

Radio Digest

Illustrated

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TRADE-MARK

Vol. 1

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E. C. Rayner

CHICAGO, ILL., SATURDAY, JUNE 17, 1922

No. 10

ANNOUNCE AC RECEIVER

CROSS COUNTRY IN BROADCASTING CAR

CONCERTS TO BE GIVEN IN TOWNS ENROUTE

Auto Equipped with Super Receiving Set—Two Aerials Provided for Emergency Use

DETROIT.—The broadcasting car of America's first cross-country Radio tour recently gave a concert and immediately left on the first leg of its overland journey to San Francisco by way of the Lincoln highway.

Two automobiles equipped with super-sensitive receiving sets built by Thomas E. Clark, local Radio engineer, will furnish Radio concerts to the towns throughout the route.

The Radio receiving set consists of a very delicate tuner combined with three steps of Radio frequency and two steps of audio frequency amplification.

Two Aerials Used

Two aerials are provided, one a loop aerial built solidly upon the sedan top, and the other an emergency overhead aerial, wound on a drum and ready to be strung out to a tree or building in a moment's time. The battery equipment, used both to drive the car and to operate the Radio set, was built in Ypsilanti.

The broadcasting cars while on tour will tune back to Detroit's broadcasting stations and will be able to cut in on other broadcasting centers along the route.

BROADCAST STATIONS MUST CUT OFF POWER

Government Warns That Carrier Wave Causes Interference

WASHINGTON.—"Broadcasting stations should shut off transmitters when not in actual operation to prevent unnecessary interference from carrier wave," says an official warning from the Bureau of Navigation of the Department of Commerce. This interference is a result of the formation of audible beats with other continuous wave emitters, such as another transmitter or a sensitive vacuum tube receiving instrument.

FIRST HEARING LOVE NOW USED BY CUPID

OKLAHOMA CITY.—When the soft tones from Frank Bird's voice came through the ether the heart of Dolly Smithson was all a-flutter. Her receiving set picked up the orchestra music. Mr. Bird is director of the orchestra. It was a case of love at first hearing. A few letters were exchanged and now there is a wedding.



AD MEN LISTEN TO TRAIN RADIOPHONE

Boston Club Train Bound for Milwaukee Meet Radio Equipped

BOSTON, MASS.—New Englanders were given their first view of a Radiophone equipped train recently, when more than 100 advertising men members of the Pilgrim Publicity Association, started from the South Station on the first leg of their journey to the convention of the Associated Advertising Clubs held in Milwaukee. Through officials of the New York Central railroad, working with officials of a big Radio manufacturing company and prominent Boston advertising men, arrangements were made for the Radio equipped train. Besides a loud speaking device installed in each of the coaches, there were individual sets for every guest on the trip.

Western Youth Invents Ball Type Variometer

Vance Eastwood of Kansas City Discovers New Device

KANSAS CITY.—For years Vance Eastwood, 19 years old, has been experimenting in building Radio sets and apparatus. Recently he designed a variometer that is not only a great improvement over many types in use but has many new features.

The variometer is of the ball type, void of framework with the exception of a fiber strip about the two coils, holding them on the axis.

It is made by winding wire on aluminum plates, and coating them with a special preparation, which holds them in a rigid position, providing only air insulation between the two coils. The plates are removed and the halves of the two coils united by the fiber strip.

NO BATTERY REQUIRED IN NEW CIRCUIT

Bureau of Standards Shows How Special Transformer Eliminates Cells

Works Well as Amplifier

No Humming Results Although Ordinary House Lighting Alternating Current Is Used

(Special to RADIO DIGEST)

WASHINGTON.—Announcement is made of a Radio receiving set designed by the Bureau of Standards, in which the usual batteries are satisfactorily eliminated, and instead connection is made to the ordinary electric lamp socket. The apparatus constitutes three stages of Radio frequency amplification, a crystal detector, and two stages of audio frequency amplification. It may be used with the ordinary outside antenna system, a coil aerial, or other special forms of antennae. Eliminating as it does the drawback of storage and high voltage batteries to the general use of Radio receivers, the new circuit may be considered a distinct improvement in the realm of Radio.

Transformer Replaces Batteries

The battery ordinarily required to light the filaments of the electron tubes must be charged from time to time; it is bulky and heavy, and the acid in it is a source of danger and damage in a household. In the announced amplifier unit, both the filament storage battery and the dry battery used in the plate circuit are replaced by a special transformer and an electron-tube rectifier and accessories, the aggregate bulk and weight of which is less than that of the batteries.

It uses a small 10-volt dry battery in the grid circuit which is required to deliver only a very small current and should have a life practically equal to the life of the battery if not used at all, that is, at least several months. In order to reduce the

(Continued on page 2)

IMPROVISES AERIAL FROM A WIRE FENCE

WALTER WAHLFEIL of Chicago claims that recently he made a trip to Diamond Lake, Area, Ill., and, using 'only a fence wire seventy-five feet long for an aerial, a variometer, a piece of galena, and a pump for a ground connection,' heard KYW very QSA (clearly). This is an exceptionally good record considering the distance and the apparatus used. Write us again, Wally.

NO BATTERY

(Continued from page 1)

hum of the alternating current, there are more adjustments to make than in the ordinary amplifier supplied from batteries.

Transformer Most Costly Addition

Of the parts which in this amplifier replace the storage battery in the ordinary amplifier, the special transformer is the only one the cost of which would approach the cost of a storage battery. The cost of the transformer would probably be mainly the labor of assembling.

The transformer has its primary designed for a 110-volt, 60-cycle alternating current. It is fitted with four secondaries, two of which yield eight volts each, one four volts, and another 300 volts. If not used with a loud speaker requiring field excitation, the four volt secondary is unnecessary.

Circuit Avoids Humming

A few details of the amplifier, which utilizes 60-cycle current supply for both the filaments and plates of the electron tubes, are as follows: Has three Radio frequency stages and two audio frequency stages, and uses a crystal detector.

The 60-cycle current, when used in an ordinary amplifier circuit, introduces a strong 60-cycle note in the telephone receivers and makes reception impossible. This has been practically eliminated by the balancing resistances, grid condensers and special grid leaks of comparatively low resistance, telephone transformer in the output circuit, and use of crystal detector instead of electron tube detector. In the final form of the amplifier, there is only a slight residual hum which is not objectionable.

Amplification Proves Good

The amplification obtained with AC supply was as good as that obtained with the same amplifier used with DC supply. The complete outfit is compact and portable. The amplifier as constructed operated most satisfactorily for wave lengths from 200 to 750 meters. This range was determined by the working range of the Radio frequency transformers used. By using suitable Radio frequency transformers, this range can be extended to receive any Radio waves. The circuit diagram of the outfit, including the means of supplying current to a loud-speaking telephone receiver, is given on page 2, center columns.

ANNOUNCE TENTATIVE EXPOSITION PROGRAM

Tentative program National Radio Exposition, Leiter Building, Chicago, June 26th to July 1st, inclusive:

MONDAY, 2 P. M.

Meeting of Manufacturers

Address of welcome.
Talk on advertising.
Address by Alexander Eisemann.
Open Forum discussion.

TUESDAY, 2 P. M.

Meeting of Jobbers

Address of welcome by Paul A. Westburg.
Talk on advertising.
Open Forum discussion.

WEDNESDAY, 2 P. M.

Meeting of Retail Dealers

Address of welcome by George B. Foster.
Talk on advertising and merchandising.
Open Forum discussion.

THURSDAY, 2 P. M.

Meeting of Farmers

Address of welcome by S. R. Guard.
Evening Meetings and Question Box
The committee will arrange a series of evening meetings, which everyone is invited to attend. In addition to the address to be delivered by prominent men, Open Forum discussion will be held. A question box will be placed in a convenient location where people may write out their questions and these will be read, discussed and answered at the evening meetings.

FRIDAY, 2 P. M.

Meeting of Civic Industrial Radio Clubs of Chicago
Open Forum discussion.

WEATHER REPORT NET EXTENDED FOR LAKES

All Shipping Now Served by Forecast Service

WASHINGTON, D. C.—Following the establishment of the Pacific coast Radio weather-reporting program by the Weather Bureau of the Department of Agriculture in March, this service has been extended since April for the benefit of shipping and aviation on the Great Lakes. This completes the service to all shipping interests in waters about the United States—in the Atlantic, Gulf of Mexico, Pacific, or Great Lakes. Heretofore this type of service was only in operation along the Atlantic and Gulf coasts and in the Caribbean Sea.

In a circular available to those interested this new service is described in detail. Twice daily, at noon and 11:30 p. m., seventy-fifth meridian time, between April 15 and December 20, the Great Lakes Naval Radio Station will broadcast on 1,988

Explorers Find Radio Most Useful in New and Uncharted Countries

Prof. Hiram Bingham of Machu Picchu Peruvian Joint Expedition Tells How Radio Was Employed for Time Signals—Chronometers Kept Accurate to Make Correct Longitude Observations

NEW YORK.—The importance of Radio to explorers in wholly or partially uncharted country was demonstrated as far back as 1915. The story of the so-called Machu Picchu Peruvian joint expedition of the National Geographic society and Yale university was told in the February, 1915, issue of the monthly magazine of that society by Prof. Hiram Bingham of Yale, who directed the expedition.

Previous expeditions in 1911 and 1912 it seems, had met with serious difficulties because of the inadequacy of the maps furnished by the Peruvian government. The pioneers had run into large areas of territory that were so completely unexplored as to have not even been represented on the maps.

Map Parties Sent First

Thus it was thought advisable to send out topographical parties in 1915 in advance of the expedition proper, whose task it would be to prepare better maps.

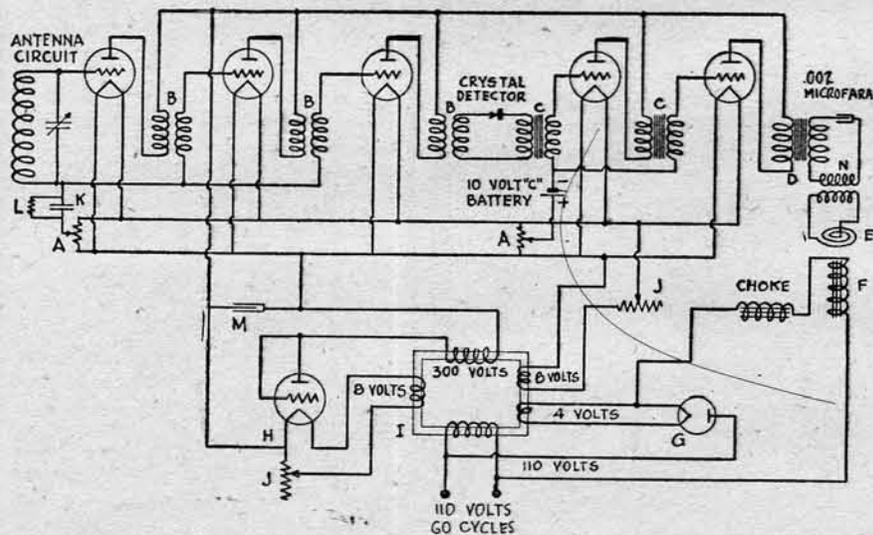
On shipboard chronometers are regularly used to determine longitude. These very delicate instruments are likely to be put out of order in being transported from place to place and a very slight error in the chronometer will cause a grave deviation in the longitude calculations based on it.

In the case of the expedition in question these difficulties were obviated by the use of Radio in the following manner:

Radio Time Signals Used

Arrangements were made with the Peruvian government Radio stations in Lima to have time signals sent out so that more exact data than had hitherto been available could be obtained: Mr. Bumstead, the head of the topographical party, according to Prof. Bingham, was enabled by means of these time signals to determine the longitude of the areas to be explored with a great degree of accuracy.

ONE TRANSFORMER REPLACES BATTERIES IN NEW BUREAU OF STANDARDS CIRCUIT



Circuit diagram of Bureau of Standards five stage amplifier receiving unit substituting ordinary 60-cycle alternating current used for house lighting, for the A and B batteries commonly used in receiving sets. The unit includes three stages of Radio frequency amplification, one crystal detector, and two stages of audio frequency amplification.

The letters used in the diagram indicate the following: A—Balancing resistance; B—Radio

frequency transformer; C—Audio frequency transformer; D—Telephone transformer; E—Armature of loud speaker; F—Field of loud speaker; G—Tungar rectifier tube; H—Plate voltage rectifier tube; I—Power transformer; J—Filament rheostat; K—.002 microfarad condenser; L—Leak resistance of 2 megohms. M—10 microfarad smoothing condenser; N—Step down transformer for loud speaker.

meters wavelength a message giving surface weather conditions as observed at 8:00 a. m. or 8:00 p. m., and aerological observations taken in the morning or afternoon of the date of distribution; the message will include also a synopsis of general conditions, wind and weather forecasts for the upper and lower lakes, and flying weather forecasts for aviation zones extending between western New York, northern Ohio, and Indiana and western Kansas, Nebraska and the Dakotas. Local bulletins will be distributed at various times during the day from the naval radio stations at Alpena, Mich.; Buffalo, N. Y.; Chicago, Ill.; Cleveland, Ohio; and Duluth, Minn. Ships may call upon any of these stations for weather reports, warnings or forecasts.

Ocean Liner Radio Opens New Field for Gamblers

For the inveterate gambler Radio on ocean liners furnishes a new field. Reports from the steamship George Washington and the steamship Homeric, which sailed from New York on the same day and reached Cherbourg on May 14, state that passengers were busy betting all the way over on the speeds of the two boats. Each of the ships was kept informed of the exact location of the other by Radio, and the betting, which is said to have been quite heavy, was done by Radio messages.

Makes High Bid on Navy Tubes

Jacob Loving of 610 Broadway, New York, was high bidder for the 30,000 surplus vacuum transmitting tubes offered for sale by the Navy Department at Brooklyn. He bid \$4,0069 each for all or none. The lowest bid was ten cents each, made by L. M. Alexander of Cincinnati.

Amrad Station Sends Radio Dance Lesson

BOSTON, MASS.—The first dancing lesson ever given by Radio was sent out from the Amrad Station at Medford Hillside, Mass., a few days ago. Prof. William H. O'Brien, a dancing master of national reputation, gave the lesson. In addition to giving a general talk on position, poise and the basics of good dancing, Prof. O'Brien gave illustrations of some steps, describing them and calling them off as in class. These included some of the new tango steps which are now becoming all the rage. Later reports showed that listeners paid close attention to his remarks, and in some instances while one listened in and called off the steps as they were given by Radio, others of the listening party went through the steps and practiced them. Prof. O'Brien is scheduled to give another lesson by Airphone in June.

Dust Keeps Radio Waves Close

Prof. Fleming of the University College, London, inventor of the two-electrode vacuum valve, recently gave his opinion that dust thrown off by the sun forms an atmosphere envelope about the earth for about 100 miles which prevents Radio waves from escaping into space. This dust-made screen acts the same as a speaking tube and permits long distance work. If it were not for the dust screen the waves would not follow the curvature of the earth.

Be very careful when soldering not to use too much flux as it may drip between connections and cause a short or leak. Better wipe clean with gasoline or alcohol and give it a coat of shellac. This was learned by experience.—F. W. Lovgren.

Radio Digest Illustrated

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"How to Make Department." An Exchange of Ideas to Help One Another in Rigging Up Sets.
Broadcasting Directory. In the New Form There Is a Complete, Correct Station and Schedule List. This List Grows Each Week.
Famous Stations You May Have Heard. Each Week There Is One or More New Station Shown.
Radio Illustrated. All of the Very Latest News Pictures Are Shown.

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RADIO BILL PENDS ACTION OF HOUSE

DEPARTMENT APPROVES DRAFT OF NEW LAW

Senate Trust Amendment Held Pending the Arrival of House Radio Bill

(Special to RADIO DIGEST)
WASHINGTON.—The long-looked-for Radio Bill, which will give Secretary Hoover authority to designate wavelengths and, if necessary, hours for transmitting and broadcasting stations, was to be introduced in the House of Representatives this week.

Following the Department approval of the draft of the bill, based upon the recent recommendations of the technical and legal committees of the Radio conference, Congressman White of Maine is now ready to introduce it. Upon introduction, the bill will be referred to the Commerce Committee, which is now struggling with the Ship Subsidy Bill. It is now believed that Senator Kellogg will await the arrival of the House bill in the Senate before offering his amendment to prevent the formation of a Radio trust.

Should Meet No Opposition

According to officials, the bill will incorporate as far as practical the recommendations of Secretary Hoover's Radio conference committee, and amend the present laws enacted on August 13, 1912. Some changes have been designated and necessary additions made to carry out the recommendations of the Committee.

Backers of the Radio Bill are of the opinion that it will pass through the House speedily and meet with little opposition in the Senate as nearly every State is enthusiastic in Radio development, and the bill will not only clear the ether, but will clear up many difficult situations in the administration of present Radio law, by granting the Secretary of Commerce additional authority.

Broadcasts Hold Sway Deep in Maine Woods

ROCKWOOD, MAINE.—Guides here get many surprises but very little pleasure from the multitude of contrivances people from the city bring with them on hunting and fishing trips. But, according to four veterans of the trail, the Radiophone set is not to be placed in the same class with such foolishness as air mattresses and electric toasters unaccompanied by power houses.

To Camp Scott, a log cabin near here, a Radio set was taken. The owner, his son-in-law and daughter and four guides, sat around the fire one night, the three campers a bit uncertain about whether anything could be heard and the four guides more or less skeptical. Despite the isolation, the concerts broadcasted at Newark and Pittsburgh came through clearly.

The performance seemed like oldtime witchcraft to the listeners in the woods and wilds.

The call of the woods reaches many in the city at this time, but this is the first summer that those in the woods hear the call of the city.

Ground Antenna Combats Strays

A recently developed aerial that can be folded like an old hoop skirt makes it easy for the amateur who is not allowed to erect one on the roof of an apartment building or house where he lives. This collapsible style aerial can be hung out of the window, on a clothesline or a fire escape for the time the receiving set is in use. No lightning arrester is required and in case of storm it can be folded or taken down quickly.

