Glass Panel Construction Explained—Page 4

Radio Digest

EVERY WEEK **Illustrated** TEN CENTS

TRADE-MARK

Vol. II | Copyright, 1922, R. D. P. Co. Inc. | CHICAGO, ILL., SATURDAY, AUGUST 5, 1922 | No. 4

NO MEN IN NEXT WAR

ETHER NOTABLES TO SPEAK AT CONGRESS

PLAN AWARD OF MEDAL TO MARATHON VICTOR

Session August 6 to 8 Being Held in Connection with Pageant of Progress

CHICAGO.—The world's greatest experts in Radio development and construction and the fastest operators in America will attend the International Radio Congress, August 6, 7 and 8, held in conjunction with the Pageant of Progress at the Municipal Pier here.

Maj. J. O. Mauborgne, signal officer of the Sixth Army Corps Area, located at Chicago, and associate with Maj. Gen. George O. Squier, chief signal officer of the United States Army, is president of the congress, and will preside at the main sessions, of which there will be five. The details of arrangement are in the hands of a committee of Chicago Radio men, headed by Commissioner George E. Carlson, of the department of electricity, of the City of Chicago, and head of the Chicago Municipal Radio station, as chairman.

Foremost Radio Men Scheduled

Among the noted Radio developers who will address the congress are: Chas. P. Steinmetz, Senatore Guglielmo Marconi, Benjamin F. Miessner, Edwin H. Armstrong, Dr. Lewis Cohen, F. W. Dunmore, Dr. J. E. Dellinger, Samuel M. Kintner, John Mills, R. E. Heissing, A. A. Hebert, Lt. Col. L. R. Krumm, and Dr. H. W. Nichols.

The opening session will be on Sunday, August 6th, at 10 a. m., when the Radio code speed contest will be held. A diamond medal has been donated by Mr. Carlson for first award. Contestants must receive straight commercial press in Continental code and transcribe message

(Continued on page 2)

FRENCH TRAVELERS WANT AIR WARNINGS

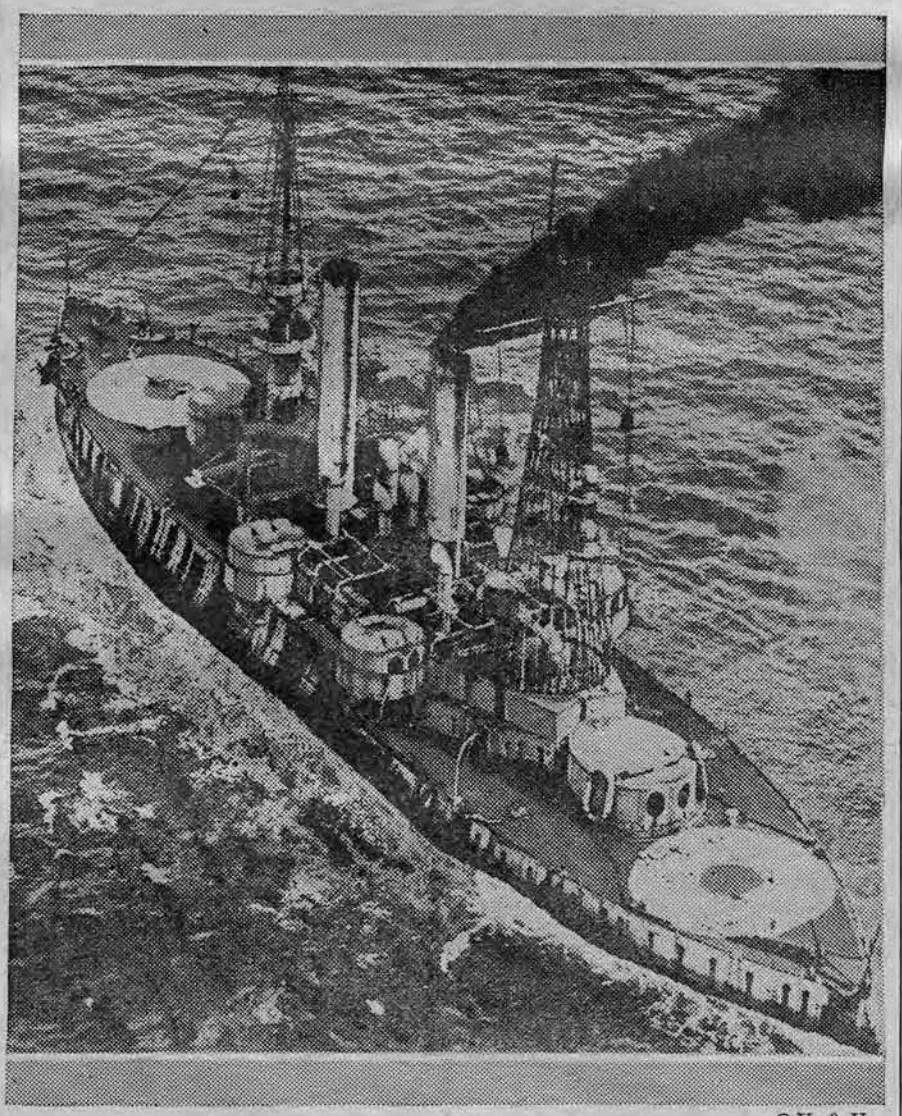
Communication Between Trains and Stations Sought

PARIS, FRANCE.—Because of the numerous disastrous accidents on French railways in the last two years, which have spread alarm among the traveling public, French railway officials are experimenting with Radio telephone communication between moving trains and stations.

CONTINUOUS JABBER KEEPS AERIALS HOT

NEW YORK.—A ninety per cent efficiency Radio connection is in operation between Berlin and New York. The gigantic stations—able to receive and send at the same time—work twenty-four hours a day. Very little time is allowed for the contacts of the keys at either end to cool off. Three shifts of operators are used.

ETHER WAVES MANEUVER IOWA



©U. & U.

Here is the Battleship Iowa—not a man on board—doing all sorts of tricks off Virginia Capes in response to Radio signals sent from the Battleship Ohio, five miles away. The many successful tests of this new control device lead to a prophesy of manless wars.

RADIOPHONE, RUM, RENO

Wife Names New Art as Corespondent in Divorce Suit

WASHINGTON.—Divers reasons have been advanced in petitions for divorce filed in the District of Columbia Supreme Court by wives, but for the first time in the history of the court, Radio was named as a contributing cause for separation by Mrs. Elizabeth R. Tibbs, who seeks to have the bonds of matrimony with J. Fletcher Tibbs dissolved. In her petition for limited divorce, the wife claims that her husband had been spending all of his time—and for that matter most of his money—on a Radio set, and that since taking up the fad he has developed a taste for strong drink and abuse. Maybe the "hootch" was broadcast.

SELLS SUB CHASER SETS

Navy Offers 295 Units to Public—Good For Broadcasting

WASHINGTON.—Approximately 295 unused Radiophone sets of short range are being offered for sale by the Navy Department by sealed bids on August 7th. Bids should be mailed to U. S. Naval Central Sales Office, Washington, D. C. All the sets include sending and receiving equipment known as Type CW-936, originally supplied for submarine chasers and other craft during the war, but good for small land broadcasting stations as well as yachts and seagoing craft. The apparatus includes transmitter and receiver, amplifier, switchboard, dynamometer system, head set and loud speaker, but not storage batteries or vacuum tubes.

CONTROL BY RADIO WILL SAVE LIVES

Ether Waves Maneuver Battleship Iowa Without Soul on Board

Exit Naval Heroes' Day

Tanks, Planes, Whatnot to Be Manned Only by Special Receiving Sets

By Carl H. Butman

WASHINGTON.—The days of naval heroes are numbered; no more will there be a call for volunteers to sink a ship in a narrow channel with the hope of "bottling up" a fleet as did Hobson at Santiago Harbor, for the call will be for Radio operators in the future. Dynamite-laden colliers will not be run into harbor mouths under fire and sunk by gallant crews, nor will such marine maneuvers as the Allied attack on Heligoland be undertaken by manned ships of war. These hazardous and almost hopeless tasks will be left to Radio-controlled vessels, without personnel aboard.

Battleship Iowa Radio-Controlled

A year ago the battleship Iowa, a relic of the Spanish War, but controlled and maneuvered by modern Radio from the Ohio over five miles away, was bombed by an aerial fleet of planes, which registered some hits. Nearly everyone was excited about the prospective conquest of the sea by the air forces, especially when a little later aerial bombs demonstrated that German war craft could actually be sunk; but no one was particularly elated over the performance of the gigantic Iowa, which was herself the real marvel of that historical occasion. For the first time in history, practical demonstration of remote control by Radio was seen. Radio control of a small craft had been perfected before the war, but most witnesses foresaw only a new mechanical or electrical toy. This demonstration, applied to a seagoing battleship, should have indicated astounding

(Continued on page 2)

JOHN BULL DIRECTS PLANES TO HANGARS

LONDON, ENGLAND.—Successful tests have been made with Radio for guiding airplanes in foggy weather at Croylon, the aerdrome terminal here. An operator on the ground is able to tell the pilot of the airplane into which section of the aerdrome he can make a safe landing and the exact moment when he may descend.

NO MEN IN NEXT WAR

(Continued from page 1)

future developments to the witnesses of the Iowa's remarkable performance off the capes of Maryland and Virginia last June and July, but it didn't.

Maneuvered With Ease

Without a soul aboard this great hulk of a fighting ship was maneuvered by Radio for hours and for miles, at half speed, at full speed—which was only eight knots but could easily have been increased with more boilers in operation—she plowed the sea, turning to port or starboard at the will not of the man at the helm but the Radio officer several miles astern aboard the Ohio. He could as well have been a hundred miles away.

Today expert electrical engineers and naval officers say the old Iowa is the first of a fleet of Radio-controlled ships of war; crewless ships which will go into battle against an enemy fleet or enter an alien harbor in response to an invisible master mind, miles away, who guides them by the means of Radio signals. These ships, like the Iowa, would not be operated by power sent by Radio but would be self-propelled ships with standard engines, oil-burning boilers and mechanically-aimed and fired guns—all directed by ether waves.

Prophesy Many Applications

Far-sighted naval engineers have prophesied Radio-controlled barrages of air and water torpedoes, fleet movements, gunfire, mine explosion, airplanes, tanks, dynamite ships and mine sweepers—unmanned but operated by Radio and sent on errands of destruction and extermination.

To the skeptics who say, "Impossible!" they ask, "Why not?" and point to the successful operations of the Iowa, the Radio-controlled automobile of Glavin and the tank of Captain Vaughan, which not only was maneuvered at will but made to fire a pistol and do all manner of tricks within a fraction of a second.

The Bureau of Engineering of the Navy is not standing still; some of the more advanced problems have been solved already, others are under way, and even the conservative experts admit that within five years we may have an auxiliary fleet of unmanned war vessels entirely controlled by Radio.

How The Iowa Is Controlled

Naval engineers will not reveal the technical details of her "innards" but explain the operation of the Iowa generally as follows:

A crew of men, after starting the oil burners and the engines, abandon ship. The control ship takes charge. A signal from her aerials is picked up by the antenna on the Radio ship and transmitted below. There it is amplified and made to operate a very sensitive relay, which manipulates a larger relay. The main relay controls an electric circuit which governs a pneumatic valve. This opens and closes the throttle of the main engines mechanically by compressed air, at the will of the distant Radio operator. The main relay also manipulates a sort of commutator, which is the key to a standard steam steering system controlled by electrical motors. Maneuvering is also effected automatically in this Radio ship by means of a gyro compass, likewise connected to the master commutator, enabling the operator to "set the wheel," so to speak, on a given course.

Time Clock Stops Runaway

All sorts of devices are installed for carrying out the details of operation, such as controlling water and fuel oil feeds; but the "mechanical brain" of the Radio monster is the commutator, which literally interprets the Radio signals and executes "orders," all within a second. A time clock device is provided to keep the craft from running away in case the control ship's apparatus should cease to function properly. If Radio signals are not received after a certain lapse of time, the clock takes charge of the crewless ship and shuts down everything. Practically all of the apparatus was developed by Radio engineers of the Bureau of Engineering of the government. The scheme is "all-American" and is a carefully guarded secret.

The first Radio-controlled battleship is not through by any means. She is still in special commission at the Hampton Roads Operating Base, where she is in charge of a trained crew of mechanics and electricians, awaiting the fall maneuvers of the Atlantic fleet, when she will again become a target ship, this time for gunfire practice.

Will Maneuver Again in Fall

The Iowa will not be destroyed. Her future is assured, for she is far too valuable to be sunk with all her special equipment, while there remains so many experiments yet to be tried before her successors are developed. However, she will serve as the first Radio-controlled moving target for the fall practice of the fleet, an event postponed from the summer maneuvers at Guantanamo Bay, Cuba, due to lack of funds and fuel. Special shells are being cast for the several types of naval guns which will fire at her this fall; shells which will not be armor piercing nor explosive but which will nevertheless indicate hits. They may carry away a smokestack or pilot house, but such damage is of little consequence to this craft, whose progress would be undisturbed unless her vital aerials were shot away.

The Iowa bears watching, and the next few years will tell whether naval prophets are right about the practicability of Radio-controlled fleets.

Ohio Prison Farm Set Gives Men World News

LONDON, O.—Through the installation this week of a Radio receiving set at the Ohio prison farm of 1,700 acres, four miles west of London, O., hundreds of men at the farm waiting for the days to pass until liberty is given them will be able to keep in direct touch with the outside world and be entertained and instructed through concerts, news, sermons and specialties broadcast from the country's largest stations.

It is planned to put up aerials over all the buildings of the farm colony, including the mess hall, chapel and dormitories, and to move the set from place to place to give all of the men the opportunity to listen in.

Manless Sub to Feature Pittsburgh Radio Day

PITTSBURGH, PA.—Thursday, August 24, will be Radio day in Pittsburgh and thousands of Radio fans will unite in a celebration. The celebration will be conducted at West View park by the Radio Engineering society, supplemented by the co-operation of Radio dealers throughout the Pittsburgh district.

Among other features, attempts will be made to control a submarine by Radio, to fire a cannon and to control other things from distant points. A general Radio display will exhibit many new and novel attractions, and a dance will give to many their first experience in dancing by Radio. Amusements throughout the park will feature Radio.

TRIODE TUBE GROWS SMALLER

© K. & H.

Rather than larger, vacuum tubes for Radio reception grow smaller with development. Starting at left, first is original two element tube of Dr. J. A. Fleming; second, later type with third element, the grid, added by Dr. Lee De Forest; third, is a modern type tube; fourth, "peanut tube," still in process of refinement. A. Ringel, City College, New York, is showing tubes.

Wants Radio Concerts to Replace Park Bands

City Official Urges Air Music for Summerr

WODSTOCK, ONT.—That public Radio concerts in the city hall should now supplant the time honored band concerts in the city parks, was the suggestion made by Alderman Shaver here recently. Woodstock is this year having difficulty in arranging for the usual summer series of band concerts owing to the disorganization of the band of the 22nd Oxford Rifles and the unwillingness of the Salvation Army band to undertake the task. A sum has been set aside by the council for music during the summer, and Alderman Shaver suggested that this money be invested in a Radio receiving outfit and free concerts held as often as possible in the city hall. Alderman Shaver asserts that there is enough music in the air to keep the public supplied for a long time.

Marriage by Radio Runs Amuck

ST. PAUL, MINN.—St. Paul's first Radio marriage has run afoul some discordant air and earth currents that recently brought it into the divorce court. When Otto H. Arntzen and Minnie Smith were married here April 26, the broadcasting station of a local newspaper let this section of the world hear the ceremony by Radio.

Today Arntzen filed suit for annulment of the marriage, charging his bride had been the common law wife of another man, whom he had seen embrace her since the Radio wedding.

U. S. Signal Corps Stations Now Number Fifty-Three

WASHINGTON.—The opening of the new Signal Corps Radio stations at Fort Benning, Ga., and Fort Totten, N. Y., brings its total stations to fifty-three, and with the co-operation of the naval station at Boston one more point is reached. A new station planned for Fort Sill, Okla., will hook the 8th Corps Area into the Army Radio net, which will then embrace practically the whole country.

RADIO CONGRESS

(Continued from page 1)

on regulation telegram typewriters. Elimination will decide the winner.

The code "marathon" will be conducted by Lawrence R. Schmitt, former U. S. Radio Inspector, 9th District.

Congress Opens Monday

The next day, Monday, will see the opening of the congress by Major Mauborgne at 10 a. m. Speeches in the morning will be "A Secrecy System for Radio Communication," by Mr. Miessner, and "The Technique of Broadcasting," by Mr. Kintner.

In the afternoon Dr. Cohen will speak on "Wired Wireless and Its Application to Broadcasting on Power Line." "How Speech is Carried," will be a talk by Mr. Heissing, and Dr. Dellinger will also speak. Mr. Marconi will address the Congress in the late afternoon on "Radio Telegraphy."

Tuesday's program will include: "Amateur Radio," by Mr. Hebert; "Broadcasting Operations," by Lt. Col. Krumm; "Radio Communication," by Dr. Nichols; "A Relay Recorder for Remote Control by Radio," by Mr. Dunmore; "Line Radio," by Major Squier; "Radio," by Dr. Steinmetz.

Radio Digest Illustrated

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CONTENTS

Looking Ahead

Everyday Analogies for Radio. A continuation of the series by Letson Balliet is soon to start.

Vacuum Tube Receiving Sets, Section II. Peter J. M. Clute will tell about the regenerative triode tube receivers next issue.

How Music Is Broadcast. Have you wondered what goes on inside the Broadcast Station? Watch the future issues of RADIO DIGEST for this elucidating explanation.

Panel Units for Your Receiving Sets. Two additional panels of the standard type. The best way for an amateur to build up his set is by standard panels.

Broadcasting Directory. Gets better and larger each week. The only convenient reference to aid you in finding a station heard.

"How to Make Department." Many kinks every week are interchanged here.

Radio Illustrated. The picture page is the best of its kind.

GOTHAM AIR LINE TO HAVE RADIOPHONES

FOUR STATIONS WILL BE IN PLANES' RANGE

Passengers Between New York and Boston to Hear Concert Programs

BOSTON, MASS.—At a very early date a multiple fast airplane passenger service will be established between Boston and New York. Work is now complete on a 16-passenger hydro-aeroplane, and plans are well formulated by the builder for the establishment of intercity communication by the air route. In a day or two the big plane will leave on a trial trip. Simon Davey, of New Britain, Conn., is the designer and builder. Lieut. Carl J. Dixon, formerly of the British Royal Flying Corps, will be the pilot of the machine in the trial flights, and undoubtedly will be the navigating officer when it goes into regular traffic service. The passenger capacity of the plane is eighteen, but for safety's sake not more than sixteen will be carried at one time, together with light baggage.

Passengers to Hear Broadcasts

A complete Radio equipment is part of the plane's appointments, and it will be possible for passengers to "listen in" to concerts and other broadcast programs at any time during the flight. The machine's Radio outfit will have a range that will include Medford, Schenectady, New York and Newark at least during its flight, and the pilot will also be able to communicate with earth stations, including the two landing stations by Radio.

The general cabin is 25 feet by 6 feet, with a substantial glass opening in the floor, so that passengers may see the sights on earth below them. A smoking room and retiring cabins are also provided, and there are eight luxurious chairs ranged along either side. A speed of 100 miles an hour is expected of the plane when in regular traffic, although its maximum is greatly in excess of that. Three hydro-Glycier 300-horse power engines will drive it.

Towerless Aerial at Navy Air Base

Latest Antenna Rigged Low to Clean Landing Field for Planes

LAKEHURST, N. J.—A new type of Radio transmitting antenna without towers has just been installed here at the American naval airship base, naval Radio station NEL. In an effort to keep the big landing field clear for the two giant rigids ZR 1 and ZR 3, and to eliminate high towers and aerials, the Radio engineers of the navy designed a long low aerial. It is nearly 800 feet long and fully 120 feet wide, forming a sort of gridiron, mounted on poles only 60 feet in height instead of between 150 and 200 feet. Technically it is a multiple-tuned antenna with several ground leads. By erecting aerial along one side of the field, a clear open space is left for maneuvering the ships.

Ten Days for Cleveland Radio-Electrical Show

CLEVELAND, O.—This city will stage a Radio and electrical show combined August 26 to September 4. It will be held in the Cleveland Public Hall. There will be display booths for more than two hundred exhibits. Prizes will be awarded for home-made Radio sets displayed at the exposition.

FIRST RADIO BICYCLE APPEARS IN CAPITOL

WASHINGTON, D. C.—Inaugurating a novel plan for Radio entertainment, three Radio fans, Francis Murray, 16, Fred Randall, 13, and Kemp Mish, 13, attracted hundreds of pedestrians and theater goers the other night on Pennsylvania avenue. With a loop antenna and set attached to a bicycle, they encircled the city while listening to concerts from nearby stations.

SWITCH CITY LAMPS BY CARRIER WAVES

NAHANT, MASS.—This city is using "carrier current" to switch on and off the street lights. This current is really a Radio current guided by wire. Engineers experimenting found that the carrier current would travel along the power lines and actuate a switch relay for controlling the lights, thus doing away with the key boys or other more expensive control devices.

MOVIES SPEAK BY AIRWAVE

©U. & U.

Movie producers have the craze! Here is Colleen Moore furnishing words for her part in a picture play being shown miles away by use of the broadcasting set recently installed at the Lasky studios in California. The transmitter is at the left and is not shown

AERIAL STOPS LIGHTNING

Practical List Made During Toronto Electrical Storm

TORONTO, CANADA.—A Radio aerial will not only catch concerts, but it is a good lightning rod. This was given a test recently during an electrical storm here, when a bolt struck the aerial on the National Steel Car Company's building, and was grounded without doing any serious damage to the building.

The outfit was installed by the employes, so that they could tune in on evening concerts and have music with their work. The bolt struck the aerial, came down through the lead-in which runs through the stock room, and was grounded without damage.

RADIO HOTEL FOR CHICAGO

Individual Set for Each Apartment Is Architect's Plan

CHICAGO.—This city is to have a real Radio hotel, if the Radio experts can furnish the equipment. The latest of the new structures which go to make the new hotel district of the near North Side will be the Hotel Pine Grove, between Diversey avenue and Surf street. The building will have ninety-five unfurnished apartments, and will cost $1,000,000.

There is planned a large Radio room wherein Radio reception will be furnished for the guests. A plan is being worked out by the architects to have all guests to receive Radio music individually in their apartments.

TEACHER PRODUCED FIRST SET IN WORLD

PRECEDED HERTZ TRIALS BY TWELVE YEARS

Professor Elihu Thompson Used Graphite Pencil Points in Experiments of 1871

LYNN, MASS.—Twelve years before Heinrich Hertz announced his Radio discoveries, Professor Elihu Thompson, now of Lynn but then a professor of chemistry in a Philadelphia high school, produced and operated the first Radio set in history.

Following up the experiments of Hertz, Guglielmo Marconi produced the first practical Radio apparatus and adapted it to commercial use. Professor Thomson, according to Professor L. M. Knoll, of Philadelphia, made no practical application of his work, but conducted it solely as an experiment. In the Journal of the Frank-

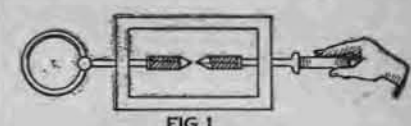


FIG.1

lin Institute for 1876 appear articles by Professor Thomson describing his experiments as far back as 1871. He conducted experiments whereby electric sparks were drawn from blades of penknives held near water pipes leading to the ground, the sparks being produced by high frequency waves sent through the air by an ordinary induction coil. Credit is given by Professor Thomson to his colleague, E. J. Houston.

