Blueprint Section Every Month

RADIO AGE

The Magazine *of the* Hour

April
1926

Short Wave Set Blueprints ¶ A Balanced Capacity Receiver ¶ Duplex Photogram Machines ¶ Testing Your Tubes at Home

25

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In Each Issue

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RADIO AGE

500 N. Dearborn St., Chicago


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Pioneers in the Radio Industry
4219 BELMONT AVENUE, CHICAGO, U. S. A.
Complete instructions for building a similar "Permanent Plate Supply Unit" may be had free upon request. Specify Bulletin B-82.

RADIO AGE

The Magazine of the Hour

Established March, 1922

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CONTENTS

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A Chat With the Editor

AN eastern manufacturer recently sent to the editor a statement in which the following paragraph was included:

The swelling army of radio fandom has its dangers as well as its advantages. It has become so large that the influence of the early amateurs is disappearing and that is a distinct loss.

We do not have to remind our readers that this magazine has industriously sought to keep alive the "influence of the early amateurs." This publication has made a specialty for four years (this is the first issue of our fifth year) of showing beginners how to take their initial steps into the big radio adventure.

It may not be out of place to say here, then, that the manufacturers of radio sets who are now complaining of the loss of that enthusiasm which marked the interest of the radio public a few years ago, are themselves responsible for the present situation. Many of them have transferred their allegiance from the radio magazines and have literally poured their gold into the coffers of publications which never published a hook-up or explained a circuit in their entire careers.

But if some manufacturers of sets refuse to indorse radio publications it is their own business. Meanwhile those who still take delight in making their own sets,—or who are just learning the game, might do well to help the magazines that are helping them. One way to do it is to buy goods from the manufacturers of parts or complete sets, who advertise in radio magazines, and by that policy are assisting publishers of radio magazines to give you a better magazine each month.

Frederick Smith

Editor of RADIO AGE.

"Your radio is always top notch. What do you do to keep it so full of pep?"

KEEPING your "B" batteries full of pep, without frequent renewals, is simply a matter of using the right size Eveready for your particular set with a "C" battery*.

The rule which determines the right size "B" batteries to use is so simple no one can make a mistake, and once learned it definitely settles the question of "B" battery service and economy.

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, No. 772, on 1 to 3 tube sets, will last for a year or more, and Heavy Duties on sets of 4 or more tubes, for 8 months or longer.

These life figures are based on the established fact that the average year-round use of a set is 2 hours a day.

A pair of Eveready No. 772's for a 5-tube set instead of 2 Eveready No. 770's or 2 Eveready Layerbilts No. 486—looks at first glance like an economy because of lower first cost. But in a few months the 772's will be exhausted and have to be replaced. After the same length of time the Eveready No. 770's or the Eveready Layerbilts No. 486 will still be good for many more months of service.

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

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

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

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

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

EVEREADY
Radio Batteries
—they last longer

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

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

Pacific Coast, Eveready Program,
KGO—*San Francisco, 8 to 9 P. M.*

RADIO EDITORIALS

NEVER in the history of journalism has a new industry developed such a flood of "free publicity" as that let loose by the radio industry in the last year. Somebody apparently has spread the word that editors will eat up anything they can get on "how to make" subjects, swallowing with these gratuitous articles the more or less adroitly injected free advertising that is invariably their more or less subtle characteristic. If any editor should be so foolish as to publish any considerable number of these press agent yarns he soon would find himself without readers. Also he would find himself without advertisers. Having obtained the free exploitation of their goods the advertisers would not need paid advertising. It seems to us that certain houses would do better to give their advertising agencies more work and take some of the load off the shoulders of their publicity representatives.

Occasionally the editor of this magazine asks a manufacturer to supply an article on a certain subject. We have found that some of the engineers in manufacturers' staffs can write admirably on special lines in which they have been making research. Their work is eagerly accepted by the readers as well. The reader of a radio magazine is a discriminating and a wise gentleman in these days of advanced radio and he recognizes genuine stuff. You can't fool him with a sugar coated advertisement merely by the device of placing that advertisement in the editorial columns instead of in the advertising pages.

To all these publicity experts we would offer the suggestion that their time and their envelopes and their stamps and their salaries and their letter paper and their office rent and their telephone and telegraph expense would do much more good if devoted to an appropriation for paid advertising. And their activities would take on a more business-like aspect. The radio industry is not a circus or a movie show. It is a commercial enterprise. By the same token a radio magazine or a radio section in a newspaper is not merely a convenient means where publicity agents may "put over" enough of their stuff to make a good showing with their employers. Magazines and newspapers have to pay for printing and print paper, for offices and personnel, for express and postage, for rent and for engravers, for artists and for writers, and, yes, they themselves buy advertising space. Why should anybody want them to support this astonishing troop of publicity experts in addition to their other expenses?

No, boys, you must not take offense at these brusque words. You are good writers and we like you. But there are too many of you. You overwhelm us with literature and if you do not soon cut down on the supply we shall have to buy another waste basket so that we may have one on the right hand as well as upon the left hand and these shall be our first line of defense.

THERE was no radio in the time of Samuel Pepys. In fact when heavy rainfalls turned the London roads to muck, back there in the days of Charles II and Louis XIV, it was impossible to deliver the mails; much less transmit intelligence of the world's events through the air. 'Tis a pity about Mr. Pepys, for, were he writing his audacious diary today he surely would indite for posterity a simple yet graphic story of dial twisting. And it might run something on this order:

"Up again betimes and to the radio, albeit still in my night-gowne and turban, looking much like a Tourke. There was a man discoursing there who was giving strict instructions on how to bend the knees and contriving other genuflections which he called setting up exercises, the like of which I never saw in all my life. And so pretty merry I being alone, and finding the musique of the harpsicon very fine, and in the midst of it my wife came to the chamber and at last I did take notice of her and she contenting herself mightily with watching my contortions.

"So to dress myself and back to hear another gentleman discourse upon the weather for that day and the next, and he predicting cold and foule which I hope will prove a foolery. To breakfast and while I eat the gentleman discoursed on the news at home and abroad which left me with a thousand sad thoughts upon the times. I to my newspaper and my wife to listen to a wench broadcasting advice on the manner to cook a chine of beef, a dish of fowl and a venison pasty, my wife afterward repeating all to the man-cooke who did later try these recipes but all spoiled in the dressing. So to the office where I fell to tuning my superheterodyne and a gentleman giving newes of the Exchange and finding reasons for this and that and all people at a losse what to expect. Thence by coach home, and at dinner admirable musique on the Lyra viall and the Theorbo. Left it and then to tune in a discourse by Colonel Billy Mitchell, he being late of the American Army. So idled through the whole afternoon. At supper tuning in more musique, a lady fell to playing the lute and singing but, singing basely, I broke off and went to my chamber, there to complete my Journall.

"So back again and to quarrel with my wife until darke night on whether it were best to listen to our own city's broadcasting or give eare to players more distant, she giving over when I fetched her a lace handkercher to sew on her neck. So to more talke about a man who had lost his dogge and then to an houre of bedtime tales for the children and several discourses by notable gentlemen. Left them, hoping not to offend, and now it was 11 o'clock. Thence to wave 326 and some good dance music and very good sport and mightily pleased I was with the saxophone. My people to bed and I waiting to hear Los Angeles but having an aerial too scant, which I do not like, I hear nothing but trifling discourse by code. So broke off and at last to bed."

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

Radio Fans *Should* Welcome Shields and *Metal* Panels

Good-bye Body Capacity; Simpler Wiring and Other Advantages are Noted

By FRED HILL
(Associate Editor)

NO matter what you may desire, if you wait long enough someone will make it for you. The truth of this more or less philosophical assertion was borne out rather strongly recently in the Radio Age laboratory.

Building a good metal shield for a receiver and piercing a metal panel had always been a bugbear for us. We remember yet with pain the weary

Figure 1

hours spent in hammering, bending, warping, cutting and finally getting into shape something which closely resembled one of Barnum and Bailey's tents and yet to which we clung with pride and called a "shield" for our set. Regardless of whether the shield was made of copper, tin, Swedish or other foreign iron, the results were always the same—we accumulated a cast iron grievance against the man who made these metals so non-workable. What we would have preferred would be something with the plastic qualities of tinfoil yet with the stoutness of copper. Whenever we finally did finish a job we were in no position to get the balance of the set into the shield without the use of a shoe horn and a hoisting crane.

Today our worries are over. We no longer regret we did not take a course in metal working. We do not even have to worry over the type of a set we are going to put into the shield.

THIS sudden relief of our anxieties was brought about with the discovery that a Chicago manufacturer, the Crowe Name Plate and Mfg. Co., is now building for several radio set manufacturers a brass shield (made up sectionally) and a metal panel on which the parts may be mounted. The panel and shield scheme was fostered by the Bremer-Tully people in connection with their "counterphase" models while other manufacturers are said to be flocking to the metal panel and shield like the proverbial bees to the flowers.

In Figure 1 we are showing a sketch of the punched panel; in Figure 2, the metal shield itself, while the chart in Fig. 3 shows the different resistance values of coils resting on panels of brass or bronze. The full unbroken line in the chart shows the resistance of the tested coil away from the panel. The tests were made by R. S. Glasgow, of the Department of Electrical Engineering, Washington University, St. Louis, Mo.

His report is very interesting and

(Please turn to page 55)

Figure 2

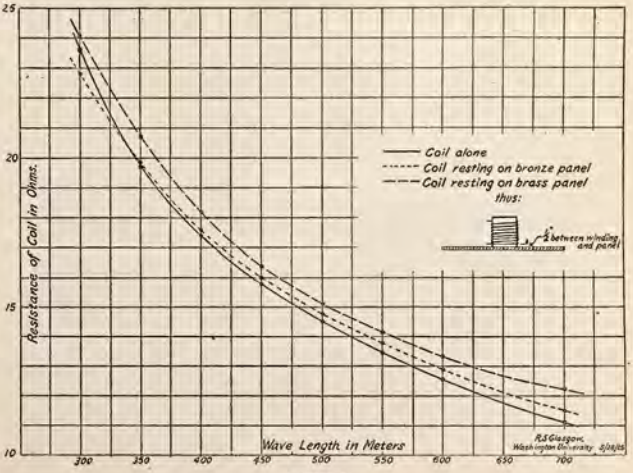

Figure 3

Hints on *How* to Get Rid of *Interference*

Super-Het Brings in Sign Flasher While Owner Becomes Disgusted

By Armstrong Perry

RECENTLY a well-to-do citizen of Chicago was bitten by the radio bug. He wanted the best receiving set he could buy, and he thought he knew which one that was. By spending several dollars for telegrams, he secured immediate shipment of a big super-heterodyne from New York. It was installed—and brought in with loud volume a flashing electric sign on a bowling alley across the street!

At the same time, a group of amateur experimenters at a Y. M. C. A. dormitory were building "supers" and having trouble with interference. They were in a congested district, half a block from an elevated railroad on which trains were passing every minute. They were in a steel-frame building with metal lath that absorbed much of the radio energy they wanted. There were countless electric motors, flashing signs, x-ray machines, violet ray devices and other electrical apparatus all around them. In spite of all, they succeeded eventually in securing results which they considered satisfactory.

Static Unconquerable

THERE is no question as to the possibility of eliminating much of the noise that troubles the broadcast listener. Perhaps the only unconquerable interference is that from the atmospheric disturbance called "static." That occurs at all frequencies used for broadcasting, and sometimes over the whole range of frequencies at one time. Weagant designed circuits that trapped enough of it so that commercial code stations of the Radio Corporation of America were enabled to maintain communication with all continents during at least the greater part of every day, using long waves. Experiments with very short waves, ten to eighty meters, indicate that static interference is much less at those wavelengths than on those used for general broadcasting. Dr. Rodgers dodged static by using underground antenna systems. But most radio users will have more or less trouble with static until some genius discovers a method for trapping all the stray radio waves and unscrambling them from the useful waves, or a method for amplifying the desired waves without amplifying those that are not wanted. During times of serious static disturbance, the best thing to do is to concentrate on the nearest and most distinct stations, and wait for better radio weather to do the DX work.

Not all that crackles is static, however, nor does all interference come from outside the set. It is so much easier to blame the neighbors, the electric light company, the transmitting amateurs, the government stations and the weather than it is to examine the receiver, that many a radio fan puts up with interference for weeks that he could get rid of in five minutes. Run-down batteries cause some noise. Loose connections are likely to be microphonic. It is an easy matter to run the eye over the aerial and lead-in, and the interior of the set, testing suspicious spots with a little pressure of the finger. Cleaning the connections with a little wood alcohol on a brush or rag, as the inspection proceeds, will improve results enough to pay for the time.

Look to Batteries

IF THE interference continues after the set is known to be in good condition, a test of the batteries should be the next thing. A momentary test with a voltmeter is not satisfactory. A weak "B" battery may show up well in such a test and then slump before the evening is over. Substitute a new battery if there is any question about the old one. Even a storage battery may be faulty, through unintentional misuse such as leaving it in a run-down condition during an absence from home, or charging or discharging it at too rapid a rate. If charging is done at home, let a battery man look it over at the first sign of trouble.

Interfering noises sometimes come in through the electric light wires. A simple test will show whether the lighting circuit is at fault or not. Open the switch at the house meter. If the interference continues, it comes from outside the house.

The real trouble makers are electric spark discharges. Every spark starts radio waves that may interfere with somebody's reception. Sparks will jump from electric wires, over insulators, to the ground. They will pass from wires to branches of trees that rub against them, especially in wet weather. Light and power companies usually are grateful when their attention is called to disturbances from such causes. Every leak in the line means loss for them. Many companies have trouble shooters who go forth armed with sensitive receivers and coil antennas. These receivers operate like radio compasses. By drawing lines on a map from the several points where the interference is heard, toward its source, and then searching for it at the point where these lines meet, it usually is possible to locate the cause of the noise.

A number of useful electrical devices make trouble for radio listeners, while operating correctly to all appearances. The brushes on direct current motors may do so, even though sparks may not be visible. Cleaning the commutator and setting the brushes will reduce the trouble to the minimum, and that will take but a few minutes of the engineer's time.

Rural Troubles

SOME rural telephone lines use ringing machines which spark and thus start interfering radio waves. This type of interference can be stopped by connecting a filter between the machine and the ringing keys. The filter is described herein.

Electrical precipitators in chimneys are offenders, also. Extremely high voltage is required in their operation and the rectifiers that supply it produce sparks. When the rectifier is close enough to the chimney so that there are no long connecting wires to serve as transmitting aerials, the disturbance is negligible. If a company operating one of these devices is unable or unwilling to place the rectifier near the chimney, it may be willing to apply another remedy, such as surrounding the wires with a grounded wire screen. Still another way to eliminate the interference is to insert damping resistances at several points in the line, to prevent radiation. A fourth way is to connect tuned circuits across the spark gap of the rectifier to absorb the radio-frequency power.

Heating pad thermostats, some kinds of battery chargers, buzzers, gasoline engines, x-ray machines, violet ray apparatus and any electrical device that causes spark discharges may be responsible for interference, but the wheels of industry, the pleasure of motorists, the necessities of surgery and the processes of beautification cannot be stopped while we listen for Europe and way stations. Filter circuits connected across the sparking points is the standard remedy. Such circuits are made with choke coils and condensers. One of these filter circuits should be connected on each side of the line and connect the line with the ground. Even a single condenser of 1-microfarad capacity, connected across the sparking points, may eliminate the trouble. Or, one condenser on each side of the line, connected with the ground. A screen of sheet metal or wire, thoroughly grounded, placed about

(*Please turn to page 51*)

Radio Age *Begins* Fifth Year

WITH this issue Radio Age passes its fifth mile post in its journey along the highway of radio progress. On this fifth anniversary it is peculiarly appropriate that we publish herewith three messages from distinguished leaders in radio activity to readers of our magazine. These expressions are from Secretary Herbert Hoover, of the United States Department of Commerce, Frank W. Elliott, President of the National Association of Broadcasters and Henry M. Shaw, President of the National Radio Trade Association.

In his letter accompany the message to readers, Mr. Elliott says, "I want to congratulate you on the splendid magazine you are getting out." Mr. Hoover, as readers will remember, already has expressed sentiments regarding the usefulness of Radio Age, which commendation we shall continue to strive to justify.—The Editor.

Davenport, Iowa, Feb. 4, 1926.

To the Editor,
Radio Age,
Chicago, Ill.

The thousands of radio fans who have recently purchased a radio set, and have not experienced the thrill of building a single circuit receiver, cannot appreciate what has transpired during the past five years in the broadcasting field. Little do they know about the conditions that were experienced in the early stages of the game, and perhaps, it is just as well for progress that they do not know. They are perhaps more enthusiastic over broadcasting than those who have gone through all of the stages of its development, and who really understand the difficulties that must have been worked out to bring the art to the present state of development.

The National Association of Broadcasters is the outgrowth of two or three Associations, formed in different parts of the country, to get the broadcasting interests into one unit. Many of the broadcasters who are coming into the field today little appreciate the difficulties that were experienced in the early days of broadcasting, and that, too, perhaps augments well for the future.

With five years of experience as a background, we predict that the next five years will see even greater wonders than have transpired in the past in the field of radio communication, and it behooves us all to be as patient with the situation as possible in respect to matters of legislation, for we do not want to have any laws enacted on our statute books, which will appear as ancient in five years from now as the laws of 1912, which govern the present situation, now appear to us. What the future holds for us in that line, cannot be dreamed of at the present time by one not thoroughly conversant with all of the developments. I am

Very truly yours,

Frank W. Elliott

FRANK W. ELLIOTT, Pres.
The National Association of Broadcasters.

To the Editor, Radio Age, Chicago, Ill.

We have great reason to be proud of the results achieved in radio development in the past five years, many of which were due to the conferences on radio.

From them have been established principles upon which our country has led the world in the development of this service. We have accomplished this by a large measure of self-government in an art and industry of unheard of complexity, not only in its technical phases, but in its relations both to the government and the public.

Four years ago we were dealing with a scientific toy; today we are dealing with a vital force in American life. We are, I believe, bringing this lusty child out of its swaddling clothes without any infant diseases.

We have not only developed traffic systems by which a vastly increasing number of messages are kept upon the air without destroying each other, but we have done much to establish the ethics of public service and the response of public confidence.

Herbert Hoover

To "Radio Age," Chicago. Feb. 20, 1926.

Sincere Birthday Greetings:

May the "Radio Age" always live, prosper and continue to display its common-sense idealism and progress leavened with sympathy for the Broadcasters, Listeners, Amateurs and Knights of the Key.

The immutable law which permits only "the survival of the fittest" will take care of its contributors and advertisers.

During the coming year there will be no radical changes in apparatus used for radio transmission and reception of sound.

The best and simplest expressions of life in music and words,—clean, interesting, non-sectarian, non-political and non-controversial,—will be the broadcast program of the future.

Yesterday, today and tomorrow is only a human division of time and effort in space. The invisible source of the sound of yesterday reaches the invisible hearers of today, and both—Via Radio—will become VISIBLE tomorrow.

All creeds, nationalities and colors of the Human Race will be influenced by its service in promoting happiness, good will and peace.

Henry M. Shaw

Pres., National Radio Trade Association.

Super Power Transmitters Aid Radio Receiver Development

Department of Commerce Holds That Science Shall Not be Stalled by Un-selective Sets

By CARL H. BUTMAN

THE time worn maxim that necessity is the mother of invention is being found to hold in the radio industry to an even greater degree than in many of the older and established businesses. The rule has been: The more trouble —the better sets.

With the development of broadcasting, and the advent of high power, came increased interference between stations, accompanied by the difficulties of local listeners to separate stations. Some programs overlapped, as a result of the increased ranges of these higher powered transmitters. The growing number of stations on the air and the consequent use of wave channels much closer together, tended to make it more and more difficult for fans to get the station they desired, or to separate two or three stations on adjoining waves. But the result has been better receivers.

Local Radio Blanket

IN practically every city where power was increased from 100 to 500 watts or from 500 to 1000 or 5000 watts, came complaints to the Department of Commerce against these monsters of the air, which blanketed local reception. That high-power stations, say over 1000 watts, should not be granted, was the purport of most of the indignant letters and telegrams which threatened to swamp the desk of the Chief Radio Supervisor. But did the Department close these stations? No, the radio officials were too far sighted to do this and interfere with radio development; they permitted the increase in power, under certain restrictions and in localities where congestion was not too great. The policy was established that advance in radio must go on. This required improvements in the receivers. It was better than limiting the strength and range of the transmitters to suit receivers. Improvement of many receiving sets in use followed and the design of new sets benefited by the troubles encountered.

If we only had 50 watt transmitters there would be little need for anything but crystal and one tube sets.

Fix Up Your Set

WHEN the complaints of fans against the first five-KW stations were at their height, Chief Supervisor Terrell pointed out that sets must be made more selective and less sensitive. This has been accomplished; the fans who did not want to or could not afford to improve their receivers, had to be satisfied with what they could get on their old sets, but those more interested made adjustments or put in wave traps so that their reception improved. Today we are certainly further advanced in broadcast reception, and better off than we could have been if broadcasters had been limited to a maximum wattage of 500.

The latest instance of similar agitation has just about petered out; it was the flood of complaints from upper New Jersey against the blanketing of the neighborhood by the new transmitter of Station WJZ of the Radio Corporation. It was first designated as 2XAR, the experimental 50-KW station. Congressmen and Senators were at first indignant at the injustice done their constituents by the Corporation which moved its transmitter from New York to a peaceful and ideal radio location, where with the great power of 40 to 50 Kilowatts it was preventing the reception by local listeners of practically all other stations in the country. Investigators reported that agents of the Corporation had even tried to sell wave traps and other paraphernalia to disgruntled fans, so that WJZ's radiations could be suppressed or at least confined to a smaller portion of the dials on their nearby sets. Radical opponents even accused the Corporation of "creating a nuisance in order to benefit by the sale of the remedy." This charge is now generally conceded to have been unjust, and merely the natural activity of local radio agents in meeting the demands for auxiliary equipment to aid in reducing interference. Practically all the Congressmen and most of their constituents are now appeased with the efforts of the Corporation to reduce interference by cooperating with the owners of sets affected.

It's All Settled Now

IN order to have a "show down," the Department called a hearing to which the complainants and the Corporation officials were invited. At this meeting in Washington, complaints against the use of super power by WJZ were shown to be fast disappearing. Secretary Hoover was told that within about three months the engineers of WJZ expected to satisfy all listeners, except perhaps the owners of single-circuit and crystal sets. To date 400 out of 1300 fans living within a radius of ten miles of WJZ, from whom complaints have been received, have been visited by representatives of the Corporation, with the result that all but eleven owners have been satisfied, due chiefly to improvements, made or adjustments suggested.

So the status of the WJZ case remains the same. The Corporation is to continue its experimental broadcasting with 40,000 watts and also its efforts to cooperate with listeners whose sets fail to function adequately in the shadow of WJZ. This has proven the maxim—necessity brought improvements

Betters the Service

HIGH power is making for better broadcast service; having a tendency to over-ride static and increase the range of stations, but its use has been heralded with local complaints wherever it has been tried. To be sure, a certain space on the dials is blanketed by every nearby station, but many other stations on other wave bands always are available. To limit a station's power by the ability of receiving sets to pick it or other stations up, would be putting the cart before the horse. It would be equivalent to preventing new automobiles from using the streets because they were higher powered and capable of greater speed than the low-powered cars in use.

High Power to Stay

ANOTHER defendant of the radio development of high power likens the situation to requiring our highways to be of standard grades so that all motor cars could make the hills. Limiting the power of stations upon the selectivity of receivers, would be as bad as preventing the high-powered cars from pulling the highest hills which less powerful automobiles might not be able to negotiate.

So it appears high power is here to stay; even the super-power as used by WJZ and WGY. We must improve our sets or let the engineers do it. They will keep pace with broadcast transmitter design; the more difficult the problem, the better the inventions resulting.

TEST YOUR TUBES AT HOME *For* UNIFORMLY GOOD RESULTS

Best Tubes Go in R. F.; Then Detector and Finally Audio

By BRAINARD FOOTE

WHEN signals begin to weaken; when the farthest DX stations unaccountably grow faint; when the set seems to lack its wonted pep and punch, don't you cast suspicious glances at the grid leak, "low-loss" coils or tuning condensers? Don't you test out the batteries thoroughly and put in new cells where they are needed?

However, most of us aren't equipped to test our own tubes. Indeed, we usually fail to realize the importance of this matter. In most cases, indeed, the difference between a good set and a poor one, operated under the same conditions, is one of tubes.

We all know that the mere fact of a tube's lighting properly is no indication that it will amplify. I have a dozen fine-looking specimens of radio tubes which may be lighted as merrily as ever but which are just as dead in performances as though the socket held no tube at all! Here's another instance where beauty is more than skin-deep.

Moreover, even in buying brand new tubes, we can't be certain that we are getting 100% amplifiers, can we? They'll operate in a set on the dealer's counter, but have they the highest possible "amplification factor"? Variations in manufacture, practically impossible to overcome, make tubes slightly different, so that even with new tubes, it's desirable to know something of their conditions.

Tube-testing equipment was formerly of a complicated nature and involved several expensive instruments. The radio manufacturers are meeting the popular demand, however, with lower-priced apparatus that brings a tube tester within reach of all radio users—simple instruments that tell the set owner all he requires to know about his tubes and their condition, just as the doctor, by an examination, will tell anyone the state of his health.

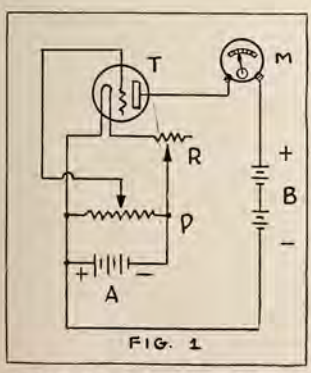

FIG. 1

Fig. 1. Radio tube hooked up with A and B batteries, a potentiometer to vary the charge on the grid and a current meter to record changes in the drain on the B battery. This is a simple testing circuit.

Principles Involved

AND it is even practicable for the radio fan to make his own tester, should he wish to save something on cost and learn a bit at the same time. To understand how the tube tester operates, it's essential to know what happens when tubes go bad. For those who have been over this theoretical ground, a review won't be harmful. In Fig. 1 we find a tube connected to its filament battery A, its B battery B and a rheostat R to control the filament temperature.

Use-Up Thorium

WE probably know what "electron emission" is. At any rate, when the filament is heated by the current from the A battery, it gives off electrons in great profusion. Electrons are nothing but negative charges of electricity and may be regarded as tiny specks of energy. Formerly, the filament was made of pure tungsten and had to be white hot before electrons were emitted. Modern tubes use a filament impregnated with thorium, an element which has the unique property of speeding up the electron emission, so that it is possible to light the filament only to a yellow heat and obtain more electrons than ever. The tube goes "dead" when the thorium is all used up.