"DOUG" TO AIRPHONE ROTARIAN'S CONCLAVE

"DOUG" FAIRBANKS, movie star, intends to write a thousand-word "thriller" each day of the happenings of the annual convention of Rotary clubs soon to gather in Los Angeles. This is to be broadcast daily to all Pacific coast stations and relayed by code to other central points throughout the United States. Watch out for Fairbanks' contortions.

RECEIVING SETS ON STATE POLICE AUTO

LANSING, MICH.—The state department of public safety will give the Radio telephone a trial soon, according to Colonel Roy C. Vandercook, commissioner. Automobiles and motorcycles of the state police will be equipped with receiving outfits and orders directing their movements will be sent from the Michigan Agricultural College station.

CHICAGO SCIENTIST MEETS CHALLENGE

MIESSNER DEFENDS HIS SECRET RADIO PLAN

Gives Successful Demonstration on Question from John Hays Hammond, Jr.

A story in a daily newspaper describing a secret Radio system announced by John Hays Hammond, Jr., chapter seventeen of "Radio Dynamics," a book written and published in 1916 by Benjamin F. Miessner, which describes "a means of obtaining selectivity," and two telegrams, one to Mr. Hammond from the RADIO DIGEST and the other his reply, all worked together in such a manner that Mr. Miessner last week, at the suggestion of this paper, demonstrated before authorities that his Radio secrecy system, invented in 1912, was entirely practical for broadcasting and had great commercial possibilities.

The telegrams really must be given in order that the reader may understand the challenge which was given and how it was accepted.

What Telegrams Said

The telegram sent Hammond follows:
May 23, 1922.

John Hays Hammond, Jr., Gloucester, Mass.

Chicago Tribune May 22 gives your Radio secrecy story, "Radio Dynamics," 1916, chapter 17, gives plan according to current rumor. Is your basic plan same as book gives? If not, rush proofs and refutation and wire at our expense to insure accuracy. Address 123 West Madison Street, Chicago.

RADIO DIGEST ILLUSTRATED

His reply was:
May 23, 1922.

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

My answer to rumors try and operate secret Radiophone system as per disclosure chapter 17 of Miessner's alleged invention.

JOHN HAYS HAMMOND, JR.

Answer Accepted as Challenge

The telegram from Mr. Hammond puzzled RADIO DIGEST. Mr. Miessner, upon being asked if the secrecy system invented by him really would work and when shown the telegram inviting a test, immediately offered to stage a demonstration of his system before experts. On Monday, June 5th, the demonstration was given.

Among those present were L. R. Schmitt, Radio inspector for the ninth district; J. Elliot Jenkins, and W. D. Pease of Midwest Radio Central Station WDAP; F. D. Pearne, Radio editor for the Chicago Herald and Examiner, and representatives of RADIO DIGEST.

All professed themselves amazed at the results of the test, and were surprised when documentary evidence was shown by Mr. Miessner to prove his invention of the scheme in 1912 when associated with John Hays Hammond, Jr., in the development of Radio control for torpedoes and other devices.

Practical Applications of Scheme

Two major applications of the scheme are evident. It means that as many as five, or possibly more, distinct programs or messages can be sent on the same wave length simultaneously by a broadcasting station, and that only the program or message desired would be received by the Miessner type receiver. Another application is found in the practicability of a number of broadcasting stations all transmitting simultaneously on the same wave length, but with no interference. The Miessner receiver would pick from the group only the station for which it was tuned.

Ordinary receiving sets would only receive a jargon of mixed unintelligible sounds. The secret of the system is shown by the two circuits, the sending and receiving.

(Continued on Page 4)

RADIO PROTECTS BALLOONISTS



Major Oscar Westover in basket army balloon entered in recent National race. The bag was equipped with transmitter and receiver. © P & A

ST. LOUIS SHOW IN JULY REMOTE ISLE GETS NEWS

Exhibitors' Association in Charge of Exposition

It is being announced that a big Radio show is to be held at the Coliseum in St. Louis, July 3rd to 8th, inclusive. This show is in charge of the Southwest Exhibitors' Association. Efforts are being made to have this show one of the best events of the season. Spaces are being taken rapidly by manufacturers throughout the country.

Radiophone Opens Up Tristanda da Cunha

A small island in the middle of the South Atlantic, belonging to the British, possesses a population of 120. The inhabitants have been practically isolated for years, but two missionaries recently carried in supplies and took along with them a Radio receiving set. The island, Tristanda da Cunha, is no more than the top of a mountain.

THE ANTENNA BROTHERS

Spir L. and Lew P.

WET "B" BATTERIES



Radio Waves and What They Do

By Letson Balliet

Part I

What are the Hertzian waves, or Radio waves? How do they differ from other waves in the air, water or ether? What is meant by the "wave length"? What is meant by "tuning in" for a given wave length and "tuning out" all other wave lengths?

The widespread and almost universal interest that has been manifested in Radiophone operations has caused the above questions to be frequently asked. An explanation of the matters suggested by the questions will show how simple the Radiophone and Radiotelegraph really is.

It might be well to inject, before we start, that "Radio" does not come from radium, nor has any more to do with radium than it does with potatoes. The origin of the word doubtless comes from "radius" inasmuch as the waves radiate from the center outward and might properly be called the "radiating waves," like those that radiate in water when a pebble is thrown into the pond. "Radio wave" is doubtless a contraction from "radiating waves" and "Radiophone" was coined from the telephone, to distinguish it from the wire-phone.

Why of the Ether

If we ask a scientist what ether is, he will tell us that he does not know. It is a theory. It simply fills a need. It is supposed to be a substance that pervades everywhere, very elastic in its nature and able to transmit vibrations, just as water transmits vibrations or waves.

All we know is that the waves do exist and that they are transmitted. Something must transmit them, the waves must come through something that will transmit them, or there could be no waves. We do not know what it is, but whatever it is that the waves come through we call "ether."

It will be a jolt to many of us to know that there is a very decided relation between Radio, heat, light and electric vibrations or waves. We have often heard of light waves, and probably some of us have heard of heat waves. We know that

waves of heat and waves of light radiate from the sun. We know that if we put a thermo-vacuum bottle, filled with ice water, in a hot oven, the water will stay ice cold, because there is nothing to conduct the heat through the vacuum to the water.

If the vacuum is a complete or perfect vacuum the water will stay ice cold forever. We also know that radiant heat comes from the sun, because we can stand inside a glass window and feel the heat even if a high wind is blowing on the outside. The wind, which is merely moving the air, cannot blow the heat waves nor the light waves out of line.

AS SMOOTH as flowing water runs the pen of Letson Balliet, consulting engineer of Tonopah, Nevada. This article, the first of a series of four, is so easily understood that the greenest novice can readily glean an understanding of Radio.

Evidently the moving air does not move the ether waves, but it will move sound waves, for we can hear sound farther with the wind than against it. It is obvious that an ether wave will travel farther and radiate in all directions, with or against the wind, while air waves will not radiate equally.

How Waves are Heard

As our ear-drums are designed to detect certain vibrations in the air, and carry the information to the brain that the air is vibrating, it seems that the matter of "hearing" a Radio message, depends upon our inventive ability to transform air waves into ether waves, and then bring them back into air waves again. Every sound is nothing more than an air wave. Your ear detects the wave. There is no noise or sound in the waves, but your ear-drum responds to the waves and you "hear" or detect the waves. If

the waves are short the sound is high pitched; if they are long the sound is bass. If the waves are big or high, the sound is loud; if the waves are small or nearly flat the sound is weak or low. Waves have two dimensions, length and height, whether in water, air or ether.

And Then the Wave Length

What is meant by wave length? Sound travels through air at the rate of about 1200 feet per second. If there are a large number of vibrations per second, as in a high pitched note, say 800 vibrations per second, the first vibration has passed 1200 feet away from the starting point before the last vibration of the second has left the point of origin.

That means that there are 800 vibrations or waves within 1200 feet distance of the starting point; therefore, each wave length of that note is one and a half feet long. If the sound was very bass or low, the vibrations might be as low as 200 per second, in which event the wave lengths would be six feet. If you could see these waves they might look very much like accordion pleats.

Like Accordion Pleats

If the pleats were an inch apart the sound would be high, if they were very deep between pleats the sound would be low and high pitched; if they were shallow the sound would be faint and hard to hear but still high pitched. Likewise if they were six inches between ridge of the folds, the sound would be bass. If the valleys between the folds were deep the sound would be loud and bass.

Two steam whistles may be equally loud and be heard the same distance away, but one may be bass and the other sharp and shrill. In which case, the depth of the waves are the same but the length of the waves are different. In the case of the bass violin and the piccolo the human ear can almost detect the different number of vibrations per second.

Editor's Note—Mr. Balliet's interesting analogies will be continued in the June 24 number of RADIO DIGEST ILLUSTRATED. His simple explanations of technical terms will be greeted with enthusiasm.

WORKS SECRET RADIO

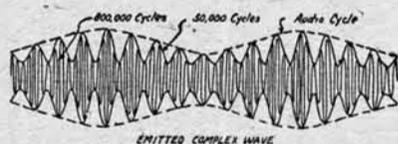
(Continued from page 3)

ceiving, and the emitted wave, given on this page.

Carrier Wave Is Doubly Modulated.

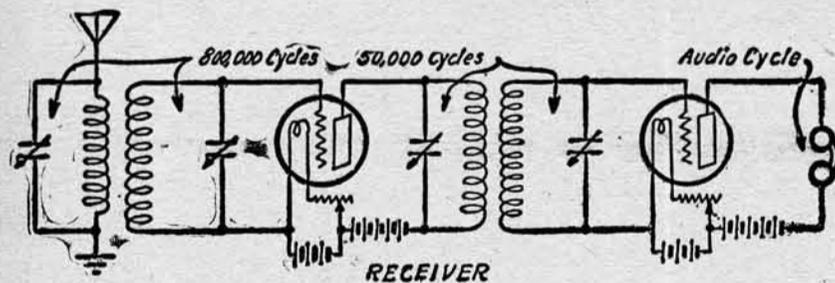
The system is based on the emission of a complex wave and its reception by only a special tuned receiving circuit. A carrier wave of say 800,000 cycles frequency, is modulated by a super or ultra audible frequency wave, say 50,000 cycles, and this complex wave is again modulated at an audible frequency, produced by a tone modulator for telegraphy or a microphone for telephony. The wave diagram gives the picture of the complex wave as it leaves the transmitter antenna.

Modulation by a third, or even more super audible frequencies is possible in this system. The resultant complex wave emitted would then be more selective in nature.



Explanation of Multiplex Radiophony

In employing the scheme at a transmitting station for multiplex Radiophony,



RECEIVER

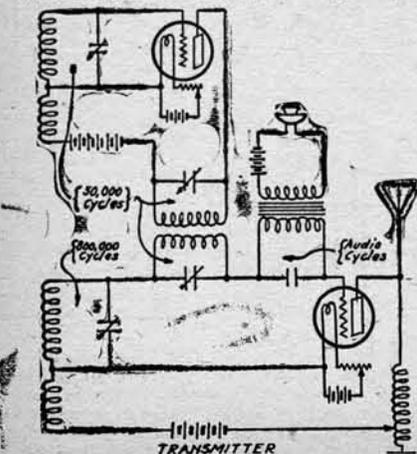
The Miessner receiver has its first circuit tuned to the carrier wave frequency, 800,000 cycles in the example. The current, after rectification in the first circuit, but with the super audible and audible frequencies still intact, passes by induction through the 50,000 cycle tuned transformer and into the second circuit, where the current is again rectified, leaving only the

that is, the transmitting of two or more messages or broadcast programs simultaneously, the 800,000 cycle carrier wave would be common to all, while this in turn would be modulated by an individual super audible frequency for each message or program. The super audible frequencies used, however, should be from 15,000 to 20,000 cycles apart in order to prevent the formation of audible beats between any two super audible frequencies. Thus it would be entirely practical to use the five distinct super audible frequencies, 20,000, 40,000, 60,000, 80,000 and 100,000 cycles.

Used Alternators First

In his early experiments in 1912, Mr. Miessner employed a high frequency alternator to generate the continuous carrier wave, which in turn was interrupted at two distinct frequencies. The receiving circuit was the same as that used in the test, with the exception that in the latter vacuum tube detectors instead of crystal rectifiers were used. The transmitter used in the demonstration employed vacuum tube oscillators to generate the high frequency alternating currents. The basic principle, however, is the same as that proposed by Mr. Miessner a decade ago.

Beginning with the idea in 1912, Mr. Miessner gave lectures in 1914 on the scheme applied to torpedo control, both at Purdue University and before the members of the Chicago Electric Club.



TRANSMITTER

audio frequency which is in turn converted to sound by the telephone receivers.

Distributors FOR DeForest Radio Sets All Types IMMEDIATE SHIPMENT Head Sets Vario-Coupler Variometers and all necessary parts for constructing your own set. Write for Complete Price List Special Discounts to Dealers

THOS. E. WILSON & CO.

42 South Wabash Avenue Dept. R. D. Chicago

Carter Radio Co. 209 S. STATE STREET CHICAGO

New design TU-WAY plug jacks, variable condenser, V.T. socket, rheostat and head sets. If your jobber is unable to supply, write us.

"ALL AMERICAN" Amplifying Transformers STAND THE TESTS Audio Frequency Ratios 10-1 & 3-1 Radio Frequency AT ALL LEADING DEALERS

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ONLY \$6.00 WITH BULB CLEAR AS A BELL

IMMEDIATE DELIVERY

NATIONAL RADIO RECEIVER

NATIONAL DETECTOR BULB

PRICE \$1.00

National Radio Receiver No. 3a "CLEAR AS A BELL" Camera finish panel 5" x 7". Equipped with National Three Point Bulb Detector. PRICE ONLY \$6.00 TESTED GALENA 15c BOX

National Detector Three Point Bulb ULTRA-SENSITIVE Bulbs are Interchangeable. PRICE \$1.00 TESTED SILICON 15c BOX

Dealers write for our discounts

NATIONAL RADIO WORKS

NEWARK, NEW JERSEY

BROADCASTS OF WKY POPULAR

Daily Oklahoman Station Keeps Southwest Ether Full of Music

Transmits to Both Coasts

Varied Program Liked by Listeners —WKY Pioneers in Railway Radio Tests

(Special to RADIO DIGEST)

OKLAHOMA, CITY, OKLA.—WKY the broadcasting station of the Oklahoma Radio shop and used exclusively by the Daily Oklahoman is one of the big stations of the southwest.

It is not unusual for WKY to be heard on the Gulf of Mexico. Recently a ship on the Gulf of California picked up the signals from WKY. Many stations over the country tune in every evening to listen to the excellent programs broadcasted from this station, which is the pioneer Radio station of the great southwest.

The Daily Oklahoman opened its service at this station during the latter part of February. Its first venture was the broadcasting of the concert given in Oklahoma City by Madame Alma Gluck. The concert of Frieda Hempel was another big feature put over by the Oklahoman.

Has Coast to Coast Range

The station has a coast to coast range and is one of the best equipped and operated in the United States. Earl Hull, operator, was a former Buffalo, N. Y. boy and served as an instructor in the army both in this country and over seas. He has been working with Radio for the past twelve years.

The Daily Oklahoman has averaged four programs each week at this station and every program has been the very best that could be secured. Regular entertainers have become a part of the program of the Oklahoman and the fans have come to know just what to expect when it is announced that Delma Millikan, soprano soloist, known in both Oklahoma and Texas and Miss Lillian Wilson, pianist, will broadcast one of their popular programs.

Bird's six piece jazz orchestra are also established favorites with the fans in this section of the country as the famous Towers orchestra.

Program Becomes Popular

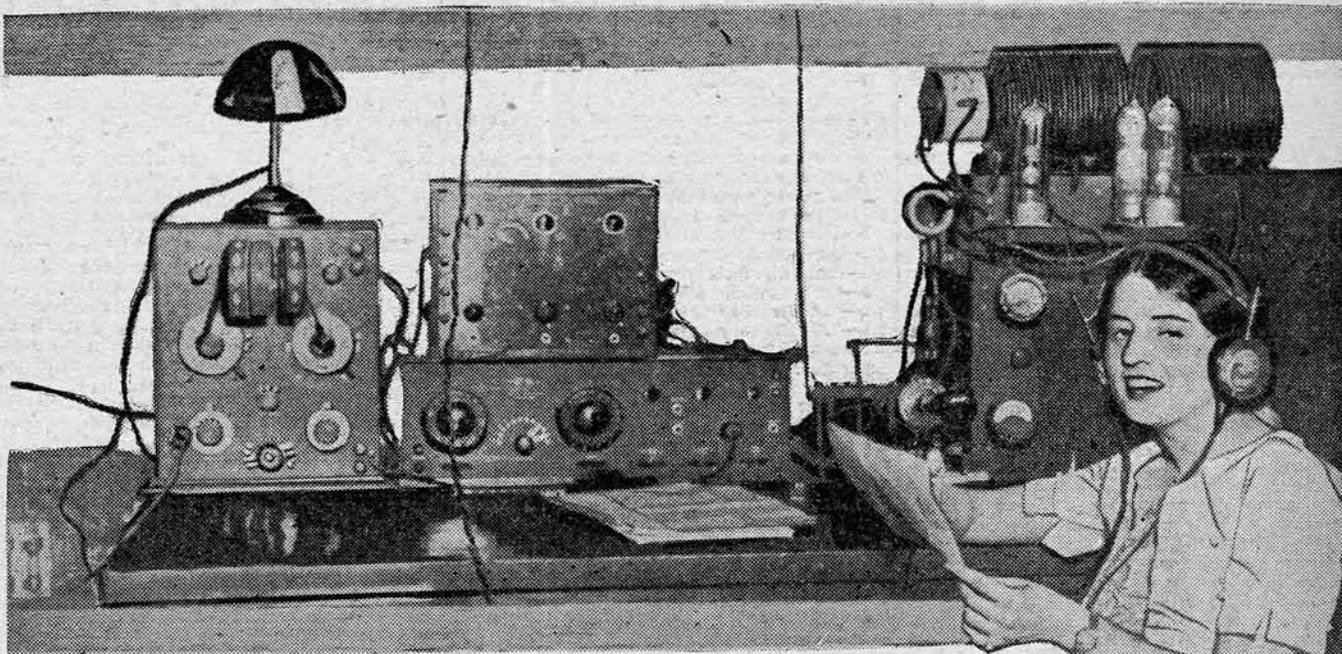
The Daily Oklahoman broadcasts every evening the baseball finals, road conditions, weather, market reports, news items and music in addition to the special programs and the baseball fans over the state, especially in the small cities, phone the Oklahoman when the baseball results are not received on schedule time.