Make First Experiment in 1875

"While we were both teachers in Central high school in the latter part of 1875, Philadelphia," writes Professor Thomson, "this experiment was made. An induction coil with a two-inch spark gap was used. For the receiver we used a black box open on one side, with two graphite pencil points adjusted about a fraction of an inch apart inside, one pencil being connected with a large brass ball outside, as shown in Figure 1.

"We observed a tiny spark between the two pencil points. It was an indication of a shock, commotion or wave, electrical in

FIG.2

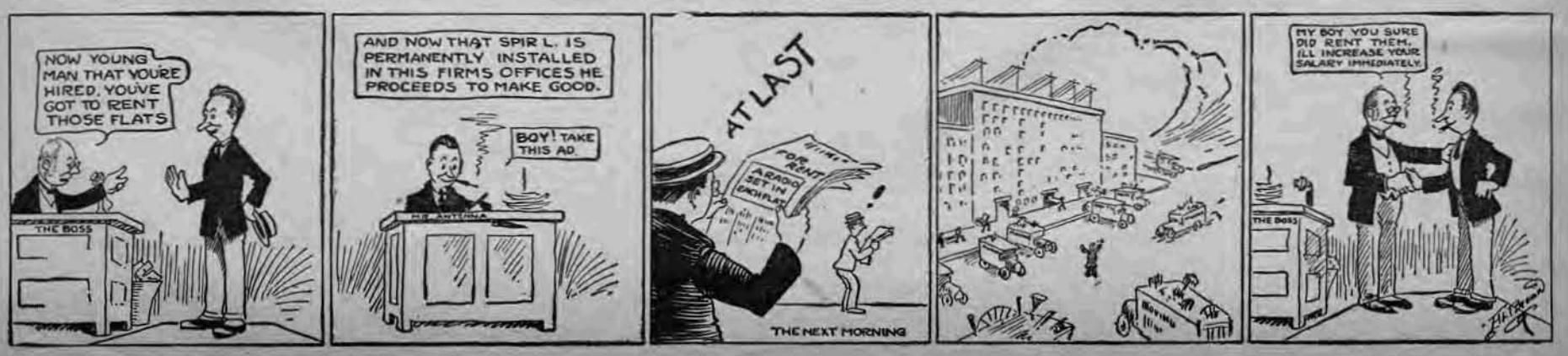
its character, in the ether. As an aerial on our sending apparatus, we used a large tin can on top of a glass jar, Figure 2 insulating it from the table, the can being connected to one wire of the secondary of the induction coil.

"Tests for detecting the impulses were carried on not only in rooms on the same floor (the basement), but we went from floor to floor, finally reaching the astronomical observatory on the roof, more than twenty feet from the physics room and separated from it by five brick walls. We found here that metal pieces not even connected with ground wires would yield sparks."

Army Sells 1,000 Surplus Tubes

CHICAGO.—One thousand vacuum tubes, type V-T 11 of the General Electric Company, declared surplus, were sold July 31 at the General Intermediate Depot of the U. S. Army, located here. The tubes were all new and of the hard or amplifier type, using 4 volts on the filament.

THE ANTENNA BROTHERS — Spir L. and Lew P. — A Tip for Real Estate Men



Glass Panels Show Assembled Parts

Copper Tube Makes Bit To Bore Holes in Glass

The tendency in Radio seems to have turned to the transparent face set with a glass panel in place of the bakelite section front. The glass makes a very attractive looking piece of work, provided the wiring of the instruments behind the "scenes" are perfectly hooked up and present a clean, neat looking appearance. The glass panel does not lend itself admirably to a piece of work that, while all right from the point of Radio reception, uses lengths of odd wire with spare lengths of spaghetti tubing and half a dozen different colored wires with splices made with black tape running in every which way all over the place.

Glass Hard to Work.

Glass is no easy substance to work. Primarily, because it is hard and brittle and cracks under the least strain. Often after several unsuccessful attempts amateurs compromise with their desires and put a bakelite panel in the front of the instruments and make the back of the instrument case of glass so as to be able to show the interior of the set.

In selecting a piece of glass for a receiving panel care should be taken to get a perfectly clear glass in which no metallic substance has been used for coloring purposes. The presence of a metal in the glass will give the same result as painting a panel—the whole thing will be full of leaks and reception poor. Several methods of working glass have been tried, but the following seems to be the most practical and to give the best results: Using an ordinary piece of window glass for a panel on a regenerative receiver, the biggest job is drilling the holes through the glass.

Drilling Glass.

First cut a board the same size as the desired glass panel and drill the holes in this just where required on the finished product. Then use another board to lay the glass on and lay the pattern board with holes in it on top of the glass. The upper boards and glass are held in place both by clamps and by driving nails close to the edge, using wooden pegs for wedging purposes to secure the layout.

For drilling the holes use any kind of a breast drill or automatic screw driver.

For the bit a piece of copper tubing of the same size as the holes can be used. The actual cutting is done by dry emery dust and oil. Emery paste will accomplish the same results but will cost a little more.

Care should be taken not to put too much pressure on the drill or to raise it up or down, as it will crack the glass. It is also necessary to be very careful when the hole is nearly through, as it is very easy to knock a piece of glass out at the back and spoil the entire job. It will take about fifteen minutes to drill one hole.

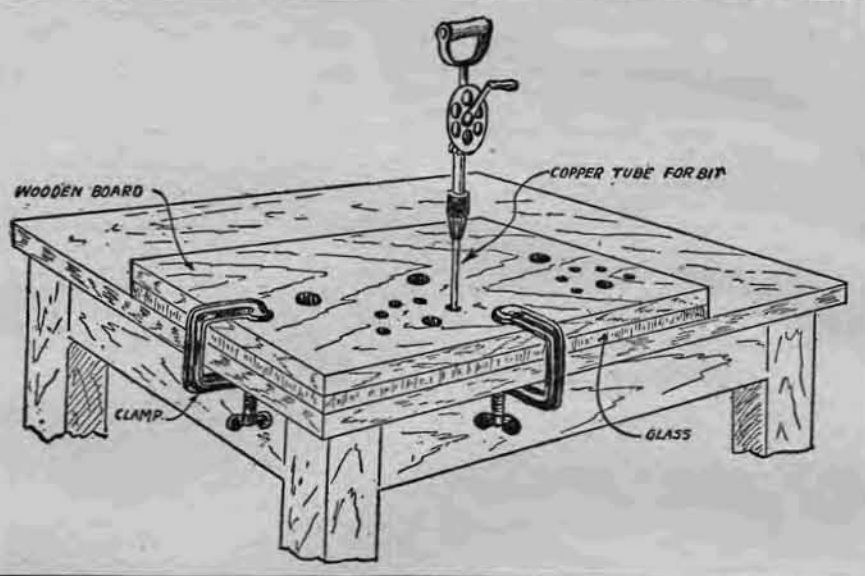
If a steel or diamond drill is used a solution of camphor or turpentine should be applied during the drilling process to keep the drill from overheating and breaking the glass.—Raymond Norton, Detroit, Mich.

WORKSHOP KINKS? EARN A DOLLAR—

THERE are many little kinks worked out at home that would aid your fellow Radio worker if he only knew about them. There are new hook-ups, new ways of making parts and various unique ways of operating sets that are discovered every day. RADIO DIGEST is very much interested in securing such material. Send them in with full details, including stamped envelope so rejected copy may be returned. The work must be entirely original, not copied.

RADIO KINKS DEPARTMENT,
RADIO DIGEST,
123 West Madison St., Chicago, Ill.

DRILLING HOLES IN GLASS



Correct Aerial Installation

Important as the correct connections of your Radio set may be for good reception, the same holds true in the installation of your aerial in the best possible manner. The accompanying chart explains some of the more common and effective methods of putting up an outside aerial.

The aerial may be horizontal, vertical or diagonal to the earth. For average crystal receiving sets the length may vary from 75 to 90 feet, with lead-in wires, which will bring the sum and total to not more than 115 feet.

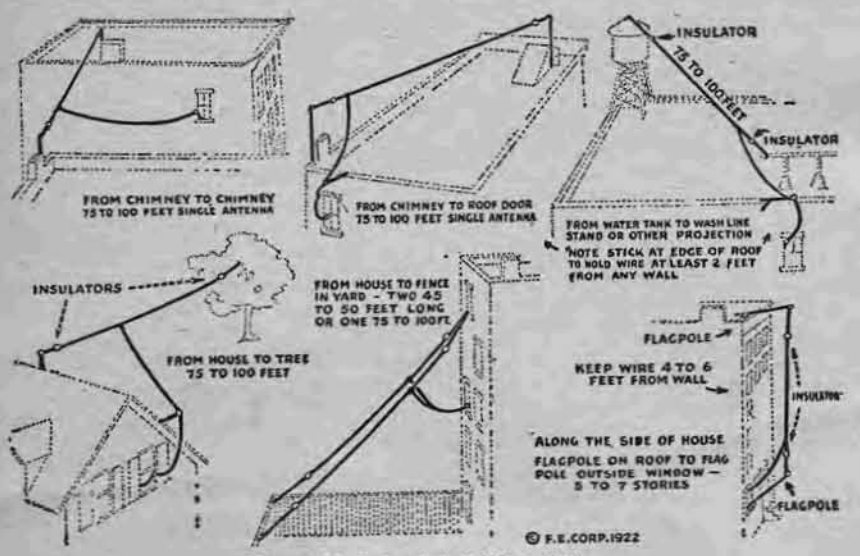
Keep the aerial and lead-in wires from 3 to 5 feet away from the building. If erected on a roof, place the wires on poles at least six feet high. If running from the house to a fence or to a tree, connect your insulators 3 to 5 feet away from the building and fence.

If possible, use a single wire for receiving, but if this is not possible run two wires 35 to 45 feet long and at least 3 feet apart. For best results, connect your lead-in to one end of the aerial, not to the middle, for the end connection gives the advantage of greater effective length.

The aerial may be put up between two houses; from chimney to chimney; from chimney to roof-door; between wash lines on a roof; from roof or window to tree or fence; from one window on the top floor on an apartment house to another window lower down; from one window at one end of a flat to another window 30 or 40 feet or more to a side.

Some Radio enthusiasts have had very good results by connecting to a metal bedspring, to the electric doorbell wires, to wires run around the molding near the ceiling of a room. In fact, almost anything may be used for an aerial, if the receiving set is sufficiently sensitive and if near to a broadcasting station.

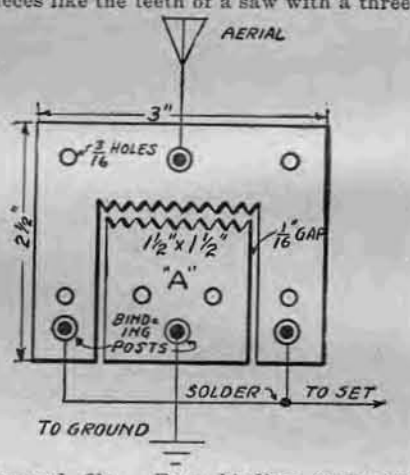
With the usual small crystal set, the outdoor aerial is, however, always recommended. Sometimes if the aerial fails to give satisfaction, a change of its direction will help.



Various Methods of Aerial Installation

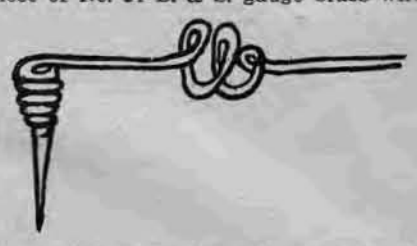
A Simple Lightning Arrester

A good lightning arrester may be made from a piece of $\frac{1}{8}$-inch brass 2½ inches wide by 3 inches long. A piece is cut out as shown at A. This is done with a jeweler's saw. Notches are cut in the pieces like the teeth of a saw with a three-cornered file. Four binding posts are attached as shown. Six holes are drilled in the pieces for screws to hold the parts on a base of insulating material. When attaching them to the insulating material allow about $\frac{1}{16}$-inch space between the saw teeth.—J. Oscar Johnson, Wakarusa, Kansas.



Sewing Needle on Wire Makes Detector Point

The illustration shows a way to connect a wire for the top of a crystal detector. A piece of No. 24 B. & S. gauge brass wire



is coiled like a spring and a piece of ordinary steel sewing needle, about a half inch long, should be soldered to the wire. The sharp point of the needle makes an ideal contact on the crystal.

Radio Shorthand Practice

This new use for Radio will prove of interest to girls and boys studying stenography and who find it hard to get some member of the family to spend the evening reading out loud so that they may make perfect records.

With a Radio instrument one can spend the day copying the lectures and other spoken matter that comes over the Radiophone. The Radiophone has one advantage that is in favor of the beginner, which is the slow and distinct way in which the experienced Radio talkers deliver their speeches. A great many schools are advising the use of Radio for students who study shorthand.

ALABAMA PIONEER STATE BOON

Market Reports from WSY, Birmingham, Valued Highly by Growers

Speeds News to Farmers

Furnishes Sermons to "Shut-ins" and Aids Humanitarian Campaigns

By Geo. H. Watson

BIRMINGHAM, ALA.—Featuring local artists in nightly concerts, Station WSY, owned by the Alabama Power company, is the pioneer broadcasting station of the state, with the result that there are now hundreds of amateur operators over Alabama and surrounding states who "listen in" regularly.

Besides the concert which is given between 8 and 9 o'clock each night, a business service has recently been inaugurated, giving closing quotations of the stock exchanges, liberty bond prices, local quotations of fruits, produce, live stock, hides and tallow, fish, grain, feedstuff and poultry.

This service is meant especially to serve the outlying sections of Alabama, Mississippi, Tennessee and Georgia, where it would possibly be a day or two before such information is obtained in the regular way. In other words the farmer who has cotton to sell will know a few minutes after the markets close just what his cotton is worth.

No commercial advertising of any kind is allowed to be over, WSY. However, it has already given valuable assistance in local humanitarian campaigns. A concert was recently given for the benefit of the Children's Hospital during a drive of the Civitan club to raise funds for the institution. The tots were lulled to sleep by the music broadcasted by WSY, while a member of the Civitan club told of the services rendered by the hospital.

Baseball fans are delighted by the baseball scores sent out each night by the station. They eagerly wait them with pad and pencil in hand. Another service of inestimable value is the sending out of correct standard central time nightly.

"Boost Alabama by Radio" is the slogan of a recent letter sent out by officials of WSY to the various civic clubs of the city asking them to furnish speakers from time to time. Each speaker in this series of talks will be asked to discuss some phase of Alabama's industry.

Each Sunday night a sermon of a local church is broadcast. A receiving set has been installed in Capitol Park, where hundreds gather in the open air for the church services. This service is also of especial value to "Shut-ins" who for one cause or another are unable to attend church. A feature of the services will be the reproduction at an early date of the McCoy Memorial Chimes of the South Highlands Methodist Church.

Although a nightly program is given, WSY has found it easy to obtain ample and excellent talent. Church choirs, the Birmingham music association, orchestras and individual artists have been anxious to contribute to the success of the concerts. Civic leaders of the city have also been willing to deliver lectures to the vast invisible audience.

WSY has been given such a welcome over the state that the Alabama Power company is now preparing to establish a station several times more powerful than the one in use. Equipment for the new station will include five 250-watt transmitting tubes supplied by a 3½ kilowatt, 2,000 volt motor generator set. It is designed to be the most powerful in the south with a sending radius covering the northern and eastern states.

WSY at present has only 200 watts capacity, as shown in accompanying photographs. Although officially its range is given as 150 miles, the concerts have been picked up as far north as Montrose, Mich., while D. R. Bartsch, an ardent fan of Galena, Ill., heard every word of the program sent out from Birmingham. When the new station is erected, the old one will be used by the Alabama Power company in the private operation of its business. It will probably be the first organization to use a Radio outfit solely for communication between its different units which are scattered throughout Alabama.

WSY has fostered the speedy increase in numbers of amateur operators to such an extent that the first Radio show of the south was recently held in the city. A number of prizes were offered to builders of home-made receiving sets, and the contests revealed remarkable talent on the part of young Radio enthusiasts.

New Louisville Broadcast Station Runs Kentucky Radio Interest High

Courier-Journal's Recently Licensed Studio Is One of Best Equipped in Country—Offer of Premium Sets Arouses Young Amateurs of City and Country—Much Enthusiasm Evident

By I. Crow Taylor

LOUISVILLE, Ky.—Radio interest in Kentucky is at high pitch now because the Courier-Journal broadcasting station has been tested and is now settling down to regular program work.

The commercial license for this station was received a few weeks ago, giving it the call WHAS. The first test of station WHAS was made Saturday night and Sunday, July 15th-16th. The first tests were for the purpose of tuning up and making adjustments. These gave results which were clear and fine so that arrangements were made to start regular programs beginning Tuesday, July 18.

The first thing on the first program arranged was very appropriately "My Old Kentucky Home," a violin solo by Charles Letzler, accompanied by Mrs. Newton Crawford.

Newspaper Offers Premium Sets

The Courier-Journal and Louisville Times is awakening a keen interest on the part of young amateurs by making a subscription premium offer of two different kinds of receiving sets. The two sets they are offering for subscriptions are the Aeriola Jr., made by the Westinghouse company, and the Etherion, made by the Mengel company of Louisville.

It is the latter which is the less expensive set and is given with three new six-month subscriptions to the daily and Sunday Courier-Journal. The Aeriola Jr. is given with twelve six-month subscriptions to the daily and Sunday Courier-Journal.

Test Signals Heard Far

F. S. Bernhard of the Western Electric Co., who installed the new broadcasting station here and made the preliminary tests, says that under ideal conditions the broadcasts from here may be picked up 2,000 miles distant. Approximately 50 per cent of the time the average will be a hundred to a thousand miles, and under even bad conditions it should carry easily a hundred miles or more and be heard with any tube receiving set.

Many replies from all over the surrounding territory were received by the Courier-Journal from its preliminary tests. One communication indicates that the music was heard 400 miles away.

There has been quite a lot of local interest in amateur activity for some time and now the opening of the new broadcasting station has not only added to this but is bringing into action enthusiasts in the surrounding territory covering a radius of at least a hundred miles.

Has Well Equipped Studio

The new station has one of the best equipped studios in the country. A floor space 30 by 50 feet is made use of and this is divided off into suitable rooms for the various requirements. The studio, which is sound proof, is 15 by 30 feet, and is equipped with electric and baby grand pianos, and an Estey studio organ. All the rooms from reception room to the Radio room are finely finished and furnished for convenience and comfort as well as in compliance with the technical needs of such a station.

Besides the room devoted to the microphoning of music, there is a speakers' room, an office, a reception room, and a room for the receiving and transmitting apparatus with a partitioned small room adjoining which contains batteries and motor generators.

CUPID IN AIR STARTS ROMANCE FOR SINGER

Charmed Rancher Writes Concert Songstress for Appointment

CINCINNATI.—Bachelor girls, sing for the Radio! Accept this tip if you are looking for a husband!

Miss Ivy Buchtman, who sings every once in a while at the broadcasting station of the Crosley Manufacturing Company, Cincinnati, the call letters of which are WLW, will tell you that Radio and romance go hand in hand, her assertion being based on the following letter she has just received:

"Chickasha, Okla.

"My Dear Young Lady:

"You will please pardon the liberty I take in writing to you. I have never met you personally, but, after hearing your lovely voice over the Radio, I am so charmed to tell you how happy you have made me and how anxious I am to meet the charming possessor of such a marvelously beautiful voice.

"I am the owner of a large ranch many miles from any town of importance, and, until the advent of Radio, I had very few opportunities of hearing good music. But thanks to Radio, which has conveyed the beautiful tones of your voice to me here, I am now looking forward to the time of the year when I again will be able to hear WLW, where, I understand, you sing quite regularly.

"Now, the prime object of this letter is to endeavor to arrange to meet you; that is, if you are young and not married. I am 30 years old, wealthy, and considered good looking. I never experienced an extra pulse-throb until I heard your sweet voice on the WLW Radio. Please tell me if there would be any objection to my coming to Cincinnati to meet you and your parents. May I send you one of my photos and in exchange will you send me one of yours?

"Hoping I may have the pleasure of hearing from you, please allow me to remain, Yours respectfully,

"JASON MORDKIN."

The present stage of development of the romance is unknown. So, bachelor girls, don't forget! The Radio microphone is a great little husband getter!

Ivy Buchtman's notes hit heart

SETS FOR RURAL FRANCE

Farmers to Be Warned of Weather Surprises by Airphone

PARIS, FRANCE. — Radio is being pressed into the service of French agriculture. At Elysee recently the Air Minister, M. Laurent-Eynac, and the Minister of Agriculture, M. Henry Cheron, told of measures they have decided to take in order to protect the rural regions of France against sudden weather surprises.

Radio receiving stations will be placed in the parish schools and gendarmerie stations from which the peasants will be warned of impending storms by ringing a bell. The cost of the receiving stations will only be two hundred francs.

The "Happy Six" dance orchestra jazzes up WSY, Birmingham, Ala., occasionally when it isn't making Columbia records. At right is transmitting room of the southern station

England Prepares for Broadcasts

Sanction of Government Only Thing British Airphone Service Needs

LONDON, ENGLAND.—Government sanction is all that is needed to make Radio a national public utility in England.

News of this development follows reports from America that a national system of broadcasting, with rental of Radiophone receiving sets in homes, was being planned there. That England is actually preparing for such Radio service in the near future is gleaned from a statement issued by Godfrey Isaacs, managing director of Marconi's Wireless Telegraph Company.

In this statement, Isaacs looks forward to the time when Radio will be as popular as the telephone and outlines a program for an organized public service which the Marconi company is ready to install as soon as the necessary authority is obtained.

Thirteen Plant Permits During Week July 17-22

CHICAGO.—Thirteen limited commercial stations were licensed during the week of July 17th to 22nd, for the transmission of public service broadcasting. The stations are as follows:

WIAB, Joslyn Automobile Co., Rockford, Ill.; KFBC, W. K. Azbill, San Diego, Calif.; WHAZ, Rensselaer Polytechnic Institute, Troy, N. Y.; WIAK, the Stockman Journal, Omaha, Nebr.; KFAU, Independent School District, Boise City, Idaho; WHAT, Yale Democrat & Yale Telephone Co., Yale, Okla.; KFAT, Dr. S. T. Donohue, Eugene, Oregon; KDPM, Westinghouse Elec. & Mfg. Co., Cleveland, Ohio; WIAJ, Fox River Valley Radio Supply Co., Neenah, Wis.; WIAI, Heers Stores Co., Springfield, Mo.; WIAH, Continental Radio Mfg. Co., Newton, Iowa; WHAY, Huntington Press, Huntington, Indiana; WHAX, Holyoke Street Ry. Co., Holyoke, Mass.

TOLEDO BANKS TO GET FINANCIAL AIRWAVES

Cleveland Trust Concern Sets Up Station

TOLEDO, O.—Several Toledo banks are planning to tune in their Radio receiving sets for the new broadcasting station of the Union Trust Co., Cleveland, which will be open for business on August 15. This will mark a new era in bank communication and is a remarkable means of linking up the banks of this section of the state.

The Merchants' & Clerks' Savings bank will have a set conveniently located for patrons to hear the bank news, the Ohio Savings Bank & Trust Co. already has a set installed, and the Northern National bank is planning on putting in an up-to-the-minute receiving outfit.

After the opening of the banks in the morning and again in the early afternoon, the banks and all Radio fans may listen in on current financial news broadcast from Cleveland.

NEW YORK.—With a population of only 120, Tristan da Cunha, the British island in the middle of the South Atlantic, will soon have a Radio station. Its population is mostly descendants of Napoleon's St. Helena guards.

Book Reviews

Wireless Telegraphy. By W. H. Marchant. A practical handbook for the use of operators and students. This book is intended primarily for the use of those engaged in the practical operation of Radio telegraph installations, and for students who already possess some knowledge of electrical science. Price, $2.25.

Radio Communication. By John Mills. The fundamental principles and methods upon which recent developments are based are emphasized. The vacuum tube is treated in a simple, fundamental and up-to-date manner. Present methods and tendencies of the art are explained in a chapter which is non-mathematical. Price, $2.00.

