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RADIO AGE

The Magazine of the Hour

June 1926

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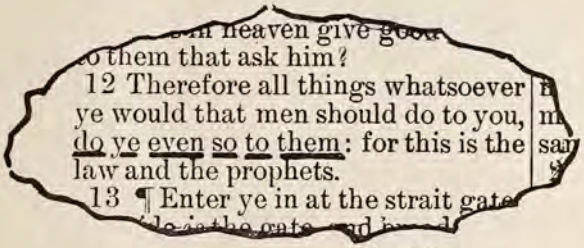

Matt. 7:12

Radio Age's Golden Rule Receiver

¶ So interesting has been the building of the June Radio Age Golden Rule receiver that another version of it has been prepared, tested, and is to be described in the July issue of this magazine. Basically the circuit is the same but minor alterations have been made in order to further simplify the set for the home builders. It will be found fully described in the blueprint section of the July Radio Age.

¶ Shielded completely by means of both a metal panel and a metal cabinet, the July Golden Rule receiver leads its builders to believe that simplification has been carried as far as possible. Logging of the set is the same as in the June model but for local work the shielding helps some to cut down the breadth of local signals. The shielding is also effective in minimizing extraneous interference, notably leaky power lines and other disturbances coming within the classification of "man-made static." Better tonal quality has also been secured by use of a different model of audio frequency transformer.

Order Your July Copy Now

RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 5 *June, 1926* *Number 6*

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FOR JUNE ISSUE

Cover insert by A. P. Mehlum

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Chats With the Editor

HOUSED in its nice metal panel and shield the July version of the Golden Rule receiver is very simple and works as smoothly as a well-oiled machine. Our next issue will give all the details, together with pictures and diagrams in the blueprint section.

Neutrodyne owners will be glad to find a means of improving their present sets; the hints are written by L. Hillegas-Baird, amateur 9HO who is well known in the dot and dash fraternity.

Adding a resistance to the secondary of your audio transformers will often flatten out what otherwise might be an objectionable frequency peak. Result:—better audio quality over an even range of frequencies.

Radio communication on short waves is brilliantly described by Lieut. Commander A. H. Taylor of the Naval Radio Laboratory, who pays homage to the amateurs who pioneered on the very short wavelengths when others believed these wavelengths useless.

Armstrong Perry goes into the elimination of alphabetical batteries —the A's, B's and C's. Written for all types of readers, regardless of their previous condition of radio servitude.

Crystal control for all radio stations (tube operated) is here to stay without a doubt. Read about the manner in which WGY controls the output of the huge transmitter with a small quartz crystal.

Gwen Wagner tells our readers of WENR, the All-American Radio Corporation station while E. D. Cahn takes us on an interesting journey to Havana where PWX holds forth.

Summer no longer holds any terrors for the radio addict. Instead of blaming static, sun spots and other phenomena for his hard luck, he merely goes to work at that time and makes over his receiver for the good season to come shortly. Headphone operation takes the place of the loud speaker on distant reception. The appalling declivity—the terrible slump —which characterized the first year of popular broadcast interest has been gradually smoothed down so it is not very difficult to see, in this or next year, radio activity continuing unabated through the months of June, July and August. Radio Age is doing its share by giving its readers plenty of material during the summer on which they may whet their appetites for a newer or better set.

Frederick Smith

Editor of RADIO AGE

"I've *just had a lesson in radio economy, and, believe me, it's illuminating*"

"I WENT into my radio dealer's this noon for a couple of Eveready 'B' Batteries and said, 'Tom, give me a pair of Eveready 45-volt "B" Batteries No. 772's.'

"'How many tubes in your set, Jim?' he asked.

"'Five,' I answered.

"'Then what you want is a pair of Eveready Layerbilt No. 486's.'

"'Why?' I asked.

"'Because the Eveready 772's are meant for sets having one to three tubes. With average use of the set, and used with a "C" battery*, they should last a year or longer. But on a five-tube set, with average use and with a "C" battery, they will only last about four months. Anyone with a four or five tube set should buy a pair of Eveready Layerbilts No. 486. Used with a "C" battery they should last eight months or longer.'

"'Yes, but the 772's cost only $3.75 each,' I said, 'and the Layerbilt $5.50. There's some difference.'

"'Well, figure it out for yourself,' said Tom. 'Two sets of 772's should last you about eight months, and will cost you $15. One set of Eveready Layerbilts should last about eight months, and will cost you only $11.'"

The simple rules for this satisfaction and economy are:

On 1 to 3 tubes—Use Eveready No. 772.
On 4 or more tubes—Use the Heavy Duty "B" Batteries, either No. 770, or the even longer-lived Eveready Layerbilt No. 486.
On all but single tube sets—Use a "C" battery.

When following these rules, the No. 772, on 1 to 3 tube sets, will last for a year or more; and the Heavy Duties, on sets of 4 or more tubes, for eight months or longer.

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

LEFT—No. 486, for 4, 5 or more tubes. $5.50.

RIGHT—Eveready Dry Cell Radio "A" Battery, 1½ volts.

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Radio Batteries
—they last longer

*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a "C" Battery.

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WCAE—*Pittsburgh*
WSAI—*Cincinnati*
WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO { *Minneapolis* / *St. Paul*
KSD—*St. Louis*

RADIO EDITORIALS

WE DO not share the gloomy view taken by Secretary Hoover of the Department of Commerce as to the probable results of the decision in which the Zenith Radio Corporation won a United States court battle with Mr. Hoover's department. The Zenith Corporation, not being able to induce the department to allocate to their station, WJAZ, a wave length and license that would not conflict with the time and wavelength used by a Denver station, appropriated a wavelength of 329 meters and went on the air as the first "pirate" broadcaster. The government brought criminal charges against the corporation and demanded that its broadcasting equipment be confiscated. Judge Wilkerson, of the U. S. Circuit court, Illinois, recently decided in favor of the corporation. He held that under the law of 1912, the only existing statute covering radio regulation, the Secretary of Commerce had exceeded his powers in arbitrarily assigning wave lengths and broadcast time periods to stations.

Under those circumstances it might appear to the hasty observer that there is nothing to stop any man or group of men from building a station, selecting a wave-length that pleased their fancy and proceed to shoot the ether full of music and talk, to the great confusion of those who are attempting to separate one station from another. For example it might appear that numerous "pirate" broadcasters might decide to transmit on a wave-length of 400 meters. That would surely destroy the usefulness of all stations on that wave-length. Or many broadcasters might select wave-lengths so near to those already in use that the owner of a set which was not extremely selective would be unable to tune any one of the number out.

But there will be no such chaos. In the first place the law of 1912 will prevent it. That law specifies that those engaged in the commercial transmission of messages may use wave-lengths over 200 meters and does not give the Secretary of Commerce any specific right to say what wave-length they shall choose. It will be seen readily that only a small group of broadcasters could take advantage of this rather broad license, because there are scarcely half a dozen big companies using radio for the transmission of commercial dispatches.

The law of 1912 gives the same broad privileges to manufacturers who are engaged in experimental work. This would appear to let down the bars to all manufacturers who desired a license and a wave-length. And it does. But the manufacturers know that if they go on the air on wave-lengths duplicating or approximating the wave-lengths already in use they will cause confusion. Manufacturers do not want confusion. They want the best reception possible in order that there may be a continued and increasing demand for their products, which are chiefly radio receiving sets. Therefore it is not likely that either commercial message senders or manufacturers will create chaos.

Secretary Hoover went so far as to warn us that the Wilkerson decision would render useless about $600,000,000 in radio receiving sets. It is a huge figure and it is a disturbing thought. Not only would such a loss be a serious one to the listening public in dollars and cents but it would mean the end of their broadcast listening. But another alarming thing to consider is the effect that such a disaster would have on the radio industry. That industry has grown to mammoth proportions and like all new industries it has had its troubles. It is near stabilization and standardization at this time.

Let us repeat that we are confident there is going to be no chaos. The word looks well in newspaper headlines but it hasn't scared anybody much. As time goes on legislation will be planned and enacted that will fully protect the great national pastime of listening in.

IT IS a pleasure to present a design for a "Golden Rule" receiving set this month. Those who tried to listen in on Europe during the international tests last fall will remember how emphatically it was brought home to them that radiating receivers are the curse to radio neighbors. Those who are using sets that radiate and kill their neighbors' pleasure are not doing so because they are reckless or indifferent air vandals. They are causing interference in most cases without any fault on their own part except that they bought or made a radiating receiver without realizing they were on the downward path to Bloopville.

In the four-tube set described in this issue Mr. Hill has not only produced a receiver that does not bloop but he has made one that is extremely simple in construction and operation. Yet, with all these merits to its credit the set has other distinct advantages. It has volume, distance and quality. The set has been thoroughly tested in Radio Age Laboratories and has met every requirement. In fact it was being developed and improved for months before it found its way into the pages of our magazine. It you want to stop blooping and still lose none of the joy of listening make one of these anti-blooping, do-as-you-would-be-done-by receivers and then you can look your neighbor square in the eye and make pointed reference to his old man.

RADIO reception is in the hands of the natural forces and they work in a mysterious way, their wonders to perform. Reception recently has been better than it was in mid-winter and yet the wise men tell us it should not be. Reception throughout last winter was distinctly more unsatisfactory than it was the previous winter. Therefore we are listening with some attention to those who predict a summer of fine reception this year. Perhaps we are at last to scotch that serpent of the radio industry—the constantly reiterated assertion that summer reception is not good and radio goes when the bluebird arrives and comes back when the wild goose honks southward.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

Condensers *and* Inductances Were *First* B-T Products

Interesting Sidelights on Growth of Organization From Early Radio Days

By FRED HILL
Associate Editor

RADIO fans for years have been buying radio parts and receivers largely upon their own need for such units. They have done this without much knowledge of the individuals and personnel back of the many organizations now engaged in the radio business, a business which bids fair to become one of the largest in the United States. There have been numerous questions asked as to the make-up of organizations; how they started and whence they are headed. It is in response to many requests from readers that Radio Age is printing this story, the first of a series, covering the larger and more established manufacturers in the game today.

Harry A. Bremer, vice-president and secretary of the Bremer-Tully Manufacturing Co.

If there is romance in oil; or personality in the automobile business, or interest in the canning of vegetables, then of necessity the reader can find much more in the history of radio. Starting as a fad (so said the croakers) radio has become the national indoor sport and those who had the foresight in the early days to make a good product and sell it thoroughly on its merits, are now occupying an enviable position in the business of today. This, in spite of the patent situation, which at times has threatened to turn the industry topsy-turvy. After all the patent situations have been handled there still remains a good, big field, for the manufacturers who intend to remain in the game with a gradual healthy growth each year. The radio business seems no different than other large industries. None were developed over night. None made a million the first year of their existence. Instead the radio business had to be cultivated just the same as the manufacture of shoes or condensed milk. Honesty of products, sound merchandising and judicious advertising all contribute to the building up of an industry, especially that of radio where there are so many competing lines.

Bremer-Tully History

SINCE inductances and capacities have always been an essential to radio reception and the Bremer - Tully Manufacturing Co. has long held a high position in this line we decided to

John C. Tully, president of the Bremer-Tully Manufacturing Co.

A section of the plant where condensers are assembled

give our readers an insight into their business and give a few bits of history which will enable fans to become better acquainted with the spirit back of many of our large radio manufacturers.

Background for Harry A. Bremer's experience in the radio game was furnished by his taking "High Frequency currents" as his thesis in his sophomore year (1905) at Armour Institute in Chicago. At this time he built his first coherer and spark coil, just as many of the old-timers have done. After graduation as an electrical engineer he went into the manufacture of auto radiators, with especial emphasis on the design and building of special machinery for their construction. He also specialized in the construction of precision apparatus, experience in this last named field coming in particularly handy in his present organization for the design and construction of variable condensers.

Their First Items

FIRST items manufactured by the Bremer-Tully people were the one plate vernier condenser in 1921; the second item was the three circuit tuner, covering a range of approximately 40 meters (from 360 to 400 meters), since at that time all broadcast stations were lumped on 360 meters. Early in the beginning of the broadcast craze they began the pictorial showing of set building for the many novices. Today the pictorial plan is all right for the newcomer, but the seasoned experimenter (the novice of 1922-1923) now will look at nothing but a schematic circuit, all of which goes to show that while the manufacturer of parts grows with time, the user of parts likewise is becoming better educated as to values and functions of the different units represented in a radio set. This factor permits one to understand why the radio public is becoming more critical day by day.

Build for Future

OPPORTUNIST ideas in the business do not net any manufacturer much, according to the two partners in the Bremer-Tully organization. Most of the items they originally manufactured two and three years ago are still selling strong. The "Nameless" circuit, which they developed, is as interesting to the radio public today as it was when it was first announced. Since then Mr. Bremer has secured patents on the idea underlying the operation of the "Counterphase" and this circuit is now found in a complete set, entirely shielded, which the B-T organization is marketing. While originally this concern started as a parts manufacturer they are now handling a good volume of business on complet-

In the foreground is one of the machines used in winding primaries and interiors of torostyle coils. Finished primaries are seen under the spool of wire, while to the right are a few of the finished coils. Special machinery had to be developed for winding this type of coil, as explained in the article

ed sets, believing that since they make all the integral parts of a set they are in an excellent position to handle the assembled set too. This gives them an opportunity of seeing that all the parts in the completed set are properly designed for that particular type of receiver instead of taking an assortment of parts made elsewhere and trying to group a receiver around them.

One of the interesting things about the B-T organization is the little booklet, called Better Tuning, which they issue five times a year and in which can be found many homely bits of philosophy concerning the radio game.

Amateurs and Listeners

BOTH the amateurs and the broadcast listeners have been taken care of in the marketing of B-T inductances; the short wave tuner for the amateurs, these covering all the very short waves, while the broadcast type covers the band from about 200 to 550 meters. Their newest product (its been out for some time, too) is their torostyle in which the winding is wound square, then coiled into a circle. Special machinery had to be developed to make this particular type of coil. In the manufacture of their factory-built Counterphase the company at first put out both a shielded and unshielded model. Now they are specializing on the completely shielded model, for if shielding is good for a certain class of fans who have interference to contend with, it will not be harmful to the ones who do not have any interference.

Here is a corner of the experimental laboratory where measurements on condensers and inductances are made. It is also here where preliminary tests are run on all apparatus before the company commits itself to the manufacture of a new article

Sales, advertising, technical service, set manufacturing and three other manufacturing departments are located at 520-528 South Canal Street, Chicago, Ill., while the balance of the business is carried on at 532-536 South Canal St.

General offices of the firm are at 532 South Canal St., Chicago, Ill. In this picture is shown a portion of the office

The Two Principals

THE two principals of the Bremer-Tully Mfg. Co. present an unusual combination of ability in various phases of business, coupled with a background of successful experience not only in design, invention, and the manufacture of high quality apparatus of various kinds but also in the distribution of their products through reliable channels.

It is doubtful if a wider range of practical experience is found in any other two men in the industry, both being graduate electrical engineers who came into contact with the technical side radio 15 to 20 years ago, and both having manufacturing experience before radio parts and sets became a business. At the same time both possess the broadening influence of having tackled many problems presented in the various angles of business. For a man educated as an

(Please turn to page 49)

Antenna

By S. W. Hull*

Fig. 5. Cage type of antenna popular with amateurs

A NECESSARY and important part of every radio receiving set is the aerial, or antenna. This usually consists of one or more bare copper wires stretched between insulators (see Fig. 7) for the purpose of gathering the electrical impulses sent out by broadcasting stations.

The most efficient antenna is the outside type which should be placed as high as possible where it will not come in contact with trees and other obstructions.

While the past years have seen many styles of receiving antennas grow in favor, the old-style outside antenna still holds its own. The inverted L, the T and the single straight aerials are the commonest forms of outside aerials.

The L Type Antenna

THE inverted L antenna, gets its name from its shape. It is widely used and with good results, though it has one defect, its directional property.

This defect sometimes is turned to advantage. It receives loudest when the end to which the lead-in is connected is pointing towards the transmitting station.

Most satisfactory aerials of the inverted L type employ two wires when the space between the insulators does not allow a single wire of 50 feet or more. When two wires are used they should be spaced three feet apart, with a light piece of wood for a spacer.

Such an aerial should be at least 35 feet above the ground and is better if it is 50 or 60 feet high. The lead-in should be taken from the end nearest the receiving set.

The T Type Antenna

THE T aerial as the name implies is T shaped. It is free from directional properties of the inverted L type—it receives impulses from any direction with equal success.

A single wire T type antenna should be 100 to 125 feet long. If conditions prevent putting up a single wire antenna 100 feet or more in length then a multi-wire construction is used. Four or more wires should be placed at least 2 feet apart. The lead-in should be taken from the exact center of the aerial.

The lead-in should always have the same area or cross-section of wire as the antenna to avoid cutting down the capacity of the aerial. Generally the multi-wire type is used on apartment houses or other buildings. In such cases it is best to place it above any other antennas there may be on the roof.

Straight Line Antenna

THE straight line antenna as the name implies (see Fig. 4) has but a short lead-in coming as it goes almost direct to the set. Generally one end is higher than the other and is placed above roof and treetop interference. This arrangement is favored by many, it is simple and efficient. The antenna and the lead-in are one piece of wire as a rule and therefore cut down any resistance that a joint might cause.

The Cage Antenna

THE cage antenna as the name implies (see Fig. 5) is built like a cage. Generally 6 wires are used and are spaced on rings about 10 or 12 inches in diameter. The advantage of the cage is its low resistance. It can be made into a T type or L type or straight line antenna as desired.

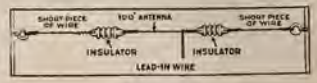

Figure 7

*President S. W. Hull & Co., Cleveland, Ohio

Design

It is generally about 75 feet long and the wires are continuous. No break being made to attach the lead-in unless the T type is used. In this case care must be taken to solder the joint and if possible the lead-in should be of cage design.

The cage has come into prominent use during the last year in cases where record distance was desired and every detail of efficiency was carried out. Members of the American Radio Relay League and other transmitters have long known the advantage of the cage antenna both for transmitting and receiving.

Lightning Arrester and Ground

NO matter what type of antenna is used certain precautions must be taken. If you don't insulate properly you are bound to fail. Fig. 6 illustrates the proper method of insulating an antenna, attaching the lightning arrester, and bringing the lead-in through a window.

Many people have asked the writer just what the difference was between a regular antenna and a loop antenna? It must be acknowledged at the start that as an antenna or radio wave pick-up device, its efficiency is usually about 1% of the average outside elevated type aerial.

To dispel the illusion of a good many people, a loop can in no way, when substituted for a regular outdoor antenna, equal it for signal strength on nearby or distant stations, with the same number of tubes.

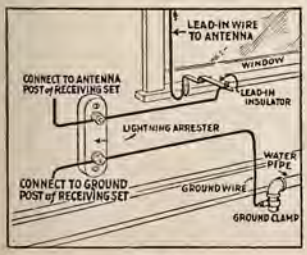

Figure 6

Fig. 4. Straight wire antenna for extreme simplicity

The reason is that trees, houses, etc., absorb energy just the same as an antenna and therefore weaken its strength before it gets to the set. Therefore your antenna should be as high as possible and unshielded by surrounding objects. (Also the surface presented to advancing wave fronts by a loop is much smaller than an antenna—hence the necessity of greatly increasing the number of tubes.—Editor.)

When we consider that the strength of a radio wave is less than one-million part of a horse power the importance of a high unshielded antenna can be appreciated.

A Few Details

A HIGHLY efficient antenna installation is erected with the following details in mind:

1. Over-all length not over 150 feet.

2. No close approach to trees or buildings.

3. Horizontal part as high as possible.

4. Lead-in away from building.

5. Absence of joints, soldered or otherwise (where possible).

6. As few insulators as possible.

7. Ground wire to be connected to water pipe.

8. Set close to window where lead-in enters.

9. Wire fairly heavy (No. 14) and rigid.

10. Clean connections throughout.

11. Straight well secured steel masts.

Height is of course your first and important factor.

Careful Consideration

ERECTION of an aerial mast should receive careful consideration. It should be light and strong and easily raised into position. For instance any size mast when erected should withstand a 500 pound pull at the top. The mast itself should weigh but a few pounds. It is light weight that simplifies erection.

All guy wires should be galvanized and securely fastened to insure proper strength during a high wind. It is advisable to use a mast head pulley so the antenna can be raised and lowered at will with the least possible effort.

A good aerial is well worth the trouble it takes to make. For where the average man gets long range occasionally, the man with a first class aerial gets it consistently—that is the difference. High priced radio sets often may prove disappointing or even a total loss to a would-be radio fan, if his aerial is not properly put up.

Neutrodyne *Owners* May Improve *Their* Receiver

Addition of Variable Resistor in Plate Circuit Will Add to Flexibility of Set

By L. S. Hillegas-Baird
(Radio 9HO)

IN AN effort to obtain clear reception and prevent oscillation in the radio frequency amplifier, designers of the neutrodyne have balanced this receiver with small neutralizing capacities, using one condenser for each tube in the radio frequency circuit, but frequently, particularly with home built receivers, neutrodynes are found that are by no means efficient as they could be made. The trouble can usually be traced to excessive oscillation at the shorter wavelengths, and when correcting this it is advisable to consider the cause and effect of oscillation in the set.

Any circuit including a coil and a condenser is capable of electrically oscillating, provided its resistance is low enough. One of the chief purposes of the vacuum tube is to compensate for resistance losses in oscillating circuits. It supplies energy from the "B" battery at the proper frequency and phase to make the circuit sensitive. If the energy supplied by the tube more than compensates for the resistance loss, however, the circuit will generate sustained oscillation and will not clearly reproduce radio broadcasting when in that condition.

IT IS evident from this that the circuits of a radio receiver must be adjusted up to oscillation to insure efficient reception, but some controlling factor must be provided or the tubes supply too much energy and set up continuous oscillation, or the regenerative whistles familiar to all radio fans. The neutrodyne controls this factor with a counter electromotive force introduced by means of the neutralizing condensers. Unfortunately, the adjustment for a wavelength of say 500 meters is not suitable for a wavelength of 300 meters, and vice versa, since radio receivers tend to oscillate more at the shorter wavelengths, and if oscillation at the short wavelengths is balanced out there is such a lack of sensitivity at the longer wavelengths that many stations cannot be heard well.

Distance fans will welcome a scheme whereby in exchange for an occasional squeal or two, volume on distant stations will be increased and the range of their neutrodyne extended several hundred miles. This is possible by making use of a non-critical oscillation control that can be adjusted from the panel, and with this adjustment the radio frequency circuits can be maintained in their most sensitive condition at all wavelengths.

From the accompanying diagram it will be seen that very few changes need be made in the standard neutrodyne. The two neutralizing condensers, which are connected from the grids of the two radio frequency amplifier tubes to the secondaries of the succeeding radio frequency transformers, may be deneutralized, or still better, entirely removed from the circuit.

To control oscillation a non-inductive variable high resistance is introduced in series with the positive "B" battery leads running to the primaries of the radio frequency transformers. It is important to use a resistance of proper value and taper and the 200,000 ohm non-inductive type made by Centralab is suggested.

An important feature in changing the circuit is to connect a by-pass condenser of approximately 1 mfd. exactly as shown in the diagram bridged from plate to filament circuit. Most neutrodynes already have a condenser that can be connected in this position; it must be added to the others. This provides a direct path for the radio frequency currents, which otherwise would encounter resistance in the control and "B" batteries. It is obvious, therefore, that the radio frequency circuits will be free to oscillate without added resistance, insuring greatest selectivity and sensitivity. Oscillation can be exactly controlled, however, by varying the resistance knob, which in turn varies the pressure of the "B"

(Please turn to page 50)

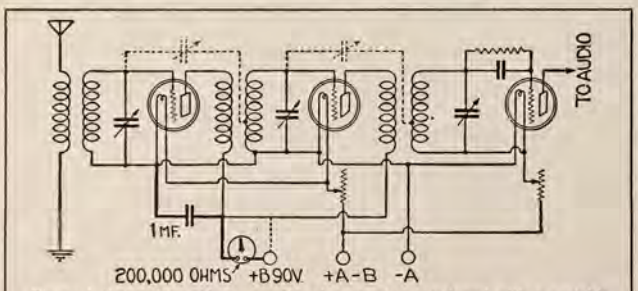

Figure 1 above shows the conventional neutrodyne equipped with a variable plate resistor. Remove wires indicated by dotted lines and add wiring shown by heavy lines

Simple *Crystal* Set *for the* Newcomer *in* Radio

Scheme Used in Washington May Well Be Duplicated in Other Centers

ALTHOUGH the Naval radio engineers are doing all they can to eliminate interference from their code and broadcast stations, which, it is so often alleged, cause the fans great inconvenience, they have decided to try to help the Washington listeners help themselves.

The main problem of many persons living in congested radio areas, is how to construct an inexpensive broadcast receiver which will give reasonable relief from local interference and render satisfaction and enjoyment in receiving good programs. In an effort to aid the fans, Lieut. Commander T. A. M. Craven, of the Navy Radio Engineering Bureau asked the Naval Research Laboratory engineers to sketch out and describe a simple crystal receiver which could tune out some stations and be easily and cheaply made.

Inductively Coupled

ACCORDING to Commander Craven, a set assembled as directed, successfully operates in Washington where considerable complaint has been made that NAA on 435 meters interferes with WCAP and WRC operating on 469 meters. The set can be tuned to either wave length without noticeable interference from the other. Being a two circuit hook-up, it is more selective than the so-called single circuit receivers in general use.

"No difficulty should be experienced in tuning out stations of the same power separated by 35 meters in the broadcast band, whereas difficulty is reported with the usual crystal set in separating stations even 100 meters apart," Commander Craven says. This receiver, which is of course neither new nor unique, is much less affected by interference from electric light and power lines, street cars, and radio telegraph signals, he explains. It gives excellent quality in local station reception and is even capable of getting some outside stations during good winter reception weather. Such receivers should be of service to fans living in congested districts like Chicago, New York, and other big cities.

