April 13th, 1929 15 Cents

RADIO WORLD

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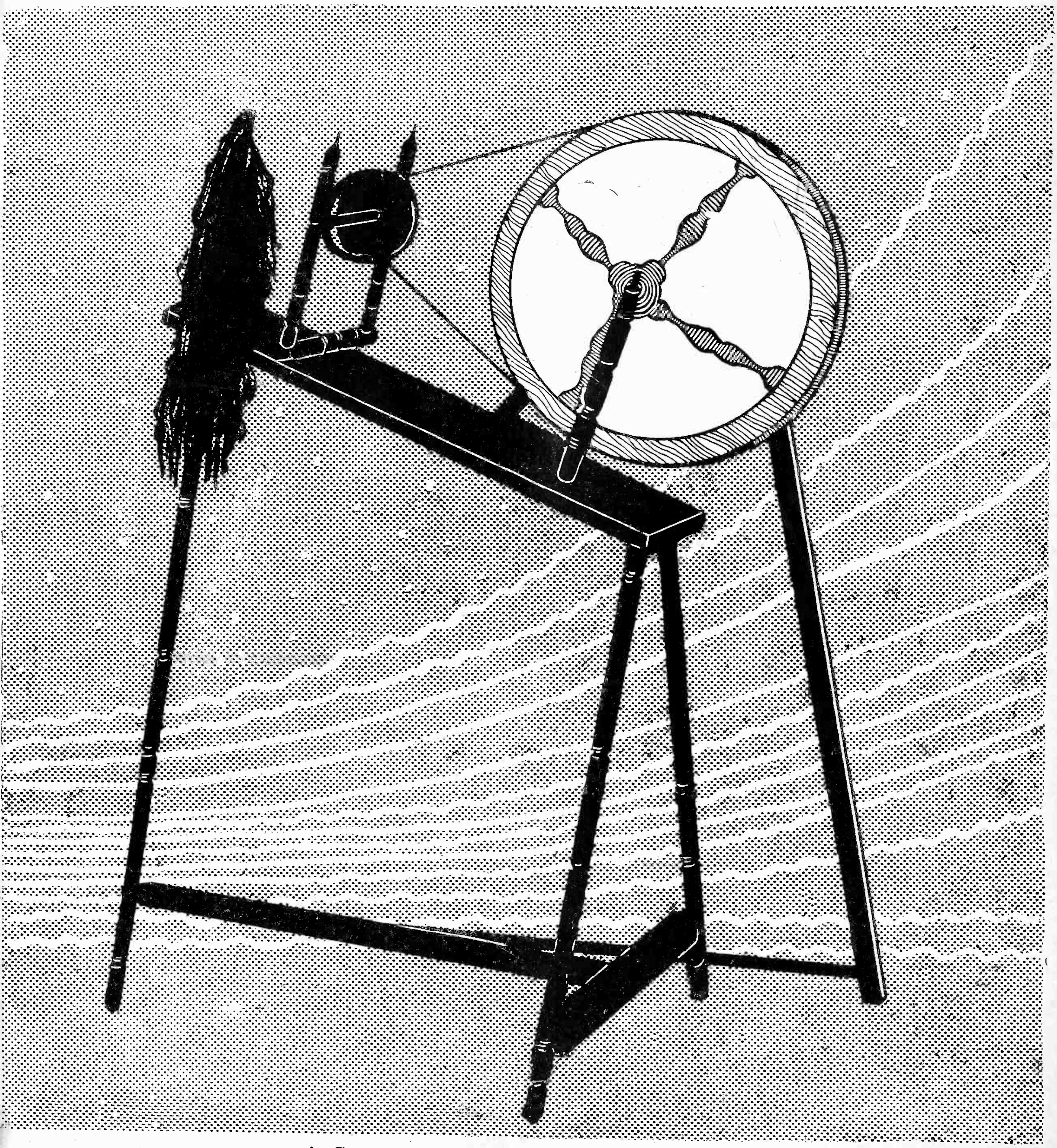
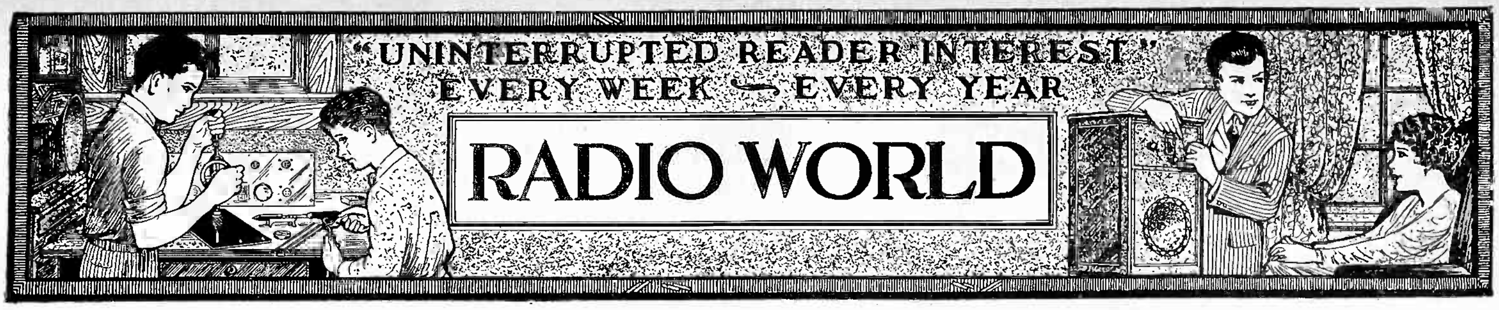


A Spinning Wheel Loudspeaker. See page 17

President and Treasurer, 145 West 45th Street, New York, N. Y.; Herman Bernard, Secretary, 145 West 45th St., New York, N. Y.



Vol. XV, No. 4. Whole No. 368.
April 13th, 1929
15c per Copy, $6.00 per Year
[Entered as second-class matter, March 1922, at the Post Office at New York, N. Y., under Act of March, 1879.]

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EIGHTH YEAR

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McCRACKEN DIPS INTO FUTURE OF RADIO AIRPLANE

Washington.