Experimental Wireless Stations. By P. E. Edelman. This is a standard book on this subject and the volume that anticipates every need of the reader who wants to know all about Radio. The book has been endorsed by the foremost instructors for its clear accuracy and dependable designs. Price, $3.00.

The book department of the Radio Digest is prepared to send you any of the books on Radio published, whether listed in our Book Review or not. Let us know what book you want, send us your check and we will see that the book is mailed to you. Book Department, Radio Digest Illustrated, 123 W. Madison St., Chicago, Ill.

Books

GET secret of how to make practical radio receiving set for less than four dollars. Send one dollar for illustrated book by Lieutenant W. L. Shields, formerly aircraft radio officer in the Pacific Air Force. Write today to Lieutenant Shields, 423-424 Timken Bldg., San Diego, California.—Adv.

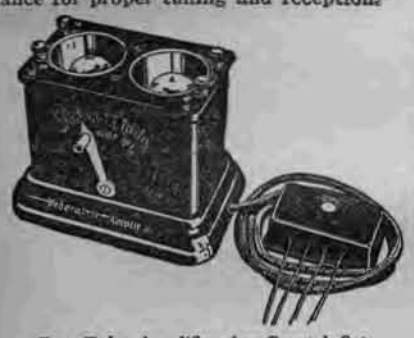
The Radiophonist's Mart

OF UNUSUAL interest to the Radio fan who is now using the crystal type of receiving set is the announcement by the Federal Telephone & Telegraph Company of Buffalo, N. Y., of a two-stage amplifier particularly designed to use with crystal receivers, both for the amplification of voice or music, and making it possible to employ the advantages of the many types of loud speakers or to use with phonograph reproduction.

Connecting this amplifier to an ordinary crystal receiver not only vastly increases the voice or music volume, but also increases the range of such sets from their usual range of 25 miles up to 100, while during or under ideal conditions ranges of 125 miles and over are not uncommon.

It comprises two stages of voice amplification secured by means of any of the standard vacuum tubes in conjunction with the Federal amplifying transformers, with rheostat controls conveniently arranged for proper regulation. A three conductor cable connecting to a connection block with provision for concealing all A and B battery connections, is a part of the unit. These are plainly marked in order that even the novice may experience no difficulty in properly making connections.

The entire unit is housed in a spot welded enamel brass case of very neat design, which not only makes for neatness in design, but also has the decided advantage of totally shielding the unit against body capacity and outside magnetic influence, a feature of vital importance for proper tuning and reception.



Two Tube Amplifier for Crystal Set

While designed primarily to fill the want for an amplifier to be used with crystal receivers, the unit may be used as a two-stage amplifier with any standard detector tube set. It is, therefore, universal in its application. Of even greater importance is its design, which allows it to be used as a detector amplification unit where Radio frequency is desired in conjunction with crystal detectors.

THE TERM variometer is a coined name that has always been used by the Radio fraternity for a continuously variable inductance. At the present time the majority of the Radio receiving sets make use of one or more of these devices as the variometer is recognized universally as one of the most efficient tuning devices ever known to the art.

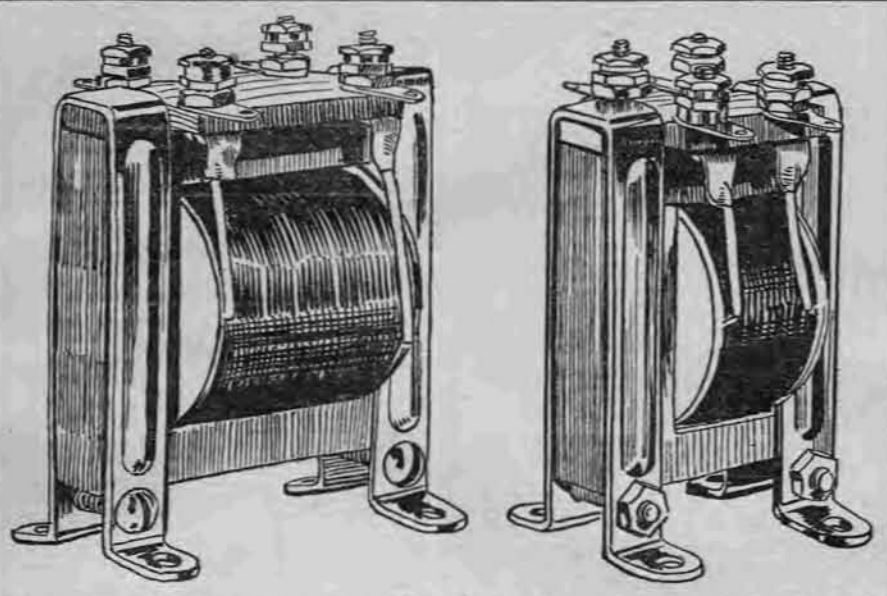
However, any mechanism is subject to improvement of design. There is being placed on the market an improved type of variometer known as the Rogers Receiving Radiometer, manufactured by Ludwig & Hommel & Company, Pittsburgh, Pa., embodying such simplicity of design that it will retail for two-thirds the price of the usual design. Yet it will function as well if not better than the ball-type variometer with the additional feature of occupying but a fraction of the usual space necessary in the modern receiving set. It will appeal very quickly to engineers and designers because of the small space feature. First appeal to the amateur or new Radio fan is very likely to be to the pocketbook, especially if finer tuning and better results may be obtained in addition.

Ordinarily, a single stationary winding produces an electromagnetic field, which is opposed or assisted by a similar electromagnetic field from a movable winding mounted in close inductive relationship to the stator or stationary winding.

In this new design a pair of flat disks are substituted for the tubes or wooden rotors and stators used heretofore, and the magnetic fields are divided into two separate components. The stationary disk is clamped to a panel bushing with a single nut. The rotor or movable assembly consists of a second disk clamped between nuts on a shaft held by the supporting panel bushing. The current is conducted through the two fields of the stator which are in series, then to the bushing, to the shaft, and out through the two fields on the movable disk to a terminal near the center of shaft. A circular movement of 180 degrees gives a variation of inductance from a minimum value to a maximum depending on the amount of winding.

Each of the four windings are of "D" shape and are interwoven in slits around the periphery of the disks. The wire is

Amplifying Transformers in Two Sizes



held in place without recourse to paraffin, shellac, varnish or compound of any nature, and as silk insulation is used, the usual detrimental capacity effect between separate turns is practically nil. This accounts for the wonderful efficiency and sharpness of tuning possible with this type of variometer.

By using a single supporting bushing for the entire assembly and again using it for the electrical contact connection between the two inductors, it requires but a few moments for mounting. Only a single hole for the bushing need be drilled in the panel.

A special spring washer is placed on the shaft before attaching the moulded knob and dial to complete the assembly. This washer serves to take up unnecessary play in the shaft, keeps the disks in close inductive relationship and provides the right amount of friction for a permanent adjustment.

Two sizes of bushing nuts permit mounting on any support from ⅛" to ¼" thickness. Patents are pending on the device and large production is planned.

THE TWO types of transformers shown in the illustration are manufactured by the Jefferson Electric Mfg. Company, of Chicago, Ill. The small one is the No. 45 Navy type transformer. In these transformers for audio frequency amplification the inherent capacity effects have been eliminated considerably by a special method of winding. The larger transformer, type 41, is wound with No. 40 wire, while the smaller, type 45, is wound with No. 44 wire. For this reason the No. 41 is slightly larger in size, and consequently a little less free of capacity effect. The primary winding of type 41 consists of 4,000 turns of No. 40 wire with a resistance of about 900 ohms. The secondary has 15,000 turns of the same wire with a resistance of about 5,000 ohms.

The smaller transformer, type 45 has a primary winding of 3,900 turns of No. 44 wire with a resistance of about 1,800 ohms. The secondary has 12,000 turns of the same wire and a resistance of 8,500 ohms. The core is made of extremely light gauge silicon steel laminations especially rolled for the purpose with a resultant tremendous increase in efficiency. Transformers can be secured either mounted or unmounted. The primary, secondary, and high side binding posts are plainly marked in either case.

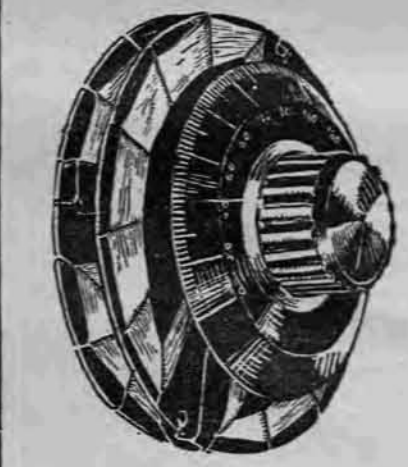
THE STORAGE cell type of "B" or plate battery is not new, but there is an increasing progress in new developments on old and standard apparatus. The B type Radio battery illustrated by the cut, is manufactured by the Vesta Bat-

B Storage Battery Gives Even Current

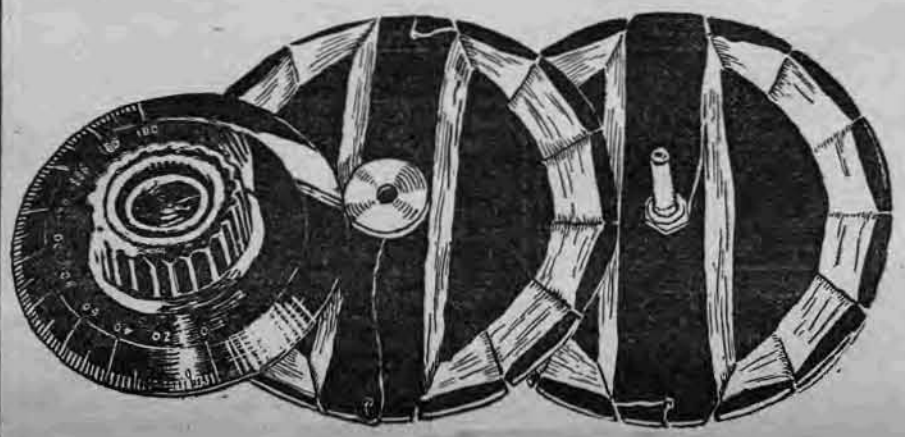
tery Corp., of Chicago, Ill. The case is of the hard rubber type and the cells are compactly assembled and covered with a top of the same material which is sealed into the plates. Each cell, however, has two eyelet type of vent holes inserted in the cover plate. Four binding posts are fastened to the sides of the container. The negative terminal is plainly marked. The three additional binding posts are positive terminals for 20, 22, and 24-volt taps. The battery is compactly built and makes a neat unit for the Radio set. The design leaves but little possibility of spilling the electrolyte. This storage B battery is claimed superior to dry cell batteries as it maintains an even voltage and eventually costs less, although its initial cost is higher than dry cells.

The storage type of plate battery is to be recommended for Radio work in view of the advantages now available with all standard type of charging devices. Provision is usually made for the charging of high voltage batteries, and it takes but little time in view of the low amperage capacity of such cells. Charging can usually be done overnight.

The usual precautions for keeping battery in water and re-charging whenever gravity goes below a specific gravity of 1,200 applies to all batteries of this type. The hydrometer is always recommended for use so that the condition of the battery and its requirements for re-charging can be known at a glance.



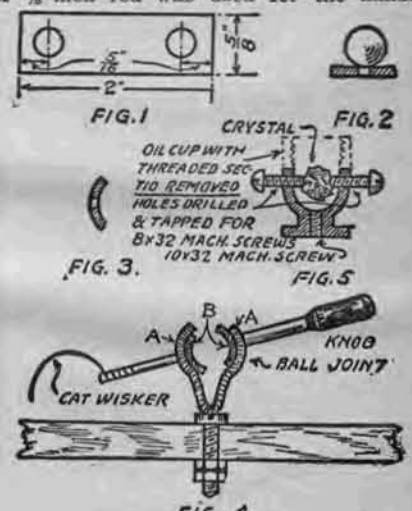
An entirely new and radical design is embraced by this variometer. The coils are wound somewhat similar to the spider web or involute method, but only for a semi-circle—not for the entire circumference.



Ball Joint for Detector

The holder for this detector handle is made of a piece of brass ¼-inch thick, ⅝-inch wide by 2 inches long. Two holes are drilled in the piece, as shown in Figure 1. Two washers were formed into cups of parts of a sphere, as shown in Figure 2. The manner of doing this is clearly shown. A ⅝-inch steel ball was procured and placed into the hole and struck with a heavy hammer. The washer was placed on the end grain of a piece of soft wood while this operation was followed out. The washer formed into a cup ready for the standard is shown in Figure 3.

The steel ball was again used to shape the tops of the standards, A, in Figure 4. A ⅛-inch rod was used for the handle.



This was driven through the cup-shaped washers and the washers were then fitted into the standards at A. The holes in A are sufficiently large to allow the handle to be moved about for a considerable distance.

A cat whisker may be made of No. 30 magnet wire, wound on a needle in a coil spring form. This, when taken from the needle, will fit snugly over the ⅛-inch rod used for the handle. An oil cup makes a good crystal holder as shown. Two machine crews are fitted in the sides of the cup and the crystal is held between the ends of the screws.—O. W. Feldman, St. Louis, Mo.

Good Workmanship Necessary

Those who wish to make or install a Radio set should remember that everything must be almost perfect as workmanship will make it. Coils and windings must be carefully and solidly attached to the panels or wooden bases. Wires hanging loosely from the contact points are not only unsightly but inefficient and they may make a set completely useless.

One of the easiest and most convenient methods of mounting coils is called the "pillar" mounting. A short length of brass rod, about a half inch in diameter is cut and "faced off" in one-inch lengths. It is bored so that an 8-32 thread will pass through it freely. A hole is carefully bored in the cardboard tube and a corresponding one through the panel. Then the brass pillar is simply interposed between the cardboard tube and the panel and is held in place by a nut. Instead of the pillar, brass tubing can be used with just as much satisfaction. Washers should be placed between the tube and the cardboard winding to prevent it from damaging the cardboard. Flat head machine screws are best, and they require counter-sinking of the panel holes.

Sometimes it is desirable to mount the coil with its end to the panel. To do this, parts of the cardboard base are cut away, and the projecting sections that are left will provide surface for fastening on the small angle pieces that hold it to the panel. The cardboard is cut away to permit the taps to pass to the contact points.

Cutting cardboard tubing is an easy matter if safety razor blades are used. A pencil line is marked around the tube and this guide line is followed around with the razor blade. A clean cut edge will result after going around several times, each time penetrating deeper.

Radiophone Broadcasting Stations

Corrected Every Week.

CONTENTS AND HOW BEST TO USE—

THE STATION schedules, given below, are listed alphabetically by call letters. Following the call is given the city and state, the wave length (PROVIDING a wave length other than 360 meters is used), the miles range of the station, the owner of the station, the schedule of operating hours, and the kind of time used.

The state, city and call list given following the station schedule list is merely an index. One wishing to find the calls of the stations in his vicinity, will find this index useful. All licensed broadcasting stations in operation are given in the index, while only those which have made special reports to RADIO DIGEST, are given in the station schedule **list.**

Station Schedules

AGI, Presidio of San Francisco, Cal. 50 mi. Signal Corps, U. S. A. Sun, 7-9 pm, instruction. Pacific.

CFCB, Vancouver, Canada. 440 only. 500 mi. Daily Province. Daily ex Sun, 8:30-9:30 pm, news, weather, concert. Pacific.

CFCF, Montreal, Can. 440 only. 200 mi. Marconi Co. Daily, 1-1:30 pm, concert. Mon, Thurs, 8-9 pm, concert. Eastern. Daylight Saving.

CHBC, Calgary, Canada. 410 also. 1,000 mi. W. W. Grant Radio Ltd. (Morning Albertan.) Daily, 8:45-10 pm, news, stock quotations, music. Mountain.

CHCB, Toronto, Canada. 440 only. 500 mi. Marconi Co. Tues, 8-10 pm, concert. Eastern.

CHCQ, Calgary, Canada. 400 only. 200 mi. Western Radio Co. (Calgary Herald.) Daily ex Sun, 3:30-4:30 pm, music, news, baseball; 7:45-8:45, music, etc. Sun, 7:45-8:45 pm, church service. Mountain.

CHVC, Toronto, Canada. 410 only. 200 mi. Metropolitan Motors Co. Daily ex Sat and Sun, 5-5:30 pm, news, concert. Eastern.

CJCA, Edmonton, Canada. 450 only. 500 mi. Edmonton Journal Ltd. Daily ex Sun, every evening, music, bedtime story, news, weather, markets, etc.

CJCD, Toronto, Canada. 410 only. 200 mi. T. Eaton Co. Daily ex Sat and Sun, 4-4:30 pm, concert. Sat 12-12:30 pm, concert. Eastern.

CJCG, Winnipeg, Canada. 410 only. 300 mi. Manitoba Free Press. Every other wk, beginning July 31, Mon, Wed, Fri, 10-10:30 am, news; 12-1 pm, stocks, markets, weather; 8-10, concert. Tues, Thurs, Sat, 9:30-10 am, news; 1-2 pm, stocks, markets, weather; 7-8 pm, music. Sun, 8 am on, sacred concert. For fill in weeks, Mon, Wed, Fri same as Tues, Thurs, Sat above, and Tues, Thurs, Sat same as Mon, Wed, Fri above. Sun, 9:15 am on, sacred concert. Central.

CJNC, Winnipeg, Canada. 420 only. 500 mi. Tribune Newspaper Company. Daily ex Sun, 12-2 pm, markets, news; 7-10:30, concert, baseball. Sat, 2-3 pm or 3-4, kiddies' hour. Sun, 3-4 pm or 4-5, sacred concert; 8-10:30, concert. Central.

CKCE, Toronto, Canada. 450 only. 200 mi. Can. Indep. Tel. Co. (Toronto Star.) Daily ex Sun, 7-7:30 pm, baseball, stocks, concert. Tues, Fri, 8:30-9:30 pm, concert, address. Eastern.

DD5, Denver, Colo. 340 only. 1,500 mi. Fitzsimmons General Hospital. Daily ex Sun, 8:15 pm, weather, news, concert. Thurs, 8:15-9:30 pm, special concert, speech. Mountain.

KDKA, Pittsburgh, Pa. 1,000 mi. Westinghouse Elec. Mfg. Co. Daily ex Sun, 10-10:15 am, 12:30-1 pm, 2-2:20, 4-4:20, music; 7:30, bedtime story; 7:45, news; 8:30-9:30, music, news. Sat, 3-4 pm, concert. Sun, 10:45 am, 3 pm and 7:30, church service. Eastern.

KDN, San Francisco, Cal. 485 also. 250 mi. Leo J. Meyberg Co. Daily ex Sun, 11-12 am, 1-2 pm, 4:30-5:30, concert; 7-7:15, weather; 8:30-9, concert. Sat, nothing after 5:30 pm. Sun, 10-11 am, sacred concert. Pacific.

KDPT, San Diego, Calif. 250 mi. Southern Elec. Co. Daily 7:30-9 pm, news, weather, concerts, lecture. Pacific.

KDYL, Salt Lake City, U. 485 also. 300 mi. Salt Lake Telegram. Daily ex Sun, 7-8 pm, music, baseball, news, weather; 9-9:30 (occasionally). Sun, 2-3 pm, church service. Mountain.

KDYS, Great Falls, Mont. 200 mi. Tribune. Wed, 8-10 pm, bedtime story, concert. Sun, 4 pm, church service. Mountain.

KDYX, Honolulu, Hawaii. 750 mi. Star-Bulletin. Daily ex Sun, 12:15-1:15 pm, stocks, markets, business news; 6:30-7:30, concert, lecture. Sun, 11-12 am, church service; 4-6 pm, concert, lecture. Honolulu.

KDZE, Seattle, Wash. 300 mi. The Rhodes Co. Daily ex Sun, 3:30-4:15 pm. Mon, Wed, Fri, 7:15-8:15 pm. Pacific.

KDZQ, Denver, Colo. 500 mi. Wm. D. Pyle. Mon, Wed, 8:15-9:30 pm, concert. Mountain.

KDZZ, Everett, Wash. 100 mi. Kinney Bros. & Sipprell. Daily ex Sun, 2:30-3:30 pm, 8-9:30. Pacific.

KFAC, Glendale, Cal. 485 also. 150 mi. Daily News. Mon, Wed, Fri, 3-3:15 pm, baseball, news. Mon, Thurs, 8-9 pm, concert. Sat, 7-8 pm, dance music. Pacific.

KFAD, Phoenix, Ariz. 485 also. 100 mi. Mon, Wed, Fri, 8-9:15 pm, concert, weather, stocks, markets. Sun, morning, church service. Mountain.

KFAE, Pullman, Wash. 200 mi. State College of Wash. Program irregular.

KFAF, Denver, Colo. 1,000 mi. Western Radio Corp. Daily, evenings, music, news, sermons, etc.

KFC, Seattle, Wash. 700 mi. Northern Radio & Electric Co. Daily, eight hours, miscellaneous. Pacific.

KFI, Los Angeles, Calif. 200 mi. Earle C. Anthony, Inc. Daily, 1:45-2:30 pm, music, news; 4.30-5, news. Sun, 10:45-11:30 am, 4-5 pm. Pacific.

KFU, Gridley, Cal. 500 mi. Precision Shop. Mon, Thurs, Sun, 8-9 pm, concert. Sun, 3-4 pm, concert. Pacific.

KFZ, Spokane, Wash. 300 mi. Doerr Mitchell Elec. Co. Daily ex Sun, 7:30-9:30 pm, concerts and voice. Pacific.

KGB, Tacoma, Wash. 200 mi. Wm. A. Mullins Elec. Co. (Tacoma Ledger.) Daily, 4-5 pm, 7:30-9:30. Pacific.

KGC, Hollywood, Cal. 300 mi. Elec. Lighting Supply Co. Tues, Thurs, Sat, 7:30-8 pm, concert. Pacific.

KGF, Pomona, Cal. 150 mi. Pomona Fixture & Wiring Co. Thurs, 7:30-8:15 pm, news, markets, concert. Mountain.

KGG, Portland, Ore. 500 mi. Hallock & Watson Radio Service. Daily ex Sun, 4:30-6 and 7-7:30 pm, baseball scores, markets, news. Sat, 9:10 pm, instruction. Sun, 4:30-6 pm. Pacific.

KGN, Portland, Ore. 500 mi. Northwestern Radio Mfg. Co. Daily, 12-1 pm, concert, lecture; 2:30-3:30, miscellaneous. Mon, Fri, Sun, 9-10 pm, health bulletin, concert. Tues, 7-7:30 pm, miscellaneous; 8-9, concert. Wed, Thurs, Fri, Sat, 7-7:30 pm, miscellaneous. Pacific.

KGO, Altadena, Calif. 300 mi. Altadena Radio Lab. Daily, 1-2 pm, 6-7. Pacific.

KGW, Portland, Ore. 200 mi. Ship Owners Radio Service Inc. (Daily Oregonian.) Daily, 3:30-4:30 pm, news etc. Mon, 7:30-8:30 pm, concert. Wed, 8-10 pm, concert. Fri, 8-9 pm, concert. Sun, 7-8 pm, church service. Pacific.

KGV, Lacey, Wash. 100 mi. St. Martins College. Tues, Fri, Sun, 8:30-9:30 pm, concert, news. Pacific.

KHD, Colorado Springs, Colo. 200; 485 meters only. 100 mi. Aldrich Marble & Granite Co. Daily except Sun, 8:15 am, weather, forestry bulletins, etc. Mountain.

KHJ, Los Angeles, Calif. 50 mi. C. R. Kierulff & Co. (Los Angeles Times.) Daily ex Sat and Sun, 1-1:45 pm, 7:15-8, concert, lecture, news. Pacific.