With the coming of fall WKY will be enlarged and improved to take care of the extensive program outlined for the fall and coming winter. A 100 watt set will be installed and many other improvements made.

So popular has WKY become with its excellent programs and other broadcasting service that the operator has only to announce the WKY is ready to broadcast their evening program and every instrument for many miles tunes in. After the programs have been completed the stations send in their reports as to how the programs were received. If for any reason something has gone wrong due to trouble at WKY it is remedied before the next concert. The fans then express their opinions as to the kind of programs they enjoy the most and the Daily Oklahoman makes every effort to comply with their wishes.

Made Early Railroad Tests

During the week of June 1 the Daily Oklahoman with the co-operation of the



Myrtle Schaaf, youngest star of the Metropolitan Grand Opera Company, likes to hear through WSB's receivers. Maybe she hears a contemporary hitting high C.

St. Louis and San Francisco railway made the first Radio experiments attempted by any railroad west of the Mississippi river.

The experiments were made on the Oklahoma City-Lawton division of the Frisco. The large government station at Post Field, Fort Sill, Oklahoma, assisted with the experiments.

Vice-president T. A. Hamilton of the Frisco lines and a number of other officials of the company are enthusiastic Radio fans and made the trip with a representative of the Oklahoman and the Oklahoma Radio shop on the days the tests were made.

Atlanta Journal Station Broadcasts First in South

WSB Famed for Visits of Notables—Newspaper Teaches Class How to Make Sets

(Special to RADIO DIGEST)

When the call signals "WSB" flashed through the ether for the first time less than three months ago, signifying that the Radio broadcasting station of The Atlanta Journal was formally and officially "in the air," the southeast had scarcely awakened to the possibilities of Radio. The number of receiving sets in the entire state of Georgia was probably less than a hundred, and these were located chiefly in Atlanta.

Today practically every home is equipped with a radio set. A wild enthusiasm for things Radio swept over the state,

and aerials sprang up like mushrooms over night. Residents in villages and hamlets in remote sections hastened to acquire the necessary instruments to tune in with broadcasting centers.

First in South

This sudden interest and enthusiasm for Radio manifested in this section is attributed to the installation by the Journal of a broadcasting station capable of transmitting concerts, news and other features to all sections of the south. The Journal was the first newspaper in the south to equip and operate a Radio station as a phase of its service for its readers, and has remained pre-eminent in this field.

From the very beginning a regular schedule of broadcasting has been observed. At noon and again at 2:30 o'clock, Central Standard time, stock and market reports and weather forecasts are transmitted on a wave-length of 485 meters. At 5 o'clock a special program consisting of late news bulletins, baseball returns and bedtime stories for kiddies is broadcast. The evening concert, beginning at 7 o'clock and continued an hour, is sent out on a wave length of 360 meters.

Heard All Over Country

Hundreds of letters received from enthusiastic Radio fans throughout the south and in many northern states indicate that concerts and other features of entertainment from WSB are heard and enjoyed in widely scattered sections.

One woman, residing in Oberlin, Ohio, an ardent devotee of Radio, writes that she listens in regularly on programs put on at WSB and particularly enjoys hearing the weather reports transmitted each afternoon, as Georgia weather at this season is in striking contrast with that prevailing in Ohio.

From Detroit and other sections of Michigan almost within the shadow of Detroit's station WWJ, come reports of the reception of music from WSB. The station also has been heard in Dallas, Texas, in the Panama Canal zone, and in Canada; while fans in Indiana, Missouri and Ala-

bama are numbered among the vast throng of Radio enthusiasts who compose WSB's invisible audience. "The Journal Covers Dixie Like the Dew," a slogan made famous by one of the oldest and greatest newspapers in the south, has been given a new and significant meaning by the activities of WSB.

Studio Frequented by Notables

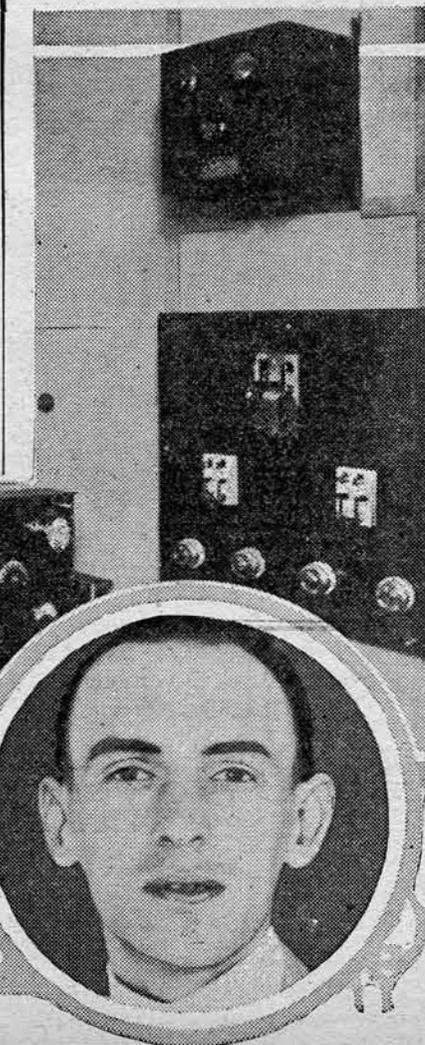
The commodious Radio studio on the fifth floor of The Journal building has been the scene of epoch-making events in the history of broadcasting during the brief period of the station's existence. Persons whose names are familiar throughout the country have sent messages coursing through the air to listening thousands, using WSB as a medium of transmission.

Not the least of the notables who have visited The Journal's Radio studio is the King of Flivverdom, Henry Ford himself. Mr. Ford, while journeying to Florida recently, stopped off in Atlanta and visited WSB. He complimented The Journal for its foresight in entering the broadcasting field while Radio was still in its infancy, and told of plans for equipping trains over his railroad with Radio receiving sets.

Alma Gluck, Efram Zimbalist, Rosa Ponselle and other grand opera stars; Hanford MacNider, national commander of the American Legion; Harry Stillwell Edwards, a native author of Georgia who has won national recognition by his stories of the old South; Corra Harris, author of "The Circuit Rider's Wife" and frequent contributor to The Saturday Evening Post, also a native of Georgia; and other distinguished persons have visited The Journal's Radio studio and contributed to the success of WSB broadcasting.

Newspaper Teaches Radio Class

One of the most unique phases of the Radio activities at WSB is a weekly Radio class, at which the process of constructing a Radio receiving set is explained in detail while hundreds of youthful novices, typical representatives of Young America, make notes. A complete set is built for purposes of demonstration at each class, and at the close of the lesson is presented to one of the youngsters present.



Corner of Station WKY showing transmitter. Insert shows Earl Hull, operator. Earl isn't sick. He just dislikes to have his picture taken.

EXPLAINS FEDERAL UNIT 8 IN DETAIL

ADAPTABLE FEATURE IS AID IN HOOK-UPS

Experimenter Afforded Much Leeway—Endless Variety of Circuits Possible with Set

(See Diagram, Page 7)

The average standard receiving set is so complete that the amateur has little or no chance to try out different circuits and hook-ups. Occasionally he wants to use it for long range, then again for short wavelengths, sometimes the inclination runs towards a regenerative circuit, then again not. Countless letters come in asking, how can I connect a step of Radio frequency amplification to my standard receiving set. All these conditions point to the demand for a flexible set that can be connected up to suit the fancy of the owner.

The Federal Type No. 8 Detector and one-step Amplifier Unit shown in this number can be used in connection with any type of tuning equipment. In the diagram, the unit is shown with a regenerative hook-up, using a loose coupler or vario coupler and two variometers. Naturally, there are no limits to the actual number of hook-ups that can be used with the unit. If desired, one or two steps of radio frequency amplification can be added before the detector tube, likewise more steps of audio frequency can be added after the one-step of amplification already embodied in the unit. Honeycomb coils or even simple tuning coils of the one and two-slide type can be used.

Connections for Tuning Units

There are five binding posts on the left-hand side of the unit as shown in the front view. Reading from the top down, they are marked "GRID" "FIL" "PLATE" "+" "-" (Detector Tube Plate Battery Terminals).

The one side of the Grid Variometer is connected to the "GRID" binding post, while the other side connects with the secondary coil of the tuning apparatus. The other end of the secondary coil is connected to the "FIL+" binding post. If desired a .0005 Mfd variable can be shunted across the secondary coil. The antenna and ground are connected to the primary coil as indicated, similar to any standard receiving set connection. To help in tuning a .001 Mfd Variable condenser should be added to the primary or antenna circuit.

The plate variometer is connected to the two binding posts marked "PLATE" and "+."

Battery Connections

The Plate or "B" Battery for the detector vacuum tube is the usual 22½ volt type. This is connected to the two lower binding posts on the left-hand side marked "+" and "-" making sure that the proper terminals are connected together.

The two binding posts on the bottom of the front view of the panel, marked "-" and "+" are for the Filament or "A" Battery connections. This battery is the usual six volt type. The connections in this case also should be checked to see that the proper terminals are connected to the binding posts as indicated.

On the right-hand side, there are also five binding posts. Reading from the top to the bottom they are marked as follows: the two on top, "OUTPUT," the next two, "PLATE BATTERY" "+" and "-", and the one on the bottom, "FIL. CONTROL." The two on top and the one on the bottom are used if additional steps of amplification are desired.

The two binding posts marked "PLATE BATTERY" "+" and "-" are for the amplified tube battery connections. This Plate or "B" Battery can be 45 volts or more if desired. If the battery has a number of taps, they can be connected to a tapped switch, to permit control of the plate voltage.

Receivers or Loud Speaker

The unit has two jacks, of the filament control type, that means that when the plug is inserted, it automatically lights the filament in the vacuum tube by closing the battery circuit. The jack marked "DET." connects the phones or loud speaker to the detector stage only, and just lights the filament of the detector vacuum tube. The jack marked "AMP." connects the phones or loud speaker to the amplifier stage and automatically lights the filaments of both the detector and amplifier vacuum tubes.

Filament Control Rheostats

The two knobs on the front of the panel are for the control of the current to the filaments of the vacuum tubes. The one on the left controls the detector vacuum tube filament current and the one on the right controls the amplifier vacuum tube filament current. These should be adjusted as each step is being used.

The same warning applies as always, don't try to force your filament current too strong, it creates howling and hissing, and in addition shortens the life of the tubes.

The knobs should be set to the point just before the actual starting of the hissing and purring.

List of Parts

For the benefit of those readers that are interested in the parts making up the unit the following list is given:

- 1—Audio Frequency Transformer.
- 1—Grid Leak.
- 1—Grid Condenser.
- 2—Rheostats.
- 2—Tube Sockets.
- 2—Telephone Jacks.

The detector and amplifier vacuum tubes are not furnished with the unit.

The parts required to complete the receiving set are listed as follows:

- 1—Detector Vacuum Tube.
- 1—Amplifier Vacuum Tube.
- 1—Pair of Receivers 2000 or 3000 ohms.
- 1—"A" Battery 6 Volts.
- 1—"B" Battery 22½ Volts.
- 1—"B" Battery 45 Volts.

Tuning Units depending upon the type desired, Antenna and Ground.

Tuning

Tuning in with this set, depends entirely upon the type of circuit used. In general, the primary circuit is tuned in to the approximate wavelength, then, usually by means of a condenser or the single turn tapped switch, the finer control to wavelength is adjusted. After the primary circuit is adjusted the secondary circuit is tuned in. In conjunction with the secondary circuit, the plate circuit is controlled by means of the grid variometer or honeycomb coil. The variable condenser in the secondary circuit helps for finer control of adjustment in this circuit.

RECEIVING RECORDS? WATCH 'EM GROW—

THE race continues! Amateurs who are able to beat the records listed below, or who can claim distance receiving records (100 miles or better) for stations not listed below, but which are given in the broadcasting directory, need only send in their records to be listed along with their names.

One condition exists. Every record aspirant MUST GIVE THE NUMBER OF MILES represented by the record, if his letter is to be considered. Otherwise it will be thrown out.

Records to date are given below.
—Broadcast Editor.

Station, Miles Record, and By Whom Heard.

DD5—1,265—C. D. Mason, Cleveland, O.
KDKA—1,000—R. Cole, Oklahoma City, Okla.
KDN—700—E. Thornton, Walla Walla, Wash.
KDOW—1,370—F. D. Weeks, Milwaukee, Wis.
KFC—380—6BNG—Watsonville, Calif.
KFU—700—E. Thornton, Walla Walla, Wash.
KFV—150—E. Thornton, Walla Walla, Wash.
KLP—1,300—H. Wantuck, Fayetteville, Ark.
KNJ—1,150—N. M. Holmes, Chippewa Lake, O.
KQW—1,725—W. E. Long, Sterling, Ill.
KVQ—520—T. E. Buchholz, La Grande, Ore.
KWG—670—E. Thornton, Walla Walla, Wash.
KYG—200—E. Thornton, Walla Walla, Wash.
KYJ—1,300—H. Wantuck, Fayetteville, Ark.
KYW—720—G. W. Perkins, Thomson, N. Y.
KZM—570—T. E. Buchholz, La Grande, Ore.
KZY—690—E. Thornton, Walla Walla, Wash.
WCAC—550—N. G. Garlock, Galena, Ill.
WCN—1,000—W. Lerne, Elkhart, Ind.
WDY—1,000—F. D. Weeks, Milwaukee, Wis.
WEI—2,000—Wm. Hayes, E. Liverpool, O.
WFO—375—N. G. Garlock, Galena, Ill.
WGF—635—C. D. Mason, Cleveland, O.
WGY—1,350—R. Cole, Oklahoma City, Okla.
WHA—900—J. B. Dusak, Worcester, Mass.
WJZ—1,200—N. H. Schensted, Brocton, Minn.
WKN—750—A. N. Hopkins, Ashtabula, O.
WLB—600—Thos. Carr, Willard, O.
WMH—620—G. W. Perkins, Thomson, N. Y.
WOH—970—M. Simmons, Shreveport, La.
WOI—500—A. E. Strong, Flagler, Colo.
WOK—700—F. D. Weeks, Milwaukee, Wis.
WOQ—1,100—G. W. Perkins, Thomson, N. Y.
WRR—231—M. Simmons, Shreveport, La.
WSB—1,800—S. S. "Betty B." Canal Zone.
WSY—570—M. Simmons, Shreveport, La.
WWJ—2,200—F. W. Hill, Cristobal, C. Z.

London Secret Radio System Is Successful

Secret Radio communication has been carried on for one hundred miles in and about London. Only the parties called could listen to the conversation. Marconi says that his new method of transmission has transatlantic possibilities which he will develop. This makes the third secret Radio system to be announced as successful within a period of two weeks.

Radio Beats Pugilist to K. O.

Recently the ring battle between Georges Carpentier and Kid Lewis in England was broadcast by a daily paper from a station on the roof of the Marconi building. One amateur who listened in claimed the news came so fast that he knew the results before Kid Lewis learned them.

MINNEAPOLIS.—On account of the recent Radio conference at Washington recommending universities and other public institutions being granted wider privileges than individuals, the governor of Minnesota has requested the newspapers to put their broadcasting stations under the control of the University of Minnesota.

CANADIAN STATION AIDS NEW COUNTRY

CJCA PLAYS ROLE OF CIVILIZER AT EDMONTON

Fur Traders Will Save Money on Falling Markets by Means of Radio

EDMONTON, CAN.—It will be summer time all the year around in the far reaches of the northland with the inauguration of the Journal here of a broadcasting service of information, education and entertainment, to reach the 40,000 people in the vast closed-in regions several hundred miles north of Edmonton in the Peace River country. This territory with the exception of three weeks in summer and two months in winter has been without telegraphic communication with the rest of the world. The Journal's broadcasts will virtually open up this great undeveloped country to news, education and music such as only the fur traders enjoy in the summer time months in the winter.

All New Territory

The new empire, being developed in the Peace River watershed to which the air message from Edmonton will go, is a strip of land 700 miles long and from 100 to 300 miles wide with productive soil and splendid climatic conditions. Beyond this country is the Mackenzie River basin extending more than a thousand miles to the Arctic Ocean. The banks of that river are dotted with trading posts of the Hudson Bay Company and other great commercial organizations. The Fort Norman oil fields where the Imperial Oil Company is drilling for oil on a mammoth scale is included in this great territory to be opened up by Radio.

Traders To Save Money

The new broadcasting station will be able to reach Fort Norman instantaneously. What this means to the fur traders of the north is shown by the fact that when fur prices were falling fast in the winter time one trading company lost a half million dollars. The buyers were under instructions to pay certain prices to the Indians for raw furs and there was no means of reaching them with the news that furs had dropped one-quarter of their previous value. In the future the fur traders will be equipped with Airphones and at specified time will listen in for market information broadcasts from Edmonton.

Book Reviews

Radio Hook-Ups. By M. B. Sleeper. There are 82 circuits ranging from a simple detector and phone hook-up to those using several steps of amplification.

Home Radio. How to make and use it. By A. Hyatt Verrill. 75 cents. 12 full-page illustrations and diagrams.

This book is intended particularly for the amateur and for those who wish to know how to make and adjust Radiophones. The author has avoided technical terms and has aimed to make the directions plain and simple.

Directive Wireless Telegraphy. Direction and Position Finding, etc., 57 illustrations and 5 tables. Price, 85c. By L. H. Walters, M. A.

The A B C of Vacuum Tubes in Radio Reception. By E. H. Lewis. An elementary and practical book on the theory and operation of vacuum tubes as detectors and amplifiers. Explains non-mathematically the fundamental principles upon which all vacuum tube circuits are based. Price, \$1.00.