In the future passengers on the big airships will be served music and the latest news by means of radio, according to a statement by W. P. MacCracken, Jr., Assistant Secretary of Commerce for Aeronautics.

Mr. MacCracken predicts that in a few years people will travel by airplane as safely and as comfortably as they do now by automobile, and that the passengers of the big airships will not be deprived of their radio entertainment while they are speeding in the high altitudes. The favorite programs will be picked by a radio receiver on board and will be made available to all.

"These programs," he said, "could be tuned in right now in any properly equipped airplane when the weather is such that the pilot has no need for his radio apparatus. In the big passenger carrying planes of the future there doubtless will be the most complete equipment, enabling each passenger to enjoy the radio entertainment.

"Sitting comfortably in easy chairs up there in the high altitudes, they will be able to hear the pleas of orators in any one of a hundred cities, the rhythm of jazz bands or the harmonies of symphony orchestras, the quips of comedians and the precepts of domestic science.

"Further great development will be made in radio communication between an airplane and the ground. Imagine sitting in your home and talking over the telephone to some one who is racing through the air many miles distant, at a speed of 100 miles an hour. I first had such an experience about two years ago."

Acts by 3-Man Board Are Called Illegal

Washington.

The Federal Radio Commission filed with the Supreme Court of the District of Columbia a motion to dismiss the bill of complaint against it filed by the National Radio Press Association, Inc., of New York.

The association, in its bill, contended that the Commission, with only three members, is not a legally constituted agency, because the law specifies that it have a membership of five, and asked that the Commission be restrained from making any decision on the allocation of 20 continental short-wave channels to the nation's press until after its own application has been heard.

The court now has under advisement the bill of complaint and arguments against it made by Paul M. Segal, Assistant General Counsel of the Commission.

Studios Supply "Talkie" Doubles

Los Angeles.

The increasing demand by motion picture producers for competent voice doubles keeps several KFI artists on the qui vive filling appointments at the various studios.

While many screen stars possess voices recording successfully, scenes taken at any distance from the microphone force them to raise the voice to an unnatural pitch. This distortion of the tone quality causes the various squeaks and lisps which made the "talkie" slow to gain public favor.

Through the use of the voice double this objectionable feature has been practically overcome. The "double" is placed close to the recording device and perfect synchronization of his voice with the movement of the star's lips completes the illusion that the voice is actually that of the star.

The advent of the sound picture has opened a new field to radio artists, and KFI officials are finding it difficult to cope with the requests for "doubles" received by the station.

HILL CHIEF OF BOARD'S STAFF

Washington.

Captain Guy Hill of the Army Signal Corps, who has been head of the broadcasting engineering division of the Federal Radio Commission, has been appointed acting chief engineer of the Commission.

Captain Hill succeeded Dr. J. H. Dellinger, chief of the radio division of the Bureau of Standards, who resigned his assignment to the Commission to resume his duties in the Bureau of Standards.

Captain R. H. Marriott, assistant chief engineer of the Radio Commission, also has resigned. He plans to return to his private practice of consulting radio engineer in New York.

Mr. Marriott has handled all matters pertaining to the first zone for the Commission since February 23rd, when Commissioner Orestes H. Caldwell resigned. Capt. Marriott was employed by the Commission as an engineer to draft new regulations and has been with the Commission since January.

EISEMANN A FINANCIER

Alexander Eisemann, formerly chairman of the Freed-Eisemann Radio Corporation, has formed the firm of Alexander Eisemann & Company, investment bankers. Mr. Eisemann retired from the radio industry about a year ago. Paul Plunkett, for many years financial adviser to the Eisemann family, is associated in the business.

AERIAL POINTED TO BYRD GIVES LOUD PROGRAM

Schenectady, N. Y.

An antenna that increases ten-fold the directional power of W2XAF, the short wave station of WGY, making a 20 kilowatt station the equivalent of 200 kilowatts in effectiveness in one direction, has been erected at the South Schenectady transmitter laboratory of the General Electric Company.

This antenna faces the south and it is used for one program only and then only once every other week. The engineers call it the "Byrd" antenna because when this particular radiator is in use, the message is directed to Commander Richard Byrd and his men at Little America, Bay of Whales, Antarctica.

Seek Reliability of Reception

The Byrd antenna is Dr. E. F. W. Alexanderson's contribution to happiness of the expedition personnel as they winter through the long Antarctic night. In erecting this special antenna, General Electric engineers are bringing to the broadcasts to Byrd the latest devices known to the art to promote reliability of reception.

While it is too much to hope that all programs will reach their Polar destination, it is expected that by the use of the Byrd antenna, the chances of getting through static with a good signal are very much enhanced.

This particular antenna was used for the first time Saturday night, March 23d, and within fifteen minutes after the conclusion of the program, WFA, the Byrd transmitter, reported in code that the entire program had been received through the loudspeaker.

Horizontal Checkerboard

The Byrd antenna is of the horizontal checkerboard type and is similar to the radiator constructed for program transmission to Germany and for facsimile developmental work with the Pacific Coast. It is one of a dozen or more antennas which sway above the 54-acre transmitter laboratory at South Schenectady. These antennas hang from steel masts from 150 to 300 feet high, from plain wooden masts and from masts with cross bars, not unlike scaffolds in appearance. Ordinarily, W2XAF, the 31.48 meter transmitter of WGY, uses a vertical antenna about 50 feet in length.

The new antenna is actually twelve antennas in one, consisting of two sections of a checkerboard, each section made up of three squares. One section is known as a reflector. Only the horizontal wires of the system function as antennas, the vertical wires being for support or power transmission to radiating wires.

GERNSBACK HAS RADIO-CRAFT AS OWN MAGAZINE

Hugo Gernsback, formerly editor of "Radio News," which is now under new management, announced the foundation of a new 25c monthly magazine of his own, "Radio-Craft." The first issue will be the June number. The magazine is published by Gernsback Publications, Inc., 96-98 Park Place, New York City.

In a printed advance notice Mr. Gernsback says in part:

"Another new radio publication? In 1929? At this late date? Why and wherefore? Aren't there enough radio publications now—most of which, as the trade well knows, are not successful?

"The answers to these most obvious questions are quite simple.