Not Very Expensive

THIS receiver can be constructed with inexpensive parts purchased at local radio retail stores for only $3.51, exclusive of headphones and antenna. Headphones vary in price from about $2.00 to $10.00, depending on the quality desired.

The necessary parts of the receiver proper (exclusive of antenna and phones) with their prices follow:

2 switches with 10 switch points @ $.20	$0.40
1 detector stand	.15
1 crystal	.10
1 standard rotary, straight line frequency, variable condenser	1.61
5 binding posts @ $.02	.10
1 fixed condenser for by-pass around phones	.10
Fibre or paper tubing	.20
Wire	.15
Dial for condenser	.35
Solder	.10
Wood board	.25
	$3.51

The receiver is of the so-called "loose-coupler" type, which has been known to the radio art for over ten years but which is not manufactured in large quantities for the "broadcast trade." It is designed to use a single wire antenna, between 50 and 150 feet long.

Primary Coil

THE primary coil consists of 90 turns of No. 24 B. & S. gauge covered copper wire,

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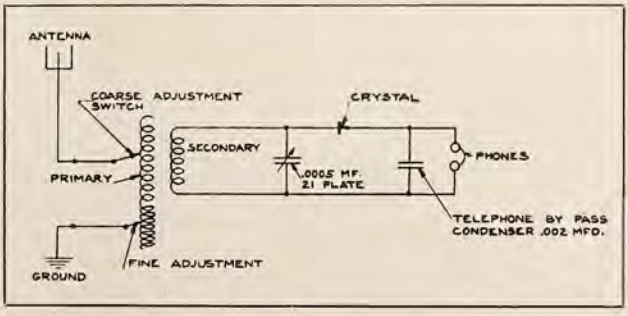


New Theory is *Advanced* Linking Static *and* Fading

Map Shows Result of Tests Made During Month of February

The above map shows the results of the fading tests conducted by the Stewart-Warner Corporation in cooperation with Northwestern University Feb. 11th. Vertical lines, slight fading and static, diagonal lines marked fading and static, crisscross lines severe fading and static.

IN AN entirely new theory concerning the propagation of static J. K. Smith, of Chicago, has placed the blame for virtually all radio interference on the phenomenon known as "fading" and laid the foundation for a more complicated argument, if not a more simple investigation of the things that make radio reception as poor as it is.

It is the theory of Mr. Smith that static and fading are not only closely related to one another as was indicated in the recent survey of atmospheric conditions conducted by the Stewart-Warner Corporation in cooperation with the Physics Department of Northwestern University—but that they are one and the same thing. Mr. Smith represents Stewart-Warner in these tests, which are being conducted monthly.

The theory does not attempt to get to the basic causes of the thing. It links static with fading, but advances no explanation of what either static or fading may be.

Origin Not Traced

AS SO far developed, it does not claim that all static and all fading may be brought together as one single phenomenon—that point will require further investigation. But it is pointed out in logical fashion that the automatic recorders used in the first of the nation-wide tests have demonstrated that fading—hitherto looked upon as one of the manifestations of an increasing silence—is undoubtedly the cause of a great deal of noise, the origin of which has never been traced.

To understand Mr. Smith's theory it is necessary to go back to the elemental principles of radiophone broadcast. The transmitting station sends out first a wave of continuous amplitude, vibrating so rapidly that the human ear cannot detect it. The so-called voice currents are sent out in another wave superimposed upon the first. This is known to the trade as modulation—a mouth-filling term that is never readily understood by the layman.

Modulation Explained

WHAT actually happens in modulation is this: The transmitting apparatus interrupts the flow of the carrier wave at intervals which correspond to the vibrations of tones in the audible scale.

The receiving set through its detecting apparatus translates those interruptions into electrical impulses, which are amplified more or less and eventually are turned out to work the diaphragm of a speaking device.

Something of the process may be learned from the common alternating house current which changes sixty times each second. Manifestly in this current there is no such thing as one wave being laid on top of another by some hocus pocus which the learned may call modulation. There is just one wave which reverses sixty times a second and by the most technical of engineers it is never called anything but a sixty cycle current.

The current makes no noise as it delivers light to an incandescent bulb. But that it is noiseless nobody who has ever attempted to operate a set on "B" battery eliminator will ever have the temerity to claim.

Put a pair of headphones in series with the house light-

(Please turn to page 46)

Try This *Stunt* on Your *Audio* Transformers

Reduction of Distortion May Be Accomplished By Use of Resistance

A FURTHER means of improving the quality of audio transformers may be utilized in which a half-megohm fixed resistance is shunted across the secondary so as to flatten out the curve of the transformer characteristic.

In the drawing shown at the bottom of this page is represented the difference in characteristic curves of a good, well-made, audio transformer. Curve A with the steep hump is the audio transformer characteristic plotted over a range of cycles per second, the predominant part of the hump being from 3,000 to 5,000 cycles per second. At these points the voltage amplification is shown as the highest.

CURVE B, which is secured by means of placing a half-megohm fixed resistance across the secondary terminals, shows the curve considerably flattened out over the sector of 3,000 to 5,000 cycles, although at somewhat of a sacrifice in the voltage amplification.

The curves represent a careful measurement made on a standard and well-known make of audio transformer and show that at a fixed degree of amplification certain of the high frequencies are accentuated, this resulting in the distortion of the output of the receiver.

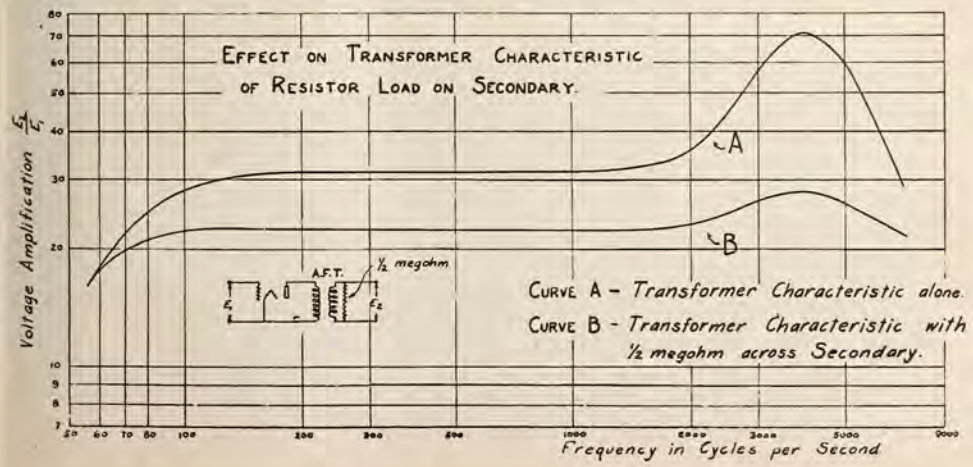
The introduction of a 500,000 ohm fixed resistor as shown in the left portion of the drawing, showed a small decrease in amplification, but a very considerable correction to the amplification curve of the higher frequencies. From an inspection of these two curves it appears that the introduction of a resistance across the secondary terminals materially corrects the distortion present as shown in curve B.

Several manufacturers have conducted experiments along these lines and have found it to their advantage to add a fixed resistor in shunt across the secondary circuit. If the same thing appeals to a manufacturer, broadcast listeners and experiments might find something of interest in the scheme outlined herein.

WESTERN ELECTRIC, so we are informed, makes use of a half-megohm Durham metallized resistor, while the General Electric and the Westinghouse interests use a 40,000 ohm resistor of the same make which is included in the assembly of the Radiola 20, 25 and 28 models.

Experimenters desiring to take advantage of this hint might find it of advantage to use more than one size of resistor to secure the best possible results, since perhaps each of the audio transformers on the market might require a different value of resistance.

What benefit would accrue from the addition of a resistor to the secondary of some transformers on the market with straight line frequency characteristics we cannot say, but a radio experimenter will try anything, and sometimes one may find interesting facts from trying everything that is suggested.



Some *Inside* Information On Wavelength Assignments

Ten Kilocycle Separation Is Found To Be Most Feasible Considering Band Limits

MANY broadcast listeners have perhaps wondered why it is the government has assigned the five hundred odd broadcasting stations in the United States to a wave band containing exactly 94 channels each separated by ten kilocycles from each other. It has generally been felt that the process of alloting a wave length to a certain station was a mystic process when as a matter of fact the allotment must follow certain definite radio and mathematical rules.

For example it has been found both by theory and by actual practice that any two stations operating on a wave band closer than ten kilocycles removed from the next band, will of necessity spill over into the adjoining channel and cause serious interference. For the benefit of many receivers it would be nice if the kilocycle separation were set at 20 kilocycles, but that would allow only 47 channels for the 540 stations on the air at present, and what a wail of protest would arise from stations having to split their time two, three and four ways, is not hard to mentally picture.

WHEN the first *real* session of the radio supervisors was assembled at Washington considerable time and energy was spent in devising a method of cramming in over 500 stations onto a space in which there are at the most only 94 channels.

In going over the problem it was found necessary to split the stations into two classes: the A and the B classes. The latter were the higher powered, high class stations, while the Class A section included the smaller powered stations where high quality was not necessarily an adjunct.

Since transmitters operating on adjacent wave bands will cause heterodyning between each other it was necessary to have each station separated by an arbitrary kilocycleage to prevent the possibility of heterodyning.

Also each transmitter has a series of harmonics ranging from the second (which is twice the fundamental frequency or half the fundamental wavelength) on down to the fifth and sixth harmonic of the fundamental. The second harmonic was found to be the most persistent cause of trouble and means of eliminating this trouble had to be evolved.

WITH a pencil and paper anyone interested can easily find where the harmonic (the second one) of a station on a given wavelength might interfere with the fundamental frequency of another transmitter. An example of this can be seen when you consider KSD with a fundamental frequency of 550 kilocycles whose second harmonic, if not suppressed, would beat with the fundamental of stations on the 1100 kilocycle band, such as WRM, WSBF, WHK, KFAD, etc. Thus we see that the Class B stations would cause interference with the Class A stations unless some means were adopted to swallow, or filter out, the second harmonic of the higher wave stations. However, now the Class B stations have most all installed harmonic suppressors by means of which the radiation of the second harmonic of the fundamental (twice the fundamental kilocycleage) is eliminated. Thus with the second harmonic gone there will be no interference between the Class B station and the Class A station.

In order to make this possible it was necessary to arrange the boundaries of the Class A and Class B stations so that they would not overlap. Consequently the Class A stations were given a location from 202.6 meters (1480 kc.) to 277.6 meters (1080 kc.) or a total of 41 channels, each separated by ten kilocycles.

Fifty-three channels were left available for the Class B broadcasting stations, extending from 280.2 meters (1070 kc) on up to 545.1 meters (550 kc). These channels are in the majority since on these wavelengths the bulk of the good stations requiring high power are to be found.

ALL of these considerations must depend upon each of the broadcasters maintaining their assigned frequency. If one of them slips off far enough to one side of the assigned band there will be serious interference with other stations.

Fans who encounter interference at night may well know that this arises, in nine cases out of ten, from a broadcaster not remaining on his predetermined frequency either through negligence on the part of the operating staff or indifference or the fact that frequency standards used are not properly calibrated.

CRYSTAL control, with its universal adoption among the broadcasters of the country, will solve a great majority of the causes of complaint, but it will take some time before all of the stations are so equipped. For example KDKA, WGY and perhaps one other station are now equipped with crystal control so that under no circumstances can the frequency be altered from its standard, the crystal oscillating only at one frequency (the frequency for which it is ground).

Radio fans, station operators and the government in general will welcome the day when all stations can be accurately kept on their assignment. When that day comes interference will be eliminated insofar as the stations alone are concerned and we will have to look elsewhere for new sources of trouble.

An Efficient Long Wave Receiver

By C. W. PRESTON

DURING the past few seasons practically all of the average radio enthusiast's attention has been given to broadcast reception on the regular wavelength band of from 200 to 550 meters, with what little was to spare devoted to the shorter waves which have rapidly been gaining in favor for transmission purposes. Practically no thought at all has been given to the longer waves of from 5,000 meters up except by inveterate experimenters—those individuals who at present consume the major portion of the parts output of American manufacturers.

For some time past, however, very interesting experiments have been conducted in transoceanic telephony on waves in the neighborhood of 5,000 to 6,000 meters. Within the past few weeks mention of these experiments has been given prominence in the newspapers of the land, with the result that many fans not hereofore familiar with them, becoming interested, desire to construct receivers suitable for this class of reception.

Wide Range Covered

IN the accompanying photos an extremely satisfactory type of long wave receiver is illustrated, capable of covering a wavelength of 4,500 to 15,000 meters. This receiver consists of one stage of tuned radio frequency amplification, one stage of untuned amplification, a detector and two stages of audio amplification. Standard parts easily procurable upon the open market are used throughout, with the result that the set may be constructed in a very short time by the interested fan.

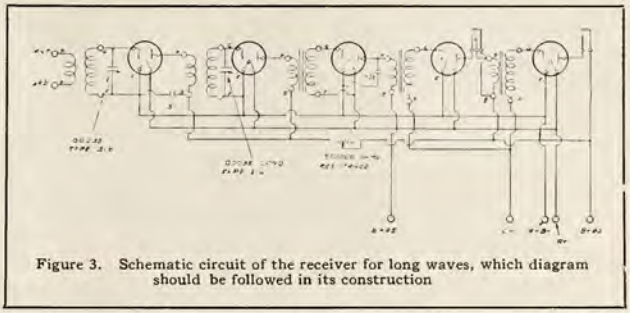


Figure 3. Schematic circuit of the receiver for long waves, which diagram should be followed in its construction

The circuit of the receiver is shown in figure three, from an examination of which certain things will become evident. A standard sharply tuned long wave transformer is used to couple the antenna to the input of the first tube. The secondary of this transformer is tuned by a .00035 straight line frequency condenser of approved design, while the primary remains untuned. Coupling the first and second r. f. amplifier tubes is a second transformer of the same type, tuned by a similar condenser. These two tuned transformers will give more than enough selectivity for long wave conception, so the output of the second r. f. amplifier is fed to the detector tube by means of a comparatively broad-band, iron-core transformer, of a type intended for most efficient operation at from 45 to 60 kilocycles, though capable of amplifying quite effectively other waves as well.

The detector tube, rectifying by virtue of a grid condenser and leak is coupled to the first audio amplifying tube through a spe-

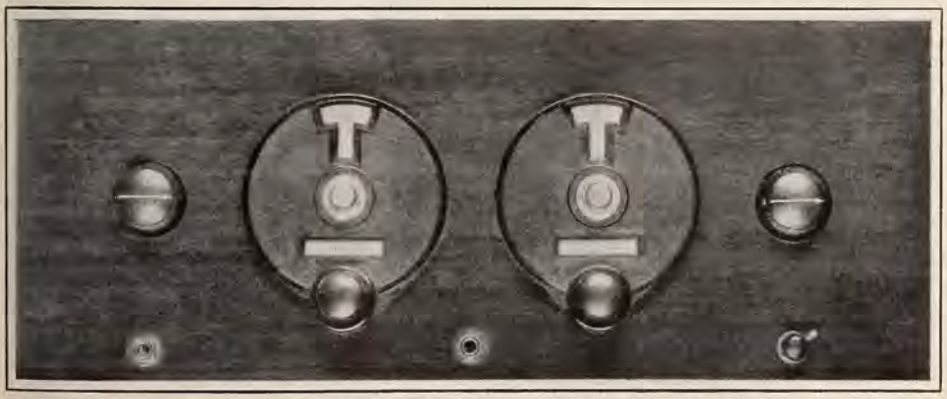


Figure 1. This is the front panel view of the receiver described by Mr. Preston

cial type of transformer designed to transmit with minimum attenuation all frequencies between 30 and 7,000 cycles—those required for distortionless speech and music reproduction. This tube is in turn coupled through a similar transformer to the second audio amplifying tube. Jacks are provided so that either one or both stages of audio amplification may be used at will.

Single Rheostat

A SINGLE rheostat is provided for all five tubes, which may be either dry cell or storage battery types, the UV201A's are recommended for best results. A 500,000 ohm resistance is connected in the plate circuit of the two r. f. amplifiers, to stabilize them and control oscillation. This resistance is also quite effective as a volume regulator.

The entire assembly is mounted upon a 6½x17x⅛" sub-panel and a 7x18x⅛" front panel, of bakelite. No dimensions are given, as the instrument locations can be very easily determined from the photos, and each individual constructor will wish to exercise his own ideas in the assembly of the receiver.

The parts necessary to construct the receiver are listed below. While the parts recommended need not of necessity be employed—others of the same mechanical and electrical characteristics being satisfactory—it is suggested that in the case of the long wave transformers substitution be not indulged in since those specified are particularly suitable for operation over the frequency range involved in the trans-oceanic telephone tests.

2—.00035 SLF condensers
2—Vernier dials
2—Tuned long wave transformers
1—Iron-core long wave transformer
5—UX tube sockets
2—Audio transformers
1—3 ohm rheostat
1—500,000 ohm resistance
1—1-spring jack
1—2-spring jack
1—Battery switch
1—Grid condenser with clips —.00025
1—.002 condenser
1—.05 condenser
1—Pair mounting brackets
1—7x18x⅛ bakelite front panel
1—6½x17x⅛ bakelite sub-panel
Miscellaneous wire, screws, nuts, solder, etc.

In assembling the receiver, the parts should first be located upon the panels, the necessary holes laid out with scriber and center punch and then drilled to the proper size. The panels may be grained by rubbing in one direction with fine sandpaper and oil and, if desired, engraved, to add to their appearance.

In mounting, all parts should be placed upon the panel that are seen upon it in the photos. Similarly, all parts illustrated upon the baseboard should be mounted upon the smaller bakelite panel with the .05 condenser fastened beneath base. The two panels may then be joined together by means of the mounting brackets and the wiring put in place.

Wiring may be done using either bus-bar and spaghetti or flexible insulated wire. In any case it will be neecssary to drill holes through the sub-panel to bring the necessary leads through from the jacks, switch, etc. It is suggested that the wiring be continued in the form of five leads to extend a distance of four or five feet beyond the set. These leads may be braided together and used directly for battery connections, no binding posts being provided. Similarly, the antenna and ground connections are made directly to the primary of the first 211 transformer, no un-

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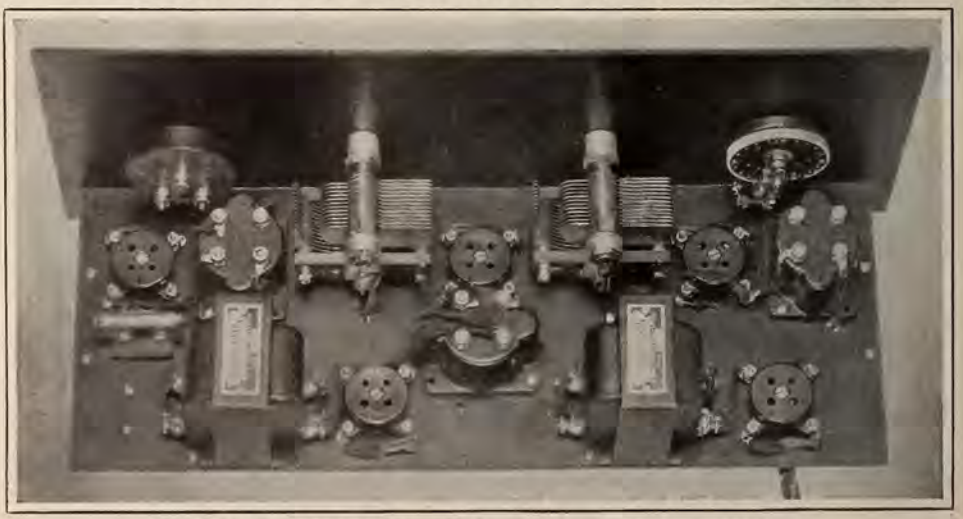

Figure 2. Rear panel view of the completed receiver showing all parts placed and wired

Eliminating the Radio A's, B's *and* C's

By ARMSTRONG PERRY

"ACCEPT no substitutes" was a familiar slogan in the not very distant past. It appeared on almost every patent medicine label and on a lot of other things. Millions of dollars were spent by advertisers in an effort to drive dealers who dared to say that they have something "just as good" out of refined society. The manufacturer who offered a substitute for anything in common use had to overcome a lot of conservation fostered by the fellows who kept on making and selling the same old thing.

But the old order changeth. Today the world is looking for substitutes. The women have substituted drug store goods for complexions. The labor unions have substituted strikes for the work by which workers used to earn a raise. Anything that will take the place of anything else is purchased more eagerly than the thing itself. What radio users want right now is a substitute for radio batteries.

Did Good Job

THE batteries have done a good job, on the whole, during the hectic days since the birth of broadcasting, but their days seem to be numbered. First, the storage battery, or wet battery, became *persona non grata* and the public wanted a substitute for it. No one loves a fat man, it is said, and a heavy battery is under a similar disadvantage. Also, it is a great eater. Its mouth waters at the sight of an expensive curtain or an Oriental rug and it will eat holes in them if it has a chance. One storage battery ate the front out of a pair of Sunday pants against which it rested while being carried from the car to the house. Such batteries are voraciously cannibalistic and will bite the hands that feed them. They are always running charge accounts and then getting discharged. Their one good point is that they work along steadily and faithfully, while they work, and any stenographer will tell you that you have to do a lot more than that to hold a job these days.

The dry cell went in as a substitute for the storage battery. Even the old soaks who would rare up and get purple in the face at the mere mention of the word "dry" in other connections began buying dry cells instead of wet, although the dry cell tube never did deliver quite so much volume of sound in the loud speaker as its older and more portly relatives, the 6-volt tubes.

REGARDLESS of what units are used in radio there is always a knack of describing them for the benefit of the lay mind. Even the seasoned experimenter gets quite a "kick" out of a simple, yet accurate description of anything pertaining to radio—especially if it is written by Armstrong Perry, whom we believe has pounded more good sense into the head of fans by the simple expedient of making what he says interesting and ofttimes humorous.

Take the case of the elimination of batteries of all kinds, A, B and C's—here we have Mr. Perry at his best in telling a story interestingly. Watch future issues of RADIO AGE for other features by this noted radio writer.

—The Editor.

Why Not Electricity?

THIS went on for a time, then the public began to inquire why, since it had electricity in the house, it could not use it in the radio set as well as in the electric lights and washing machine. 'Lectricity was 'lectricity, wasn't it! What for was it necessary to have electric light wires and two varieties of batteries in the house to produce the same thing! While often kicking about the electric light company, folks seemed anxious to place themselves still more completely in its power. They had to depend on the company if they wanted to see anything and now they are trying to get into a position where they will have to depend on it if they want to hear anything, as though the telephone was not bad enough.

The accommodating manufacturers started at once to meet the demand. Now, it is possible to buy many different substitutes for batteries. The only question is whether and how soon the purchaser will wish he had the batteries back again.

The substitute, in order to take the place of A, B and C batteries, must do several things: reduce the line voltage to the voltages required for the tubes; increase the voltage if more than the line voltage is needed on an amplifier plate circuit; change the alternating current to direct current; and eliminate the hum which alternating current tends to produce in the phone or loud speaker. The greatest difficulty seems to be the hushing of the hum.

Sensitive Devices

PHONES and loud speakers are very sensitive devices, ten times as sensitive as the microphone that picks up the voice or music that is transmitted from a broadcasting station. The mike does not need to be so sensitive, because there is almost unlimited power available to amplify the energy that it picks up. The receiving phone must be highly sensitive because the radio receiver may pick up as little as three-trillionths of the energy radiated from a broadcasting antenna. Even though this received energy may be amplified to a million times its value, by the addition of power from the home radio batteries or substitutes, there is still need of a sensitive device to change the energy back into sound waves and make them strong enough to

satisfy the listener. Since these devices at the receiving end are so sensitive, they will produce sound, and even distracting noise, from energy that never was intended to enter the radio circuits.

The electric light and power lines that serve our homes usually carry alternating current. Commonly it is 60-cycle current, so called because it reverses its direction 120 times each second, making sixty cycles from its direction at any given instant to the opposite direction and back again. According to the laws of electricity, which are among the few that have not as yet gone up to the Supreme Court for a decision as to their constitutionality, there is a tendency to set up a current in neighboring wires or other conductors of electricity whenever the current in one wire stops or changes its direction. This 60-cycle alternating current, by this action, produces the 60-cycle hum in any phone or loud speaker connected with a circuit on which it can impress this characteristic. It is as hard to eliminate as the noise the family makes when only one of its members is listening in, but the battery eliminator should eliminate it completely, for even if there is so little of it left that it cannot be heard as a separate sound, it mars the effect of the broadcast music.

Change the Current

ALTERNATING current at the correct voltage can be used to light the filaments of tubes, and the filaments will throw off electrons when so lighted, but the results in the phones are less satisfactory than those obtained from direct current such as the "A" battery delivers. A. C. in the plate circuit is as bad, or worse. That is why the battery substitute must change the alternating current received from the electric light line to direct current for use in the tubes.

Some radio amateurs who operate transmitting sets accomplish this by using a motor-generator in which an alternating-current motor uses the current "as is" from the light line. This motor turns a shaft on the other end of which is a direct-current generator that produces current of the kind desired. But the rank and file of radio users would not purchase so expensive an outfit, and in the hands of operators who were not expert in the use of electrical machinery it might not give satisfactory results. The electron tubes are very sensitive to even the small changes of current that occur when a motor-generator changes its speed slightly, due to variations in the voltage on the line, or to other causes.

The battery substitutes offered today change the voltage by using transformers, change the alternating current to direct current by the use of rectifiers, and try to eliminate the 60-cycle hum by means of filters.