KJC, Los Angeles Calif. 100 mi. Standard Radio Co. Barker Bros. Daily ex Sun, 11:30-12 noon. Mon, 10-11 am. Wed, 9-10 am. Sun, 1-2 pm, 5-6. Pacific.

KJJ, Sunnyvale, Cal. 200 mi. The Radio Shop. Tues, 8:15-9 pm, concert. Fri, 7:30-8:15 pm, concert. Pacific.

KJR, Seattle, Wash. 200 mi. Northwest Radio Service Co. Daily ex Sun, 8-9 pm, miscellaneous. Pacific.

KLB, Pasadena, Cal. 300 mi. J. J. Dunn Co. Mon and Fri, 7:30-8:15 pm, concert. Sun, 3-4 pm and 8-9, concert. Pacific.

KLN, Monterey, Cal. 150 mi. Noggle Electric Works. Daily, 12-1 pm, weather, markets, news; 7-8 pm, concert. Pacific.

KLP, Los Altos, Cal. 1,500 mi. Colin B. Kennedy Co. Mon, 7:30-8:30 pm, industrial news, concert. Thurs, 8:30-9 pm, concert. Sun, 4-5 pm, concert. Pacific.

KLS, Oakland, Cal. 150 mi. Warner Bros. Daily, 12-1 pm, concert. Sat, 7:30-8:15 pm, concert. Pacific.

KLZ, Denver, Colo. 485 also. 1,000 mi. Reynolds Radio Co. Daily ex Sun, 7:30 pm on, news, markets, bedtime story, concert. Sun, 8-9 pm, church service. Mountain.

KMC, Reedley, Calif. 100 mi. Lindsay-Weatherill & Co. Mon, Wed, Fri, 8:30-9 pm, concert. Pacific.

KMO, Tacoma, Wash. 200 mi. Tacoma Times. (Love Electric Co.) Daily ex Sun, 11-1 pm, 6-7, 9:15-10, concert, news, lecture. Pacific.

KNJ, Roswell, N. M. 300 mi. Roswell Public Service Co. Daily, ex Sun, 7-9 pm, weather, financial, markets, news. Sun, 7-9 pm, church service. Mountain.

KNN, Los Angeles, Calif. 100 mi. Bullock's. Standard Radio Co. Tues, Thurs, Fri, 10-11 am. Pacific.

KNT, Aberdeen, Wash. 400 mi. Grays Harbor Radio Co. Daily, 5-5:30 pm, 7:30-8:15, news, concert. Pacific.

KOA, Denver, Colo. 485 only. 100 mi. W. H. Smith (Y. M. C. A.). Daily, 9:55-10:25 pm, time, weather reports. (Telegraph only.) Mountain.

KOG, Los Angeles, Calif. 300 mi. Western Radio Elec. Co. (Evening Herald). Daily 12:15-12:30 pm, markets; 5-5:30, news. Tues, Wed, Fri, 8:15-9 pm, concert. Pacific.

KON, Los Angeles, Calif. 200 mi. Holzwasser Inc. Daily ex Sun, 4-5 pm and 8:15-9, concert, news. Sun, 10-11 am, 4-5 pm and 8:15-9, church service. Pacific.

KQP, Hood River, Ore. 100 mi. Blue Diamond Elec. Co. Daily ex Sun, 7-7:30 pm, news. Mon, Wed, Fri, 8:30-9:15 pm, concert. Pacific.

KQV, Pittsburgh, Pa. 100 mi. Doubleday-Hill Elec. Co. Daily ex Sat and Sun, 12-12:30 pm, 2:30-3 pm. Mon, Wed, Fri, 10-11 pm. Sat, 12-12:30 pm. Sun, 4-5 pm. Eastern, daylight saving.

KQW, San Jose, Cal. 200 mi. Chas. D. Herrold. Daily, 1-1:30 pm. Wed, 8:15-9 pm, concert. Pacific.

KQY, Portland, Ore. 100 mi. Stubbs Elec. Co. Daily, 1-2 pm, 6-7, miscellaneous. Pacific.

KRE, Berkeley, Cal. 100 mi. Maxwell Elec. Co. Sun, 1-2 pm, 6-7 pm, concert. Pacific.

KSD, St. Louis, Mo. 1,000 mi. St. Louis Post-Dispatch. Daily ex Sun, 4 pm, markets, news, concert; 7:45 pm, concert, lecture. Central.

KSL, San Francisco, Cal. 50 mi. The Emporium. Daily ex Sun, 10-11 am, concert, news; 2-3 pm, concert, educational talk. Sun, 2-3 pm, concert and educational talk. Pacific.

KSS, Long Beach, Calif. 25 mi. Prest & Dean Radio Research Lab. Daily ex Sun, 3:30-4:30 pm, news, concert. Pacific.

KTW, Seattle, Wash. 200 mi. First Presbyterian Church. Sun, 11-1 pm, 7:30-10, church service. Pacific.

KUO, San Francisco, Cal. 1,500 mi. San Francisco Examiner. Daily ex Sun, 3-3:30 pm, and 5:30-6:45, news, etc. Sun, 5-6 pm, news, etc. Pacific.

KUY, El Monte, Cal. 200 mi. Coast Radio Co., Inc. Daily ex Sun, 4-4:30 pm, music, lectures. Mon, Thurs, 9-10 pm, concert, etc. Pacific.

KVQ, Sacramento, Cal. 1,000 mi. J. C. Hobrecht (Sacramento Bee). Daily ex Sun, 5:30-6:30 pm, concert, news, markets, weather. Wed and Sat, 8-9 concert. Sun, 5-7 pm, concert. Pacific.

KWG, Stockton, Cal. 1,500 mi. Portable Wireless Telephone Co. Daily ex Sun, 4-5 pm, news, concert, markets. Tues and Fri, 8-9 pm, concert. Sun, 2-3 pm, concert. Pacific.

KWH, Los Angeles, Calif. 300 mi. Examiner. Daily ex Sat, 12:30 pm, music, news, crop reports. Daily, 5:30-6:30 pm, music, news. Sunday, 2-3 pm, sacred concert. Pacific.

KYG, Portland, Ore. 700 mi. W. P. Hawley, Jr. Tues, Thurs, 9-10 pm, concert. Sat, 8-9 pm, concert. Pacific.

KYJ, Los Angeles, Cal. 1,000 mi. Leo J. Meyberg Co. (Hamburgers). Daily ex Sun, 4-5 pm, concert, markets, weather, news. Mon, Thurs, Sat, 8-9 pm, same program. Pacific.

KYW, Chicago, Ill. 485 also. 800 mi. Westinghouse Elec. & Mfg. Co. Daily ex Sun, 9:35 am-1:20 pm, market quotations every half hr; 2:15, news, markets; 3, baseball; 4:15 and 6:30, news, final markets and stocks; 7:30, baseball, bedtime story; 7:45, feature; 8-9, concert; 9, news. Sun, 3:30 pm, church service. Central, daylight saving.

KZC, Seattle, Wash. 50 mi. Public Market & Dept. Store Co. Daily ex Sun, 6:45-7:15 pm, prices of foodstuffs. Pacific.

KZM, Oakland, Cal. 200 mi. Preston D. Allen. Daily ex Sun, 7:15-7:30 pm, news. Tues, 7:30-8:15 pm, concert. Fri, 8:15-9 pm, concert. Pacific.

KZN, Salt Lake City, U. 100 mi. Deseret News. Daily ex Sun, 3-4 pm, weather, markets, music; 8-9, news, concert. Mountain.

KZY, Oakland, Cal. 1,500 mi. Atlantic Pacific Radio Supplies Co. Daily ex Sun, 3:30-4:30 pm, concert; 6:45-7 pm, news. Wed, 7:30-8:15 pm, concert. Sat, 8:15-9 pm, concert. Sun, 11-12:15 pm, church service; 3-4 pm, concert. Pacific.

WAAG, Shreveport, La. 50 mi. Bordreaux Co. Daily ex Sun, 7:30-9 pm, baseball, concert. Central.

WAAJ, Boston, Mass. 50 mi. Eastern Radio Inst. Mon, Wed, Fri, 9-10 pm, concert. Eastern.

WAAO, Charleston, W. Va. 40 mi. Radio Service Co. Daily ex Sun, 6:45-7:45 pm, music, news, weather, baseball. Eastern.

WAAQ, Greenwich, Conn. 600 mi. New England Motor Sales Co. Daily ex Sun, 9:30 am-5:30 pm, every half hr. Eastern, daylight saving.

WAAT, Jersey City, N. J. 70 mi. Jersey Review. Wed, 7-8 pm, concert, lecture. Sun, 7-8, church service, concert. Eastern.

WAAV, Athens, O. 500 mi. Athens Radio Co. Daily, 7-9 pm, miscellaneous. Central.

WAAY, Youngstown, O. 300 mi. Yohrling Rayner Music Co. Tues, Thurs, Sat, 5:45 pm, baseball, news; 7:30, music; 8-9, address, music. Eastern.

WAAZ, Emporia, Kan. 250 mi. Hollister-Miller Motor Co. Daily ex Sun, 9:45-1:15 pm, market quotations every half hr; 7-8 pm, concert, weather. Sun, church service, 2 pm. Central.

WBAA, W. Lafayette, Ind. 100 mi. Purdue University. Fri, 8:15-8:30 pm, educational lecture. Other features irregular. Central.

WBAB, Syracuse, N. Y. 150 mi. Andrew J. Potter. Daily ex Sun, 7-8 pm, concert, baseball, weather, news, bedtime story. Sun, 6:30-7:30 pm, church service, etc. Eastern.

WBAD, Minneapolis, Minn. 100 mi. Journal. Mon, Fri, Sat, 9:30 am, markets; 7:50 pm, concert. Central.

WBAG, Bridgeport, Pa. 485 also. 300 mi. Diamond State Fibre Co. Daily ex Sun, 10:45-11:15 am, weather, markets. Eastern.

WBAJ, Toledo, O. 450 also. 500 mi. Marshall-Gerken Co. Tues, Thurs, Sat, 6-7:30 pm, news, bedtime story. 8:00 pm, concert. Eastern.

WBAM, New Orleans, La. 100 mi. I. B. Rennyson. Daily ex Sun, 10-11 pm, real estate bulletins, lecture, concert. Central.

WBAN, Paterson, N. J. 100 mi. Wireless Phone Corp. Daily ex Sun, 10:30 am, on the hour to 9:30 pm, concert, baseball. Eastern.

WBAP, Fort Worth, Tex. 485 also. 100 mi. Star Telegram. Daily ex Sun, 8:45-9 am, opening markets; 11-11:30, weather, markets; 1:30-2 pm, closing markets; 3:45-4, news, road conditions; 5:15-5:30, police; 6:30-6:45, baseball, police news; 9:30-10, music. Sun, 11-12:15 pm, church service; 2-2:30 pm, sermonette; 3:30-4, concert; 6:15-7 baseball. Central.

WBAQ, South Bend, Ind. 100 mi. Myron L. Harmon. Daily, 5:30-6 pm, news, concert; 8 pm, concert, news, police reports. Sun, 3:30 pm, church services. Central.

WBAV, Columbus, O. 200 mi. Erner & Hopkins Co. Daily ex Sun, 5:30-7:30 pm. Central.

WBAX, Wilkes-Barre, Pa. 200 mi. John H. Stenger, Jr. Three nights of week, not regular.

WBAZ, Richmond, Va. 300 mi. Times-Dispatch. Daily, 7-9 pm, news, concert, markets, etc. Eastern.

WBL, Anthony, Kan. 300 mi. T. & H. Radio Co. Daily ex Sun, 8:50 am, 9:50, 10:50 and 1:15 pm, Kansas City grain markets; 1:15, roads, local markets; 7-8, concert, etc. Sun, 4-5, concert. Central.

WBT, Charlotte, N. C. 485 also. 500 mi. Southern Radio Corp. Daily ex Sun, 11 am, weather; 9:30 pm, markets. Mon, Wed, Fri, 8:30-9:30 pm, concert. Sun, 11 am, 8 pm, church service. Eastern.

WBZ, Springfield, Mass. 500 mi. Westinghouse Elec. & Mfg. Co. Daily ex Sun, 7:30 pm, children's hour; 7:45, markets, weather, lecture; 8-9, concert. Sun, 3 and 8, church service. Eastern.

WCAB, Newburgh, N. Y. 100 mi. Newburgh Daily News. Daily ex Sun, on half hour 12:30-6:30 pm, news, sports, concert; 10:30-11 pm, concert, feature. Eastern, daylight saving.

WCAC, Fort Smith, Ark. 500 mi. John Fink Jewelry Co. Fri, Sun, 8-10 pm, music, talks, sermon. Central.

WCAH, Columbus, O. 300 mi. Entrekin Elec. Co. Tues, Fri, 7-8 pm, concert, bedtime stories. Sat, 3-4 pm, lecture, music. Central.

WCAK, Houston, Tex. 200 mi. A. P. Daniel. Daily ex Sun, 7-7:15 pm, news etc. Wed, Sat, 8-9 pm, concert. Sun, 3-4 pm, concert. Central.

WCAL, Northfield, Minn. 400 mi. St. Olaf College. Fri, 9:15-10 pm, concert, lecture, news. Sun, 8:30-9:30 pm, chapel, music. Central.

WCAQ, Defiance, O. 200 mi. Tri-State Radio Mfg. Co. Daily, 11:30-12:30 pm, 3, baseball; 6-6:30, baseball, concert; 8, special program. Central.

WCAW, Quincy, Ill. 200 mi. Quincy Elec. Sup. Co. (Quincy Herald.) Daily ex Sun, 8:45 am, markets; 11, markets; 1 pm, markets; 5, music, baseball. Tues, Wed, Thurs, Sat, 8:30-9:45 pm, concert. Sun, 6:30-7:30 pm, religious. Central.

WCK, St. Louis, Mo. 50 mi. Stix Baer & Fuller (Grand Leader). Mon, Wed, Fri, 6:45-8 pm, concert, lecture, bedtime story. Central.

WCN, Worcester, Mass. 485 also. 100 mi. Clark Univ. Daily, 11:15 am, 5:15 pm, weather. Evening program irregular. Eastern.

WDAB, Portsmouth, O. 100 mi. H. C. Summers & Son. Mon, Wed, Sat, 2-2:45 pm, 8:30-9:30 pm, concert. Sun, 2-2:45 pm, church service. Central.

WDAF, Kansas City, Mo. 500 mi. Kansas City Star. Daily ex Sat and Sun, 3 pm and quarter hours after, baseball. Mon, Wed, Fri, 7:30, news, concert. Central.

WDAH, El Paso, Tex. 500 mi. Mine & Smelter Supply Co. Tues, Thurs, Sat. 7:30-8:30 pm, concert. Mountain.

WDAJ, College Park, Ga. 300 mi. A. & W. P. R. R. Co. Daily, 9-10 pm, concert etc. Central.

WDAL, Jacksonville, Fla. 485 also. Times-Union. Daily ex Sun, 3-3:15 pm, 4-4:15, 5-5:15, 6-6:15, baseball, markets, weather; 8-9:50, general. Eastern.

WDAP, Chicago, Ill. 485 also. 1,000 mi. Midwest Radio Central Inc. Daily ex Sat and Sun, 9:45 am, 10:45, 11:45, 1:45 pm, 3:15, foreign exchange; 3:17, closing Chicago stocks. Sat, 9:45 am, 10:45, 11:45, 12:45 pm, foreign exchange; 12:17, closing Chicago stocks. Sun, 8:30-10:30, concert. Central, daylight saving.

WDAQ, Brownsville, Pa. 200 mi. Hartman-Riker Elec. & Mach. Co. Daily ex Sun, 10:30-10:50 am, music; 12:50-1:10 pm, music, news, weather; 5:05-5:30 music. Tues, Thurs, Fri, 9:15-10 pm, concert. Sun, 5 pm, chapel. Eastern.

WDAU, New Bedford, Mass. 50 mi. Slocum & Kilburn. Mon, Wed, 7-9 pm, concert etc. Eastern, daylight saving.

WDAW, Atlanta, Ga. 485 also. 500 mi. Georgia Ry. & Power Co. Daily ex Sun, 6-7 pm; 9-9:55. Sun, 3:30-4:30 pm. Central.

WDAX, Centerville, Ia. 250 mi. First Ntl. Bank. Daily ex Sun, 11:30 am, 2:30 pm, markets, news. Mon, Thurs, 7:30 pm-9:30, concert. Central.

WDAY, Fargo, N. D. 485 also. 100 mi. Fargo Radio Service Co. Daily ex Sun, 12:15 pm, weather; 7-7:30, news, music. Mon, Wed, Fri, 9-10 pm, concert, etc. Sun, 12:15 pm, weather. Central.

WDM, Washington, D. C. 50 mi. Church of the Covenant. Sun, 10:30 am, church service; 3 pm, lecture; 7:30, church service. Eastern.

WDZ, Tuscola, Ill. 70 mi. James L. Bush. Daily ex Sun, every half hr., 8:30 am-12:15, Chicago Board of Trade quotations. Tues, Fri, 7-8 pm, concert, entertainment. Central.

WEAD, Atwood, Kan. 485 also. 150 mi. N. W. Kansas Radio Supply Co. Daily ex Sun, 11-11:30 am, markets, music; 12, markets; 1:45 pm, markets; on half hour 3:15 to 5:45, news, baseball. Tues, Wed, Thurs, Sat, 7:30-9, concert. Sun, 11 am, church service; 3 pm, sacred music; 7:30, church service. Central.

WEAH, Wichita, Kan. 485 also. 500 mi. Lander Radio Co. Daily ex Sat and Sun, markets at 8:40 am, 9:40, 10:40, 11:40, 12:30 pm, 3:15. Wed, Sat, 8-9 pm, concert. Sat, markets at 8:40 am, 940, 10:40, 11:40. Sun, 8-9 pm irregular, concert., Central

WEAK, St. Joseph, Mo. 100 mi. J. B. Aberambie. Daily, 12-1 pm, St. Joseph live stock markets; 7:30-8:45, concert. Central.

WEAN, Providence, R. I. 100 mi. Shepard Co. Daily ex Sun, 3-5 pm, music; 6-8, bedtime stories, baseball, weather, lecture. Mon, Wed, 8-10 pm, concert. Eastern.

WEAP, Mobile, Ala. 485 also. 50 mi. Mobile Radio Co. Daily, 4-5 pm, 7-8:55. Central.

WEAS, Washington, D. C. 100 mi. The Hecht Co. Daily ex Sun, 3-4 pm, music, retail news. Wed, 7-8 pm, concert. Fri, 7:30-8:30 pm, concert. Eastern.

WEAV, Rushville, Nebr. 200 mi. Sheridan Elec. Service Co. Wed, Fri, Sun, 8-9 pm, concert, news, etc. Mountain.

WEAZ, Waterloo, Ia. 100 mi. A. C. Sweetman. Mon, Thurs, Sat, 7-8 pm, news, concert, lecture. Central.

WEW, St. Louis, Mo. 485 only. 100 mi. St. Louis University. Daily ex Sun, 10 am, weather, opening grain and live stock markets; 2 pm, closing of markets. Sat, 2 pm program at 1 pm. Central.

WEY, Wichita, Kan. 485 also. 500 mi. Cosradio Co. (Wichita Beacon.) Daily ex Sun, hourly, 8:40 am-12:40 pm, stock markets. Daily, 10:45 am and 4:30 pm, weather; 8-10 pm, baseball, concert, lecture; 10:45 weather. Sun, 8:10 pm, church service, concert. Central.

WFAA, Dallas, Tex. 485 also. 250 mi. News-Journal. Daily ex Sun, 12:30-1 pm, weather, talk; 2-2:30, baseball, markets, news; 3:30-3:45, markets, news; 6:45-7, baseball finals; 8-8:30, concert. Sun, 2-2:30 pm, chapel; 6:30-6:45, sacred concert; 9:30-10, baseball, weather. Central.

WFAC, Superior, Wis. 100 mi. Superior Radio Co. Daily, 7:30-9 pm. Central.

WFAD, Salina, Kan. 100 mi. Watson Weldon Motor Supply Co. Daily ex Sun, 8:45 am, 9:45, 10:45, 11:45, 1:15 pm, markets; 4, news. Tues, Thurs, Fri, 8 pm, concert. Sun, 11 am, church service; 8 pm, concert. Central.

WFAM, St. Cloud, Minn. 485 also. 100 mi. Granite City Elec. Co. Daily ex Sun, 3:30-4:00 pm, markets; 7:30-9, entertainment. Central.

WFAN, Hutchinson, Minn. 485 also. 500 mi. Hutchinson Elec. Service Co. Daily ex Sun, 1 pm, markets etc. Central.

WFAP, Peoria, Ill. 200 mi. Brown's Business College. Daily ex Sun, 10:30 am, weather; 12-12:15 pm, music; 1:45-1:55, markets; 4:30-4:50, business lecture; 7:45-8:55, baseball, news, concert. Sun, 11 am, church service. Central.

WFAT, Sioux Falls, S. D. 300 mi. Argus Leader. Daily ex Sun, 7:30-8 pm, baseball, concert. Tues, Thurs, special concert, 8-9 pm. Sun, 7:30-8 pm, concert. Central.

WFAV, Lincoln, Nebr. 485 also. 300 mi. Univ. of Nebr. Daily ex Sun, 10:10 am, weather, markets. Sat, 9:00 pm, concert. Central.

WFAX, Binghampton, N. Y. 50 mi. A. L. Kent. No fixed schedule.

WFI, Philadelphia, Penn. 350 mi. Strawbridge & Clothier. Daily ex Sun, 1:16 pm, news; 3:30-4:30, concert; 5:30-6, baseball. Mon, Fri, 6:30-7 pm, Radio talk. Wed, Fri, Sat, 7:30-8:30 pm, concert. Fri, Sat, (alternate weeks) 7:30 pm, concert at 8:30 pm. Sun, 4 pm, church service. Eastern, daylight saving.

WFO, Dayton, O. 485 also. 300 mi. Rike-Kumler Co. Daily ex Sun, 9-9:30 am, concert, news; 11-12 and 4-5 pm, concert, news, markets, weather. Mon, Wed, Fri, 7-8 pm, concert, lecture. Sun, 11-12 am, church service. Central.

WGAB, Houston, Tex. 485 and 600 also. 250 mi. QRV Radio Co. Daily ex Sun, 8:30-9:30 am, police, news; 12:30-1:30 pm, music, readings; 4-5, baseball, news. Mon, Wed, Fri, 8 pm on, concert. Eastern.

WGAD, Ensenada, Porto Rico. 200 mi. Spanish-American School of Radio Telegraphy. Irregular, 7:30-11:30 pm, entertainment. 60th Meridian.

WGAL, Lancaster, Pa. 35 mi. Lancaster Elec. Supply & Construction Co. Mon, Wed, Fri, 7-8 pm, concert, lecture. Sun, 3-3:30 pm, church service. Eastern.

WGAM, Orangeburg, S. C. 150 mi. Orangeburg Radio Equipment Co. Daily ex Sun, 10 am, markets, weather; 11:55, time; 4 pm, Radio talk, markets, baseball; 6, music, lecture; 10, time, weather, entertainment. Sun, 11 am, church service; 11:55, time; 10 pm, time, weather, music. Eastern.

WGAQ, Shreveport, La. 300 mi. W. G. Patterson. Daily ex Sun, 7:45 pm, news, sports, music. Sun, 11 am, 7:45 pm, church service. Central.

WGAT, Lincoln, Nebr. 100 mi. Am. Legion, Dept. of Nebr. Mon, Wed, 9 pm, announcements. Fri, 9-10 pm, patriotic program, concert. Sun, 3-5 pm, sermon. Central.

WGAY, Madison, Wis. 100 mi. North Western Radio Co. Daily ex Sun, 9-10 am, financial news; 11:30, news, opening markets; 4 pm, news, closing markets. Mon, Wed, Thurs, Sat, 7:30-8:30 pm, concert. Sun, 10:30-12 am, sermon. Central.