"In the first place, 'Radio-Craft' will be a strictly specialized class publication, covering only a restricted field, namely: radio set builders, radio constructors, short wave fans, service men, amateurs (hams) and television enthusiasts. As the name of the new publication explains, 'Radio-Craft' will go only to those who construct, i. e., the buying class. No attempt will be made, either now or later, to cover any other radio field.

Cites 250,000 Builders

"Particular stress is laid upon the fact that the broadcast listener, better known as B. C. L., does not enter at all into the scheme of 'Radio-Craft.' That, therefore, does away with a great deal of waste circulation, because it is well known that the B. C. L. does not buy parts and, as a rule, has only one radio set, which, as statistics show, he keeps over four years before it is replaced.

"There is in this country, in Canada, as well as scattered over a number of other countries, a total of between 250,000 to 350,000 active radio enthusiasts who build radio sets, either for profit or for pleasure.

At another point Mr. Gernsback said:

"I have been urged by a number of radio friends and advertisers to start a specialized radio publication and I am doing so now, in the face of the fact that practically ALL other present radio publications are admittedly on the decline.

"It is not intended to push the circulation of 'Radio-Craft' beyond 100,000 copies.

What Will Be and Won't

What "Radio-Craft" will contain is described by Mr. Gernsback in another circular in part as follows:

"The newest hookups; the latest things in radio; every new article and apparatus brought out; radio construction galore; service man's data; short wave dope by the ream; a real big section on questions and answers; blue print articles in profusion—in short, you'll get a 'he-man' radio dope sheet that's chock full of the very stuff you want.

The following won't be printed:

"Rehash stuff, so sadly prevalent in present-day radio magazines; pictures of the latest radio mast in Timbuctoo; stories how Roxy killed a fly on the mike; picture gallery of radio broadcast announcers flanked by goggle-eyed sopranos; radio mathematics that are swell food for Einstein, but that give you indigestion; curves, graphs and charts of everything imaginable—glorious dope for university professors, but a total loss to you."

Tube Guide System Backed by Trade

The Radio Manufacturers Association has issued a statement as a guide on the question of the number of tubes in an installation.

So many new tubes for different purposes have been developed, said H. B. Richmond, director of the engineering division of the Radio Manufacturers Association, that the public should be apprised of the number and functions of different types of tubes in the modern receiving set by dividing the two classes of tubes into their respective groups, their numbers separated by a dash. Thus 6-3 would mean six tubes in the receiver proper and three tubes as rectifiers, or regulators.

"In the first group would be placed those tubes used as radio-frequency amplifiers, detectors, and audio-frequency amplifiers," said he. "Oscillator tubes required in such circuits as the Super-Heterodyne, would be included.

"In the second group would go the special service tubes, such as voltage control or ballast tubes, those for automatic volume control, and those for rectification, either for plate or filament use.

"In the 6-3 illustration already referred to, a typical set would be one having three radio-frequency amplifier tubes, a detector and two audio-frequency amplifier tubes which would comprise the six receivers. The three special service tubes could be a voltage control tube, a rectifying tube and an automatic volume control tube."

CFRB, CANADA, ON CBS CHAIN

William S. Paley, president of the Columbia Broadcasting System, has announced that CFRB, Toronto, has joined the Columbia System on a weekly basis. While various Canadian broadcasters have been linked with American networks for the transmission of events of international importance, this expansion of the Columbia chain marks the first time a foreign station has been hooked upon a regular schedule.

The transmission will operate only one way, but experts are of the opinion that the hook-up will eventually lead to a regular international exchange of programs.

CFRB is owned and operated by the Standard Radio Manufacturing Corporation, Ltd., and is regarded as one of the best broadcasters in the Dominion.

In commenting on the arrangements with CFRB, Mr. Paley expressed pleasure that Canadian listeners would be able to hear the American programs from one of their own stations. He said:

"We realize that many Canadians, especially those living along the border, have been among our audience for a long time. But this situation does not bear the significance of catering regularly to an international audience as does the actual hookup with a station operating under another flag."

ADELMAN VICE-PRESIDENT

Leon L. Adelman was elected vice-president and general sales manager at a recent meeting of the board of directors of A. M. Flechtheim & Co., Inc.

FRIEDMAN-SNYDER NAMED

The Rola Company, Oakland, Calif., is represented in the New York Metropolitan territory by the Friedman-Snyder Company, 15 Park Place, New York City.

BIDS ARE MADE FOR MAGAZINES IN BANKRUPTCY

The creditors of Experimental Publishing Company, which gets out "Radio News," "Science & Invention" and other magazines, and of the associated Consrad Company, received bids before Peter B. Olney, Jr., referee in bankruptcy, in the Federal Building, New York City.

B. A. Mackinnon, of 225 Varick Street, offered $200,000 in cash and $250,000 in notes of $20,000 a month, except that the last note would be $30,000. All debts would be assumed by the bidder, including the cost of the bankruptcy. Liabilities have been estimated at $600,000, although schedules filed placed the figure at $500,000. The schedules did not state assets, but these were estimated at $182,000.

The Mackinnon offer embodied 100% settlement on all cereditors.

MacFadden Groups Bid

MacFadden Publications, Inc., publishers of "True Stories," "Physical Culture" and other magazines, offered $250,000 in cash, or $50,000 more than Mackinnon, of which $250,000 half would be used to pay off at once in full all claims of creditors for $3,000 or less, the other $125,000 to be pro rated among the remaining creditors, the rest from profits. This differed from the Mackinnon bid in that Mackinnon would pay $500,000, half in cash, half in notes, to pay off all creditors regardless of profits.

Following the reading of the bids, an offer of $60,000 was received for WRNY, owned and operated by the company. C. W. Cuthell, 20 Pine Street, New York City, made the offer for a client.

Mackinnon thereupon improved his bid by offering $60,000 extra in cash (the amount then to be deducted from the note items), in the event Cuthell bought the station.

The Macfadden group had no intention of selling the station.