How It Is Done

A TRANSFORMER consists of a primary coil, through which the current from the line passes, and one or more secondary coils in which a secondary current is produced by the induction of the primary current. The voltage of the primary, current and the number of turns of wire in the different coils determines the voltage of the secondary current or currents. The more turns there are in the secondary coil, the higher the voltage of the current induced in it. The variocoupler, a device familiar to most radio users, is one type of transformer and it works on the same principle as the transformer used in the battery substitute. If the substitute is to take the place of the "A" battery, it must reduce the light line voltage, usually around 110, to six volts or whatever the tube filaments require. If it is to replace the "B" battery, it must reduce the 110 volts to 22½ for the detector plate, to 45 for the plate of the first amplifier tube, and so on up to the plate voltage of the power tubes now coming into use in the last stage of audio-frequency amplification, which may require an increase rather than a decrease of the light line voltage. To replace the "C" battery, it must deliver still another voltage. For each different voltage delivered, there must be a separate secondary coil in the transformer, or an outlet from the rectifier through resistance of the proper value. Variable resistances are used in several types of substitutes.

Types of Rectifiers

A RECTIFIER is, in effect, a valve which permits current to flow in one direction but not in the other. The electron tubes used in receiving sets are rectifiers. If the filament be lighted by alternating current, the current delivered to the phones or loud speaker by the plate circuit will be direct current, just the same as though the filament were lighted by direct current. A crystal detector is a rectifier also, and changes the alternating current that comes in through the antenna into direct current for use in the phones.

Rectifiers are used successfully for charging storage batteries from A. C. lines. Some of the devices called battery substitutes contain batteries which are charged through rectifiers either while they are supplying the radio receiver, or during the time when the receiver is not in use, or both. If the A. C. is shut off while the receiving set is in operation, of course the results will be the same as though a battery without a rectifier were used, unless the close proximity of the A. C. outlet and wires produce some effect.

Method of Rectification

SEVERAL types of rectifiers are used in battery substitutes. Some contain electrolytic cells, with two electrodes and a solution, through which current passes as it does through a battery but without the same chemical action that takes place in batteries. The solution in some is the same sulphuric acid mixture used in storage batteries, while others contain a solution said to be harmless. Others use electron tubes having filaments and plates but no grids. Amateurs have made rectifier tubes of ordinary types of receiving tubes, by connecting the plate and grid, but types of tubes designed specially for rectification are likely to be more efficient. Some of the special rectifier tubes con-

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Radio *Communication* On Short Waves

Head of Naval Radio Laboratory Traces Interesting History

By Lieut. Commander A. H. Taylor

RADIO as an art had its genesis in the experiments of Hertz in Gemany in 1885. Hertz used waves of very short length, namely, in the neighborhood of the band from 1½ to 3 meters. The first radio signals, which could scarcely be called messages, were sent across a room in a physical laboratory. The region in which waves were studied rapidly extended from a few meters to several thousand meters in wavelength.

The experiments of early investigators have been forgotten by many, but within the last three years some very remarkable results have been obtained as the outcome of studies of communications on short waves, which although not quite as short as those used by Hertz are nevertheless of the same general order of magnitude. I refer in particular to wavelengths in the band between 10 meters and 100 meters.

Gives Vacuum Tube Credit

THE early experimenters had neither adequate devices for detecting short waves nor means of producing short waves conveniently with any considerable amount of energy. Indeed, until the invention of the vacuum tube transmitter it would have been utterly impossible by any means known to the art to produce short wave radiation of strength sufficient for experiments at any distance. In the meantime the art had naturally extended itself into the range of longer waves where greater energy could be produced and there were many things to be done in this line of development.

The United States Navy had been using as far back as 1917 or 1918, waves as short as 150 meters and sometimes 125 meters, but only for communication at short distances within the fleet. Aside from this limited use of fairly short waves by the navy, comparatively uo use was made in this country of waves shorter than 200 meters. All waves shorter than 200 meters were considered worthless for reliable long distance work.

Not Taken Seriously

IN THE early days of amateur radio communication, the amateurs operated on a great variety of wavelengths, but they were restricted when government regulations finally stepped in, in the interest of avoiding interference. Operating in the 200 meter band, the amateur stations of 5 to 10 years ago established many remarkable long distance transmission records, but it was found upon analysis of these records that very few transmissions were recorded for distances over 150 miles by daylight and that the nocturnal transmissions were extremely erratic and unreliable. Indeed they were so uncertain that the military and commercial interests of this country were well satisfied that they were not in this wave band.

For a number of years no one thought seriously of attempting long range experiments on still shorter waves because as one studies the behavior of transmissions from 15,000 meters down to 200 meters, it is easy to see that the daylight ranges rapidly decrease and that the night ranges become more and more erratic and unreliable. However, the amateurs of this country made a strenuous and concerted effort to get signals from this country into Europe with low power transmitters operating on the 200 meter band, but the experiments were attended only with a very limited amount of success.

Praises American Amateurs

SOMEWHAT later, experiments were undertaken in the neighborhood of 105—110 meters which showed entirely different results. The experiments by American amateurs are of particular interest because they were carried out, in most cases, with less power in the transmitting antenna than would be required to operate an ordinary electric flat iron and yet several of them were able to put signals into Europe consistently for a good many hours at a time for many nights in succession.

The behavior of those waves in the neighborhood of 100 meters was a distinct reversal of form and exactly the opposite of what would have been expected by every one familiar with the developments in the longer wavelengths. Instead of signals being of less intensity than those sent out on 200 meters with the same power, they were of much greater intensity and instead of being more unreliable, they were a great deal more dependable.

Opened World's Eyes

THE success of the American amateur in bridging the Atlantic even if only during the night hours with a ridiculously small amount of power, opened the eyes of the whole world to new possibilities in short wave

communication. From that time on, the development has been extremely rapid, and in this new development the technical staff of the Naval Research Laboratory, located in the southern end of the District of Columbia, has played no inconsiderable part. For more than a year one of the transmitters, built at this laboratory and placed at the disposal of the Navy Department during the night hours, has carried almost the entire night load of our high-powered station at Annapolis which has resulted not only in the saving of a considerable sum of money for the Navy, but has relieved broadcast listeners in Baltimore, Washington and Annapolis of the extremely disagreeable radio interference which emanated from the high-powered, long wave station at Annapolis.

Will Reduce Interference

ONE OF the greatest advantages of the use of short waves is in the enormous reduction of interference which is to be expected as the new short wave stations are developed and gradually take over work during broadcast hours at least.

The Naval Research Laboratory has just completed an investigation of the conditions of broadcast reception within half a mile of our powerful transmitter and it has been found that a moderately selective receiver of the type not making use of any oscillating tubes, shows no serious amount of interference even if as close as half a mile.

The interferences which will occasionally be observed, although they are very rare indeed, from short frequency transmitters, generally are not the result of the high frequency transmitters themselves, but are due either to a very non-selective receiver or to a combination of a number of other transmissions from different sources with the short wave transmission. This sort of combination is not peculiar to high frequencies but can occur in any powerful transmission.

Investigations have proceeded far enough to state definitely that the interference from the transmitters used at the Naval Research Laboratory on high frequencies in communicating with the commander-in-chief of the U. S. fleet during the Australian cruise, and which had no difficulty in putting signals directly into New Zealand, 9,000 and 10,000 miles respectively, is not nearly so great an interference by a factor of many times, as the interference which would have been experienced from a long wave transmitter which at best would not have been capable of handling similar traffic much further than the Pacific Coast.

A very great change in the nature of the observed effects occurs as the waves are shortened still further and it would appear from theoretical considerations which have been published in "QST" that waves much shorter than 14 meters will not be of much use for really long distance work. Even in the band between 20 and 40 meters, a new phenomena occurs which we call the skip distance effect.

It is now definitely known that the wave directly radiated from the antenna and spread out over the ground in the usual manner is very quickly absorbed and is of no use in long distance work. On the other hand, the portion of the rays which radiate up slantwise towards the sky from the antenna are refracted from an ionized region whose height varies from 50 to 700 miles according to the time of the year and time of the day, and these rays coming down to earth again after a considerable distance, are the ones which are valuable in communication.

Connecticut via London

UNDER certain conditions, when operating in the band from 20 to 40 meters, stations at relatively near-by points, that is, a few hundred miles away, will be skipped over or missed entirely, whereas very intense signals will be received much further on. This effect naturally was very puzzling before it was understood.

I can recall an occasion when I was in communication on the 20-meter band with a British station between 12 and 1 in the afternoon; at the same time, two American amateurs, one in St. Paul, Minn., and one in Connecticut, were listening in on the test. The only way I could communicate with the man in Connecticut was to relay a message either through St. Paul or through London. He was unable to hear my signals, and I was unable to hear his. On the other hand, I was perfectly well able to work London. The St. Paul man on the other hand being outside the skip distance which at that time of the year was about 600 miles for that wave, was able to communicate with everybody.

Now during the night hours the skip distance is very great indeed. I have communicated directly with Sydney, Australia, in the 20-meter wave band without having my signals heard anywhere in the United States outside of 8 or 10 miles which would be penetrated by my rapidly absorbed ground wave.

Using the Sky Wave

IT IS a common experience at this time of the year when operating in the 40-meter band, to notice that as the ionized layer of the earth's atmosphere rises to high altitudes after sunset the skip distance is increased so that the New England stations become gradually weaker as the night hours wear on and disappear at Washington, but at the same time, European stations working in this band and our Mid-West and West Coast stations, to say nothing of New Zealand and Australia, come in very well indeed. It is due to the use of the "sky wave" (as it has been termed by Mr. Alexanderson) which passes through a medium not capable of absorbing it, that such immense distances can be covered with such a small amount of power. Communication between the United States and Australia has been maintained on a number of occasions by American amateurs using only a few watts; in other words, much less power than is required to light a 25-watt electric lamp. I do not say that communication was fully

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WGY'S *Super Power* Set is Held Constant By Crystal Quartz

General Electric Engineers Making Tests on Signal Audibilities

A PIECE of quartz crystal less than an inch square, ground to a thickness of a shade less than an eighth of an inch is controlling the frequency of the 50 kilowatt output of WGY's giant developmental transmitter. This is one of the first superpower transmitter to utilize crystal control and those who listened to broadcasting of WGY during the International week tests, found the wave holding its frequency undeviatingly. In fact, the best available measuring instruments fail to record even a fractional departure from the 790 kc. frequency assigned to the station by the Department of Commerce.

Crystal quartz has been utilized for frequency control on the regular 5 kilowatt transmitter of WGY for several months. Special conditions had to be met in adapting this form of control to fix the frequency of 50 killowatts output.

Beside the General Electric Company's developmental transmitter wtih its bank of eight 20 kilowatt, water-cooled tubes, are two small copper covered cabinets with dials, switches and meters built in the faces. One of these boxes contains the crystal and a single exciting tube. In the second box is a single amplifying tube. Successive stages of amplification up to 1 kilowatt, are placed in separate panels.

THE small slab of crystal quartz is enclosed in a metal chamber which is connected to work directly on a 5 watt tube. The crystal and tube in combination act as a high frequency generator whose output is determined by the contraction and expansion of the crystal. This particular crystal is ground to provide a frequency or pulsation period of 790 kilocycles. The interaction of crystal and tube may be described as the setting up of a mechanical force which is converted into an electrical force of a definite fixed frequency dependent upon the dimensions of the piece of crystal used. The thinner the crystal the higher the frequency.

The five watt tube, directly connected to the crystal works into a 50 watt tube, resulting in the amplification of the original energy at the fixed frequency. Still further amplification is obtained by connecting the 50 watt tube to a 250 watt tube and then a fourth stage is secured by connecting the output of the 250 to a 1000 watt tube. All tubes used up to this point are air cooled tubes. In the next stage a metal water-cooled tube rated at 20 kilowatts is introduced. This single metal tube stage is part of the transmitter and was formerly used as the master oscillator. This tube, before the introduction of the crystal was a self-excited generator. Now, it is excited by the preceding stages of crystal amplification. The 20 kilowatt tube then excites the bank of eight 20 KW power tubes of the transmitter.

The average radio listener may not know how a broadcasting station maintains its frequency and he may not be interested in the method. However he strongly advocates a strict adherence to frequency because stations are spaced so closely in the broadcast band that interference is almost sure to occur if a station wavers periodically from its frequency. There is also fairly good evidence that fading tends to decrease when the frequency is held constant. Radio engineers of the General Electric Company have demonstrated that crystal control may be successfully adapted to any practical power.

RADIO signals are better 600 miles from a broadcast transmitter than they are at 300 miles, according to engineers of the radio department of the General Electric Company, under whose supervision an exhaustive investigation of radio wave propagation is now being made.

For several weeks past, thousands of radio listeners have been cooperating with the General Electric Company by reporting on reception of signals on broadcast bands. These cooperative tests are still under way and the conclusions are only such as suggest themselves from the preliminary reports. The engineers do not claim that the conclusions are absolute and caution that more exhaustive investigation may reveal some facts not yet apparent.

In observing the variation of signal strength, it was found that the strength of the signal drops off rapidly during the first 300 miles from the station and that, contrary to what might be expected, the signal strength actually increases and is apparently a little stronger at 600 miles than at 300 miles. Beyond the 600 miles point, the strength decreases again slowly to the limit of the range of the station. These distances are not definite values; they are averages from a large number of reception reports.

A study of the zones in which fading occurs shows that it is worst at about 200 to 500 miles from the station and this zone, from 200 to 500 miles, is the territory in which there is the greatest percentage of rapid-fading reports. Broadcast service is better at 600 miles than 300 from a station because fading is less

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RADIO ITEMS *from the* National Capitol

By Carl H. Butman

SO many branches of the Federal government use radio in one way or another that the Interdepartmental Radio Advisory Committee meets every two weeks to handle the many technical and administrative problems. This committee, established by Secretary Hoover in April, 1922, has a membership of eighteen men, representing fourteen departments or bureaus of the government interested in radio.

In the opinion of Assistant Secretary Stephen Davis of the Department of Commerce, who is chairman of the Radio Advisory Committee, that body serves a very useful purpose. It forms the only means of coordinating the various radio services of the government and to a certain extent aids in their coordination with commercial stations. Literally this committee, with its representative membership, is a clearing house for the exchange of ideas from the various points of view of the different departments concerned with radio in any way.

Many differences, which might have attained serious proportions, have been ironed out through committee action. The representatives of bureaus in disagreement over a radio problem have been able to get together in committee sessions and adjust matters amicably, without the aid of outside parties or executive action. Since the operations of the committee, no friction has arisen, and many inter-departmental matters have been taken care of.

At its fortnightly meetings during the past four years, this committee has handled the allocation of all governmental radio channels, determining what frequency bands the several governmental bureaus should use so as to avoid conflict and interference. This work is particularly important in connection with the extensive circuits operated by the Naval Communication Service and the War Department Radio Net, besides certain allocations made to the Post Office for air mail radio stations and airplanes, and to Coast Guard and Shipping Board Vessels.

A LARGE part of the routine work has to do with the solving of technical radio problems, which the experts assigned by the different services to sub-committees to handle. Efforts to standardize radio equipment and accessories used by the government are being made with a view toward economy and the interchangeability in government sets. Other matters receiving the attention of the committee include the transmission of official governmental messages over the radio systems of the Navy and Army; non-military activities of all departments; the use of governmental stations for both radio telegraphic and telephonic broadcasting, as well as the distribution of matter to private broadcasters on government activities.

The achievements of this committee are seldom made public for various reasons, chief among them, because it is usually up to a particular department or bureau to announce its activities itself, whereas the committee is merely advisory, assisting in the coordination of the several activities. Frequently this committee receives from Secretary Hoover a special problem submitted for study and report, and to date it is understood that most of them have been satisfactorily worked out.

The committee membership on April 1 included the following bureau representatives: Dr. H. A. Brown, Reclamation Service; Interior, E. B. Calvert; U. S. Weather Bureau; A. E. Cook, Labor Department; Lt. Com. T. A. M. Craven, Navy Engineering; Stephen Davis, Dept. of Commerce, Chairman; Dr. J. H. Dellinger, Bureau of Standards; T. C. Gale, Post Office Dept.; J. C. Gilbert, Dept. of Agriculture; T. A. Gillis, Interstate Commerce Commission; Capt. J. P. Jackson, Chief Coordinator's Office; Dr. C. B. Jolliffe, Bureau of Standards; Capt. Ridley McLean, Naval Communications; Maj. J. O. Mauborgne, Army Signal Corps.; H. C. Moore, Shipping Board; W. D. Terrell, Dept. of Commerce; Lt. E. M. Webster, U. S. Coast Guard; W. R. Vallance, State Department; W. A. Wheeler, Bu. Ag. Econ.; and W. E. Downey, Department of Commerce, Secretary.

DESPITE the tendency toward shorter wave broadcast transmission in Europe, and the use here of the band between 200 and 550 meters, radio engineers of Australia believe their present so-called long-wave transmitters serve more effectively throughout the commonwealth, according to Trade Commissioner Babbitt at Sydney. It must be remembered that in Australia the broadcast band is higher than in the United States, reaching to 1250 meters.

Where the same power is used, these Australian experts insist that a 1500 meter station would have a possible daylight range equal to three or four times the range of a 350 meter transmission, which they admit is probably more effective in darkness. They are not even convinced that, with the increased range of the shorter wave station in darkness, its extreme range is much greater than that of longer wave

transmitters. In Australia, they point out, it is important that the broadcasting stations carry to the whole state at all hours, day and night, and they consider our short-wave achievements more or less freaky.

Although the radio trade is urging a standardization of broadcast channels now reaching from 296 to 1250 meters, so they can produce standard receiving sets covering a smaller band, the broadcasters do not favor a reduction in wave lengths; at least two stations of 5000 watts, 2FC at Sydney owned by Farmer & Co., and 6WF, owned by the Westeralian Farmers' Ltd., at Perth, declare they see no reason to seriously consider the lowering of their wave lengths, which are 1100 and 1250 meters respectively.

Following a long investigation as to the value of the ordinary broadcast wave band such as is used in the United States, and the longer waves used in Australia by two stations, the engineers do not believe a change to shorter waves would be of advantage to the listeners.

The long wave stations at Perth and Sydney, they claim, practically cover the whole of Australia in daylight; which is of particular importance commercially, in that it insures continuous service for the listeners, which fading on the shorter wave channels would not guarantee except for short distances.

RADIO exports in February aggregated $543,972, and included 3,673 radio receivers, and 67,220 tubes. The value of the receiving sets exported was $172,910. Tubes amounted to $96,791; parts, $105,281; accessories $166,719 and transmitting sets and parts $2,271.

Total electrical equipment shipped in February was valued at $6,862,910, and storage batteries amounted to $301,340.

THE total number of applications for broadcasting stations continues to grow. Practically every one with a few thousands of dollars and some time to spare, together with a desire for publicity seems anxious to establish a broadcasting station and get on the air.

Some of the 526 applicants listed at the department appear to have good and legitimate reasons for opening a broadcasting station but many have no backing and little excuse.

Applications received cite many curious reasons back of the popular desire to mix in this great game of telling the world something. For example; some correspondents have daughters or sons who can recite or sing, others claim there is no station in their town or even county, while one believes he should get a permit to broadcast, since he owns a fine phonograph and many very good records. Another applicant says his name is the same as that of a cabinet member, which he believes would attract considerable attention once he got on the air.

There are other reasons advanced, but the Department refuses to be quoted as to them, and withholds the names of those considered as out of the ordinary applicants.

WHILE the Congress of the United States is considering new radio legislation, the question of reorganizing the British broadcasting monopoly is before Parliament.

A special broadcasting committee has just recommended that a new commission succeed the present British Broadcasting Company.

Agreeing that broadcasting in Great Britain should remain a monopoly to avoid the confusion resulting from free and uncontrolled transmission and reception in the United States, the committee urges state control.

The creation of a British Broadcasting Commission of between five and seven paid members of judgment and independence, to serve in the capacity of directors of a public service is urged. The members would be appointed by the Crown for a period of five years; such a commission would become effective on Jan. 1, 1927, and control all broadcasting with the assistance of the Postmaster General in the matters of licensing receivers and the collecting of fees. Blind persons would be permitted to listen in free.

"Broadcasting is not only an institution, but has become a necessity throughout the civilized world," the report states, adding that it will become a "handmaiden rather than the usurping rival of literature and the arts."

The British broadcast system, which opened its first station at London in November, 1922, now includes ten main and eleven relay stations and contemplates more high-powered stations, similar to that opened last July at Daventry. On January 31, there were 1,840,268 receiving licenses in effect, but the total number of listeners is estimated at two or three times that figure.

Commenting on the new scheme, one British publication urges Parliament to ascertain whether or not the listeners are satisfied with the present system before making any radical changes.

In its report, the committee states in part as follows:

The new commission would assume control on January 1, 1927, when the license of the British Broadcasting Company expires. The motive for this recommendation lies in the belief that a corporation for such public service should be publicly, rather than privately owned.

TWO proposals for the organization of the commission were made: The first, its creation by act of Parliament, which would specify its organization and the manner of its operation; the alternative, to create a corporation under the Companies Acts, with shareholders to be appointed by the Postmaster General.

All property and operations of the existing company would be transferred to the commission, arrangements being made to prevent any interruption of broadcasting service, by taking over the present operating staff. The commission would receive a ten-year license, similar to that now held by the B. B. C.

What the Broadcasters are Doing

THIS is the gentleman whose voice always precedes the ticks of the famous clock at PWX, Havana, Cuba. He is Remberto O'Farrill Hernandez who deals out his announcements to the palpitating radio world in both English and Spanish—a combination especially desirable for a station like PWX which caters to both of the Americas. You only need one guess, after looking at the middle portion of his name, to know that while Britannia may rule the wave, the Irish control a goodly portion of the air. *Felicidades*, R. O. H. and may your vocal cords never wane.

Research Work is Planned for Summer

ARRANGEMENTS have just been completed whereby Prof. C. M. Jansky, Jr., of the electrical engineering department of the University of Minnesota, and consulting engineer for WCCO, will devote his entire time for the three months of the University vacation to the work of the station. Prof. Jansky is recognized as one of the foremost authorities on radio communication in the United States, and for the past five years he has been in constant and close touch with the progress of radio engineering as applied to broadcasting.

In spite of its enormous development, broadcasting is still in a stage comparable to that of the automobile business in the days when people talked about "horseless carriages," and argued that the gas-driven car was so uncertain that steam was the only dependable motive power. Innumerable technical problems have yet to be solved before broadcasting can reach its true level of efficiency. Among these are such questions as fading, dead spots, power surges, uneven transmission on land lines, microphone circuits, wave length measuring and power loss in transmission.

No radio station has as yet satisfactorily solved these problems, and it is partly in order to improve its own transmission, and partly to contribute more generously to the sum total of our knowledge of broadcasting conditions, that the Gold Medal station has added Prof. Jansky to its full-time staff for the period when he is available from his University duties.

Chain Broadcasting For the West Coast

FOR the first time in the northwest several broadcasting stations—KJR, Seattle and KHQ, Spokane, were tied in simultaneous line for an experiment to send out the weekly program of Keep Joy Radiating Order from their Belfry at KJR.

A direct wire from KJR to Spokane enabled small crystal set owners in the two cities to hear. Firms sponsoring programs were delighted with the increased publicity resulting as noted by the hundreds of telegrams and telephone calls received. Other northwest stations plan to join hands.

Seattle Station Heard In Gold Mine

STATION KTCL, Seattle, was plainly heard on the 2,160-foot level of a deep gold mine at Goldfield, Nev., during a series of tests made in that town.

Proofs received at the Seattle broadcasting station declare the program came in strongly on a small set used by Rev. C. P. Lewis, pastor of the Goldfield Community Church, who went down the long shaft with a party of radio investigators. There, half a mile underground and 1600 miles distant, the Seattle broadcasting was heard. This reception is believed to set a new record for that station.

Eveready Hour Is Program Pioneer

THE "Eveready Hour" is the oldest regular feature broadcasting today.

A recent survey of the whole field of radio entertainment features revealed the fact that the "'Eveready Hour" is the "veteran" of them all, in point of regular and continuous service.

This weekly broadcast program first went on the air on December 4, 1923. From that time on, without exception, each week has had its "Eveready Hour," through Station WEAF and, since early in 1924, a gradually extending network of stations scattered throughout the East and Middle West. There are contemporary broadcast features which began just about the same time as the "Eveready Hour," but none of these others has had an unbroken run.

The "Eveready Hour," in its earliest days, however, was not the same type of broadcast program that it is today. It began, like most other features, as a program of more or less miscellaneous numbers. Slightly less than a year after its debut it launched its present type of program which has come to be known as the "continuity" radio program—a sort of radio scenario which tells a story with a combination of music and the spoken word. The first of these "continuity" programs was broadcast on the evening of November 10, 1924, on the eve of Armistice Day and the story was that of America's part in the World War.

All-American Station Shows *Steady* Growth

WENR Goes Into New Quarters at Kimball Hall

By

GWEN WAGNER

E. N. Rauland, president of the All-American Radio Corporation station WENR, Chicago, adjusting the controls of the transmitter

STRICTLY speaking, I am not what you would call a radio hound. Although it is in line with my duties to keep in touch with the studios I do not, night after night, make the rounds of them and sit wide-eyed and palpitating while somebody gets up to sing or sits down to play. There are many things I like fully as well as radio programs. Wrestling matches for example, or good, rousing melodramas.

All this probably has no earthly bearing on radio station WENR, Chicago, except that as I sit down to write about this station I feel, stealing over me, an urgent desire to become eloquently enthusiastic about it and I fear this eloquence may, unless it is explained, be taken for the feverish outpourings of an overburdened soul, hopelessly addicted to radio.

So I repeat again. I am not a radio hound. However, I am in a fair way to become one. I am in a fair way to become one of those shameless enthusiasts who rises up in the midst of any gathering and declares emphatically that such and such a station is the best on the air and who's going to dare say it isn't?