Surrounding the filament, which is shooting off its negative particles, is a cylinder called the plate, and this is charged positively by being connected to the plus end of a B battery. The other end of the B battery goes to the filament. The positively charged plate attracts these electrons and as they strike the plate the negative energy is neutralized by an equal amount of positive energy from the B battery, giving place to more positive charges from the B battery and thereby creating a current from the B battery towards the plate of the tube. If we insert an instrument between the B battery and the plate to record the current we can measure the drain on the B battery. An ordinary ammeter is too insensitive an instrument for this work and we use a "milliammeter" which reads in milliamperes or thousandths of an ampere.

But between filament and plate is a coil of wire called the grid, Any charge on the grid will effect the stream of electrons, since they have to dart between the wires of the grid on their way to the plate. Suppose we connect the grid to a potentiometer P, that is bridged across the A battery. If we slide the movable contact, to which the grid is connected, over to the left, the grid is charged positively. It attracts the electrons even more than before, so that the plate current shows an increase, registered by the meter M. But, sliding the potentiometer contact to the right charges the grid negatively. Negative repels negative, so that fewer of the electrons get through the grid and the meter M registers a reduced plate current.

Radio Signals

THE radio signal acts on the grid much like the movement of the potentiometer arm. It corresponds to moving the arm back and forth with extreme rapidity, putting negative and positive charges on the grid in almost infinite succession. Naturally, the most sensitive tube is the one that shows the greatest fluctuation in plate current for a given variation in the voltage of the grid. The signal may be so weak that its change in grid charge would correspond to moving the potentiometer contact back and forth only the distance from one wire on the winding to the next, giving hardly any change in grid charge. However, if a noticeably great change in the plate current results, the tube is a sensitive one. The circuit of Fig. 1 can be used as a tube testing circuit. However, it is not necessary to have a potentiometer to vary the grid voltage. All we need is a method of charging the grid either positively or negatively by connecting it to one side or the other of the A battery and a meter to record the two resulting measurements.

In Fig. 2 we have a plan view of a simple and effective tube testing outfit, with the parts fastened to a simple board about 8 or 10 inches square. We require the following:

1 Socket
1 Milliammeter

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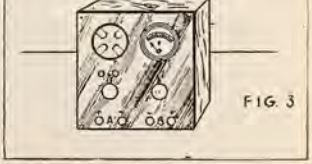
FIG. 3

Fig. 3. How a good portable tube tester can be rigged up. Instruments are mounted on a small panel, with socket set in flush and the panel fastened to a shallow cabinet.

1 Switch knob, lever and two switch points
1 Rheostat
4 Binding posts
1 Wooden base
Few lengths wire for connections

It is not even necessary to have a milliammeter, for a high resistance voltmeter may be pressed into service. A filament voltmeter is better than a B battery voltmeter, since it is more sensitive, although a combination voltmeter, set for the filament scale, will do very well. Of course, using a voltmeter does not give the actual measurements, but it will tell you which of your tubes is best and give a good basis of comparison. Be careful to note that a low resistance voltmeter will not work, and the watch-case type of voltmeter that sells for a dollar or so will not answer at all.

The milliammeter is not so very costly, a good one can be had for prices between $5 and $10. One with a moderate maximum deflection is best—not over 50 mils maximum (mils is the same as milliamperes). Since the tubes used in radio never read more than 20 mils (even on power tubes) it is unnecessary to have a scale with too high a maximum, especialy as this reduces the actual motion of the needle.

The tube socket should be of the right kind to fit the tubes you are using or wish to test. If you prefer to have the tester "universal," simply use a standard socket and procure a set of adapters to take the WD-11, 199, etc., in each case using, of course, the proper sort of A battery. The rheostat should be appropriate in resistance to the type of tube selected, or for the universal tester, use a 30 ohm rheostat with a carrying capacity of at least one-half ampere.

The parts are fastened to the base as indicated in Fig. 2. It is very important to mount the two switch points far enough apart so that it is impossible for the switch arm to rest on more than one of them at a time. Should it touch two, it would short-circuit the A battery momentarily. This wouldn't damage the tube or "B" battery or milliammeter, but might harm the A battery if left on for a while.

The connections are plainly shown, so that little explanation of these is called for. A more sumptuous-looking model of tube tester is outlined in Fig. 3, where a small panel (at least 6x7 inches) is affixed to a heat wooden box or cabinet deep enough to contain the tube socket and allow its rim to extend through a circular aperture in the panel and stand flush with the panel. The wiring and mounting are so simple that anyone can construct a device like that of Fig 3 in short order.

How To Test Tubes

FIRST of all, connect the A battery posts to the type of A battery required for the tube selected. For instance:

UV 201A or C 301A types, 5 volt, ¼ amp.—6 volt storage battery

WD-11, WD-12, C-11, C-12 types, 1½ volt, ¼ amp.—one 1½ volt dry cell.

UV-199, C-299 types, 3 volt, .06 amp. —4½ volt dry battery, of 3 dry cells in series.

Try a tube in the socket to see whether it lights O. K. Then connect up a 45 or 90 volt B battery to the other posts. The 90 volt battery is preferred, since it gives greater readings and differences in tubes are more noticeable. Detector tubes may be compared with lower plate voltages, of course, but when the same type of tube is used throughout the set, 90 volts is suitable for the tester B voltage.

Next get a sheet of paper and pencil and arrange a row of numbers, according to the number of tubes you have on hand. Also number each tube by scratching a number on the base or writing it on the label. Continue this numbering system as you buy new tubes and keep the data in a small note-book in the radio cabinet where you can keep track of the way your tubes stand up.

Then insert tube number one, lighting it to the normal brilliancy and leaving the rheostat at this setting permanently. Be sure the A battery is charged or new. If in doubt as to the filament current, use a high resistance voltmeter across the F posts of the socket to measure the filament voltage. Should this be the voltmeter you intend using as the substitute milliammeter, you may disconnect it from the usual circuit of the tester long enough to measure the filament voltage and then put it back, leaving the rheostat fixed from then on.

First move the switch S to the right and note the reading of the meter when the grid is charged negatively. Then move it to the left and observe the higher reading as the grid becomes positively charged. Suppose your tube readings line up something as follows:

Tube Number	*—Milliamperes+*	
1	*2*	*9*
2	*3*	*10*
3	*1*	*2*
4	*0*	*1*
5	*3*	*9*
6	*2*	*10*

Analyze Results

HOW would you analyze these results and what tubes would you select as best? No. 4 you may tell at once is perfectly useless. Perhaps it may be improved to usefulness by treating it with a tube reactivator or rejuvenator, but even that is doubtful as the tube appears practically "gone." Keep in mind the fact that the tube showing the greatest difference between the two readings has the highest amplification factor and is therefore the best amplifier of the lot. This is certainly tube No. 6, having a difference of 8 and maximum of 10. Next we have either No. 1 or No. 2, both of them having a difference of 7. But since No. 2 has a higher maximum, it is probable that it is more suited to an amplifier socket and that No. 1 would make a good detector. No. 5 is pretty good but No. 3 is another "dud," though not quite so bad as No. 4.

A comparative test like this is most illuminating. You can then use the best tubes, discard or attempt to reactivate the others and replace them. Reactivated tubes can be tested against the good ones, too. In every case, a new tube should be tested before it is used and its measurements noted down. In case you question the dealer's statements about the sensitivity of the tube, you can back up your words by taking your tube tester to him

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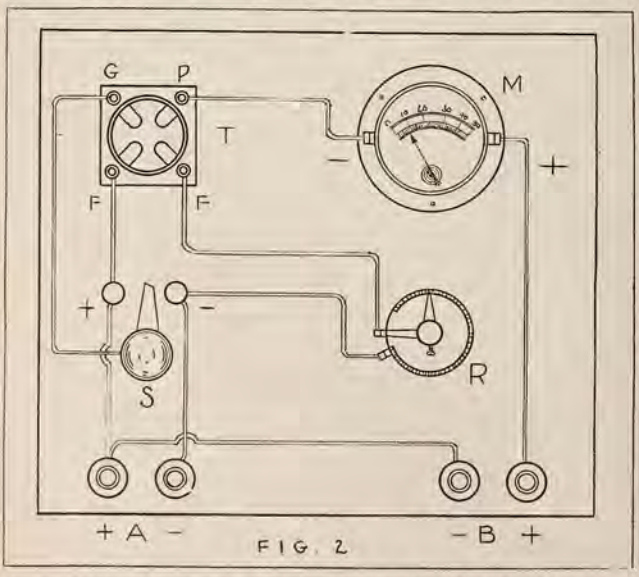

FIG. 2

Fig. 2. A practical home tube testing arrangement. T—Tube socket; M—milliammeter (or high resistance voltmeter); R—rheostat; S—switch lever and two contact points; A—filament lighting battery posts; B—plate battery binding posts. Note polarity of the meter. Switch points must be far enough apart so that lever can touch only one at a time.

Using *Single* Dial Control in a Ten Tube *Receiver*

Loose Coupling Between R. F. Stages Makes For Better Selectivity

By H. C. FORBES

RECEIVING sets in the past have been designed and built to satisfy a large and varied number of requirements, ranging all of the way from the set that is just "built to sell," to the set that is openly designed to be the "best set at the price."

One manufacturer, however, has conceived a new idea—that of building a set that embodies what is considered to be the highest type of refinement in every detail regardless of cost. The selling price is then determined only after the acme of perfection has been reached. Such a set must first be mechanically perfect, and must embody the same nicety and perfection of mechanical refinement as is sold in the highest grades of any manufactured merchandise. Given this construction, the electrical circuits must of course be similarly designed to secure faultless operation.

The Zenith DeLuxe is admittedly a set constructed in the attempt to build such a receiver. The four fundamental requirements of an ideal receiver are considered to be:

1—Single dial control.
2—Exceptional selectivity.
3—Absolutely faithful reproduction.
4—Sensitivity limited only by the "interference level."

In order to secure a truly single control receiver it can be readily understood that more radio-frequency amplification is needed than is required in a multi-control set, since any slight inaccuracies of the various stages operated by the single control must of necessity sacrifice a certain slight amount of volume. The first requirement of any single control receiver is then more radio-frequency amplification.

IT IS A WELL-KNOWN fact among radio engineers that the only satisfactory means to secure real selectivity (meaning of course that degree of selectivity which will cut through a powerful local station a few hundred feet away and bring in a distant station on the adjacent frequency band) is to use a larger number of tuned circuits loosely coupled together. This method has long been known as securing the "concommitant selectivity" of a group of tuned circuits. Now the best possible way of utilizing a number of tuned circuits loosely coupled together is to again use tuned radio-frequency amplification, as each tuned stage constitutes one of the tuned circuits so necessary to secure super-selectivity.

Everyone of course is aware that the fundamental purpose of tuned radio frequency amplification is to increase the sensitivity of any receiver, so it appears that the basic requirement of an ideal receiver is to simply add more tuned radio-frequency amplification. It might also be mentioned that radio frequency amplification, of the type where each stage is not pushed to its utmost in the attempt to gain volume, is very desirable in order to secure perfect reproduction, as distortion in the radio frequency amplifier will then be absent.

A further requirement of a receiver in which perfect reproduction is to be obtained, is that a suitable audio amplifier be used, one which need not be "pushed" so hard in the effort to secure more volume that quality is thereby sacrificed.

SUCH a design has been followed in the receiver being described. Ten tubes are used, with five stages of tuned radio frequency amplification, a tuned detector, and four stages of very low ratio transformer coupled audio amplification. The five tuned radio stages and the detector stage are all tuned by variable condensors operated from a single shaft. The circuit used is closely identical with former Zenith circuits, which use a small rotor coil in the plate circuit of each stage coupled with the succeeding grid circuit. This rotor coil is operated whenever the main tuning control shaft is turned, and automatically maintains each stage of the amplifier

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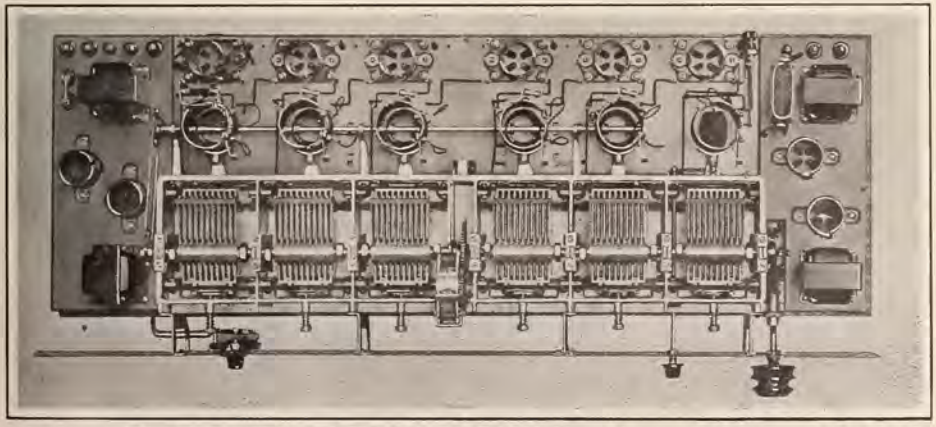

In the photograph above is shown the "chassis" of the ten tube receiver. Control is accomplished by means of the knob at the right which turns all condensers simultaneously

at the point of best coupling as the wavelength is varied. All of the rotor coils are mounted on one shaft, which is in turn driven from the main condenser shaft by a link mechanism. Special one to one ratio audio transformers having an unusually large iron section and winding space are used. The merit of any audio frequency amplifying transformer is measured pretty largely by its primary inductance, and it may be pointed out that the transformers used have a primary inductance of 75 henrys, whereas in the majority of other transformers this inductance is less than 10 henrys. An output transformer to match the loudspeaker units which are supplied with the sets is incorporated in the receiver. This transformer incidentally removes the direct-current components from the loud speaker units.

THIS receiver has only three knobs or adjustments on the front panel, and there are no internal or hidden adjustments. One of these knobs is the main tuning adjustment. Another knob serves to operate the volume control, and this same knob also serves as the "Off and On" filament control. The third knob is a vernier control on the first radio frequency amplifier which is used to compensate for the various sizes of antenna that are encountered in different locations. Once placed in its proper adjustment, this knob needs no further attention. In operation, all of the tuning is done with the right hand, while the left hand is used to control the volume of the various stations as they are tuned in.

The sensitivity of this set is equal to or better than that of any other receiver on the market, irrespective of the number of controls or tuning adjustments. It will produce the same or better volume from any given station than may be secured from other receivers, even though the other receiver is used in its greatest volume (least selectivity) position.

The selectivity is such that a frequency band only approximately 10,000 cycles wide is actually received. This means that even though this receiver is used on an outside antenna very close to a powerful local broadcasting station, it is possible to receive distant stations on practically adjacent frequency bands. Often times it will be found that two distant stations are transmitting on wavelengths so close together that an audible beat-note or whistle is also heard and on most receivers the programs from both of the stations are hopelessly garbled together. By careful tuning however, it is nearly always possible to satisfactorily separate the two stations, since the lower sideband of the lower wave station, or the upper sideband of the higher wave station may be received at will. An experienced musician or an acoustic expert will note that on receiving even local stations, it is possible to so operate the receiver that certain high or low notes may be excluded. Thus, by tuning somewhat off of the wavelength of a local station it is entirely possible to separate the high notes of a violin solo from the deeper bass notes of a piano accompaniment. When tuned in the normal manner, of course, the full sideband is received, and perfect reception occurs. Such selectivity is, of course, of great advantage in congested district such as New York, Chicago, Los Angeles, and other similar cities.

WITH the one tuning dial, it is possible to run over the entire broadcast range of the receiver in less than a minute and to note the nature of the program from every station in operation at the moment. Oftentimes this means that fifty or more stations are received within that space of time.

A further provision is the low-wave adjustment. The normal wavelength range of the set is from somewhat below 200 meters to 550 meters. A group of small switches are provided, however, which, if all are closed, reduce the wavelength range so that the set covers the band from 80 meters to 225 meters. While at the present time there are no broadcast stations operating exclusively outside of the 200 to 550 meter band such an assignment is probable for the future, and the ideal set should be capable of receiving on these wavelengths. At the present writing, the station of the General Electric Company, WGY, at Schenectady, New York broadcasts on 109 meters simultaneously with the regular broadcast on 370 meters. In many sections of the country the 109 meter transmission may be easily received on the low-wave adjustment during the daytime at distance so great that the regular 370 meter wave is not audible.

The mechanism receiver has been very carefully worked out from the standpoint of the mechanical engineer. The fundamental problem in a receiver of this type is that the condensers shall run very closely alike in capacity over their entire wavelength range, and that they shall not only be capable of holding this adjustment during commercial handling and shipment, but shall also hold their adjustment indefinitely without regard to changing temperature and atmosphere conditions. The frame of the six-unit variable condenser (which also serves as the chassis of the set itself) is one of the largest and most intricate aluminum die-castings ever made. Within this frame are mounted the all die-cast stators of the six condensers, which have been made of a special construction to eliminate even the slightest mechanical variations.

ROTORS are also individual die-castings clamped upon a large sized ground steel shaft. The shaft itself is supported for end-thrust in its center, so that expansion and contraction due to temperature changes will be minimized. Seven cast and fitted babitt-metal bearings are used on the single shaft, to eliminate any possibility of variations from shaft misalignment. The condenser rotor shaft is operated from the front of the panel by a double-threaded worm and wheel drive, in which a special mechanism has been used to eliminate all end-play and back-lash. A separate friction adjustment is provided so that the "feel" of the knob may be adjusted independently of the condensor bearing adjustments. The inductance coils are attached to the condenser framework by metal brackets, and a steel shaft is run lengthwise of the frame through the lower part of each of the coils (with the exception of the antenna coil) which serves to support and to rotate the plate circuit rotor coils in accordance with the movement of the main condenser shaft. These two parallel shafts are connected together with a link mechanism, similar to that used to connect the drivers of the steam locomotive. The antenna compensating vernier consists of a rotor coil of small dimensions within the first stage tuning inductance coil. This rotor together with the tuning inductance constitutes a miniature variometer. The rotor is operated by a link mechanism connecting the shaft of the rotor to the shaft which extends through the condense frame to the front panel.

The dial drum is driven by gears operating from the main condenser shaft, and back-lash in the gears is removed by a helical spring.

MECHANICAL problems in this receiver have been so carefully worked out, that the assembly of the set at the factory is extremely simple. Special machinery has been designed and built for the machining and assembly of the various parts so that unskilled labor can complete the assembly of the entire set and at the same time maintain the high degree of accuracy required. For instance after the condenser unit has been assembled in the fixtures which serve to locate the rotor and stator units with respect to the frame, the variations in capacity of the condenser at any part of the scale will not exceed 1-½ micro-microfarads from the highest to the lowest. Any variation greater than this is cause for rejection, and the greater majority of the condensers actually run alike within one micro-microfarad at all parts of the capacity range. This is an accuracy of ¼ of 1% of the maximum capacity.

The tuning inductance coils of course must be balanced so as to be exactly alike just as acurately as are the variable condensers. Special forms of alternating current bridges have been designed and built for both the condensers and coil inspections. These bridges are capable of measurement of errors of one part in twenty thousand, and are of special and unique, construction. Shielding, fifter circuits, and special amplifiers are all parts of this bridge equipment. Both types of bridge are so constructed as to be "fool-proof" and are readily operated with reliability by persons with no particular knowledge of such devices.

When the condenser assembly with its associated parts is completed, the audio bases and tube bases are assembled to it, and the shielding framework is put into place.

Each cabinet contains battery compartments, and is equipped with dual loud speakers to adequately take care of the entire musical range.

A pilot light is mounted within the cabinet to illuminate the dial, and this light is controlled by the switch on the panel which places the set into operation.

Horizontal Reception of Broadcast Waves

E. F. W. Alexanderson, radio consulting engineer of the General Electric, at Schenectady, who discusses the subject for the readers of this magazine.

Dr. Alexanderson has been kind enough to favor Radio Age with a brief statement as to the possibilities of horizontal reception of broadcast waves, as well as a discussion of the recent paper by Greenleaf W. Pickard on the "Polarization of Radio Waves."

This subject holds considerable interest for the average reader and for the dyed-in-the-wool experimenter it opens a new field of activity. Dr. Alexanderson's paper shows the manner in which the readers may make their own tests to determine the value of the different types of reception.

—The Editor.

WHETHER horizontal polarized reception can be used to advantage in broadcast reception between 200 and 500 meters has not yet been fully determined. From evidence presented in Dr. Pickard's paper at the January meeting of the I. R. E., one would conclude the horizontal field is negligible on those wave lengths. This is undoubtedly so in most cases, however, I pointed out in my discussion of Dr. Pickard's paper that the apparent changes in the direction of wave propagation which have been noted at all wave lengths including the transoceanic waves, may be explained by horizontal polarization.

Broadcast listeners may easily make some tests to throw more light on this subject. These tests can be performed by any type of receiving set using an ungrounded loop antenna. Under normal conditions when only vertically polarized radiation is present this loop antenna should give correct direction finder bearings. In this case the loop gives a maximum signal when its plane is pointed towards the transmission station and zero at right angles. When, on the other hand, a horizontally polarized wave is present the direction finder behaves in an abnormal way.

SOMETIMES it is found that the loop gives maximum and zero indication in unusual positions. If the angle of shift should be as great as 90 degrees it is an indication that the wave is purely horizontal. In other cases the maximum remains in the normal position but the position that should give zero gives a fair signal strength or the signal appears to be equally strong from all directions. In this latter case, we have a circularly polarized wave which means that there is a horizontal and a vertical component 90 degrees out of phase. Thus whenever the signal reception is fairly strong in the position of the loop which should normally give zero, this indicates that horizontally polarized waves are present.

IT is sometimes observed that the horizontal wave is strong at the moments when the vertical wave fades and in such cases the signal can be brought back by turning the loop from the normal to the abnormal position. This is however an exceptional case although not so very rare and it would be interesting to know whether broadcast listeners will find practical advantage in this procedure to minimize fading. Instead of receiving the horizontal wave on a loop oriented at right angles to its normal position, a horizontal Hertzian antenna may be used. The Hertzian antenna is more difficult to operate but has the advantage if properly adjusted that it receives only the horizontal wave component. It is thus immune to the vertically polarized static which is received by the loop.

MR. PICKARD mentions in the introduction to his paper that it has been assumed from the inception of the radio art that if the wave was vertically polarized at its origin it would remain so at all distances and that the measurements of Austin and others confirm this assumption. There can be no doubt about the unanimity of opinion that has existed on this subject but a number of facts have recently been brought out through work on polarization of short waves which leads us to think that the evidence collected in the past may be given a different interpretation.

Extensive systematic measurements undertaken by A. Hoyt Taylor, Austin, and others have shown that direction finder bearings on long wave stations show great irregularities during the hours of darkness. It has been assumed that these irregularities meant actual change in the direction of wave propagation. We find now in dealing with short waves that such apparent changes in direction of wave propagation can be reproduced regardless of daylight by controlling the plane of polarization of the radiated wave. When a wave is radiated from a horizontal loop, it is found in the immediate neighborhood of the antenna that a direction finder gives bearings at right angles to the direction where the station really is. In other respects, the instrument responds as if it were receiving an

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ordinary vertically polarized wave. The loop gives maximum response in the vertical position and nearly zero response in the horizontal position. This evidence may be coupled with the experience in aviation practice, according to Capt. W. H. Murphy, that a direction finder station on the ground may give false indications on an air plane as great as 45 degrees or more. The false indications have proven to be the greatest if the antenna is allowed to trail horizontally, and if the air plane is flying at right angles to the direction from which bearings are taken. The antenna is therefore held as vertical as possible by a weight and the personnel is instructed to take bearings only when the plane is pointed towards the observing station. In the light of what we now know, these experiences can clearly be interpreted to mean that an antenna trailing at right angles to the line of observation radiates horizontally polarized waves and that the false indications of the direction finder are due to the wave polarization. The inference from this is also that the apparent changes in direction of long waves observed by Taylor and Austin are due to the presence of horizontally polarized wave components. In fact we may say that this apparent change of direction of propagation is a characteristic by which the horizontally polarized wave may be recognized.

IT remains to explain why the horizontally polarized wave is received at maximum intensity with the loop in the vertical position. The reason for this is the following:

The electromotive forces of the horizontally polarized wave are parallel to the ground. However, close to the ground we cannot have any difference of potential because of the short circuiting effect of the ground. However, the horizontal electromotive forces are transformed into currents in the ground. These ground currents are at right angles to the true direction of wave propagation. The fact that the loop gives maximum response in vertical position at right angles to the direction of wave propagation is explained by these currents in the ground which are also at right angles to the wave propagation and therefore inductively related to such a loop. From this reasoning, it can be concluded that the false direction indications are to be expected only in the close proximity to the ground. Some measurements have been made which confirm these conclusions. A set of tests was made exploring the characteristics of a wave radiated from a horizontal loop by making frequent measurements to within ten miles of the station. The composite picture which was obtained from this test was a continuously twisting plane of polarization with alternate points of plane and circular polarization. At intermediate points the polarization was eliptical. The plane polarization was indicated by sharp direction bearings and circular polarization by equal intensity from all directions. The observations indicating plane polarization gave bearings sometimes towards the transmitting station and sometimes at right angles.

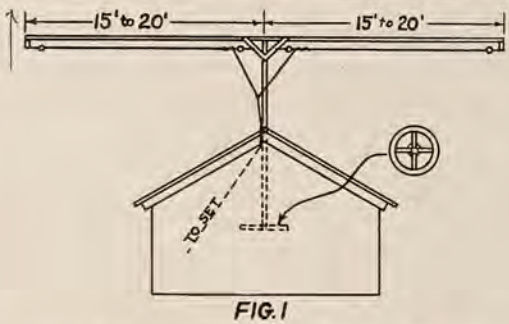

FIG. 1

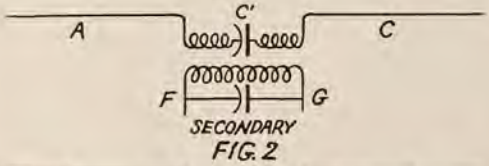

FIG. 2

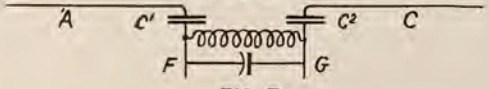

FIG. 3

Three figures are shown above to help the broadcast listener who desires to experiment with horizontal reception of broadcast waves. In Figure 1 is shown the general idea of a Hertz antenna, which can be swung in any direction desired. It can also be arranged so as to swing up and down over a limited range for tilting, although the latter is not absolutely essential. In Figures 2 and 3 are shown the method of coupling from the signal circuit to the receiver, both of which figures are self-explanatory.