Other Bidders

Among the other bids was one from Motion Picture Publications, Inc., which offered $50,000 in cash, or $25,000 in cash and $50,000 in notes for Amazing Stories. Roscoe Fawcett of the Fawcett Publishing Company, Robbinsdale, Minn., in a telegram, offered $30,000 immediately in cash for Science and Invention. Another bid was from Robert M. McBride, publisher, who offered $300,000 for Science and Invention and Amazing Stories, while W. Norins of 319 West Forty-ninth Street offered $40,000 cash, or $50,000 in deferred payments, for the radio stations.

The Experimenter Publishing Company publishes "Radio News," "Science and Invention," "Amazing Stories," "Your Body," 'How To Make It" and will publish "Aero Mechanics." It owns WRNY and the station's short-wave counterpart, 2XAL.

The Consrad Company publishes "Radio Listeners Guide and Call Book" and some radio books.

Mr. Mackinnon is circulation manager of the Experimenter and Consrad publications under the reorganization, and Arthur H. Lynch is managing editor of the publications. Both were put there by the Irving Trust Company, the receiver. The successful bidder will be announced the Irving Trust Company, the receiver. in a few days

...President and Treasurer, 145 West 45th Street, New York, N. Y.; Herman Bernard, Secretary, 145 West 45th St., New York, N. Y.

STATIONS TAX HURTS PUBLIC, SAYS LAFOUNT

By Harold A. Lafount

Federal Radio Commissioner

In keeping with a Senate resolution the Commission has before it a request for a tentative or suggested schedule of fees to be charged for the different kinds of radio licenses issued to offset the cost of Government supervision of radio.

While it is proposed to tax all licensees, including the 16,000 amateurs, it has been suggested that the burden of the charge should be borne by the broadcasters.

It will be a comparatively easy matter to work out such a schedule imposing a tax on the 616 licensed broadcasters whereby a large fixed sum can be raised to be turned over to the Treasury. A graduated scale can be adopted whereby the tax would depend on the size of the station, its relative position in the spectrum, etc., that would be fair and equitable to all broadcasters.

Doubts Wisdom of Tax

The broad question of taxing broadcasters and others has not come before the Commission as yet, and the views of my colleagues on the subject are unknown.

Personally I have grave doubts about the wisdom of such a procedure. Of course, all we can do is to propose, while it is the prerogative of Congress to dispose. In discussing this subject it is not my purpose to dictate to Congress; but, owing to the importance of the issue, it should be viewed from all angles.

Certainly it is the desire of Congress to enact only such radio legislation as will enable the public to receive the greatest possible benefit from the use of the air. For that reason I believe a discussion now of the proposal is most timely.

Broadcasters Only a Part

In the first place, the supervision of broadcasting stations represents only a small portion of the work and expense of the Commission. Point-to-point radio communication, television, radiotelegraphy, marine wireless, aircraft stations, etc., all require much time and attention of the Commission. In many respects these problems are of more vital importance than broadcasting. That being so, why should the broadcasters be required to bear the brunt of radio supervision?

Many other factors enter into the consideration of this subject. For instance, the broadcasting stations on frequent occasions present to their listeners many items of national importance such as the inauguration, election returns, the President's speeches, talks by different members of Congress and educators on live issues, etc., which are not sponsored but are presented by the broadcasting stations.

The value of this service to the citizens of this country is difficult to estimate. It is admittedly a real contribution to the public welfare, benefiting all classes. The average broadcaster also presents many matters of local interest and importance, broadcasting agricultural reports, weather forecasts, stock market, church programs, community chest drive, hospital benefits and many others which benefit all, and the public itself is interested in such programs.

Let us consider this service in connection with the fact that the United States Government spends millions of dollars annually for the benefit of agriculture and industries of all types and characters.

The cost to the United States Government of the maintenance of the Federal Radio Commission and the Radio Division of the Department of Commerce amounts to approximately $800,000 per annum. It is estimated there are 40,000,000 radio listeners daily, so that the cost of Federal radio supervision is only 2 cents per annum per listener.

This seems to be a very cheap and efficient way of disseminating much valuable information assembled by the Government for the benefit of all the people. This service in connection with that rendered for the benefit of local communities is without doubt worthy of consideration, so that the question is, can the Government justify the expense of supervising radio since the advantages to the people are so manifest? I think so.

Money Might Kill Quality

If the broadcaster had to pay a fee, or Government tax, and if he should confine his efforts to the presenting of sponsored or paid-for programs, would the public actually be benefited and would revenue to the United States Government compare with the public service programs now so frequently broadcast?

It may be argued that the broadcaster would not necessarily discontinue the broadcasting of matters of national and local importance even though he was required to pay a tax to the Government. However, it should be remembered that the heavier his expense the more time he must sell in order to produce revenue sufficient to meet his obligations.

We appreciate the fact that there are certain fixed charges or costs attached to the operation of a broadcasting station, such as rent, light, power, heat, operators, engineers, announcers, stenographers, advertising, and many other items. The broadcaster's only income is derived from the sale of time. The heavier his expenses, the more time he must sell, thus reducing his opportunity of presenting programs of a public nature.

Talent Fund Less

If the income of a broadcasting station happens to be considerably in excess of the fixed charges, then a fair sum can be paid for talent and a portion of the time used in the public service, but certainly as the general expenses or fixed charges increase, the amount available for talent and good programs must be reduced, and the amount of time given free in the public interest must likewise be reduced.

Hence, the listener suffers in that he is bound to get more mechanical reproductions, smaller orchestras, and programs of less interest. Consequently, great care must be used in the establishing of any license fee or tax so as not to impose too much financial responsibility upon the broadcaster, for certainly the real value of a radio broadcasting station is in the service and programs that it renders.

The public demand for better programs is very evident; consequently I believe in the future the Commission will require a strict account of the stewardship of each broadcasting station to enable them to determine the extent of the public service rendered.

I believe stations will also be required to modernize, and to continue improving their equipment in order that the listener may receive a clear, sharp, true reproduction, transmitting exactly upon the assigned frequency. This will not be accomplished without the expenditure of considerable sums of money.

These, with many other facts, must be considered when we talk of a license fee for broadcasting stations. Certainly it is the desire of Congress to make such radio laws as shall enable the public to receive the greatest possible benefits from the use of the air.

READY TO LINK CHAINS BY AIR, REPLACE WIRES

Washington.