How to Make Commercial Type Radio Apparatus. By M. B. Sleeper. A guide book for those who desire to make their equipment equal in appearance as well as performance to the commercial type of apparatus. It gives a world of data on how to make efficient radio stations. The illustrations more than the descriptions show the niceties of design developed by the commercial companies. Price, 75 cents.

Radioactivity and Radioactive Substances, by J. Chadwick, M.Sc., 32 illustrations and 9 tables. Price, 85c. (Just out.) With a foreword by Sir Ernest Rutherford, F. R. S.

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.

RADIO FOR THE BEGINNER

tells you what you want to know about radio. It explains the principles of radio, the vacuum tube, radio tuning, etc., in plain language, and will help you make your set work better. Handy pocket size book, price \$1.00. Order to-day.

ALFRED FOWLER

15 Board of Trade, Kansas City, Missouri

Federal HEAD TELEPHONES



THEIR ABILITY OF PERFECT REPRODUCTION OF SPEECH AND OTHER SOUNDS

HAVE MADE

Federal HEAD TELEPHONES
EXTREMELY POPULAR
WITH ALL CLASSES OF USERS

THEY ARE DURABLY CONSTRUCTED — LIGHT IN WEIGHT — CAREFULLY MATCHED IN TONE

DEMAND FROM YOUR DEALER

THE GENUINE Federal ACCEPT NO SUBSTITUTE

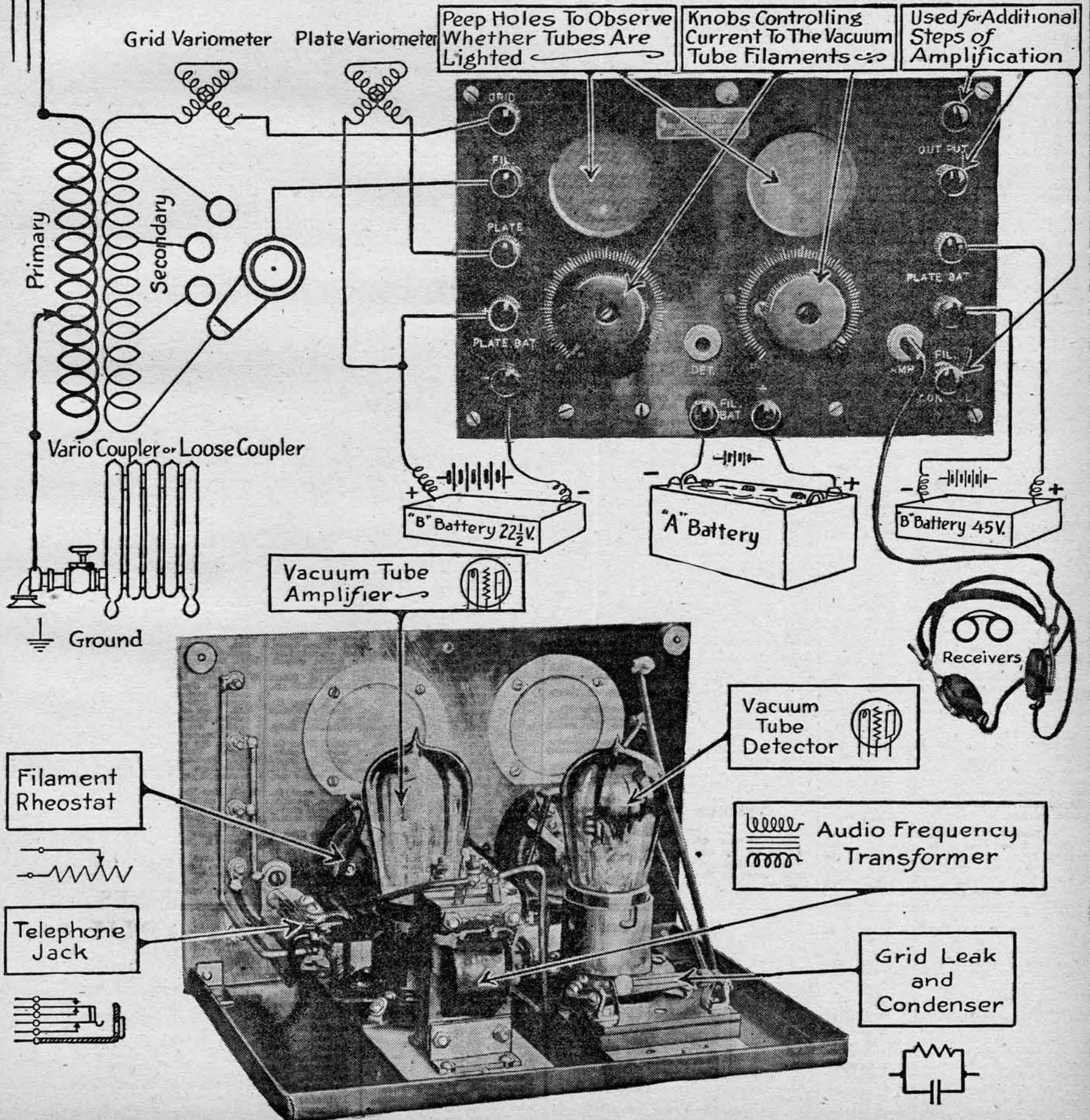
Federal Telephone and Telegraph Company
BUFFALO, NEW YORK

Radio Receiving Sets

Federal Type 8 Detector and Amplifier Unit

As the ninth of the series of standard receiving sets, RADIO DIGEST presents the Federal Type 8 Detector and Amplifier unit, manufactured by the Federal Telephone and Telegraph Company of Buffalo, New York. Full information of this

receiving unit, and the method of connecting the tuning apparatus, will be found on page 6, first column. This unusual unit is an interesting one for the amateur who desires to experiment with different kinds of hook ups.



Radiophone Broadcasting Stations

Corrected Every Week.

CONTENTS AND HOW BEST TO USE—

A CHANGE in the broadcasting station directory has been made in order to give RADIO DIGEST readers maximum information about each station in the most useful form for the user. The directory, now listing 368 broadcasting stations in the United States, Canada and Hawaii, is, as it always has been, the most complete and authoritative directory of its kind. At much expense and trouble, this feature is revised and brought up-to-the-minute every week.

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. 1,450 also. 50 mi. Signal Corps, U. S. A. Sun, 7-9 pm, instruction. Pacific.

CFCF, Montreal, Can. 440 only. 200 mi. Marconi Co. Daily, 4-1:30 pm, concert. Mon, Thurs, 8-9 pm, concert. 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.

GAM, Montreal, Quebec, Canada. 440 only. 200 mi. Marconi Co. Daily, 4-1:30 pm, concert. Mon, Thurs, 8-9 pm, concert. Eastern, daylight saving.

KDKA, Pittsburgh, Pa. 1,000 mi. Westinghouse Elec. Mfg. Co. Daily ex Sun, 10-10:15 am, 12-13:15 pm, 2-2:20, 4-4:20, music; 7:30, bedtime story; 7:45, news; 8:30-8:50, 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.

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

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

KGC, 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.

KG, 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 (Daily Oregonian.) Daily, 8:30-4:30 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.

KIC, Los Angeles, Calif. 100 mi. Standard Radio Co. 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, Redley, 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, 11-11 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.

KNW, Los Angeles, Calif. 100 mi. Bullock's. Tues, Thurs, Fri, 10-11 am, Pacific.

KNT, Aberdeen, Wash. 400 mi. Grays Harbor Radio Co. Daily, 6-5:30 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. (Telephone only.) Mountain.

KOG, Los Angeles, Calif. 300 mi. Western Radio Elec. Co. 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.

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

KQW, San Jose, Cal. 200 mi. Chas. D. Herrold, Wed, 7:30-8:15 pm, concert. Sun, 5-6 pm, concert. Pacific.

KRE, Berkeley, Cal. 100 mi. Maxwell Elec. Co. Sun, 12-1 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.

KUC, 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.

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 pm, 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, 12-13 pm, music, news, crop reports. Daily 5:30-6:30 pm, music, news. Sunday, 2-3 pm, sacred concert. Pacific.

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

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

KVW, 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 food-stuffs. Pacific.

KZC, Los Angeles, Cal. Western Radio Elec. Co. Daily ex Sun, 5-5:30 pm, news, concert. 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.

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. Bordeaux Elec. Co. Daily ex Sun, 7:30-9 pm, baseball, concert. Central.

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

WAAG, 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.

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

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. 100 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. 200 mi. Star Telegram. Daily ex Sun, 11-11:30 am, weather; 2-2:30 pm, road conditions; 3:30-4 pm, news, markets; 6:30-7, baseball; 8-8:30 pm, bedtime story, lecture; 10:30-11, concert. Sun, 2-2:30 pm, sermon, 3:30-4, concert. Central.

WBAQ, South Bend, Ind. 100 mi. Myron L. Harmon. Daily, 5:30-6 pm, news, concert; 9 pm, concert, news, police reports. Sun, 8:30 pm, church services. Central.

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

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.

WBZ, 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.

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

WCWA, Quincy, Ill. 200 mi. Quincy Elec. Supp. Co. (Quincy Herald.) Daily ex Sun, 8:45 am, markets; 11 am, 12 pm, 3:30-4:15 pm, 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, 6:45-8:30 pm, concert, lecture, bedtime story. Central.

WDC, Worcester, Mass. 485 also. 100 mi. Clark Univ. Daily, 7:15-8:15 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.

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.

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.

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.

WEW, 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.

WF, 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.

WF, Dayton, O. 485 also. 300 mi. Rice-Kunmer 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.

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 am, 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.

WGO, Buffalo, N. Y. 485 also. 200 mi. Federal Telep. & Teleg. Co. Daily, 12 pm, 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, 7:45-8 pm, concert, lecture. Eastern.

WHA, Madison, Wis. 485 also. 600 mi. Univ. of Wis. Daily ex Sun, 12:30-1 pm, weather, markets, time. 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.

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, market, 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.

WIK, McKeesport, Pa. 500 mi. K. & L. Elec. Co. Daily ex Sun, 6:30-7 pm, Tues, Thurs, 9:30-10:30 pm, 3:30-2:30 pm and 6:30-7 pm, concert. Eastern.

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

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

WIK, 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. 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, music. Eastern, daylight saving.

WKC, Baltimore, Md. 300 mi. Jos. M. Zamolski 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. 1,200 mi. Crosley Mfg. Co. Tues, Thurs, Fri, 8 pm, concert, lecture, news. Sun, 8 pm, church service. 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.

WNI, 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. 485 also. 300 mi. Buckley Radio Service Co. Mon, Wed, Fri, 7-8:15 pm, concert, news, lecture. Sun, 10-12 am, church service. Eastern.

WOH, Indianapolis, Ind. 700 mi. Hatfield Elec. Co. Daily ex Sat and Sun, 10-11 am and 4-5 pm, financial, concert. Mon, Wed, 8:30-10 pm, concert. Sat, 10-11 am and 1-2 pm, financial, music. Sun, 10-11 am, concert. 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.

WOO, 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, 11:30 am, weather; 7:30 pm, baseball, concert; 9:30, news; 9:50, weather. 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.

WPI, 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.

WRI, 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, 7 pm, police news, sports, weather; 8:30-9:30, concert. Sun, 11 am and 7:30 pm, 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. 1,000 mi. Atlanta Journal. Daily ex Sun, 12 m, weather; 2:30 pm, markets; 4, concert; 5, baseball, news, bedtime story; 7-8, concert. Sun, 11 am and 6 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, 8:30-9:30 pm, concert, addresses etc. 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.

WTW, 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 May 28 and every other week, 7-8 pm, concert, lecture. Fill in weeks, 8:30-11 pm, concert, lecture. Sun, May 28 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.

9WD, Denver, Colo. 235 only. W. D. Pyle. Sat, 8-8:30 pm, concert. Sun, 5:30-7:00, concert. Mountain.

9VY, Lincoln, Neb. 375 only. 300 mi. Univ. of Neb. Daily ex Sun, 10:10 am, stock and grain markets, weather; 7:30 pm (irregular), concert. Central.

State, City, Call	State, City, Call	State, City, Call	State, City, Call	State, City, Call	State, City, Call	
Alabama: Birmingham, WSY Montgomery, WGH	Hollywood, KGC Long Beach, KSS Los Altos, KLP Los Angeles, KDZP Los Angeles, KNX Los Angeles, KJC Los Angeles, KNR Los Angeles, KNY Los Angeles, KON Los Angeles, KUS Los Angeles, KWH Los Angeles, KXS Los Angeles, KZI Los Angeles, KJS Los Angeles, KOG Los Angeles, KQL Los Angeles, KJY Los Angeles, KZC Los Angeles, KFI Los Angeles, KHJ Los Angeles, KNN Los Angeles, KDZD Los Angeles, KDZF	Modesto, KXD Monterey, KLN Oakland, KKL Oakland, KLS Oakland, KZM Oakland, KZY Pasadena, KBYR Pasadena, KLB Pomona, KGF Redwood City, KDYN Sacramento, KVQ San Diego, KDYM San Diego, KDYO San Diego, KDPT San Diego, KYF San Francisco, AG1 San Francisco, KDN San Francisco, KGB San Francisco, KSL San Francisco, KPO San Francisco, KUO	San Francisco, KDZG San Jose, KQW San Jose, KSC Stockton, KJO Stockton, KWG Sunnyvale, KJJ	Colorado Springs, KHD Denver, KDYY Denver, 9WD Denver, DD-5 Denver, KLZ Denver, KOA	Washington, WXX Washington, 3YN Washington, WPM Washington, WIL	Florida: Jacksonville, WCAN Jacksonville, WDAL Tampa, WDAE

State, City, Call

Kansas:
Anthony, WBL
Atwood, WEAD
Eldorado, WAH
Emporia, WAAZ
Lindsborn, WDAD
Manhattan, WTTG
Wichita, WEY
Wichita, WAAP
Wichita, WEAH

Kentucky:
Louisville, 9ARU

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

Maine:
Auburn, WMB

Maryland:
Baltimore, WCAO
Baltimore, WKC

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

Michigan:
Bay City, WTP
Dearborn, WWI
Detroit, WWJ
Detroit, KPO
Detroit, WCX
East Lansing, WHW
Flint, WEAH

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

Missouri:
Columbia, WAAN
Jefferson City, WOS
Kansas City, WDAF
Kansas City, WKB
Kansas City, WOQ
Kansas City, WPE
St. Joseph, WEAK
St. Louis, KSD
St. Louis, WAAE
St. Louis, WCK
St. Louis, WEB
St. Louis, WEW

Montana:
Great Falls, KDYS

Nebraska:
Lincoln, WCAJ
Lincoln, 9YY
Omaha, WOU
Omaha, WOV
Omaha, WAAW

Nevada:
Reno, KDZK
Reno, KOJ

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

New Mexico:
Roswell, KNJ
State College, KOB

State, City, Call

New York:
Albany, WNJ
Buffalo, WGR
Buffalo, WWT
Canton, WCAD
Ithaca, WEAI
Newburgh, WCAB
New York, WBY
New York, KDOW
New York, WVP
New York, WWZ
New York, WDT
New York, WDAM
Rochester, WHQ
Ridgewood, WHN
Schenectady, WGY
Schenectady, WRL
Syracuse, WDAI
Syracuse, WBAB
Tarrytown, WRW
Utica, WSL

North Carolina:
Charlotte, WBT

North Dakota:
 Fargo, WDAY

Ohio:
Akron, WOE
Athens, WAAV
Canton, WVB
Cincinnati, WAAD
Cincinnati, WLW
Cincinnati, WMH
Cincinnati, WIZ
Cleveland, WHK
Columbus, WBAV
Columbus, 8YO
Dayton, WFO
Dayton, WA-1
Defiance, WCAQ
Fairfield, WL-2
Granville, WJD
Hamilton, WBAU
Hamilton, WRK
Lebanon, WPG
Marietta, WBAW
Portsmouth, WDAW
Toledo, WHU
Toledo, WJK
Toledo, WBAJ
Youngstown, WMC
Youngstown, WAAJ
Zanesville, WPL

Oklahoma:
Muskogee, WDAV
Oklahoma City, WKY
Oklahoma City, 5XT
Tulsa, WEH

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

Pennsylvania:
Bridgeport, WBAG
Brownsville, WDAQ
Clearfield, WPI
Erie, WSX
Erie, WJT
Harrisburg, WBAB
McKeesport, WIK
Philadelphia, WCAU
Philadelphia, WFI
Philadelphia, WIP
Philadelphia, WGL
Philadelphia, WOO
Philadelphia, WJP
Philadelphia, WDAW
Pittsburgh, WCAE
Pittsburgh, KDKA
Pittsburgh, KQV
Pittsburgh, WAAJ
Pittsburgh, WPB
Villanova, WCAM
Wilkes-Barre, WBAX

Rhode Island:
Edgewood, WEAG
Pawtucket, 10J
Pawtucket, 1XAD

State, City, Call

South Dakota:
Rapid City, WCAT

Tennessee:
Memphis, WKN
Memphis, WPO
Nashville, WDA

Texas:
Amarillo, WDAG
Austin, WCM
Dallas, WRR
Dallas, WDAO
El Paso, WDAK
Fort Worth, WBAP
Fort Worth, WPA
Houston, WCAK
Houston, WEV
Paris, WTK
San Antonio, WCAR

Utah:
Ogden, KDZL
Salt Lake City, KDZY
Salt Lake City, KZN

Vermont:
Burlington, WCAJ

Virginia:
Norfolk, WSN
Richmond, WBAZ

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

West Virginia:
Charleston, WAAO
Huntington, WAAR
Morgantown, WHD
Zanesville, WPL

Wisconsin:
Milwaukee, WCAJ
Milwaukee, WAAK
Madison, WHA

Hawaii:
Honolulu, KGU
Honolulu, KDYX

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

in a similar manner, the Florida State Marketing Bureau, the Florida Times-Union, and the Southeastern Radio company co-operating in the work.

At Roswell, N. Mex., the Public Service corporation will broadcast reports received from the Kansas City office of the Bureau of Markets and Crop Estimates. At Milwaukee, the Chamber of Commerce will broadcast their grain quotations in conformity with suggestions made by the federal bureaus.