BESIDES these measurements around the vertical axis, observations were made with the loop in the horizontal plane. On flat fields the horizontal position gave nearly zero response. At the top of a steep hill and a high bridge the response in the horizontal plane was equal to the vertical.

These results indicate the presence of a horizontal and a vertical wave component with different velocity of propagation. Whenever the two waves are in phase, they give plane polarization When they are 90 degrees out of phase they give circular polarization. The observation with the loop in the horizontal position on the top of the hill and the bridge show that even a moderate elevation is sufficient with short waves to reach the point where the horizontal electromotive forces are not short circuited by the ground.

All this leads me to think that horizontal polarization is not confined to short waves only. Direct observation of horizontal polarization at long waves could be made only at great heights but indirect observation through the effect of ground currents can be made by ordinary direction finders at any wave length. If this theory is correct it means that the irregularities of direction finder indications recorded by A. Hoyt Taylor and L. W. Austin on long waves can be explained by the presence of horizontally polarized wave components.

RADIO AGE feels the question raised by Dr. Alexanderson as to the possibilities of horizontal reception on broadcast wavelengths, can be answered to the satisfaction of the readers of this magazine by a little experimentation on their part. This work should appeal to our readers because it will be more in the line of research (no matter how humble), and yet simple enough not to require a complete technical education. In addition it will be a pleasant diversion from just listening alone to programs as with the listening there will be combined the act of making notes of differences in volume on received signals.

There are probably enough loops in use so the loop mentioned by Dr. Alexanderson will not be a stumbling block to the carrying out of the experiments. The use of an audibility meter, which is rather expensive, is necessary for accurate measurements of signal strength differences, but in its absence the reader may, for his own information, arrange a table of audibilities with which he can soon become familiar. For example an extremely loud signal may be designated with the numeral 10, a medium signal with the figure 5 and faint signal at 1.

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Home Service *for* Radio Sets

Analogy of Radio and the Automobile is Depicted

By MORRIS S. STROCK*

A RADIO set is in one respect very similar to an automobile. Both require service, and this is true irrespective of how good the product may be. Since the automobile is so universally known and used, it is advantageous at the beginning of this talk to take a little time to bring out this point of comparison. Good service to a radio set does not necessarily mean that one needs to be a radio expert any more than one needs to be an experienced mechanic to give proper care to his car.

The majority of automobilists do not have an intimate knowledge of the construction and operation of their cars. They have, in fact, only a general idea of the various parts and their relation to one another; beyond this their knowledge is rather vague.

This large group of motorists may be subdivided into two fairly distinct classes. The first class includes owners who do not attempt to learn any but the most important facts about the care of their cars. They know when to replenish the supply of gasoline and when to add oil to the engine, and they are generally aware of the need of water in the radiator and air in the tires. Such persons go to the service station for all other items of attention.

The second class of motorists have a more extensive knowledge than this; they know when to drain out the old oil from the crankcase and add a fresh supply; they test the air pressure in the tires quite regularly and give some attention to the storage battery; they attend to miscellaneous details of lubrication and minor adjustments.

CONSIDER a motorist taken from each of these two classes, which one secures the most dependable service from his car? Quite without fear of contradiction, the motorist taken from the second class.

Reference is not made here to still another group of motorists who are almost as familiar with their cars as expert mechanics. Such persons almost always get satisfactory results from their cars but the results are not necessarily any better than those secured by motorists belonging to the second group who turn to a reliable service station for adjustments or repairs extending beyond their knowledge. It is also true that this group of motorists is not in danger of forming the habit of tinkering.

You can give home service to your radio set without having an intimate knowledge of radio or of the theory of operation of the circuit. If you do this you will not neglect the more common adjustments and repairs which are necessary for consistently satisfactory results. When trouble occurs which extends beyond your knowledge or experience you may fall back upon the service from a reliable radio shop, preferably the store where the set was purchased. By this procedure you will be placing yourself in the class of owners of radio sets which corresponds to the second class of owners of automobiles just mentioned. As in the case of automobile owners, no reference is made here to that group of radio enthusiasts who may be collectively classed as "experts." The majority of such persons build their sets (although it must not be inferred that broadcast listeners of limited knowledge do not) and in many instances their home product gives results equal to those obtained from the better class of factory built sets. However, in this experimental group of broadcast listeners, the habit of tinkering is all too common, and right here ends the comparison with the well-informed motorist who tinkers with his car. "Tinkering" with the radio set may be defined as the habit of meddling when there is no actual trouble in the circuit,—in other words, when the causes of the difficulty are external. Trouble with an automobile is invariably of the tangible sort; "trouble" in the radio set may be entirely imaginary. This emphasizes the importance of keeping in mind the fact that considerable variations in the strength of signals from distant stations will occur on different nights or even over very short periods of time on the same evening.

BEFORE discussing the methods of trouble hunting, which from the nature of this talk must be applicable to all the more general types of receiving sets, let us divide the receiving apparatus into four distinct components. These are: the antenna or "aerial"; the ground connections; the source of power supply to the electron tubes in the set; the receiving set itself. One may say that this division is too general since the receiving set itself consists of many very special parts, each with a special duty to perform. It is true that the receiving set is in itself, complex; nevertheless the general classification given above is all that is needed in discussing the preliminary steps in trouble hunting. Consideration of the integral parts of the receiving set will be given as required, bearing in mind that this is not a technical treatise and that trouble arising from derangements of a complex nature or trouble peculiar to a particular type of receiving set should be referred to a reliable radio shop.

The method of diagnosis to be described will generally indicate one or more of the following conditions: (1) when the difficulties are entirely outside the receiving equipment; (2) the source of the trouble, if within the receiving circuit; (3) when the correction of trouble is outside the scope of "home service." In detecting one of these three conditions, attention will be given in turn to each of the four "parts" of the receiving equipment just mentioned.

LET us assume that the radio set has been giving satisfactory service for some time and then becomes noisy or insensitive. These two conditions cover a multitude of sins. However, we will first turn our attention to the antenna, which for our purpose is specifically defined as the total length of wire leading out from the antenna binding post of the receiving set including the lightning arrester or grounding switch and all wires connecting to it. We will attempt to ascertain first of all whether or not the difficulty with the set is outside the complete receiving circuit.

Disconnect the antenna lead-in from the receiving set (receiving set adjusted for normal operation) and note if the disturbing noises are considerably reduced in intensity or cease altogether. If so, you may be reasonably sure that these noises are due to external causes. To discuss such noises in detail is quite outside the scope of this talk. Their source may possibly be in your own home,—electric motors or electric heating or cooking appliances. Again, these noises may be caused by more distant electrical disturbances of many sorts, or heterodyne whistles from broadcasting stations or receiving sets. Just before disconnecting the antenna you must note very carefully the character of these noises, otherwise you may confuse them with noises originating in the receiving circuit which are caused by its being thrown into an unstable condition by the removal of the antenna lead-in. With some receiving sets a readjustment to a condition of less sensitivity may be necessary before the antenna is disconnected.

If the test just described fails to definitely locate the source of trouble, it should be repeated by disconnecting both the antenna lead-in and the ground wire from the receiving set. This brings up the question: "Assuming that the disturbing noises are now shown to come from the receiving circuit, how can one tell that they are not caused by some defect in the antenna or in the ground connection?" This question is a natural one, and since the antenna and ground are a part of the receiving circuit we are ready to begin the tests which bear

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upon the second point in the method of diagnosis—the location of the trouble within the receiving circuit.

An apparently "insensitive" condition of the receiving set may be caused by a loose connection in the antenna or around wires. It is a simple matter to examine the ground wire and determine if it is intact. This should be done while the set is tuned to the local station, and particular attention should be given to the point of contact of the ground wire with the water or steam pipe. In the event of an insecure contact, a grating sound will be produced in the phones or loudspeaker when the wire is shaken slightly.

An examination of the antenna is, for evident reasons, not nearly so convenient, and indeed many broadcast listeners prefer to leave this to a radio service man. This action should be taken only after tests upon the receiving set itself fail to indicate the difficulty. If the antenna has been carefully installed, it is not likely to give trouble. Most antennas are equipped with a lightning arrester, and this is a possible source of difficulty. While the receiving set is adjusted as for normal operation the wire leading from the lightning arrester to ground should be disconnected. If this causes a noise in the loudspeaker it indicates that the lightning arrester is defective.

SO FAR no mention has been made of the coil antenna, more commonly called a "loop," which in some receiving sets replaces the antenna and ground. Since this is simply a coil of wire the probability of its being defective is extremely small. If one terminal of the coil antenna is connected to one terminal of a B battery, and terminals of the phones or loudspeaker are touched to the free terminals of the coil and B battery, a sharp click will indicate that the winding is continuous.

We will now turn our attention to the power supply for the electron tubes in the receiving set, and although it may seem out of order to place this ahead of the receiving set in the discussion, the reason is that there is a greater probability of trouble here than in the set itself. The trouble originating in either the receiving set or the power supply may be evidenced by noise, insensitiveness, or silence.

The power supply to the receiving set may come from batteries or from an attachment to the electric lighting circuit. The latter device is less likely to get out of order. An inspection of the rectifier tubes (in case alternating current is employed) to see that they are making proper contact in the sockets and that they are not burnt out and an examination of all external connecting wires is about all that can be done in the home service plan. This failing to disclose the trouble, the device may then be referred to the service station provided the subsequent examination of the set discloses no further difficulty.

The battery supply for the receiving set may be storage batteries or dry cells. Examine the wires leading from the batteries to the receiving set to ascertain that there are no loose connections or misplaced wires. Storage batteries should be tested with a hydrometer for condition of charge. If the charging operation requires disconnecting the wires leading to the receiving set, be sure that these connections are not reversed.

DRY cell A batteries are rather limited in their length of service. Without having recourse to an ammeter, an idea of their condition may be obtained by noting the settings of the rheostats on the receiving set, assuming that the set is capable of receiving a local station. If the signals increase in volume as the rheostats are turned all the way around to the right, the dry cells should be discarded and replaced with new ones.

B batteries should, if possible, be tested with a voltmeter, and if the voltage of a B battery unit normally registering 22.5, drops below 17 or 18, the battery should be thrown away. The term "noisy" as applied to a B battery is a misnomer. The battery itself can produce no noise, but it may be in such condition that it delivers an unsteady current. Touch the tips of the phone cords to the B battery terminals, being careful to secure firm contact, and listen for any sounds other than those caused by the operation of making connections. This test will, incidentally, serve to indicate a break in the circuit of the phones or loudspeaker.

The tests which have been discussed may disclose the fact that noise in the radio circuit is due to external causes or they may indicate that the source of trouble is in the antenna, ground, or power supply. In the latter event, if the trouble can not be located and corrected, it will be necessary to call upon a service station.

We will now consider the receiving set itself. Confining our attention to the most common sources of difficulty, which happily do not require an extensive knowledge of radio for their detection. The examination of the source of power for the electron tubes should have revealed any difficulty which would render the set entirely "dead." With this thought can be mentioned that unfortunate mistake of connecting the plate supply voltage to the A battery binding post of the set. It goes without saying that in this case it will be quite necessary to consult the radio store, not for service but for new tubes. If the tubes are intact and the set is incapable of producing sounds, it probably has some rather serious derangement which can not be readily located by the home service plan.

The most common source of trouble within the radio set is in the electron tubes or the sockets. Connect the phones to the set so that the minimum amount of amplification is used, then ascertain which tubes are functioning, by removing all others from the sockets. Let us say that the set is so constructed that two tubes are now in use. Substitute as many tubes as are available in turn in these sockets and note any difference in sounds produced in the head phones. This will not only serve to locate a defective tube but it will frequently disclose the fact that the tube is making poor contact in the socket. Hence, examine the contact springs in the sockets and the pins on the tubes and if necessary clean the contact surfaces with fine sandpaper.

The phones or loudspeaker are now plugged in so as to include another stage of amplification and the same tests are repeated. This procedure will often indicate that the trouble is in the audio stages of the receiving set.

ALTHOUGH the nature of this talk prohibits going into a detailed discussion of all the various parts of the receiving set, nevertheless attention may be called to one particular part which is well known to the non-technical person, namely, the grid leak. This will usually be found mounted near one of the electron tubes. It should be removed to ascertain the effect upon any noises in the headphones. If possible, another grid leak should be substituted. Among other parts of the receiving circuit which may receive attention here are the variable condensers. If dirt has accumulated between the plates of these condensers it should be carefully removed. Loose connections to the rotating condenser plates are often a source of trouble. This will generally be made evident by rotating the condenser knobs and listening for scratchy sounds in the headphones. The reference to the variable condensers brings to mind the fact that every radio set should have a careful overhauling at least once a year, and although details of this overhauling process can not be given here, it includes the important point of examining all connecting wires in the circuit to reveal any loose or broken connections.

In attempting to locate any difficulty with your receiving set which falls under the home service plan, keep in mind the fact that poor reception may be due to conditions outside your control. In many cases it would be preferable, instead of jumping to the conclusion that something has gone wrong, to get in touch with your neighbor and compare the results obtained with your set with the results which he secures from his own equipment. In some instances at least you will find that some apparent trouble in the radio circuit was due in part to a period of perhaps three or four days when receiving conditions were unusually poor. The radio set is, as previously suggested, similar to an automobile in that it requires servicing, but on the other hand the troubles arising from the use of the radio set may not be at all comparable to troubles with an automobile since in the former case they may be due to conditions beyond your control.

AS A CONCLUDING remark to these suggestions for home service to the radio set may be mentioned a general procedure, which, for lack of a better name, we can designate as the "substitution" method. This is in fact merely an application of good common sense and many of the suggestions given in this talk are quite in line with this idea. However, to add a little emphasis to this method of procedure, let it be suggested that in considering the four parts of

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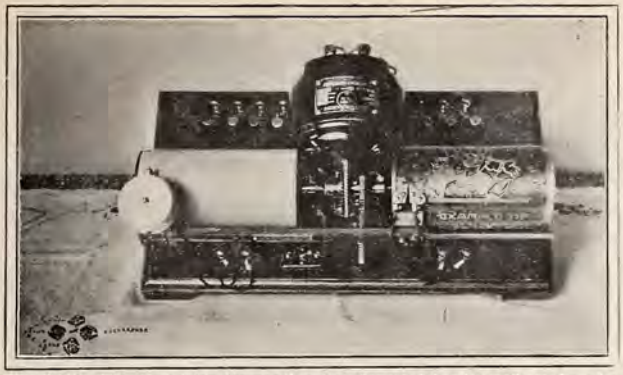


Electrically driven machine for sending and for receiving by radio or by wire, pictures, messages, sketches, maps, etc.

Amateurs *Take* Up *Radio* Vision

New Field Opened by Jenkins' Invention

By S. R. WINTERS

JOHN L. Reinartz, who demonstrated the utility value of very short wave lengths and whose ingenious high-frequency work facilitated communication between the Donald McMillan Arctic expedition and amateurs the world over, is now experimenting with the transmission and reception of pictures, sketches, maps, and diagrams by radio. In other words, this well known radio amateur has invaded the comparatively new field of radio vision. This is considered significant because when radio amateurs seriously attack this problem, it means that the science of seeing by radio is transferred from the experimental laboratory to the field of practical service.

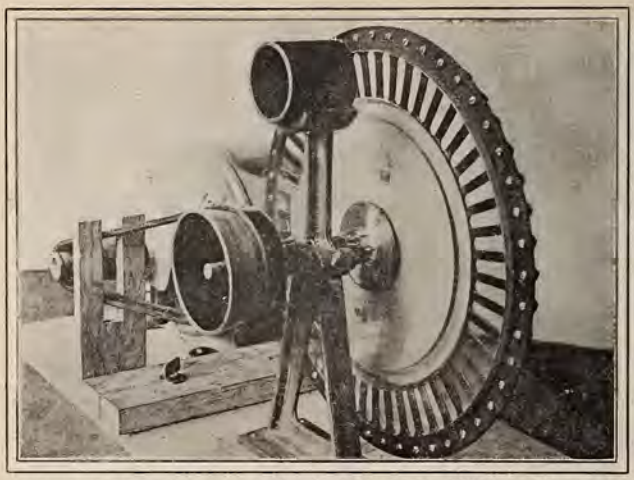
John Reinartz and his neighboring radio amateur, George H. Pinney, have obtained two duplex "photogram" machines from C. Francis Jenkins, the inventor, and the sending and receiving of script, sketches, maps, etc., is in contemplation between these two amateur stations in the vicinity of Glastonbury, Connecticut. The distance intervening these stations is approximately seven miles. The inclusion of a Jenkins' duplex photogram machine, so called, in the radio equipment of these amateur stations means that when these pioneers in wireless development tire of exchanging telegraphic code with amateurs in Australia they can switch to the picture-transmitting unit.

The Jenkins duplex photogram machine, which simultaneously sends and receives, by radio or by wire, photographic copies of messages, letters, sketches, maps, pictures, etc.

THESE photographic impressions may take the form of a pencil-written greeting, a sketch of the antenna system at the respective stations, a map of the conditions surrounding the stations, or a picture of the transmitters in use. Or, if these amateurs are given to humor, they may entertain each other by alternately transmitting from each station ludicrous cartoons. Irrespective of the subject thus treated, there will be an irresistible fascination in this unbroken ground of experimentation. And the latter is aptly descriptive, because the approximately 20,000 bona fide amateurs are on the threshold of a new and fruitful period of experimentation.

PRINCIPLES underlying the mechanism of this equipment for the transmission and reception of sketches by radio was for the first time described by this writer. Since that time reams have been written in magazines and newspapers relating to the invention, but with certain modifications in minor details, such as the means of copy the sketch or map, the mechanism remains unchanged. It fits the following description:

The machine is connected to a small electric motor which engages with a gear as a means of driving a shaft. On each end of this shaft a brass cylinder is mounted. A second threaded shaft engages with the cylinder shaft through a pair of gears. Mounted on this threaded shaft is a pair of arms connected together with an insulated bakelite bar. The rotation



A laboratory test set for demonstrating Radio Vision, the ability to see in one place what is happening in a distant place. A rotating ten inch disc carries a plurality of lenses in front of a Prismatic Ring. The black box contains the light element which makes the picture on the small receiving screen (not shown)

of this threaded shaft moves the bar of bakelite longitudinally with respect to the cylinders. Furthermore, mounted on this insulated bar are two contact fingers, one coming in touch with the cylinder used for sending photographic impressions and the other makes contact with the cylinder employed in receiving the maps, sketches, pictures, etc.

MESSAGES, whether taking the form of a business letter, or a sketch to represent a radio diagram, are written with pen and ink, the latter giving a more permanent impression than a pencil-written copy. The ink used is peculiarly adapted to this purpose. The strip of paper containing writing to be sent by radio is wrapped around one the brass cylinders and secured thereto with a fragment of sticky paper.

A switch is closed in an electric circuit which connects the cylinder at the contact finger with the transmitting machine. Whenever a line of writing passes under this contact finger, a radio wave is propagated into space just as the closing of a telegraph key sends forth an electric impulse. At all of the receiving stations of this "photogram" system of communication the incoming radio signal passes through the contact finger on the receiving cylinder and makes a mark on the paper. That is to say, every time a line of writing at the sending station passes under the contact finger a mark is made on every receiving-station cylinder.

FITTING, is it not, that Mr. Jenkins, whose mechanical ingenuity conceived the beginning of the billion-dollar-a-year motion picture industry, should also invent the practical machine that ushers in radio vision to the 20,000 amateur radio stations? He has been experimenting along the line of picture projection for more than 30 years. He has been issued more than 300 American and foreign patents—ranging from spiral liquid containers to self-starting devices for automobiles.

Mr. Jenkins foreshadows a time when radio vision will make it possible for us to view the Olympic games in Europe and peoples of other nations will be enabled to see at long range the inaugural ceremonies of a President of the United States. The placing of duplex "photogram" machines in the hands of radio amateurs is a step in that direction. It means a thorough exploitation of the abstract idea of seeing as well as hearing by radio.

WITH the perfection of the photo-electric cell and the focussing of attention on the part of many individuals of an inventive mind, to say nothing of the interests back of the transmission of news and pictures, the years 1926 and 1927 should see great strides in the development of television in many fields.

With the greater development there is bound to come a demand for a special channel for television and so far such channels have not been allowed for to any great extent. At the present time experiments could not be carried on in the broadcast spectrum nor on the amateur strata so undoubtedly before long the demand for a separate band for television will be insistent and compel attention on the part of the government.

News gathering and distributing agencies will probably be the first to take full advantage of the rapidity with which pictures and other matter may be duplicated at a distance in a very brief interval. Thus the requirements of the press—speed—would be fully met.

IN addition there is the angle of movies by radio. This subject is more or less connected with the news-gathering organizations, although the large movie interests may see in its perfection the realization of dream of a central distributing station from which will radiate movies reproduced simultaneously in hundreds of picture houses the country over, eliminating the necessity for the printing of so much film and giving every city the advantage of a first run at the same moment.

Television opens up almost as universal a field, if not more so, than the radio, although the entertainment function of the radio will probably always attract the greatest attention. The public apparently wishes to be entertained first—and educated afterwards.

Radio Photo sending machine, lamp house to the left (for illuminating the picture); (2) four Prismatic Rings for moving the picture over the (3) light sensitive cell in the box at the right; time for each picture three minutes; distance limited only by power of the broadcasting station

HERE'S A NEW

Principle *In Sound* Reproduction

This is a picture of the audalion which embodies the principles discussed in Dr. De Forest's article

Structural and Other Changes Necessary for Big Volume Without Distortion

By LEE De FOREST

SINCE the days of the first telephone receiver of Bell, every practical telephone reproducer has been operated on the same general principle, that is, by moving a diaphragm or some form of membrane in the direction perpendicular to its surface. It seems that telephone engineers have been unable to get away from the idea that a medium which produces sound waves must work like a piston. While this method has proven quite satisfactory so long as applied to ear-phones, it has certain inherent defects which become apparent when a larger body of air is agitated, as in the case of a loud speaker.

When used in connection with the Phonofilm, or talking moving picture, these defects of the diaphragm piston-action are quite objectionable. The successful presentation of the Phonofilm requires that a large theater be filled with sound of uniform volume without objectionable intensity in any location. The reproduction, of course, must be perfectly natural so that the audience will not have to exert conscious effort in order to understand what is being said. Furthermore, the reproducer must be free from directional qualities so that

the audience will concentrate attention upon the screen and thus gain the illusion that words are coming from the lips of the actors rather than from some adjacent source.

LOUD speakers of the diaphragm and horn type are unsuited for use in theaters and large auditoriums, owing in part to the fact that such speakers project their primary sound energy into a space of approximately the form of a cone, with waves of maximum amplitude along the axis, while the diaphragm itself forms the truncated apex. Attempts to produce sufficient volume outside of this conical limit, as is necessary to supply the side rows of a theater result in objectionable intensity nearer the apex, or in the middle front seats, The line of maximum amplitude along the axis produces a distinct directional effect, making the source of sound easily detected by aural triangulation. Furthermore, the piston impact creates impure waves or distortion, which impair the naturalness of reproduction. Even a large number of speakers placed across the stage produce the same results, each individual in the audience tracing the source of sound to the particular speaker which transmits to him the predominant energy.

IN SEEKING a solution for this baffling problem, I felt compelled to abandon diaphragm reproducers of both the cone and horn types, and as a result discovered an entirely new principle of sound reproduction which avoided all the defects mentioned above. In this new method I found that when an electromagnetic telephone unit is applied tangentially to the edge of a properly curved membrane, instead of at right angles to it, the entire surface takes up the vibrations in a gentle whipping or rolling action and sends out sound waves of the correct amplitude in all directions. Many of these waves are projected radially by the displacement of the membrane normal to its surface, but the predominant action seems to be due to either the rolling or the frictional effect which transmits waves tangentially. This is shown by the fact that the maximum sound energy is propagated from the area of the membrane which has the least radial displacement and the greatest circumferential motion, as the portion near the edge to which the tangential impulses are applied.

It was found that the maximum efficiency is obtained when the membrane is approximately cylindrical or a section of a cylinder; but a true circular contour is not satisfactory because it imposes a variety of stresses which results in distortion due to creating natural periods of dissonant vibrations. The membrane must be permitted to assume a particular horseshoe form or more specifically, a catenary, and there must be an opening in the back so as to avoid resonance, or the "barrel tone."

THE distinctive characteristics of this new form of wave action are extreme clarity and naturalness of reproduction, and the ability to fill a large room with uniform volume without objectionable intensity nearby or in any one direction. This may be explained by the fact that a larger section of air receives the primary impulses at a uniform amplitude and in all directions simultaneously, thus avoiding certain interferences and the necessity of readjusting the wave action after it has been propagated. In other words, each impulse travels in a straight line from the membrane to the hearer without dissipating its energy in adjacent sound voids as represented by the space in the rear of a horn type speaker. The increased carrying power without intensity is due to the larger source of energy with less concentration per unit of cross-section.

At first I constructed two models of the Audalion, as this new reproducer is called, a large one for theater work and a smaller size for radio use in the home. But I found that the smaller size was equally efficient in the theater, owing to its wonderful carrying power and distributive qualities. The actuating unit, which is of the balanced armature type, is extremely sensitive both to the lowest musical note and to the highest audible overtones. This sensitiveness is essential to the faithful reproduction of the individual instruments of an orchestra in their natural timbre, but it also necessitates good broadcast reception, for a reproducer can not make up for the deficiencies of the receiver. Radio is rapidly approaching a high degree of efficiency, however, and both receiver and reproducer must contribute their share. Furthermore, the public is demanding better equipment, and as the mystery of radio wears off, people are learning the importance of careful tuning and the proper care of batteries.

AN interesting psychological reaction has been observed in the introduction of the Audalion. Probably the most beautiful masterpiece of Beethoven would receive scant appreciation from primitive peoples whose weird chants have profound emotional and even religious significance to them. Likewise, modern jazz, which has such strange effects upon our younger generation, receives little commendation from the older folks whose tastes run more to the dreamy waltz. The confirmed radio enthusiast has become accustomed to the "horn-tone" of reproduction, which he is prone to call "fullness" and "blending." When he hears clear and natural reproduction, therefore, something seems to be lacking. On the other hand, the trained musician who has had pronounced aversion to radio reproduction, or "canned" music of any kind, readily appreciates this new style of reproduction for the very reason that it avoids the added resonance to which he has objected. These comparisons merely show that so far as music is concerned, at least, we prefer that to which we are accustomed. But since the public is becoming more discriminating every day, it seems safe to predict that in the long run the best quality of reproduction will prevail.