Representatives of WENR, Chicago, operated by the Great Lakes Broadcasting Company and owned by the Insull public utilities interests, appeared before the Federal Radio Commission with plans for the development of a system of rebroadcasting radio programs, both here and abroad, based on the use of short-wave channels for connecting the stations in place of wires.

They applied for experimental licenses for short-wave channels for this purpose. At the same time they presented arguments in favor of an application for experimental licenses for waves to be used for visual broadcasting.

Hogan Speaks for WENR

John V. L. Hogan, consulting radio engineer of New York, John E. Wing, Chicago, counsel, and G. L. Gager, Chicago, chief engineer, appeared for WENR. The Commission took the applications under advisement.

Mr. Gager explained that the primary purpose of the company is to develop the scientific knowledge of rebroadcasting so as to increase the listener coverage of programs originating at WENR.

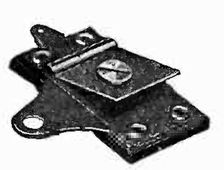
Arrangements already have been made with two stations, WWVA, at Wheeling, W. Va., and WDRC, New Haven, Conn., for the rebroadcasting of the experimental short-wave programs, Mr. Gager stated. He also said that two other stations, WRUF, Gainesville, Fla., and WEBR, Buffalo, had asked permission to rebroadcast the WENR programs, picking them up from the regular broadcast wave.

Tests Highly Successful

Mr. Hogan said that arrangements already had been worked out for the rebroadcasting experiments, and that if they were successful "a new type of service in increasing the reliable service area of a particular station will have been established." Mr. Hogan outlined results that had been obtained on rebroadcasting from the regular wave and said that "the tests had been highly successful."

Hammarlund Has 80 mmfd. Equalizer

The Hammarlund Manufacturing Co. has introduced a new capacity of equalizing condenser. It is the EC-80 and is of 80 mmfd. with a minimum of 20 mmfd. It serves as a grid condenser for all types of short wave receivers and as an equalizing capacity in any circuit. Full information on this and other Hammarlund parts may be had on application to the Hammarlund Manufacturing Co., Inc., 424 West 33rd Street, New York City. Mention RADIO WORLD.—J. H. C.



A THOUGHT FOR THE WEEK

IT has been some time since orators have stood before more or less interested listeners and declared that radio is still in its infancy. They're afraid of being laughed at—but why? Of course radio is still in its swaddling clothes. If you don't believe it, ask those who know so much they don't know the half of it.

TWO PROPOSE NEW STATIONS

Washington.

Two applications for permits to erect new stations were received by the Federal Radio Commission. Lyman C. Rader, Deshler, Ohio, one of the two, requested authority to erect a station using 20 watts power and a frequency of 830 kilocycles with daytime hours.

Arthur Brook, Lexington, Kentucky, the other, requested authority to erect a station using a frequency of 560 kilocycles, 50 watts power, one-half time on the air.

Other classes of applications follow:

WIRZ, Maine Broadcasting Company, Bangor, Maine, increased power from 250 night and 500 watts day to 500 watts power day and night.

WOOD, Walter B. Stiles, Inc., near Janeson, Michigan, increased power from 500 watts to 1 kilowatt.

KGIQ. Radio Broadcasting Corp. Twin Falls, Idaho, for consent transfer station license from Stanley M. Soule to applicants named above.

WBMS, Fort Lee, N. J., requests increased power from 250 watts to 500 watts, change in frequency from 1,450 to 920 kilocycles, and from sharing with WNJ-WKBO-WIBS to daytime until sunset at Detroit, Mich.

WWNC, Asheville, N. C., change in frequency from 570 to 580, 880, 590 or 630 kilocycles.

KOFI, Corpus Christi, Tex., authority to have the license of San Angelo Broadcasting Co., Inc., transferred to applicant, Eagle Broadcasting Co., Inc.

KSOO, Sioux Falls, S. Dak., requests increased power from 2 kilowatts to 5 kilowatts.

KVI, Tacoma, Wash., requests change in frequency from 1,340 to 710 kilocycles and from sharing time with KMO half time, to 6 a. m. to sunset, Pacific time, after WOR shuts off.

New Radiola 33 6-Tube Console Set

A new Radiola combination for AC operation was announced by the Radio Corporation of America.

The new receiver, Radiola 33, is of the console type. Three stages of tuned radio-frequency amplification, detector, and two stages of audio-frequency amplification, are employed. The tubes are four 226, one 227, and one 171A, as well as a 280 rectifier.

The new magnetic loudspeaker 100-B matches Radiola 33 in design and fits into a border groove on top of the receiver.

Proskauer Analyzes Condenser Breakdown

The Truetone Radio Sales Co., 114 Worth Street, New York City, under the direction of Julien J. Proskauer, inventor of the Si-len-ser, and other successful radio devices, announce the perfection and production of two new models of the Si-len-ser. One is for small motors, the Junior Si-len-ser, and the other to take the hum out of dynamic type speakers. These will be ready for delivery after April 10th.

According to Mr. Proskauer, the original, or Senior Si-len-ser, enjoys a phenomenal sale from coast to coast as well as in Canada and many foreign countries, and it is his belief that the Si-len-ser Junior and the Midget Dynamic Speaker Hum Eliminator will probably even surpass the success of the Si-len-ser Senior.

One point brought up regarding the life of the condensers in the Si-len-sers brought forth the following statement from Mr. Proskauer: "Experience has taught us the requirements of a satisfactory condenser, which are minutely adhered to by us in the processing. False economy has been the cause of failure of many condenser banks. Condensers adulterated with chemical compound possessing a high dielectric capacity in order to have the amount of tin foil and paper has been one of the main reasons for condenser failure. Such chemicals when added to paraffine do not form a chemical compound, but remain as a mixture and in short time crystallize and separate from the basic impregnating material.

"There has also been a tendency to use these chemical compounds possessing a high dielectric capacity in whole, but experience shows that these possess the property of crystallizing in short time. A fundamental law of electricity shows that the quantity of electricity charged upon a condenser is equivalent to the capacity multiplied by the potential applied. Since by the use of a high dielectric the capacity of a condenser is increased and consequently less material is used per microfarad, the strain per given area is increased. When crystallization takes place the paper must stand this additional strain and hence a breakdown occurs when the condenser is unable to do so. Si-len-ser condensers are vacuum dried and impregnated with a pure non-crystallizing wax of low dielectric capacity."