I wouldn't attempt to say that radio station WENR is the best on the air. How can there be any such classification anyway? However, I am prepared to say that radio station WENR is one of the most consistently entertaining stations on the air and that it is one of the fastest growing and hardiest children in the whole kindergarten of studios.

Makes Its Goal

WENR is a shining example of what can be accomplished with a radio station if you set a goal to shoot at and then keep on shooting. The trouble with a

The All-American Pioneers, a quartette of jazz musicians featured over the All-American Radio Corporation station WENR, Chicago

good many radio stations as I see it, is that they start out with no definite idea of what they are going to do. WENR started out with the idea that it was going to entertain people and that's what it has done and is still doing.

The station was a year old April 7 this year. It was founded by E. N. Rauland, president of the All-American Radio Corporation, Chicago, and sang its first song in the studio which was fitted up in the corporation's office building at 4201 Belmont avenue.

Mr. Rauland said he established WENR because, being in the radio manufacturing business, he felt it was his duty to contribute something toward the entertainment of the radio listening world.

"That may sound odd," says Mr. Rauland, "but it's the truth just the same. I honestly thought it was my duty to put up a station."

When Mr. Rauland founded his station it was with one idea in mind. That was—entertainment.

"When a man has worked all day and goes home tired and worn out and takes his shoes off and turns the radio on, I think he wants to be amused," says Mr. Rauland. "I don't think he wants to be preached to or talked at or given something that's going to tax his brain in finding out what it's all about. As a matter of fact, I think the American public in general wants to be amused.

Classic Dinner Music

"DURING the 6 to 8 period in the evening we broadcast our classical program. Classical music fits in with dinner somehow. After that, though, on our 8 to 10 and our 'Midnight Frolics' programs, we give 'em popular music, popular songs and popular ballads. I've found out from experience that that's what they want."

To make sure that the majority of the people wanted popular music Mr. Rauland, with the assistance of Frank Westphal, station director and announcer, arranged a series of experimental bills. They tried interpolating some classical music along with the popular. Try and do it! According to Mr. Westphal, the howl of protest that went up from listeners could be heard in China without a loud speaker.

So WENR went back to the popular programs.

The first thing that attracted me to WENR was its orchestra called the All-American Pioneers. As I believe I said in a previous article in this magazine, the All-American Pioneers' Orchestra is a litle four-piece affair that, from the listening end of a radio set, sounds like a whole symphony. In fact, a group of eight radio experts once listened in on WENR's orchestra and debated on the number of pieces it contained. They judged all the way from eight to fifteen and only stopped there because they figured a studio couldn't accommodate a large orchestra.

Right Instrumentation

INCIDENTALLY, Mr. Westphal tells me this apparent trick of making a four-piece orchestra sound like a whole symphony is merely the result of determining the right combination of instruments and the right method of broadcasting which, he says, he learned from recording for phonographs. Mr. Westphal, I might add, is leader of the All-American Pioneers.

For almost a year WENR stayed in its first studio out in the All-American Radio Corporation building. It kept putting on snappy programs with its lively little orchestra and it kept broadcasting other radio entertainment that made listening a pleasure.

WENR never made any great plays to the grand stand. It never hauled celebrities out to the studio to broadcast just because they were celebrities. If they could entertain and still be celebrities, all right. Otherwise, why put them on the air?

Because WENR never attempted any spectacular splurges, but just went along on the line that it was there to amuse, people were a little slow in recognizing the station. They'd tune in to ABC because ABC was touting some glittering movie star or a world-renowned tennis player. After a while radio listeners learned that all movie stars and tennis players are not radio entertainers and they began casting about for amusement. In due time they'd arrive at WENR and, once having arrived, they were bound to stick.

WENR's mail began to pile up. Its listening public began to grow. Almost before the radio

world knew what it was all about WENR had moved into a downtown studio and had become a personality to reckon with. WENR, a lusty likeable youngster for so many months, suddenly sprang into the long pants class.

Now Has Loop Studio

THE downtown studio, (located in Kimball hall in Chicago's great "loop") is a very beautiful affair. Indeed, it is such a jump from the homey little studio of WENR's first days that when I first went into it I was quite dazzled. It has all the rich rugs and period furniture and lamps and silk scarfs and whatnots that any radio studio would want. It has a waiting room for its artists, a reception room for its guests, names on its doors and a score of studio attendants to keep you from slamming into places that are more or less sacred precincts.

Moreover, WENR has an air. It is still whole-hearted and cordial and thoroughly democratic but it has an air never-the-less. It is an air of distinction that comes from having arrived at some place, not through a sudden boost, but by a steady, honest growth. You have a feeling that WENR has built from the ground up and that it's going to keep on building.

The last time I was in WENR's new studio there was a quartet on the program that I had a great time listening to. Frank Westphal said, "Oh, that's a regular barber shop quartet." But he grinned and I knew he thought it was a good quartet. So did I.

Then there was a girl with an Irish name on the program and although I think sentimental ballads are an abomination in front of any microphone, this girl sang them so heart-movingly that the telephone operator and I who were listening in out in the reception room, nearly broke down and sobbed.

There was a blues singer who had the blues beautifully and there were a couple of song writers who could sing as well as write and then there was music by the All-American Pioneers' orchestra which gave me a mingled feeling of pleasure and pain because I liked to listen to it but had no facilities for dancing.

I stayed until the finish of the program and thoroughly enjoyed every minute of it. I relate this because I want to make it clear that WENR is doing what it set out to do—entertain folks and while of course this particular brand of entertainment may not appeal to everybody it must appeal to the majority because WENR has enough fan mail to choke a good-sized river.

Buys Its Talent

YOU'LL hear some people say that WENR is an advertising station; that is, that it sells "time" to various corporations and collects money for so doing.

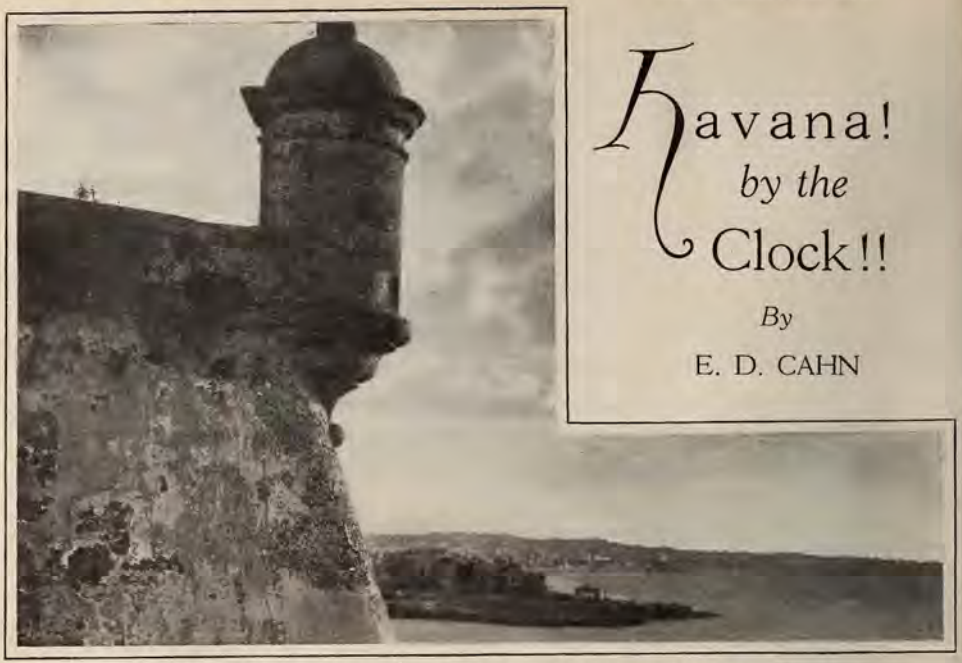
WENR does sell time (not much), to various corporations and it does collect money for so doing. But it doesn't sell its time to make money for the company. The money is used to buy radio talent. Not highfaluting, exalted entertainment, but entertainment that the average American citizen will enjoy listening to when he goes home in the evenings and wants to have a nice, pleasant time with the radio and the family.

"I want to make WENR a station that everyone will enjoy," says Mr. Rauland. "Kind of like a newspaper that everyone can read and understand. I don't want to cater to a select few. I want to please everybody."

In a little booklet that contains "facts of interest about WENR," it may be noted that "WENR has been heard in the farthest corners of the United States and Canada, in Cuba, Mexico, Central America, Alaska, Hawaii and New Zealand." That gives you some idea of the station's power. Further, "Whatever the character of the program, we endeavor to keep our modulation so perfect that our listeners may enjoy unimpaired tone reproduction at all times." That's true too if you've listened in.

Frank Westphal, station director, and whom, I might say in passing, is a mighty good one, told me not long ago that those interested in WENR were trying to make it the WEAF of that section of the country of which Chicago is the heart. I don't believe WENR is ever going to be that. I think it's going to be too big to be referred to by any other name but its own. I'm inclined to believe, that, after all, that's what Mr. Rauland, Mr. Westphal, and the rest of the people back of WENR, think too.

The New Kimball Hall Studio of All-American Radio Corporation station WENR, Chicago. Frank Westphal at the piano



Havana! *by the* Clock!!

By

E. D. CAHN

A view of Morro Castle, over whose grim walls the waves of PWX pass on their ethereal journey

TO the travelled American Cuba means Havana with its gardens and palm-filled patios, Spanish Opera, a gay and cosmopolitan throng busily engaged in colorful pleasures, where existence seems to be all laughter and pleasure.

But to the stay-at-home citizen who does his traveling by means of his radio set, Cuba, and particularly Havana, means PWX—the pleasant Latin tones of R. O. H.—the click of castanets, the throbbing rhythm of Spanish music and the ticking of a clock.

This clock has the best known tick of any in the western hemisphere, for between numbers, when the station is otherwise silent for a few moments, the clock is placed on the microphone and sends its own voice out upon the invisible waves.

And this is the reason, good fans, that when you are reaching out through the ether seeking distant voices and you hear the ticking of a clock you may know that you are in tune with PWX.

Fine Mansions

AS you listen employ the brief interval imagining the old white buildings of the city, the delicate iron grille work of the balconies, the courtyards filled with the exotics of this tropic isle. Picture the fine old mansions standing like Castillian grandees beside the most modern structures of this busy age, for here old and new jostle each other and pep and languor meet and smile whimsically at each other.

There are many beautiful drives of which Miramar Boulevard, beside the sea, is the favorite. It is pleasant to watch white sails go tacking across the harbor while the grim old Morro Castle stands guard over the spot where the Maine went down.

Fine old churches, full of historic interests; botanical gardens filled with curious tropical plants; the Gran Casino—reached via the Prado, famous as the Fifth Avenue of Havana—cigar factories, the sugar mills and plantations; all hold out their various appeals and when they fail there is always the Cuban national game, "Jai-Alai" waiting to claim its devotees.

Bilingual Announcements

THE voice of the announcer, Señor Remberto O'Farrill Hernandez, does nothing to mar the picture you conjure up. The musical Spanish tongue sounds even more musical when he uses it and the perfect English either following or preceding it, comes over the air in distinct and pleasant tones.

The announcements of PWX are in both English and Spanish for this Cuban station is heard in both Americas as well as in Cuba and its neighboring islands.

Señor O'Farrill has a natural qualification for this bilingual position. The Hernandez part of his name refers to his Cuban mother and O'Farrill reveals his father's descent and explains,

Overlooking Parque Colon at Havana stand the towers of PWX. The lower portion of the picture shows the type of vegetation for which Havana is noted

perhaps, the laughter which seems to lurk in his voice sometimes.

Built in 1922

PWX is the radio station of the Cuban Telephone Co. of Havana and is affiliated with the International Telephone and Telegraph Corporation of New York. PWX and WKAQ, Porto Rico, were installed at the same time during the summer of 1922 and are twin stations. WKAQ is located on the roof of the Porto Rican Telephone Company and is also affiliated with the International Telephone and Telegraph Company of New York. The only difference is in wave length —Havana is on 400 meters, Porto Rico on 341 meters.

Henry C. Hart, of the Cuban Telephone Company, is the Chief Engineer of PWX. A. Howard Soler is Supervisor. Juan R. Rios is the operating engineer and Ricardo D. Diego his assistant.

Urbano del Castillo finds that his previous newspaper experience is of benefit to him in his present position of Artistic Director of the station.

Band Concerts

THE Cubans are exceedingly fond of band music and PWX gives considerable attention to it, broadcasting the Sunday night concerts from Malecón bandstand as well as the Wednesday night concerts. There is a municipal, an army and a marine band and their open-air concerts are a never-failing popular feature of Havana life.

The people of Cuba are much interested in radio and, according to Government figures of 1925 there are 50,000 sets in use there, about 30,000 of which are home made.

PWX estimates its average daily audience, in Cuba, at 100,000. In the United States it puts it very modestly at 250,000.

Beginning with two broadcasts a week and a few special national holiday concerts it now broadcasts regularly every night except Thursdays. Friday nights a special concert is given by artists from the leading Cuban families. This is called Noche de Moda (Fashion Night) and is revealing some very fine talent.

Many novel means of identifying radio stations have been hit upon but none so popular and so completely unique as the clock used by Havana to keep its wave channel alive during the program interludes

This fashion night has begun the station's campaign to increase the quality and variety of its programs and it is intended to introduce many special features and new artists.

Keeps Growing

THAT PWX is growing in popularity is shown by the fact that during 1925 an average of

(Please turn to page 47)

The Cuban Army band is shown above, with its director Capt. Jose Molina Torres, and assistant director Lieut. Luis Casas Romero. This famous band plays in the stand on the Malecon from where the music is picked up and broadcast by PWX

CORRECT diction, breathing and resonance are some of the fundamentals of a unique course of instruction—voice culture by radio—at KOA, Denver, every Monday night. John C. Wilcox, famous music master, heads the class.

BECAUSE her daylight hours are split three ways by family responsibilities, business cares and club activities, the modern woman is gladly resorting to radio as a first aid in solving her culinary problems. Here is a good picture of Clara Hoover, expert of the Solitaire food laboratories, at Denver, who conducts the cooking features for KOA.

HERE is an action picture of the famous Apollo male quartette who are heard frequently from KYW. Seated at the piano is Lloyd Rowles, baritone; standing left to right are: Omar Covert, first tenor; W. F. Willard, second tenor and A. H. Carpenter, bass.

KATHRYN BROWNE, of the Chicago Civic Opera, who sings on the Federal Master programs, broadcast by KYW from the Edison studio at Chicago.

MARY CORNELIA MALONE, soprano, is one of those who nightly entertains thousands from WSM at Nashville, now the stronghold of "The Solemn Old Judge."

Radio Taste *Seems* to Vary With *the* Hour

George Allen at WOK is Busy Catering to Long Distance Public With Dance Music

WHAT'S "on the air" tonight? Can we get it clearly, is it worth listening to, and does the program run along smoothly without annoying disturbances? These thoughts are uppermost in our minds when we pull the filament switch of a modern radio receiver, and then tune in one of the really high class stations which provide the varied programs. We settle back in our easy chairs and prepare to enjoy ourselves. The one thing which impresses us (if we are of that nature) is the smoothness, and time-tablelike precision with which one feature after another is sent through "Mike."

Let's take a little trip and see how they do it at WOK, the Neutrowound Station of Homewood, Ill., operated by remote control from the Chicago Beach Hotel, Chicago. George W. Allen is director and Chief Announcer of WOK, and under his guidance this station is rapidly becoming one of the best liked stations in America.

Operatic Student

ABOUT a year ago, George was all set to leave for Italy to continue his studies for the operatic stage, but was drawn to radio by the unlimited future that its inevitable progress dictated, and took over the destinies of WOK which was to go on the air July 20, 1925. Station WOK was not long under way until his clear, cheery voice had earned for the station the name of a congenial newcomer and for himself the appellation of "The Announcer with the Smiling Voice."

WOK was soon backing George with a Class "B" license, and government permission to operate on 5000 watts, so his cheery "W—OK" was soon flooding the country from coast to coast. Legitimacy was the watchword of this powerful

GEORGE ALLEN

newcomer, and everything that left its towers, no matter what the class of music, bore the stamp "well done." A large following soon began voicing their approval, by wire, by mail, and by 'phone.

Being intensely interested in making WOK a station of real value to the American public, the young director made an analysis of programs that might serve the best interests and his views may best be summed up in the following paragraphs.

Varies With Hour

AMERICAN taste for music seems to vary with the hour of the day, according to Mr. Allen. During the day, it might be classified as a preference for ballads and music of a semi-classical nature, involving both vocal and instrumental offerings. But when night comes, and Dad is home ready for dinner, we find that music of a more classical nature is desired. Everybody is tired from a day's work, and while it is true people like music with their meals, most of them also enjoy their food and you cannot combine jazz music with mental and digestive processes and get away with it over a period of time. Steak and mashed potatoes taste far better with beautiful soothing stringed music than they do with hot dance numbers. A little later in the evening, after the dishes are done, and everybody is comfortably settled in the living room, there is a desire to be amused, to laugh and forget everything that's happened during the day. So at this time we find the air is full of diversified programs, each with its following of listeners.

As the evening wears on, everybody has laughed and listened to his heart's content, and a little action is not amiss. The rugs are rolled up and sister Nellie demonstrates a few new "Charleston" steps, keeping time with the red hot dance music that's coming in. Or maybe there is a little party on, and everybody gets up and dances a little. In other words, there is a pleasant reaction to the stimulating programs of lighter nature and popular music now filling the air.

SO far, so good. This outline could readily serve as a key to programs that would please the majority of listeners within a radius of a few hun-

dred miles. But a super-power station, reaching from coast to coast, finds itself presenting a program of serious music at the dinner hour at the center of the nation, while at the Atlantic Coast, it is an hour later and people find a diversified program more interesting. At the same time, away out on the Pacific Coast, where the sun is just beginning to sink, the romance of the twilight hour is reflected in the desire for ballads and lighter music. Hence a program pleasing to local listeners might prove less interesting to two-thirds of a station's audience in different sections of the country. To please all, really becomes a difficult problem that studio directors must face. And then again enters the big factor of the type of program that enjoys the best reception at a distance and would prove to be of interest to the distant tuner who only stays with a station for a few moments and then moves on to the next.

Perhaps this national perspective of radiophone broadcasting has not occurred to the average listener who listens to the programs of a local station and sometimes questions the judgment of the operators in presenting a particular quality of program.

The great number of radio stations in America, are serving at the present time as an enormous laboratory for the experiment of the most pleasing programs. WOK is exciting a great deal of interest from all over the country by a plan conceived by George Allen. This plan is an innovation in radio broadcasting and tends to draw aside the curtains of a few years to let us glimpse the probabilities of the future. Allen goes on to say, "I firmly believe that before radiophone broadcasting is much older, stations will be specializing in certain classes of programs to the exclusion of others and will be nationally known and tuned for a certain kind of program. It seems a logical view when analyzing the congested programs that Chicago, the center of radio in the world, pours forth, most of them duplications of each other, and each with its following. In tuning from one station to another, the same kind of program is encountered and one despairs of finding the class of program desired. With a systematized organization in which each station has a particular field, the listener would be served to a real advantage, and radio would become the tremendous educational and recreational factor that it is bound to be in American life, without the hinderance of cluttered and glaring commercialism that takes little cognizance of the value of programs to the listeners, but considers chiefly its own income."

General Studio

Operating and Control Room—Station WOK

Dance Numbers

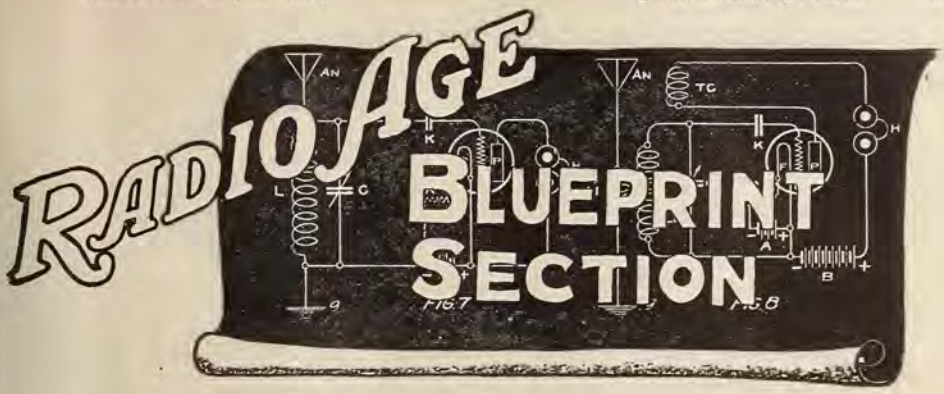
WORKING upon this basis, Director Allen carries on his experiment by presenting from WOK a three and one half hour program of straight dance music from 10 p. m. to 1:30 a. m. Central Standard Time, featuring three of the best dance orchestras which Chicago boasts. These bands are placed upon a fixed schedule, to play at definite times, one after the other, all being controlled from the general studio in the Chicago Beach Hotel, and there is rarely a time a studio selection is called for unless it is to grant some special request. Direct signal communication is carried on by telephone and a system of lights so there is no delay by the orchestras.

These orchestras are situated miles apart and there is no announcer at any place except the orchestra leader himself. When the broadcasting starts at 10 p. m. everybody is checked up to see that all watches are beating in unison. The program for the first orchestra is taken over the phone, announced at the Chicago Beach Hotel Studio, the switches are thrown, the orchestra leader signalled by a flash in his light, and you immediately get dance music, several miles from where you heard the announcement. At the end of each number the orchestra leader announces through his "mike" that you have just listened to his orchestra broadcasting through WOK.

One After Another

IN the meantime, the next orchestra has been called by phone and their numbers lined up. As soon as the first orchestra has finished playing, they are cut off, the second one switched on and you again hear music broadcast several miles from where you heard the first program. And so it goes throughout the entire evening. Smooth, precise control at all

(Please turn to page 61)



Radio Age Develops a

Golden Rule Receiver

Double Regeneration Has Been Utilized Without Radiation

By FRED HILL
(Associate Editor)

FEELING there have been too many six and eight tube sets exploited and that not enough four tube receivers have been given proper attention, the writer has been experimenting for the past three months and is now in position to disclose a circuit arrangement which is believed to contain something more or less novel in its application and an economical, efficient receiver to build.

This receiver is called the Radio Age Golden Rule receiver principally because of the fact it will not radiate except under extraordinary conditions. Operated properly, even with oscillation in the detector circuit, the emission will not reach the antenna. Therefore we believe the name Golden Rule aptly describes the set.

Technically the circuit might legitimately be called the Double Weagant, since it is an elaboration of Weagant's original circuit, although adapted to double functioning of the regenerative portion of the circuit. It lends itself well either to double or triple regeneration, the latter form to be taken up and described in a forthcoming issue of RADIO AGE.

Multiple Regeneration

LANDON (V. D.) of the Westinghouse interests has recently done some experimenting with the multiple regeneration applied to tuned r. f. receivers, but such work we did not find very well adapted to single control, whereas with the double Weagant scheme to be outlined herein we found it possible to get down to single dial wave control for two circuits and single regeneration control for two regenerative circuits. The methods by which this was accomplished are detailed in this article, and presented by steps as taken during the experiments.