WGAZ, South Bend, Ind. 100 mi. South Bend Tribune. Daily ex Su, 9-9:30 am, home hints, menus; 2-3 pm, news, music; 7-8, news, music. Central.

WGH, Montgomery, Ala. 1,000 mi. Montgomery Light & Water Power Co. Tues, Thurs, Sat, 11 am, weather; 4 pm, storm warnings; 8:30-9:30, concert, agricultural. Sun, 8:30-9:30, church service. Central.

WGI, Medford Hillside, Mass. 500 mi. Am. Radio & Research Corp. Daily ex Sun, 2:55 pm, music; 3, news; 7:30, baseball, news; 7:45 pm, police reports. On Tues and Thurs, 7:30 and 7:45 pm programs at 7:45 and 7:55 pm, respectively. Sun, 8 pm, church service; 8:45 am, sacred concert. Special features week nights, 7:30-9 pm. Eastern.

WGL, Philadelphia, Pa. 2,000 mi. Thos. F. J. Howlett. Tues, Thurs, Sat, 7:45-11:30 pm, concert. Eastern.

WGR, Buffalo, N. Y. 485 also. 200 mi. Federal Telep. & Teleg. Co. Daily ex Sat. and Sun, 12m, 5:30 pm, markets, weather; 8, baseball, news, bedtime story; 8:15, concert. Eastern.

WGY, Schenectady, N. Y. 1,000 mi. General Electric Co. Daily ex Sat and Sun, 7 pm, markets. Tues, Thurs, Fri, 7:45-9 pm, concert, address. Eastern.

WHA, Madison, Wis. 485 also. 600 mi. Univ. of Wis. Daily ex Sun, 12:30-1 pm, weather, markets. Tues, Thurs, Fri, Sat, 12-1 pm, weather, markets, time. Tues, 8-9 pm, concert. Fri, 8-9:15 pm, news, concert. Sat, 1-1:20 pm, instruction. Central.

WHAA, Iowa City, Ia. 150 mi. State Univ. of Ia. Daily ex Sun, 7-7:30 pm, news, music. Sun, 10:45-12 am, church service. Central.

WHAB, Galveston, Tex. 485 also. 500 mi. C. W. Thompson Co. Daily ex Sun, 9:30 am, police news; 9:45, weather; 10, markets; 12 m, markets; 3 pm, markets; 5, weather, police news, general news. Mon, Wed, Fri, 8 pm, entertainment. Sun, 10 am, church service. Central.

WHAE, Sioux City, Ia. 300 mi. Automotive Elec. Service Co. Daily ex Sun, 12:30-5:30 pm on half hour, news. Thurs, 8:30 pm, concert. Central.

WHAG, Cincinnati, O. 100 mi. Univ. of Cincinnati. No regular schedule.

WHAI, Davenport, Ia. 30 mi. Radio Equip. & Mfg. Co. Daily ex Sat and Sun, 2-2:30 pm, 4:30-5-30, 10-11. Sat, 10-11 am, 2-2-:30 pm, 5-5:30, 11-11:30. Central.

WHAJ, Bluefield, W. Va. 200 mi. Daily Telegraph. Daily, 5-5:30 pm, baseball. Mon, Thurs, 7:45-9 pm, concert, lecture. Sun, 11 am, 7:30 pm, church service. Eastern.

WHAL, Lansing, Mich. 100 mi. Phillips, Jefferys & Derby. Daily ex Sun, 8-9 am, 10:30-11:45, 1-2 pm, 3-4, 6:30-8. Eastern.

WHB, Kansas City, Mo. 485 also. 1,000 mi. Sweeney Auto & Tractor School. Daily, 10 am, 3 pm, 5, weather. Daily ex Sun, 2 pm, ladies' hour; 7, bedtime stories. Tues, Thurs, Sun, 8-10 pm, concert. Central.

WHD, Morgantown, W. Va. 100 mi. W. Va. University. Daily, 4-6, 7-7:30, news etc. Eastern.

WHK, Cleveland, O. 100 mi. Warren R. Cox (The Radiovox Co.). Daily, 1:30-2 pm, 3:30-4, miscellaneous. Tues, Thurs, Sun, 8-9:30 pm, concert. Eastern.

WHQ, Rochester, N. Y. 485 also. 50 mi. Times-Union, Inc. Daily ex Sun, 12-12:15 pm, news, concert; 7:30-8, markets, bedtime story, lecture; 8-8:30, concert. Sun, 3 and 7:30 pm, church service. Eastern.

WHW, East Lansing, Mich. 485 only. 150 mi. Stuart Wm. Seeley. Daily ex Sun, 11:30 am and 12:30 pm, weather and markets. Eastern.

WIAC, Galveston, Tex. 485 also. 100 mi. Galveston Tribune. Tues, Thurs, Sat, 7 pm on, bedtime story, evening prayer, concert. Central.

WIK, McKeesport, Pa. 500 mi. K. & L. Elec. Co. Daily ex Sun, 6:30-7 pm. Tues, Thurs, 9:30-10:30 pm. Sun, 1:30-2:30 pm and 6:30-7 pm. Eastern.

WJAC, University Place, Nebr. 485 also. 150 mi. Nebr. Wesleyan Univ. Daily ex Sat and Sun, 12 m, weather; 4 pm, markets. Sat, 12 m, markets, weather. Tues, Thurs, 9:30 pm, concert. Central.

WJD, Granville, O. 100 mi. Dennison University. Daily, 5-6 pm, concert, lecture. Central.

WJH, Washington, D. C. 250 mi. White & Boyer Co. Tues, 7:30-10 pm, concert, address, lecture. Eastern.

WJK, Toledo, O. 300 mi. Service Radio Equipment Co. Daily ex Sun, 3-4 pm, concert. Mon, Wed, Fri, 7:30-9 pm, concert, lecture, etc. Sun, 7:30-9 pm, church service, concert. Eastern.

WJT, Erie, Penna. 1,000 mi. Elec. Equipment Co. Daily ex Sun, 7:30 pm, baseball, markets, weather, police reports. Mon, Wed, Fri, 8, bedtime stories; 8:15, concert, lecture. Sun, 7:45 pm, church service. Eastern, daylight saving.

WJZ, Newark, N. J. 1,500 mi. Westinghouse Elec. & Mfg. Co. Daily ex Sun, 15 minutes hourly from 9 am to 6 pm; 12-12:30 pm; 7-10:15 pm. Miscellaneous program of highly varied nature. Sun, 3-10:15 pm, misc. Eastern, daylight saving.

WKC, Baltimore, Md. 500 mi. Jos. M. Zamoiski Co. Tues, Thurs, Sat, 7:30-9:30 pm. Eastern, daylight saving.

WKY, Oklahoma City, Okla. 485 also. 500 mi. Oklahoma Radio Shop. (Daily Oklahoman.) Daily, 12 m, weather; 7-7:30 pm, baseball, specials; 8:30-9:30, concert; 9, weather, news. Sun, 3:30-4:30 pm, concert. Central.

WLK, Indianapolis, Ind. 300 mi. F. F. Hamilton. (Indianapolis News.) Daily ex Sun, 11-11:30 am, music, weather; 12-12:30 pm, music; 2-2:30, music; 3-3:30, music; 5, baseball; 10, weather. Tues, Thurs, Sun, 8:30-10 pm, Special, Sun, 2-4 pm, church services; 10, weather. Central.

WLW, Cincinnati, O. 2,000 mi. Crosby Mfg. Co. Daily ex Sun, 1 pm, market letter; 1:30, weather; 2:30, N. Y. stocks; 2-3, music. Central.

WMA, Anderson, Ind. 25 mi. Arrow Radio Lab. Mon, Wed, Fri, 7:30-8:30 pm, concert, news, etc. Central.

WMC, Youngstown, O. 500 mi. Columbia Radio Co. Mon, Wed, Fri, Sat, 8:30-9:45 pm, concert, address etc. Eastern.

WMH, Cincinnati, O. 485 also. 1,000 mi. Precision Equipment Co. Daily ex Sun, 11 am and 4 pm, weather, markets. Mon, Wed, Sat, 8:15-10, concert, lecture, vaudeville, news. Central.

WMU, Washington, D. C. 100 mi. Doubleday-Hill Elec. Co. Daily, 4:30-5:30 pm, concert, baseball. Thurs, 8-9 pm, concert. Eastern.

WNJ, Albany, N. Y. 60 mi. Shotton Radio Mfg. Co. Mon, Wed, Sat, 8-9:30 pm, music, entertainment. Eastern, daylight saving.

WOC, Davenport, Ia. 485 also. 150 mi. Palmer School of Chiropractic. Daily ex Sun, 12-12:15 pm, markets, weather, concert; 3:30-4, lecture; 5:45-6 and 7-8, concert. Sat., 8-8:15, business review. Sun, 9-10 am and 5:30-6 pm, sacred concert. Central.

WOE, Akron, O. 50 mi. Buckeye Radio Service Co. Mon, Wed, Fri, 7-8:15 pm, concert, news, lecture. Sun, 10-12 am, church service. Eastern.

WOH, Indianaoplis, Ind. 1,000 mi. Hatfield Elec. Co. (Indianapolis Star.) Daily ex Sun, 10-11 am, music;

10:15, financial, markets; 1-2 pm, music; 1:20, markets; 4-5 pm, music; 4:15, police notes; 4:50, baseball. Mon, Wed, Sat, 8:30-10 pm, Concert. Central.

WOI, Ames, Ia. 300 mi. Iowa State College. Daily, 9:30 am, 12:40 pm, weather. Central.

WOK, Pine Bluff, Ark. 1,000 mi. Arkansas Light and Power Co. Daily, 7:30 pm, baseball, markets, weather, news. Tues, Fri, 8-9:30 pm, concert. Sun, 11 am and 7:45 pm, church service. Central.

WOQ, Kansas City, Mo. 485 also. 300 mi. Western Radio Co. Daily ex Sun, every half hour 9:30-1:15 pm, markets; 11:30 am, 2 pm, 7:30, markets, weather, road conditions; 7:45-9, concert, vaudeville. Sun, 7 pm, church service. Central.

WOR, Newark, N. J. 150 mi. L. Bamberger & Co. Daily ex Sun, 20 minutes on half hour from 10:30 am to 6:30 pm, miscellaneous. Eastern, daylight saving.

WOZ, Richmond, Ind. 485 only. 300 mi. Richmond Palladium. Daily ex Sun, 12-12:15 pm, markets; 4-5, concert, news, markets; 6:30 pm, concert, news, weather, lecture. Central.

WPA, Fort Worth, Tex. 485 also. 500 mi. Fort Worth Record. Daily ex Sun, 11:30 am, 2:30-3 pm, 6-6:15, 7:15-7:30; 9-9:30, Sun, 3-3:30 pm, 6:30. Central.

WPE, Kansas City, Mo. 300 mi. Central Radio Co. Mon, Fri, Sun, 7:45 pm, concert. Sun, 8:15 pm, sermonette. Daily, afternoon, baseball scores. Central.

WPJ, Philadelphia, Pa. 30 mi. St. Joseph's College. Daily ex Sun, 2:30 pm, 8:30, sports, news. Sun, 10:45-12 noon, 7:45-8:30 pm, church service. Eastern.

WPM, Washington, D. C. 200 mi. Thos. J. Williams, Inc. (Washington Daily News.) Daily ex Sun, 12:30 pm, news. Mon, 8 pm, concert. Eastern.

WPO, Memphis, Tenn. 200 mi. United Equipment Co. (News-Scimitar.) Daily, 7-9 pm, concert, news. Central.

WRK, Hamilton, O. 1,000 mi. Doron Bros. Elec. Co. Mon, Wed, Sat, 8:30-10:30 pm, concert, news. Fri, 7:30-9:30, concert. Sun, 10:45 am and 7:30 pm, church service. Central.

WRL, Schenectady, N. Y. 800 mi. Union College. Sun, 7:30 pm, sacred concert, speeches, etc. Irregular miscellaneous weekday program. Eastern.

WRM, Urbana, Ill. 410 also. 200 mi. Univ. of Ill. Thurs, 8:30-8:55 pm, 9:05 on, news, concert, lecture. Special concerts irregular. Central.

WRP, Camden, N. J. 200 mi. Federal Inst. of Radio Teleg. Daily ex Sat. and Sun, 10-10:45 pm, instruction. Eastern, daylight saving.

WRR, Dallas, Tex. 485 also. 200 mi. City of Dallas. Daily ex Sun, 12-12:30 pm, weather; 3-3:30, baseball, markets, news; 7-7:15, police news; 8:30-9, music. Sun, 11 am, church service; 7-8 pm, police news, church service. Central.

WRW, Tarrytown, N. Y. 1,500 mi. Tarrytown Radio Research Lab. Tues, Thurs, Sat, 10:05 pm. Sun, 10:30 am, 2 pm, 10:05, Eastern, daylight saving.

WSB, Atlanta, Ga. 485 also. 1,000 mi. Atlanta Journal. Daily ex Sun, 12 m, markets; 2:30 pm, markets; 4, music; 5-6, baseball, markets, music, bedtime stories; 7-8, concert, etc. Sun, 11 am, 5 pm, church service. Central.

WSN, Norfolk, Va. 100 mi. Shipowners Radio Service Inc. Mon, Wed, Sat, 8:15-9:30 pm, concert. Eastern.

WSX, Erie, Pa. 75 mi. Erie Radio Co. Tues, Thurs, Sat, 10-10:55 pm, news, concert, lecture. Sun, 12:15-1:30 pm, sermon, Eastern, daylight saving.

WSY, Birmingham, Ala. 150 mi. Alabama Power Co. Daily ex Sun, 2:30 pm, markets, stocks; 8, concert. Sun, 8 pm, chapel. Central.

WTG, Manhattan, Kan. 485 only. 75 mi. Kan. State Agri. College. Daily ex Sun, 9:55 am, weather (code). Central.

WTK, Paris, Tex. 300 mi. Paris Radio Elec. Co. Daily ex Sun, 10 am to 5 pm, 7-11 pm, miscellaneous. Sun, 11 am to 8 pm. Central.

WTP, Bay City, Mich. 75 mi. Ra-Do Corp. Daily ex Sun, 1-2 pm, 6:30-7:30, 10-11, concert, baseball, markets. Sun, 1-2 pm, 6:30-7:30, 9-10. Eastern.

WWI, Dearborn, Mich. 300 mi. Ford Motor Co. Wed, 10-11 pm. Eastern.

WWJ, Detroit, Mich. 485 also. 1,000 mi. Detroit News. Daily ex Sun, 9:30-10:30 am, hints to housewives, concert, weather; 10:55, time signals; 12:05-12:45 pm, concert; 3:30-4:15, markets, weather; 5-6, news, baseball. Week of July 10 and every other week, 7-8:30 pm, concert, lecture. Fill in weeks, 8:30-10 pm, concert, lecture. Sun, July 9, wk etc., 9:30 am-2:30 pm, church services and special; 4-6 pm, special. Sun, fill in wk, 2-4 pm, special; 6-10, church services and special. Eastern.

WWX, Washington, D. C. 1,160 only. 600 mi. Post Office Dept. Daily ex Sun, 10 am, weather; 10:30, markets; 5 pm, 7:30, 8, markets; 9:50, weather. Eastern.

WWZ, New York, N. Y. 200 mi. John Wanamaker. Daily ex Sun, 1:40-2 pm, 2:40-3, 3:40-4, 4:40-5, 10:30-12 midnight, concert. Eastern.

3YN, Washington, D. C. 100 mi. Nat'l Radio Inst. Daily, 6:30-7:30 pm, instruction. Eastern.

9ARU, Louisville, Ky. 200 only. 200 mi. Darrell A. Downard. Mon, Wed, 8 pm, police news, concert. Central.

WEY—925—W. G. Mann, London, Ont., Canada.
WDAE—400—M. Owen, Starrsville, Ga.
WDAF—1,040—C. A. Winchell, Cortland, N. Y.
WDAJ—780—T. R. Gentry, Dallas, Tex.
WDY—1,250—H. L. Peterson, Charles City, Ia.
WFI—300—L. Fletcher, Baldwinsville, Mass.
WGF—1,000—E. K. Kitts, Bluefield, W. Va.
WGM—675—W. G. Mann, London, Ont., Canada.
WHAS—350—H. S. Rahiser, Pittsburgh, Pa.
WHB—900—E. K. Kitts, Bluefield, W. Va.
WHK—465—D. R. Bartsch, Galena, Ill.
WIK—260—F. F. Sims, Petersburg, Va.
WJX—1,000—H. L. Peterson, Charles City, Ia.
WOC—475—D. Ploesser, Canton, O.
WOH—1,050—F. S. Cates, Jacksonville, Fla.
WOO—285—D. Ploesser, Canton, O.
WOZ—340—D. R. Bartsch, Galena, Ill.
WPA—465—R. P. Shelton, Memphis, Tenn.
WPO—750—Wm. J. Lee, Jacksonville, Fla.
WRL—310—W. E. Thomas, Altoona, Pa.
WWI—1,200—F. S. Cates, Jacksonville, Fla.
2XJ—300—F. F. Sims, Petersburg, Va.

State, City, Call

Alabama:
Birmingham, WSY
Mobile, WEAP
Montgomery, WGH

Arizona:
Phoenix, KDYW, KFAD
Tucson, KDZA

Arkansas:
Fort Smith, WCAC
Little Rock, WCAV, WEAX, WSV
Pine Bluff, WOK

California:
Altadena, KGO
Bakersfield, KDZB, KYI
Berkeley, KQI, KRE
El Monte, KUY
Eureka, KNI
Fresno, KDZH, KMJ
Glendale, KFAC
Gridley, KFU
Hanford, KFBD
Hollywood, KFAR, KGC
Long Beach, KSS
Los Altos, KLP
Los Angeles, KDZD, KDZF, KDZP, KFI, KHJ, KJC, KJS, KNN, KNR, KNV, KNX, KOG, KON, KQL, KUS, KWH, KXS, KYJ, KZI
Modesto, KOQ, KXD
Monterey, KLN
Oakland, KLS, KLX, KZM, KZY
Pasadena, KDYR, KLB
Pomona, KGF
Reedley, KMC
Redwood City, KDYN
Sacramento, KVQ
San Diego, KDPT, KDYM, KDYO, KFBC, KYF
San Francisco, AG1, KDN, KDZG, KDZW, KDZX, KPO, KSL, KUO
San Jose, KFAQ, KQW, KSC
Stockton, KJQ, KWG
Sunnyvale, KJJ

Colorado:
Boulder, KFAJ
Colorado Springs, KHD
Denver, DD5, KDYY, KDZU, KLZ, KOA

Connecticut:
Greenwich, WAAQ
Hartford, WDAK
New Haven, WCJ, WGAH

District of Columbia:
Washington, WDM, WEAS, WHAQ, WIL, WJH, WMU, WPN, WWX, 3YN

Florida:
Jacksonville, WCAN, WDAL
Miami, WFAW
Pensacola, WGAN
Tampa, WDAE, WEAT

Georgia:
Atlanta, WAAS, WDAW, WSB, 4CD
College Park, WDAJ
Fort Smith, WGAR
Savannah, WGAV, WHAO

Idaho:
Boise City, KFAU
Lewiston, KFBA
Moscow, KFAN

Illinois:
Chicago, KYW, WAAF, WBU, WDAP, WGAS, WGU
Decatur, WBAO, WCAP, WHAP
Peoria, WBAE, WFAP
Quincy, WCAW, WCAZ
Rockford, WIAB
Springfield, WDAC
Tuscola, WDZ
Urbana, WRM

Indiana:
Anderson, WMA
Fort Wayne, WFAS
Huntington, WHAY
Indianapolis, WLK, WOH
Richmond, WOZ
South Bend, WBAQ, WGAZ
Terre Haute, WEAC
West Lafayette, WBAA

Iowa:
Ames, WOI
Centerville, WDAX
Davenport, WHAI, WOC
Des Moines, WGF
Fort Dodge, WEAB
Iowa City, WHAA
Newton, WIAH
Shenandoah, WGAJ
Sioux City, WEAU, WHAE
Waterloo, WEAZ, WHAC

Kansas:
Anthony, WBL
Atwood, WEAD
Eldorado, WAH
Emporia, WAAZ
Independence, WFAY
Lindsborg, WDAD
Manhattan, WTG
Salina, WFAD
Wichita, WAAP, WEAH, WEY, WHAN

Kentucky:
Louisville, WHAS, 9ARU

Louisiana:
New Orleans, WAAB, WAAC, WBAM, WCAG, WGV, WWL
Shreveport, WAAG, WDAN, WGAQ

Maine:
Auburn, WMB
Sanford, WFAR

Maryland:
Baltimore, WCAO, WEAR, WKC

Massachusetts:
Boston, WAAJ, WFAU
Holyoke, WHAX
Medford Hillside, WGI
New Bedford, WDAU
Springfield, WBZ
Worcester, WCN, WDAS, WDAT

Michigan:
Bay City, WTP
Dearborn, WWI
Detroit, KOP, WCX, WWJ
East Lansing, WHW
Flint, WEAA
Lansing, WHAL

Minnesota:
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Minneapolis, WAAL, WBAD, WBAH, WCAS, WCE, WLB
Redfield, WCAL
St. Cloud, WFAM
St. Paul, WAAH

Mississippi:
Corinth, WHAU

Missouri:
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Cameron, WFAQ
Columbia, WAAN
Jefferson City, WOS
Joplin, WHAH
Kansas City, WDAF, WHB, WOQ, WPE
St. Joseph, WEAK
St. Louis, KSD, WAAE, WCK, WEB, WEW
Springfield, WIAI

Montana:
Butte, KFAP
Great Falls, KDYS
Havre, KFBB

Nebraska:
Lincoln, WCAJ, WFAV, WGAT
Omaha, WAAW, WIAK, WOU, WOV
Rushville, WEAV

Nevada:
Reno, KDZK, KFAS, KOJ

New Hampshire:
Berlin, WEAQ

New Jersey:
Atlantic City, WHAR
Camden, WRP
Deal Beach, 2XJ
Jersey City, WAAT
Moorestown, WBAF
Newark, WAAM, WBS, WJX, WJZ, WOR, 2XAI
N. Plainfield, WEAM
Paterson, WBAN

New Mexico:
Roswell, KNJ
State College, KOB

New York:
Albany, WNJ
Binghamton, WFAX
Brooklyn, WGAC
Buffalo, WGR, WWT
Canton, WCAD
Ithaca, WEAI
Newburgh, WCAB
New York, KDOW, WBAY, WDAM, WDT, WVP, WWZ
Poughkeepsie, WFAF
Rochester, WHAM, WHQ
Ridgewood, WHN
Schenectady, WGY, WRL
Syracuse, WBAB, WDAI, WFAB
Tarrytown, WRW
Troy, WHAZ
Utica, WSL
Waterford, WFAG

North Carolina:
Asheville, WFAJ
Charlotte, WBT

North Dakota:
Fargo, WDAY

Ohio:
Akron, WOE
Athens, WAAV
Canton, WWB
Cincinnati, WAAD, WHAG, WIZ, WLW, WMH
Cleveland, KDPM, WHK
Columbus, WBAV, WEAO
Dayton, WA1, WFO
Defiance, WCAQ
Fairfield, WL-2
Granville, WJD
Hamilton, WBAU, WRK
Lebanon, WPG
Marietta, WBAW
Portsmouth, WDAB
Toledo, WBAJ, WHU, WJK
Wooster, WGAU
Youngstown, WAAY, WMC
Zanesville, WPL

Oklahoma:
Muskogee, WDAV
Oklahoma City, WKY, 5XT
Tulsa, WGAF
Yale, WHAT

Oregon:
Eugene, KDZJ, KFAT
Hood River, KQP
Klamath Falls, KDYU
Portland, KDYQ, KFAB, KGG, KGN, KGW, KQY, KYG

Pennsylvania:
Bridgeport, WBAG
Brownsville, WDAQ
Clearfield, WPI
Erie, WJT, WSX
Harrisburg, WBAK
Lancaster, WGAL
McKeesport, WIK
Philadelphia, WCAU, WDAR, WFI, WGAW, WGL, WIP, WOO
Pittsburgh, KDKA, KQV, WAAX, WCAE, WHAF
Villanova, WCAM
Wilkes-Barre, WBAX

Rhode Island:
Edgewood, WEAG
Pawtucket, 1OJ, 1XAD
Providence, WEAN

South Carolina:
Charleston, WFAZ
Orangeburg, WGAM

South Dakota:
Rapid City, WCAT
Sioux Falls, WFAT

Tennessee:
Memphis, WKN, WPO
Nashville, WDAA

Texas:
Amarillo, WDAG
Austin, WCM
Dallas, WDAO, WFAA, WRR
El Paso, WDAH
Fort Worth, WBAP, WPA
Galveston, WHAB, WIAC
Houston, WCAK, WEAV, WEV, WFAL, WGAB
Paris, WTK
Port Arthur, WCAH
San Antonio, WCAR

Utah:
Ogden, KDZL
Salt Lake City, KDYL, KDZV, KZN

Vermont:
Burlington, WCAX

Virginia:
Norfolk, WSN
Richmond, WBAZ

Washington:
Aberdeen, KNT
Bellingham, KDZR
Centralia, KDZM
Everett, KDZZ
Lacey, KGY
Pullman, KFAE
Seattle, KDZE, KFC, KHQ, KJR, KTW, KZC
Spokane, KFZ, KOE
Tacoma, KGB, KMO
Wenatchee, KDZI, KZV
Yakima, KFV, KQT

West Virginia:
Bluefield, WHAJ
Charleston, WAAO
Clarksburg, WHAK
Huntington, WAAR
Morgantown, WHD

Wisconsin:
Madison, WGAY, WHA
Milwaukee, WAAK, WCAY, WHAD
Neenah, WIAJ
Superior, WFAC
Waupaca, WIAA

Hawaii:
Honolulu, KDYX, KGU

Porto Rico:
Ensenada, WGAD

Canada:
Calgary, CHBC, CHCQ, CFAC
Edmonton, CJCA
Fort Frances, CFPC
Halifax, CFCE
Hamilton, CKOC
London, CJGC
Montreal, CFCF, CHYC, CJBC, CKAC
Ottawa, CHXC
Regina, CKCK
St. John, CJCI
Toronto, CFCA, CHCB, CHCZ, CHVC, CJCD, CJCN, CJSC, CKCE
Vancouver, CFCB, CFYC, CHCA, CJCE, CKCD
Winnipeg, CHCF, CJCG, CJNC, CKZC

RECEIVING RECORDS? SEND THEM IN—

The next complete list of receiving records will appear in the August 19 number of RADIO DIGEST. Amateurs who have beaten old records or made new ones will have their names listed each week. To be considered, the records sent in must have the number of miles given.—Broadcast Editor.