Readers are invited to write to Trutone Radio Sales Company, 114 Worth Street, New York City, concerning any interference trouble. Mention Radio World.—J. H. C.

SCHMIT WITH CUNNINGHAM

Dominic F. Schmit, of New York City, has been appointed chief engineer of E. T. Cunningham, Inc., radio tube company, succeeding Roger M. Wise, who went with Grigsby-Grunow Co., preparatory to the manufacture of Majestic tubes. Mr. Schmit is a specialist in radio tubes.

DAILY SCORES OF BALL TEAMS TO BE RADIATED

A daily resume of scores in all major league baseball games, beginning with the opening games April 16, will be broadcast over two National Broadcasting Company networks throughout the season. The scores will be compiled and broadcast in cooperation with the United and Associated Press sport news staffs.

Alan J. Gould, general sports editor for the Associated Press, will give a resume of the games on the opening day through an NBC network headed by WJZ, New York. William J. Fagan, United Press radio editor, will read the scores daily, except Sundays, through an NBC network, of which WEAF is the New York outlet.

Associated Press scores will be heard through associated NBC stations headed by WJZ from 7 to 7:05 p.m., Eastern Standard Time, Sunday, Monday, Tuesday and Wednesday evenings, 6:25 to 6:30 p.m. on Thursday and Saturday evenings and from 6:55 to 7 p.m. on Friday evenings. Two exceptions to this schedule will be Wednesday, April 17 and Saturday, April 20, when the scores will be broadcast from 7:15 to 7:20 p.m. EST.

Stations associated with NBC System headed by WEAF will hear United Press scores on Mondays from 6:25 to 6:30 o'clock; Tuesdays, Wednesdays and Thursdays from 6:55 to 7 o'clock; Fridays and Saturdays, 7 to 7:05 o'clock and Sundays 7:30 to 7:35 o'clock. The exception to this is also Saturday, April 20, when the scores broadcast is set for 6:25 to 6:30 o'clock.

Chain to Carry Safety Programs

In an effort to reduce America's annual 100,000 death toll from accidents, the National Broadcasting Company, in conjunction with the National Safety Council, will present thirteen weekly programs entitled "Universal Safety Series."

Charles M. Schwab will speak on the initial program of the series Saturday night, April 20, at 7:30 p. m. (EST) over a nationwide network. Twelve other prominent men will participate in the series.

The talks will deal with safety in the various lines of human endeavor, from the home to aviation. Each speaker will deal the problem as it effects his or her own particular field.

Those who have accepted invitations to talk include Robert P. Lamont, Secretary of Commerce; James J. Davis, Secretary of Labor; Madam Ernestine Schumann-Heink, concert and operatic star; Dr. Miller McClintock, of Harvard University; Grover A. Whalen, New York Commissioner of Police, and Joseph E. Sheedy, executive vice president of the United States Lines.

Stations That Send Television

The Federal Radio Commission listed the licenses for television transmission as follows:

Call Letters	Transmitter Location	Frequency (Kilocycles)	Power (watts)
W1XAE	E. Springfield	2000-2100	20
W1XAY	Lexington	2000-2100	5
W2XBA	Newark	2750-2850	50
W2XBV	Portable-initial location,		
W2XBV	Portable-initial location, New York	2000-2100	5
W2XBW	Portable-initial location, Bound Brook	2000-2100	5
W2XCL	New York	2000-2100 2750-2850	250
W2XCO	New York	2100-2200	5
W2XCR	Jersey City	2100-2200	5
W2XCW	Schenectady	2100-2200	20
W2XX	Ossining, N. Y.	2000-2100	100
W2XK	Washington, D. C.	2000-2100 2850-'2950	5
W3XL	Bound Brook	2850-2950	
W4XE	Winter Park, Fla.	2000-2100	2
W6XN	Oakland	2000-2100	10
W7XAO	Portland, Ore.	2750-2850	100
W8XAV	E. Pittsburgh	2000-2100 2100-2200 2750-2850	20
W9XAO	Chicago	2000-2100	500
W9XAA	Chicago	2000-2100	1
W9XAZ	Iowa City	2000-2100	500
WRNY	Coytesville, N. J.	1010	250
W9XAG	Chicago	2100-2200	5

When Voltage Sags

Many AC set users are troubled at times with sagging line voltage. And this always occurs at a time when some fine program is on the air, or a fight broadcast is at its most thrilling moment. It is particularly embarrassing when a houseful of company is present and one not only has the worry but has to listen to joking remarks and quips on the set. A 25-500 ohm Power Clarostat in the primary will avoid such embarrassment.

...President and Treasurer, 145 West 45th Street, New York, N. Y.; Herman Bernard, Secretary, 145 West 45th St., New York, N. Y.

List of Stations by Frequency, With Wavelength and Location

Canadian shared
* Canadian exclusive
-Studio

550 KC, 545.1 METERS
VEAN-Providence, R. I.
VGR-Buffalo, N. Y.
VEAO-Columbus, O.
VKRC-Cincinnati, O.
FUO-Clayton, Mo.
S-St. Louis, Mo.
SD-St. Louis, Mo.
FDY-Brookings, S. D.
FYR-Bismarck, N. D.
TAB-Oakland, Calif.

560 KC, 535.4 METERS
VDGY-Minneapolis, Minn.
VHDI-Minneapolis, Minn.
VLIT-Philadelphia
VFI-Philadelphia
FDM-Beaumont, Tex.
VMBF-Miami Beach, Fla.
VNOX-Knoxville, Tenn.
VOI-Ames, Iowa
FEQ-St. Joseph, Mo.
OAC-Corvallis, Ore.
LZ-Dupont, Colo.