At first it appeared a good idea would be to use the anti-regenerative effect originally used by Tuska in the superdyne, and combine it with the regenerative effect of the Weagant circuit. With that end in view the parts listed in another portion of this article were secured and laid out on a breadboard for the sake of simplicity and conservation of time. In the first set the regenerative portion of the first torostyle was reversed, electrically, so when the regenerative condenser was turned, theoretically, there would be no feedback but rather an anti-regenerative effect. In practice it developed this method of having the first r. f. stage anti-regenerative and the detector stage regenerative, added a great deal to the instability of the set, and the anti-regenerative effect did not follow either a step behind or a step ahead of the regenerative effect of the detector plate coil. Consequently we had to abandon that scheme and next decided upon the following:

Connected Alike

BOTH the first and second torostyle plate windings were connected up for regenerative effect. Thus the r. f. stage was regenerative and so was the detector. However the r. f. stage had a tendency to slip into os-

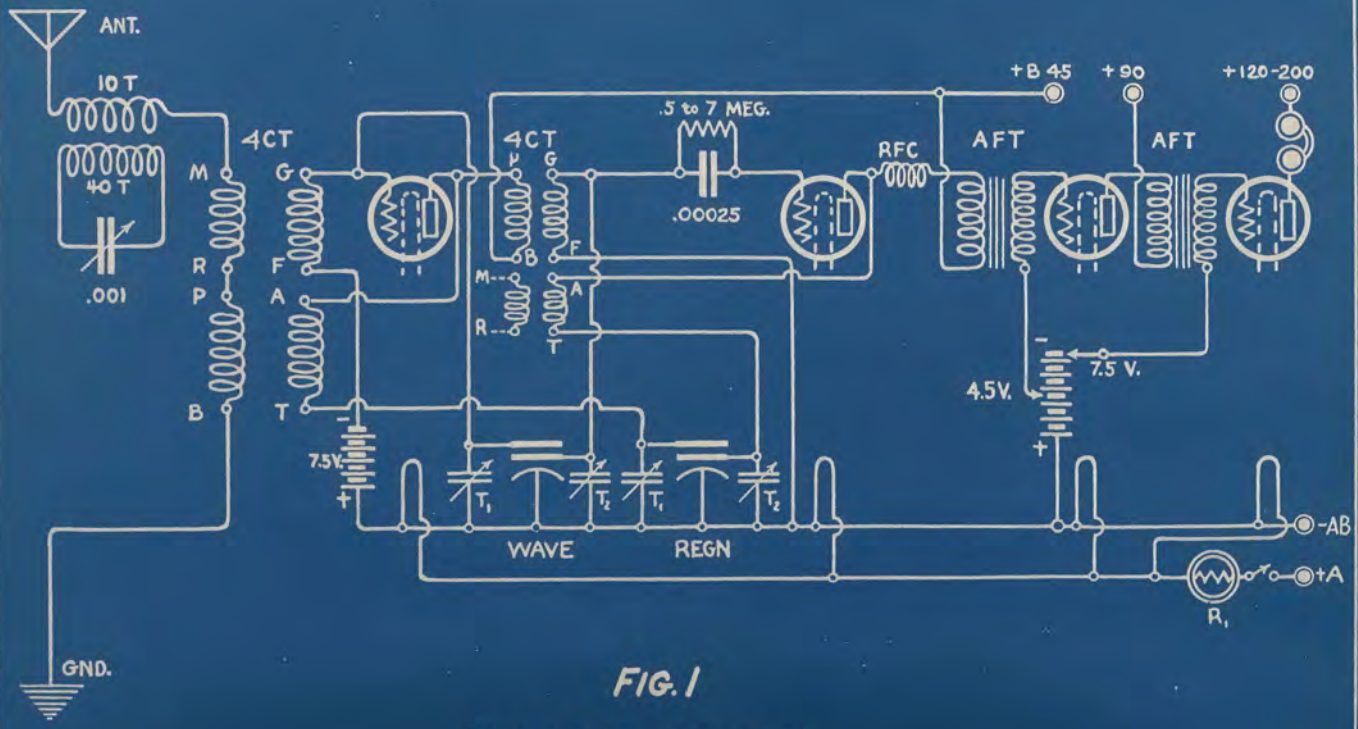


FIG. 1

SCHEMATIC DIAGRAM

RADIO AGE GOLDEN RULE RECEIVER

W.T. GARLAND

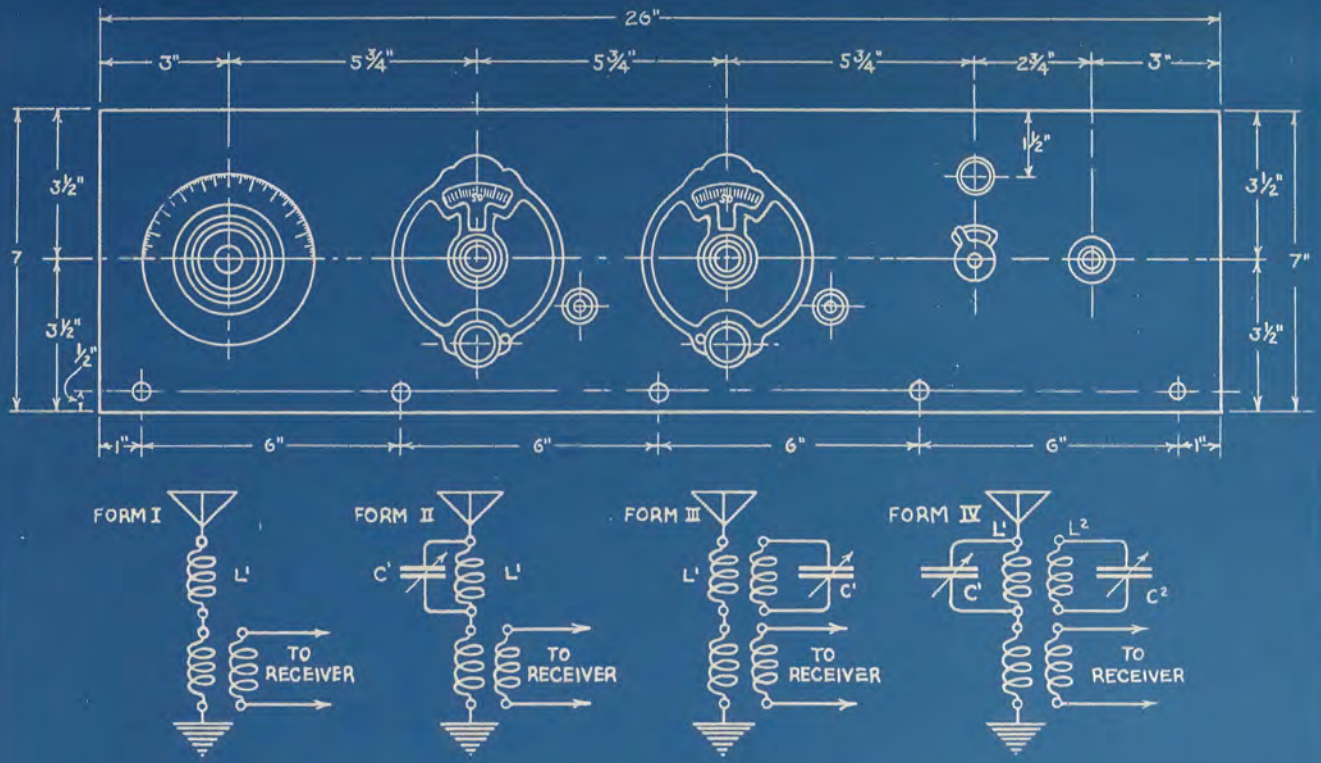


FIG. 2

DIMENSIONED PANEL LAYOUT AND FILTERS

W. T. GARLAND

cillation simultaneously with the detector. By means of the trimmer condensers on the B-T tandems we finally worked out a balance where the capacity of the second unit in the regenerative tandem was in excess of that unit running to the r. f. stage plate coil. This meant in practice that the detector circuit would oscillate (previously having undergone regeneration) a step ahead of the r. f. stage slipping into oscillation.

Thus encouraged we found by further experimenting with grid bias values on the r. f. tube we could add greatly to the stability of the receiver and at the same time cut down further and further the tendency of the set to radiate. In doing this we ran a series of tests of various C battery values on the r. f. tube until we arrived at the point at which we secured maximum amplification with the minimum possibility of radiation.

In Figure 1 the schematic circuit of the receiver is illustrated. It should be consulted by the prospective builder so he can trace the steps of the experimental work which we performed. The schematic is the final circuit, of course, and does not represent previous experiments.

Having tested several tubes to find good r. f. amplifiers and good detectors we placed a 201-A in the first socket for the radio frequency unit and another 201-A in the detector. Inserting a zero to ten milliammeter in series with the plate circuit of the first tube (the r. f. only) we worked out values of C battery voltage. A few steps in this work may be of interest to radio fans.

Grid Bias Values

With zero bias on the grid of the first r. f. tube, and 45 volts on the plate, the reading on the meter was 3 milliamperes for the r. f. tube in normal functioning of the circuit, although with considerable instability as regards regenerative effect of the two circuits. By going to 1.5 volts negative the milliamperes dropped to 2 but with only a slight increase in the stability of the set. When the detector regenerative effect began it threw the detector into oscillation and it required a relatively large capacity change (backing up the condenser) to free the set from oscillator effects. During this process of course the milliamperes in the plate circuit of the first tube increased and radiation took place into the antenna although at a small value.

By running the grid bias successively to 3, 4.5, 6 and 7.5 volts negative we altered our plate readings from 1.5, .9, .5 and finally .2 of a milliampere. At this point the set became well stabilized, the detector circuit functioned extraordinarily well, and regeneration in both circuits was just enough out of step to permit the detector to oscillate first and the r. f. stage to oscillate about 10 degrees further on the scale, corresponding to an increase in capacity over that of the detector section.

LIST OF PARTS

- 2 Bremer Tully tandems, .00035 mfd. each
- 2 Four circuit Bremer Tully torostyles
- 4 Benjamin cushion sockets
- 2 Thordarson 2-1 audio transformers
- 1 Jones base mounting multiplug
- 1 Daven No. 5 ballast resistor and mounting
- 1 Electrad .00025 mfd. grid condenser and clips
- 1 Radio Foundation "no-noise" grid leak
- 1 Samson r. f. choke coil
- 2 National type B vernier dials, clockwise
- 2 Burgess 7.5 volt C batteries
- 1 Yaxley panel light and switch
- 1 Yaxley phone jack
- 1 Aero coil (r. f. coupler type)
- 1 Amsco .001 mfd. variable
- 1 4 inch bakelite dial
- 1 7x26x$\frac{3}{16}$ inch panel
- 1 Baseboard

Positive Biases

JUST for the fun of it we reversed our line of work and used progressively a 1.5, 3, 4.5, 6 and 7.5 positive bias on the r. f. grid with readings, respectively, of 3.7, 4.7, 6, 7 and 8 milliamperes, with a great increase in signal strength but with too much instability for the average set user and with entirely too much plate current consumed in the first r. f. tube. So we went back to our best value in the preceding paragraph, which was 7.5 volts negative applied to the r. f. grid.

Elsewhere in these columns will be found the log of the Golden Rule receiver. The set was purposely not tried on a Monday (silent night) since it was felt it would not be a true test for selectivity. It was tried on successive nights and each night it surprised us with its ability to pick up the distant stations and deliver them to the loud speaker with good volume.

An idea of the operation of the receiver may be gained from the following example. WSMB at New Orleans on 319 meters (940 kilocycles) was picked up on account of the constancy of signals. That station appeared at 33 degrees on the left hand dial (the first vernier in the picture). The second vernier, which controlled the regenerative tandem condenser, was then swung with the following results: From about 25 to 37 degrees regeneration was progressively stronger with an increase in capacity. At about 38 degrees fuzzines began to appear, a forerunner of oscillation, and at 39 degrees the detector slipped into oscillation with an even, soft hiss. No change noted in the milliammeter reading of the first tube. Placing the hand on the antenna post the signal did not waver or warble, an indication that no radiation was taking place. This gentle oscillatory condition of the detector circuit lasted until the dial had been turned to 45 degrees where a slight change in the plate milliampered, an increase from .2 to .3 of a milliampere was noticed. This proved to be the forerunner of the r. f. stage going into oscillation. At 50 degrees the plate current had risen to .5 of a mill and the r. f. tube in full state of oscillation. At 60 degrees the greatest change took place when the plate reading ran up to 4 mills, while at 80 degrees it was 9 mills; these readings showing the first r. f. stage was doing nobly as an oscillator.

Maximum Amplification

HOWEVER in all the journey from the time the detector tube slipped into a gentle oscillatory condition at 39 degrees until we had reached the end of the 100 degree scale no signal came through in its true form since oscillation totally destroys any possibility of undistorted signals. Even the zero beat method of reception in this case proved eminently unsatisfactory.

Maximum amplification, that is, regenerative amplification, was found between the values of 25 to 37 degrees. With these settings WSMB came through on a cone loud speaker quite loud and with pleasurable clarity.

Only when the regenerative condenser was turned beyond 45 degrees did the first tube slip into oscillation. Even then such radiation would not be perceptible but for a very short distance. We could not pick it up on a receiver in a neighbor's house 100 feet away. With the plate voltage of 45 volts and .3 of a mill on the plate the wattage dissipated by the tube alone would be .13 of a watt, input. Allowing about 50 per cent for tube efficiency, radiation would be less than .06 of a watt. The coupling being loose further decreases this amount. The fact that we could not pick up the emitted wave at a distance of 100 feet and the fact that placing of the hand on the antenna post did not change the note of the station, leads us to believe emission was not reaching the antenna. We would like to have the benefit of experience of set builders in making up this particular receiver, which we believe is about the best combination so far designed as far as simplicity of control is concerned and with due regard to the cost of the parts involved.

Selectivity Fine

SELECTIVITY was excellent and volume fine. In the last stage we used a UX 112 with 140 volts on the plate and a 7.5 negative bias. The loud speaker could just barely handle the output of signals at that point, and on many of the locals the set had to be cut down by turning back the regenerative tandem.

As a concession to the many radio fans who live within the shadow of a broadcasting station, we included a wave filter in the circuit so by setting the filter on an offending station you can proceed with your normal tuning without the adjacent local pouring into your ears constantly. The log of the set will give the average reader some idea of the selectivity encountered in normal operation of the set. In actual operation of the receiver there are only two controls: the wave control on the first vernier dial on the left and the regeneration control on the right vernier. The single four-inch bakelite dial on the extreme left is only set for an offending station and left alone. No rheostats are used. While other parts of equal merit may be used in making up this set, those parts shown in the accompanying parts list were actually used and the story of the receiver's performance is based upon their use.

Having disposed of the preliminary details we will go about showing how this receiver may be duplicated by the average radio fan. The schematic circuit is shown in Figure 1. Figure 2 is a front panel view, together with four forms of wave filters, any form of which may be adapted to the receiver. The form actually used in the receiver is shown in the schematic circuit. The top view of the receiv-

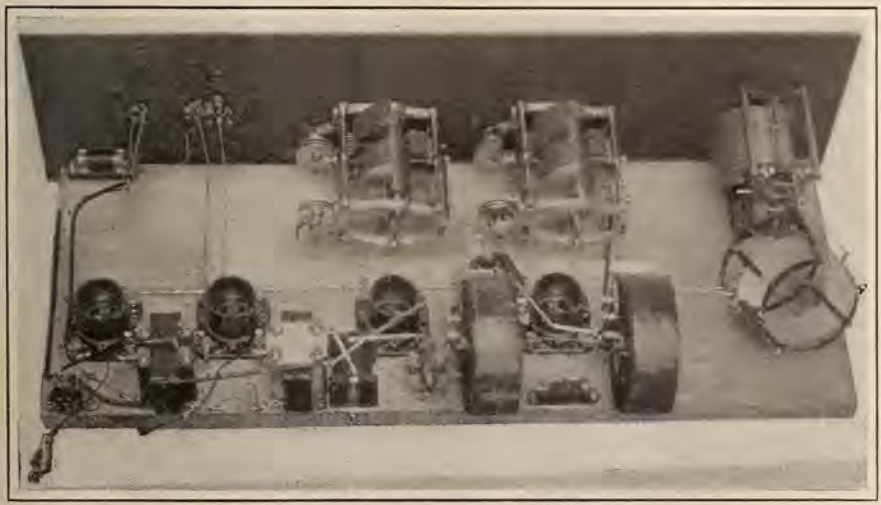


Figure 5. Rear View of the Completed Golden Rule Receiver

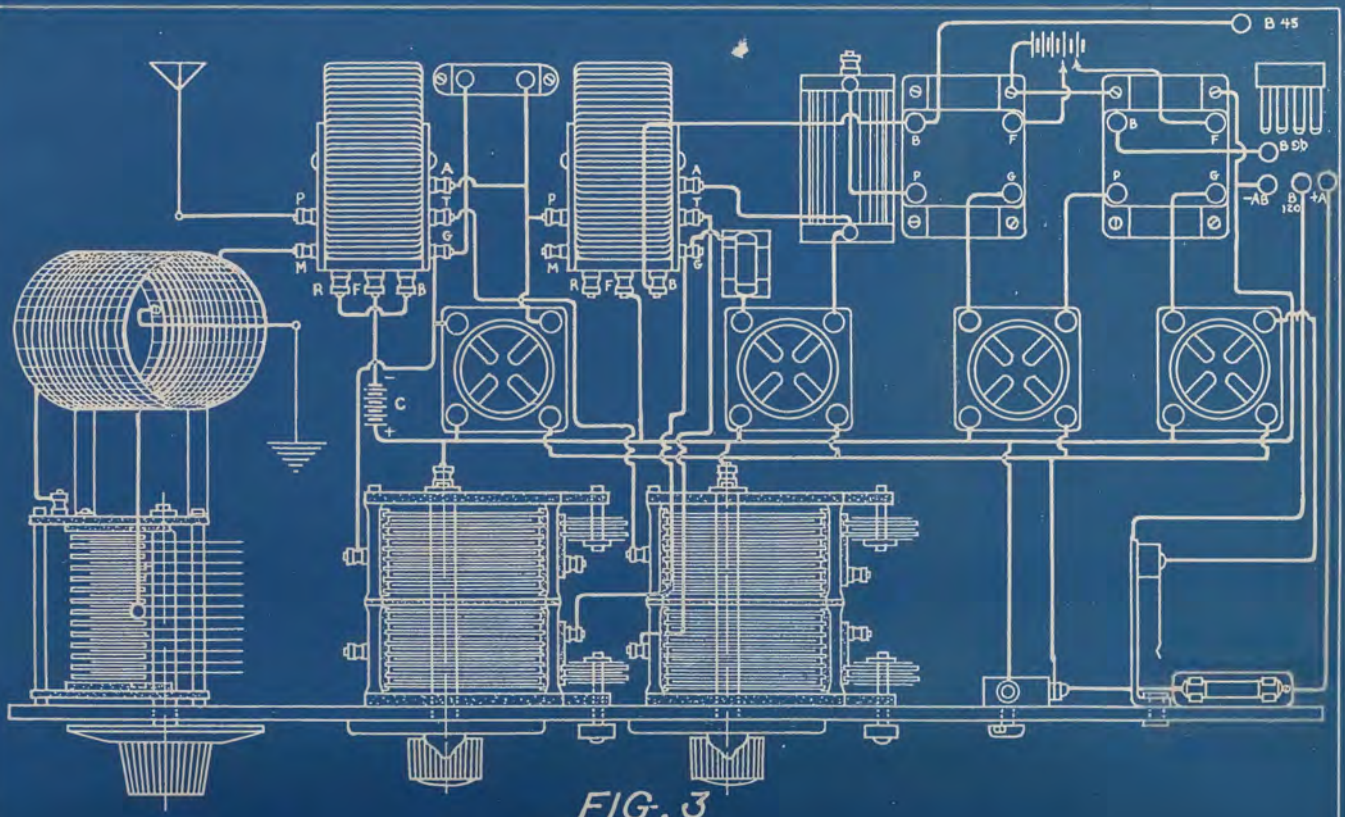


FIG. 3
TOP VIEW
RADIO AGE GOLDEN RULE RECEIVER

W.T. GARLAND

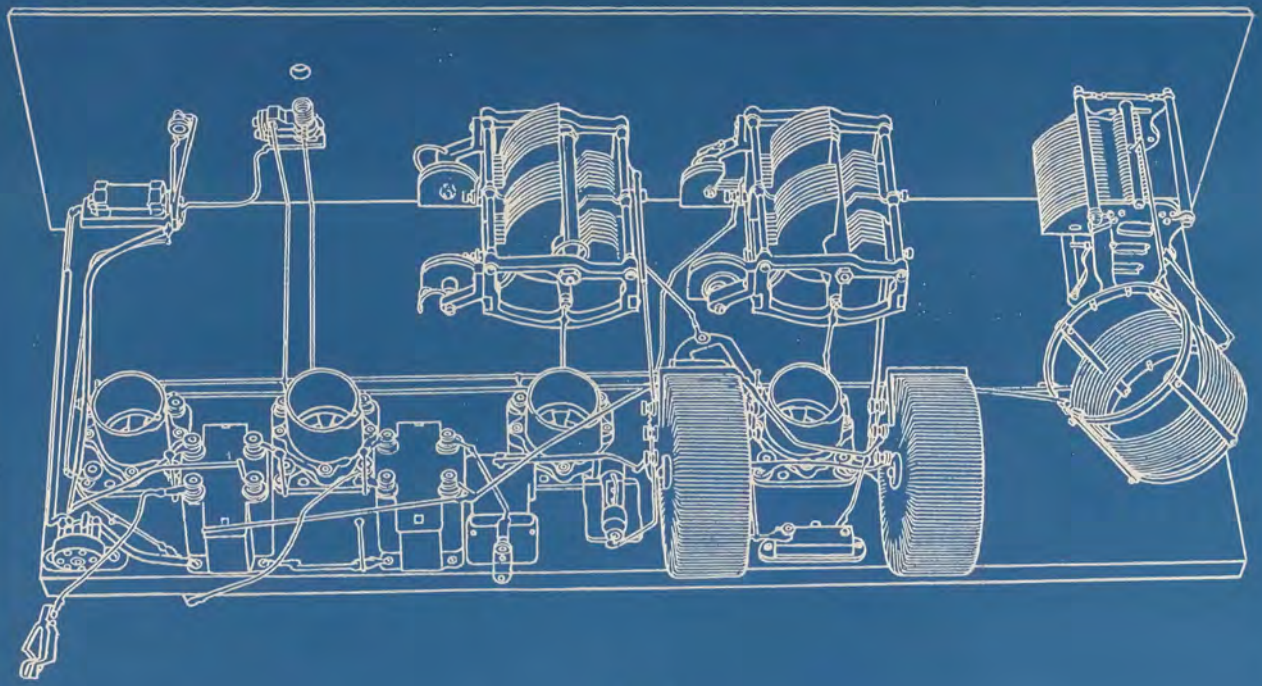


FIG 4
SEMI-ISOMETRIC SKETCH

RADIO AGE, INC.

er is shown in Figure 3 and an isometric sketch of the same is pictured in Figure 4. Figure 5 is a rear panel picture.

The panel size used is a 7 by 26 with all center mounting holes on a line dividing the panel (3½ inches). The left hand condenser is located 3 inches from the left edge of the panel; the first tandem is 5¾ inches to the right; the second tandem 5¾ inches to the right; the panel switch and light is 5¾ inches further to the right; the jack is 2¾ inches to the right of the switch. This is shown in detail in the front panel view illustrated in Figure 2.

Four Circuit Coils

TWO four-circuit Bremer-Tully torostyle coils are used on account of already having a regenerative winding provided. Bremer-Tully tandem condensers were also used on account of the trimmers by means of which the capacity phase of the regenerative tandem could be altered, and also because a trimmer is more or less of a necessity in tuning two circuits simultaneously where individual wiring and other factors might not permit peaking for maximum response.

Four Benjamin cushion sockets are shown mounted, with two Thordarson 2-1 audio transformers. The right hand Thordarson transformer looks slightly different from the first one on account of our having taken off the label. Electrically and otherwise they are the same.

For a r. f. choke we made use of a Samson r. f. choke coil which mounts easily, is rugged and has the helical form of winding which to some extent cuts down the distributed capacity effect of such a winding.

For easy assembly we made use of the Daven No. 5 ballast resistor and mounting, the No. 5 having been decided upon because we intended using a UX-112 in the last stage and this tube draws about twice the filament current the 201-A tubes do. This eliminated the necessity for rheostats and their attendant controls.

Jones' base mounting multi-plug forms the terminus of all of the wiring and permits having a standard cable in the laboratory into which any type of receiver can easily be plugged and tested.

For shutting off the set and also to show when the set is on the Yaxley combination panel light and switch is used, as well as a jack made by the same concern.

LOG

Wave	Station	Dial
206.8	WJBA	12
209.7	WSBC	13
214.2	WCLS	14
225.4	WIBO	15
238.0	WHT	16
241.8	WWAE	17
249.9	WMBB	19
258.5	WPCC	20
265.3	WENR	22
275.1	WSWS	23
277.6	KOIL	24
280.2	KMOX	25
282.8	WSM	26
285.5	WEMC	27
293.9	WEAO	28
296.9	KPRC	29
302.8	WGN	30
309.1	KDKA	31
315.6	WGBS	32
319.0	WSMB	33
322.4	KOA	34
325.9	WSAI	35
329.5	WJAZ	36
336.9	WJAX	37
344.6	WLS	39
352.7	WWJ	42
361.2	WHN	43
365.6	WHB	44
370.2	WEBH	45
374.8	KTHS	46
379.5	WGY	47
384.4	WMBF	48
389.4	WTAM	50
394.5	WOAI	51
399.8	WHT	52
405.2	WOR	53
410.7	PWX	55
416.4	WCCO	57
422.3	WLW	58
428.3	WSB	59
440.9	WOS	63
447.5	WQJ	64
454.3	WJZ	66
461.3	WCAE	67
468.5	KFI	69
475.9	WFAA	71
483.6	WOC	73
491.5	WEAF	75
499.7	WMC	77
526.0	WOAW	85
535.4	KYW	87
545.1	KSD	91

For shutting off the set and also to show when the set is on the Yaxley combination panel light and switch is used, as well as a jack made by the same concern.

No Neutralizer

WHILE in the picture is shown a neutralizing condenser between the two torostyle coils, in the final tests on the set we eliminated the neutralizer since there was no longer a necessity for it. However it would not do any harm to have one around the work shop.

The condenser shown on the wave filter on the extreme left is an Amsco .001 mfd which was purposely used instead of a smaller condenser to give a quicker capacity change with rotation of the dial, and also to cut down the amount of winding required in the inductance portion of the circuit. There are about 40 turns in the inductance unit secondary, which is a cut down Aero-Coil, while the primary is left unchanged. The unit is the regular Aero-Coil r. f. transformer adapted for use as a wave filter.

Wires for the bias battery are shown as flexibles back of the audio transformers. A separate battery was used for biasing the r. f. stage since we did not desire to have the r. f. grid return running all over the baseboard. The r. f. bias is not shown in the pictures but is shown in its proper position in the schematic circuit in Figure 1.

45 Volts on R. F. Stage

IN THE matter of plate potential for the r. f. and detector tube we arbitrarily used 45 volts on both since we desired the two oscillator circuits to act as nearly in step as possible.

The grid condenser is an Electrad .00025 mfd with clips while the grid leak is a variable "no-noise" grid leak made by the Radio Foundation, Inc., and has a range from about a half-megohm to seven megohms.

Dials were of the vernier type, made by the National Company, and known as type B, clockwise, while the single dial on the wave

filter is an ordinary bakelite 4 inch dial. The gear ratio on the first National vernier (at the left) is set for slowest motion on account of wave tuning while the regenerative tandem dial is set for fastest motion on account of desiring the regenerative condenser to act quickly.

A few words concerning the log of the Golden Rule receiver might be of further interest to those building the set and wishing to get maximum efficiency from it.