Station, Miles Record, and By Whom Heard.

KDKA—1,175—Wm. J. Lee, Jacksonville, Fla.
KFAC—450—J. L. Davis, Oakland, Cal.
KFC—1,660—C. R. Williams, Janesville, Wis.
KLP—2,125—W. G. Mann, London, Ont., Canada.
KLZ—1,600—E. K. Kitts, Bluefield, W. Va.
KMC—190—D. Wolfe, San Jose, Cal.
KQV—100—D. Ploesser, Canton, O.
KSD—1,000—F. S. Cates, Jacksonville, Fla.
NOF—745—D. R. Bartsch, Galena, Ill.
WAAL—600—E. Amos, Chetopa, Kan.
WAAQ—400—H. S. Rahiser, Pittsburgh, Pa.
WBAO—580—E. S. Bee, Brookhaven, Miss.
WBAY—715—H. E. Jameson, Milwaukee, Wis.
WCAU—285—D. Ploesser, Canton, O.
WEAH—300—T. R. Gentry, Dallas, Tex.

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Who Are Interested in Radio?

Broadcasting Stations Receiving Letters of Cheer

BROADCASTING stations throughout the land receive thousands of letters each week. You may ask the questions, "Who are writing these letters? Are they adults, children, 'amateurs' or just folks generally, and what is the subject of their letters?" The operators of these stations say that the letters come from persons in all walks of life—bankers, farmers, brick masons, druggists, teachers, machinists. The letters received from children are relatively few.

The general trend of these letters is for information about musicians, titles of songs, data on the construction of antennae, and advice on results to be expected from certain sets, but most of them are written to tell how well they like the Radio service.

Improve Quality of Entertainment

"Canned Music" Will Not Be Tolerated

ALMOST every householder has a phonograph and a number of favorite records. However, if there is no talking machine in the home, he can hear "jazz" at any shoe shining parlor or cheap music store. It is not the desire of any person to listen to inferior records. Some broadcasting stations persist in sending out "canned music" in place of procuring the services of skilled artists. If they intend to cheapen the services, they may better shut down their stations. If broadcasting is to continue in its present state of popularity, the entertainment sent out must improve. There is no excuse for putting on phonograph records and cluttering up the ether with poor reproductions of something already in the home.

Distinctness of Entertainment

An Evening with Radio Has Wide Variety of Features

THE RADIO industry is now a permanent form of entertainment in the American home. Radio concert receiving has a fascination of its own. Listening to the unknown voices in the air is making hundreds of new fans every day. While Radio at first thought appears to be a competitor of the phonograph and the theater, it is, by careful analysis, found to be a competitor only in the same way that the moving picture competes with the speaking stage, or the player piano competes with the phonograph. Radio is a distinct form of entertainment within itself.

New Course of Manual Training

Schools Find an Interesting Subject

IT IS NOT difficult to lure the boys into manual training schools, for there is usually some course which is most interesting to each individual. There is no scientific development, however, which has taken such a hold on boys as the making and installing of Radio sets. The demand for instruction in this science has grown so large that many schools are making extensive preparations for public instruction as a part of the curriculum.

When a boy begins to work on a Radio set he does not limit his time within school hours. Instructors are kept long after hours to be with the boys in their work, and many of them continue on at home, preferring this mode of play rather than fishing or attending a ball game.

Public Clamors for Knowledge

Books on Radio Eagerly Sought

THOSE CHIEF croakers who have been shouting, "I told you so," "It's going already," "It won't last," are sadly waiting for a boom to shake them down. The prime difficulty for a slight depression came from inexperienced dealers who overstocked on Radio goods, not knowing that there would be a slump during the summer. Naturally the wholesalers and manufacturers were hit with temporary cancellations. Few of them, it is apparent, have made any real inquiry into the situation as to whether there is any serious slackening in the basic interest in Radio.

One of the most convincing indications of the underlying public interest is that the Bureau of Standards at Washington has an average number of two hundred requests daily for the new special book on Radio and has not yet been able to catch up with the orders. The public is not only interested but it is gaining in knowledge and in conviction that Radio is practical and immensely desirable.

Ye Ed Asks 'imself

Question.—In a wired Radio system will it be possible to use sets which are more simple in design and construction than those which are employed in receiving so-called aerial signals?

Answer.—The sending instruments as well as the receiving instruments which are used in a wired Radio system can be of very simple design and construction. In order, however, that a proposed subscriber may desire to receive aerial service as well as wired Radio service it may be desirable not to recommend the use of a special set for wired Radio systems. In other words, if a set can be used for more than one purpose, it will naturally add to the sale of such material and equipment.

Question.—Who was the original inventor of the oscillation generator system for transmitting stations?

Answer.—A patent number 1201270 was issued to Dr. DeForest on October 17, 1916, and was applied for on September 14, 1914. This patent was, however, contested by Mr. Armstrong, who claimed prior invention in the year 1912. Mr. Armstrong won this suit last spring.

One of the principal features involved in Dr. DeForest's patent is in the use of a fixed condenser in the grid circuit and also the use of a variable condenser and a non-inductive resistance in parallel. The use of this generator system increases the energy from a microwatt to .10 watts.

Question.—Has a patent been issued covering the use of alternating current as a source of power in Radio transmitting stations?

Answer.—Patent has been awarded to Mr. W. C. White, number 1195632, issued August 22, 1916.

This invention provides the use of alternating current as a source of power in the form of an alternating current generator in the antenna circuit, and also provides the use of alternating current through a transformer for heating the filament. The principal feature of this invention consists in the use of a tap wire from the center of the transformer secondary to the grid of the tube, thus neutralizing the effect of the differences of potential between the grid and the filament due to potential alterations of the source of A. C. current for heating the filament.

Question.—Explain the capacity effect of the antenna circuit.

Answer.—In general the receiving instrument is connected to a number of wires in the form of an aerial which is grounded. This is called a capacity condenser because the wires in the air and the earth's surface form the two plates of a condenser; the space between being occupied by air is subject to stress as currents rise and fall in the antenna. In such a circuit a complete alternation may occur and the current will flow in such a source when voltage of an alternating type is impressed upon it. This may be proven by the fact that when the ground connection is not properly made the capacity of the antenna circuit will be smaller and very little current will be absorbed. This is further proven by a good ground connection located in poor soil, and the capacity effect of the antenna circuit primarily is brought out by the use of a counterpoise, which is insulated from the ground.

Question.—Furnish a brief analysis of resistance and inductance of an antenna circuit.

Answer.—An antenna circuit absorbs energy by induction and resistance in the same way that energy is induced into wires of a magneto or generator as they pass through the fields of a magnet. Since the current in such a circuit is alternating and very small, the antenna circuit must be developed to the highest efficiency. Such a circuit, therefore, should be composed of the best kind of material. The size and length of the wires used should be satisfactory for the purpose for which the antenna is to be used. It is, of course, essential that its resistance shall be as low as possible. While low resistance is essential, the sacrifice must be made for inductance because the proper amount of inductance used will more than offset the loss of a comparatively higher resistance, inasmuch as the greater the magnetic field, the greater the amount of current which may be stored in such a field. This is, of course, the proper definition of the term inductance.

Question.—What is the principal upon which the tuning of a receiver circuit is based?

Answer.—In an electrical circuit vibrating bodies of energy are transferred in different forms. In such a circuit inductance and capacity are the principal elements, and a circuit containing these two elements has a natural period or pitch. In this way also an antenna has a particular frequency of oscillation. Therefore, when such a frequency of oscillation is adjusted to the frequency of oscillations sent out, electrical resonance will occur.

Because of its capacity and inductance elements it will be clear that such a circuit may be loaded by means of inductance and capacity. By means of loading the wave length range of the system may be increased. In an opposite method the wave length of an antenna may be decreased by inserting a condenser in the antenna circuit. The smaller the capacity of this condenser, the lower the wave length may be decreased.

Question.—Are local battery sets required in a wired Radio system?

Answer.—Local battery sets can be used in a wired Radio. The total capacity of these batteries will be determined by the amount of application required for loud speaking service, and the extent of such service.

W. N. Furthman.

RADIO INDI-GEST

Felinically Broadcasting

The static purred playfully in my receivers. I adjusted my cat whisker. Oh, those signals! They came in like the cat's meow.—Elem Eno.

Try a Hudson Tube Amplifier, Honey

Dear Indi:

I see that that D. A. Bartsch of Galena, Illinois, holds two receiving records for distance. Is it a fact that his town favors long distance receptions?—Honey Comb.

Yes, Honey, Bartsch has his ground buried in Galena. —Indi.

Strong Signals, We'll Say

An exchange says: "The Radio set is more considered than the social set, but the onion set is claiming attention just now." The latter has great potentialities but comparatively short waves.

The Complete Radio Lover

(*Not by Isaac Newton*)

Dear, are you sure your rheostat
And amplifiers are just right?
Your variometer—how's that,
And are your variocouplers tight?
I'm doing all I can, my sweet,
To make myself distinct and clear;
I love you only, I repeat—
Don't mind that; it was static, dear.

I'm glad you get me better now;
Your lattice was at fault, no doubt;
I wish I dared to tell you how
You've caused my fears to flicker out.
Your amperage is mighty high,
At least to me it seems to be;
Please, dearest, won't you tell me why
You broadcast so reluctantly?

I'll tell the world, and gladly, too,
That you're my precious binding-post;
Of all the tuning signals, you
Affect my filament the most!
You have me coiled; my batteries
Are at your service for all time;
Restrict my wave lengths as you please,
I'll still consider you sublime.

If as your grid condenser I
May serve I'll gladly do my part,
And if your honeycomb tunes high,
I'll get you, anyhow, sweetheart.
Please let our hook-up follow soon,
Our dials set for ecstasy,
And we will gladly keep in tune,
From atmospheric troubles free.

A Current Happening

A. Fan—I just purchased this battery and I can't get any current out of it.

Salesman—Was it charged?

A. Fan—No! I paid cash for it.

Get Dr. Plank's Radio Scalpel

The story is going the rounds again about the ship's cook who cut off a passenger's leg 800 miles at sea, upon specifications furnished by Radio, and using a butcher knife and a meat saw. It suggests great possibilities. The first thing we know we will hear of how the stewardess removed the appendix of the skipper's wife with a pair of dressmaker's shears and a button hook.

Politics Am Not Music

Eastern Radio clubs protest against a government ruling which prohibits their broadcasting music, etc. Some of the amateurs say this is the first step by corporate interests to obtain a monopoly of the air. Million-airs probably.—Daily News.

Radio Telephony for Amateurs and Beginners

Part X—Vacuum Tube Receiving Sets, Section I

By Peter J. M. Clute

To Explain—

The following article by Peter J. M. Clute is a continuation of his series. Articles to come are:

X. Vacuum Tube Receiving Sets, Section II.
XI. Amplifiers.
XII. Useful Information.

THERE ARE two distinct types of Radio receiving apparatus: the set using the crystal detector and the set employing the vacuum tube as a detector. In our previous discussion, we have considered in more or less detail, the construction and operation of representative types of crystal detector receivers. The crystal detector set is suitable for reception over extremely short distances and will not bring in signals as strong as

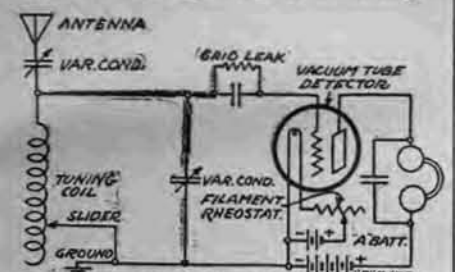


FIG. 1 SIMPLE VACUUM TUBE RECEIVER WITH SINGLE-SLIDE TUNER.

the tube type. Hence, when using the mineral detector set, it is necessary for the operator to wear a head set. Broadness of tuning is an inherent characteristic of all such sets; tuning to the incoming wave length cannot be done sharply nor can all of the interference from the powerful commercial and naval stations along the coast be cut out.

With sets of this sort, Radiophone signals are received not over thirty or forty miles, and under favorable conditions this range may be increased to fifty miles. It has been reported that some crystal detector sets have been able to detect Radiophone signals one hundred miles or more. However, such freak conditions are not to be depended upon and the receiving range of the set should be considered solely on the basis of minimum perfor-

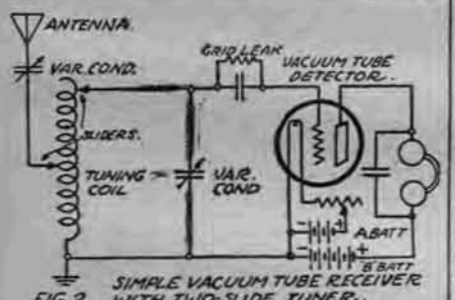


FIG. 2 SIMPLE VACUUM TUBE RECEIVER WITH TWO-SLIDE TUNER.

mance. Radio telegraph signals reach much farther than Radiophone, so that crystal detector sets might easily receive such signals one hundred miles or more distant.

The Vacuum Tube Receiver

With the vacuum tube type of receiver, signals may be received up to ninety miles, depending upon atmospheric conditions, the contour of the intervening territory and the power of the transmitting station. The vacuum tube detector has more stable and more sensitive characteristics than the crystal detector and has the advantage in the matter of increased range, louder signals and better adjustment. The vacuum tube can be used in place of a crystal detector in almost any circuit and as such will prove quite a considerable improvement over the latter. By using special vacuum tube hook-ups, especially

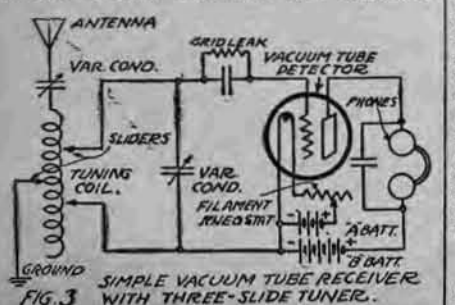


FIG. 3 SIMPLE VACUUM TUBE RECEIVER WITH THREE-SLIDE TUNER.

of the so-called "regenerative" variety, the sensitiveness of the vacuum tube is so far superior as to render a comparison useless.

Various Circuit Arrangements

The number of different arrangements and connections that may be followed in making up a Radio receiving set is difficult to even estimate. The diagrams given are merely intended as a preliminary guide for beginners. As the operator

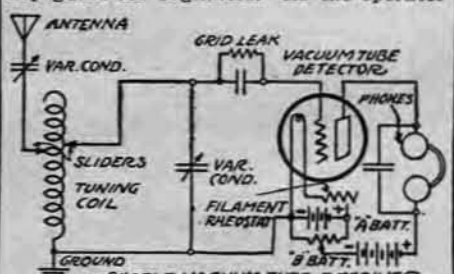


FIG. 4 SIMPLE VACUUM TUBE RECEIVER WITH POTENTIOMETER IN PLATE BATTERY CIRCUIT

gradually becomes more proficient, he soon learns or discovers new arrangements and hook-ups that may give him more efficient signal reception.

It would be quite a strenuous, and next to impossible task to give definite operating instructions for the numerous varieties of commercial receiving sets. Vacuum tube receiving sets may be roughly classified into three sections, namely: simple single circuit receivers; simple two-circuit receivers; and "regenerative" receiving sets. The present discussion will consider the first two of these classes and the representative hook-ups. Broad, comprehensive operating instructions for each class will undoubtedly cover every case, due allowance being made for the characteristics and peculiarities of each particular set.

Simple Vacuum Tube Circuit

The simplest vacuum tube receiving set is of the single-circuit variety, no coupler being employed. In addition, no regenera-

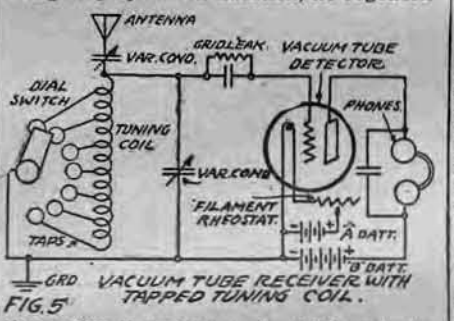


FIG. 5 VACUUM TUBE RECEIVER WITH TAPPED TUNING COIL.

tive action is made use of, which omission although making the set less sensitive than it might be, greatly simplifies the operation of tuning. Figures 1, 2 and 3 illustrate the connections of vacuum tube receivers with single-slide, double-slide, and three-slide tuning coils, respectively. The slider moving over the bared section of wire on the tuner, varies the number of turns of the tuning coil included in the circuit. Adding effective turns on the coil, by means of the sliding contact, permits reception of incoming signals of longer wave length than the fundamental wave length of the antenna system. Tuning is accomplished by using a condenser and a tuning coil to obtain capacity and inductance in conveniently adjustable form. One, or the other or both of these tuning devices must be adjustable. A short wave

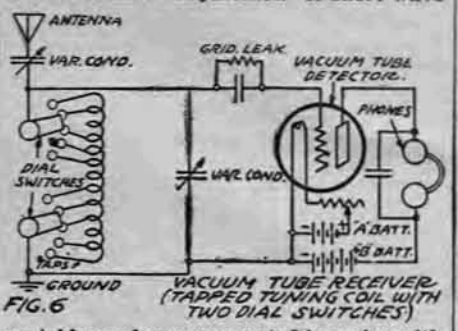


FIG. 6 VACUUM TUBE RECEIVER (TAPPED TUNING COIL WITH TWO DIAL SWITCHES)

variable condenser connected in series with the antenna to include additional capacity, enables the open circuit to be tuned in to waves of short wave length. Additional antenna series loading inductance may be inserted when it is desired to receive waves greater than the natural wave length of the receiving aerial, and fine adjustments may be obtained by varying the condenser settings. If the variable condenser is connected in multiple with the series loading inductance, it increases the wave length in proportion to the amount of capacity used.

Connections With Tuner

Referring to Figures 1 to 3, the vacuum tube detector is shown connected to the tuner with the standard hook-up and apparatus, grid leak unit, "A" and "B" batteries and filament rheostat. A small fixed condenser shunted across the telephone receivers, offers a path of low impedance to the high frequency current to be detected, and thus, it is found to increase the strength of the incoming signals. The function of the variable condensers, shown in diagrams, is to give the necessary fine adjustment for tuning.

For detailed information on the functioning of the vacuum tube detector, the reader is referred to the second installment of Part VI of this series. A discussion on the "A" and "B" batteries, used for the proper functioning of the vacuum tube, has been given in Part VII of the series.

Function of Filament Rheostat

In operating the vacuum tube, the filament rheostat should be adjusted until the clearest signals are obtained after tuning them in to the greatest strength. If the filament rheostat is adjusted to the point before the hissing is audible in the 'phones, the signals will usually be loudest and clearest. The plate voltage is critical for the best operation of most tubes, hence the "B" battery should be of the variable voltage type or a rheostat or potentiometer should be placed in series with the battery in the plate circuit.

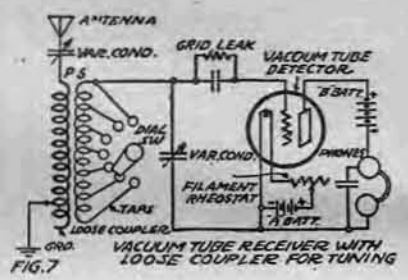


FIG. 7 VACUUM TUBE RECEIVER WITH LOOSE COUPLER FOR TUNING

Figure 4 shows a potentiometer connected in the "B" battery circuit for fine adjustments.

Multi-point Switch

A modification of the slider arrangement for the tuning coil is found in the multi-point switch, having contact points connected to include fixed steps on the tuning coil, as shown in Figure 5. Rough tuning is accomplished on the tuning coil and the fine variations are obtained by adjusting the condenser in the antenna circuit.

Relatively fine adjustment is possible by the use of two multi-point switches instead of one. Figure 6 gives a hook-up using this type of tuner. One switch takes in groups of five to ten turns, while the other cuts in one turn at a time. A vari-

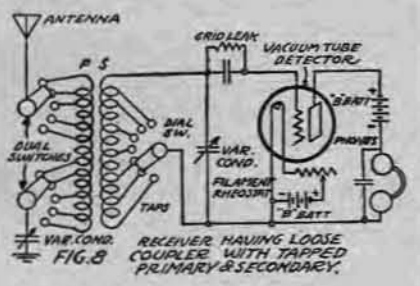


FIG. 8 RECEIVER HAVING LOOSE COUPLER WITH TAPPED PRIMARY & SECONDARY.

able condenser in the antenna circuit permits closer tuning on short wave lengths.

Loose Coupler and Vario-coupler

Thus far, there have been considered only the simplest types of receivers, with fixed step tuning. If loud and clear signals are desired, closer and sharper tuning is essential. Continuous variation of tuning inductance is generally accomplished by using contrivances in which the relative motion of two windings changes the mutual inductance. In one form these windings form a loose coupler. In another they are known as a variocoupler. Still another arrangement employs compact coils so mounted that their positions may be adjusted. Receiving circuits containing such tuning devices are known as two-circuit receivers.