RADIO WINS FIRST PLACE FOR SPEED

Coast Test Proves Airphone More Economical and Speedier Than Wire

SAN FRANCISCO.—A recent test conducted by Shipping Board representatives at San Francisco, to determine the more efficient and economical method of handling communication between points gave the honors to Radio. After a two weeks' trial with similar messages sent between San Francisco and Los Angeles, San Diego, Portland, Seattle and Tacoma, the average time elapsed between filing messages at Shipping Board offices and the receipt of same by addresses for wire lines averaged 37 minutes, where as the average was only The traffic costs was between 40 and 50 per cent less using Radio communication with the result that most of the coastwise traffic is now being given to the Radio circuit, although some difficulty may be encountered with summer static.

A Special to Milwaukee Show

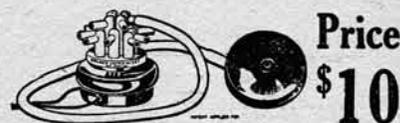
Because of the heavy demand from the Radio fans in Chicago for reservations, the Chicago, North Shore & Milwaukee Railroad will run a Radio Special during the Radio Show, June 21-25, inclusive. A Radio outfit will serve to entertain the passengers en route.

RADIO For Everybody

Make Radio a profession instead of a plaything. You can earn big money as a Radio-trician. Learn by mail, in spare time, how to design, construct, install, repair, maintain, operate, sell and demonstrate complete radio outfits. Write for free 32-page catalog describing our course entitled, "How to Learn Radio at Home." National Radio Institute, Dept. 1161, Washington, D. C.

★ Radio Bugs! ★
Try This on Your Cat's Whisker

To the tune of Yankee Doodle



Price \$10

Gregg's Listen In set, is a marvel, you bet, Through which the waves come "abuzzin'". Attach to the phone You now use alone, - And the program is heard by a dozen. Yes, a dozen hear the news, A dozen hear it dandy. Everyone should have Gregg's Set. Because it is so handy. The family should get Gregg's Listen In set. Does for all, even uncle and cousin. No more all alone Does one use the phone, The set sends it out to a dozen.

Write for Catalogue

Gregg Company
Room 505, 35 South Dearborn Street
CHICAGO

BREMER-TULLY

Radio products are guaranteed superior in design and workmanship to anything on the market.

Vernier Condensers

23 Plate, Only . . \$7.50
43 Plate, Only . . \$9.00
Knob and Three-inch Dial Included

Vernier Rheostat . \$1.50
Variable Grid Leak, 60c
Grid Condenser . . 35c
POSTPAID

IMMEDIATE DELIVERY

Discounts to Dealers

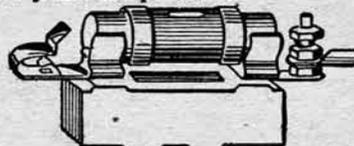
BREMER-TULLY RADIO CO.
532 South Canal Street
CHICAGO

Telephone Harrison 2964-6658

BRACH

VACUUM LIGHTNING ARRESTER

Here is exactly what owners of radio outfits want—real protection for their wireless and their homes—protection not only from lightning bolts direct, but from resulting static that fills the air after every lightning flash and which can cause fire. The Brach Arrester is simple in operation, does not require switching on and off, and cannot become grounded. Experts agree it is the best of all arresters. 16 years use proves it.



Sold by Dealers Everywhere
L. S. Brach Mfg. Co.
Newark, N. J.

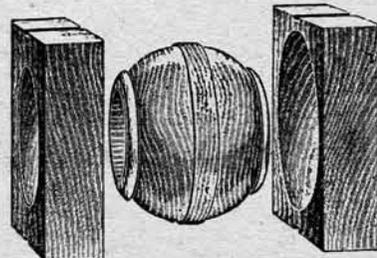
SELECTOR

A selective radio contact switch. For varying the number of turns in any kind of radio tuning coil.

The SELECTOR can be mounted on coupler or coil direct, thus reducing leads to a minimum. Short leads and positive contact in radio instrument wiring are not only necessary, but are imperative for highest efficiency.

The SELECTOR combines these essential features and in addition is compact, positive and will give that commercial appearance to your panel.

ROTORS AND STATOR SECTIONS



Carefully and accurately made from specially selected and treated woods. Not "mere wood turnings," but manufactured to pattern makers standard.

Rotors packed 50 and 100 in package. Stator sections packed 100 and 200 in package.

Dealers! Send for interesting circular and attractive proposition.

NORRIS ELECTRICAL SPECIALTIES CO., Inc.
126 Liberty Street
NEW YORK CITY
Telephone Rector 6669

MAKES SIMPLEST SET AT SIXTY-CENT COST

Government Employee Lays Out Receiver by Metric Measure

Special to RADIO DIGEST
WASHINGTON.—What is believed to be the simplest and most inexpensive (though not the smallest or most compact) Radio receiving set has been designed by C. A. Briggs, of this city. Mr. Briggs, who is connected with the weights and measures division of the Bureau of Standards, has followed closely recent developments in amateur Radio, and his knowledge of the metric system and its extraordinary simplicity suggested the idea of constructing the simplest possible receiving set. As a result, the set which he has constructed is laid out entirely to metric dimensions, and he has designed it as Metric Set No. 1.

Aside from the antenna, ground wire, detector, and phones, which are necessary to all sets, the arrangement consists of 2 simple coils wound on strips of flat cardboard. No variable condenser or sliding contacts are necessary. All tuning within the range of the set can be accomplished by sliding one coil over the other, first using the upper one with one face turned to the top, and then with the other face turned up, according to the wave length of the incoming signal.

The cost of all the material actually entering into the set, aside from the antenna and telephone receivers, will be about 60 cents which includes the cost of the crystal detector and all necessary screws and other metal parts. As almost every one can locate some of this material around the house, the actual cost in many cases would probably be limited to 20 or 25 cents. With this set an Airphone message broadcasted from Schenectady, 300 miles away, has been heard without amplification in Washington.

New Stations Open South to Farm News

Comprehensive Service Given Southern Farmers by the Department of Agriculture

WASHINGTON.—Arrangements for broadcasting weather, crop and market news by Radiophone from Memphis, Jacksonville, Roswell, New Mexico and Milwaukee, have been made by the Department of Agriculture. This will make 41 stations in the United States from which agricultural news is being broadcast by Airphone.

The Radio news service of the Department of Agriculture was started in an experimental way less than 18 months ago. The practicability of getting market reports to farmers and other agricultural interests by this means was soon demonstrated. The department has received many requests from private and public agencies to furnish them with weather, crop, and market news for broadcasting. These requests have been granted to stations licensed by the Department of Commerce to broadcast agricultural reports. Recently, the Department of Commerce assigned a wave length of 485 meters for the exclusive use of stations broadcasting agricultural news. This eliminates as far as possible any interference.

At Memphis, marketing conditions regarding cotton, fruits, vegetables, live stock, and other commodities at the important market centers of the country will be broadcast under a co-operative arrangement between the Memphis Press and the Reichman-Crosby company, an electrical firm. The reports will be telegraphed to Memphis from the St. Louis office of the Bureau of Markets and Crop Estimates, and will be augmented by reports of conditions in local markets. The broadcasting program for Florida will be conducted

Radio Digest Illustrated

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In a new scientific field where many writers are contributing articles there will arise some controversy over the expressions of opinions and statements made from time to time. Some of these controversies may be taken into the courts for settlement. The priority of inventions may be claimed as well as the merits of some part entering into the construction of the radio apparatus. The Radio Digest is an outlet for these expressions and the publisher disclaims any responsibility for opinions or statements made in connection with radio apparatus. The news will be printed as it comes to us.

Vol. 1 Chicago, Saturday, June 17, 1922 No. 10

Concerts for the Motor Boat Owner

While Taking a Cruise, Enjoy Music by Radio

JUST as the motorboat season opens up Radio takes another turn. Those persons fortunate enough to own canoes or expensive power boats are installing receiving sets. There is no better way for the tired business man to get rest and relaxation than by taking a cruise in a motorboat during the warm summer evenings. To add to the amusement, Radio now comes. Entertainment direct from singers, orchestras, and multitudinous other sources may be had even though the tired business man may be miles away from shore.

They All Talk About Static Now

Will This Summer See It End?

SO MUCH is said about static these days that the person who now desires to purchase a receiving set makes many inquiries before he takes one home with him. Static is the first cousin to lightning and it's prevalent during hot weather and will depart with the return of winter. While this enforced Radio vacation may be disappointing to many that are new in the game, there is hope for its complete eradication before another summer rolls around. Perhaps before this summer is over the problem of static may be solved and its elimination insured. Dr. Louis Cohen and Major Mauborgne are finishing experiments on an anti-atmospheric apparatus. You may be the one who will discover a satisfactory way out of this difficulty.

Ninety Per Cent Sold Beginners

Broadcasts Result in Sale of Many Assembled Sets

LONG before broadcasting started the needs of the Radio amateur, with his little transmitting and receiving station, was considered an interesting side line. Manufacturers did a comfortable business selling transformers, tubes, sockets, rheostats and other parts of apparatus to the amateur or person interested in assembling his own set, perhaps bit by bit on the kitchen table.

During this preliminary period about ninety per cent of the demand was for the component parts of the Radio set and not for the assembled set. When broadcasting came along then everything was changed. The beginner then became the big factor in the business, by demanding whole sets rather than parts.

The beginner of today is not especially a mechanic, but he desires music and entertainment in a hurry and without much bother. The demand for assembled sets has become ninety per cent of the Radio business. Of course, the demand for component parts has grown much greater than the demand a year ago.

Regulations Too Slow for Radio

Second District Allots Time for Broadcasting

THE speed of Radio has pushed it far beyond any rules and regulations that were enacted and enforced heretofore. While bills are being drafted at Washington the situation continues to grow worse.

Probably one of the best intended actions that has marked orderly procedure in the field of Radio broadcasting was taken by the authorities in the Second District in an effort to let all licensees of the broadcasting fraternity to get in the air and have an equitable division of the time which, it is assumed, the average enthusiast spend with his receiving set. All of the owners of stations in the district licensed to broadcast on 360 meters were called into conference and after a week's deliberation and discussion, the tentative allocations of time were given to the various stations.

This new schedule, which regulates the time of the station in and around New York City is the first action

of its kind to be taken and is considered a very important move in controlling the air.

This order of procedure is one way to overcome the conglomerate mess the national situation is fast becoming, and it may show a way to aid federal Radio regulation. However, it is not expected that the new plan will conflict with the federal government's policy which is expected within a few weeks.

Comments from Newspapers

Radiophones Spoken of by Many Editors

THERE is every indication to believe that grand opera will have a chance to be recognized for its real value if Radiophone broadcasting of concerts is maintained in the future. The editor of the World (Omaha, Neb.) speaks of grand opera and the Radiophone as follows:

"Grand and the lighter operas, both of which heretofore have been looked upon, more or less, as entertainment for the rich, now have the chance of 'going on trial' in every home in the land, with the advent of the Radiophone.

"No one, of course, can foresee at this time the possibilities of the Radio, but already it has been the means of introducing the opera to many who had never heard it before, and practically gratis, too.

"Operas are criticized mostly by people who have never heard them; by those who have never had the opportunity to appreciate them. Most of these look upon them with displeasure—the opera as a place where only the elite go to display the gorgeous gowns and dresses they wear, but once the strains of the opera singer's voice or from the symphony orchestra go floating on the ether into the homes in every village, hamlet and at every cross-road, and are heard as they are rendered—not just reproduced—opinions may be changed.

"Opera music must be heard to be appreciated. It's like eating olives. At first you don't like them, but when you try them a second time they taste better, and on the third trial you find that you actually are fond of them. So it is with opera."

There is no way to get figures on the manufacture of Radio parts or how much apparatus has been sold. In the columns of the Chicago Commerce there is mentioned in this regard the following:

"As an industry, Radio, in all its branches, has furnished one of the most remarkable chapters in the history of Chicago business. The great change in the popularity of Radio in the middle west was last October, when operatic performances were sent out. Those who had receiving sets kept them constantly busy while music was being sent out, and their friends hastily put in orders for apparatus. Manufacturers were swamped and the industry grew fast. So rapid has been the growth that there is now a great deal of confusion with regard to the real facts. Statisticians who have tried to gather facts about the manufacture and sales of Radio apparatus admit they are miles behind with their data. It is frankly admitted that the figures given out about the manufacture and sales of Radio apparatus are nine-tenths guesswork."

It is soon going to dawn upon some of us that Radio is going to turn out to be a time saver. The congressman does not need to go home to make a speech, or the minister travel miles to fill a pulpit. The editor of the Independent (Stockton, Cal.) writes of conventions by Radio:

"It looks as if Radio were going to turn out to be a great little time saver, not to mention economy of railroad fare. In due time, no doubt, conventions will be held by having delegates all over the country sit down in their own homes or offices while they listen to addresses, resolutions and reports by means of the Radiophone.

"The St. Louis sending station is sending out social service messages on such subjects as the Boy Scout movement, the prevention of tuberculosis and the operation of community chests. Pittsburgh is telling the world nightly all about co-operation and citizenship, city government, safety in the streets and better citizenship through organized play and recreation. In Los Angeles last week leaders in social work took part in a state social service conference in another city, although they did not leave their own city. One of these leaders turned from the work at his desk only long enough to deliver a lecture by Radio from his office."

Some say that the progress of Radio has abated, but there is considerable in the air yet, and just as many enthusiasts remain. All of them may not be talking at once as they were a month ago, but they are still there and busy at it. The Telegram (Adrian, Mich.) says of Radio progress:

"The announcements of new inventions improving and facilitating the broadcasting and the receiving of messages by Radio are being made so fast these days that it is difficult for the layman to comprehend their significance. The government recently announced that a series of experiments had developed a piece of Radio equipment that will eliminate the necessity of storage batteries and that will permit owners of receiving sets to obtain their power from ordinary house electric lighting circuits. France is doing away with atmospheric electricity, or static, by substituting underground tubes for overhead antenna.

"Another inventor more recently has brought out a set that needs no more wires than a coil hung on the back of a box and many amateurs are finding that bed-springs, picture wires in the living room and countless other mediums that two years ago would be looked upon with ridicule, are proving efficient conductors of the messages from the air."

RADIO INDI-GEST

Give the Radio a Shot!

He gave up home brew
Weeks ago
To work on home made
Radio,
But up to date can't
Make it go.



Instructions for Radio Fans

Speak directly into the broadcaster.

If you have trouble getting your party do not jiggle the antennae; shake the aerial pole or hammer on the roof.

Be courteous over the Radiophone. Do not shout: "Get off the ozone!" "Aw, hang up?" "This is a private wave length," or other vulgar commands.

Never lose your patience to the point of yelling. Remember, after a hard day's work the little electrons become very exhausted and nervous.

To correct lack of attention on the part of the atmosphere, complaint operators will be maintained in blimps over all larger cities.

Never ask for "information." Just listen long enough and you'll get both ears full.

To report a fire, say "I wish to report a fire." In case you have a fire just at the time the "Man in the Moon" stories are being broadcasted you will have to wait until they are finished. The management will send subscribers a booklet on "How to Keep Fires Going Until an Opportunity Comes to Report Them" on request.

Subscribers will please excuse slight errors in establishing connections on the Radiophone. If you ask for "Saxophone Selections by J. Goofus Zuff" and get a "Fashion Talk by Arabella McNally" kindly "excuse it, please." Likewise, if you call for "Address on the Darwinian Theory by Professor Duncan Dodobird" and are looped up with the Man in the Moon, you will please hang up, call the complaint operator and say in a courteous voice, "I got the wrong annoyance."

Subscribers must not swear thru the air. It is likely to singe the feathers of birds in flight.—Denver Post.

Program for This Evening

K K K (Atlanta)—6:00 P. M., lecture, "Now Is the Time to Have Your Tonsils Cut," by Dr. E. T. Lutz, chiropodist. 7:30 P. M., sacred concert by boys' band of W. C. T. U. 8:15 P. M., moving pictures. 9:15 P. M., address, "The Four-Power Treaty Will be Opposed in Senate as Long as Mule Power and Lung Power Are the Only Recognized Powers," by Senator Wheatake. 10:00 P. M., fancy gargling by male octet from laryngitis ward. 10:45 P. M., balloon ascension. 11:30 P. M., bedtime stories for the kiddies, told by Pancho Villa. 12:15 A. M., election returns from Congo Free State. 1:30 A. M., travelogue, "Seeing Nellie Home," with Merton Gomes.—Indiana Daily Times.

Hoopskirts Radio Back

A hoopskirt has been successfully used as an antenna. Ladies will have a distinct advantage in the matter of Radio receiving if this quaint and now remodernized fashion comes back.



Full of Hot Air

It won't be long before the Radiophone will develop to the point where we hear: "The air's busy."—Brooklyn Eagle.

How About the Antenna?

"Are your new neighbors modern people?" "Modern? Say, they sent in last night to borrow our Radio set!"—Buffalo Express.

Jealous of Radio

There are persons that have a mania for getting plenty of free advertising. Now that Radio is in the limelight the manufacturer of automobiles is secondary and it does not quite suit some folks. This is what Henry says in his weekly about Radio: "Stripped of all veneer, the broadcasting of these programs is merely a press-agenting of Radio wares." How about those old wise cracks about flivvers, Henry?

How to Make Simple Radio Recorder

Old Razor Blades Make Good Condenser Wings

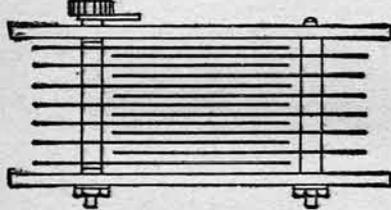
A very efficient condenser for use with Radio sets can be made from a few discarded safety razor blades, as shown in the illustration. It is very difficult to determine in advance the capacity of a condenser, especially when used in small re-

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.

ceiving sets. While it is easy to obtain precise regulation of the self-induction placed in the circuit in a similar way, by means of a runner of some sort which varies the number of coils on the spool that come into play, it is a little more difficult to construct a condenser the capacity of which can be regulated at will. It is well known that a condenser is made of plates of a conducting metal, al-



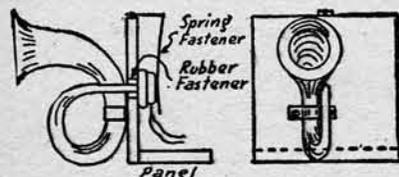
ternating with insulating plates or dielectrics, and that the capacity of the apparatus is a function of the surfaces that face each other as well as of thickness of the dielectric. The razor blades, then, will form the conducting plates and the air will serve as a dielectric.