Channel Separation

LOCALLY WGN, WJAZ, WLS, WEBH, WHT, WQJ and KYW are the stations which seem to have the "fattest" signal on wavelengths near which distant stations may be found. However by proper use of the filter Denver was brought in while WJAZ was broadcasting; WJZ while WQJ was on the air; KSD came through even though KYW was running, although his signal had a slight tendency to modulate KSD's signal; KDKA (when he was decently audible) was not bothered by WGN, and so on through the list of "pet peeves" which the average broadcast listener has accumulated. On the still lower waves the wave filter worked even better and as a result none of the short wave stations were allowed to interfere with reception of a desired station. In some points the Golden Rule receiver will give ten kilocycle separation, while in others it gives twenty kilocycle separation, which is considered pretty good for any receiver in the local area. We should like to hear of results with this receiver from points like New York, Boston, Washington, Philadelphia, Pittsburgh, San Francisco, Los Angeles and other centers where high power broadcasting is carried on.

A final word about the condenser sections. The section next to the panel (of the wave condenser) should go to the r. f. grid. This gives panel trimmer control of the value of inductance in that circuit so it can be matched against that of the detector.

On the regeneration condenser the section next to the panel is connected to the plate coil of the detector so that circuit can also be altered. The section on the inside part of the tandem on the wave control goes to the grid of the detector tube while the inside section of the regenerative control goes to the plate coil of the r. f. tube. This will allow maximum flexibility in making capacity changes.

Symbols

SYMBOLS shown in the schematic circuit, Figure 1, are as follows: 4CT is four circuit tuner, AFT is audio frequency transformer; WAVE is the secondary tuning tandem with T 1 and T 2 being the trimmers on this condenser; T 2 is the trimmer which goes through the panel for front operation; REGN is the regenerative tandem, with T 1 and T 2 being trimmers, and the T 2 being the trimmer which projects onto the front of the panel. Connections from G on the coils and T on the coils should be made exactly as shown in the diagram to secure best results. Windings R and P on the torostyles are tied together, the connection M going into the primary winding of the wave filter, and connection B connected to the ground. The wave filter primary winding has 10 turns while the secondary, which is spanned by a .001 mfd variable, consists of 40 turns, as has been previously explained in the text. The coil connections A on both CT's go to plate, while the connections T go to the stators of the regenerative tandem. RFC is a radio frequency choke coil to keep the r. f. out of the detector plate circuit. The coil shown in dotted lines in the second 4CT with connections M and R is left *unconnected*. In the C bias for the audio stages, the bias on the first audio should be about 4.5 volts while the last stage has a bias of 7.5 volts. The UX-112 works better with a high plate voltage, anything from 150 to 220 volts. The last named voltage is the best of all, but the bias must be increased to about 12 to 14 volts negative.

Further experiments with the biasing of the first tube developed the fact that by progressively increasing the negative bias up to between 13.5 and 15 volts negative the regenerative tandem may be turned all the way in without the first tube slipping into oscillation. Under these conditions the first tube is not radiating even in its own closed circuit as far as we could determine by means of the plate milliammeter, a separate oscillator mounted on the table a few feet away, or any other means at hand.

By getting the first grid biased with the 15 volt value the selectivity of the set is increased tremendously even though at a sacrifice of volume. With decent audibility we found that even with the sacrifice of volume there was still enough to make the ordinary distant stations well audible on the loud speaker. The bias value may be altered by the individual set builder until it reaches a point he deems best for his own needs.

For absolute anti-radiative effects the grid bias on the first tube should be between 13.5 and 15 volts negative. In making these plate reading tests it is advisable to have either a Jewell or Weston zero to ten milliammeter; a handy thing to have in any experimenter's workshop. Another milliammeter reading from zero to one hundred mills is also desirable if the experimenter would like to make accurate measurements on total current consumption of the receiver. Individual tube testing may be done with the small meter, but for the total the larger one should be used.

For the benefit of the experimenter we will state that different r. f. tubes in the first stage of radio will require a different value of bias. For example with the 201-A tube it required 15 volts negative to absolutely prevent radiation, while with a Magnavox quarter ampere tube this value was cut to 7.5 volts negative and radiation stopped.

Another form of the Golden Rule receiver will be described in the July issue of RADIO AGE.

Pick-ups and Hook-ups by our Readers

Conducted by Fred Hill

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

EVEN the Irish are flocking to RADIO AGE as their medium for keeping in touch with events in the radio world as the following letter from Francis Walsh, 6 Harty Place, Lr. Clanbrassil St., Dublin, Ireland, will show:

"I have just secured a copy of your excellent magazine for the first time and after reading it I have fully decided to become a regular reader and I have given the bookseller an order to furnish me a copy every month.

"The magazine is most interesting from start to finish and far before any of the British magazines that I have read. The article on the U. S. Radio History (Naval History) showing the wonderful progress that has been made by the U. S. Naval experts clearly shows that you Americans are the leading lights in the radio world."

Mr. Walsh is studying wireless telegraphy in Dublin and also taking up electrical engineering, and is very fond of experimental work. He sends in a list of radio stations (telegraphic) which he copies regularly as a means of gaining practice in Continental code, these stations ranging from 600 to 1,750 meters. Mr. Walsh is now intent upon making a seven-tube super-het for picking up the American stations. He is now officially welcomed into the ranks of the Dial Twisters and by this time doubtless has received his emblem.

DIAL TWISTERS

Francis Walsh	6 Harty Pl. Lr. Clanbrassil St.	Dublin, Ire.
Wilbur W. Harlan	Woodlawn Ave.	Middletown, Ohio
Miss Marjorie Dougan	925 South St. Andrews Place	Los Angeles, Calif.
A. Nichols	1637 Carrolton Ave.	Los Angeles, Calif.

IN OUR May issue we printed a story by Mr. Humphrey on a method of reactivating tubes which had proved to be duds in previous reactivation processes. As a follow-up to this article the following data is furnished by W. C. White of the Research Laboratory of the General Electric Co. at Schenectady, N. Y., and which may be of interest to readers of this section:

"XL thoriated filaments are deactivated by one of the following causes: high voltage flash; surface contamination and loss of thorium. Tubes which have become deactivated through accidental filament over-voltage may be reactivated by heating the filament at 50 per cent above normal voltage, with the plate and grid disconnected for five to ten minutes. Tubes which have failed of surface contamination must be flashed at high temperature to clear the surface. Tubes which have failed of loss of thorium must be flashed to reduce more thorium from the thoria present in the wire. Then to form the required surface layer the filament must be heated at a normal operating temperature for a considerable time, or a temperature which corresponds to the most rapid diffusion of thorium to the surface for a short time. Conditions for flashing and aging are given herein: Flashing voltage for the UX and UV 199, 10 volts, .11 amperes, for thirty seconds; aging voltage 4.5 volts, for 10 minutes. Flashing voltage for the UX and UV 201-A, 15 volts, .46 amperes, for 1 minute. Aging voltage 7.5 for ten minutes. For the UX 120 the flash voltage is 10, .23 amperes for one minute, whlie the aging voltage is 4.5 volts for ten minutes. Throughout the flashing and aging the plate and grid are left unconnected. Because of the nonlinear scale on an ac voltmeter and the voltage range required, a two scale voltmeter should be provided if the 199 and 201-A tubes are to be reactivated on the same set. The voltmeter should not be disconnected from the filaments after the voltage adjustment has been made on account of the large current drawn by the ac voltmeter. Provision should be made which requires turning off the filament before the tubes are removed from the sockets, if the regulation of the transformer is such that excessive voltage is placed on the last tube when the tubes are removed."

WE HAVE often made the remark that radio is one of the few things in which women do not exhibit the same inquisitiveness as regards the whys of the game, but there are exceptions to all rules—otherwise there wouldn't be any rules. So we are glad to welcome into the family circle Miss Marjorie Dougan, 925 South St., Andrews Place, Los Angeles, Calif., who writes as follows:

"First of all I am a woman, but none the less a fan. I have built two models of the three tube regenerative set according to blueprints in the RADIO AGE Annual." Miss Dougan then lists the parts used and other intimate details of the set, showing her knowledge of the art. We have had several feminine readers of this department who actually make their sets and it does us good to see that building a radio set is not a closed book for the ladies.

A. NICHOLS, 1637 Carrolton Ave., New Orleans, La., found his interest strongly attached to the March issue of RADIO AGE in which Brainard Foote described a battery eliminator, so he made up the set (despite the protests of his friends) and now it is working like a charm. He says the eliminator is so noiseless you have to put your head in the horn to even discern a faint hum.

WILBUR W. HARLAN, Woodlawn Ave., Middletown, Ohio, tells of his experience with a Big Five Logodyne on which he has logged 125 stations, including 6 Canadians, 1 Mexican, 2 Cuban, 1 Porto Rican and 5 Californians. He uses a 100-foot antenna with a 35-foot leadin.

IT IS not often we hear from a Dial Twister after he has secured the emblem which we award on his DX work, but George Haas, Jr., R 1, Box 713, San Gabriel, Calif., came back with this: "I felt just like a kid once again when I received your DT button in the morning mail. I will always have a place for it on my coat."

WARREN E. DANLEY, consulting statistician, 155 North Clark St., Chicago, Ill., has an interesting idea on the tuning of r. f. amplifier primaries to the same frequency as that of the antenna circuit as a means of permitting single dial control of many circuits. He has applied for patents on the r. f. amplification method, some specifications of which we give herewith; in the words of Mr. Danley:

"In the circuit which I have devised, an adjustable condenser, (not variable in the customary sense), is shunted across the primaries of each of the radio frequency transformers which follow the aerial stage, as shown in the diagram. When the set is connected to an aerial, these condensers are adjusted so that the natural frequency of these primary circuits is the same as the natural frequency of the aerial circuit. This is a simple adjustment, correctly made when maximum volume is secured for any station, preferably a distant one of relatively low wave length. With the correct adjustment, there are identical coupled circuit effects in all radio frequency stages, given coils and tuning condensers which are mechanical equivalents. Accordingly there is no need for an auxiliary control of the tuning of the aerial stage, for identical variations of the capacities in shunt with the secondaries of the several transformers will produce identical tuning effects in all stages.

"In an aerial circuit there is, of course, some inductance in addition to that of the primary winding of the first transformer. From the theory of coupling, it follows that, given transformers which are mechanical equivalents, the coupling in the first stage is somewhat looser than that in the following stages. Therefore, theoretically, there should be some way of equalizing the several couplings. Practically, however, the couplings are commonly so loose that there is no necessity for coupling adjustment. In other words, given relatively loose coupling, the tuning of the individual circuits is much more important in determining the frequencies to which the coupled circuits will resonate than the exact degree of coupling.

"The gain in selectivity, suggested above, is appreciable at the higher frequency settings of the tuning control. In the common transformer coupled radio frequency amplifier, the natural frequency of the primary is of such high order that the coupled circuit effects are almost negligible. When the primary is made resonant to a frequency materially nearer the secondary frequency there is a coupled circuit effect.

"My experiments with the circuit have led me to believe that there is a definitely preceptible gain in over-all amplification. Certainly there is no loss. The theory of coupled circuits offers a ready explanation. When two circuits of different natural frequencies are coupled together and excited by oscilla-

(Please turn to page 47)

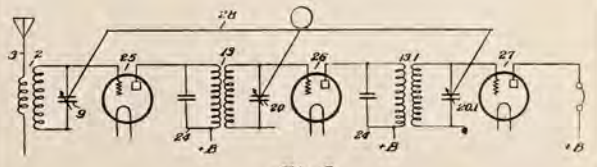


Fig. 2.

Schematic circuit showing Mr. Danley's idea of tuned primaries.

WITH THE MANUFACTURERS

Filtrola is Product of All-American

FOR USE of broadcast listeners located in troublesome spots as regards interference from nearby transmitters, the All-American Radio Corporation has designed a wave filter, called the Filtrola.

It is inductively coupled, having two capacity controls. By proper manipulation interfering stations may be absorbed and eliminated. In operation at the RADIO AGE laboratory the Filtrola performed very satisfactorily and should be a welcome device for the listener who does not care to make his own wave trap. The Filtrola is built into a metal cabinet and is attractive in appearance.

Ferguson Model 10 Uses Resistance Coupling

THREE stages of resistance coupled amplification highly developed for that particular receiver, is found in the new Model Ten receiver marketed by J. B. Ferguson, Inc.

Complete shielding and single control for tuning are two of the features of this set. Calibration of the tuning dial is in meters so the fan has only to consult the papers for a given wavelength and set the dials accordingly. The set will operate with an outdoor antenna, indoor antenna or a balanced loop.

Underground Antenna

A NEW device known as Pitts' Underground Antenna is finding its way into the Eastern market. Several thousand of these are in use in California where static and power noises are very serious. The circulars describing the device are very interesting. Ernest Walker Sawyer, factory representative at 1915 Sante Fe Ave., Los Angeles, handles the Pitts'.

Jefferson Puts Out New Audio Model

Typifying the general tendency on the part of fans to use audio transformers with straight line characteristics over a fairly wide frequency range, the Jefferson Electric Mfg. Co., has placed on the market a type AL, 2 to 1 audio transformer which is completely sealed and exceptionally useful in connection with the power tubes now in use in many sets.

The new transformer is shown in the illustration above. It has practically a straight line curve down to 30 cycles and up to 10,000 cycles, the former for the low notes and the latter for the high notes. The sealed effect thus makes the transformer imperious to outside influences.

Daven Publishes New Resistor Manual

WE have just received a copy of the new edition of the Resistor Manual, published by the Daven Radio Corporation, one of the most authentic publications on the subject of resistance coupled amplification. It clearly explains resistance coupling, what and why it is, and gives many photographs and wiring diagrams showing how resistance coupling can be added to present sets.

It also gives complete construction data for building many standard circuits, including the Daven bass note circuit arrangement.

Interesting Manual for CR-18 Receiver

AN INTERESTING manual for users of the Grebe CR-18 receiver (designed for the lower wave bands) has been issued by the A. H. Grebe and Co., Inc.

Included in the instruction book is a time chart showing time in different sections of the world; a list of short wave commercial and experimental stations and the list of frequency assignments for short wave work. The range of the receiver is variable, running from 10 to 200 meters by means of plug-in inductances.

Resistor Coupling

ILLUSTRATED above is a new coupling unit, manufactured by the Amsco Products, Inc., for use in resistive coupled audio frequency amplifiers. It departs from the conventional design in the arrangement of the binding posts which are so placed that the "couplers" are lined up before the sockets, rather than between them. Connections are made to the grid and plate posts of the sockets by soldering directly lug to lug, no leads being necessary. In addition to the constructional advantage, this arrangement results in the compactness not otherwise possible, cutting three inches from the average panel.

A coupling condenser of the optimum value is molded into the bakelite base. Massive prongs clip the resistors, of the same manufacture, into a permanent mechanical and electrical contact.

Radio Forecast By Century Old Writers

THOUGH radio broadcasting is scarcely four years old from a practical viewpoint, yet its invention was forecast by scientists centuries ago, according to Edwin S. Pridham, chief engineer of the Magnavox Company.

In a recent speech Mr. Pridham quoted Sir Francis Bacon, writing in "The New Atlantis" some 300 years ago, in which the great English philosopher said: "We represent small sounds as great and deep, likewise great sounds extenuate and sharp . . . We have certain helps which set to the ear to further the hearing greatly. We also have divers strange and artificial echoes reflecting the voice many times, and as if it were tossing it; and some that give back the voice louder than it came, some shriller, and some deeper." This clearly forecast the Magnavox loudspeaker which existed before popular radio, magnifying the voice so that in 1919 the late President Wilson could make himself plainly heard by 45,000 people in the San Diego stadium. This was the first time a President of the United States ever used a public address system.

IN 1888, Edward Bellamy published his famous novel, "Looking Backward," which forecast that in the period A. D. 2000, we should hear music, the human voice or other sound magnified to any desired volume. The Magnavox antedated this prophecy by nearly a century. In 1899, H. G. Wells wrote "When the Sleeper Awakes," foreseeing a "General Intelligence Machine" by which a speaker would address himself to unseen multitudes. Wireless telegraphy was then a fact, but not wireless telephony. A decade later Mr. Pridham and his future partner, Peter L. Jensen who had been working on wireless problems with Dr. Valdemar Poulsen of Copenhagen and a radio pioneer, were both experimenting with wireless and telephone improvements in the course of which they invented the Magnavox, a device for amplifying sound afterwards developed into the Magnavox loudspeaker.

The first Magnavox was mounted on the chimney of their factory in Napa, in 1915, and greatly mystified the inhabitants of that little California City, who heard the "Great Voice" (which is what magnavox means) for the first time. Spoken messages and phonograph music were heard all over the town, yet none could locate the origin of the sound.

New Double Range Voltmeter for Radio Work

A DIRECT-CURRENT voltmeter, a portable instrument designed especially for use with radio receiving sets and known as type DO-3, shown above, has been introduced by the General Electric Company. The instrument has a double scale, 0-7.5 and 0-150 volts, which combinations are most suited for measuring filament and plate voltages ("A" and "B" batteries).

This instrument may be mounted on a panel if desired, but will probably be more useful as a portable instrument. It operates on the D'Arsonval principle, is of unusually rugged construction, and is accurate to a high degree.

The resistance of the 7.5-volt circuit is approximately 500 ohms, and of the 150-volt circuit 10,000 ohms, or 66 ohms per volt. Consequently the drain on either "A" or "B" batteries is negligible. Each instrument is supplied with a set of 18-inch leads with terminals.

New Theory is Advanced

(Continued from page 12)

ing current and immediately there is noticeable a low-pitched, monotonous roar, which is called by the sages of the science a "sixty cycle hum." An interruption has occurred at a rate of sixty times per second and the interruption has registered on the ear as a hum.

It is not difficult to comprehend how this phenomenon may be reproduced by other methods. A current of air, interrupted sixty times in a second, would come to the ear with a hum pitched quite like that of the house-lighting current. There might be some difference in quality and timbre due to overtones but basically the two would be the same.

And so, holds the new theory of static and fading, it is possible to produce the effects of static by imposing upon a carrier wave interruptions of a frequency corresponding to that of the crashes which science has identified for want of better explanation as electrical discharge in the atmosphere.

Automatic Records

AUTOMATIC records of the occurrence of fading in the recent tests show that this diminuation of a signal does not appear as the ears report it, gradually and leisurely. True, when fading occurs sufficiently to make reception bad it is usually noticeable in precisely that fashion. The signal falls away so gradually that one might think to plot its action with a straight line.

As a matter of fact, recording galvanometers, much more sensitive than ears, show that a signal may fall from maximum to almost zero amplitude many times a second. Coming back instantly to maximum amplitude, this radio fading is not detected as much. The signal goes on as it has been going on.

BUT IT seems reasonable to suppose that if this fall from maximum to zero has occurred sixty times in a second we have once more approximated the condition so readily observable in the sixty-cycle current.

Havana—By the Clock!

(Continued from page 29)

100 letters and post cards was received every week. These came from all over North and South America as well as places in Europe. In January of this year the average had increased to 250. On February 1st, following the International Radio Tests, the mail for one day jumped to 941 letters and cards.

PWX co-operates, free of charge, with the Government in the dissemination of knowledge tending to add to the advancement of Cuba and its industries.

Talks were given during 1925 in Spanish and English about a dozen times a month on such subjects as tourist travel, agriculture, the cane industry, sports, commerce and exhibitions of various kinds.

They have proved so valuable that they are now to be heard four times a week, on an average, during the present year.

There is an art which can make this sort of feature absorbingly interesting and PWX seems to be an able practitioner of it. The health talk by Dr. Lopez del Valle being a case in point.

Once a week some well-known person such as a Cabinet Secretary or a Director of a National Institution will speak on his own special subject.

Mondays there is a series of talks called "Radio for Radio Fans" given in Spanish and English which is unique and much approved of by the people for whom it is intended.

National Flavor

So much for the purely instructive. On the entertainment side there is plenty of dance music, much of it with a distinctive national flavor, such music as conjures up visions of brilliant shawls, high red heels, the jingle of spurs and flashing dark eyes beneath the mantillas; gorgeous flowers and a life as romantic and dreamlike as some fabulous story.

When Carlos Fernandez sits down at the piano in the studio of PWX you can settle back for a treat. When Valero Vallve draws a bow across the strings of a violin and Antonio Plana's baritone mingles with that of Alberto Marquez—or Nena Plana chimes in with her fine contralto—PWX is sending its best out upon the ether.

North, south, east, west the music flows, the great civilizer of life. The friend, the companion, the ambassador of good will and the universal brotherhood of man.

PWX, out there in the blue seas, is sending us Cuba's message and whether it be song or speech or the ticking of the clock on the microphone between numbers it is always the same message of friendship and good cheer.

Pickups and Hookups

(Continued from page 43)

up in both these circuits. Ordinarily, in the aerial stage, where the available energy is least, the energy which sets up and sustains the oscillations of the higher frequency is lost, for neither the plate circuit of the first tube nor the grid circuit of the following tube is resonant to this frequency. On the other hand, the circuit described should, theoretically, amplify all the energy originally available.

"A test of the circuit does not require a single control set up. In fact, a test run on a radio frequency amplifier built of matched individual condensers and matched coils will yield the best possible demonstration of the truth of my claim that the several stages can be made to tune exactly alike throughout the range of the receiver. In general, capacities substantially equal to the capacity of the aerial used are required for tuning the primaries. To compensate for stray and different tube capacities, it may be necessary to make some provision for shunting small fixed capacities across the secondary tuning condensers.

"I have tried the circuit with aerials of widely different capacities and in no case were results disappointing. Of course it was always necessary to avoid the use of any stabilizing method capable of an appreciable tuning effect."

Use the Log-a-Wave Chart
Page 64

Simple Crystal Set for the Newcomer in Radio

(Continued from page 11)

wound on a tube 4 inches long; 3 inches outside diameter and 2⅞ inches inside. In winding the coil, twists should be made in each turn from which leads are made, so as to make soldering connections easy. This coil is tapped at zero and on each of the first ten turns, also at 18, 26, 34, 42, 50, 58, 66, 74, 82 and 90 turns, or every eight turns. The leads from the first ten taps go to the first ten-point switch, and the remaining ten leads to the second switch. The two tap switches should be placed approximately three inches apart on the panel.

The secondary coil consists of 60 turns of No. 24 B. & S. gauge DCC copper wire, wound on a tube 3 inches long, and of 2¾ inches outside diameter, so it will slide into the first tube.

The condenser specified is a variable one, of the straight-line frequency type, having a capacity of .0005 microfarads, and consisting of 21 plates.

Tuning of the primary circuit is accomplished by varying the two ten-point switches. One of these switches varies one end of the coil ten turns at a time, while the other switch varies the other end of the coil a single turn at a time.

The coupling between the primary and secondary circuits is accomplished by sliding the secondary coil towards or away from the primary. Coupling adjustments have a very important effect on the operation of the receiver.

Tuning of the secondary circuit is accomplished by turning the knob of the "straight line frequency," variable condenser.

The crystal is mounted on a panel near the secondary tuning dial, where it is easily accessible for adjustment. The proper adjustment of the crystal is most important, as the intensity of the received signal may be reduced to almost nothing if the crystal is in poor adjustment.

(An excellent crystal detector is the carborundum unit manufactured by the Carborundum Co. of America, which has a fixed adjustment, the sensitivity being controlled by a potentiometer. It is shown pictorially on page 11.—Editor.)

Condensers and Inductances Were First B-T Products

(Continued from page 5)

engineer, John C. Tully, particularly, seems to have had a very much different experience in the business world than most technical men whose horizon is narrowed to this particular field or some small part of it. He seems in fact to have deliberately devoted a considerable period of his life to gathering experience, rather than specializing in any one department, even though it meant financial sacrifice to do so. For example, while acting as credit manager for an electrical manufacturer and jobber, he organized a trade association in the automotive equipment field and while serving as president of the same was offered a position with a financial agency at double the salary he was receiving. He states at that time he was more interested in experience than salary and very shortly thereafter was transferred from management of credit and accounting to the position of general superintendent in charge of stocks, purchasing traffic, etc.

HAVING been a newspaper reporter, advertising manager, professor of college mathematics, a real estate sales manager, and assistant bank cashier (some of which positions were held prior to entering engineering school), it has to be something decidedly new or unusual if he has not come in contact with it in one way or another in his past experience. In spite of the manifold duties of radio manufacturing, he finds time to serve as vice-president of a National bank, director of a first mortgage company, director of the Radio Manufacturers Association, secretary and treasurer of a Bakelite moulding plant, executive committee member of the Electrical Credit Association and a member of various committees of the Associated Manufacturers of Electrical Supplies.

AT THE time Mr. Tully became acquainted with Mr. Bremer, he was at work on the development of a domestic oil burner, another industry which in recent years has shown wonderful development. Mr. Bremer was engaged principally in the manufacture of the Bremer V-tube radiators used by some thirty leading manufacturers of trucks, tractors and gasoline locomotives. Their first job together was in the development of a semi-automatic machine for "tinning" auto radiator tubes, overflow pipes, etc. Business was ready and waiting for any one who could build such a machine, which has since entirely replaced hand labor in this line. As in the radio business, a number of these products were such as to require not only development of the product itself but of the machine to make the product and their experience in these and other manufacturing jobs has contributed largely to the success of B-T radio manufacture where many jobs had to be undertaken which to be successful required complicated machinery. This concern has always built practically all of its own machines. In fact, at different times when behind in production and more equipment was desired, particularly in the winding of coils, it was well known about town that this concern was trying unsuccessfully to find some one who could supply them with additional copies of machines from their own models that had been built up and were in operation.

ONE of the illustrations shows a few of the machines for winding the interior primary of the torostyle transformer. These machines are semi-automatic and appear very simple but the product must pass such severe inspection tests that extremely accurate work must be accomplished and at the same time a reasonable output be maintained. These machines as well as others employed in winding the secondary and other parts of the torostyle transformer were developed entirely by Mr. Bremer—it being probably somewhat unusual in radio—where the same man invented the circuit, designed and patented the coils to be used therein and designed and built the machinery for making the coils.

Use the Log-a-Wave Chart on page 64

Neutrodyne Owners May Improve their Receiver

(Continued from page 10)

battery current passing to the radio frequency amplifier tubes.