Dr. Lee DeForest, author of this article, is shown in his laboratory where original work was done on the new loud speaker, known as the audalion

Balanced *Capacity* in the *Isofarad* Receiver

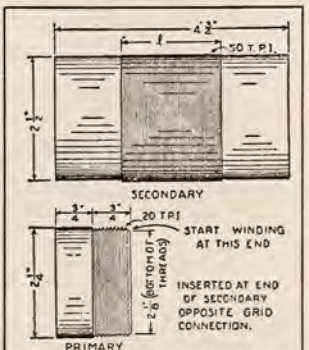
Constructional Details of This Type of Receiver Are Given

IT HAS been quite some time since anyone has departed very far from the conventional radio receiving circuits, except to make a few minor changes or to think up a new name. During the last year the greatest development in receivers was noticeable in the tuned radio frequency circuits. This undoubtedly was due to the fact that many leading manufacturers were licensed under the basic tuned radio frequency patents owned by the United States Navy.

Despite the great success of the tuned radio frequency receivers in the last year, it has been felt by leading engineers that existing circuits were accomplishing only a fraction of their theoretical posibilities. The general opinion was that they were limited in their performance by capacity coupling between the elements of the tubes.

Various methods have been attempted to overcome this capacity coupling. Present indications are that the use of a variation of the century-old Wheatstone bridge, as worked out by the engineering staff of the Walbert Manufacturing Company, comes more closely to getting the desired results. This all-capacity bridge, now used in the new isofarad circuit, allows much greater efficiency without any tendency to oscillate.

IN MOST other forms of tuned radio frequency circuits, sufficient losses are introduced, either intentionally or unintentionally, to prevent the energy from building up to a point where oscillation will occur. Some set builders obtain this result by limiting the number of turns in the primary windings of the transformers. Others simply get it with parts having such a high loss that there never is enough energy to cause oscillation. In any case, the signal strength and quality of the receiver suffers.



COIL No.	SEC. TURNS	PRI. TURNS	DIRECTION OF PRI.	DIRECTION OF SEC.	D
1	102	6	R.H.	R.H.	2"
2	102	12	R.H.	R.H.	2"
3	56	6	L.H.	R.H.	1 3/4"

Fig. 1. Winding diagram for making "canned coils" for use in the isofarad circuit.

If an attempt to overcome this condition is made by introducing resistance, the selectivity decreases. This, in itself, is not a vital defect if the set is to be used at a considerable distance from all broadcasting stations.

In the balanced, or neutralized, circuits it is almost impossible to make them remain balanced for all frequencies when a high value of amplification per stage is used.

THE isofarad circuit obtains a high value of amplification per stage and the inherent grid-to-plate tube capacity is balanced out over the entire range of the receiver. Thus, the principal obstacle to tuned radio frequency amplification is eliminated at its source.

The coils used in the isofarad are completely shielded by being enclosed in grounded metal containers so there can be no interaction of the magnetic fields of the coils. The torus coils made their big bid for fame because they prevented this spraying effect. This was a great improvement. By using "canned coils" the isofarad circuit gets the benefit of solenoid coil efficiency and the non-spraying qualities of the toroids as well.

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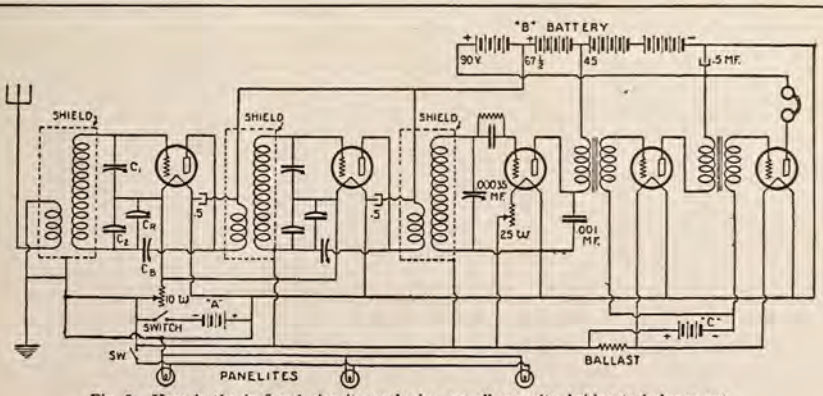


Fig. 2. Here is the isofarad circuit employing an all-capacity bridge to balance out the capacity coupling between the tube elements, and the "canned coils" which have all the power of the solenoids combined with the non-spraying qualities of the toroids.

Radio *Measuring* Instruments *and* Their Circuit Functions

Purpose of Various Types of Meters Shown in Summary

By HERBERT BERNREUTER

THE number of various electrical measuring instruments used in connection with the radio industry is so large that a detailed description of each particular meter is beyond the scope of this article. However, a brief summary of some of the types available and their outstanding characteristics may not be out of order.

There are a number of these instruments particularly adapted to transmitting apparatus, others are used chiefly in receiving sets, while still others find their greatest use by manufacturers and dealers. However, these groups overlap each other, and no single meter is used in only one field of radio.

In strictly radio frequency measurements the wavemeter and the ammeter are the principal measuring instruments used, and with these two most of the important radio measurements can be made. These two instruments therefore will be described a little more in detail.

RADIO'S most generally useful measuring instrument at radio frequencies is the wavemeter. It measures primarily frequency, which is customarily expressed in terms of wavelength. When equipped with a buzzer or other source of power a wavemeter may also be used as a generator of currents of known frequency. A wavemeter is essentially a simple radio circuit consisting in its usual form of a condenser and an inductance coil connected in series. A galvanometer or a small lamp is usually placed in the circuit to show when maximum current is flowing. In the commercial form of wavemeter the condenser is usually variable and when used with a fixed inductance coil a definite range of wave lengths is covered by the meter. For instance, one wavemeter has the values of inductance and capacity such that wavelengths from 150 to 625 meters can be determined thus covering the broadcast range. To measure the wavelength of certain oscillations the wavemeter is loosely coupled to the source of these oscillations and the condenser varied until the galvanometer or lamp shows maximum current flowing in the wavemeter circuit. The wavelength is read directly from the condenser setting under this condition.

MOST ammeters used for low frequency currents are entirely unsuitable at high frequency. The reason for this is that the circuit within the meter must have as low capacity and inductance as possible. Otherwise part of the current will flow through the dielectric, the amount varying with the frequency, and the calibration of the meter will not be correct for all frequencies. Evidently the best circuit for this work then is a straight wire of small diameter. This very circuit is employed in both the hot-wire and thermo-couple type ammeter.

In the hot-wire meter the "hot-wire" is of resistance metal and its increase in length when heated is indicated by a pointer operated by a thread attached to the wire and held taut by a spring. The great difficulty with the hot-wire ammeter is that it is affected by room temperature and by the tendency of the wire to stretch.

In the thermo-couple type of high frequency ammeter a thermo couple of two dissimilar metals is welded to a heater wire through which the current passes. The small voltage produced by the heated thermo-couple is applied to a standard D'Arsonval direct current movement. This voltage can only be produced by a difference in temperature between the hot and cold ends. Consequently a variation in the room temperature will not affect the zero adjustment and the chief difficulty of the hot-wire instrument is overcome by the thermo-couple type.

AMMETERS using the hot-wire or thermo-couple principle are used in the antennaes of transmitting stations, their range being anywhere from one-half to seventy-five amperes. Sensitive galvanometers of this type are often used to indicate high frequency currents such as the current in the oscillating circuit of the superheterodyne receiving set. By a careful balancing arrangement thermo-couple type ammeters can be made for accurate calibration which will hold for both low and high frequencies. The most sensitive galvanometers of this type, however, are made to read accurately at only a limited range of frequencies.

AT THE present time there are available on the market a large number of direct current meters for checking the voltage of the different batteries used on transmitting and receiving sets. In fact the majority of troubles in the average receiving set are traced to low batteries and poor tubes so that a voltmeter on a receiving set is becoming almost essential.

The more accurate of the battery voltmeters are of the standard D'Arsonval permanent magnet type. For radio sets they are usually made for flush mounting so that they can be placed in the panel. It is not necessary to have separate meters for the "A" and "B" batteries, as compact miniature instruments are available with a switch mechanism for placing either the "A" or "B" battery on the meter. These meters are built in almost any range necessary to cover all needs for the voltage measurement of the batteries. Scales with special markings at the proper voltages of different batteries are convenient for rapid testing.

The large number of receiving sets which have come into use during the last year has resulted in an enormous sale of vacuum tubes. This necessitated some means of determining whether tube sold over the counter would function as it should in a receiving set. The mere fact that a tube will light does not mean that it will detect or amplify an incoming signal. The real genuine signature of a good vacuum tube is its mutual conductance. This is nothing more than the change in the plate current for a given change in the grid voltage. In a receiving circuit the voltage of the incoming wave is impressed on the grid of the tube and this should cause a maximum change in the "B" battery current flowing between the plate and the filament for best results. Vacuum tube testers have standard direct current meters arranged in a circuit to measure this mutual conductance. The "A" voltage is set and the "C" voltage varied, these voltages being read on direct current voltmeters. The change in the "B" battery current flowing through the plate circuit is read in a milliammeter placed in the circuit and the mutual conductance calculated.

VERY special meters such as grid leak testers have come into use and the use of this special testing apparatus has resulted in better parts to put in a receiving set. In fact radio fans and manufacturers are finding the salvation of their difficulties in the more extended use of radio measuring instruments.

Operating Many Sets *from a* Single Antenna

Naval Practice May Contain Hint for Apartment Dwellers

By S. R. WINTERS

WHEN, to employ the figure of speech of another, antenna masts are planted atop roofs of houses and city apartments in such great numbers and of unsightly arrangements as to resemble burnt over poles after a forest fire, there is not only justification but a demand for a solution to the antenna problem. This is a condition and not merely a theory in congested centers where occupants of apartment houses are not afforded facilities for erecting their masts and stringing wires above a limited roof area. Or, landlords may place certain restrictions as to the number of antennae that may be placed on tops of buildings.

This is a perfect analogy of a problem confronting the United States Navy several years ago in the use of radio communication on battleships. Like the occupants of an apartment house, there was only one antenna on a battleship and yet it was not only desirable but well-nigh a necessity that several radio messages be received at the same time. The adage, oft repeated but never too old to bear fruit, that necessity is the mother of invention reasserted itself. In this case, the inventive mind of the United States Navy came to the rescue with the so-called coupled tube receiver.

Dr. Taylor's Invention

THIS device, when stripped of all technical verbiage, is simply a means of using a number of radio receiving sets—a dozen or more—on one antenna without the confusion that would arise under similar circumstances in the absence of this invention. It is a patented apparatus, the designing of which is credited to Dr. A. Hoyt Taylor, Superintendent of Radio of the Bellevue Naval Research Laboratory, Bellevue, District of Columbia. Of course, this ingenious arrangement whereby several radio receivers are coupled together by use of a series of resistance units is for specific use by the Navy on ships where simultaneous radio reception on a number of channels is a desired objective. Yet, other services and civilian interests can make useful application of this invention.

In fact, the United States Shipping Board is making use of the "coupled tube receiver" on its trans-Atlantic vessels and commercial seagoing interests will undoubtedly equip their ships with this device, in the event of a need for using several channels of radio communication at the same time. Opportunities for civilian use are quite as apparent. This writer recalls the incident of a Southern college objecting to the promiscuous and numerous erection of antennae on the roofs of the dormitories. Students in subtle defiance to this edict, resorted to the use of bed springs as antennae systems. However, the coupled tube receiver could have been used to better advantage—erecting one antennae on the roof of a dormitory and hooking up a dozen or more receiving sets to this single collector of energy.

For Congested Areas

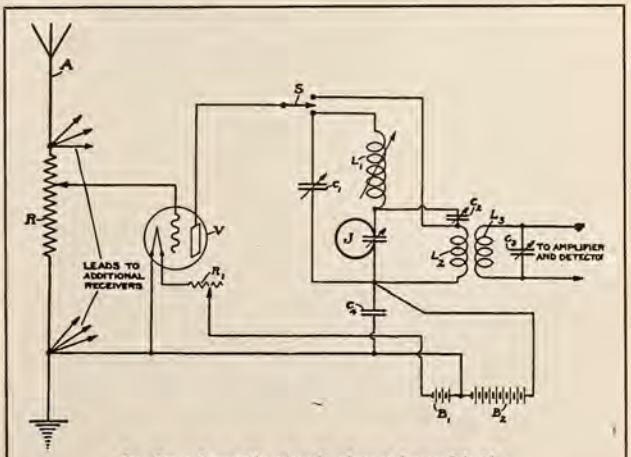
IN Washington, where radio conditions are not as congested as in Chicago and New York City, this writer counted as many as eight or ten separate antenna systems on one small apartment house. This instance could be multiplied. The unsightly appearance of so many dangling wires and masts clustering like poles in a burnt over forest must be objectionable to owners of these apartment houses, and once the saturation point is reached other occupants must forego the use of radio receiving sets or otherwise employ loops or coils of wire. The latter are unsatisfactory if there is steel or other objects which offer shielding effect to electromagnetic waves. Office buildings are particularly susceptible to setting up barriers against the invisible waves, rendering such collectors of energy as small coils of wire ineffectual.

Once this new invention of the Naval Research Laboratory is adopted for use by apartment houses, office buildings, and in other quarters where humanity huddles together, the janitor or superintendent of the building could supervise the upkeep of the antenna system. This would be imposing only a small task, in addition to his other duties in preserving the cleanliness of the buildings and "keeping the home fires burning." This new duty of keeping the antenna system in working order would mean a "keeping of the home dials turning."

Details Given

DR. TAYLOR describes his invention in detail, as follows:

"My invention relates particularly to the reception of a multiplicity of high



In the schematic circuit shown herewith the general scheme of connections for operating several receivers from a single antenna is shown

frequency electrical signals employing the same collector or antenna.

"The particular object is the multiple reception between the several receivers connected to the one collector.

"My improvement is of particular value on shipboard where it may be desirable to receive a large number of signals simultaneously, and where the facilities for rigging a number of antennae are limited.

"My invention will be best understood by reference to the accompanying drawing, the figure illustrating its use for the reception of radio signals. In the figure A is an antenna having a high resistance in series therewith. The thermionic vacuum tube V has its grid circuit connected between two points in this resistance. The plate circuit of this vacuum tube contains the tunable high frequency circuit having inductance L and variable capacity C in parallel relation. I find it preferable to make the ratio of inductance to capacity in this circuit large. There is also included in this circuit a device J which I term a rejector. It comprises a very low inductance element having very low resistance, usually being one or more turns of very heavy copper strip or wire and a large capacity condenser constructed to have small resistance, the condenser being made variable in order to permit of tuning the rejector element to the desired wave length. Shunted around the rejector is a tunable circuit containing inductance L and variable capacity C in series. A receiver is associated with this last named circuit usually through a tunable circuit containing inductance L and variable condenser C with leads to detecting device or to an amplifier and detector as desired. B is a source of current for heating the filament of vacuum tube V and B is a source of current for the plate circuit of this vacuum tube. These same sources may be used in connection with the amplifier and detector if vacuum tubes are used in connection therewith. The capacity C is preferably large and is introduced mainly for the purpose of preventing a short circuit of battery B. The antenna may be tuned but this is not essential as the high resistance R in series therewith renders it aperiodic.

Any Number of Sets

"ANY number of receivers may be connected with the antenna through similar vacuum tubes and circuits as described above through additional leads connected between points in the resistance R as illustrated.

"I term the vacuum tube V a coupling tube because it couples the collector to the selective circuits and receiver as illustrated and at the same time prevents a reaction caused by variations in these circuits on other circuit connected to the collector.

"The operation of the system is as follows:

"Assuming that a number of signals of different frequencies are being collected on the antenna A, the desired signal is selected out by tuning the inductance L and C to this frequency which admits this particular signal to the circuit containing these elements. However, as other signals cannot be entirely excluded from this circuit, the tuning of the rejector J to the frequency of the desired signal permits further selectivity, the desired signals being accepted by the rejector and all other signals being rejected or by-passed by the low inductance element of this device. The desired signals are then passed on to the receiver through the tuned circuit containing inductance L and capacity C, any residual undesired signal being excluded from this circuit through being out of tune with it.

"To aid in picking up signals I provide the switch S which in its up position eliminates the intermediate selective circuits, connecting the coupling tube directly to the circuit containing inductance L and capacity C. This arrangement not being very selective permits of the signal being picked up promptly and adjusting the receiver containing inductance L and capacity C to the desired frequency. Having found the desired signal and adjusted the receiving circuits, the switch S is thrown to the down position connecting in the intermediate selective circuits and these are then tuned until the desired signal is brought in and the undesired signals excluded.

> The use of more than one receiving set from a single antenna has always been more or less of a problem for radio interests, but the system explained in Dr. Taylor's patent specifications will go a long ways toward solving the difficulties usually encountered.
>
> The associated apparatus necessary for making up a coupler tube comprises principally inductances, capacities and a resistance, all of which items can be readily secured. Since the condensers are for tuning purposes and the range to be covered by the average receiver is not greater than the 200-600 meter span it would seem that .0005 mfd variables would be suitable for this purpose. The rejector J in the diagram can be made of one or two turns of stiff copper wire or copper braid. The high resistance in series with the antenna renders the antenna circuit aperiodic.
>
> —The Editor.

The Claims

"HAVING described my invention I claim:

"1. In a system for the reception of high frequency electrical signals the combination of a collector circuit having a high resistance in series therewith, a coupling thermionic vacuum tube having its input circuit connected between two points in said resistance and an output circuit having in series therewith a tunable circuit containing variable constants in parallel relation, a tunable rejector circuit in series relation within said tunable circuit, a tunable circuit in parallel relation to said rejector, and a receiver associated with said last tunable circuit.

"2. In a system for the reception of high frequency electrical signals the combination of a collector circuit having a high resistance in series therewith, and a plurality of receivers connected thereto each through the following elements; a coupling thermionic vacuum tube having its input circuit connected between two points in said resistance and an output circuit having in series therewith a tunable circuit containing variable constants in parallel relation, a tunable rejector circuit in series relation within said tunable circuit, and a tunable circuit in parallel relation to said rejector."

RADIO experimenters desiring to duplicate the "coupled tube receiver" will find it necessary to determine for themselves, by experiments, the values of inductances and capacities in this multi-receiving system. For the present, the Naval Research Laboratory is not prepared to give out, in specific instances, the number of turns of wire of the inductance units and the resistance of the antenna.

However, radio experimenters should not encounter much difficulty in solving this problem, because in each instance the inductance and capacity are matched so as to cover the band of wave lengths assigned to broadcasting stations—from about 200 to 600 meters. That is to say, the inductance and capacity values are worked out just as in the construction of any homemade radio receiving system—for instance, if you have a large inductance the capacity should be correspondingly small.

While this multi-receiving system has been installed on vessels of the United States Navy and the Emergency Fleet Corporation of the United States Shipping Board, it has not been commercialized to the extent of being sold over the counters of retail radio stores. As soon as this invention has reached that stage of perfection, then radio amateurs and broadcast listeners may call for a coil of so many turns of wire and a condenser of so many plates and a loop of so many turns of wire with the assurance that they will have a complete "coupled tube receiver" or an arrangement whereby a dozen sets are operative from one antenna system.

MEANWHILE, radio experimenters, who wind their own coils, assemble their own cabinets, and do wiring jobs, are invited to this interesting problem of solving for themselves the number of turns of wire of "L1", "L2", etc., and determine the antenna resistance. The Naval Research Laboratory, having indicated that the inductances and capacities are matched so as to cover the range of broadcast wave lengths, members of the "Home Constructors Club" are urged to get busy and solve the relatively simple, even though uncompleted, puzzle. If the first coil you wind does not match the capacity being used, then add extra turns of wire or subtract a few as the particular problem may suggest. Thus you have not only earned the satisfaction of having "rolled your own" but will have a finished product which your neighbors (in an apartment house) may participate in the benefits thereof.

Milwaukee *Firemen* Scale *Musical* Heights

MOST ignorant people associate firemen with music only in connection with those two immortal ditties, "Fireman, Save My Child," and "Oh, for the Life of a Fireman." It's all wrong. The truth is that firemen—Milwaukee firemen, that is—are likely to be known in the future as challengers of the world in the catch-as-catch-can music, no holds barred and the winner to take all the purse.

For they have burst into the radio firmament through the instrumentality of WHAD, the Marquette University-Milwaukee Journal station and are going strong on that station's programs.

Over on Milwaukee's South side at 438 National Avenue is the headquarters of Engine Co., No. 3. In the back room of the engine house, where the stables used to be but which is now the kitchen, daily are given concerts which would fairly knock your ear out. Music? Hot diggety dog!

SOUTH side engine house has come to be the rendezvous of all the musical firemen in town when off duty. An old grand piano that has lost its ear but retains the pep of its youth is installed in the music room (otherwise kitchen). The walls are proof against the most violent jazz.

Merritt Ramus, pianist; Tom Saskowski, banjoist, and August Boehm, harmonocist, trombonist are the nucleus of the present organization. They began by appearing at various entertainments given by and for firemen and before long they were famous. Now they have attracted other stars and the gang is growing. Most of the practicing is held in Engine House No. 3, where Ramus, Saskowski and Boehm are stationed. Capt. Ernest Glander, of Engine Co. No. 3, is the manager of the outfit. Chief Steinkellner appointed him to keep the boys from blowing the roof off.

NOT all the music offered by the firemen is instrumental. They have a vocal quartet that takes a back seat for nobody and soloists that need no scaling ladder to reach the high ones. Tom Murphy, Engine Co., No. 30; Joe Ross, No. 10; Adolph Ketelholm, No. 16, and Tom Dugan, retired, are the singers. Between them they can make any ballad extant say "Uncle" and when they all get to going at once there is volume, boys, and nothing but. Snappy stuff is their specialty, but songs like "When You and I Were Young, Maggie," and other classics are put over with the tremolo stops wide open and the harmony true as a die.

WHAD is the result of a cooperative arrangement between one of Wisconsin's leading educational institutions, Marquette University, Milwaukee, and Wisconsin's leading newspaper, The Milwaukee Journal. The transmitting station is located in the new Science building of the University and the technical staff of the station is furnished by the University. The Journal organized and mans the remote control stations, arranges programs, and promotes new ventures.

The university and the newspaper joined forces in January last, putting on the air Milwaukee's first 500 watt radio broadcasting station. Broadcasting is now done from seven strategical points in the city, not including broadcasting of Wednesday night and Sunday afternoon

(Please turn to page 46)

Here are a bunch of the Milwaukee firemen who appear frequently over WHAD, the Marquette University-Milwaukee Journal broadcasting station at Milwaukee. Our correspondent did not state the purpose of the box of milk bottles in the lower right portion of the picture, but the balance of the picture is self explanatory

What the Broadcasters are Doing

TIRING of the land of perpetual sunshine as represented in Los Anglaise where he used to announce from KFI, Harold H. Isbell has become a part of KYW at Chicago, and now runs the programs from the Congress studio as well as the sessions of the Insomnia Club from the Balloon room of that hotel.

We, Too, Would Like to Know Their Identity

GUESSING who "Sam 'n' Henry" is rapidly becoming the favorite sport of radio fans who listen regularly to WGN, and they are busy flooding the station's mail bags with all manner of wild surmises. "Sam 'n' Henry," are the two colored boys heard each evening over WGN at 10 o'clock, Central Standard time.

Fans made their acquaintance about a month ago when they boarded the train in Birmingham, Ala., bound for Chicago. Each night since then one of their adventures has been chronicled in their own humorous dialect. Their ten minute period each evening is rapidly proving one of WGN's best liked features. It is low comedy translated into terms of radio entertainment, and regular fans have followed the boys through the vicissitudes of their first job, the horror and humor of hunger, a term in the guardhouse for playing "African dominoes," and the joys of the first big city hair-cut, as well as other notable and humorous incidents.

They have become so popular that listeners are beginning to inquire about their actual identity. Visitors to the studio at 10 o'clock—most of them attracted by the desire for a look at the happy pair—go away disappointed, as the boys are kept carefully concealed. As soon as their term on the air is completed, the WGN telephone operator prepares for a flock of telephone calls from listeners who wish to hazard their guesses.

One radio fan wrote in to say that if it were not for the fact that Bert Williams were dead, he would swear this old theatre favorite was taking the part of "Henry," the low, deep-voiced member of the pair. "Sam's" voice is high and shrill, and it is usually Sam who finds himself in the majority of scrapes as each evening's episode unfolds itself.

One Case Where Watt Doesn't Mean Power

PROBABLY the only watt broadcasting station in the country is in Boston, but the designation does not stand for power; it signifies the call. WATT is the new call sign of the Edison Electric Illuminating Company's portable station, formerly designated as station WTAT. The dialogue between listeners discussing what station they have picked up no doubt sounds like old Webber and Fields stuff.

WENR Makes Visit to New Zealand in Daylight

COMPLETE programs broadcast from WENR, the All-American Radio Corporation station, in Chicago, were heard for fifty-five minutes, without interruption on Dec. 20, by Walter I. Burne, P. O. Box 35, Hawkes Bay, New Zealand. This is said to have established a record for continued reception over such a great distance.

In a letter just received at WENR, Mr. Burne said with a five tube tuned radio frequency set, with two stages of radio frequency amplification, detector and two stages of audio amplification, and using only the first stage of audio, he listened continuously from 6:35 to 7:30 o'clock, New Zealand standard time, when WENR signed off at 2 a. m. central standard time. Mr. Burne gave the complete program, both names of performers and numbers, for the entire period, and it checked completely with the station records. He mentioned particularly Frank Westphal and Marie Tully.

A remarkable feature of the reception was the fact, as stated by Mr. Burne, that it was daylight in New Zealand at the time he made the record. This proof of reception almost completes a round-the-world chain of listeners who have heard WENR.

CKCD Puts on Two-Piano Mendelssohn Concerto

TWO piano numbers by radio, while used once in a while in the United States, have not been broadcast by Canadian stations until recently when CKCD, owned by the Vancouver Daily Province, at Vancouver, B. C., put on a Mendelsohn concerto by Phillis and Dorothy Fewster, under the direction of Arthur J. Foxall.

As a rule the broadcasting stations do not go in much for two piano numbers except where provision can be made for adequate pickup of both instruments.

Cut Time on Radio Numbers at WHT

IF THE particular number coming from WHT does not suit your fancy, wait three minutes and another will succeed it. Such was the announcement made by Pat Barnes, newly appointed program director, who will also continue in his capacity of chief announcer.