To construct this instrument, mount between two plates of fiber a number of blades varying with the maximum capacity to be obtained. Mount them immovably on a conducting axle riveted to a frame. A second set of blades must be mounted on another axle in such a way that they will pass freely between those which are fixed, taking care that the thickness of the layer of air forming the dielectric shall be as thin as possible.

The apparatus is complete when a corrugated button is mounted on the end of the axle, carrying the movable blades in such a manner that these may be turned to vary the capacity of the condenser at will. A pointer fixed under the button and a graduated scale on a circular disk on the frame will make it easy to regulate once for all the position on which the blades are to be turned, in accordance with the sending station which it is desired to hear.

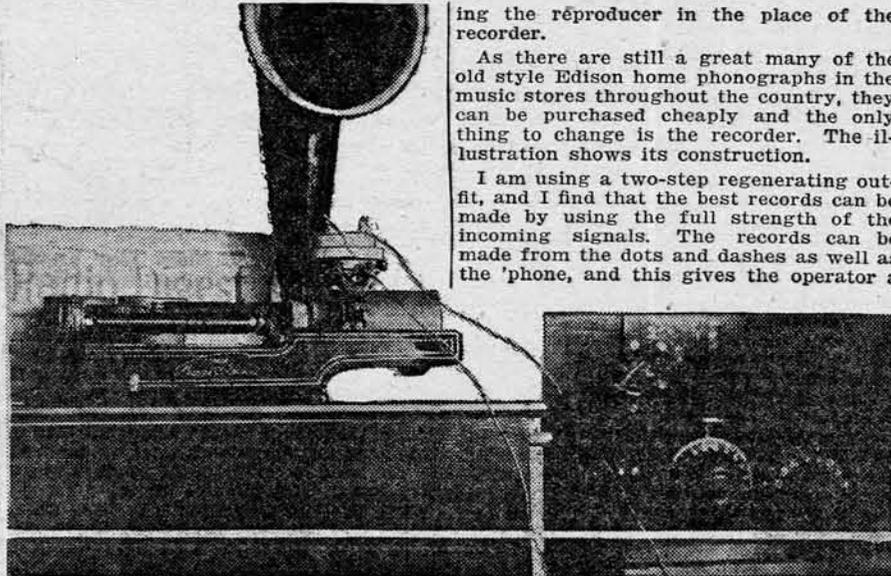
Auto Horn Makes Loud Speaker

The illustration shows a novel kink which I believe is original. An old-fashioned automobile horn was procured and the hose that connected the bulb and horn was removed. This made a fairly good loud speaker, but not being satisfied with



the results I took the rubber bulb and cut a piece off from the smaller end so that it fitted snugly over the end of the horn. This was mounted as shown. Very good results were obtained on one step of amplification. Music can be heard 75 feet away from the horn. On a simple crystal set it could be easily heard at 10 feet.—Jack Ward.

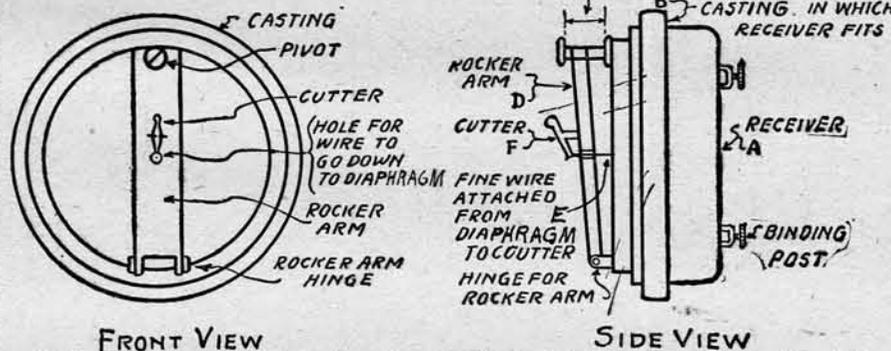
HOME RADIOPHONOGRAPH



ing the reproducer in the place of the recorder.

As there are still a great many of the old style Edison home phonographs in the music stores throughout the country, they can be purchased cheaply and the only thing to change is the recorder. The illustration shows its construction.

I am using a two-step regenerating outfit, and I find that the best records can be made by using the full strength of the incoming signals. The records can be made from the dots and dashes as well as the 'phone, and this gives the operator a



A 1000-ohm receiver. A fits into the casting B. The pivot C allows the rocker arm D to slide up and down. A small wire E passes through a hole in the rocker arm and one end is connected to the diaphragm of the receiver. The cutter F is connected by a small wire from the diaphragm to the cutter. The waves passing through the receiving set are intercepted by the phone on which the cutter is attached. The vibrations from the diaphragm are recorded on a wax record by the moving of the cutter upon the record cylinder.

No doubt there are many amateurs that would like to try recording signals. This may be done with the outfit illustrated. The outfit I am now using is an old Edison home phonograph. I have connected a fine wire to the diaphragm of a Brandes 1000 ohm 'phone' and connected this wire to the cutter of the recorder. This is easily accomplished by making a bracket to fit in the hole in which the reproducer fits. The old style wax cylinder records are used, and after they have been cut by the recorder, they can then be reproduced on the same machine by replac-

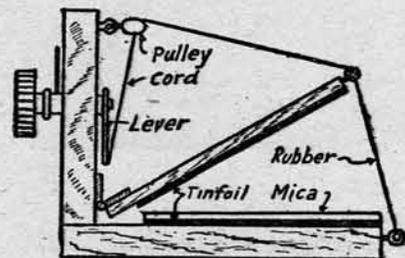
ing the reproducer in the place of the recorder.

chance to read some of the fast signals which he never has had the chance to read, because of the high rate of speed in which they are sent, but after the dots and dashes are recorded the phonograph can be set to run at any speed, thus enabling the operator to read the message. I have much enjoyed my recorder, as I have made quite a few records of the concerts I have received the past few weeks. These records can be made and kept for future use, or they can be used over again by simply washing the wax record with gasoline.—Hobert W. Frey.

Making Book Type Condenser

One of the most commonly used condensers is the book type. However, it is like most new developments in Radio—it can be much improved. One of the newest types can be made for experimental work as shown in the illustration.

In place of mica on the fixed plates, waxed paper may be used and any conductor may be used in place of tinfoil. The operation of the condenser is sim-



ilarity itself. As the knob is turned the lever on the back of the panel turns nearer to the pulley and allows the upper plate to move toward the lower plate. When the lever is touching the pulley the top plate will touch the bottom plate. The knob should be rather light so that the rubber cannot pull it around and so that it will stay put.

Stand "B" Batteries Upright

In many cabinet receiving sets there is space for the "B" batteries. The "B" batteries are sometimes placed in an upright position, and at times laid on their side. This last procedure is a bad one, for it tends to shorten the life of the battery considerably. The batteries should be placed in an upright position, and in a cool place. The reason why many of the "B" batteries do not last out their six or eight month period is due to carelessness in handling, and in short circuiting the terminals through faulty wiring of the set.

Three Cardinal Rules To Save Vacuum Tubes

Three-electrode tubes used as detectors and amplifiers should last for at least several hundred hours of service. When they do finally burn out, the failure should be a simple burning out of the filament exactly as happens in an ordinary incandescent lamp.

If the life of the tubes is very short, the trouble may be due to manufacturing defects which are not discovered in the inspection tests made before the tubes are sold. However, abnormally short life of the tubes more usually results from mistreatment.

There are three important principles which all users of vacuum tubes should bear in mind in order to keep their tubes in condition as long as possible. These are:

Never burn the filaments more brightly than is necessary to give satisfactory signals.

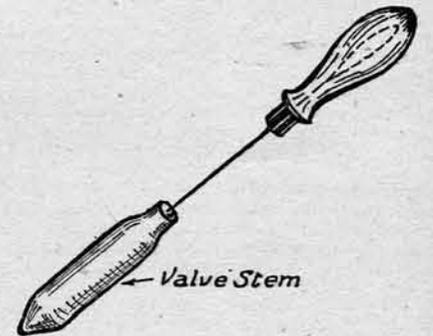
Never use so many plate batteries that a "blue glow" can be seen in the detector tube.

Do not burn the filaments when you are not using the set.

If you connect a voltmeter directly across the filament terminals of the detector tube, you can easily adjust the rheostat to bring the filament voltage up to the best value. This method of controlling filament brilliancy will help to prolong the useful life of the tubes.

Fan's Homemade Soldering Iron

To make good connections in circuits and to have a receiving set to work in an efficient manner all joints should be soldered in the circuit. If the amateur does not have a soldering iron one can be made from the metal of an old valve stem taken from a discarded inner tube of an auto-



mobile tire. The large end of the stem is filled to a point and then it is driven on the end of a heavy piece of wire. The other end of the wire is fitted with a wood handle.

How to Combat Strays.

Some relief from bothersome Radio "strays" in summer time can be obtained with sets having good amplifiers by using a "ground antenna." This is a long insulated wire run in a shallow trench or on the surface of the ground. The ground wire should be run in the direction of the station from which the most signals are to be received, and should preferably be several hundred feet long.

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Radio Telephony for Amateurs and Beginners

Part V—Tuners and Tuning

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:

- VI. Detectors: Crystals and Vacuum Tube, Section I Crystal Detectors.
- VI. Detectors: Crystal and Vacuum Tube, Section II Vacuum Tube.
- VII. The Batteries.
- VIII. Receivers and Loud
- IX. Crystal Detector Receiving Sets.
- X. Vacuum Tube Receiving Sets.
- XI. Amplifiers.
- XII. Useful Information.

enables the open circuit to be tuned in to the waves of short wave-length.

For reception at 360 meter wave-length, the series loading inductance may be omitted. Satisfactory tuning may be effected by the use of a variable condenser in the antenna circuit and by adjustment of the tuning coil.

When current flows in a wire or conductor, some of the electrical energy is converted into magnetic energy, which is manifested by the magnetic field set up around the wire. The strength of this field is proportional to the strength of the current in the conductor. This relation of the magnetic field strength to the current flowing in the conductor, is termed the "inductance" of the wire. If in another wire, the same value of current produced a stronger magnetic field, the increase must be caused by some property, or some condition, of the wire or of the circuit.

If a wire through which a current is flowing is coiled, each turn of the coil will have a magnetic field around it, as stated above. Thus the total field strength is increased for the same value of current inasmuch as the fields due to each turn of wire add to each other. In other words, by coiling a given length of wire, its in-

ductance is increased. Hence, it can be stated, that the more turns there are wound in a given space, the greater will be the inductance. In Radio work, the object of coiling is to get the necessary length of wire in a reasonably small space

essentially of two sets of semi-circular plates, having a common axis and being alternately spaced; one set is fixed and the other movable. The maximum capacity is obtained, of course, when the plates of one set are directly above those of the other.

Variations in inductance for tuning purposes may be produced by fixed steps or continuously. Illustrative of the first case is the tapped tuning coil, shown diagrammatically in Figure 2 (a). The dial switch is so arranged as to vary the inductance included in the circuit. Variations of small steps may be obtained by using a continuous single-layer coil with one sliding contact, as shown in Figure 2 (b). By means of the slides, the number of turns on the coil, connected in the circuit, may be increased or decreased at will. The adjustment of the tuning coil can be made to neutralize the antenna capacity reactance for any desired frequency. Inasmuch as frequency varies inversely as the wave-length, adjustment of the single-slide coil permits tuning to any wave-length with the coil limits.

With the double-contact, or two-slide, tuning coil, shown diagrammatically in Figure 2 (c), closer tuning can be obtained than with the single-slide tuner. The slid-

stationary and the other moving, so that their mutual inductance may be varied. The relative motion of the two coils may be accomplished in any of several ways, the most common being the loosecoupler, the variocoupler and the variometer.

The loose coupler, shown in a typical circuit in Figure 3, is superior in many ways to a tuning coil. It has two windings, called the primary and the secondary, the latter being so wound that it may slide in and out of the primary winding in order to vary the coupling. Two coils must be wound in the same direction, because if the fields of these windings oppose each other, it will decrease the efficiency of the coupler. The primary winding is provided with a slider arrangement for cutting in or out more or less turns, while the secondary is tapped to a multipoint switch. The secondary is entirely separate from the primary, that is, there are no connections from one coil to the other. If desired, the primary winding may be tapped and switches with contact points may be used instead of the slider. Figure 4 shows this arrangement. The loose coupler acts as a filter, keeping out the undesirable signals and allowing the signals to pass that are tuned in and desired. The loose coupler is more selec-

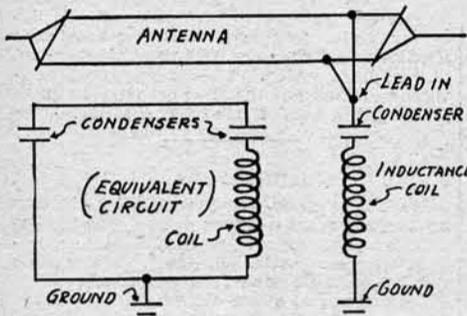


FIG. 1: ANTENNA CIRCUIT AND EQUIVALENT

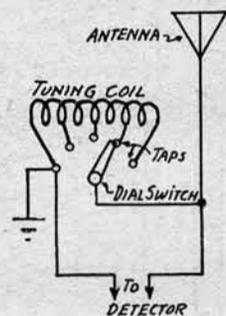


FIG. 2(a): TAPPED TUNING COIL WITH DIAL SWITCH

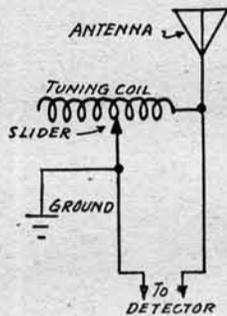


FIG. 2(b): SINGLE SLIDE TUNING COIL

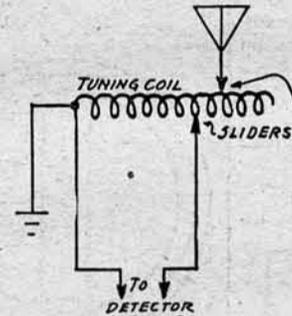


FIG. 2(c): TWO SLIDE TUNING COIL

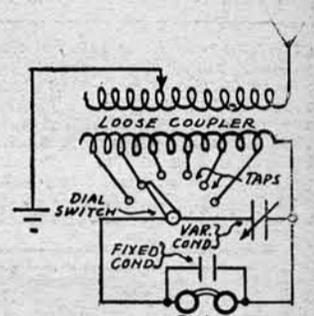


FIG. 3: LOOSE COUPLER IN RECEIVING CIRCUIT

As previously explained, the electromagnetic waves sent out by a Radio transmitting station and impinging upon a receiving antenna will induce therein oscillations of radio frequency, only if the receiving system is "tuned" to the frequency of the incoming waves. "Tuning" is the operation of adjusting the receiving equipment to be in "electrical resonance" with the transmitting station it is desired to hear. Two circuits of Radio frequency are in electrical resonance if they are so adjusted that the products of the inductance and capacity in both circuits are equal in value. When a receiving station and a transmitting station are exactly in tune, the signals will be strongest, and if they are not in tune, the transmitting station will not be heard.

When a transmitter, for instance, is adjusted to send out on a 360 meter wave-length, the frequency of the oscillations will be 833,300 cycles per second. To receive at this wave-length, the receiving equipment must be adjusted to a frequency of 833,300 cycles; in other words, it must be tuned. Under these conditions, both circuits will have the same natural period of oscillation and the maximum amount of energy in the oscillations in one circuit can be set up in the other circuit by electromagnetic induction. Oscillations of maximum amplitude are produced in the receiving circuit only when the latter is exactly in tune with the antenna or radiating circuit of the transmitter system.

A diagram is shown in Figure 1 of the antenna circuit. This is theoretically a closed electrical circuit, since the aerial wires and the ground form another condenser, the aerial being one plate and the ground the other.

An additional antenna loading inductance is required only when it is desired to receive waves greater than the natural wave-length of the receiving antenna. Increasing the number of turns in the series inductance prepares the antenna circuit for reception at longer wave-lengths.

When the length of the incoming wave is shorter than the fundamental wave-length of the receiving antenna, a short-wave condenser, connected in series with the antenna to include additional capacity,

ductance is increased. Hence, it can be stated, that the more turns there are wound in a given space, the greater will be the inductance. In Radio work, the object of coiling is to get the necessary length of wire in a reasonably small space

ing contacts are positive in action and touch only one turn at a time. The maximum wave-length afforded will permit reception of signals from any station sending out up to 1000 meters in length.

The triple-slide tuning coil will tune

tive, as the signals received will be louder than similar signals received with a tuning coil. The freedom from interference from other stations will be much greater, inasmuch as the loose coupler can be set for a definite wave-length, while the tuning coil may respond simultaneously to several waves, because of its construction.

The variocoupler, as its name implies, is a coupling device used to transfer the energy of the antenna circuit to the secondary of the receiving circuit. It consists essentially of two coils, one revolving within the other. The coils are not connected together, the energy transfer being caused by induction. There are a number of different types of variocouplers, or receiving transformers, the most common being those shown diagrammatically in Figure 5 (a), (b) and (c).

In the receiving circuit shown in Figure 5 (a), a straight variocoupler is used, without tapped primary and secondary. The primary circuit can be tuned, in a measure, by the variable condenser in the antenna circuit, while the secondary variation in wave-length is accomplished by using a variable condenser in parallel with it. The degree of coupling is varied from minimum to maximum by a knob which rotates the ring carrying the fixed secondary winding.