Secret at Sensitive Point

CARE should be taken to use the resistance control in such a way as to keep the set at the point of maximum sensitivity. If the circuit does not oscillate enough to make this possible, turns should be added to the primaries of the radio frequency transformer coils, adding one turn at a time until the desired results are attained.

The modified receiver will use less "B" battery current than before, particularly at the shorter wavelengths, and "B" batteries, therefore, will last much longer. By far the greatest advantage, however, is the fact that the receiver is rendered more sensitive and selective on the short waves where congestion exists, as tuning will be sharper in the associated circuits. Undesired signals are more readily excluded. The variable resistance, furthermore, provides an excellent volume control, and since oscillation can be adjusted so smoothly and accurately, there will be a noticeable improvement in the tone quality.

Have Work Shop For Radio Fans

AS A MATTER of fact, it is very easy to build a radio receiving set of any kind—declares a large radio supply company in Seattle—and when you are through guarantee it will work.

To prove this theory the retail firm leased additional floor space and built therein workbenches and bought tools. In their daily advertising they featured the school-shop, as it was named. Here any one might learn free of charge to build any set in mind, with competent radio instructors to show exactly what and how to do.

The work room provided enough space for thirty workers and in a few weeks this space was filled each night for a three-hour period. The results were beneficial to the radio fans.

Eliminating the Radio A's, B's and C's

(Continued from page 18)

tain gas, instead of being exhausted to the highest obtainable degree of vacuum. Some are half-wave rectifiers, utilizing only that part of the alternating current going in one direction, and others are full-wave rectifiers.

The filters employed in battery substitutes are made up of choke coils and condensers. It seems to be more difficult to secure satisfactory filtration than it is to obtain satisfactory rectification. The relation of selling price to sales is such that manufacturers cannot always afford to put into their battery substitutes the number and quality of condensers and coils that will ensure the best results. In compromising between cost and quality, a substitute may be produced that is satisfactory under some conditions but that fails to meet other conditions. A battery substitute may work well with one type of receiver and give bad results with another. A trial of the battery substitute with the purchaser's own receiver is the best safeguard against disappointment.

Radio World's Fair Sept. 13-18

U. J. HERRMANN, managing director of the Radio World's Fair, which will be held in New Madison Square Garden Sept. 13-18, 1926, has sent the following telegram to RADIO AGE in response to reports there will be no radio exposition under his management in New York City next year:

"No truth in statement that this is our last New York Show. We will run in 1927 and give our radio friends of the past, present, and future the best money can buy."

This is the response to the statement issued by the newly formed Radio Exhibition Corporation, handling the radio show which will be held in New York simultaneously this year with the Radio World's Fair, that only one exhibition would be held in New York City next fall and indicating that their show would be that one.

NO CHAOS TO RESULT FROM WAVE PIRATING

Hoover Seems to Take Extremist View of Situation

THERE is no cause for alarm in the radio industry and the ranks of the listeners over the recent court case in which the Zenith organization was given a favorable verdict in the suit which the government, through the Department of Commerce, brought against that company. Station WJAZ was charged with operating on a wavelength not authorized by the Department of Commerce.

This is the consensus among leaders in the radio industry and others. The view taken by Secretary Hoover that the winning of the case by the Zenith people would result in chaos and the junking of $600,000,000 worth of radio sets, is declared to be entirely out of proportion to the probable consequences of the case.

Secretary Hoover's idea appears to urge congress to pass legislation on which the regulation of the radio broadcasting may be placed in the hands of one cabinet official, himself. There is some opposition to vesting so much power in one individual.

CONGRESSMAN Fred A. Britten, Illinois, chairman of the committee on aeronautics of the committee on naval affairs said:

"I believe it has been clearly demonstrated that regulation of radio by one individual is not only undesirable but un-American in principle. I do not believe that Congress will become unduly excited, nor that the Senate will hastily pass legislation which will perpetuate Hoover as the czar of the air."

IRVING HERRIOT, attorney for Zenith, said:

"Recent Department of Commerce statements have caused misapprehension in the public mind. The law of 1912 is still intact. The decision was not to attack the validity of that law, but merely a provision of the regulations of the Department under which Zenith was prevented from broadcasting as it desired when one of these same regulations states that any person engaged in bona fide commercial communication or *in experimentation in connection with the manufacture and sale of radio apparatus for commercial purposes may use any wavelength up to six hundred meters*, and likewise provides that no person not engaged in either of these particular classes of business may use a wave length in excess of two hundred meters without special authority granted by the Secretary of Commerce. Mr. McDonald and Zenith Radio have always been heartily in favor of legislation to regulate radio. Their only point of difference with the Department is that they advocate vesting the authority in an independent commission not controlled nor appointed by the Secretary of Commerce, nor subject to the domination of any officer of the government."

Since the law of 1912 is not invalidated by the recent decision, but rather its provisions affirmed, the only classes of stations which could take a wavelength in excess of 200 meters would be either a company engaged in radio communication or else an organization manufacturing and experimenting with radio apparatus.

Hence part of this provision would be only open to a radio manufacturer. There are not enough manufacturers who are desirous of broadcasting and as a result there is no need for fear on the part of either the industry or the public.

"THERE never has been," said Mr. E. F. McDonald, Jr., President of the Zenith Radio Corporation, "nor is there now, any question in the minds of thinking people as to whether or not Federal control of radio shall continue. It is merely a question of what department or commission of the government that control should be vested in."

WGY'S Super Power Set is Held Constant by Crystal Quartz

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and the signal strength is slightly greater. These distances vary slightly with the power of the transmitter. Rapid fading is not often observed, however, and in this respect the regular broadcast waves seem to be different from the short waves. The reports indicate that the rate of fading increases steadily as the wavelength grows shorter.

The main objective of the investigation in cooperation with widely scattered, volunteer assistants, is an answer to the question—what is the relation between weather and radio reception, or do weather conditions influence radio? Variations of signal strength, static and fading are all bugaboos of the listeners and an effort is being made to relate these irregularities to changes in barometric pressure and temperature. If definite relationships between radio reception and weather conditions can be established, it will be possible to predict receiving conditions in any part of the country as reliably as it is now possible to forecast weather conditions.

Thus far investigations by General Electric engineers indicate that the connection between barometric pressure and temperature with radio conditions is not definite, or if it is definite, that it is so complex that it is not yet understood. Temperature seems to have no effect on the signals themselves, although it is known that in summer there is an increase in static. The study so far shows that the barometer makes little difference when both transmitter and receiver are at the same pressure. When transmission is from a high to a low area transmission is best at short and at long distances, but at medium distances of about 600 miles it is best from an area of low pressure to an area of high pressure. The phenomena is apparently related to the distribution of storm areas over the country and requires a great deal more study.

Elements of Radio Communication

ELLERY W. STONE, Lieutenant Commander (U. S. N. R.), who is well known as a writer on radio engineering, has completed a new third edition of his "Elements of Radio Communication for the engineer, amateur, student and laymen. It is published by D. Van Nostrand Co., New York and discusses the theory and practice of radio in easily understandable terms.

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	East Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDYL	Newhouse Hotel	Salt Lake City, Utah	246
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. K. Azbill	San Diego, Calif.	216
KFBK	Kimball-Upson Co.	Sacramento, Calif.	248
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	Bishop N. S. Thomas	Laramie, Wyo.	270
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFDD	St. Michaels Cathedral	Boise, Idaho	278
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	250
KFDY	South Dakota State College	Brookings, S. D.	273
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank Co.	Portland, Ore.	248
KFEL	Winner Radio Corp.	Denver, Colo.	254
KFEQ	J. L. Scroggin	Oak, Neb.	268
KFEY	Bunker Hill & Sullivan Min. & Con. Co.	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	242
KFGQ	Crary Hardware Co.	Boone, Iowa	226
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colo.	Gunnison, Colo.	252
KFHL	Penn. College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	468
KFIF	Benson Polytechnic Institute	Portland, Ore.	248
KFIO	North Central High School	Spokane, Wash.	265
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Daily Commonwealth	Fond du Lac, Wis.	273
KFJB	Marshall Electrical Co.	Marshalltown, Iowa	248
KFJC	R. B. Fegan (Episcopal Church)	Junction City, Kans.	219
KFJF	National Radio Manf. Co.	Oklahoma City, Okla.	261
KFJI	Liberty Theatre (E. E. Marsh)	Astoria, Ore.	246
KFJM	University of North Dakota	Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son	Portland, Ore.	263
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	S. W. Baptist Theological Seminary	Ft. Worth, Tex.	254
KFKA	Colo. State Teachers College	Greeley, Colo.	273
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
KFKZ	F. M. Henry	Kirkville, Mo.	226
KFLR	University of New Mexico	Albuquerque, N. M.	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelical Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFLZ	Atlantic Automobile Co.	Anita, Ia.	273
KFMR	Morningside College	Sioux City, Iowa	261
KFMW	M. G. Sateren	Houghton, Mich.	263
KFMX	Carleton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	263
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	Chamber of Commerce	Burlingame, Calif.	226
KFON	Echophone Radio Shop	Long Beach, Calif.	233
KFOO	Latter Day Saints' University	Salt Lake City, Utah	236
KFOR	David City Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Board of Education, Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul. Minn.	252
KFPL	C. C. Baxter	Dublin, Texas.	252
KFPM	The New Furniture Co.	Greenville, Texas.	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Calif.	231
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	266
KFQA	The Principia	St. Louis, Mo.	261
KFQB	The Searchlight Publishing Co.	Fort Worth. Texas	263
KFQD	Chovin Supply Co.	Anchorage, Alaska	227
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. Riker	Holy City, Calif.	217
KFQW	C. F. Knierim	North Bend, Wash.	216
KFQZ	Taft Products Co.	Hollywood, Calif.	225
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	City of Paris Dry Goods Co.	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFRW	United Churches of Olympia	Olympia, Wash.	219
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros. Music Co.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	239
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver ,Colo.	234
KFUR	Peery Bldg. Co.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	261
KFUU	Colburn Radio Labs.	San Leandro, Calif.	220
KFVD	McWhinnie Electric Co.	San Pedro, Calif.	205
KFVE	Film Corporation of America	St. Louis, Mo.	240
KFVG	First M. E. Church	Independence, Kans.	236
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Fairmont, Minn.	227
KFVS	Hirsch Battery and Radio Co.	Cape Girardeau, Mo.	224
KFVW	Airfan Radio Corp.	San Diego, Calif.	246
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWA	Browning Bros. Co.	Ogden, Utah.	261
KFWB	Warner Bros.	Hollywood, Calif.	252
KFWC	L. E. Wall	San Bernardino, Calif.	211
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Chico, Calif.	254
KFWI	Radio Entertainments, Inc.	South San Franciso, Calif.	226
KFWM	Oakland Educational Society	Oakland, Calif.	207
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	Wilbur Jerman	Portland, Oreg.	213
KFXB	Bertram O. Heller	Big Bear Lake, Calif.	203
KFXD	Service Radio Co.	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Colorado Springs, Colo.	250
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	Mt. States Radio Dist. Inc. (Portable Station)	Denver, Colo.	216
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Mary M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	205
KFYJ	Chronicle Publishing Co.	Houston, Texas	238
KFYO	Buchanan-Vaughan Co.	Texarkana, Tex.	210
KFYR	Hoskens-Meyers, Inc.	Bismarck, N. Dak.	248
KGO	General Electric Co.	Oakland, Calif.	361
KGTT	Glad Tidings Tabernacle	San Francisco, Calif.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii.	270
KGW	Portland Morning Oregonian	Portland, Oreg.	491
KGY	St. Martins College	Lacy, Wash.	246
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Seattle, Wash.	394
KJBS	J. Brunton & Sons	San Francisco, Calif.	220
KJR	Northwest Radio Service Co.	Seattle, Wash.	384
KLDS	Reorganized Church	Independence, Mo.	441
KLS	Warner Brothers Radio Supplies Co.	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	266
KMA	May Seed & Nursery Co.	Shenandoah, Iowa	252
KMJ	Fresno Bee	Fresno, Calif.	234
KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KMOX	Voice of St. Louis	St. Louis, Mo.	280
KMTR	Turner Radio Corp.	Los Angeles, Calif.	238
KNRC	C. B. Juneau	Los Angeles, Calif.	208
KNX	Los Angeles Evening Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322

Radio Communication on Short Waves

(Continued from page 20)

reliable with such power, but nevertheless, a number of messages have been thus exhanged.

One result of the short wave development has been the eager entry of amateurs in almost every country of the world into the transmitting game. This brings its troubles and makes necessary very careful government supervision to prevent trespass upon bands allotted to the government and commercial activities. On the other hand, however, this has given the radio art a tremendous advance and it has permitted the forming of almost countless international acquaintances. It is not at all uncommon these days to listen in on conversations between South Africa and New Zealand, or between Great Britain or America, or between France and South America. I have known an American amateur to communicate with amateurs of three or four different nationalities in one evening.

I do not need to tell you that all this is bringing the world closer together and helps people who are geographically far apart to understand each other better, which is one of the best ways to reduce the chance of armed conflicts in the future.

Another very interesting thing has come out of the short wave development, and that is that it is entirely possible to receive a radio signal on short waves over greater distance than one-half around the world. Knowing the properties of these waves, we can definitely say, if Johannesburg, South Africa, hears one of our West Coast stations at a time of the day when there is nine hours of daylight between that station and Johannesburg, that a 40-meter wave could not possibly have traveled such a distance during daylight; therefore, it must have gone the other way around the world, namely, a distance of 16,000 miles.

Sometime when the conditions are just right, it should be possible to locate a receiving station within the skip distance of a transmitter operating on very short waves, and to receive a signal from that transmitter after it has traveled completely around the world.

I am the last person to minimize the great value of broadcasting as it exists today. Some of you who in the old days long before the existence of WCAP or WRC remember the pioneer work done by NSF and NOF, which stations were operated by the Navy under my direction, and were the first stations in the world to broadcast a presidential speech and various addresses by cabinet members, members of Congress and other officials, and also the first to put on the air the United States Navy Band.

KOAC	Oregon Agricultural College	Corvallis, Oreg.	280
KOB	N. Mex. College Ag. & Me. Arts	State College, N. Mex.	349
KOCH	Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Monarch Manufacturing Co	Council Bluffs. Iowa	278
KOIN	H. B. Read	Portland, Ore.	319
KOMO	Bert F. Fisher	Seattle, Wash.	306
KOWW	Blue Mt. Radio Assn	Walla Walla, Wash.	256
KPO	Hale Bros	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Post Dispatch	Houston, Texas	297
KPSN	Star-News Publishing Co	Pasadena. Calif.	316
KQV	Doubleday-Hill Electric Co	Pittsburgh, Pa.	275
KQW	Charles D. Herrold	San Jose, Calif.	231
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Printing Co	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad Co	Santa Maria, Calif.	210
KSO	A. A. Berry Seed Co	Clarinda, Iowa	242
KTAB	Associated Broadcasters	Oakland, Calif.	240
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	Brown's Radio Shop	Portland, Ore.	263
KTHS	New Arlington Hotel Co	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa	256
KTW	First Presbyterian Church	Seattle, Wash.	454
KUOA	University of Arkansas	Fayetteville, Ark.	300
KUOM	State University of Montana	Missoula, Mont.	244
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	231
KVOO	The Voice of Oklahoma	Bristow, Okla.	375
KWCR	H. F. Paar	Cedar Rapids, Iowa	278
KWG	Portable Wireless Telephone Co	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KWKH	W. G. Patterson	Kennonwood, La.	261
KWSC	State College	Pullman, Wash.	349
KWUG	Western Union College	Le Mars, Iowa	252
KWWG	City of Brownsville	Brownsville, Texas	278
KYW	Westinghouse Electric & Mfg. Co	Chicago, Ill.	535
KZIB	I. Beck	Manila, P. I.	250
KZKZ	Electrical Supply Co.	Manila, P. I.	270
KZM	Preston D. Allen	Oakland, Calif.	240
KZRQ	Far Eastern Radio	Manila, P. I.	222
KZUY	F. J. Elser	Manila, P. I.	360
NAA	U. S. Navy Dept.	Arlington, Va.	434
WAAD	Ohio Mechanics Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAW	Omaha Grain Exchange	Omaha, Nebr.	278
WABB	Harrisburg Radio Co.	Harrisburg, Pa.	204
WABC	Asheville Battery Co., Inc	Asheville, N. C.	254
WABI	1st Universalist Church	Bangor, Me.	240
WABO	Lake Avenue Baptist Church	Rochester, N. Y.	278
WABQ	Haverford College, Radio Club	Haverford, Pa.	261
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt. Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Coliseum Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons (Allen Theatre)	Akron, Ohio	258
WAFD	Albert B. Parfet Co	Port Huron, Mich.	275
WAGM	R. L. Miller	Royal Oak, Mich.	225
WAHG	A. H. Grebe & Co	Richmond Hill, N. Y.	316
WAIT	A. H. Waite Co	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Radisson Radio Corp.	Minneapolis, Minn.	244
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	248
WARC	American Radio & Research Corp	Medford, Mass.	261
WATT	Edison Electric	Boston, Mass.	244
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAL	Consolidated Gas & Elec. Co	Baltimore, Md.	246
WBAO	James Millikan University	Decatur, Ill.	270
WBAP	Wortham-Carter Pub.(Star Telegram)	Ft. Worth, Texas	476
WBAW	Braid Elec., & Waldrum Drug Co	Nashville, Tenn.	236
WBAX	John H. Stenger, Jr	Wilkes-Barre, Pa.	256
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment Co	Chicago, Ill.	226
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc	Rossville, N. Y.	273
WBBS	First Baptist Church	New Orleans, La.	252
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf.Co."B" 118th inf	Charleston,S.C.	268
WBBZ	C. L. Carrell	Chicago, Ill.	216
WBCN	Foster & McDonnell	Chicago, Ill.	266
WBDC	Baxter Laundry Co	Grand Rapids, Mich.	256
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBNY	Shirley Katz	New York, N. Y.	210
WBOQ	A. H. Grebe & Co., Inc	Richmond Hill, N. Y.	236
WBPI	I. R. Nelson	Newark, N. J.	263
WBRC	Bell Radio Corporation	Birmingham, Ala	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
WBZ	Westinghouse Elect. & Mfg. Co	Springfield, Mass.	331
WBZA	Westinghouse Elect. & Mfg. Co	Boston, Mass.	242
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	263
WCAE	Kaufmann & Baer Co. & The Pitts. Pr	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Place, Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAM	Galvin Radio Supply Co	Camden, N. J.	236
WCAO	A. A. and A. S. Brager	Baltimore, Md.	275
WCAP	Chesapeake & Potomac Tel. Co	Washington, D. C.	468
WCAR	Southern Radio Corp. of Texas	San Antonio, Texas	263
WCAT	State College of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur C. Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co	New Orleans, La.	263
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Charles Swarz	Baltimore, Md.	229
WCBR	C. H. Mester	Providence, R. I.	210
WCCO	Washburn-Crosby Co	Anoka, Minn.	416
WCLO	C. E. Whitmore	Camp Lake, Wisc.	231
WCLS	H. M. Couch	Joliet, Ill.	214
WCOA	City of Pensacola	Pensacola, Fla.	222
WCSH	Henry P. Rines	Portland, Maine	256
WCSO	Wittenberg College	Springfield, Ohio	248
WCWS	Chas. W. Selene (Portable)	Providence, R. I.	210
WCX	Free Press and Jewett R. & P. Co	Detroit, Mich.	517
WDAD	Dad's Auto Accessories, Inc	Nashville, Tenn.	226
WDAE	Tampa Daily Times	Tampa, Fla.	273
WDAF	Kansas City Star	Kansas City, Mo.	366
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	268
WDAY	Radio Equipment Corp	Fargo, N. Dak.	261
WDBE	Gilham-Schoen Elec. Co	Atlanta, Ga.	270
WDBJ	Richardson Wayland Elec. Corp	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio.	227
WDBO	Rollins College, Inc	Winter Park, Fla.	240
WDBZ	Boy Scouts, City Hall	Kingston, N. Y.	233
WDEL	Wilmington Elec. Specialty Co	Wilmington, Del.	266
WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc	Chattanooga, Tenn.	256
WDRC	Doolittle Radio Corp	New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc	Cranston, R. I.	441
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	American Telephone & Telegraph Co	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
WEAN	Shepard Co	Providence, R. I.	270
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Goodyear Tire and Rubber Co	Cleveland, Ohio	389
WEAU	Davidson Bros. Co	Sioux City, Iowa	275

Modulator Plug Handy for Cutting Interference

CENTRALAB has added another item to its popular list of resistances, this being a modulator plug. It is a variable resistance unit incorporated into a phone plug and serves as a means of cutting down the volume of reception without recourse to extra jacks in the receiver.

The device is illustrated above. On test at the Radio Age laboratory it was found especially desirable on short wave work (code) where by means of altering the resistance of the modulator plug it was possible to eliminate interfering stations by dimming them out against a stronger signal. It also served happily in cutting down somewhat power line leak signals in the background. On broadcast reception it also helped in cutting down the background noise so desired signals could come through with good clarity.

Cushioned Tubes Made by Van Horne

TO ELIMINATE microphonic noises in tubes in a novel manner the Van Horne Co. has designed a ring of soft resilent crepe rubber which is incorporated into the base of the tube. According to the tests made on the new method of tube mounting the rubber cushion eliminates all mechanical vibrations of the tube and also prevents sympathetic vibrations from the set and loud speaker acting upon the tube.

Since the crepe rubber ring is incorporated in the base of the tube no change in wiring is necessary. The tube fits any sockets and has the standard UX type prongs.

WEBC	Walter Cecil Bridges	Superior, Wisc.	242
WEBD	Electrical Equip. & Service Co	Anderson, Ind.	246
WEBE	Roy W. Waller	Cambridge, Ohio	234
WEBH	Edgewater B. H. & Herald Examiner	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co	New York, N. Y.	273
WEBL	Radio Corp. of America (Portable)	New York, N. Y.	226
WEBQ	Tate Radio Corp	Harrisburg, Ill.	226
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBW	Beloit College	Beloit, Wisc.	268
WEBZ	Savannah Radio Corp	Savannah, Ga.	263
WEEI	The Edison Elec. Illuminating Co	Boston, Mass.	349
WEHS	Robert E. Hughes	Evanston, Ill.	203
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	285
WENR	All-American Radio Corp	Chicago, Ill.	266
WEW	St. Louis University	St. Louis, Mo.	248
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	275
WFBC	First Baptist Church	Knoxville, Tenn.	250
WFBD	Gethsemane Baptist Church	Philadelphia, Pa.	234
WFBE	John Van De Walle	Seymour, Ind.	226
WFBG	The Wm. F. Gable Co	Altoona, Pa.	278
WFBH	Concourse Radio Corp.	Richmond Hill, N. Y.	273
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	Onondaga Hotel Co	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co	Indianapolis, Ind.	268
WFBR	Fifth Inf. Md. Nat'l Guard	Baltimore, Md.	254
WFBZ	Knox College	Galesburg, Ill.	254
WFDF	F. D. Fallain	Flint, Mich.	234
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	F. K. Bridgman	Chicago, Ill.	217
WFRL	Robert Morrison Lacey	Brooklyn, N. Y.	205
WGAL	Lancaster Elec. Supply & Const. Co	Lancaster, Pa.	248
WGBB	Harry H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co	Evansville, Ind.	236
WGBI	Scranton Broadcasters, Inc	Scranton, Pa.	240
WGBM	Theodore N. Saaty	Providence, R. I.	234
WGBR	George S. Ives	Marshfield, Wis.	229
WGBS	Gimbel Brothers	New York, N. Y.	316
WGBU	Florida Cities Finance Co	Fulford By-The-Sea, Fla.	278
WGBX	University of Maine	Orono, Me.	234
WGCP	D. W. May, Inc	Newark, N. J.	252
WGES	Coyne Electrical School	Oak Park, Ill.	250
WGHB	G. H. Bowles Developments	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGMU	A. H. Grebe & Co. Inc., (Portable)	Richmond Hill, N.Y.	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School Technology	Atlanta, Ga.	270
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquett Univ. & Milw. Journal	Milwaukee, Wis.	275
WHAM	Univ. of Rochester (Eastman S. of M.)	Rochester, N.Y.	278
WHAP	W. H. Taylor Finance Corp	Brooklyn, N. Y.	240
WHAR	Seaside House	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chas. W. Howard	Bellfontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co	Ft. Wayne, Ind.	234
WHBL	C. L. Carrell	Chicago, Ill.	216
WHBM	C. L. Carrell, (Portable Station)	Chicago, Ill.	216
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBP	Johnstown Automobile Co	Johnstown, Pa.	256
WHBQ	St. John's M. E. Church South	Memphis Tenn.	233
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Ind. Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc	Rochester, N. Y.	258
WHK	The Radio Air Service Corp	Cleveland, Ohio	273
WHN	George Schubert	New York, N. Y.	361
WHO	Banker's Life Co	Des Moines, Ia.	526
WHT	Radiophone Broadcasting Corp	Deerfield, Ill.	238
WHT	Radiophone Broadcasting Corp	Deerfield, Ill.	400
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAS	Home Electric Co	Burlington, Iowa	254
WIBA	The Capital-Times Studio	Madison, Wis.	236
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WIBH	Elite-Radio Stores	New Bedford, Mass.	210
WIBI	Frederick B. Zitteli, Jr	Flushing, N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	Billy Maine (Portable)	Chicago, Ill.	216
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBR	Thurman A. Owings	Werton, W. Va.	246
WIBS	T. F. Hunter (portable)	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Grid-Leak, Inc	Utica, N. Y.	205
WIBZ	A. D. Trum	Montgomery, Ala.	231
WIL	Benson Radio & The Star	St. Louis, Mo.	273
WIOD	Wonderful Isle of Dreams	Miami, Fla.	248
WIP	Gimbel Bros	Philadelphia, Pa.	508
WJAD	Jackson's Radio Eng. Laboratories	Waco, Texas	353
WJAG	Norfolk Daily News	Norfolk, Nebr.	270
WJAK	Clifford L. White	Kokomo, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co. (J. Samuels & Bro.)	Providence, R. I.	306
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAZ	Zenith Radio Co.	Mt. Prospect, Ill.	322
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	Financial Journal	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co	LaSalle, Ill.	234
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co	Decatur, Ill.	270
WJBO	Valdemar Jensen	New Orleans. La.	268
WJBR	Geusch and Stearns	Omro, Wis.	227
WJBU	Bucknell University	Lewisburg, Pa.	211
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WJR	Jewett Radio & Phon. Co. & D. F. P.	Pontiac, Mich.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	New York, N. Y.	454
WKAF	WKAF Broadcasting Co	Milwakuee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	285
WKAV	Laconia Radio Club	Laconia, N. H.	224
WKBB	Sanders Bros.	Joliet, Ill.	214
WKBE	K. & B. Electric Co	Webster, Mass.	231
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKRC	Kodel Radio Corp	Cincinnati, Ohio	326
WKRC	Kodel Radio Corp	Cincinnati, Ohio	422
WKY	WKY Radio Shop	Oklahoma City, Okla.	275
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLAQ	Arthur E. Shilling	Kalamazoo, Mich.	283
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBL	Bureau of Marketing	Stevens Point, Wis.	278
WLIB	Liberty Magazine	Elgin, Ill.	303
WLIT	Lit Bros.	Philadelphia, Pa.	394
WLS	Sears Roebuck & Co	Crete, Ill.	345
WLSI	Lincoln Studios	Cranston, R. I.	441
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Mfg. Co	Cincinnati, Ohio	422
WLWL	Miss. Society of St. Paul the Apostle	New York, N. Y.	288
WMAC	C. B. Meredith	Casenovia, N. Y.	275
WMAF	Round Hills Radio Corp	Dartmouth, Mass	441

An Efficient Long Wave Receiver

(Continued from page 16)

necessary wiring or binding posts being employed.