570 KC, 526 METERS
VNYC-New York, N. Y.
VMCA-Hoboken, N. J.
S-New York, N. Y.
VSYR-Syracuse, N. Y.
VMAC-Cazenovia, N. Y.
VSMK-Dayton, O.
VKBN-Youngstown, O.
VWNC-Asheville, N. C.
GKO-Wichita Falls, Tex.
VHA-Madison, Wis.
VNAX-Yankton, S. D.
VPCC-Chicago, Ill.
VIBO-Desplaines, Ill.
S-Chicago, Ill.
UOM-Missoula, Mont.
XA-Seattle, Wash.
MTR-Hollywood, Cal.
PLA-Los Angeles

580 KC, 516.9 METERS
VTAG-Worcester, Mass.
VOBU-Charleston, W. Va.
VSAZ-Huntington, W. Va.
GFX-Pierre, S. D.
SAC-Manhattan, Kans.
VSUI-Iowa City, Iowa

590 KC, 508.2 METERS
VEEI-N. Weymouth, Mass.
VEMC-Berrien Spgs., Mich.
VCAJ-Lincoln, Nebr.
VOW-Omaha, Nebr.
HQ-Spokane, Wash.

600 KC, 499.7 METERS
VTIC-Hartford, Conn.
VCAC-Storrs, Conn.
VCAO-Baltimore, Md.
VREC-Whitehaven, Tenn.
VOAN-Lawrenceburg, Tenn
VEBW-Beloit, Wis.
FSD-San Diego, Calif.
WYO-Laramie, Wyo.

610 KC, 491.5 METERS
VFAN-Philadelphia
VIP-Philadelphia
VDAF-Kansas City, Mo.
VOQ-Kansas City, Mo.
FRC-San Francisco

620 KC, 483.6 METERS
VLBZ-Bangor, Maine
VDBO-Orlando, Fla.
VDAE-Tampa, Fla.
VTMJ-Brookfield, Wis.
GW-Portland, Ore.
FAD-Phoenix, Ariz.

630 KC, 475.9 METERS
VMAL-Washington, D. C.
VOS-Jefferson City, Mo.
FRU-Columbia, Mo.
VGBF-Evansville, Ind.

640 KC, 468.5 METERS
VAIU-Columbus, O.
FI-Los Angeles, Calif.

650 KC, 461.3 METERS
VSM-Nashville, Tenn.

660 KC, 454.3 METERS
VEAF-Bellmore, N. Y.
S-New York City
VAAW-Omaha, Nebr.

670 KC, 447.5 METERS
VMAQ-Addison, Ill.
S-Chicago, Ill.

680 KC, 440.9 METERS
VPTF-Raleigh, N. C.
PO-San Francisco

690 KC, 434.5 METERS

700 KC, 428.3 METERS
LW-Mason, Ohio
FVD-Culver City, Calif.

710 KC, 422.3 METERS
OR-Kearny, N. J.
S-Newark, N. J.

730 KC, 413 METERS
GN-WLIB-Elgin, Ill.
S-Chicago, Ill.

***730 KC, 413 METERS**

740 KC, 405.2 METERS
SB-Atlanta, Ga.
MMJ-Clay Center, Nebr.

750 KC, 399.8 METERS
JR-WCX-Silver Lake
S-Detroit, Mich.

760 KC, 394.5 METERS
JZ-Boundbrook, N. J.
S-New York, N. Y.
EW-St. Louis, Mo.

770 KC, 389.4 METERS
FAB-Lincoln, Nebr.
BBM-WJBT-Glenview,
S-Chicago, Ill.

780 KC, 384.4 METERS
BSO-Wellesley, Mass.
TAR-WPOR-Norfolk, Va.
MC-Memphis, Tenn.
ELW-Burbank, Calif.
KTM-Santa Monica, Cal.
S-Los Angeles, Calif.

790 KC, 379.5 METERS
WGY-Schenectady, N. Y.
KGO-Oakland, Calif.

800 KC, 374.8 METERS
WSAI-Mason, Ohio
WBAP-Ft. Worth, Tex.
KTHS-Hot Springs Nat'l Park, Ark.

810 KC, 370.2 METERS
WPCH-Hoboken, N. J.
S-New York, N. Y.
WCCO-Anoka, Minn.
S-Minneapolis.

820 KC, 365.6 METERS
WHAS-Jeffersontown, Ky.
S-Louisville, Ky.

830 KC, 361.2 METERS
WHDH-Gloucester, Mass.
KOA-Denver, Colo.

****840 KC, 356.9 METERS**

850 KC, 352.7 METERS
KWKH-Kennonwood, La.
WWL-New Orleans, La.

860 KC, 348.6 METERS
WABC-WBOQ-N. Y. City
KFQZ-Hollywood, Calif.

870 KC, 344.6 METERS
WLS-Crete, Ill.
S-Chicago, Ill.
WENR-WBCN-Chicago

***880 KC, 340.7 METERS**
WQAN-Scranton, Pa.
WGBI-Scranton, Pa.
WCOC-Columbus, Miss.
KLX-Oakland, Calif.
KPOF-Denver, Colo.
KFKA-Greeley, Colo.

***890 KC, 336.9 METERS**
WJAR-Providence, R. I.
WKAQ-San Juan, P. R.
WMMN-Fairmont, W. Va.
WMAZ-Macon, Ga.
WGST-Atlanta, Ga.
KGJF-Little Rock, Ark
WILL-Urbana, Ill.
KUSD-Vermillion, S. D.
KFNF-Shenandoah, Iowa

900 KC, 331.1 METERS
WFBL-Syracuse, N. Y.
WMAK-Martinsville, N. Y.
S-Buffalo, N. Y.
WKY-Okla. City, Okla.
WFLA-WSUN-
Clearwater, Fla.
WLBL-Stevens Point, Wis.
KHJ-Los Angeles, Calif.
KSEI-Pocatello, Idaho
KGBU-Ketchikan, Alaska

****910 KC, 329.5 METERS**

920 KC, 325.9 METERS
WWJ-Detroit, Mich.
KPRC-Houston, Tex.
WAAF-Chicago, Ill.
KOMO-Seattle, Wash.

***930 KC, 322.4 METERS**
WIBG-Elkins Park, Pa.
WDBJ-Roanoke, Va.
WBRC-Birmingham, Ala.
KGBZ-York, Nebr.
KMA-Shenandoah, Iowa
KFWM-Oakland, Calif.
KFWI-San Francisco

940 KC, 319.0 METERS
WCSH-Portland, Maine
WFIW-Hopkinsville, Ky.
KOIN-Sylvan, Ore.
S-Portland, Ore.
KGU-Honolulu, T. H.
KFEL-Denver, Colo.
KFXF-Denver, Colo.