Commenting on this new rule, Mr. Barnes said it would give the entire program more freshness and more variety. Moreover, he added, the artists themselves are in favor of being limited to three minute selections, which will allow them to play but one number. It will allow them to concentrate on this number and give it "a more intense interpretation", as one of them put it.

In addition, ensembles will be more limited in frequency of their appearance. This rule was made, he said, after it was shown that under the present system of broadcasting it is impossible to get a balanced effect from an ensemble. Too much emphasis was placed on one group of instruments, he felt.

The only exception to these general rules will be special speakers, who will be allowed eight minutes, and dance orchestras, who will be allowed about the same amount of time, Mr. Barnes said.

Canadian Broadcasters Organize Association

CANADIAN Broadcasting stations have just organized to improve broadcasting, promote the interests of the listeners and boost Canada. All radio stations including the ten Canadian National Railway stations, as well as manufacturing interests and newspapers carrying radio, are represented. The recent requirement of copyright that radio stations be licensed to broadcast their compositions, paying for the use, is said to have been the chief reason for the organization of the Canadian Association of Broadcasters.

The Canadian Parliament will consider the amendment of the national copyright act to cover radio broadcasting and permit the Reproducing Rights Association to issue licenses, this session, it is reported. No fees are mentioned, which, it is pointed out is one of the handicaps of the business as experienced in the United States, where license fees vary greatly.

NAA Weather Broadcasts on Air Nightly

COMPLAINTS from fans, particularly in the east that the weather reports broadcast at ten p. m., each night, through NAA at Arlington, interfere seriously with some of the finest entertainment offered on the air, are met at the Weather Bureau and the Navy Department with two answers:

First, that NAA broadcasts on an exclusive wave so that most sets should be able to tune it out if the information is not desired.

Second, that large numbers of farmers pick up this station each night to get information of considerable importance to them and not available prior to that time.

The Weather Bureau points out that ten p. m. is the earliest hour upon which the nightly forecasts can be released, because the necessary data from their many stations is not in or compiled in the form of forecasts until about 9:55 p. m. To rearrange the schedule of taking observations throughout the country would cost approximately $150,000, necessitate a new traffic schedule with the telegraph companies, and require some west-coast observers to start their daily work as early as 2:30 a. m., at which time telegraph service would not be available. The bureau officials make it quite clear that ten p. m. is practically the earliest and only time the weather reports can be broadcast, putting the solution of the problem up to the broadcast stations interferred with.

Many Radio Fans Become WGN Listeners

DAILY reports from listeners on every detail of program reception is the latest plan of WGN, the Chicago Tribune station on the Drake Hotel, and it is already under way with the organization of a body of radio fans to be known as the "Official WGN Listeners." The station has been broadcasting an appeal for regular listeners willing to assist in improving the quality of its broadcasts, and nearly a thousand WGN devotees have responded to the call.

In the opinion of WGN officials, these listeners will prove an invaluable adjunct to the station. They will offer a regular channel through which worth while information on program and broadcast quality will reach the station, information which formerly had to be culled from the thousands of letters which come to the station each week. While the station maintains a special department which analyzes the mail received, this new method will enable it to grasp worth while information in a much quicker way.

Official listeners are being selected from points in all sections of the country, and their very distance from the station will be an admirable way of judging reception in their localities. All of the listeners are being furnished with blanks on which space is provided for marking the quality of the program, the volume of the station, for checking fading and objectionable atmospheric conditions.

Western Jewelers Get KOA Time Tick

WESTERN jewelers in small centers of population are now enabled to check their master timepiece at regular intervals with the aid of special time signals which are flashed daily except Sunday by KOA, Denver station of the General Electric.

A telegraphic dash, used to sign off noon broadcasts, is heard at the exact minute of the hour and is preceded by the following announcement from a staff member:

"The beginning of the following telegraphic dash will be exactly — o'clock, mountain standard time."

The signal lasts one second and is followed by the station call letters, which are transmitted in the Continental code, according to Robert Owen, engineer in charge of the control room at Denver. The standard signal which indicates the end of transmission is then flashed.

"Chronometers such as those used at sea are employed as an assurance of correct time," Mr. Owen explained.

"Ordinarily in signing off, the time of day is announced at the nearest quarter of a minute with a maximum permissible error of thirty seconds," he continued.

"In using the telegraphic dash system, however, the permissible error does not exceed one-half second, hence jewelers and others in outlying communities are equipped to check their master clocks to the dot."

Yo-ho-ho- and a bottle of wave lengths!

On Friday night, February 5, the Zenith radio broadcasting station WJAZ went on the air with an operetta entitled "The Pirate." It proved to be one of the most unusual and interesting features of radio broadcasting that has ever been put on the air.

The present interest, which has been aroused in behalf of the Government's suit against WJAZ, has developed one of the latest angles in radio broadcasting, and in which the WJAZ station has been termed "Pirates of the air."

Who Says You Can't Get 'Em Up?

THE Christie Comedy sports girls are in a fair way to become internationally famous for their hurdling and baseball and boating activities, as well as the usual flickerings in the fun films if they keep up the strides they are making in the world of outdoor sport.

In the meantime they have discovered a new wrinkle in keeping the girlish figure, which is all-essential in the strenuous battle of beauty accomplishment in moving pictures. Here they are shown tuning in back of the studio for the early morning setting-up exercises, getting their "one, two, three, roll" and "four, five, six, jump" orders which are broadcast daily from a broadcasting station at Hollywood.

Old Time Fiddler

"Pop Goes the Weasel. Swing your partners to the right and don't get too close to the coal-oil lamp or we'll be in the dark."

Uncle Jimmy Thompson has been fiddlin' for more than sixty years and the people of the South recently nominated him by almost a unanimous vote taken in Texas, as the greatest barn dance fiddler of his time. Uncle Jimmy is eighty-two years old and he says by the time he is ninety he will be a young man. Not only does he play three hundred seventy-five different numbers, but he dances each one of 'em off while he plays. He is one of the most attractive features on the programs of WSM, The National Life and Accident Insurance Company's station, Nashville.

Program *Arranging* Calls *for* Considerable Work

P. D. Must Be Canny as a Scot; Wily as a Serpent and Smooth as Glass

By E. D. CAHN

ONE of the things least realized by the public of radio listeners is the large share which the program arranger has in the finished offering of a broadcasting station. He, or in some cases she, it is who has the difficult and often delicate and usually thankless task of putting a program together, balancing its component parts, censoring the too loquacious speaker, weaning the temperamental vocalist away from the songs he wants to sing and persuading him to sing the ones that are more suitable to the program in hand, and sometimes by delicate suggestions and various other cunning means, even muzzling an overtalkative announcer to a considerable extent.

The program director must be as canny as a Scot and as wily as a serpent and as smooth as glass. He must be a diplomat and a hot air merchant and know all the inside secrets and ramifications of advertising as well as he knows his prayers—or better.

In many stations, particularly in the south and west, the program director is often the man who sells his station's broadcasting service to the various "patrons" or "sponsors"—descriptive nouns more euphonious to sensitive ears than advertisers but meaning exactly the same thing. What's in a name? A radio advertiser by any other designation pays just as much!

W. E. Branch, program director at WBAP

BUT to continue. In cases where the program director is also the drummer up of business and the persuader of captal his work is complicated ten fold. It is to his efforts that radio audiences owe some of the best programs ever put on the air. The real honest to goodness program director has to have creative imagination enough not only to see ahead but around many corners as well. He must be able to pick out likely game, visualize its advertising needs, imagine an attractive radio program to suit them, then sell them the idea, get as large a financial appropriation as possible, settle on a date, get in touch with his artists and some fine day broadcast his program.

Sounds simple but just try it. Difficulties bristle on every hand like the quills on the most fretful of porcupines. The advertiser has to be convinced and sometimes that takes time and patience and stick-to-it-iveness enough to exhaust a whole row of plaster saints.

This accomplished, the next thing is to find an open date. Popular studios are always hungering and thirsting for more and newer advertisers but their calendars are always crowded weeks ahead when it comes to getting an immediate date for some reluctant advertiser who is just looking for an excuse to back out anyway.

However, the program director who knows his business always gets a date by hook or crook and then rounds up his talent. Of course the advertiser has his own favorites and he demands them and great is his chagrin and mighty is his wrath when he finds that he can't have them. Popular artists have a way of being busy, or under contract, or sick in bed, or something. There is no end to their ways and means of greying the hair of the poor program director.

But finally he gets a program together. Not too much voice in the offering. Not too many chestnuts in the selections to exasperate the young folks and not enough jazz to infuriate the old ones. He has made it as snappy as he dares and as solid as he can. He has fought a pitched battle with his customer, who wants to cut out the best number in order to deliver fifteen minutes of straight advertising talk, and has won after a stern struggle. It is no child's play to convince a man who is spending his money on a first radio program that indirect advertising is the best and that he can't say it with bill-boards in radio.

But it can be done and J. Howard Johnson, program director of KHJ, Los Angeles, is one of the most successful men in the country in the doing of it. Mr. Johnson has all the qualities necessary for a successful program director, plus a few more. He is one of those people who never consider no an answer if he thinks the correct one is yes and he keeps right on working until he convinces the enemy that yes was what they meant in the first place.

For instance, he took it into his head early in the year that the great Philharmonic Orchestra which had been delighting large audiences during a brief season, ought to broadcast a program for the benefit of all those who could not hear them in person.

Everybody said no, too big, too expensive, the studio at KHJ would never hold that army of men and instruments and many and varied were the objections raised.

But J. Howard Johnson just shut his mouth up like a steel trap and hustled out to see somebody and when he came back it was all arranged that one of the churches would build a special platform and provide special facilities and as it

(Please turn the page)

J. Howard Johnson, program director at KHJ

G. Allison Phelps, program director at KNX

turned out the Philharmonic was duly broadcast just as he said it could be all along.

Like so many of the most successful people in radio activities today Mr. Johnson fell into it more or less accidently. The concern with which he was working in a more or less modest clerical capacity became interested in radio and was one of the first to see its possibilities as an advertising medium.

Young Johnson, happening to be at hand, was put in charge and got his first glimpse of a radio studio and his first insight as to how such advertising should be done during the building and broadcasting of that first program.

ONE of his gifts consists in just happening to be around when anything new is being done or anything original or interesting in process of being born. He rarely is heard to ask a question and even more rarely makes a remark. He is as mum as an oyster and as observant as Sherlock Holmes. He is rather slow to move, seemingly, but when he gets under way his progress is speedy. From the taciturn office man who put over a highly successful first program he soon developed into the even more taciturn official program director of KHJ where he has been ever since.

Though art is married to business here, as in so many stations, the marriage has been more successful than most alliances of convenience so KHJ, its advertisers and the public at large are all the gainers thereby.

In Fort Worth, Texas W. E. Branch is program director at WBAP. Here the policy of the Star-Telegram is as liberal as that of the Los Angeles Times and KHJ, but the public is made up of a more stationary and stay-at-home class than that of the coast city. Features which will be a great success in one place will not go in the other at all and Mr. Branch is so well aware of it that he never makes a mistake.

The people in the Cow Country thereabouts take their radio as they used to take their beverage, straight. They like good music but don't care for the kind with frills. The quickest way to arouse their ire is to "sling on the agony" and it's a rare song that goes out from WBAP with a trill in it.

WBAP is fortunate in having a real humorist for its Hired Hand and a man with genuine senses of humor and proportion to direct its programs for the results are pleasant to hear and the cause of radio is furthered and not impeded by this station.

MISS V. A. L. JONES of KSD, the St. Louis Post Dispatch, combines the duties of program arranger with those of announcer of a large and popular station. She is in sole charge and her responsibilities are many and varied The standard is very high here and Miss Jones finds less difficulty in living up to it at all times than she might if she were not fitted by her experience as a newspaper woman, a musical critic and a pianist to form an accurate judgment of the work of others.

She was busily engaged in conducting her own advertising business in St. Louis at the time that the Post Dispatch was becoming interested in radio and looking about for someone to take charge of its station when completed. Miss Jones was talking to the managing editor of the paper about a supplement she was preparing and he was so impressed with her peculiar blend of business, literary and artistic ability that he offered her the job.

She had never thought of such a thing and said that she did not wish to give up her own business. He replied that she would not have to and she returned that if such were the case she believed she had better think about it. She did so and began; not really knowing what her duties would be; and developing them as she went along.

She has been continuing in this way, with conspicuous success, for nearly three years. Many great artists have done their stuff for her, no less than sixty bands also, and orchestras from the most frivolous jazz to the most high-brow symphony.

General Pershing received his baptism as a radio speaker at her hands and Francis Macmillan, the eminent violinist, gave his first radio concert in her studio.

SUCH things do not merely happen. It takes tact and plenty of business ability to arrange them and see that they take place to the satisfaction of all—on time, smoothly, and so arranged that they will have the widest possible popular appeal.

Miss Jones has had many difficulties to overcome but they have only added zest to the game for her. She loves the job and it would be even harder to fire her than it was to hire her for she would dig in her toes for sheer love of the game while all St. Louis would cheer her on.

G. Allison Phelps, best known as the radio philosopher of KHJ has now taken over the double task of program directing and announcing at KNX, Hollywood.

Mr. Phelps has a large public of his own and is in the happy position of knowing all sides of the game. Accustomed to approach the problem as an artist he knows the peculiar needs and notions of the actual contributor of entertainment; his fears, nervousness and jealousies. And he also knows the needs and exasperations of their sponsors as well as his own problems, relating to the happy reconciling of so many conflicting aims and ambitions, as announcer.

Mr. Phelps has that mysterious quality so poorly described by the overworked word "personality"—a combination of insight, tact, sympathy, intellectual and emotional understanding, good manners and hearty good will which not only endear him to his fellow artists but enables them to do better work under the stimulation of his presence.

HE has had a varied career as a writer and advertising man but has found his proper niche as a program director and great things are taking form at KNX; things full of laughter, imagination and a healthy philosophy of life.

Freeman H. Talbot, program director of KOA the Rocky Mountain Station at Denver, Col., is another original minded man whose abiding detestation of all pose and whose catholicity of taste combines well with a wide knowledge of humanity to result in programs always above the average in type and tone.

So these five labor among many others in their respective sections of the country each exerting a large influence upon the lives of very many thousands, even millions of people. For the most part they are unknown to the public yet upon their judgment, industry and imagination depend the quality of entertainment which comes to you when you tune in on their stations.

Freeman H. Talbot, program director at KOA

SHALL THEY
Announce or Chatter?

Dorothy Brister Stafford Asks and Answers the Question Which Worries All Directors

THERE are times when one, who has appointed himself trail-blazer for the multitude of radio listeners who are forever demanding facts and fancies about the voices of the air, feels like amending poor old Macbeth's observation on life to read:

Radio "is a tale
Told by an idiot, full of sound and fury
Signifying nothing."

For, with only an occasional high light such as the New York Symphony or De Luca's mighty voice breaking through the somewhat mediocre sameness of our entertainment, it is not surprising that the reviewer, who is confronted with the problem of providing a weekly or monthly resume of radio events, is sometimes hard put to produce readable copy. We wonder if this paucity of ideas, which must occur ever so often, is not responsible for the many articles that pour forth villifying the announcers.

It appears that when there is nothing floating about the ether worthy of comment, the radio reviewer always feels that he can at least stand at Armageddon and battle with the knights of the silvery tongue. To us, this everlasting reiteration that the radio listener is showing poor taste in encouraging gabby announcers, is about as futile as the attempt of the dramatic critics to convince the theatre-going public that "Abie's Irish Rose" is a terrible play.

And after all is said and done one is left with the suspicion that the writer is suffering from a restricted, insular vision, —a sort of a Broadway complex as it were,—something as utterly out of place in the wide-spread field of radio broadcasting as "Down By the Winegar Works" would be on a Zion City program. It's a rather difficult thing for a man whose horizon stops at Columbus Circle on the north and Hoboken on the west to grasp the mental processes of a corn grower out in Iowa or a housewife among the hills of Tennessee, and since listeners of this class outnumber the urban type at least ten to one, it isn't surprising that what appeals to them should loom largely in broadcast procedure to the utter bewilderment of the city-bred mind.

EVEN the astute Mr. George Jean Nathan, whose opinion one has come to take without question on all matters pertaining to the amusement world, has fallen down lamentably on the few occasions when he has felt moved to consider what the broadcasters are offering. For the first time in his life he has given the impression of talking about something he knows nothing about. *His* greatest error, however, is to place broadcasting in general on a par with the moving-picture, which is unfair, for anyone who has taken the slightest trouble to do a little intelligent listening knows that the standard set by the majority of stations, whether they be in the metropolis or more remote, is so far above that of the average moving-picture producer that there can be no comparison. The people who provide the entertainment of the air have never indulged in the movie producer's alibi that the better things are over the heads of their audience. The radio producer puts them on and lets the listener struggle up to them.

But it is the informality, the loquacity and the general breeziness of the announcer of the hinterland that so persistently riles up the urban critic. He would have the unseen voice strictly dignified, making his stereotyped announcements, reciting his litany of station calls and then fading into the background. To such a listener, naturally, the program is the thing.

But tell that to the folks out in Texas, or where the voice of WSB penetrates. Do these listeners tune into these stations primarily to hear some carefully prepared program? They do not. They want to hear what the "Hired Hand" or Mr. "At-lan-tuh" Kay has to say on that particular night. And while the methods of some of these gentlemen may sound crass and crude to the more aesthetically-tuned ears of the effete east, God still seems to be creating a lot

(*Turn the page*)

The Hired Hand at WBAP

E. L. Tyson, at WWJ

and the easy, unoffensive tactics of the one who has made a place for himself in the homes of his listeners. It's the old story of personality, and one man's meat being another's poison, and it is all on the knees of the gods and the radio audience whether he gets away with it or not.

The list of men who are really successful in this newest of professions is not a very long one, and scarcely any two have achieved their places in the hearts of their listeners by the same means. In some cases it is merely a pleasant voice and manner, again it is an accident of locality or accent, and in an occasional instance a genuine sense of humor.

THIS matter of accent has done much for Lambdin Kay, the "Voice of the South," from WSB, and although we have never heard anything epochal from this gentleman, and his announcing is more like a side-show ballyhoo for the Atlanta Journal than anything else,—there is something about his inimitable drawl that appeals particularly to northern ears.

Throughout the middle west, where owing to the splendid receptive conditions, there are probably more listeners to the square mile than anywhere else in the country, E. L. Tyson, of WWJ, the Detroit News, enjoys a well-deserved popularity. Mr. Tyson has no trick accent nor familiar nickname, he doesn't sing, and we have never heard him tell a funny story,—unless his classic report of that day of the deluge down in Pittsburgh, when Walter Johnson slithered

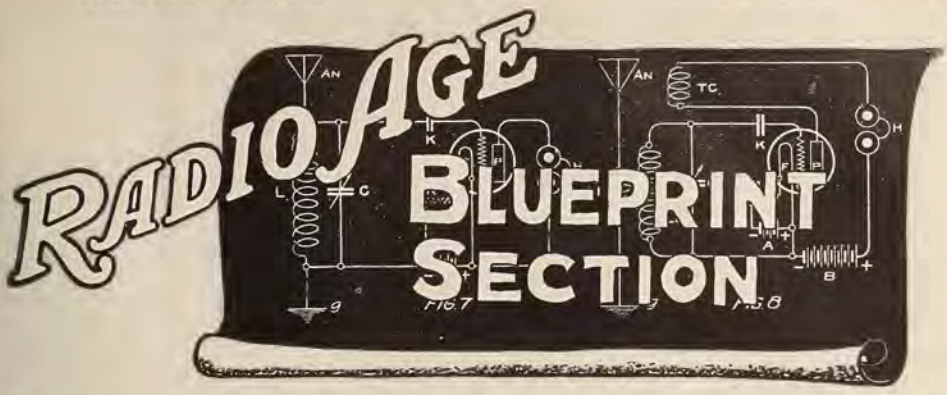
(*Please turn to page 47*)

of common people and they all seem to own radio sets.

In our early days as a listener we were quite amazed at the free and easy camaradie that seemed to exist between the personnel of some of the stations and their listeners, but in the past year we have learned a lot about *people* through listening, that has been as interesting as it has been illuminating. Those of us in the more congested settlements, who have never been west of Chicago, know nothing of the open-hearted, neighborly spirit that is the chief characteristic of the smaller towns and cities of the West and South, and if, as one writer puts it, we "are not too proud to be keenly interested in human life and human nature," we may learn a good deal from these stations. The people in this part of the country have the same friendliness for the voices that come into their homes nightly that they have for their next door neighbors, and see nothing incongruous in sending their announcer a chocolate cake, inviting him out to Sunday dinner or inquiring about his cold. We, who do not know our neighbors, naturally have a rather difficult time grasping this mental attitude.

And, while no one in his right mind would attempt a defense of the misguided souls, who labor under the delusion that they are contributing to the gaiety of the nation by the atrocious chatter they pour into their microphones, there is a definite distinction between the forced witticisms of the would-be,

The Merry Old Chief, WJR



Getting Acquainted With the Short Waves

By ARTHUR A. COLLINS
(Radio 9CXX)

THERE seems to be a growing interest among radio enthusiasts, who have more than a casual interest in the technical end of the game, in the remarkable development of the shorter wavelengths which has taken place within the last year or so, and for which that class of experimenters known as radio "amateurs" is largely responsible. Many broadcast listeners enjoy nightly programs that have been sent half-way across the continent on wavelengths between 60 and 40 meters and rebroadcast by stations on the broadcast band of wavelengths. Many of these people would be surprised to know of the numerous other activities on these frequencies which are commonly called the "short" wavelengths, i. e., from 90 to 15 meters.

A receiver for these wavelengths is the first requisite for getting acquainted with them. Although the design of such a receiver offers little difficulty to the older members of the radio fraternity, a little information as to the principles of design and constructional data should be welcomed by radio fans who are just entering the amateur game.

The Receiver

AMATEURS have found that receivers with several steps of tuned radio frequency amplification, which are so popular for broadcast reception, are somewhat impractical on the shorter wavelengths, and have almost universally adopted some modification of the less complex "three circuit regenerative."

The receiver at my station, 9CXX, is constructed in the following manner. Two well built "low-loss" condensers, one 150 mmfd. with logarithmic plates for the grid circuit, and one 250 mmfd. for the plate circuit, are mounted on a small hard-rubber panel and provided with large vernier dials. The 150 mmfd. condenser occupies the right-hand position, since this condenser is used in frequency variation, whereas the larger condenser is merely a regeneration control. The panel is mounted on a wooden base-board provided with binding-posts for battery connections, and a hard-rubber strip half an inch wide and extending the full length of the panel is mounted on the back of the panel near the upper edge by means of two small brass angles. On this strip are mounted the binding-posts for connecting the coils.

Winding Data

COILS are space-wound of No. 14 DCC magnet wire. The turns are formed by winding them around some cylindrical object 2½ to 3 inches in diameter (e. g. a wooden rolling-pin), removed, and the required number of turns clipped off, leaving sufficient surplus for the leads to the binding-posts. The turns are spaced by tying them with large cotton twine as shown in Figures 5 and 6. The coils are so tied at four or five points on the circumference of the coil, and a few drops of collodion applied to the twine *only*, for the sake of mechanical rigidity. The leads will be stiff enough to support the coils from the binding-posts.

The following coil sizes will be found suitable in most cases: *antenna coil 5 turns, plate coil 3 turns, and grid coil 16 turns for 80, 8 turns for 40, and 4 turns for the 20 meter bands.* For the sake of interchangeability, be sure to wind all coils in the same direction.

A UV 199 Radiotron is perhaps the best detector for high frequencies because of its low internal capacity and low current consumption. The tube should be placed in an inverted position and the connections soldered directly to the studs on the tube base. Incidentally, care should be taken to solder to the right studs, since a mistake may be expensive. The grid condenser and leak used with the detector should be of the very best quality, since quietness and ease of operation depend in a large measure upon these two items. A 250 mmfd. condenser and a 5 megohm leak are well adapted for use with a UV199 tube.

Short R. F. Leads

SCHEMATICALLY the circuit is shown in Figure 1. By exercising his ingenuity, the builder can assemble the parts and wire the set so that none of the radio frequency leads (shown by heavy lines in the diagram), need exceed three inches in length. A one step amplifier may be added in the usual manner, or the output leads may be connected to the input terminals of the first transformer of your broadcast receiver, thus the same amplifier can be utilized for both sets. The reader will no doubt be impressed by the simplicity of this equipment and by the ease with which it may be constructed. Simplicity and efficiency go hand in hand on the short wavelengths.

