches an unexplored area one million square miles in extent—the last remaining "blind spot" on the face of the globe.

Over this vast area will fly, this summer, two great planes of the amphibian type, piloted by U.S. Navy air pilots and equipped with the most highly perfected scientific apparatus obtainable by the United States Government. This entire expedition, which has rightly been described as the greatest expedition of modern times, is under the direction of Commander Donald B. MacMillan.

The purpose of the expedition is the study and photographic charting of this unknown area—and—new tests in radio transmission and reception of unparalleled importance. The section to be explored has never been heard from by radio. Communication will of necessity be daylight communication, for in this area the days are six months long.

On an expedition representing so great a risk, both in capital and human life, only the best in radio equipment can possibly command a place. Once more, therefore, MacMillan chooses ZENITH exclusively, both for his ships and for the two great planes flying across uncharted seas of ice.

Thus, while the world awaits reports from this greatest expedition of modern times, it is worth remembering that the only way these reports can possibly be transmitted is by Zenith radio.

Never in all your life, it is safe to say, will you require of a radio set such outstanding performance as MacMillan requires of ZENITH in the Arctic. But can you imagine greater satisfaction than to know that your receiving set can deliver such performance, any time it's called upon to do so?

Call this evening at your nearest ZENITH dealer, and ask him for a demonstration.

Zenith Radio Corporation
310 S. Michigan Ave., Chicago, Ill.

Costs More—But Does More

THE complete Zenith line ranges in price from $100 to $475. With either Zenith 3R or Zenith 4R, satisfactory reception over distances of 2,000 to 3,000 miles is readily accomplished, using any ordinary loud speaker. Models 3R and 4R licensed under Armstrong U. S. Patent No. 1,113,149. They are NON-RADIATING.

Zenith 4R - $100
Zenith 3R - $75

The new Super-Zenith is a six-tube set with a new, unique, and really different patented circuit, controlled exclusively by the Zenith Radio Corporation. It is NOT regenerative.

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—44% inches long, 18% inches wide, 12% inches high. Compartments at either end for dry batteries. Price (exclusive of tubes and batteries) $240

SUPER-ZENITH VIII—Same as VII except console type. Price (exclusive of tubes and batteries) $260

SUPER-ZENITH IX—Console model with additional compartments containing built-in Zenith loudspeaker and generous storage battery space. Price (exclusive of tubes and batteries) $355

SUPER-ZENITH X—Contains built-in, patented, Super-Zenith Duo-Loud Breakers (harmonically synchronized twin speakers and horns), designed to reproduce both high and low pitch tones otherwise impossible with single-unit speakers. Price (exclusive of tubes and batteries) $475

All Prices F. O. B. Factory

Zenith Radio Corporation
Dept. C-7
310 S. Michigan Avenue, Chicago, Illinois

Gentlemen:
Please send me illustrated literature about Zenith Radio.

Name...

Address...

* Tested and Approved by RADIO AGE *

* Long Distance *