In Figure 5 (b) is shown a coupler with fine variations in both primary inductance and the inductive coupling relation as desired. Its operating convenience is of the highest order, as all adjustments are of the rotary type. The primary inductance can be varied by two switches, while the coupling can be varied by turning the fixed secondary winding relative to the primary. A variable condenser in parallel with the secondary is used for wave-length variation. This coupler can be used on short-wave sets for wave-lengths up to 1000 meters.

Figure 5 (c) shows a variocoupler with tapped primary and secondary. In the commercial type, the primary is equipped with thirty to sixty switch points, with ten to thirty similar points on the secondary. The wide variation of sec-

(Continued on page 15)

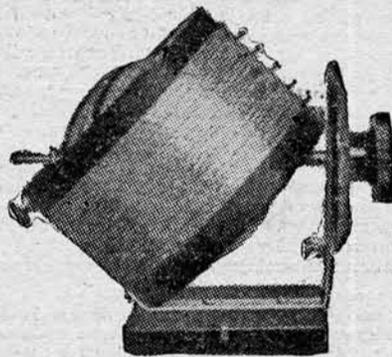


Fig. 6

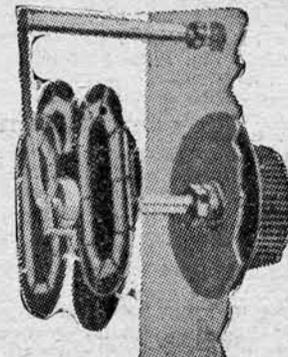


Fig. 9



Fig. 10

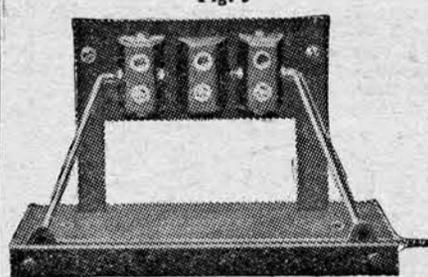


Fig. 11

where it can be easily handled and adjusted.

The tuning of an electrical circuit is accomplished easily by using a condenser and a tuning coil to obtain the capacity and inductance in conveniently adjustable form. One or the other, or both of these tuning devices must be adjustable. The variable air condenser consists es-

more closely than the two-slide type and will, therefore, aid in long-distance receiving. Many different methods of connection are possible with this coil, and very selective operation is possible; it will readily respond to wave lengths up to 1500 meters.

Continuous variation in inductance is usually effected by using two coils, one

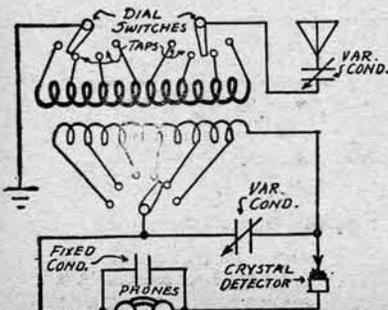


FIG. 4: LOOSE COUPLER (TAPPED PRIMARY & SECONDARY) IN RECEIVING CIRCUIT

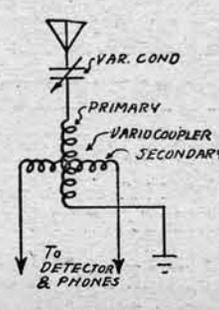


FIG. 5(a): STRAIGHT VARIO COUPLER IN CIRCUIT

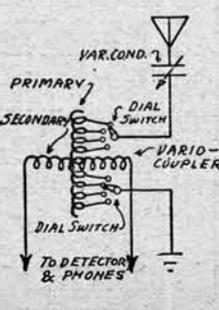


FIG. 5(b) VARIOCOUPLER WITH TAPPED PRIMARY

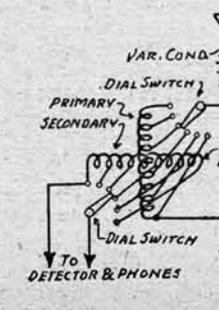


FIG. 5(c) VARIO COUPLER WITH TAPPED PRIMARY & SECONDARY

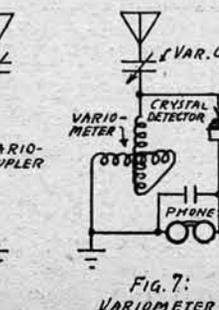


FIG. 7: VARIOMETER IN SIMPLE CRYSTAL RECEIVING CIRCUIT

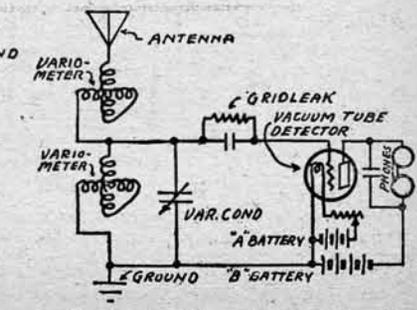


FIG. 8: TWO VARIOMETERS IN A VACUUM TUBE DETECTOR RECEIVING CIRCUIT

Simple Instructions for the Beginner

By Harry J. Marx

Tuning Apparatus Design

Part II

In Part I of this article, the methods of calculating the inductance of the primary coil necessary to raise the wavelength of the primary circuit to a specified value were explained. In addition the inductance of the secondary coil with a given condenser capacity was worked out. Then, in order to illustrate the application and value of loading coils, it was decided to increase the wavelength and find the inductance necessary in a loading coil for the new wavelength.

The required inductance of the primary coil was found to be 70,516 centimeters, or 70 microhenries that of the secondary coil was 72,972 centimeters, or 73 microhenries. The loading coil inductance necessary to raise the wavelength to 600 meters was calculated and found to be 162,162 centimeters, or 162 microhenries.

Inductance Formula

The formula for computing the inductance of any coil is as follows:

$$L = \frac{39.47K r^2 n^2}{1}$$

where
 L = Inductance of the coil in centimeters
 r = Radius of coil in centimeters
 n = Number of turns
 l = Equivalent length of coil in centimeters

K = A variable factor depending on the value of $\frac{2r}{l}$

l = the equivalent length in centimeters = the distance in inches from center to center of wire when wound, \times number of turns $\times 2.54$.
 $1'' = 2.54$ centimeters.

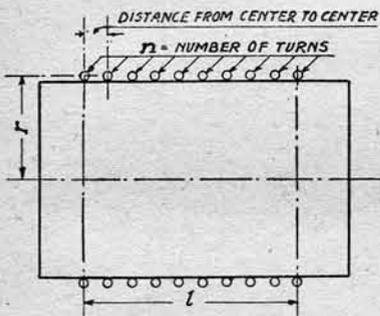


FIG. 2

In Figure 2 the dimensions r, l, and n are indicated. If, for example, the windings are of enameled copper wire, then "l" equals the diameter of the wire in inches \times the number of turns $\times 2.54$ (to change it to centimeters). If covered wire is used, the covering must be taken in consideration. Table 4 gives the number of turns per inch of copper wire with various insulations.

The value of the factor K for the various values of the fraction $\frac{2r}{l}$ is given in table 3.

In using the formula, the radius "r" of the coil is assumed, in the same manner the gauge of the wire with covering and the number of turns are approximated and the values substituted in the formula. The value of the inductance is figured out. The inductance value should check up close enough with the desired value. It may be necessary to go over this two or three times before the correct values are found. The diameter and gauge are usually decided on, and the number of turns can be altered until the inductance value is satisfactory. The inductance usually is left slightly greater as it is well to have a few extra turns in order to allow a slight range in tuning.

Primary Coil

The required inductance of the primary coil is 70,516 centimeters. The diameter of the coil can be assumed as 4", that is to say, the wires will be wound on a tube

4" in diameter. The value of "r" will be 2 inches. The primary winding will be of No. 24 B & S Gauge double cotton covered copper wire.

No. 24 double cotton covered wire has 34 turns per inch. About 20 turns for the primary ought to be sufficient then.

$$20 \times 2.54 = 1.5 \text{ centimeters-length of winding}$$

$$\text{therefore } l = 1.5 \text{ cms.}$$

$$r = 2 \text{ inches} \times 2.54 = 5.08 \text{ cms.}$$

$$\frac{2r}{l} = \frac{10.16}{1.5} = 6.77$$

therefore from table 3 — K = .26
 Substituting in the formula

$$L = \frac{39.47 \times .26 \times (5.08)^2 \times (20)^2}{1}$$

$$L = 70,862 \text{ centimeters}$$

An extra turn or two can be added, making the primary about 22 turns of No. 24 B & S Gauge double cotton covered copper wire on a tube 4 inches in diameter. For tuning purposes, taps can be taken off at every fourth turn, leaving an extra turn at each end.

Secondary Coil

In deciding on the details of the secondary coil, it is necessary to consider the type of coupling that is to be used. Will it be a coupling, loose coupler, or variocoupler construction? In the fixed coupling where the coils are rigidly mounted the secondary would probably be mounted on the same tube as the primary. In a loose coupler the secondary must be wound on a tube small enough so it will slide inside the primary tube, preferably with a minimum amount of clearance. The variocoupler necessitates a secondary tube that will rotate inside of the primary, again with the minimum amount of clearance.

The loose coupler has become rather popular, therefore it appears that this type of coupling will be the most logical to use in the problem. The coupling will have no effect on the calculations, but must be considered when the diameter of the secondary coil is decided on. Figuring that the primary tube has a wall thickness of one-eighth of an inch and allowing the same amount for wire thickness and clear-

TABLE-IV
 Turns per Inch of Copper Wire with Various Insulations

B. & S. Gauge	Enamel	Single Cotton	Double Cotton	Single Silk	Double Silk	Cotton Enamel	Silk Enamel
18	23	21	19	23	22	20	22
19	26	24	21	26	24	23	24
20	29	26	23	29	27	25	27
21	32	29	25	32	30	27	30
22	37	33	29	36	33	31	34
23	41	37	32	40	37	34	37
24	46	40	34	44	41	38	42
25	51	44	37	49	45	42	46
26	57	48	41	54	50	46	51
27	64	54	44	60	60	50	57
28	74	59	47	67	65	55	63
29	80	64	50	74	74	60	69
30	90	70	54	82	71	65	76
31	101	75	57	90	77	71	84
32	112	82	60	99	83	77	92
33	127	88	64	108	90	83	101
34	141	95	67	119	97	89	110
35	158	101	71	129	104	95	120
36	178	108	74	140	111	102	131

ance, then the secondary tube should be 3 1/2 inches in diameter and "r" equals 1.75 $\times 2.54$, therefore r = 4.445 cms.

In the secondary winding the gauge of the wire should be 26 B & S double cotton covered copper wire. From table 4 it will be found that this wire will permit 41 turns per inch. The number of turns in the secondary winding should be about 22.

$$n = 22$$

therefore

TABLE N° Two

HEIGHT IN FEET	HORIZONTAL LENGTH															
	40		60		80		100		120		140		160		180	
	CAPACITY IN MFDS.	INDUCTANCE IN CMS.														
30	.00019	13500	.00025	15000	.00033	16500	.00039	18000	.00046	19500	.00052	21000	.00058	22400	.00064	23900
40	.00019	19400	.00026	21000	.00033	22600	.00039	24200	.00046	25700	.00052	27300	.00058	28900	.00064	30500
50	.00020	25700	.00027	27400	.00034	29000	.00040	30600	.00046	32200	.00052	33900	.00058	35500	.00064	37200
60	.00021	32100	.00028	33800	.00034	35500	.00040	37100	.00046	38800	.00052	40500	.00058	42200	.00064	43900
70	.00023	38400	.00029	40100	.00035	41900	.00041	43500	.00047	45400	.00053	47000	.00059	48800	.00065	50500
80	.00024	44700	.00030	46500	.00036	48300	.00042	49900	.00048	51900	.00054	53600	.00060	55400	.00066	57200
90	.00026	51400	.00031	53200	.00037	55000	.00043	56600	.00049	58600	.00055	60400	.00061	62200	.00067	64000
100	.00027	58100	.00032	59900	.00038	61700	.00044	63400	.00050	65300	.00056	67200	.00062	69000	.00068	70800

FOR T TYPE AERIAL

TABLE-III. CORRECTION FACTOR-K

$\frac{2r}{l}$	K	$\frac{2r}{l}$	K	$\frac{2r}{l}$	K	$\frac{2r}{l}$	K
0.00	1.000000	0.40	0.849853	0.80	0.735079	2.00	0.525510
0.01	0.995769	0.41	0.846583	0.81	0.732593	2.10	0.513701
0.02	0.991562	0.42	0.843335	0.82	0.730126	2.20	0.502472
0.03	0.987381	0.43	0.840110	0.83	0.727675	2.30	0.491782
0.04	0.983224	0.44	0.836906	0.84	0.725240	2.40	0.481591
0.05	0.979092	0.45	0.833723	0.85	0.722821	2.50	0.471865
0.06	0.974985	0.46	0.830563	0.86	0.720419	2.60	0.462573
0.07	0.970903	0.47	0.827424	0.87	0.718033	2.70	0.453686
0.08	0.966847	0.48	0.824307	0.88	0.715663	2.80	0.445177
0.09	0.962815	0.49	0.821211	0.89	0.713308	2.90	0.437023
0.10	0.958807	0.50	0.818136	0.90	0.710969	3.00	0.429199
0.11	0.954825	0.51	0.815082	0.91	0.708647	3.10	0.421687
0.12	0.950868	0.52	0.812049	0.92	0.706339	3.20	0.414468
0.13	0.946935	0.53	0.809037	0.93	0.704047	3.30	0.407524
0.14	0.943025	0.54	0.806046	0.94	0.701770	3.40	0.400840
0.15	0.939141	0.55	0.803075	0.95	0.699509	3.50	0.394401
0.16	0.935284	0.56	0.800125	0.96	0.697262	3.60	0.388192
0.17	0.931450	0.57	0.797195	0.97	0.695030	3.70	0.382203
0.18	0.927639	0.58	0.794285	0.98	0.692813	3.80	0.376421
0.19	0.923854	0.59	0.791395	0.99	0.690611	3.90	0.370834
0.20	0.920093	0.60	0.788525	1.00	0.688423	4.00	0.365433
0.21	0.916356	0.61	0.785675	1.05	0.677697	4.10	0.360206
0.22	0.912643	0.62	0.782844	1.10	0.667315	4.20	0.355147
0.23	0.908954	0.63	0.780032	1.15	0.657263	4.30	0.350249
0.24	0.905290	0.64	0.777240	1.20	0.647527	4.40	0.345503
0.25	0.901649	0.65	0.774467	1.25	0.638094	4.50	0.340898
0.26	0.898033	0.66	0.771713	1.30	0.628951	4.60	0.336431
0.27	0.894440	0.67	0.768978	1.35	0.620086	4.70	0.332098
0.28	0.890871	0.68	0.766262	1.40	0.611487	4.80	0.327890
0.29	0.887325	0.69	0.763565	1.45	0.603144	4.90	0.323800
0.30	0.883803	0.70	0.760886	1.50	0.595045	5.00	0.319825
0.31	0.880305	0.71	0.758225	1.55	0.587182	5.50	0.301504
0.32	0.876829	0.72	0.755582	1.60	0.579543	6.00	0.285410
0.33	0.873377	0.73	0.752958	1.65	0.572119	6.50	0.271146
0.34	0.869948	0.74	0.750351	1.70	0.564903	7.00	0.258406
0.35	0.866542	0.75	0.747762	1.75	0.557885	7.50	0.246949
0.36	0.863158	0.76	0.745191	1.80	0.551057	8.00	0.236582
0.37	0.859799	0.77	0.742637	1.85	0.544413	8.50	0.227152
0.38	0.856461	0.78	0.740100	1.90	0.537945	9.00	0.218532
0.39	0.853146	0.79	0.737581	1.95	0.531647	9.50	0.210618

$$l = \frac{22}{41} \times 2.54 = 1.36 \text{ cms.}$$

$$\frac{2r}{l} = \frac{88.9}{1.36} = 6.54$$

then from Table 3

In order to raise the wavelength of the primary circuit to 600 meters, it was found necessary to insert an inductance of 162,162 centimeters. This coil can be taken care of by using a honeycomb coil, as explained in Part I, but for the benefit of the amateurs that would like to wind their own loading coil, this inductance will be analyzed also.

The single layer coil wound on a tube will give better results and serve the purpose better than the bank-wound type. The diameter of the tube need not be very large, and for that reason, in the problem a diameter of 3 inches will be assumed.

The wire gauge should be about 28 B & S double cotton covered copper wire. From Table 4 this gauge will give 47 turns per inch.