The testing of the receiver is extremely simple—being similar in all respects to the test of an ordinary tuned r. f. receiver.

In operation, however, there are one or two points to be observed. Trans-oceanic telephony is generally effected by means of single side band transmission. This means that the wave transmitted from the transmitting station is minus one set of side bands which are unnecessary in transmission as well as the carrier which has also been eliminated. Obviously, for satisfactory reception, a local carrier must be provided by the receiving station. This is accomplished very simply by causing the r. f. amplifier to oscillate. This adjustment is in turn effected by cutting out resistance in the resistor until squeals can be heard as the receiver is tuned. It will be noticed that these squeals in most cases, instead of varying in pitch or being steady as in the regular broadcast frequency spectrum, will be broken up into dots and dashes. These squeals indicate that some of the longer wave telegraph stations are being received, and if the operator is acquainted with the Continental code he may interpret these signals quite easily. When a long wave radiophone station is encountered, the squeal received will vary in pitch or will be perfectly steady. It will not appear and disappear periodically, however. In the case of suppressed side band and carrier transmission where only one side band is radiated, it will be necessary to adjust the receiver in an oscillating condition to a zero beat position. At this adjustment the signal will come through without distortion. It can be easily found in operation.

If the operator prefers somewhat better efficiency, it can be obtained by using a separate oscillator and preventing the receiver itself from oscillating. Such an oscillator would consist of a .001 variable condenser connected across a 500 turn honeycomb coil. One end of the honeycomb coil would connect to the grid of a vacuum tube while the other end would connect to the negative side of the 22½ volt battery, the positive side of this battery being connected to the plate of the tube. This B battery should be bypassed by a .002 condenser or larger, if possible. A center tap taken out from the approximate center of the honeycomb coil should be connected to the negative side of the vacuum tube filament, the circuit of which is completed through an A battery and rheostat. Such an oscillator may be coupled to the receiver proper by means of a small 25 to 50 turn honeycomb coil connected in series with the antenna lead of the receiver, and comparatively tightly coupled to the oscillator inductance.

In operating the receiver with an external oscillator, it is probably at first simplest to tune the receiver to the signal when it is in an oscillating condition. The modulator would then be retarded until the receiver stops oscillating, whereupon the oscillator tube should be lit and the oscillator condenser adjusted until the signal reappears in satisfactory undistorted fashion. The oscillator is then functioning as a miniature transmitter supplying the carrier frequency for the incoming signal which was omitted by the transmitting station. The reason for this elimination is that on the longer wave lengths the available transmission channels are very few due to the comparatively narrow frequency range available. Thus, in ordinary speech transmission necessitating a frequency range of from 100 to 3,000 cycles, an actual band of 6,000 cycles would be required for an ordinary transmitter. For a single side band transmitter a range of only 2,900 cycles would be required or less than half. From this it is evident that single side band transmission permits of advantageous conservation of available trans-oceanic telephone channels at the longer waves—say, from 3,000 meters up.

WMAK	Norton Laboratories	Lockport, N. Y.	266
WMAL	M. A. Lesse Optical Co.	Washington, D. C.	213
WMAN	First Baptist Church	Columbus, Ohio	278
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Mercer University	Macon, Ga.	261
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	250
WMBC	Michigan Broadcasting Co.	Detroit, Mich.	256
WMBF	Miami Beach Hotel	Miami Beach, Fla.	384
WMC	Commercial Appeal	Memphis, Tenn.	500
WMCA	Hotel McAlpin (Greenley Sq. Hotel Co.)	New York, N.Y.	341
WNAB	Shepard Stores	Boston, Mass.	250
WNAC	Shepard Stores	Boston, Mass.	280
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Bros. Co. (Frederick Lenning)	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNJ	Radio Shop	Newark, N. J.	252
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plant & Structures	New York, N. Y.	526
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOAN	Vaughn Con. of Music	Lawrenceburg, Tenn.	283
WOAW	Woodman of the World	Omaha, Nebr.	526
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOCL	A. E. Newton	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, N. J.	224
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Otto Baur	New York, N. Y.	233
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Grand Rapids Radio Co.	Grand Rapids, Mich.	242
WOQ	Unity School of Christianity	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOWL	Owl Battery Company	New Orleans, La.	270
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAK	N. D. Ag. College	Agricultural College, N. D.	275
WPCC	North Shore Cong. Church	Chicago, Ill.	258
WPDQ	H. L. Turner	Buffalo, N. Y.	205
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAC	Gish Radio Service	Amarillo, Tex.	234
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	263
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	New York, N. Y.	360
WQJ	Calumet Rainbo Broadcasting Co.	Chicago, Ill.	447
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	224
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Horace D. Good	Reading, Pa.	238
WRAX	Flaxon's Garage	Gloucester City, N. J.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wynne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio & Electric Co.	Coldwater, Miss.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRHF	Radio Hospital Fund	Washington, D. C.	256
WRHM	Rosedale Hospital, Inc.	Minneaoplis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc., M.Y. "MU-1"	New York, N.Y.	236
WRNY	Experimenter Publishing Co.	New York, N. Y.	258
WRR	Municipal Station	Dallas, Tex.	246
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WRW	Tarrytown Radio Res. Labs.	Tarrytown, N. Y.	273
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publisher Co.	Allentown, Pa.	229
WSAR	Daughty & Welch Electrical Co.	Fall River, Mass.	254
WSAU	Camp Marien	Chesham, N. H.	229
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	210
WSBF	Stix-Baer-Fuller D. G. Co.	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	275
WSDA	Seventh Day Adventist Church	New York, N. Y.	263
WSKC	World's Star Knitting Co.	Bay City, Mich.	261
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amuse. Co. & Maison B. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wisc.	246
WSRO	Radio Company	Hamilton, Ohio	252
WSSH	Tremont Temple Bap. Church	Boston, Mass.	261
WSUI	State University of Iowa	Iowa City, Iowa	484
WSVS	Seneca Vocational School	Buffalo, N. Y.	219
WSWS	Illinois Broadcasting Corp.	Wooddale, Ill.	275
WTAB	Fall River Daily Herald Publishing Co.	Fall River, Mass.	266
WTAD	Robt. E. Compton	Carthage, Ill.	236
WTAG	Telegram Pub. Co.	Worcester, Mass.	268
WTAL	Toledo Radio & Electric Co.	Toledo, Ohio	252
WTAM	Williard Storage Battery Co.	Cleveland, Ohio	389
WTAP	Cambridge Radio & Electric Co.	Cambridge, Ill.	242
WTAQ	C. S. Van Gordon	Eau Claire, Wisc.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAW	Agricultural & Mech. Col. of Texas. College Sta.,	Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WWAD	Wright & Wright (Inc.)	Philadelphia, Pa.	250
WWAE	Electric Park	Plainfield, Ill.	242
WWAO	Michigan College of Mines	Houghton, Mich.	263
WWGL	Radio Engineering Corp.	Richmond Hill, N. Y.	213
WWI	Ford Motor Co.	Dearborn, Mich.	266
WWJ	Detroit News	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275

Use the Log-a-Wave Chart on Page 64

Radio Taste Seems to Vary With the Hour

(Continued from page 32)

times, without a hitch and without disturbing delays.

This program of consistent, dance music, each band with a style of its own, has created a great deal of interest all over the country as is evidenced by the great amount of correspondence that floods the station, congratulating it upon having chosen a special style of program that can be tuned at great distances with clarity and can always be tuned when good dance music is wanted. This and the fact that the programs are so congenially presented by George Allen—of the "smiling voice"—has done much to make WOK the popular station it is today.

Worked 9BHX

RADIO AGE is now on the air on one of the amateur bands with a low power storage battery operated C. W. set. We will be glad to qsr messages any time you are qso with us.

Operator "HX" at 9BHX, located in the RADIO AGE laboratory, reports working the following amateurs with the short wave transmitter (40 meters) now in operation at that location:—

The period covers from the 21st of April to May 2.

40C
2CXL
4BY
2APJ
2KG
8DNF
8BF
4ZA
9UB
C4DT

THE RADIO AGE BUYERS' SERVICE

What do you want to purchase in the radio line? Let RADIO AGE save you time and money by sending in the coupon below. Enter the number of the article you would like to know more about in the spaces provided in the coupon.

1 "A" Batteries, all kinds
2 Aerials
  (a) Loop
  (b) Outdoor
3 Ammeters
4 Amplifiers
5 "B" batteries, all kinds
6 Batteries (A and B)
  (a) Dry
  (b) Wet
7 Battery chargers
8 Battery substitutes
  (a) "A" battery
  (b) "B" battery
9 Battery supplies
10 Bezels
11 Binding posts
12 Books on radio
13 Broadcasting equipment
14 Buzzers
15 "C" batteries
16 Cabinets
17 Code practice sets
18 Coils, all forms
19 Condensers, fixed
20 Condensers, variable
21 Contact points
22 Cords, headset, etc.
23 Couplers, vario, etc.
24 Crystals
25 Desks
26 Detector (crystals)
27 Detector tubes
28 Detector units
29 Dials
30 Dies
31 Drills
32 Electrolyte
33 Fibre
34 Filters
35 Fuses, tube
36 Grid leaks
37 Ground clamps
38 Head phones
39 Horns, all types
40 Hydrometers
41 Inductances
42 Insulation
43 Insulators, all types
44 Irons, soldering
45 Jacks
46 Jars, battery
47 Keys, transmitting
48 Knobs
49 Laboratories, testing
50 Lightning arresters
51 Loud speakers
52 Lugs, battery
53 Meters, all types
54 Mica
55 Mountings
56 Nuts
57 Panels
58 Paste, soldering
59 Patent attorneys
60 Phone connectors
61 Phonograph adapters
62 Plugs
63 Pointers
64 Potentiometers
65 Rectifiers
66 Resistances, fixed
67 Rheostats
68 Scrapers, wire
69 Screw drivers
70 Screws
71 Schools, radio
72 Sets, transmitting
73 Sets, receiving
  (a) Factory Built (b) kits
    1 Crystal
    2 Radio Frequency
    3 Reflex
    4 Regenerative
    5 Super-heterodyne
74 Shellac
75 Sockets
76 Solder
77 Supports, aerial
78 Switches
79 Transformers, a. f.
80 Transformers, r. f.
81 Transformers, sending
82 Tubes, all types
83 Variometers
84 Wave meters
85 Wave traps
86 Wire, all kinds

RADIO AGE BUYERS' SERVICE 500 N. Dearborn St., Chicago, Ill.

Please see that I am supplied with buying specifications and prices on the articles numbered herewith:

I am a— ☐ Dealer ☐ Jobber ☐ Mfgrs.' Rep. ☐ Manufacturer

Firm [If identified with Radio industry] .....

My Occupation .....

My Name .....

Address ..... (6-26)

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

Dominion of Canada

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

Republic of Mexico

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

Republic of Cuba

PWX	Cuban Telephone Co.	Habana	400	2LC	Luis Casas	Habana	250	6DW	Eduardo Terry	Cienfuegos	225
2BY	Frederick W. Borton	Habana	315	2MG	Manuel G. Salas	Habana	280	6XJ	Frank H. Jones	Tuinucu	275
2CX	Frederick W. Borton	Habana	320	2MN	Fausto Simon	Habana	270	6KW	Frank H. Jones	Tuinucu	340
2EV	Westinghouse Elec. Co.	Habana	220	20L	Oscar Collado	Habana	300	8BY	Alberto Ravelo	Stgo. de Cuba	250
2HC	Heraldo de Cuba	Habana	275	2TW	Roberto E. Ramires	Habana	230	8DW	Pedro C. Anduz	Stgo. de Cuba	275
2HS	Julio Power	Habana	180	2WW	Amadeo Saenz	Habana	210	8FU	Andres Vinnet	Stgo. de Cuba	225
2JD	Raul Parez Falcon	Habana	105	5EV	Leopoldo E. Figueroa	Colon	360	12AB	Alberto S. de Bustamante.	Habana	240
2K	Alvara Daza	Habana	200	6BY	Jose Ganduxe	Cienfuegos	300	16AZ	Valentin Ullivarri	Cienfuegos	200
2KD	E. Sanchez de Fuentes	Habana	350	6CX	Antonio T. Figueroa	Cienfuegos	170	20K	Mario Garcia Velez	Habana	360

Great Britain

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

France

YN	Lyons	550	8AJ	Paris	1,780
FL	Paris (Eiffel Tower)	2,650	ESP	Paris	458

CLASSIFIED ADVERTISEMENTS

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

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

All classified ads for the July issue must be sent in by May 25.

AGENTS WANTED

SELL MARVELOUS NEW RADIO INVENTION THAT IMPROVES summer reception 100%. Effaces marvel inside antennae gives better tone, greater selectivity, less static. Sells to every radio owner for only $4.00. Write today. Fishwick Radio Co., 135 Central Parkway, West, Cincinnati, Ohio.

Sell Five Tube Radio Sets. Thirty days free trial. Three sales weekly pays $90 profit. Experience unnecessary. DIRECT RADIO, 197-FF Fourteenth St., Milwaukee, Wisconsin.

AGENTS—STEADY INCOME. LARGE Manufacturer of soaps, perfumes, toilet articles and pure food products, etc., wishes representatives in each locality. Manufacturer direct to consumer. Big profits. Honest goods. Whole or spare time. Cash or credit. Send at once for particulars. American Products Co., 5796 American Bldg., Cincinnati, Ohio.

Agents Make $60.00 weekly. Distribute quality food and toilet preparations among friends and neighbors. No money or experience necessary. Free automobile. Desk BC3. Healthe Products Co., Cincinnati, Ohio.

Agents Wanted VANCY Guaranteed Radio Tubes with imported filament all types BEST BY TEST also transmitters. Sample tubes $1.50 each. Post Paid. Send cash or money order. Van Cleef-Deforest Radio Company, Great Kills, S. I., N. Y.

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

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

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

$50 WEEKLY EVENINGS. DEMONSTRATING A super selective 6-tube radio set. Selectrodyne Radio Co., Dept. M-325 West State, Rockford, Illinois.

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

AUTOMOBILES

Light weight ALOY-NUM pistons for all cars and trucks, low prices, get circular. Eggo, 7704 South Main Street, Los Angeles, California.

BOOKS AND MAGAZINES

Big savings monthly, exchanging RADIO Magazines. List mailed free. Spencershield Agencies, West Los Angeles, California.

EXPERIMENTAL RADIO by R. R. Ramsey, Professor of Physics Indiana University. The only scientific experimental manual. Enthusiastically endorsed by the American Radio Relay League for amateur use. Used in colleges, universities and Government schools. Measure, adjust, and perfect your set. 85 experiments. Price $2.00 post paid. Hugh Ramsey, Bloomington, Indiana.

ELECTRICAL MEN! LOCATE TROUBLE ON ELECTRICAL APPARATUS. PRACTICAL EXPLANATION WITH BLUE PRINT DIAGRAMS OF MOTOR & CONTROLLER CONNECTIONS. GREAT HELP & GUIDE TO MEN IN THE TRADE. COMPLETE BOOK FORM. PRICE $2.00 POST-PAID. U. S. SALES & TRADING COMPANY, 1457 BROADWAY, NEW YORK, N. Y.

BUSINESS OPPORTUNITIES

Drafting, Expert Commercial, Architectural, Licensed, Reasonable. Union Service, Liberty, Indiana.

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

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

CRYSTALS

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

DOGS AND BEES

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

Beekeeping backyard among the pets. Breed bees that seldom sting. Build own supplies cheap. Interesting booklet explains how—dime. Spencergrove Apiaries, West Los Angeles, California.

WHITE Spitz Puppies. Beautiful, Intelligent, companionable. Fifteen Dollars. Brookwood Kennels, 2626 East 18th Street, Indianapolis.

HELP WANTED

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

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

INVENTIONS

NEW IDEAS WANTED—Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and salable. Address: Mr. R. F. Devine, Roo m 1101, 116 West 32nd St., New York, N. Y.

MUSIC

SONG Poem Writers—If you have your words put to music let a gifted Melody Writer do it. Write Francis Conover, (Composer) AVON, New Jersey.

"MUSIC COMPOSED" TO WORDS. BAUER BROS., (formerly of Sousa's Band), Oshkosh, Wisconsin.

PATENTS

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

RADIO

CHOKES unmounted 50H. 60MA. $1.75, 30H. 50MA. $1.50, 20H. 25MA. $1.25. TRANSFORMERS—420V. from 110, 6V. filament center tap on filament and secondary windings. 70MA. for UX213 tube $3.75, 280V. from 110V. no tap. 60MA. $1.75, 190V. from 110V. no tap with 6V. filament for 201A "B" Eliminator $1.75, AUDIO 6-1 or 3-1 RATIO .90. Write for list of "B" Eliminator parts. Radio Parts Sales Company, Box 24, Orange, N. J.

NO MORE BATTERIES. You can eliminate all batteries and operate your set on light current, AC or DC—no hum—any kind of set—any type of tubes. Complete blue prints and instructions, guaranteed $2. Engineers' Service Company, Suite 203, 15 Park Row, New York.

A real DX Circuit! 5 tubes over 3000 miles range with loud speaker volume. Send $1.00 for circuit and instructions. Tuttle Radio Laboratories, Diamond, Ohio.

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

"$1.00 For Your Old Tubes regardless of make or condition towards the purchase of each new Standard $2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. Order today. Luxem & Davis Mfg. Co., 8229 Broadway, Chicago, Ill. Paste this ad in your set."

201A and 199 tubes rejuvenated 30c. Charles Bloedorn, 1394 Detroit Street, Denver, Colorado.

B BATTERY ELIMINATORS—BUILD YOUR OWN cheap; no hum; acid or anything to get out of order; blueprint and instructions; 50 cents, money order or cash. Web Radio Co., Dept. A, 5823 Calumet Ave., Chicago, Illinois.

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

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

RADIO DEALERS

DEALERS—Write for our illustrated catalog of reliable Radio Merchandise. Rossiter-Manning Corporation, Dept. D, 1830 Wilson Ave., Chicago, Ill.

RADIO SUPPLIES

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

SALESMEN WANTED

SELLS for $9.75. Prints ad on wrapping paper, envelopes, etc. $4.00 commission. Send 10c for sample work. Automatic Ad-Stamper, Joplin, Missouri.

Make $100 WEEKLY in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment; no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 126 F. Austin Ave., Chicago.

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

STAMPS

69 stamps, 4 cents. Book Stamp Company, 642 Meredith Street, Dayton, Ohio.

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

WIRELESS

Want to Memorize the Wireless Code? The Corryden Snyder Code Method. Patented is quickest. Send 25c coin, or M. O. to C. C. Snyder, 1423 Elmdale Ave., Chicago, Ill.

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

Radio Age Classified Ads Bring Results

KC	Meters	STATIONS	DIALS 1	2	3
1480	202.6				
1470	204.0				
1460	205.4				
1450	206.8				
1440	208.2				
1430	209.7				
1420	211.1				
1410	212.6				
1400	214.2				
1390	215.7				
1380	217.3				
1370	218.8				
1360	220.4				
1350	222.1				
1340	223.7				
1330	225.4				
1320	227.1				
1310	228.9				
1300	230.6				
1290	232.4				
1280	234.2				
1270	236.1				
1260	238.0				
1250	239.9				
1240	241.8				
1230	243.8				
1220	245.8				
1210	247.8				
1200	249.9				
1190	252.0				
1180	254.1				
1170	256.3				
1160	258.5				
1150	260.7				
1140	263.0				
1130	265.3				
1120	267.7				
1110	270.1				
1100	272.6				
1090	275.1				
1080	277.6				
1070	280.2				
1060	282.8				
1050	285.5				
1040	288.3				
1030	291.1				
1020	293.9				

KC	Meters	STATIONS	DIALS 1	2	3
1010	296.9				
1000	299.8				
990	302.8				
980	305.9				
970	309.1				
960	312.3				
950	315.6				
940	319.0				
930	322.4				
920	325.9				
910	329.5				
900	333.1				
890	336.9				
880	340.7				
870	344.6				
860	348.6				
850	352.7				
840	356.9				
830	361.2				
820	365.6				
810	370.2				
800	374.8				
790	379.5				
780	384.4				
770	389.4				
760	394.5				
750	399.8				
740	405.2				
730	410.7				
720	416.4				
710	422.3				
700	428.3				
690	434.5				
680	440.9				
670	447.5				
660	454.3				
650	461.3				
640	468.5				
630	475.9				
620	483.6				
610	491.5				
600	499.7				
590	508.2				
580	516.9				
570	526.0				
560	535.4				
550	545.1				

An Index to the Best in Radio Hookups!

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

March, 1924
—An Eight-Tube Super-Heterodyne.
—A simple, low loss tuner.
—A Tuned Radio Frequency Amplifier.
—A Simple Reflex Set.

April, 1924
—An Efficient Super-Heterodyne (fully illustrated).
—A Ten Dollar Receiver.
—Anti-Body Capacity Hookups.
—Reflexing the Three-Circuit Tuner.

May, 1924
—Construction of a Simple Portable Set.
—Radio Panels.
—Third Installment of Radio Age Data Sheets.

June, 1924
—Important Factors in Constructing a Super-Heterodyne.
—A Universal Amplifier.
—Adding Radio and Audio to Baby Heterodyne.
—Radio Age Data Sheets.

July, 1924
—A Portable Tuned Impedance Reflex.
—Operating Detector Tube by Grid Bias.
—A Three-Tube Wizard Circuit.

August, 1924
—Breaking Into Radio Without a Diagram.
—The English 4-Element Tube.
—Filtered Heterodyne Audio Stages.
—An Audio Amplifier Without an "A" Battery.

September, 1924
—How Careful Mounting Will Improve Reception.
—One Tuning Control for Hair's Breadth Selectivity.
—Four Pages of Real Blueprints of a New Baby Heterodyne.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6-26

A *new* "B" Battery Eliminator

worthy to bear the name of

ZENITH

AFTER months of experimentation—of side-by-side tests with the various Eliminators on the market—Zenith announces the *Zenith "B" Battery Eliminator*, matching in every respect the splendid character of Zenith radio.

The fact that this new Zenith product has been given the Zenith name is proof positive it *is different—and better.* Here is one of the many reasons:

Most Eliminators are built with an adjustable resistance. The Zenith Eliminator has a *fixed resistance* on both amplifier and detector. The 22½-volt tap will always deliver 22½ volts; the 100 intermediate tap, 100 volts; the amplifying tap, 135 volts. The operator need make no adjustments.

The Zenith "B" Battery Eliminator is specially designed to fit all Zenith models, but it may be used equally well with other makes of receivers requiring the same voltage. It is built to stand up under the most severe usage, over a long period of time.

The coupon will bring you a descriptive circular about this new and remarkable product—show you how you can maintain your radio set at the highest degree of efficiency, at a minimum cost. Ask for it *today.*

Obtained only thru authorized Zenith Dealers and Distributors

Zenith Radio Corporation

Straus Building, Chicago

Tune in on WJAZ

Dance Orchestras on Tuesday, Wednesday, Friday and Saturday Nights from 9:00 P. M. until 2:00 A. M. ¶ Musical Program from the Zenith Spanish Garden Studio 9:00 until 12:00 o'clock Thursday Nights and Special Programs 7:00 until 9:00 Sunday Nights. ¶ Central Standard Time. ¶ Authorized Wave Length, 329.5 Meters.

INQUIRY COUPON

ZENITH RADIO CORPORATION
310 South Michigan Ave., Chicago

Gentlemen: Please send me full particulars of the Zenith "B" Battery Eliminator. Show me how I can increase the efficiency of my radio set.

I own a ..... tube.....
(Name of make)

Name .....

Address .....

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Packard Campus
for Audio Visual Conservation
www.loc.gov/avconservation

Motion Picture and Television Reading Room
www.loc.gov/rr/mopic

Recorded Sound Reference Center
www.loc.gov/rr/record