As mentioned before, the variable grid condenser is used for station selection, and the plate condenser accomplishes

(Please turn to page 36)

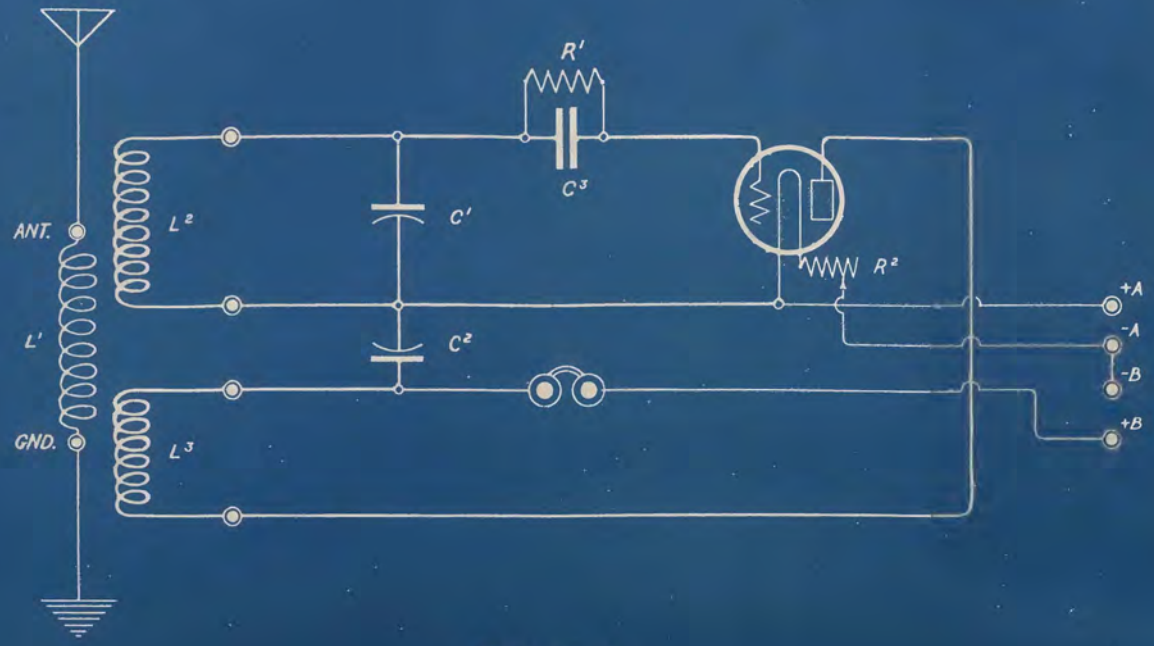


FIGURE 1

W.T. GARLAND

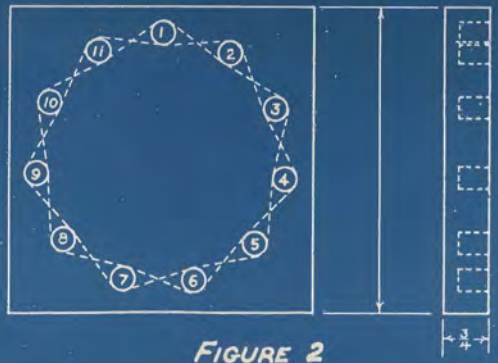


FIGURE 2

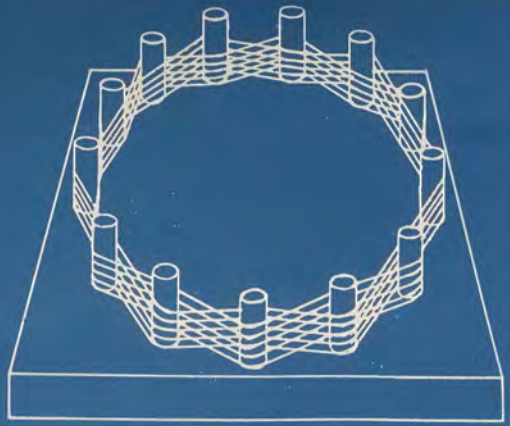


FIGURE 3

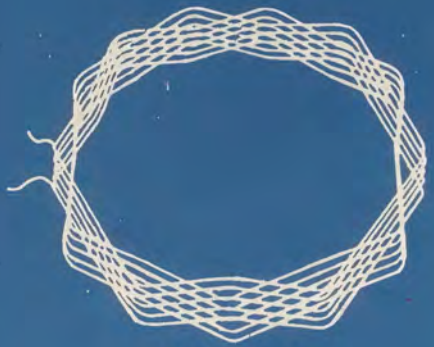


FIGURE 4

FIGURE 5

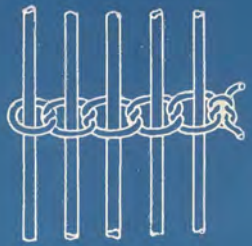


FIGURE 6

W.T. GARLAND

regeneration control. The entire range from approximately 95 to 12 meters is covered by substituting the different grid coils. It will be found that the ranges of the individual coils overlap somewhat, so that every part of the band is accessible.

Practically all communication on the short wavelengths is carried on in Continental telegraph code. If the reader is unacquainted with this code, he should be able to learn to copy it at a reasonable rate in a few weeks by applying himself diligently to practice with a hand key and test buzzer, and to listening to the many stations operating on the high frequencies.

Amateur Bands

OUR government has assigned the following bands of wavelengths to amateurs: 150-200, 75-85.7, 37.5-42.8, 18.7-21.4, 4.69-5.35, and .7477-.7496 meters. The five meter, and 74 centimeter bands are still more or less in the laboratory stage of development, but the 20, 40, and 80 meter bands are in daily use by hundreds of amateurs who maintain contact with foreign amateurs in practically every part of the globe—a feat which would be utterly impossible on higher wavelengths with the low inputs in vogue among amateurs. Perhaps the most international "DX" work is carried on near the 40 meter band. European amateurs are to be found nightly in the neighborhood of 45 meters, whereas the South American "hams" take their evening siestas around 36 meters. Our Australian brethren infest these same wavelengths in the early hours of the morning.

The question naturally arises: "Why are these high frequencies so much more effective than the lower ones?" The "Heaviside" theory of short wave propogation is quite generally accepted as an explanation of this phenomenon. The theory in its commonly accepted form is outlined briefly as follows:

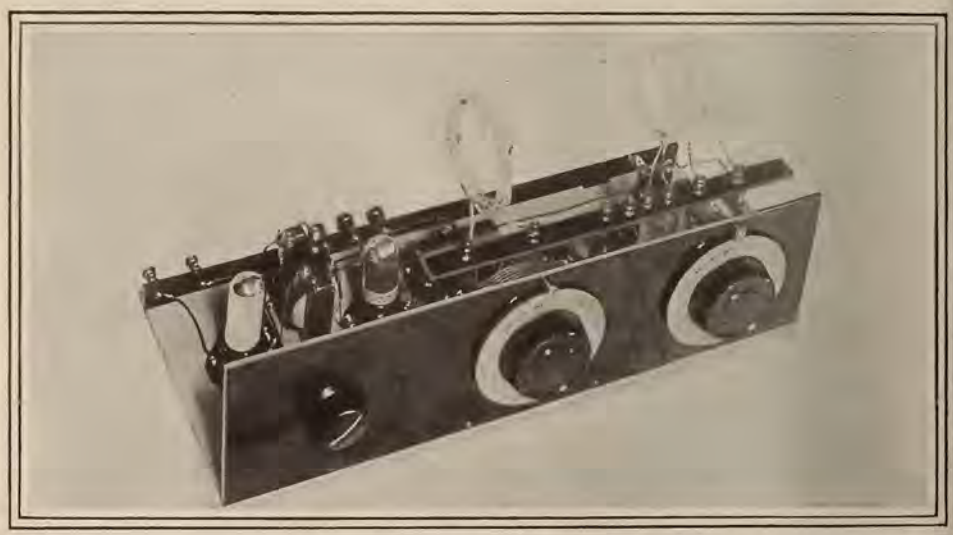
Physicists tell us that the actions of the sun's rays on the strata of highly rarefied gases bounding the earth's atmosphere cause the gas molecules to be ionized, forming a conducting layer varying in altitude with the intensity of the sun's rays. It has also been found that short radio waves show a marked tendency, increasing with their frequency, to travel less along the earth's surface and to shoot out at a tangent, only to be reflected back again by this ionized layer. From this it can be seen that a short radio wave which has traveled to this hypothetical layer and back again, would have traversed a path of very low resistance and absorption, so that a comparatively large amount of the energy leaving the transmitter in the direction of the receiver would arrive at its destination irrespective of the distance traversed. This effect is somewhat noticeable on 80 meters, is very pronounced on 40 meters, and is so unusual on the 20 meter band that the earth-wave is entirely absorbed within a very few miles of the transmitter and there is actually a skipped distance where no signals are received until the point is reached where the reflected wave returns to earth. This skipped distance is commonly 300 to 1,000 miles on 20 meters in daytime, varying with the wavelength, the time of day, the season, and the latitude of the receiver and transmitter. Short wave signals, especially those below 40 meters are remarkably adaptable for daylight communication between distant points. Complications such as double-reflection and wave polarization are frequently encountered in this connection.

Research Field

THE foregoing discussion is not presented as anything new or in the least unknown to the older members of the radio game, but as something which may be of interest to the more recently knighted fans, who may desire to gain a contact with the astounding developments which have taken place in the last year or two. A short wave receiver and a desire for information may bring you in touch with a field of research that will produce facilities of communication even more inconceivable than the present.

In the event the builder does not care to wind the coils on a solid form and space them, he may adopt the expedient shown in Figures 2, 3 and 4 in which the coils are wound on a form made up of 11 dowell pins, using the "over one and under one" winding. The manner of tying the knots on the turns is shown in Figure 6, and again in Figure 5. The No. 14 DCC wire is used on account of its rigidity which is highly desirable in short wave work where even a slight deviation in the spacing of turns (such as shaking), will prevent camping on a received wave's signal.

Readers interested in the short wave theory might find considerable information in the article, on Page 13 of the February issue of Radio Age, written by Dr. E. F. W. Alexanderson; also his comments in this issue of Radio Age on "Horizontal reception of Broadcast Waves."



Here is the finished receiver in use at 9CXX described by Mr. Collins in this article. The right hand condenser is a 150 mmf (.00015) for wavelength tuning and the left hand condenser is a 250 mmf (.00025) for regeneration control. The coils are mounted as shown in the photograph and are described in the text of this article

Universal *Wavelength* Range Feature *of this* Receiver

Plug-in Inductances Permit Fan to Jump From 50 to 550 Meters at Will

By FRED HILL
(Associate Editor)

TRUE radio fans are never satisfied. The boundaries of Amateurdom and Broadcastiana can never be fixed by the League of Nations. Alexander sighed for other worlds to conquer where if he had had a good type of receiver he could have done so and not worried latter-day students with his weeping. The B. C. L., vintage 1926, soon tires of the endless saxophone solos and butter quotations on the air, and pines for the solitudes of Continental code while the ham grows dizzy under the booming of the millionth and one CQ calls heard every evening on amateur bands. Each is forced by the sheer monotony of their lot to wish for the greener pastures just across the road.

All of the foregoing is merely a prelude to the vital story about to be told.

You can make your receiver as universal as your taste. There is no limit to the range (in meters—not miles) over which your tuning condenser can sweep with its scythe-like stroke, mowing down station after station.

WE grant you there is nothing new in the idea. It has been done before—a long time ago by General Radio for the benefit of the amateurs, but it is being done better now-a-days as the further reading of this story will disclose.

Heretofore whenever anyone made up a set of plug-in inductances they made them two circuit: primary and secondary for the r. f. portion of the circuit, and secondary and tickler for the regenerative portion. The antenna tap was brought in on the secondary. The relationship of the r. f. primary to the secondary was fixed. This scheme may have been delightful to the chap who did not care for experimenting, but for the fellows in the experimental end of the science who like their regeneration strong and their signals bold, the idea did not work so well.

But now both camps have been appeased; the tinkerer can tinker until Gabriel puts on his millennium program, while the staid listener can extract the last ounce of joy from programs on all waves, which should keep him up until 4 a. m. now instead of 2 a. m. as before, since the range of his receiver has been increased.

IN designing these new plug-in inductances, Silver-Marshall, Inc., made provision for a variable primary; that is, variable in inductive relation to the secondary. The primary is wound on a small rotor which fits inside the tube on which the secondary and tickler coil windings are placed. Then to make the picture complete they arranged six studs on the base of the coil form, which fit into six like spring clips on the inner face of a circular coil socket. And that is the complete story.

In Radio Age's laboratory we have been always more or less skeptical regarding claims made for apparatus and we try to put as much of new material to the acid test as it is possible to do. In this case we secured a coil socket, and a coil, and with remaining apparatus on hand built up the short wave-long wave receiver which is pictured in the blueprints on pages 38 and 39 of this magazine.

The results more than justified our curiosity; the amateurs from 50 meters up boomed in with fierceness; the Radio Corp's short wave trans-Atlantic stations shattered our eardrums while the broadcasters were received in orderly fashion from the lowest in the U. S. allocation to the highest. If we had been so minded (and we may yet do it) we could have secured a blank coil from Silver-Marshall and wound up a special inductance with very fine wire for the higher bands on which generally nothing but code can be found.

The general scheme of connections is shown in Figure 7 of the blueprint on page 38. It is the conventional condenser control method of regeneration worked out by Weagant a long time ago in an attempt to get around the even-then-famous Armstrong regenerative; it has been used by amateurs for years; popularized through the listeners ranks by Reinartz and masqueraded under various *nom-de-circuits*. It is by test and the judgment of the radio fans the simplest, best and most economical method of regeneration control, with all respects to Mr. Armstrong.

SCHEMATICALLY the antenna is shown going to contact 1 on the socket while the ground goes to contact 2. While contacts 2 and 4 are not shown connected, they may be tied together if it is desired to ground the negative A battery, although if that is done you will have to use a grid condenser and leak and eliminate the C battery which in this particular circuit causes detection in the detector and at the same time biases the audio stage. For code work the bias is not required, while for broadcast work it should be used.

Contact 3 is the grid contact while 4 is the grid return. Across these contacts a .00017 mfd s. l. f. condenser is placed. This is shown as C-1 in the schematic, while the regeneration control is a .00025 mfd s. l. w. condenser, shown as C-2. (For amateur work the .00017 should be used—for broadcast work the .00035 mfd on which the coil ranges are based, should be utilized.)

Contact 5 goes to the stator of the regeneration condenser, C-2 while contact 6 goes to the plate of the detector tube as shown in the circuit.

DETAILS of the audio transformer are shown schematically. The use of a rheostat is optional. In our case we used a Daven ballast resistor for two quarter ampere tubes in parallel and did away with the rheostat since we did not use a critical detector. The r. f. choke consists of 200 turns of No. 32 DCC wire wound on a one inch form.

The set is 16 inches long, 5 inches high and 5 inches deep, and is shown isometrically in Fig. 9 on page 39. The set should be wired by the schematic Figure 7. A detail sketch of the coil form is shown in Fig. 8.

The sub-panel is attached to the main panel by means of 2 cut down Benjamin brackets. The coil socket, detector socket, r. f. choke, audio transformer (6-1 ratio) and amplifier socket all mount on the sub-panel, while the wavelength condenser, the rheostat, the regeneration condenser and the Centralab modulator, used for audio transformer volume control, are mounted on the panel.

Ranges of the coils are: 111C 50 to 110 meters; 111B 90 to 210 meters and 111A 190 to 550 meters.

There are some other features of these coils that make them especially desirable but we cannot tell you about them at the present. However you might watch Radio Age for further developments along these lines.

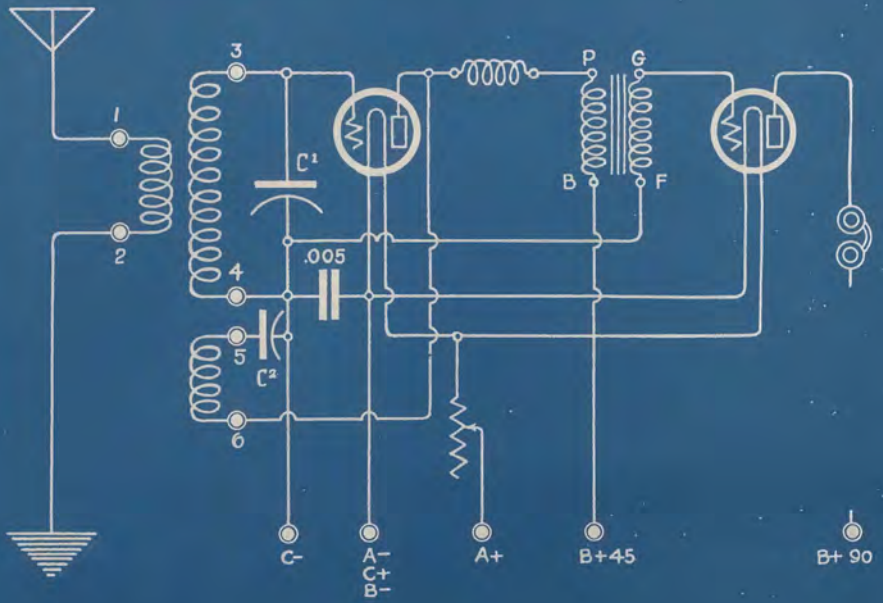


FIG. 7

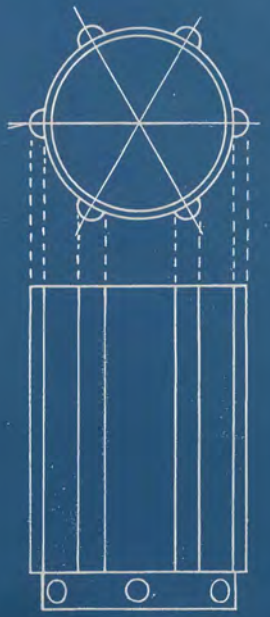


FIG. 8

W.T. GARLAND

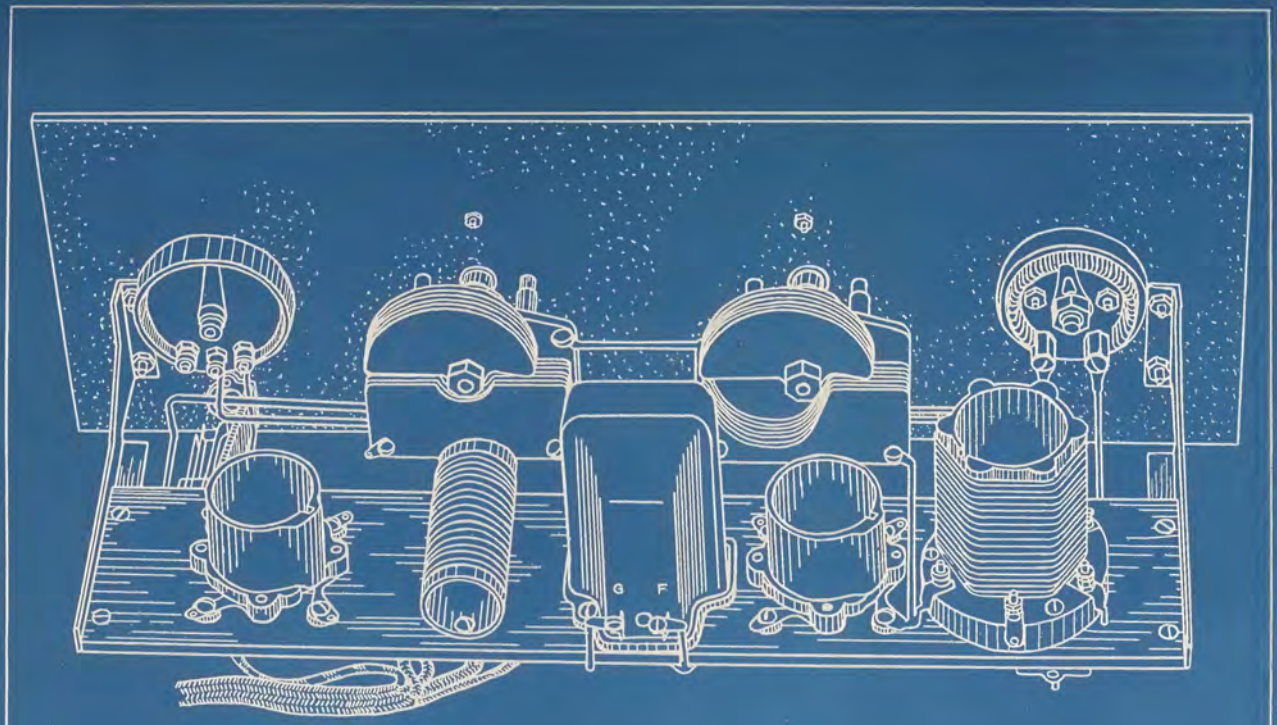


FIG. 9

W. T. GARLAND

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.

SHIELDING of receivers for those in localities where broadcast stations abound or where power line and other extraneous noises worry the fan, seems to be the best bet yet, either with the toroid coils or with the straight solenoids, as long as the coils are kept a reasonable distance from the shield. A story on page 5 of this issue, will give some details of interest. One of the pleasures we had in test work in the laboratory was placing a regenerative set and two stage amplifier in a metal shield with the lid open; take off the antenna and ground connections and tune in the locals. You can get good signal strength that way. Then slowly allow the cover to come down over the top of the shield. At a certain point the volume of the signals will increase wonderfully and then decline rapidly as the cover gets lower and lower until when the cover is just about closed the signals are swallowed up and only a faint peep of the carrier can be heard. Make sure in shielding that you do not allow too many holes in the shield or else the shield will be useless. We don't ground ours—merely let the shield float. Also be careful in putting jacks and other instruments on the metal panel to see that insulating washers are spaced properly to prevent actual contact with the metal.

MANY features included in the pages of RADIO AGE always appeal to Charles Chapman, 706 Burns St., Forest Hills, N. Y., who delights in sending us a list of 162 stations, including seven of the foreign stations. A long time ago we adopted the practice of not listing the call letters heard on account of space requirements.

GEORGE HAAS, Jr., R. 1, Box 713, San Gabriel, Calif., had the thrill that comes once in a life time recently when the Los Angeles broadcasters piped down for the Radio Ball and no one was on the air to interfere except KTBI, whom the Coast fans have dubbed the "meanest station on the coast." However despite the silent portion of the night there were plenty of bloopers on the air lanes who prevented hard workers from achieving the full measure of their ambition.

DIAL TWISTERS

Charles Chapman	706 Burns St.	Forest Hills, N. Y.
George Haas, Jr.	R. 1, Box 713	San Gabriel, Calif.
Peter Moizuk	14417 Darley Ave.	Cleveland, Ohio
V. R. Kerr	Ernhold	Saskatchewan, Canada
L. D. Van Walkenburgh	P. O. Box 58	Pedro Miguel, C. Z.
Robert E. McMonigle	2 Hybla St.	N. S. Pittsburgh, Pa.
Julius Greenfield	3442 East 128th St.	Cleveland, Ohio
Nelson Greenfield	3442 East 128th St.	Cleveland, Ohio
M. W. Mann	Minn. L. & P.	Hibbing, Minn.
H. O. Warren	556 Golden Gate Av	San Francisco, Calif.
F. E. Hammer	1586 23rd St.	Milwaukee, Wis.
E. E. Surber	830 East Market St.	Louisville, Ky.
Carl Newman	1306 Morton Ave.	Louisville, Ky.
Owen Bailey	522 Reynolds Ave.	Columbus, Ohio
Axel Jensen	15743 Joslyn Ave.	Detroit, Mich.
Arthur Free	R. F. D. 6	Jackson, Mich.
Freeman J. Santos	83 Wesleyan Ave.	Providence, R. I.
Don L. Kooken	Box 153	Garrett, Ind.
Ronald Pomeroy		Woodburn, Ore.
Russell A. Catana	122 Pearl St.	Trenton, N. J.
J. A. Grant	16 Hillcrest Ave.	St. Catherine, Can.
Walter D. Murphy	1788 Lanier Place	Washington, D. C.
Elmer A. Johnson	2553 N. Halsted St.	Chicago, Ill.

FREEMAN J. SANTOS sends us a Ham-o-graph written on telegraph forms from 83 Wesleyan Ave., Providence, R. I., in which he compliments RADIO AGE on its editorial content. He winds up by saying "I shall keep on buying RADIO AGE and patiently waiting for an isometric diagram of the perfect receiver—so's your old man." O. K. Mr. Santos—when the perfect receiver is designed you will find it in RADIO AGE.

WALTER D. MURPHY, 1788 Lanier Place, Washington, D. C., likes the department in which this is found, but wonders why we do not enlarge it by addition of the DX lists. We did that for a long time, but found the majority of readers preferred not to have the DX lists printed, so in deference to the majority we discontinued the practice. Mr. Murphy's work with a single tube is good and he gets the button even if we do not print the list.

LOUISVILLE, KY., has a fan in the person of E. E. Surber, 840 East Market St., who uses a two tube regenerative set and covers the American continent in search of distant stations. His catch numbers 86 during the course of a month and many western and southern (Mexico) stations are included.

SOUTH AMERICAN stations were pulled in during the recent International test by Carl Newman, 1306 Morton Ave., Louisville, Ky., who brought in OAX at Lima, Peru. He also picked up the Mexican stations.

ROBERT E. McMONIGLE, 2 Hybla St., N. S. Pittsburgh, Pa., takes time to write up a log of 137 stations he has heard from his home town, from which we would surmise that even KDKA and WCAE do not bother him to a very great degree.

TWO FANS in the same family, Julius and Nelson Greenfield, 3442 East 128 St., Cleveland, Ohio, report good success with the conventional three circuit set shown in blueprint form in the RADIO AGE for December, 1925. This same model can be made even better by the addition of one stage of r. f., somewhat on the order of the article on page 21, January, 1926.

M. W. MANN, at the Minnesota Power and Light Co., at Hibbing, Minn., is getting great results from his set and reports good audibility. He complains a little of body capacity but gets around it by means of the well known pencil and rubber scheme of moving the dials.

H. O. WARREN, 556 Golden Gate Ave., San Francisco, Calif., takes page 64 out of the RADIO AGE and fills it in with all of the DX work he has done —a very simple and effective method of making up a log since the various channels are already outlined and can be filled in readily. He also furnishes several calls not on our last list. In connection with this our April number has the final government broadcast list as approved by the Department of Commerce on January 30. However we have even seen the government make mistakes; in one of their publications they spoke of "harmonies" when they meant harmonics. They also deleted several stations through error and are now busy reinstating them in the list.

PETER MOIZUK, 14417 Darley Ave., Cleveland, Ohio, says he has trouble with an old ultra-audion because of some of the broadcasters covering the face of his dials. Probably a small fixed condenser in the antenna lead might help. Also rearranging the circuit so it will not radiate will help the neighbors too. See page 21 January, 1926, RADIO AGE for a circuit.

V. R. KERR, Ernfold, Saskatchewan, Canada, furnishes an interesting list of long distance work which takes in about most of the worth while stations on the continent (our continent). His location, like New Brunswick, seems to be a good one for DX and if we ever get enough money to retire on we will probably visit those two locations to do some work.

L. D. VAN WALKENBURGH, P. O. Box 58, Pedro Miguel, Canal Zone, tells us that when he wants entertainment he always tunes in KDKA on the short wave (about 61 meters) and lets the loudspeaker go full blast. He also uses WJZ on about 70 meters. Canal Zone fans have plenty of interference on account of 600 meter ship work, NBA on the arc and several other government transmitters for naval and military work.

BY WAY of contrast we have a letter from F. E. Hammer of 1586 23rd St., Milwaukee, Wis., who reports trouble with the three circuit set in the December blueprint section. He started to build the set for his three-year-old daughter (who by the way can tune most any of her father's sets) but has struck a snag and has had to rebuild. We do not know what to say in regard to this matter. Two previous correspondents report great luck; one has poor luck. Suggest going over the schematic again and following it religiously. The circuit is as simple as pie—and the results should be a foregone conclusion.

Test Your Tubes at Home

(Continued from page 10)

and showing how you know that a certain tube is not a good one.

Best Ones In R. F.

IN disposing tubes in a set, it is well to remember that the most sensitive tubes should go in the radio frequency sockets, the next sensitive in the detector and the worst ones in the audio, replacing these when possible. If you are chiefly interested in local programs and in getting these with particular clarity, you may reverse the above and note an improvement in quality with the best tubes in the audio sockets. The reason for this lies in the fact that a good tube has what is called a "linear characteristic" that is, variations of the grid voltage caused by the incoming modulations cause a fluctuation in plate current exactly corresponding. A poor tube does not follow the modulations so well and the result is distortion.

The fact that the plate current reading is so much less with a negative charge on the grid may explain why the use of a "C" battery is advised so much. The "C" battery places a still greater negative charge on the grid than with the "grid return" connected to the negative A battery alone, and the B battery current is thereby decreased considerably—sometimes by one-half. And this, without any loss in volume or quality, and usually an improvement in the later.