In the hook-ups following, with the ex-

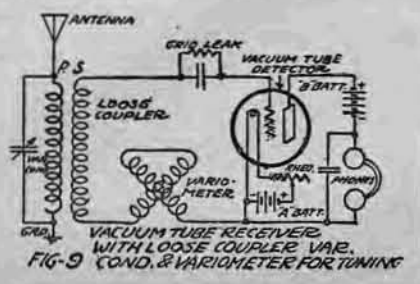


FIG. 9 VACUUM TUBE RECEIVER WITH LOOSE COUPLER VAR. COND. & VARIOMETER FOR TUNING

ception of those employing variometers for tuning, the aerial and the oscillating circuits are entirely separate; no physical connection exists between them. Transference of energy is effected by the variable inductive relation between the windings. The inductance of the combination may be varied from a minimum when the fields are "bucking," to a maximum when the coils are aiding.

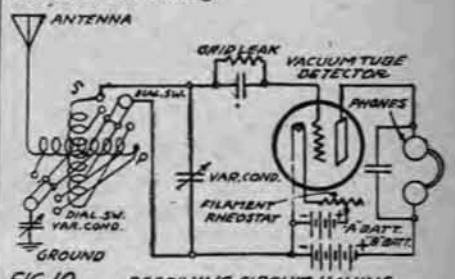


FIG. 10 RECEIVING CIRCUIT HAVING VARIOMETER (TAPPED PRIMARY & SECONDARY) FOR TUNING

Loose Coupler—Tube Hook-Up

Figure 7 gives a typical vacuum tube receiver, with a loose coupler, or receiving transformer, for tuning. Inasmuch as the coupler can be set for a definite wave length, interference from other stations will be less than with a tuning coil. It is very essential that the two windings be wound in the same direction, since the effectiveness of coupling is lessened if the fields are opposing. A multi-point switch or a slider is usually provided to vary the number of active turns in both the primary and secondary of the loose coupler.

In Figure 7, slider arrangement is used for primary inductance variation and, in addition, a variable condenser is inserted in the aerial circuit for varying the wave length. Secondary variation is obtained by means of a multi-point switch and the variable condenser connected across the secondary permits sharper tuning.

Loose Coupler With Tapped Primary

The hook-up in Figure 8 employs a

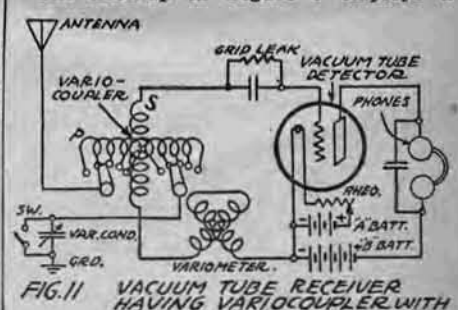


FIG. 11 VACUUM TUBE RECEIVER HAVING VARIOCOUPLER WITH TAPPED PRIMARY.

loose coupler with tapped primary and secondary windings. The use of two switches, connected to primary taps, permits relatively fine adjustment. One multi-point switch cuts in groups of five to ten turns, and the other takes in one turn at a time. A short wave condenser in the antenna circuit provides closer tuning adjustment. A multi-point switch connected to secondary taps and a variable condenser in multiple with the secondary assist in the adjustment of the detector circuit.

A variable condenser in multiple with the primary of a loose coupler is the means of tuning the antenna circuit of the hook-up shown in Figure 9. A variometer in the detector circuit allows continuous in-

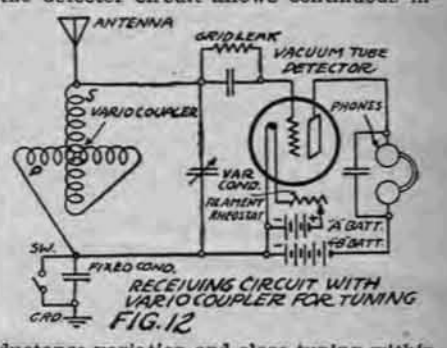


FIG. 12 RECEIVING CIRCUIT WITH VARIO COUPLER FOR TUNING

ductance variation and close tuning within a small range of wave lengths.

Variocoupler as Tuning Device

The use of the variocoupler as a tuning device follows modern practice favoring rotary adjustments instead of sliding arrangements. The secondary winding may be rotated within the field of the primary, thereby varying the degree of coupling between the two. The energy transfer takes place by induction.

Figure 10 illustrates a receiving circuit employing a variocoupler as a tuning device with tapped primary and secondary. This type of coupler is of the highest order of operating convenience, inasmuch as all adjustments are of a rotary nature. The wide range of secondary inductance renders it most efficient for use with a vacuum tube detector. When receiving the primary is tuned to the incoming wave

(Continued on page 12)

Twenty Kilowatts Sent Through Vacuum Tube

A Success Story of Radio Development

By Dr. Irving Langmuir

DR. IRVING LANGMULR, of the General Electric research laboratory, is one of the foremost and greatest physicists. He not only is the originator of the postulates bearing his name and accepted by scientists as explaining atomic structure, but he is master of the most important and fundamental thing in the world, the ELECTRON.

THE THREE-ELECTRODE vacuum tube, which first appeared as the De Forest audion, is now universally used not only for the receiving of Radio messages, but is coming into more widespread use in connection with the transmission of such messages. The original De Forest audion did not have a particularly high vacuum, and, because of the ionization of the residual gas, could not be operated at more than 30 or 40 volts, or at more than a few milliamperes of current.

Several years ago, in connection with a study of the Edison effect in incandescent lamps, I noted that, in lamps with a very good vacuum, the Edison effect was nearly absent. In other words, although there was a difference of 110 volts between the two ends of the filament, very little electron current flowed across the vacuum space between. In the presence of a little gas, however, such big currents were obtained that the currents might lead to the formation of an arc, with resulting destruction of the lamp.

Discover "Space Charge Effect"

At that time it was not at all understood why these currents should become smaller as the vacuum was improved, and a great many scientists believed that if a perfect vacuum could be made, no current at all would flow across it. Although the Edison effect in well made lamps thus caused no difficulty in their manufacture, for it practically did not exist, yet it was a point of very great scientific interest to learn why their currents were so small in a good vacuum.

It was in connection with these studies that we discovered a "space charge effect." We then understood that in a high vacuum the electrons got in each other's way, so that the electrons that had already left the filament repelled, because of their negative charge, the electrons which followed and tended to drive them back into the hot filament which emitted them. In the presence of gas this effect did not exist, because the gas formed both positive and negative ions, and the accumulation of the slowly moving positive ions in the space neutralized the effect of the negative electrons.

Paves Way for High Power Tubes

As a result of these studies it gradually became clear how it would be possible to construct vacuum tubes which would operate at high voltage and at high currents. One of the early applications of this new knowledge was made by Dr. W. D. Coolidge, who utilized this in the development of the Coolidge X-ray tube, an X-ray tube which has gradually displaced practically all of the older so-called gas tubes.

Another application was found in the kenotron and pliotron. The kenotron is a vacuum tube rectifier, having two electrodes like the Fleming valve, but capable of operating up to voltages of several thousand volts, and with currents comparable with an ampere or more. Tubes of this kind have found application for smoke precipitation, for various electrical testing devices, and in connection with the regulation of the electric generators used for the Radio transmitting outfits on aeroplanes during the war. The development of the kenotron into a thoroughly practical device for these purposes is largely the result of the work of Dr. Saul Dushman.

Pliotron Tube Developed

The pliotron bears about the same relation to the De Forest audion that the kenotron does to the Fleming valve. It is a device which contains three electrodes, namely, a filament, grid and plate, like the audion, but it is capable of being operated at high voltages and currents, so that considerable amounts of power may be controlled. Tubes of this sort are now finding widespread application for transmitting Radio messages, particularly for Radio telephony. The ordinary Radio telephone outfit, used for broadcasting, generated from ½ to 5 kilowatts of high frequency power, which is used to feed the antenna.

The design and construction of tubes of this type has been carried out principally by Mr. W. C. White.

Large Tube Finally Succeeds

It has long been realized that, following out the principles made use of in the smaller tubes, it would ultimately be possible to construct tubes of large power. There have been many difficulties to overcome, however. After years of work by Mr. W. C. White and Mr. H. J. Nolte, they have succeeded in designing and perfecting pliotrons which are capable of generating about 20 kilowatts of high frequency current. In principle these tubes resemble the smaller tubes, which are now usually called radiotrons, in that they also have three electrodes. These large tubes are used in circuits much like those used by amateurs when they cause the tube to generate oscillations. In the construction, however, there are many differences.

Dr. Langmuir compares 20 kilowatt and "peanut" tubes. Note end of plate protruding from large tube. This end is water-cooled

External Plate Water Cooled

The 20 kilowatt tube has a very large, rugged filament, many times the diameter and length of the ordinary radiotron. The grid is in cylindrical form and surrounds the filament, and the plate is a metallic cylinder about 1½ inches in diameter and 8 inches long, which is sealed directly to a glass tube through which pass the leads carrying current to the filament and grid.

Thus the plate, instead of being inside of the tube, as in ordinary radiotrons, forms a part of the outside wall of the tube. In order to dissipate the relatively large amount of energy liberated at the plate, the plate is water cooled, which is rendered particularly easy by the fact that part of its surface forms a part of the wall of the tube.

These 20-kilowatt tubes are ordinarily operated with about 20,000 volts direct current, which is obtained from ordinary 60-cycle alternating current by rectification, using two or more kenotrons, together with large condensers for smoothing out the rectified alternating current.

Ten Tubes Replace Big Alternators

A bank of ten tubes of this kind operated in parallel is capable of generating 200 kilowatts of power, which is about all that is required for most trans-oceanic Radio communication. It is probable that outfits of this kind will displace the immensely larger and more expensive alternators, the most successful type of which has been the Alexanderson alternator.

The 20-kilowatt tube merely marks one stage in the development of still larger tubes. It will undoubtedly be possible, when the need arises and when the necessary development work has been completed to construct tubes of many hundreds, or even thousands, of kilowatts. Such devices will probably be used not merely for Radio purposes, but many ultimately play an important part in such problems as the electrification of railroads and the transmission of power to long distances by means of direct current.

Erecting the Antenna Mast

Often the simplest and easiest way to put up an antenna is to erect a mast on the housetop, but it is not desirable in many cases to make holes in the roof. In order to avoid this the writer used a 20-foot length of ½-inch galvanized iron pipe and mounted it in the gable of the house as follows:

A 3-inch pipe flange was fitted with a nipple or short length of pipe long enough to clear the edge of the roof when the flange was placed on the house, and the elbow was screwed into the other end of the short piece of pipe. The flange was then fastened to the end of the house with bolts, although heavy screws may be used. The long pipe was drilled near the top and about halfway down to receive the guy wires, which were put in place before the pipe was raised.

A pulley was also fitted to the top of the pipe. This may be done by having a small hook made of iron with one end long enough to set into the top of the pipe securely. Screw eyes are put into the ridge board and into a nearby tree, and guy wires fastened in between them. The hook and pulley, fitted with ¼-inch rope long enough to reach from the roof or the ground, to the top of the pipe and back to the roof, are put in the top of the pipe. The pipe is then raised and screwed into the upturned elbow previously fastened to the gable. The guys, No. 14 galvanized iron wire, are fastened and drawn up tight. Turnbuckles may be used to take up the slack in the wires if desired, but this is not ordinarily necessary. If the guy wires are longer than twenty or twenty-five feet it is well to use a strain insulator in each one to break up the span of the wire.

When the antenna itself is completed it may be raised by the use of a rope and pulley. For the other mast a pipe may be secured to the other side of the house in the same way or, if available, a tree can be used. If a 20-foot length of pipe is not high enough a 10 or 20-foot piece of either ¾ or 1-inch pipe can be put up first and the smaller piece fastened to the top of it. However, this will be more difficult to raise and fasten securely.—John L. Robinson, Allegan, Mich.

TUBE DETECTORS

(Continued from page 11)

length; then the secondary is brought into resonance, using the variable condenser for fine adjustment. To eliminate interference the coupling of the two windings is varied until objectionable signals are cut out.

Circuit for the Variocoupler

A variocoupler with tapped primary is shown connected in the ciruit shown in Figure 11. Full range of coupling is possible by variations in the relative positions of the coils. The inductance of the primary can be varied by means of two multi-point switches, while a variometer

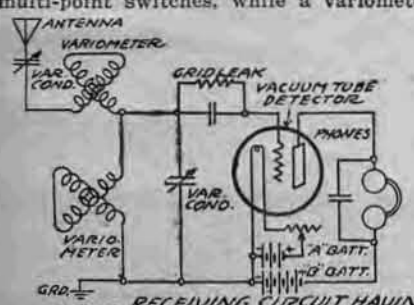


FIG. 13 RECEIVING CIRCUIT HAVING TWO VARIOMETERS

connected in the detector circuit affords a continuous variation of secondary inductance and close tuning within a comparatively short range of wave lengths.

In the circuit shown in Figure 12, a variometer is used as the tuning device, with fixed condenser in the ground lead and a variable condenser across the variometer. The coils of a variometer are arranged in series, one placed inside the other, the plane of the inner coil being rotatable about a diameter. The self-inductance of the variometer is dependent upon the relative position of the coils. When the two windings are in the same plane with current flowing through the windings in the same direction, the inductance of the variometer will be at a maximum. More resistance is offered to Radio frequency currents by a variometer adjusted to a low value of inductance than by a tuning coil with like inductance. This permits close tuning within a narrow range of wave length variation.

Use of Two Variometers

Two variometers are shown connected in the receiving circuit represented in Figure 13, one being used as a continuously variable loading inductance while the other serves as a tuner. The variable condensers in the antenna circuit and in parallel with the tuning variometer assists in the fine adjustments.

Figure 14 illustrates a vacuum tube receiver using a loose coupler in connection with a short wave variable condenser and a variometer for decreasing or increasing the wave length of the aerial circuit.

Honeycomb Coils in Circuit

Honeycomb coils are used in the circuit shown in Figure 15. The coils are wound with a bank winding in one direction, the winding being so arranged that one layer crosses the preceding layer always at an

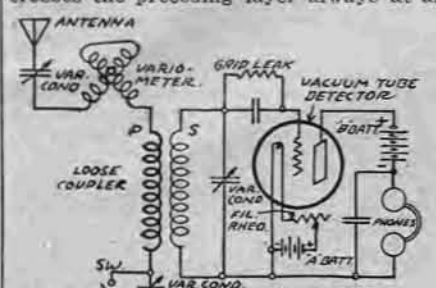


FIG. 14 RECEIVER USING A LOOSE COUPLER VARIO-METER & VAR. COND. FOR TUNING.

angle, thus making the distributed capacity a minimum. The loose coupler effect can be obtained by using a mounting stand which permits moving the coils to and from each other. Although each coil is fixed as regards wave length value, they may be used interchangeably. This feature permits variation of wave length in big unit steps, leaving the necessary fine tuning to the variometer or variable condenser connected in the circuit. By the proper selection of units the receiving set may be easily adjusted to long or short wave lengths.

Thus far, we have discussed connections or hook-ups in which the energy of the Radio frequency oscillations have been brought directly to the detector, there rectified and passed on to the telephone receivers. If this latter energy is partly

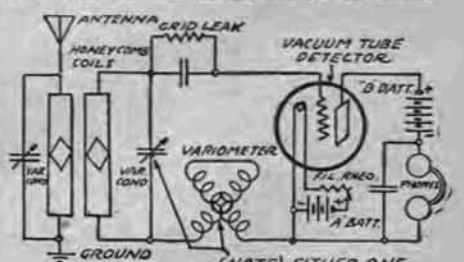


FIG. 15 VACUUM TUBE RECEIVER WITH HONEY COMB COILS USED AS A LOOSE COUPLER.

re-impressed on the grid of the detector tube, it will add quite a little to the potential of the incoming signals, in turn imparting a greater charge to the grid, thereby producing a greater variation in plate current and causing much louder signals. This regenerative or "feed-back" action greatly increases the sensitiveness of the vacuum tube, causing it to produce self-amplification.

The second installment for Part X of this series will appear in the next issue and will deal with regenerative or "feed-back" reception, giving many hook-ups employing this means of self-amplification.

Simple Instructions for the Beginner

By Harry J. Marx

Tuning the Receiving Set

Part II

IN ITS simplest form, tuning apparatus consists merely of a length of wire, which is wound on a tube and has sufficient inductance to raise the antenna circuit to the wave length desired for reception. The inductance depends upon the number of turns, the length of the winding and the diameter of the tube upon which the coil is wound. The usual commercial tuning coil is designed to meet all-around amateur conditions, and for this reason it is not apt to be highly efficient over a great part of its wave length range. If it is desired for a special range, the dimensions and natural characteristics of the aerial or antenna circuit may not be suited to give the proper wave length desired. The

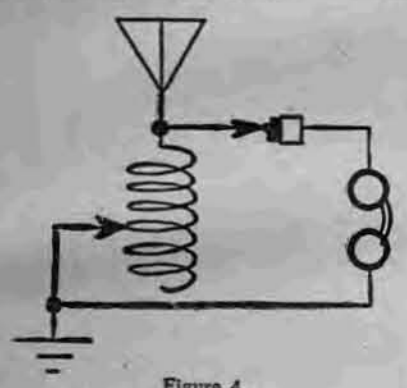


Figure 4

coil has its maximum inductance which can be reduced by cutting out part of the winding through sliders or switches.

The simplest type of tuning coil is the one equipped with a single slide making contact with the various turns for the wave length adjustment. Figure 4 shows how the single-slide tuning coil is connected in the circuit. The lead-in from the antenna goes to the coil binding post, while the wire from the ground connection is fastened to the slider binding post. The wire from the point or "catwhisker" side of the crystal detector is connected to the antenna or coil binding post. The wire from the crystal cup side of the detector goes to one side of the phone, while the other side of the phone is connected to the ground or slide binding post of the tuning coil.

The Two-Slide Tuner

The more popular type of tuning coil is the one furnished with two sliding contacts. The hook-up of this type is very similar to the single slide tuner, as can be seen in Figure 5 with the exception that the one slide of the phone is connected to the second slide instead of the same one that the ground wire is. The slide to which the ground wire is connected is used for adjustment of wave length in the antenna circuit, but the second slide permits an adjustment of the crystal and phone circuit that will materially improve reception.

Tuning coils with three slides are made, but the advantages claimed for them have not, as a rule, been justified. All the single and double-slide tuning coils are used in what is generally called a single circuit hook-up. They are also used for vacuum tube hook-ups, but when the amateur has reached the vacuum tube stage he usually feels that a better type of tuning apparatus is needed, and turns to the two and three circuit type of connections.

Transformer Type of Tuning Apparatus

In the single and double-slide tuning coils there is only one distinct circuit.

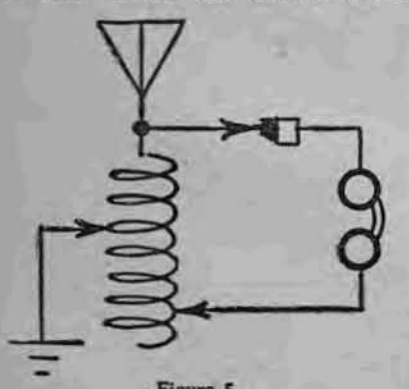


Figure 5

One of the early developments in the days of spark transmission was the use of the transformer, not only in the well-known spark or induction coil, but also in what is generally known as the receiving transformer. In using the transformer type of tuning apparatus the receiving set has at least two distinct circuits.

The first circuit remains just as before—that is the antenna circuit, which now becomes more generally known as the primary circuit. When the high frequency alternating currents pass through, this primary coil sets up a magnetic field. By placing another coil called the secondary, somewhere within this magnetic field, another flow of alternating current is induced, and it is this current that is rectified and used for operation of the receivers. Depending upon the location of the secondary and the method of controlling the induced current, there are various types of receiving tuning apparatus, such as the loose coupler, variocoupler, and honeycomb coils. Under the general heading of honeycomb coils can be grouped a number of types of windings of similar construction, such as spider web coils, involute coils and even special methods of winding the duo-lateral coils. The induction and variation of induction control is very similar for all.

The Loose Coupler

The loose coupler is often called the receiving transformer. In this instrument the primary or antenna coil is wound on a large tube and the windings are either tapped for a contact switch or varied by a slide. The primary winding is usually made large enough to cover a considerable

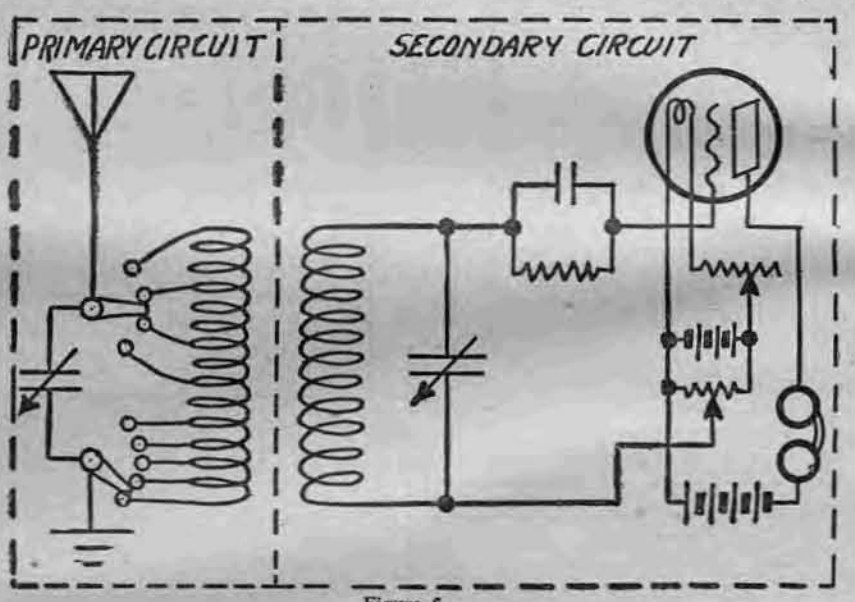


Figure 6

range of wave length. The wire is from No. 22 to 26 B & S insulated copper wire. The insulation may be enamel, cotton or silk, depending upon the selectivity and the efficiency desired.

The secondary coil is wound upon a smaller tube arranged to slide in and out of the larger one, and it is usually made as large as possible to allow but a minimum amount of clearance, thus receiving the strongest inductive effect. The secondary winding is also tapped to permit adjustment of the number of turns used therein.

Theory of Operation

The waves received by the antenna system travel through the primary and the adjustment for its wave length is controlled by the slider or tapped switch, as the case may be. Magnetic fields are built up around the primary windings which concentrate in the hollow core. This magnetic field passes through the secondary winding, and, as the current is alternating, induces an alternating current in the secondary. This secondary current corresponds to the one in the primary, since the alternations of the latter create the inducted surges of current in the secondary winding. As the secondary winding is moved in and out of the primary it is shifted into a stronger or weaker magnetic field, the field becoming weaker as the distance from the primary winding increases. Thus the strength of the induced current can be varied.

As the number of turns in the secondary winding is varied by the tapped switch there is a corresponding variation in the ratio of the number of turns of the secondary to that of the primary, which again controls the voltage of the induced current. Taking advantage of this induction feature, the wave length of the secondary is made to correspond with that of the primary, thereby getting stronger and more defined currents to pass on for rectification.

Circuit Employing Loose Coupler

In Figure 6 is shown a typical two-circuit hook-up employing a loose coupler. The primary and secondary circuits have been divided by the dash lines in the illustration and plainly indicate each. In designing a loose coupler the secondary circuit should have the same wave length as the primary or antenna circuit. It will be noticed that a condenser "C" is shunted across the secondary coil; the capacity of which need not be more than .0005 microfarads. If the desired maximum wave length in meters is known, the required inductance in the secondary can be calculated from the formula:

$$L = \frac{W^2}{3552 \times C}$$

in which W is the wave length in meters,
C the capacity in microfarads, and
L the inductance in centimeters.