$r = 1.5 \times 2.54 = 3.81$ centimeters
 About 40 turns of wire should give the approximate result. Then

$$l = \frac{40}{47} \times 2.54 = 2.16 \text{ cms.}$$

$$2r = 7.62$$

$$\frac{2r}{l} = \frac{7.62}{2.16} = 3.53$$

therefore, from Table 3

$$K = .392$$

substituting the values in the formula

$$L = \frac{39.47 \times .392 \times (3.81)^2 \times (40)^2}{1}$$

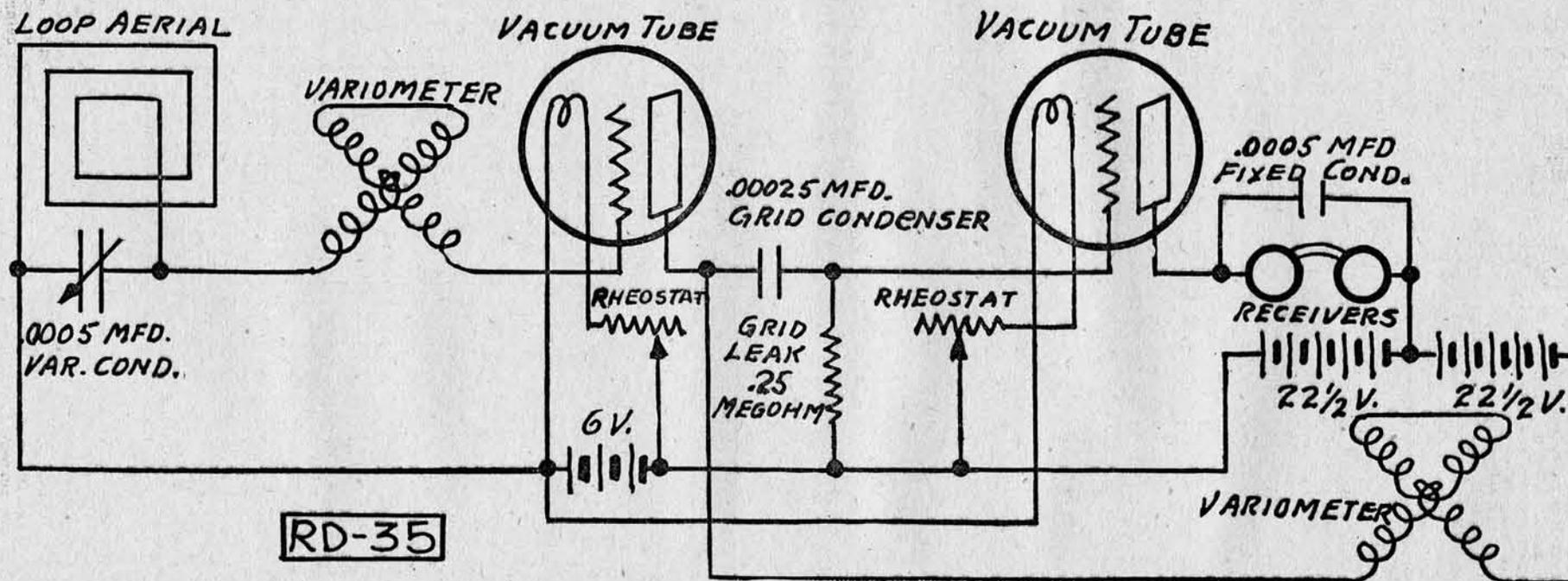
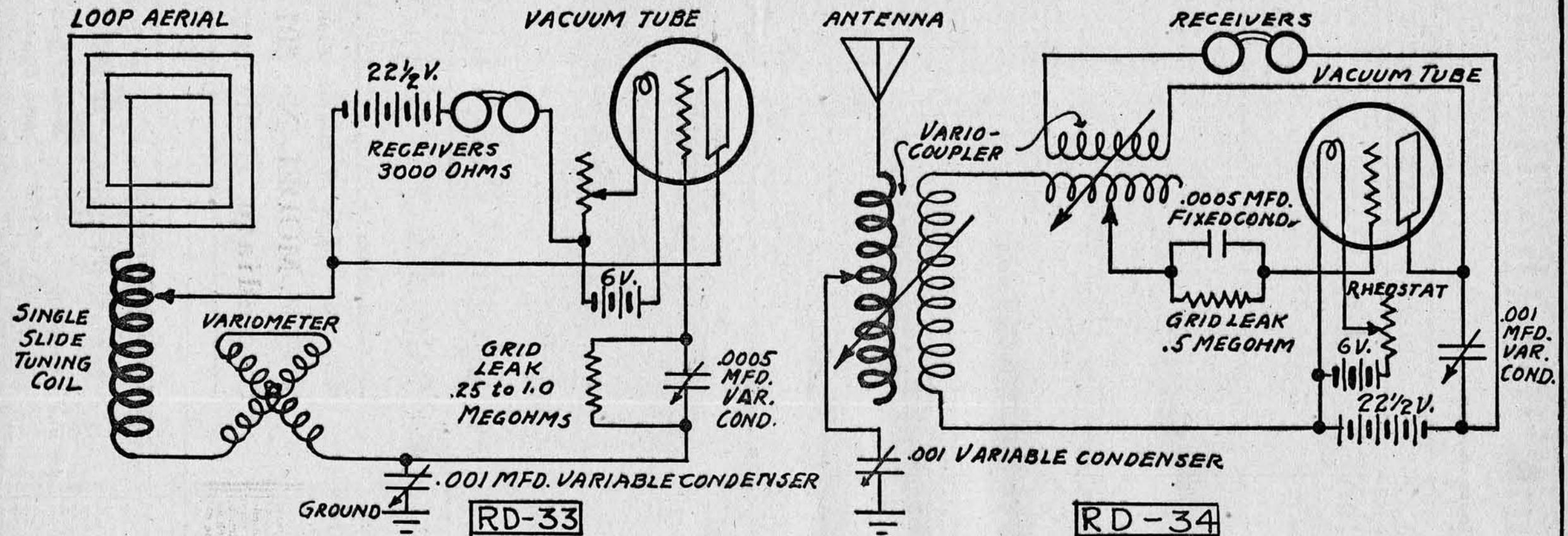
$$L = 166,000 \text{ centimeters}$$

This value is slightly greater than that required, but the surplus can be taken care of by means of the tapped switch on the primary coil and the variable condenser. The fact should not be overlooked, that in using the variable condensers in either circuit the capacity is changed; therefore the condenser also gives distinct control in tuning to the proper wavelength.

The above values as worked out will be found to be accurate enough for the amateur in determining the best units to purchase or make in assembling his receiving set.

Table 2 has been added to give the values for the "T" type of aerial, in the same manner that the Table 1 gives the values for the inverted "L" type.

Headquarters for
Radio Supplies
 and Equipment
 Radio Department
COMMONWEALTH EDISON ELECTRIC SHOPS
 72 West Adams Street
 Chicago, Ill.



Hook Ups

Questions and Answers

Radio and Audio Frequency

(213) QJ.—We received your first number out here and have been getting them since. The RADIO DIGEST is a fine weekly, just what we wanted.

1.—I will take this opportunity to ask your question and answer department for a little advice on a hook-up. We are intending to use a honeycomb coil system with a change-over switch, to also employ a short wave regenerative set, using (2) variometers and coupler. We wish to have one step of Radio frequency amplification, detector and three steps of Audio frequency amplification. In the honeycomb coil hook-up we wish to use the standard tickler regenerative circuit and the best possible hook-up on the other system. We wish to change over by using two anti-capacity switches and the plug and jack system for changing from one to two or three steps of amplification. We have 4 double-circuit jacks.

2.—With this set using a five-watt tube in the last step, will we be able to hear Radiophone messages in a room 100 feet in length and 75 wide, using about 300 volts on the plate and a concert type Magnavox?

A.—1. The answer to your letter has been delayed because we only have 700 letters to answer! But we're doing the best we can. The diagram you ask for is given.

2.—Yes.

Loose Couplers

(194) CL

Am expecting to install a Radio set and would like your advice as to the kind of a receiving set and aerial one should build to get best results. I have thought of putting up a four wire aerial of the L-type, using a copper clad wire, can make it 65 to 75 ft. long with 12 foot spreaders. Is pure copper wire best for aerial use? I had also thought of using variometers and a vario-coupler. But having read H. J. Marx's article on the loose coupler I rather think I would like it the best. Would you kindly advise me as to what it takes for a set using the vacuum tube and a loose coupler and how to hook it up? Would you get better results by using more than one variable condenser? Would you recommend the New Model 5 B B Navy Type Receiving Transformer made by Ducks.

A.—Two stands spaced four feet apart, 75 feet long is sufficient.

Copper clad wire is O. K.

Your question regarding "What it takes for a set using vacuum tube detector" is not quite clear. Do you mean price, current or parts required?

See Hook-up RD—10 issue No. 4 RADIO DIGEST, May 6th, 1922.

Yes, a 23 plate in the primary circuit and a 43 plate shunted across the secondary.

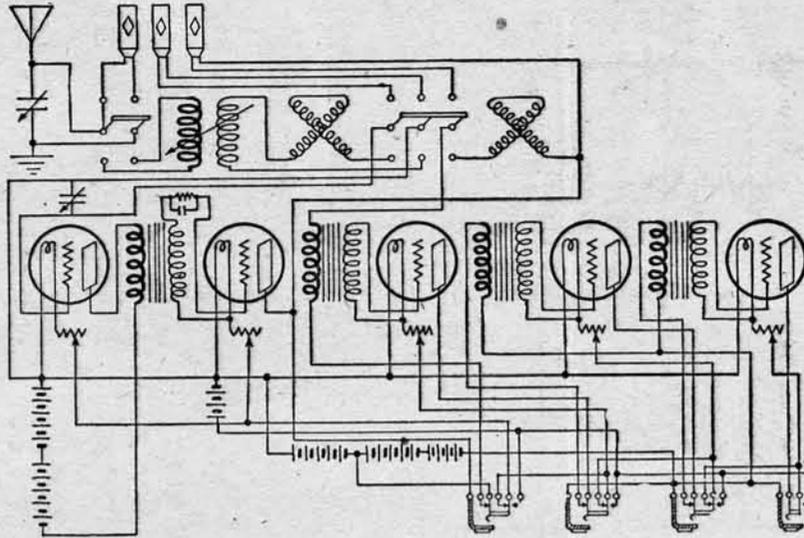
It is against our policy to favor any one make of apparatus as there are many makes which are all good. We advise you if we know they are unreliable.

Poor Hook-up

(197) JCW

As a reader of RADIO DIGEST I would like to ask what might be the matter with my set.

I have a regenerative set made by myself after the hook-up I am enclosing with this letter. I can hear all the broadcasting stations but the voice can't be



ONE STAGE RADIO FREQUENCY, - DETECTOR, AND THREE STAGES OF AUDIO FREQUENCY
Q&A-213

understood at all. Music is all blurred up and you can't tell whether it is a violin or a piano playing. Some say it is my B batteries but I cannot find the trouble. Please tell me what I will have to add on in order to remedy the trouble.

A.—Your Hook-up is poor.

Try the hook-up shown in issue No. 3 of the RADIO DIGEST page 13, Fig. 12.

Regenerative Receiver

(204) SMS

1. I live 8 houses from the "EL." Is it all right for my aerial to be parallel to the "EL"? Which way should I have it?

2. What is a good two step receiving set if you want a range of about 500 miles, or to reach Pittsburg.

3. What is a regenerative set and what is it used for?

4. A list to make a two step regenerative with parts in set in April 29 issue.

A.—1. If possible, have it at right angles to the "EL."

2. There are many good sets on the market which will receive Pittsburg.

3. A regenerative receiver is so called because the plate is coupled to the grid circuit through one inductance reacting upon the other inductance.

4. The diagram in that issue indicates all the parts—just list them up.

(207) RRM Condensers

Enclosed you will find a drawing of a simple receiving set. 1. Please tell me if stationary fixed and variable condensers could be connected to this and where. 2. Please tell me if this set with condensers could be connected in a battery circuit so as to increase the receiving range? Enclosed you will find a stamped envelope for a reply. I would like to hear from this as soon as possible so that I may get much better results with my outfit.

P. S.—I have an aerial running parallel to the telephone wires. It is about one hundred feet long and fifty feet from the telephone wires. However, if I change it it will run parallel to the electric service

wire and about seventy-five feet from it. Will I leave the aerial where it is, or shall I put it the other way?

A.—1. Yes, shunt the fixed condenser across the phones and the variable condenser across your tuning circuit.

2. No.

3. Let the aerial stay where it is.

Secondary Winding Is Wrong

(220) OBF

I am a reader of your valuable paper and would like some information as I am unable to solve my difficulty. I have made a loose coupler to get the time from Arlington but get no results. Primary is 3 1/2" dia. 7" long wound with 260 turns 26 Sec wire. Secondary 7" long 3" dia. wound with 380 turns 38 sec with 6 taps on same spaced equally. Grid condenser home made, has 2 sheets of tin foil 2" square with oiled paper as dielectric and pencil grid leak. Cunningham V.T. and Meteor phones 3,200 ohms. Aerial is 60 ft. long, 55 high inverted L, on top of two story brick building with tin roof, aerial is 12 feet above roof, and is made of two strands No. 12 copper and lead-in is single strand No. 14 insulated wire, masts are

of wood and porcelain insulators on aerial at each end, lead-in wire runs through 1/2" rubber hose when it rests on fire wall. All connections are soldered, I am unable to even get static on this outfit, I am enclosing diagram of hook-up.

A.—Your primary is all right but your secondary is wrong. We suggest 300 turns of No. 28 wire. Aerial is all right, but would suggest increase of length to 100 ft. Tin roof ought not cause any trouble. Hook-up given is all right but would suggest connecting phones between "B" battery and plate.

Wave-length Too High

(228) AHO

I am located at Elkart, Indiana, at the N. Y. C. R. R. Co. Storehouse.

I have made a Radio set, a two step amp. and det. but I am having some trouble getting it to work.

I am enclosing two drawings, one of my hook-up and one of my tickler and pri. I would like to have these two drawings checked and tell me where I am wrong.

I have a one wire aerial 176 feet long and 60 feet high and my ground is to a steam line. What is wrong?

A.—See issue No. 3, page 13, Fig. 12, for a hook-up.

Your aerial should not be more than 150 feet long including the lead-in and ground wire. Wave-length is too high.

Aerial Too Far Away

(231) CS

I am installing a receiving set in my house which is surrounded by trees about 40 feet high, do they have any effect on the receiving if my aerial is on the house?

2. Could I have my aerial 500 feet away from the house and have my receiving set inside?

3. In a two stage receiving set do we absolutely need two amplifiers and one detector? Is a set like this sufficient to hear 400 miles or more?

4. A power line A. C. of very high voltage tubes just at the corner of my house forming a right angle as this: how am I to put my aerial to avoid noises in my receivers.

A.—1. How high is your house? If it is higher than the trees, the trees will not affect your receiving to any great extent.

2. You will have too high a wave-length in your aerial.

3. Yes. Depends upon conditions.

4. Erect your aerial at right angles to the power line.

RADIO TELEPHONY

(Continued from page 12)

ondary inductance renders it most efficient for use with all types of detectors. With the average antenna, this type of coupler should respond to wave-lengths up to 2000 meters.

Figure 6 shows a variocoupler with a coupling range of 180 degrees. The primary winding has ten taps and is mounted at an angle of 45 degrees. It can be readily mounted on either table or panel.

The continuously variable inductance, known as a variometer, consists essentially of two coils connected in series, one being placed inside the other and the plane of the inside coil may be rotated about a diameter. The self-inductance of a variometer depends upon the relative positions of the two coils. When the coils are in the same plane with the current flowing in the coils in the same direction, the inductance of the variometer is maximum. When the inner coil is turned 180 degrees from the first position, the inductance of the variometer and hence the wave-length to which it will tune is at its minimum, since the current flows through the coils in opposite directions. The variometer can be made to tune very finely by variations of the position of the movable coil. Figure 7, shows a variometer connected in a simple crystal receiving circuit. More resistance is offered the radio frequency currents by the variometer adjusted to a low value of inductance than by a tuning coil with the same value of inductance. This permits close tuning within a small range of wave-length variation.

Figure 8 shows two variometers connected in a receiving circuit with a vacuum tube detector. Very close tuning is ob-

tainable with this hook-up, inasmuch as the variometer has a big advantage over other types of variable inductances using sliders or switches.

A novel form of variometer is shown in Figure 9. This instrument is constructed with four flat coils of the "zig-zag" winding type, two stationary and two movable. With this arrangement, the radio of maximum to minimum inductance is very large, due to the close proximity of the windings. It is adaptable for panel mounting as illustrated.

Before leaving the subject tuning, it may be advisable to mention briefly the use of honey-comb coils for replacing, loading and tuning coils. A typical form of honey-comb coil is illustrated in Figure 10. Honey-comb coils possess the advantage of the saving of space and convenience in coupling. They are constructed of solid wire, the winding being such as to approximate a bank winding in one direction. The coils are cellular in type, the turns of one layer crossing the preceding layer always at an angle, thus making the distributed capacity a minimum.

Each coil is mounted on a plug designed to be used in connection with a coil mounting, one type of which is shown in Figure 11. By plugging in different sized coils, a wide flexibility of adjustment is obtained and all ranges of wave-lengths can be easily covered. The coils are so mounted on the plugs that the windings always run in the same direction.

Honey-comb coils are so wound as to provide the proper amount of inductance for tuning at long wave-lengths and also possess the advantages of small dimensions. These coils are generally wound in various size units, each unit with a definite number of turns, and they can be used for wave-length ranges up to 25,000 meters.



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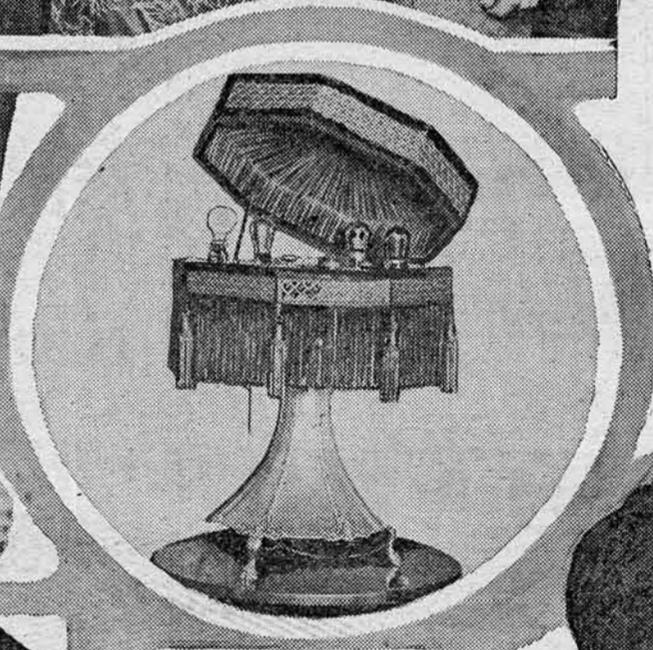
Mme. Asta Souvorina with her two sons learning American ways via Radio
© U. & U.

With this unique outfit little Ellsworth McComb can hear anything broadcasted within ten miles. The heads hide the receiving set.
© Keystone

Lobsters may make delicious salad, but now they use them in Radio sets. Broadcasting can be heard for twelve miles with this claw set
© Keystone



Canoeists make use of a receiving set by using an oar to raise the aerial
© K. & H.



The lamp form of Radiophone is neat and when it is closed there is no way telling that it is a receiving set
© K. & H.



There are many forms of receiving sets but the one enclosed in a garter is the very latest, but what would she do if it gets out of order?
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