Tubes play a bigger part than you think in radio set sensitivity. Keep good ones in the sockets and your set will stay sensitive.

Love Story Plots Out of Style for Radio

IS the world getting tired of love stories? Is "So they kissed and lived happily ever after" going out of style? Out of more than a hundred radio dramas submitted by fans to the contest being staged by WLS, the Sears-Roebuck station, and the Drama League of America, an alarmingly small number deal with that fascinating subject of falling in love.

The domestic scrimmage, with a happy ending of course, the two gun tragedy that ends in silence and smoking pistols, the crook story, the social farce, the romance of long lost brothers reunited, stirring tales of rum runners—all these seem to be crowding from the stage the good old fashioned He and She story which for thousands of years has reigned supreme.

If you ask the radio fan, married life is much more romantic than old fashioned romance. Surprisingly, perhaps, the majority of plays center around the little—and big, dramatic moments in married life.

The purpose of this contest has been two-fold: to find out what radio fans want on an evening's program, and to establish, if possible, a new radio art, the art of the drama. So far the radio program has been largely a matter of pioneering, of exploring the possibilities of sound.

Horizontal Reception of Broadcast Waves

(*Continued from page 14*)

The no-signal should be designated as zero. Of course this table would not permit the fine shadings encountered in different values of signal strength, but nevertheless it would throw the signals into one of the four classes, loud, medium, faint and no-signal.

The measurements can be made with either a super-heterodyne, a tuned r. f. set or a regenerative set, but arrangements should be made to completely shield the outfit so as to prevent the possibility of local pickup on any of the signals, and also to eliminate as much stray noises which might be bothersome in determining the relative strength of various broadcast station signals.

In the Department of Commerce inspectors have access to meters known as "field strength meters" but these involve the use of expensive meters and complicated apparatus not within the reach of the average broadcast listener.

AS between the loop antenna, as the average reader is acquainted with it, and the Hertz antenna to which reference is made by Dr. Alexanderson, it is believed the best would be the latter on account of its being acted upon by the horizontally polarized waves, while being fairly immune to the vertically polarized static waves. The use of a Hertz antenna which can be swung around in different directions and at different angles would be the most acceptable if the broadcast listener is in position to erect one on his own premises.

The Hertz antenna, so called because of its having been the simplest form of antenna originally used by Hertz in his early experiments with transmission of waves, is just an antenna and a counterpoise, both of the same length, instead of an antenna and a ground. The arrangement of the antenna and counterpoise is that form in which the counterpoise is a continuation of the antenna, with a break in the middle of the two.

Diagrammatically the Hertz antenna is shown in one of the figures accompanying this article. This type of antenna, as well as the loop, should be ungrounded in order to take full effect of directional qualities. As soon as a ground is applied directly to the circuit, the results are thrown out of balance and directivity is no longer a feature of the calculations.

IN the diagram the Hertz antenna is made up of two bamboo (or other light material), poles, butted together into a holder with a rod running down vertically by means of which the antenna may be turned. If desired the arrangement can be put on a universal joint so the antenna may be tipped either up or down. Attached to the bamboo poles are two wires, fifteen to twenty feet in length, one forming the antenna circuit, and the other the counterpoise. These two wires come down through the vertical tube and go to the receiver—the leads should be included in a shield so their vertical portion will not act as an energy collector. The vertical tube can be grounded to the shield of the receiver.

In using a r. f. set of the tuned stage type the Hertz antenna can be coupled capacitatively to the ordinary antenna coil by two midget condensers. If the ordinary loop is used the leads from the loop should go to grid and filament of the first tube. If a super is used with a simple loop no changes will be necessary other than the shielding of the vertical lead-ins and the set itself. If used with a Hertz antenna the leads from the antenna should go through capacity coupling to an antenna coupler for the super. While a super-het was used in the experiments related by Dr. Pickard (Feb. QST), nevertheless for the average experimenter the tuned r. f. set will probably be more acceptable on account of the absence of haromonics.

Those who live within the city will be handicapped in putting in a Hertz antenna on account of the space limitations, but those in suburban areas and out in the country can erect the Hertz type without a great deal of difficulty.

A FIXED Hertz antenna may be used by those in the city and can be installed in almost any attic. The scheme is the same as for the variable type although directional effects will be noted only in directions for which the antenna is erected. In putting in such an energy collector in the attic, be sure to get the antenna and counterpoise away from other wiring in the house. Probably the best position would be at the ridge of the room where the antenna and counterpoise would be far removed from any lighting circuits.

There are, generally speaking, enough broadcast stations within the 0-500 mile radius to afford many broacast listeners an opportunity of making measurements on signals. These measurements can be made even on those stations in one or two directions which the fixed antenna picks up with the strongest signal.

While the General Electric has done a good deal of work on the transmission end of the game, not much research on reception at broadcast wavelengths has been carried out, and this should present an opportunity for listeners with more than the usual amount of radio curiosity.

WITH THE MANUFACTURERS

Get Out and Sell to the Farmers

THE time has not yet arrived when all farms are radio equipped, despite reports that practically all farmers are now listening in. According to a survey by the Census Bureau in twenty states, where there are 1,853,869 farms, only 109,992 farms now have radio receiving sets, or a trifle less than six per cent. The census of the whole 48 states is not yet completed, but out of the twenty listed Illinois makes the best showing reporting 27,434 farms equipped with radio sets, Kansas ranking next with 13,189 sets.

Last September the Agricultural Department reported that approximately 555,000 farmers owned radio sets in all states, which figure represents a little over eight per cent of the total of 6,372,263 farms in the forty-eight states.

The figures check pretty well, evidently indicating that there is a great market for radio receivers among the farmers in practically every state. With the tendency of many stations to broadcast more agricultural news and information besides the usual line of entertainment, religious services and other features, it is expected that interest in reception on the farms will continue to increase.

Decimal Metric Measures Urged for United States

ADVOCATES of metric standards for the United States have gained an important victory in Congress by succeeding in having hearings called on the Britten Bill (H. R. 10), despite efforts to block consideration of this measure. The hearings began on February 1 before the House Committee on Coinage, Weights and Measures, of which Randolph Perkins of New Jersey is Chairman.

The Metric Bill, put forward by Fred A. Britten of Illinois, provides for the gradual adoption of metric units of weights and measures in merchandising throughout the United States after a transition period of ten years.

Under the proposed law, manufacturers will continue to use any measures they desire in production, but commercial transactions are to be on the decimal basis, already employed to advantage in United States coinage. All civilized nations have adopted the metric standards except the United States and the British.

Giant Eby Display

A MAMMOTH display post, measuring six by ten inches, an exact replica of their Ensign binding post, has been made up for use by dealers, according to an announcement made by the H. H. Eby Manufacturing Co.

Wins Award

Frank Conrad

THE Morris Liebmann Memorial prize, awarded annually by the American Institute of Radio Engineers for the most important contribution to radio progress, was presented to Frank Conrad, assistant chief engineer of the Westinghouse Electric and Manufacturing Company, in recognition of his work in short wave development, at the recent annual meeting of the society in New York.

The prize, a check for $500, was presented to Mr. Conrad by Dr. J. H. Dellinger of the U. S. Bureau of Standards, president of the institute.

Mr. Conrad, from whose amateur radio station KDKA was developed the pioneer broadcasting station of the world, discovered that the short waves, contrary to general opinion at the time he began work on them, were better for distance transmission than the longer ones; demonstrated that they could be used for dependable continuous, daily transmission over long distances under the exacting demands of ordinary commercial communication, and is now directing the development of a system of feeding a chain of broadcasting stations with programs from a central point by means of the short wave.

Moves Office

Ralph Bretzer, manufacturers' representative, formerly located at 128 West 42nd St., New York City, has moved his office to Suite 60, 160 West 45th St., New York City.

Change in Eastern Sales Division

THE Diamond State Fibre Company has announced changes in its Eastern sales organization. C. M. Bogert is now district manager for the state of Connecticut with offices at South Norwalk, Connecticut.

W. R. Elsenhans, formerly of the Bridgeport home office staff, is now district manager at Philadelphia with offices at 822 Drexel Building. Messrs. Bogert and Elsenhans will be in charge of the sale of both Diamond Fibre and Celoron in their respective districts.

Second Edition of Practical Radio

ANNOUNCEMENT is made by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York, N. Y., of the printing of the second edition of "Practical Radio" by James A. Moyer, Director of University Extension, Massachusetts Department of Education, and John F. Wostrel, Instructor in Charge of Industrial Subjects of the Massachusetts Department of Education.

The book comprises 271 pages of popular and modern treatment of radio for the fan and the experimenter. It is well illustrated both with pictures of apparatus and with circuit diagrams. The price is $1.75.

Benjamin Coil

ANOTHER product has been added to the Benjamin line with the announcement of the "Lekeless" r. f. transformer, made in binocular form, with self-supporting wire turns.

Supporting insulation is found at only one place in the field of these coils for which extremely low distributed capacity, low resistance and high inductance are claimed. On account of the semi-restricted field the angle of mounting is not critical. The coils are manufactured by the Benjamin Electric Co. and are shown in the picture above.

R. M. A. Secretary

B. W. Ruark, the newly elected executive secretary of the Radio Manufacturers' Association, and who was assistant to the commissioner of the Automotive Equipment Association

THE Radio Manufacturers' Association, organized less than two years ago, has now become so large and so representative of the industry it is necessary to greatly extend its activity and to set up machinery for more comprehensive work for the industry and the public. Announcement to this effect has just been made at the Chicago office of the organization.

The Board of Directors of the Association recently approved a budget for 1926, calling for an Executive Secretary, an Assistant Secretary, and a Director of Publicity, as well as the establishment of permanent headquarters in Chicago. B. W. Ruark, Assistant to the Commissioner of the Automotive Equipment Association, was chosen as Executive Secretary, and Charles H. Porter, who has acted in that capacity since the Association was organized, was selected as Director of Publicity.

This change marks an important stage in the advancement of one of the most uniquely organized trade associations in the United States. A year ago last May, a small group of pioneers, realizing the need of an association in the radio industry, gathered together and launched the Radio Manufacturers' Association, the growth of which has been so rapid until today all sections of the United States are represented in its membership and the Association is national in scope and influence.

With an eye alert to the interests of the consuming public, the Association in its infancy successfully opposed the proposed federal tax of ten per cent on all radio apparatus. It later obtained a suspension of freight rate inceases for an extended period and a final decision from the Interstate Commerce Commission, much more considerate of the needs of the radio public than would have resulted without its efforts. In these accomplishments the Association saved radio users many thousands of dollars.

BY MAKING it possible for American radio manufacturers to obtain licenses under the radio frequency and reflex circuits owned by the United States Navy, the Association contributed greatly to the advancement of the industry with consequent benefits to users everywhere. It sponsored and promoted in 1925, the Second Annual Radio World's Fair in New York City and the Fourth Annual Rado Show in Chicago, t he two most successful radio shows during the year. It has made notable progress toward stabilizing the industry through standardization and simplification—and in many other ways.

In securing the services of Mr. Ruark the Association has been extremely fortunate. The new executive is a native of North Carolina, was educated in the schools of that state, graduating from Trinity College, now Duke University, Durham, N. C., in 1914. He was engaged in school work in North Carolina for a while, after which he removed to Detroit, Michigan, where he continued in educational work and at the same time attended the Detroit College of Law. From the time he entered school work, Mr. Ruark was known as a public speaker of unusual ability. While head master of the Hudson School for boys, he enlarged his activities on the platform and spoke at many important gatherings, among them the World's Salesmanship Congress at Detroit in 1918.

In 1918 Mr. Ruark became identified with the automotive equipment industry, serving since then prominent manufacturers and wholesale institutions in various sales and sales executive positions in which he gained a practical first-hand understanding of the merchandising problems of the retailer, wholesaler, and producer, as well as a nationwide acquaintance with the men of the industry, many of whom are now large operators in the radio field.

FOR the past three and one-half years he has been affiliated with the Automotive Equipment Association, one of the strongest trade associations in the United States, first as Field Secretary and later as Assistant to the Commissioner. In this work he has been in continual touch with the modern merchandising methods, has become acquainted with the principles of successful trade association operation, which well qualifies him for the position of Executive Secretary of the Radio Manufacturers' Association.

Mr. Porter, the new Director of Publicity, is one of the best known newspaper men of the United States, having held important executive positions with several leading newspapers. About four years ago he engaged in general publicity work and since that time has handled publicity for several leading manufacturers in radio and other fields.

U. S. Navy is Receptive to Complaints

THE U. S. Navy is replacing its radio apparatus with non-interferring apparatus as rapidly as funds and development permit; meanwhile it desires to cooperate with all users of radio, a statement from the Navy Department points out.

The navy recognizes that it does create some interference in radio. Cooperation, however, implies assistance from the other users of radio, i. e., the public. If one has a complaint against navy radio, or if he thinks he has one, the navy wants to hear from him. That is the first step in cooperation. The navy will take the next step, which will be to devise ways and means of affording relief through reducing interference created by it, or, in case the navy is not causing the disturbance, to demonstrate as far as practicable, where the trouble lies.

Complaints should be filed with Naval Districts Commandants and not with the Navy Department.

Details Not Ready on Static Minimizer

PRESS reports of a static eliminator attributed to him have been greatly exaggerated, according to Prof. D. J. Demorest, of the Department of Metallurgy, Ohio State University, at Columbus, Ohio.

In a recent letter to RADIO AGE, Prof. Demorest calls his device, on which patents are pending and on which claims have been allowed, a "static minimizer", but states that any details of its construction or the operating features cannot be disclosed for some time.

Cleartron Booklet Tells of Radio Tubes

AN attractive booklet, entitled "Radio Tubes in the Light of Modern Research" has been issued by the Cleartron Vacuum Tube Co., and may be secured from that organization.

In addition to data on the tubes which this company manufactures, the booklet also has general information about tubes and shows various scenes during the course of manufacturing receiver tubes.

New Molding Compound is Developed

ANNOUNCEMENT is made of the development of a new molding compound for use in connection with the molding of bakelite, by the General Insulate Co. The compound has flexibility to a degree not heretofore practicable. The compound can be moulded with the finest of threads or metal inserts, into almost any shape either thick or thin. Two pieces can be cemented together.

Na-Ald Adapters

AMONG some of the recent issues by the Alden Manufacturing Co., are adapters and connectoralds, for use in connection with the UX and CX based tubes in manufactured receivers.

These two items have been added to the list of sockets and dials in which work the Alden company is specializing.

Milwaukee Firemen Scale Musical Heights

(Continued from page 25)

open air concerts by the city's park board band in Washington Park, a summer feature. Marquette broadcasts a Monday evening studio program. The university has two studios, one in the tower of Science hall near the operating room, and the other on the second floor of the building where larger gatherings of artists may be accommodated.

MOST important of the remote control is at Saxe's Wisconsin Theatre, the biggest theatre in the state, at which 21 microphone placements have been stationed. From this remote control there are regularly broadcast an evening hour of organ music on Wednesday and Friday; a midnight request organ recital on Wednesday from 11:30 to 12:30 p. m.; an hour dance program from 10:30 to 11:30 p. m. Wednesday from the two orchestras on the Wisconsin Roof, and a Studio Revue, comprising the best talent available from the various Saxe Theatres throughout the city, on Friday from 8:30 to 10:00 p. m.

Another remote control has been placed at the Milwaukee Athletic Club with five microphone placements, from which there is broadcast on Monday, Tuesday and Thursday, except during the summer months, an hour of evening dinner music by the Milwaukee Athletic Club orchestra and various studio programs on the same evenings during the intermission of the orchestral. Special arrangements at the Milwaukee Athletic Club permit the broadcasting of any banquet or entertainment which might be held in any of the dining rooms or private rooms.

Another remote control has been installed in the new $2,000,000 home of The Milwaukee Journal, two studios and the auditorium being used, to permit broadcasting news and daily talks by specialists on the staff, as well as musical programs.

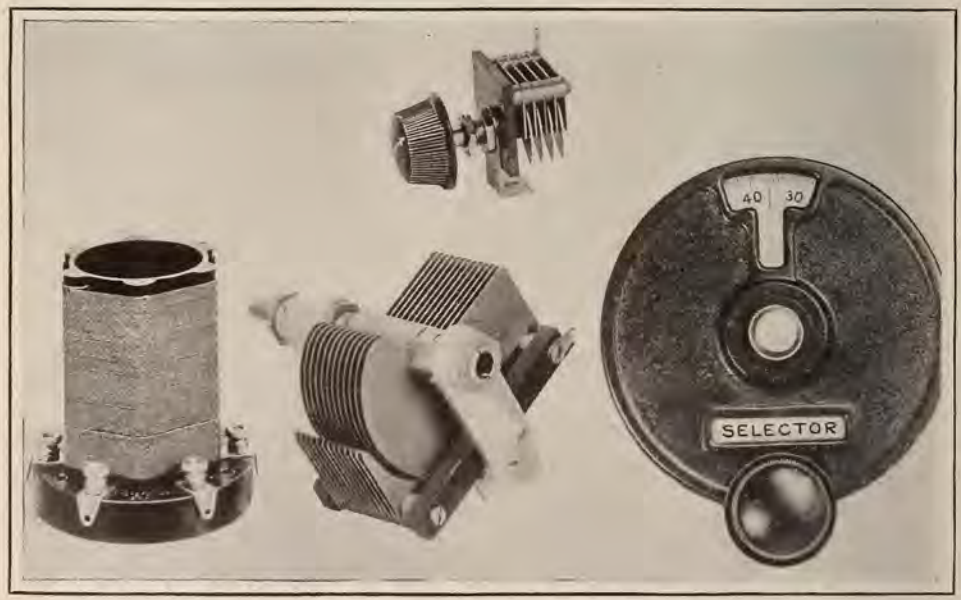
DEPARTMENT editors and special writers on the staff of The Journal broadcast daily concise comment on the news and current topics in the form of radio editorials. Day time "service schedules"—a period of 15 minutes at 11 a. m., and 30 minutes at 4 p. m., have been added to the regular schedules of WHAD, at which times there are featured important news bulletins, and sports, finance, market and produce reports, with special reference to the Wisconsin farmer. At the same time persons on The Journal staff discuss, briefly and simply, such topics as the latest books, questions of investment, practical golf, boxing, nature study gardening, radio and problems of the housewife. The afternoon program also includes musical numbers, many of which are given by Journal employes.

From a remote control at the Milwaukee Auditorium, the city's convention building, are broadcast the many programs, shows, conventions, political rallies and athletic contests held there. Football and track contests are reported from a remote control installed at the Marquette University stadium. Cardinal Mundelein, on his recent visit to Milwaukee, talked from this station.

A seventh remote control station places on the air the Sunday afternoon concerts of the Turnverein Symphony orchestra.

Station WHAD operates on 500-watts at 275 meters. The present equipment is such that 750-watts are available immediately and 1000-watts can be had with slight changes.

New Silver-Marshall Items



The four items shown in the above photograph are recent releases by Silver-Marshall, Inc. The little condenser, known as type 340 (top picture), is a small compensating condenser of 25 mmfd. intended for balancing, compensating or neutralizing. The inductance shown at the left is the type 114 inductance made with a rotor coil in addition to the other two windings. The coil is shown plugged into the Silver-Marshall socket, which carries 6 contact studs. In the center is the type 316 condenser, made so a line of variables may be hooked together, shaft to shaft, and handled for single control. The vernier dial shown at the right is type 801, made to fit any condenser, clockwise or counter-clockwise; 180 or 360 degrees. It has reversible scales and a ratio of 14.5 to 1

Shall They Announce or Chatter?

(Continued from page 32)

to his Waterloo, can be placed in the category of humorous stories, (though we believe Mr. Tyson considered it a tragedy,) and yet you will find him a favorite in many homes where WWJ is heard day in and day out. In Mr. Tyson's case it seems to be a combination of common sense, an innate courtesy and a sincere desire to please his listeners that has brought him success. He is at his best when he is over at Ann Arbor telling about the mighty Friedman's passes, or hopefully following the unlucky Tigers through one of their disastrous nine-inning exhibitions. But he is equal to any occasion and is fully as much at home broadcasting a formal concert as he is officiating at an informal studio affair,—a versatility, which unfortunately is not possessed by all the gentlemen of the microphone.

ANOTHER well known Detroit announcer, whose method is quite different from Mr. Tyson's, and yet pleasing, withal, is Leo Fitzpatrick, of WJR, who was long known throughout the length and breadth of radioland as the "Merry Old Chief" of the Kansas City Nighthawks. Mr. Fitzpatrick is the possessor of a fine singing voice, which he uses to good effect upon occasion, a pleasing personality and a bubbling sense of humor. He is an old hand at the game, and knows that what goes over big at two o'clock in the morning doesn't appeal particularly to the more conservative, early evening audience, so by the use of a fine discrimination he succeeds in pleasing almost everybody. He has what the telephone people must mean when they talk about the "voice with the smile,"—it always has a gay note that reminds us of the cheery chirp of a robin,—and if you like unalloyed foolishness you will occasionally catch him in that mood. One of the funniest things we've heard was Mr. Fitzpatrick's demonstration of the evolution of the popular song, as exemplified in his rendering of

"Alleluia—bananas
I was seeing Nelly home."

And if one is to recommend an announcer for absolute absurdity it is impossible to ignore one Art Herske, a past-master of rapid-fire chatter, who officiates at WTAM, Cleveland, on Saturday night, when this ordinarily dignified station runs riot with Everett Jones and his gang. We know of nothing in radio that can compare with the hilarious orgy of pure foolishness put on by this outfit, led by Mr. Herske, and although one would go mad listening to it oftener than once a week, we frankly admit (even at the risk of being accused of having a middle-class mind) we would miss them if the Saturday night policy of WTAM should be changed.

AND then there is the announcer, whose own mother could scarcely have the imagination to call his voice musical, and yet, when we first acquired a radio set we spent two-thirds of the time listening to him. He is Harold Hough, the "Hired Hand" of WBAP, and any critic who would seek to curtail his activities had better stay out of Texas. WBAP is one of those stations which is so incomprehensible to the eastern mind, but to us it is just the sort of informal institution that best exemplifies the big, breezy, open-hearted attitude of the state of Texas, and the homely philosphy and dry humor of the "Hired Hand" are exactly the requisites of an announcer in such a locality. For Mr. Hough has an extremely subtle sense of humor,—it's on the Will Rogers order, and he talks exactly as one would expect a cowboy to talk, and if WBAP isn't in the cow country, where is it? While his patter may sound as foreign to eastern ears as "Lopez speaking" does outside the latter's baliwick of Manhattan, there are many thousand listeners west of Pittsburgh who would rise up in their wrath at any attempt to hog-tie and muzzle the "Hired Hand."

The best thing we ever heard him do, was when WBAP, with true western enterprise, strung up microphones in a negro tabernacle and broadcast the revival services. The impromptu comments of the announcer on these occasions made them red-letter nights, and many northern listeners chuckled over the novelty for weeks. Apropos of this same broadcast, Mr. Hough told us a story we hope to use some day which fully illustrates his keen appreciation of a little humor in this vale of tears. The "Hired Hand" is much in demand at radio shows and at the opening of new stations, and one is likely to run across his broad, honest accent almost anywhere in the south and west.

It is not our presumption to hold up the aforementioned gentlemen as the best announcers in the country. They are merely several widely different types, all of which appeal to a certain class of listeners. But they are representative of what seems to please the greater per cent of the radio audience. If they didn't, you may be sure they would go back to newspaper work where most of them came from.

The East has its suave Brokenshire, the scholarly McNamee (our secret hope, which we never expect to be realized, is to hear him mispronounce a word), the affable Carlin, and many others. We like them all, but if we are any judge of human nature, the rest of the country would prefer to have its announcers just about as they are.

Radio Extends Use of English in Japan

TOKYO'S radio broadcasting station JOAK is carrying a three months' course in English, according to advices reaching the Department of Commerce. A lesson goes on the air each evening, subscribers paying 1.50 yen extra for the instruction. Students of the courses are aided by the use of printed lessons sent out in advance.

The Tokyo Amateur Dramatic Club composed mostly of British citizens, recently broadcast a play in English. By the installation of loud speakers in several public places a large number of listeners were permitted to hear the production as transmitted by Japan's 1000 watter.

Home Service for Radio Sets

(Continued from page 16)

the receiving equipment—antenna, ground, power, supply, and receiving set—it is in most cases quite possible to replace one or more of these parts by another which is known to be in good condition. Of course it is not very easy to erect a new antenna, nevertheless if you have the opportunity you can get the effect of this kind of substitution by taking your receiving set to your neighbor's house and trying it out on his antenna and ground. Similarly you may borrow a pair of phones, a loudspeaker, a B battery or an A battery or an attachment for the lightning circuit to supply the power to the electron tubes, and substitute each of these devices in turn in your own receiving circuit. After making one of these substitutions, you will probably find that the receiving equipment is once more functioning properly. Thus, you will have definitely located the source of trouble in a particular part of the receiving circuit.

Ballad Singer

Listeners who tune in WTIC, the Travelers Insurance Company's station at Hartford, Conn., will frequently hear Charles L. Flynt who sings ballads for his listeners. WTIC is now on a wavelength of 475.8 meters, having swapped places with WEEI.

Give Your Old Sets to Lighthouse Men

SOME five or six hundred serviceable radio receiving sets are desired by Commissioner of Lighthouses Putman. Following Secretary Hoover's appeal recently, about twenty-five sets have been received or promised for the lonely keepers of the government's lighthouses, many of which are out of touch with the shore for long periods.

One New York woman has contributed twelve sets to the Baltimore district, but many more are needed.

If you have a set available write the Commissioner.

Has Wave Filter

L. William Skala, young Berwyn electro-chemical engineer, who has method of operating two or more transmitters simultaneously on the same wave band.

RADIO fans in general and radio interests in particular may be interested in the recent laboratory demonstration given by L. William Skala, of Berwyn, Illinois (a suburb of Chicago) in which two or more miniature broadcast transmitters were operated simultaneously on the same wavelength without interference in the receiver, the selectivity of the receiver and that of the transmitter being embodied in a special circuit developed by Mr. Skala and now being patented in the United States and abroad.

RADIO AGE'S associate editor witnessed the demonstration on February 20 at which Frank J. Schraeder, Jr., patent attorney of 160 N. La Salle St., Chicago, representing Mr. Skala, was present with other interested parties. The demonstration, while not carried out with the safeguards of a laboratory or a technical examining committee, was such that the method invented by Mr. Skala seems to hold great promise if it is reproducible on a scale suitable to use in connection with high powers of modern broadcast transmitters.