The number of turns, diameter of winding, etc., can be calculated from the data given in previous articles of this series. A potentiometer of about 400 ohms resistance is connected across the "A" battery. This permits accurate control of the grid potential.

Variocouplers and variometers were thoroughly discussed in the issue of the RADIO DIGEST dated April 29th. Honeycomb coils were explained in detail in the May 6th number.

Fixed Coupling Tuners

A fourth type of tuning unit is one in which both the primary and secondary are wound upon the same tube, but whose positions are not adjustable relative to the magnetic field. (See Figure 7.) The primary coil is usually provided with tapped switches for both rough and fine adjustments. In addition, a variable condenser is shunted across it. The secondary may or may not be tapped but is as a rule shunted by a variable condenser. A tickler coil may be added which revolves at one end of the tube, preferably at the secondary end. The latter of course makes the set regenerative. In a fixed coupling the unit is calculated for a limited wave length range and operates at very high efficiency. A fixed and proper coupling between the primary and secondary circuits insures maximum signal strength and selectivity and at the same time removes the control that is most frequently misused by the learing operator.

Action of Feed Back

The tickler coil when added controls the feed back to the plate circuit. This feed back is a bugbear in the mind of the novice but its operation can be easily understood by the following analogy.

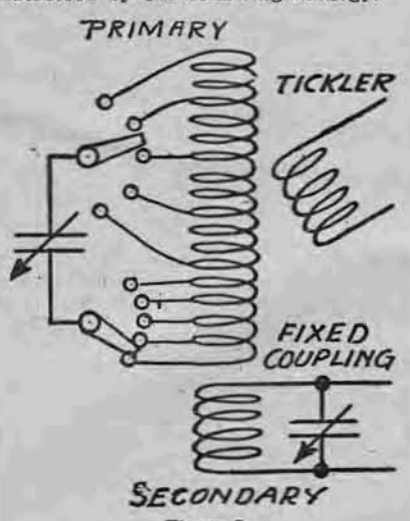


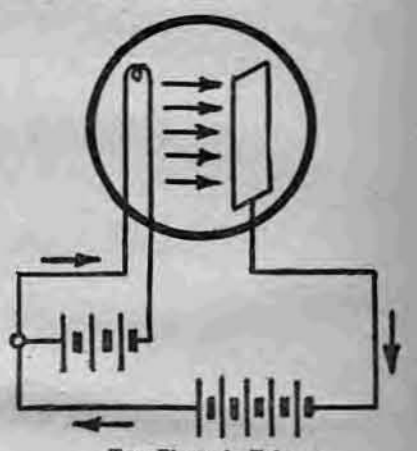
Figure 7

In the gasoline engine of an automobile it is known that there is plenty of unused fuel ejected from the muffler. Now, if it were possible to suck out the good unused gas from the exhaust and feed it back into the motor to be used over again, this process could be called a feed back.

This is exactly what happens in the regenerative circuit. The tickler coil is affected through induction in a way similar to the secondary coil and this current is fed through to the circuit. If too much is fed back, however, the circuit is choked, so that control of the feed back is provided by rotating the tickler coil. In one position it is in line with the primary and secondary and gets the full strength of the induction. When turned, the induction is decreased so that the strength of the feedback current is gradually cut down.

Fleming's Two Element Tube

Among the many elements that have contributed to the successful development of Radio is the Fleming valve, the offspring of Edison electric lights and the mother of the three element vacuum tube, used for Radio reception and transmission at the present time.



Two Electrode Tube

Prof. Fleming found that the heated filament of the electric light emitted little particles of negative electricity which are known to science as electrons. One of the peculiarities of this infinitesimal subdivision of matter is that normally in the incandescent lamp the electrons do not travel far from the heated filament because they are attracted back by the positively charged atoms from which they have been thrown off. Being negative in their consiruction they are naturally attracted by the positive filament.

Fleming watched this phenomenon closely and decided to place another element in the vacuum tube which would attract the electrons when thrown off by the heated filament. To attract the flow of electrons it was necessary to raise the new element, called a plate, to a positive potential. This was done, and it was found that the flow of electrons could be controlled by carrying the current applied to the plate, thus making the filament the negative element in the combination. The greater the potential of the plate the greater the flow of electrons to it.

This tube or valve, as it is sometimes called, was used much for Radio reception with more or less success until the grid was placed in the vacuum chamber by De Forest, creating the three element tube which has proved to be the one factor so essential to the development of Radio.

Trouble Shooting a Set

If the signals usually received loud are suddenly found to be very weak, the difficulty may be caused by any of the following reasons:

The transmitter station may have cut down its power.

The crystal detector may be out of adjustment or the crystal or contact may have become dirty. In the latter case the metal point which touches the crystal may be filed and the surface of the crystal washed with alcohol. One should not touch the surface of the crystal with the fingers after cleaning.

The receiving antenna may have become disconnected, or the ground may have become ineffective due to insulating paint or gaskets in pipe connections. It is best to have the ground lead on a cold water pipe at the place where it first enters the house.

The "A" or "B" battery may be exhausted or disconnected.

The telephone plug may not be making a good contact or one of its flexible wires may be broken.

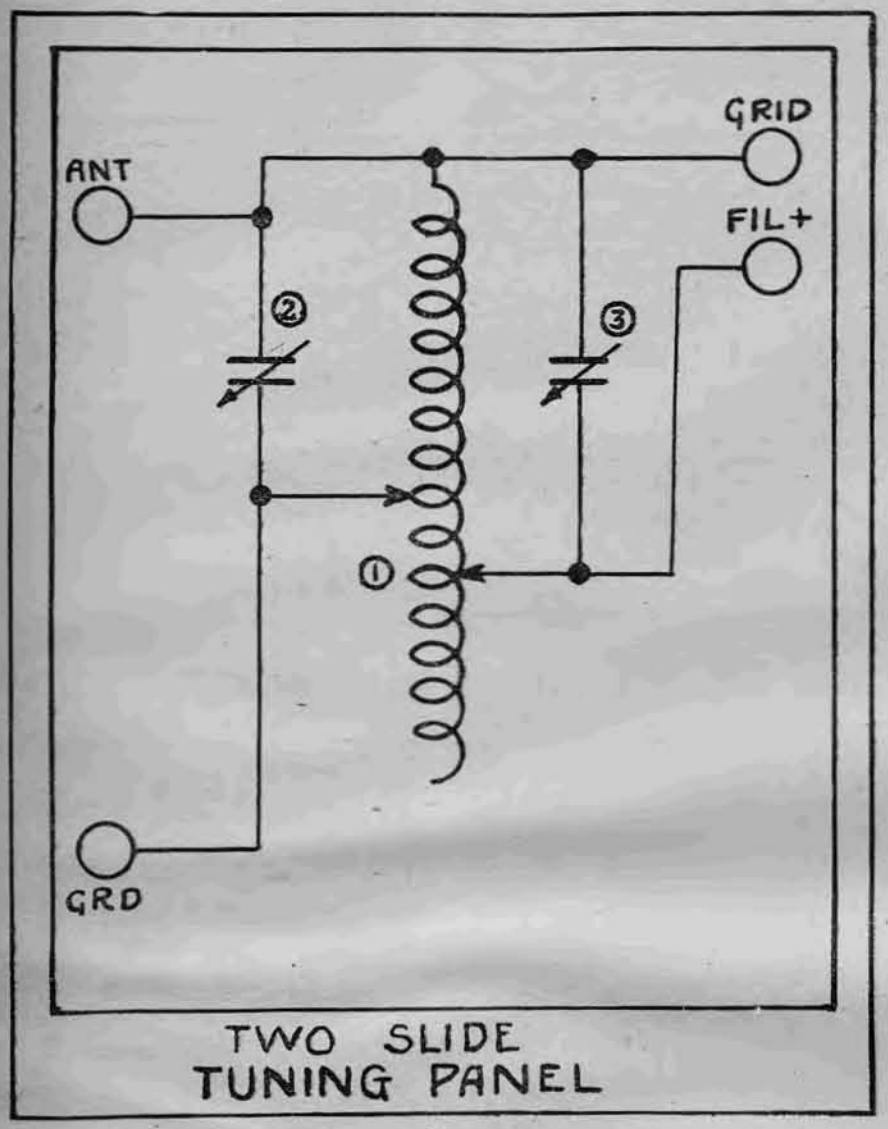
A variable condenser may have its moving plates touching against the stationary plates.

Condenser Made of Brass Tubes

A good variable condenser can be easily made by procuring two brass tubes, one of which fits loosely inside of the other. Paste a sheet of linen bond paper, which has been paraffined, over the smaller tube so that it lays quite smooth. Solder short wire leads to the ends of each tube. By moving the smaller tube in and out of the larger tube, the capacity can be varied.—John Davidson, Cleveland, O.

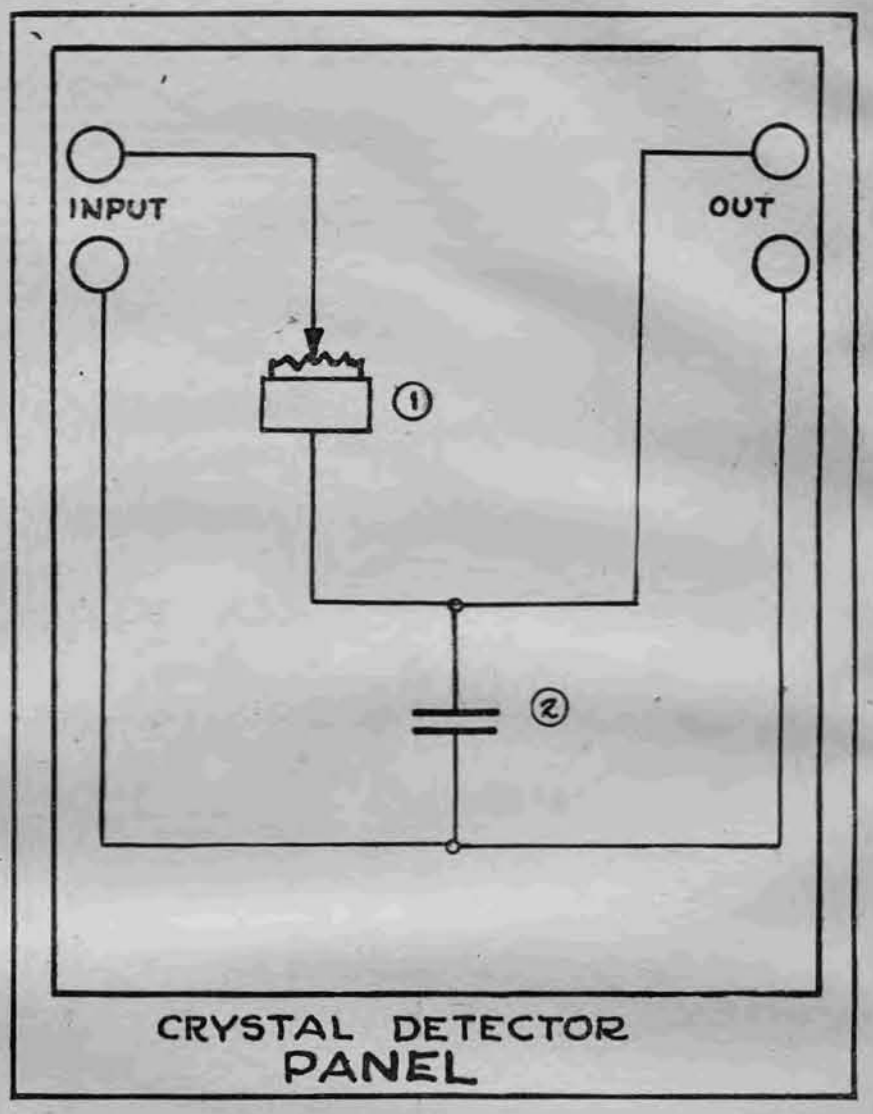
Panel Units for Your Receiving Sets

By Harry J. Marx



TWO SLIDE TUNING PANEL

S-9



CRYSTAL DETECTOR PANEL

S-17

PARTS REQUIRED FOR TWO-SLIDE TUNING PANEL

1 Panel 8″x10″x¼″
4 Binding Posts
No. 1—Two-slide Tuning Coil
No. 2—Primary Variable Condenser .001 Mfd.
No. 3—Secondary Variable Condenser .0005 Mfd.

The two binding posts on the left-hand side of the panel are for the antenna and ground. The two binding posts in the upper right-hand corner are for the "GRID" and "FIL+." This tuner is non-regenerative. Therefore the plate and positive B battery connections on the tube detector panel are strapped together when this panel is used.

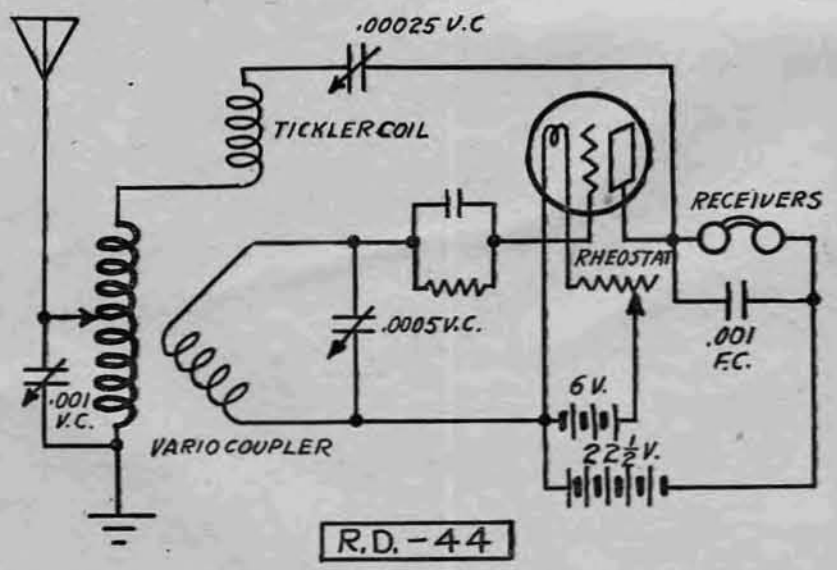
PARTS REQUIRED FOR THE CRYSTAL DETECTOR PANEL

1 Panel 8″x10″x¼″
4 Binding Posts
No. 1—Detector Mounting and Crystal
No. 2—Phone Condenser .001 Mfd.

This panel is intended primarily for the crystal detector utilizing a stage or two of Radio frequency and possibly audio frequency amplification. The two binding posts in the upper left-hand side marked "INPUT" connect to the corresponding "GRID" and "FIL+" posts on the tuning or Radio frequency panels. The two in the upper right-hand corner marked "OUT" are for the phones or to an audio frequency stage if desired.

HOOK-UP RD-44

The popular variocoupler has been shown using the primary winding for both the primary and secondary circuit and the rotor for the plate or tickler circuit. In the hook-up, the primary winding is used for the usual antenna or primary circuit. The secondary rotating coil operates under the normal functions to the grid and "A" battery without the use of a variometer. Instead of a variometer in the plate circuit, another rotating coil is added to the other end of the variocoupler and is used as a tickler coil. The one end of this tickler coil is connected to the free end of the primary winding. The other end runs to a .00025 variable condenser, the opposite side of which connects to the plate circuit. The alternating current passing through the tickler coil acts upon a variable condenser which in turn reacts upon the plate circuit, in this way intensifying the plate current and increasing the audibility in the receivers. This tickler circuit is controlled by the adjustment of the tickler coil and also by the variable condenser. Naturally, the tickler control will be very sensitive to the adjustments in the primary circuit and for that reason any change in primary adjustments will require a corresponding readjustment of the tickler controls. A 43-plate variable condenser is shunted across the primary winding. The secondary circuit is the same as normally used with a 23-plate variable condenser and the secondary circuit with the usual .00025 mfd. Grid condenser and .5 magohm grid leak. A 22½-volt plate or "B" battery will be sufficient. The filament requires a rheostat as usual.



R.D.-44

Although this circuit may be a little delicate in tuning, it will give very efficient reception and is therefore recommended to the amateurs for trial.

The tickler winding should be about 25 turns of No. 26 wire on a tube diameter the same as the secondary, mounted in a similar manner.

About Storage Batteries

Storage batteries form one of the important parts of the various apparata used in Radio reception. They are a valuable part of the Radio equipment and should be understood and cared for as any delicate apparatus should.

The storage batteries used for lighting the filament of the vacuum tubes in receiving and amplifying circuits, are rated at six volts. These six-volt batteries consist of three cells in the case of lead batteries, which are the most commonly used and of five cells in the Edison type.

The capacity of a storage battery, that is, the length of time necessary to completely discharge it, is measured in "ampere hours." Thus, a battery having a 60-ampere-hour capacity will deliver approximately 1 ampere for 60 hours, 2 amperes for 30 hours, 6 amperes for 10 hours, etc.

Batteries used for vacuum tube sets usually have a capacity of 40 to 120 ampere hours. The smaller sizes are convenient when a portable set is used, for they weigh much less than the larger types. The larger batteries are suitable when it is inconvenient or undesirable to charge a battery frequently. A 100-ampere hour battery will last for about forty to fifty hours of use on the average detector and two-step amplifier set in use today. The other types will last less in proportion.

One way to determine whether the battery needs recharging is to measure its voltage with a pocket battery voltmeter. Under no circumstances determine the state of storage battery with an ammeter. This may not only burn out the meter but ruin the battery as well.

The voltmeter is placed across the battery terminals while the vacuum tubes are in operation and a reading noted. If the voltage falls much below six volts in the three-cell battery, it should be recharged. If it reads four volts it needs immediate attention and care. Don't let the battery run down to such an extent that it will take a long time to recharge it. Finally, never short circuit a battery, accidentally or otherwise. A short circuit taxes the battery to such an extent that the plates may be buckled and the battery ruined.

Questions and Answers

Radio Frequency Amplification

(288) LED

I take great pleasure in reading your weekly paper and many of my perplexing problems are solved through your Question and Answer department. However, I have a few more and if you do not feel it an imposition, I would be very grateful for your opinion on them.

1. Would you consider a one stage Radio frequency amplifier, detector, two stage audio frequency amplifier and Armstrong super-autodyne receiver (150-800 meters) a practical set for the reception of music, etc., from the eastern broadcasting stations? If not, what would you suggest?

2. What is the difference between a three to one and a ten to one Radio amplifying transformer and which should be used in the construction of the above?

3. What types of Cunningham tubes should be used in the respective stages or would some others be better?

4. Will you please furnish hook-up for above, including control jacks, loud speaker and phones. (If, however, you suggest a change make the hook-up include your change.)

A.—1. Would suggest adding another stage of Radio frequency if a loud speaker is used.

2. Simply a question of ratio of windings. Would not recommend a greater ratio than 3 or 4 to 1 as the impedance becomes too great, and the capacity effect of the windings cuts down the ratio as the ratio increases very much.

3. Any of the standard tubes will serve the purpose. If hard tubes are used for Radio frequency the plate voltage should be at least 45 to 60 volts. A soft tube for detector and hard tubes for audio frequency are recommended.

4. See issue No. 10, June 17th, page 15, for hook-up.

Radio Frequency Amplifier

(444) AET

I have been an interested reader of your paper from the first, and I want to compliment you on its thoroughness and sound worth. I have had several dark points cleared up for me and I wish to thank you.

Wish you would examine the enclosed diagram of a set I am making up for myself, using variocoupler and variometers, Cunningham tubes, Radio frequency transformer, audio frequency transformer, grid condenser and leak, rheostats, telephone, condenser, 50-volt "B" battery, "A" battery, and Federal plugs and jacks with phones. Plug in jack 1 to light the two Radio frequency steps and the detector. Plug in jack 2 to light the two Radio frequency steps, detector, and first step of audio frequency. Plug in jack 3 to operate on all five tubes. The two-point switches on the Radio frequency circuits are to cut off either or both of these tubes at will.

1. Should the variometers be in the detector tube circuit or where they are shown on the diagram? I will have to always operate with at least the first step of Radio frequency where they are now located, but that will be an advantage it seems to me.

2. I want to try a potentiometer in the battery circuit to further regulate the potential differences between the tube elements. In wiring diagrams published, it is directly across the "A" battery. Is this not a direct short? I do not see how it can avoid it. The "A" battery will constantly discharge through the potentiometer. Just where should it be placed?

3. When using duo-lateral coils with a five-tube set like this, should not the tickler coil be connected in the plate circuit of the detector tube? If placed in either of the amplifying circuits, audio or Radio, it seems to me it will be cut out of use when only the detector tube is being used.

4. In the May 13 issue of RADIO DIGEST ILLUSTRATED, you show the "B" batteries as all being 22½ volts. Should not the voltage for the amplifier tubes be 45? Can one "B" battery be used for all circuits if it has steps from 16 to 45 volts?

5. With a 75-foot 2-wire aerial, how far should I receive with a set in the drawing? Aerial 10 feet above the surrounding trees and houses, well insulated, at right angles to the power lines one block away, and good firm ground connections using a clamp. My natural wave length is 285 meters, using 150-foot aerial wire, 30-foot lead in, and 10-foot ground load.

A—1. Tickler coil or variometer can be in plate circuit of either tube.

2. It is a short, but one of very high resistance and does not discharge battery very much. It is correct as is.

3. See 1.

4. The detector plate can take about 45 volts to advantage. Yes.

5. Range depends on amplifier design, static conditions, and terrain. Aerial is all right.

Doubtful Hook-up

(450) HWG

As I have no knowledge of Radio apparatus, or of elementary principles of electricity, I should like to secure a little advice.

1. Enclosed is a rough pen draft of a hook-up of which I am in doubt. Could you O. K. it for me? My main purpose in constructing a Radio outfit is to secure the benefits of the broadcasting station programs. The diagram from which I copied the hook-up gave no specifications of size, capacity, etc.

2. Is a .001 mfd. variable condenser necessary on the tuning circuit of this hook-up?

3. Do I need a variable condenser of .0005 mfd. in shunt across the secondary tuning coils?

4. Is a .0005 mfd. condenser too big for a grid condenser?

5. Is a potentiometer of 200 ohms sufficient?

6. And last—could I assemble the different pieces of apparatus in the relative positions shown in the hook-up on a panel not larger than 17"x22" without causing bad results in receiving?

A—1. Hook-up is doubtful. Digest gives better ones.

2. Necessary for good tuning.

3. Not if it is variable, depends on the tuner.

4. No. 5. Yes. 6. Yes, depends on your skill.

Battery Connections.

(451) CMD

1. Will you kindly provide me with some hook-ups for use where a vacuum tube detector is used in combination with a crystal detector as an amplifier being particular to note just what coils are suitable as transformers in such practice.

2. Can a single-slide tuning coil be used as the coupling transformer in such work?

3. Also, kindly make it clear why, in some of your diagrams, (Fig. 7, page 13, issue 4, Fig. 8 on same page, also "RD9" on the loose leaf page), you show the positive pole of the "A" battery connected to the negative pole of the "B" battery, instead of connecting the negative poles together as other informants take pains to caution the amateur to do?

A—1. See R. D. 39, Issue of July 1.

2. Yes.

3. Experiments prove that it works. The currents can buck or flow together. It makes no difference.

Radio Illustrated

The waves of the beach do not attract the bathing beauties so much as do the Radio waves of today. Radio outfits are so small that they can be fitted to a beach umbrella, using the ribs for the antenna. © INT.

Europe becomes Radioized. Guests are entertained on the lawn of a large estate in England by the Radiophone and ether dancing is now a feature of the evening's social event. © K. & H.

Baby Kolster is very much delighted at the sound of daddy's voice over the Radiophone. ©P. & A.

Recently in staging a war show, tanks were used in action. From the headquarters tank the division headquarters was kept informed of the results of the sham battle at a distance of five miles. © INT.