While Mr. Skala would not go into the technical features of the new invention with representatives of RADIO AGE, he and his attorney plan to present these features before Dr. J. H. Dellinger of the Bureau of Standards at Washington who will be asked to witness and direct a proper laboratory demonstration using all of the precautions necessary to prove that the method involved does not depend for its success upon the modulation of a harmonic of the fundamental or the magnetic coupling between two transmitters. Shielding will be done to add further safeguards to the demonstration, which if successful should be of widespread interest.

Use the Log-a-Wave Chart Page 64.

Balanced Capacity in the Isofarad Receiver

(Continued from page 21)

As a direct result of these improvements, the isofarad set is highly selective and one which will bring in distant stations with remarkable tone quality, even through heavy local interference. To construct the receiver the following parts are needed:

3—R. F. canned coils
2—Condensers (C1 and C2).
1—.00035 mfd. variable.
3—Vernier dials.
4—Condensers, 4 to 70 mmf. (Cr and Cb).
3—0.5 mfd. by-pass condensers.
1—.001 mfd. fixed condenser.
1—.00025 mfd. grid condenser with 2 megohm grid leak.
1—Each 25 ohm and 10 ohm rheostat.
1—Ballast resistance, capable of keeping the two audio tubes at five volts from a six volt current supply. A 10 ohm rheostat can be substituted if desired.
2—Lock switches for filament supply and panelites.
2—Audio frequency transformers.
1—Panel 26x7x7/16 inches.
1—Subpanel 25x8x7/16 inches.
5—Sockets, bus wire, binding posts, etc.

The wiring details of the canned coils are shown in the smaller illustration. In the wiring diagram only the condensers of the first stage are designated with identifying numbers because the second stage is a duplicate of the first.

After the receiver is constructed, a few simple adjustments must be made. Slowly rotate all three dials until a signal is heard between zero and fifty. Tune to the exact point of resonance and at the same time gradually turn down the rheostat of the radio frequency tubes.

Cover one filament prong of the first tube with a piece of paper and replace. Adjust the first balancing condenser, Cb, until the signal is weakest. Remove paper and replace tube. Repeat this on the second stage, using the second tube and second balancing condenser.

Turn the radio frequency tubes to full brilliancy and adjust the tuning dials to bring in a high wave-length station. If this causes oscillation it is necessary to tighten the compensating condenser, Cr, lightly, tune again to a low wave-length station and repeat the compensating process on the second tube only. The balancing condenser should finally be so adjusted that, after the receiver has been balanced on a low wave-length station, it is found to be balanced when turned to the long waves.

Eddie Borroff Back in Chicago Again

EDDIE BORROFF, the director of KYW's Congress Studio has come back to Chicago. Eddie has been down south in Florida, where all the prosperous people go when the climate becomes too frigid in Chicago, and to the rest of Chicago's vacationists, who generally go fishing in summer, this gives food for thought. Why not spend your vacation in winter and put in a couple of weeks where the balmy breezes of summer frolic in February?

Hints on How to Get Rid of Interference

(Continued from page 6)

the whole apparatus, will accomplish the same purpose.

Methods Suggested

THESE methods have been suggested by the United States Bureau of Standards. The Bureau gives this word of caution, however, that no one should attempt to connect any device to electric light, power or telephone wires without the consent of the company that owns them.

There was a time when radio was the affair of commercial companies and the sport of boys. Corporations and individuals operating electrical devices paid little attention then to complaints of interference. Today, so many officers of such corporations, and so many men operating electrical machinery have radio sets of their own, that they understand the situation and are glad to be notified of any trouble in order that they may stop it. So, when interference spoils the concert, the radio fan, in most cases, can find out what is the matter and get rid of it.

In the case of a neighbor who has a squealing set and no sense of justice, about the only thing to do is to consult a criminal lawyer and then use an axe.

Uncle Bob Quits His Business for Hobby

ALREADY having mounted the plane of "radio's Honor Roll" because of a long line of wonderful achievements in his radio work with the nation's young, Uncle Bob, the erstwhile Walter Wilson, had nothing left to sacrifice to his chosen vocation than to retire from business life and devote all his time to his radio activities and "The Curb is The Limit."

That is just what happened. Work was stacking up and a steady stream of radio letters and one thing after the other demanded more time than one man could give. He soon found that he had to choose between his office and the radio, but—reflection upon the thoughts of thousands of his juvenile friends and the enthusiasm with which they sought him as their big aspirant, led Uncle Bob to step out of the business life into the radio. Thus, as the story goes, Uncle Bob is the big uncle of Westinghouse Station KYW, where each day he meets his uncounted fire-side listeners, and where for more than two years he found the inspiration that enabled him to carry on a noble work among the children.

His work, beside telling bedtime stories, has been of great value. The Curb is the Limit Club, organized by Uncle Bob has developed into probably the greatest individual drive toward child safety, and a check-up of the 150,000 members of this club would at once reveal the contagion with which this children's safety slogan took hold over the country.

Lynn Police Quartette

Bluecoats in Lynn, Mass., are musically inclined and quite frequently appear over radio for the benefit of the listeners. In the picture above are shown: Left to right, Sergeant Arthur Flanagan, first tenor; Officer J. J. Fee, second tenor; Officer E. J. Kelly, baritone and Sergeant William J. McLaughlin, bass. Photo is by Anton Dyczus.

Use the Log-a-Wave Chart on Page 64.

Rosin Best Flux for Soldering Work

FUNCTION of the brown jelly-like paste which must be smeared on wires before they can be successfully soldered is something of a mystery to the great majority of radio fans. They all know from experience that the molten solder will stubbornly roll off the wires unless some paste is employed, but as a general rule they possess not the slightest inkling of the real action the paste or "flux" performs.

The paste itself does not make the solder adhere, but it does remove a little known agent which otherwise would prevent the soft metal from doing so, according to F. A. Klingenschmitt of the Sleeper Radio Corporation. This agent is a thin film of a chemical compound formed on the surface of the metal when the hot soldering iron is applied to it. The metal, under the influence of the iron's great heat, combines with the oxygen that forms part of the air, and its exposed surface becomes coated with an invisible layer of the new material, which is known chemically as an "oxide."

This newly created film effectively prevents the liquid solder from reaching the actual surface of the wires being connected. Unless it is removed the solder will not stick, regardless of the heat of the iron or the quantity of solder applied. The hotter the iron, in fact, the more oxide is there formed.

The specific purpose of the soldering "flux" is to absorb the film of oxide as quickly as it is generated. That's all there is to the whole affair, says Mr. Klingenschmitt. The paste simply combines with the film, the chemical reaction producing harmless substances which do not affect the soldering operation.

Soldering fluxes take the forms of solids and liquids. Muriatic acid in which pieces of zinc have been dissolved is a common liquid flux, but it is highly undesirable for fine radio connections because it is strongly corrosive. Ordinary rosin is the best flux for radio work because it does not corrode metalwork.

Navy Operators Try Talking to Amateurs

SOME of the sea-going naval radio operators have become too greatly interested in short-wave transmission and been censored by their departmental chiefs. The particular offense seems to have been in seeking to communicate with amateurs on short waves, which is forbidden. Although they may listen in all they please, on the short waves, unauthorized transmission would preclude the use of the vessel's regular radio apparatus, or at least interfere with the handling of official traffic.

The ruling is "Private transmission is not permitted from any naval radio stations ashore or afloat. Every ship of the Navy is considered a naval radio station. Every transmission must be duly authorized by competent authority."

The only work authorized with amateurs is from the district reserve headquarters and by the laboratory at Bellevue, D. C.

Blaming the Moon for Poor Radio Audibility

MOONLIGHT, a commodity generally believed to worry nobody but the writers of popular songs, has been revealed in a new role as a radio wrecker.

Preliminary tests for the national survey of fading and static conducted by WBBM in cooperation with Northwestern University, Dept. of Physics, on the nights of February 9, 10 and 11 from 8 to 11, central standard time, brought unexpected reports on the insidious activities of the moon.

Published reports of private inquiries into the causes of disturbances that prevent good radio reception so far have dealt with the manner in which atmospheric conditions are changed by sun spots, comets and eclipses. Even the aurora borealis has been investigated, but it has never been suggested the phases of the moon might have anything to do with the adenoidal performance of distant sopranos.

R. C. Therrien, an electrical engineer, of Chicago, today forwarded to J. K. Smith, director of the national tests, a report covering a period of eighteen months. He suggested it be investigated.

"Eighteen months ago I discovered quite accidentally that distance reception was almost impossible on a night when the moon was full and high in the sky," said Mr. Therrien in his report. "I thought, of course, that this might be merely a coincidence, but I remembered what I had learned regarding the magnetic effect of the moon on the tides, and it occurred to me that such a visible electrical display ought to have a definite influence on the ionized stratum of atmosphere or whatever it is that carries on, reflects or blocks radio waves. So I watched closely. Each silent night I made careful note of reception conditions and lunar phases and gradually I built up the evidence to show that my supposition was at least worthy of further investigation.

"I discovered that during the summer we frequently had nights free from static, despite warm, sultry weather. Invariably, such nights were those when the moon was in the first or last quarter. I discovered also that many nights which began with the atmosphere perfectly 'dead,' so far as radio reception was concerned, showed marked improvement later in the night when the moon had gone closer to the horizon.

"The night of December 28 of last year was a typical one. The air was crisp, cold and clear and there was no appreciable moisture—in spite of which it was impossible to pick up any but the most powerful distant stations and very few of those. The moon was just approaching fullness. For two hours it was impossible to hear anything but New Orleans and Pittsburgh. After midnight conditions improved and continued to get better until just before daylight when everything went dead again. I have noted similar conditions virtually every Monday night when the moon was full or high.

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
KDZB	Frank E. Seifert	Bakersfield, Calif.	210
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	McArthur Bros. Mercantile Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAJ	University of Colorado	Boulder, Colo.	261
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBG	W. K. Azbill	San Diego, Calif.	216
KFBK	Kimball-Upson Co.	Sacramento, Calif.	248
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District Nc. 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.	242
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
KFVH	Whan Radio Shop	Manhattan, Kans.	219
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Welcome, Minn.	227
KFVR	Moonlight Ranch	Route 6, Denver, Colo.	244
KFVS	Cape Girardeau Battery Station	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. (Port. sta.)	Denver, Colo.	216
KFXM	Neches Electric Co.	Beaumont, Texas	227
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Mary M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	205
KFYJ	Chronicle Publishing Co.	Houston, Texas	238
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.	273
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

Radio Fans Should Welcome Shields and Metal Panels

(*Continued from page 5*)

at the risk of boring our readers we are going to quote just one excerpt from that paper: "The conclusions to be reached from these tests are that the use of a metal panel in a receiving set produces no measurable increase in the resistance and hence in the losses, of the coils and condensers when mounted in the usual manner. In fact the coils may be mounted directly behind the panel, providing the panel is of high conductivity."

The chief electrical advantages of metal panels are: prevention of variation in tuning due to body capacity; simplification of the circuit wiring since the panel and shield become the negative A battery line and returns may be made direct to the panel or the shield; freedom from warping or bending, and finally the isolation of the receiving set from all extraneous electrical disturbances. In practice the shield may either be grounded or left floating on the negative A battery line, depending upon local conditions. In our experience the floating method proved more satisfactory.

YOU cannot be too careful in mounting your coils in a shielded set, regardless of all the theory on the subject. Allow at least 3 inches from end of coils, if solenoids, and not less than an inch from sides of coils to shield. Also do not think because you have a fine shield that it will be such if you have a bunch of half inch and inch holes left in the shield or the panel. In other words, to do the job properly it should be *completely* shielded and by that is meant *all* holes. If necessary you can also shield your battery cable to prevent its becoming a miniature energy collector.

High potential leads and connections should be kept at least an inch away from any metal. In the case of the counterphase the inductance switch and the switch taps should be kept a good distance away from the shield in order to prevent capacity effects which would bring about broad tuning.

If the builder is using a C battery to bias the r. f. grids much care should be expended in making such connections on account of the rotors of the condensers being normally grounded to shield. To test for a ground-to-shield a C battery and a voltmeter may be used. For example the phone jack should be absolutely free from the metal panel. Use the battery and meter to determine if a short exists.

Do not forget that the time and energy spent in *extremely careful work* will be amply repaid in dividends in the form of selectivity and freedom of extraneous noises.

Further evidence of the interest in shielding is shown by the volume of correspondence which crosses the writer's desk; the tenor of a majority of the letters being: "Show me the way to—shield."

And above is our answer.

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
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
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
KQP	H. B. Read	Portland, Oreg.	213
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KQW	Charles D. Herrold	San Jose, Calif.	231
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Printing Co.	St. Louis, Mo.	545
KSL	Radio Service Corp. of Utah	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad Co.	Santa Maria, Calif.	210
KSO	A. A. Berry Seed Co.	Clarinda, Iowa	242
KTAB	Tenth Ave. Baptist Church	Oakland, Calif.	240
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	Brown's Radio Shop	Portland, Ore.	263
KTCL	American Radio Telephone Co. Inc.	Seattle, Wash.	306
KTHS	New Arlington Hotel Co.	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa	256
KTW	First Presbyterian Church	Seattle, Wash.	454
KUO	Examiner Printing Co.	San Francisco, Calif.	250
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
KWUC	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	Hubbard & Co.	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
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
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
WCBQ	First Baptist Church	Nashville, Tenn.	236
WCBR	C. H. Mester	Providence, R. I.	205
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
WDBC	Kirk, Johnson & Co.	Lancaster, Pa.	258
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
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

Probe Bell System For Reduced Rates

THE Senate recently passed an interesting resolution directing the Secretary of Commerce to investigate the use of the Squier wired-wireless patents by the A. T. & T. Co. and make a report on the annual value of these patents to the company and the reduction in public rates if any, due to the free use of the wired-wireless patents.

Senate Resolution 149, introduced by Senator Walsh, reviews the history of wired-wireless investigation begun in 1910 by Maj. Gen. George O. Squire, USA, Retired, then a major in the Signal Corps, under an appropriation of $30.000 made by Congress. His subsequent investigations showed that multiplex telegraphy and telephony over wires could be accomplished by the application of radio to wires in the method commonly known as "wired wireless." Patents Nos. 980356-7-8-9 taken out by Major Squier in 1911, provided for their use by the Government of the United States and its citizens without the payment of royalties.

These patents are now used by the Bell Telephone system free, it was stated, a court having held that as the patents were public property the inventor was not entitled to any compensation therefor.

Now the Secretary of Commerce is directed to make a full report to the Senate to the extent to which the system is used by the A. T. & T. Co. in governmental and public service; the annual value of such use, and the reductions made in rates.

May Redistrict U. S. in New Radio Bill

IF THE new White bill passes Congress under its terms, the entire United States will be divided into five districts, each represented by a resident citizen. Originally it was planned to use the geographical division of the country into the nine radio districts, at present employed in the work of the department of commerce.

Plan Five Districts

The five districts as proposed are as follows:

1. Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, the District of Columbia, Porto Rico and the Virgin Islands.

2. Pennsylvania, Virginia, West Virginia, Ohio, Michigan and Kentucky.

3. North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Mississippi, Arkansas, Louisiana, Texas and Oklahoma.

4. Indiana, Illinois, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Nebraska, Kansas and Missouri.

5. Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Hawaii and Alaska.

WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Goodyear Tire and Rubber Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
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
WEBM	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
WFBI	Galvin Radio Supply Co.	Camden, N. J.	236
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	Onondaga Hotel Co.	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
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	Frank S. Megargee	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.	252
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
WHAT	Dr. George W. Young	Minneapolis, Minn.	263
WHAV	Wilmington Elec. Specialty Co.	Wilmington, Del.	266
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chas. W. Howard	Bellfontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBG	John S. Skane	Harrisburg, Pa.	231
WHBH	Culver Military Academy	Culver, Ind.	222
WHBJ	Lauer Auto Co.	Ft. Wayne, Ind.	234
WHBK	Franklin St. Garage, Inc.	Ellsworth, Me.	231
WHBL	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	New Jersey Nat'l Guard Hdqs. Co.	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	Dr. L. L. Dill	Logansport, Ind.	220
WIBX	Grid-Leak, Inc.	Utica, N. Y.	205
WIBZ	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	L. W. McClung	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBG	Interstate Radio, Inc.	Charlotte, N. C.	224
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
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
WLBL	Bureau of Marketing	Stevens Point, Wis.	278
WLIB	Liberty Magazine	Elgin, Ill.	303

"Night Herd" is Winning Title of WLS Contest

LEVI CHAMBERS BALLOU, of Buffalo, N. Y., is the winner of the $500 cash prize and the Hoover Trophy Cup awarded by WLS, the Sears-Roebuck Station, Chicago, and the Drama League of America in a nation wide radio drama contest.

Mr. Ballou's play "The Night Herd," was selected from among more than five hundred entries, as the most dramatic, the most unusual and the most perfectly adapted to production by radio. It is unique in that it would not be given either on the stage or in motion pictures, since the stage is the saddle, the action taking place as the characters are galloping on horseback across the western plains.

The second prize of $200 goes to Hilliard Booth, Brevard, N. C., for his play entitled "Back Stage." A third prize of $100 was awarded to J. Frank Davis, of San Antonio, Texas, for his play, "Midnight." These two plays will be presented later. Plays were received from every state in the union, from Canada and from North Wales.

Centralab Issues New Modulator Plug

CENTRALAB'S new modulator plug is a unique device that can be quickly attached, without tools, to any radio receiver having one or more jacks, and provides gradual control of tone volume from a whisper to maximum.

In appearance it is slightly larger than the average phone plug, with a small bakelite knob on one side. Turning the knob through an arc of approximately 300 degrees varies a smooth graphite resistance in the plug base. This in turn controls the tone and volume.

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
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
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	Hotel Jamestown, Inc.	Jamestown, N. Y.	275
WODA	James K. O'Dea	Paterson, N. J.	224
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Otto Baur	New York, N. Y.	233
WOO	John Wanamaker	Philadelphia, Pa.	508
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.	258
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	Bligh and Whittington	Elgin, 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	S. H. Van Gordon & Son	Osseo, 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

Supreme Court Decision Favors Amateur

REFERRING to the decision handed down by Chief Justice Taft in the case of the Radio Corporation of America against the Independent Wireless Telegraph Company involving the use of DeForest radio tubes for commercial purposes, S. E. Darby, Jr., of Darby and Darby, Attorneys for the DeForest Company points out there is nothing in this decision which in any way affects the DeForest Company or which will in any way restrict the use of the DeForest audion tubes for amateur purposes.

"The recent announcement from Washington of the Supreme Court's decision upholding the right of the Radio Corporation to sue infringers under its license in the name of the DeForest Company only serves to guarantee to the amateur radio experimentor and to the radio public as well the right to use the DeForest tubes for broadcast reception," says Mr. Darby.

"The one point at issue in this decision was whether the Radio Corporation, not as owner of the DeForest patents but as a licensee, had the right to sue the Independent Wireless Telegraph Company, making use of the name of DeForest Radio Company as a co-plaintiff without such action being favored by the DeForest Company.

"As the decision of the Supreme Court points out, the DeForest Company gave to the Western Electric Company certain limited licenses under the patents for the tubes. Subsequent to this agreement, March 16, 1917, the Western Electric Company then assigned the rights it had thus received from the DeForest Company to the American Telephone and Telegraph Company. On July 1, 1920 the American Telephone and Telegraph Company made a contract with the General Electric Company by which the General Electric Company was granted rights under the patents. From the General Electric Company the Radio Corporation received a license under the patent to sell tubes manufactured by the General Electric Company.

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) 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 .....

(3-26)

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

Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg Co., (Ltd.) Can.	Montreal, Que.	411
CFCH	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	32
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCL	Dominion Battery Co.	Toronto.	357
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	P. Burns & Co. (Ltd.)	Calgary, Alta.	434
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co. (Ltd.)	Calgary, Alta.	434
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	291
CNRC	Canadian National Railways	Calgary, Alta.	436
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	435
CNRR	Canadian National Railways	Regina, Sask	476
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	384

Republic of Mexico

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

Republic of Cuba

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

Great Britain

2LO	London	365	
5IT	Birmingham	479	
5WA	Cardiff	353	
6BM	Bournemouth	385	
2ZY	Manchester	378	
5NO	Newcastle	408	
5SC	Glascow	422	
2BD	Aberdeen	495	
6FL	Sheffield (relay station)	301	

France

YN	Lyons	550
FL	Paris (Eiffel Tower)	2,650
8AJ	Paris	1,780
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 ten cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, of five, fifteen and thirty per cent respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates and no advertisement of less than ten words will be accepted.

All classified ads for the May issue must be sent in by April 1.

AGENTS WANTED

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 BG3. Healtho 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 705G, Willow Street, Long Beach, Calif.

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

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

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

$50 WEEKLY EVENINGS. DEMONSTRATING A super selective 6-tube radio set. Selectodyne 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.

"B" BATTERIES

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

BOOKS AND MAGAZINES

Free booklet "Interesting Radio Magazine—Monthly payment subscriptions." Two-thirds publishers prices. Spencersheild Agencies, West Los Angeles, Calif.

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 & CONTROLER 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.

Peach-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

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

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. Wareland 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.

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

INVENTIONS

NEW IDEAS WANTED—Well known Radio Manufacturer whose products are nationally advertised and sold everywhere wants new Radio device to sell. Will pay outright or royalty for idea or invention which is really new and saleable. Address: Mr. R. F. Devins, Room 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), Oshkush, 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

"$1.00 For Your Old Tubes regardless of make or condition towards the purchase of each new Standard $2.50 tube. Positively guaranteed. We do not sell rebuilt or bootleg tubes. Order today. Luxem & Davis Mfg. Co., 6229 Broadway, Chicago, Ill. 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; add 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 Phusiformers, each $5.50, book of instructions included. F. A. Mall, Triopli, Iowa.

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

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

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. UZARKA, 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, 3856 Cote Brilliante, St. Louis, Missouri.

WIRELESS

Want to Memorize the Wireless Code? The Coryden 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

PERSONAL

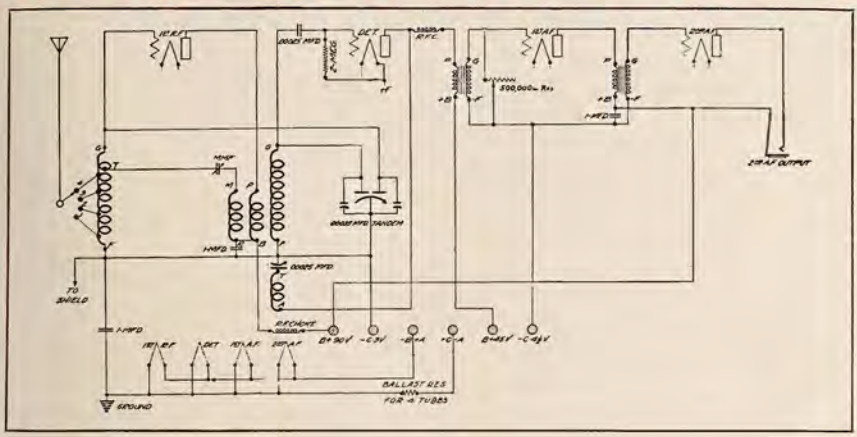
LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Eva Moore, Box 908, Jacksonville, Florida. Enclose stamp.

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				

Hookups Like This One Get Results!



You'll Find Them in The Radio Age Annual for 1926!

BLUEPRINTS
are the predominating feature of the RADIO AGE ANNUAL for 1926. Eighteen pages of actual-color blueprints of every kind of hookup, from efficient crystal set to six tube tuned radio frequency, with blueprints of a modern power supply device to top off the list.

Have you seen the new RADIO AGE ANNUAL for 1926? Thousands of fans have already bought their copies, and the end of the first edition supply is not far off. Hundreds of buyers of the ANNUAL for 1926 have supported our contention that it is the biggest radio dollar's worth ever published. Scores of new hookups, tried and tested in the RADIO AGE laboratories, many isometric, circuit and photographic illustrations, and 18 full page blueprints are some of the features that make this 96 page book invaluable to the technical fan. The expert will find the latest in experimental and multi-tube hookups, while the beginner will feel at home with a group of "how to do it" articles written especially for him.

$1.00 a Copy

RADIO AGE ANNUAL FOR 1926

$1.00 a Copy

Some of the Features:

Review of Radio During 1925
Radio Symbols and Crystal Hookups
Three Tube Inductive Coupled Receiver
An Improved Three Tube Reinartz
A Windless, Pipeless, Pipe Organ
Adding a Good Amplifier to the 3 Circuit Tuner
Taking Care of Your Radio
Audio Amplifying Circuits
More Data on a 4 Tube Tuned r. f. Set
Unique Radio Map
Inductance, capacity and wavelength chart
Single and Dual Tuning Control
Plug-in Inductances for Maximum Receiver Efficiency
Two Controls for 4 Stages of Tuned r. f.
How to Make a Power Supply Device
How to Wind a Low Loss Coil
Negative B Returns to Negative A Battery
Some Soldering Hints
Tuning With Chart Curves
Corrected List of Broadcast Stations
Log-A-Wave Chart

RADIO AGE ANNUAL COUPON

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

Gentlemen: I want to be sure of getting the RADIO AGE ANNUAL FOR 1926. Enclosed find $1.00. If I am not satisfied with the ANNUAL I will return it within five days and you will refund my dollar.

Name.....

Address.....

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

426

There Can Be Only One

ZENITH

WEBSTER
ze'nith—That point of the heavens vertically above one; the upper pole of the horizon.

FUNK AND WAGNALLS
ze'nith—The point in the celestial sphere that is exactly overhead.

ZENITH RADIO is all that its name implies .... the highest point in radio achievement. Yet Zenith makes no claims except by comparison .... comparison in your home.

By such a test, Zenith guarantees this: under like conditions—side by side with any other radio set in the world—Zenith will bring in more stations *with finer quality of tone* than any other.

There are twenty-seven broadcasting stations in Chicago, yet with Zenith you don't have to wait for "silent night."

You can tune out local stations with ease, any night in the week—and bring in distant stations *with quality.* Excellent performance in Chicago means unmatched performance elsewhere.

Call at the nearest Zenith service station—there's one in your neighborhood—and select the style you prefer. Then test it in your own home—*in side by side comparison with any other radio instrument on the market.* No obligation. Simply tell the Zenith dealer where you live and when to call.

ZENITH RADIO CORPORATION
310 South Michigan Avenue, Chicago, Illinois

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Zenith De Luxe Art Models are equipped with multiple built-in loud speakers, Bates Rotary Log, illuminated dial and single control specially constructed Zenith radio circuit ... In Colonial, English, Italian, Chinese and Spanish period style. Priced from $650 to $2,500.

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