950 KC, 315.6 METERS
WRC-Washington, D. C.
KMBC-KLDS-
Independence, Mo.
WHB-Kansas City, Mo.
KFWB-Hollywood, Calif.
KPSN-Pasadena, Calif.
KGHL-Billings, Mont.

****960 KC, 312.3 METERS**

970 KC, 309.1 METERS
WCFL-Chicago, Ill.
KJR-Seattle, Wash.

980 KC, 305.9 METERS
KDKA-Wilkins Township.
S-Pittsburgh, Pa.

990 KC, 302.8 METERS
WBZ-E. Springfield, Mass.
S-Boston, Mass.
WBZA-Boston, Mass.

1000 KC, 299.8 METERS
WHO-Des Moines, Iowa
WOC-Davenport, Iowa
KGFH-Glendale, Calif.

***1010 KC, 296.9 METERS**
WQAO-WPAP-
Cliffside, N. J.
S-New York, N. Y.
WHN-New York, N. Y.
WRNY-Coytesville, N. J.
S-New York, N. Y.
KGGF-Picher, Okla.
WNAD-Norman, Okla.
WSIS-Sarasota, Fla.
KQW-San Jose, Calif.

1020 KC, 293.9 METERS
WRAX-Philadelphia.
KYW-KFKX-Chicago.
KYWA-Chicago.

****1030 KC, 291.2 METERS**

1040 KC, 288.3 METERS
WKEN-Grand Island, N.Y.
S-Buffalo, N. Y.
WKAR-E. Lansing, Mich.
WFAA-Dallas, Tex.
KRLD-Dallas, Tex.

1050 KC, 285.5 METERS
KFKB-Milford, Kans.
KNX-Los Angeles, Calif.
S-Hollywood, Calif.

1060 KC, 282.8 METERS
WBAL-Glen Morris, Md.
S-Baltimore, Md.
WTIC-Hartford, Conn.
WJAG-Norfolk, Nebr.
KWJJ-Portland, Ore.

1070 KC, 280.2 METERS
WAAT-Jersey City, N. J.
WTAM-Cleveland, Ohio
WEAR-Cleveland, Ohio
WCAZ-Carthage, Ill.
WDZ-Tuscola, Ill.

1080 KC, 277.6 METERS
WBT-Charlotte, N. C.
WCBD-Zion, Ill.
WMBI-Chicago, Ill.

1090 KC, 257.1 METERS
KMOX-KFOA-Kirkwood
S-St. Louis, Mo.

1100 KC, 272.6 METERS
WPG-Atlantic City, N. J.
WLWL-Kearny, N. J.
S-New York, N. Y.
KGDM-Stockton, Calif.

1110 KC, 270.1 METERS
WRVA-Richmond, Va.
KSOO-Sioux Falls, S. D.

***1120 KC, 267.7 METERS**
WDEL-Wilmington, Del.
WCOA-Pensacola, Fla.
WTAW-College Sta., Tex.
KUT-Austin, Tex.
WISN-Milwaukee, Wis.
WHAD-Milwaukee, Wis.
KFSG-Los Angeles, Calif.
KMIC-Inglewood, Calif.
KRSC-Seattle, Wash.

1130 KC, 265.3 METERS
WJJD-Mooseheart, Ill.
WOV-Secaucus, N. J.
S-New York, N. Y.
KSL-Salt Lake City, Utah.

1140 KC, 263 METERS
WAPI-Birmingham, Ala.
KVOO-Tulsa, Okla.

1150 KC, 260.7 METERS
WHAM-Victor Township
S-Rochester, N. Y.
KJBS-San Francisco.

1160 KC, 258.5 METERS
WWVA-Wheeling, W. Va.
WOWO-Ft. Wayne, Ind.

1170 KC, 256.3 METERS
WCAU-Byberry, Pa.
S-Philadelphia, Pa.
KTNT-Muscatine, Iowa
KEJK-Beverly Hills, Calif.

1180 KC, 254.1 METERS
WGBS-Astoria, L. I.
S-New York City.
KEX-Portland, Ore.
KOB-State College, N. M.

1190 KC, 252 METERS
WICC-Easton, Conn.
S-Bridgeport, Conn.
WOAI-San Antonio, Tex.

***1200 KC, 249.9 METERS**
WABI-Bangor, Maine.
WCAX-Burlington, Vt.
WNBX-Springfield, Vt.
WEPS-Gloucester, Mass.
WKBE-Webster, Mass.
WIBX-Utica, N. Y.
WFBE-Cincinnati, Ohio.
WHBC-Canton, Ohio.
WLAP-Louisville, Ky.
WLBG-Ettrick, Va.
WNBO-Washington, Pa.
WPRC-Harrisburg, Pa.
WKJC-Lancaster, Pa.
WNBW-Carbondale, Pa.
WABZ-New Orleans, La.
WJBW-New Orleans, La.
WBBY-Charleston, S. C.
WBBZ-Ponca City, Okla.
WFBC-Knoxville, Tenn.
WRBL-Columbus, Ga.
KGCU-Mandan, N. D.
WJBC-LaSalle, Ill.
WJBL-Decatur, Ill.
WWAE-Hammond, Ind.
WRAF-Laporte, Ind.
WMT-Waterloo, Iowa
KFJB-Marshalltown, Iowa
WCAT-Rapid City, S. D.
KGDY-Oldham, S. D.
WMAY-St. Louis, Mo.
KFWF-St. Louis, Mo.
KFKZ-Kirksville, Mo.
KGDE-Fergus Falls, Minn.
KGFK-Hallock, Minn.
WCLO-Kenosha, Wis.
WHBY-West DePere, Wis.
KFWC-Ontario, Calif.
S-Pomona, Calif.
KPPC-Pasadena, Calif.
KXO-El Centro, Calif.
KMJ-Fresno, Calif.
KSMR-Santa Maria, Calif.
KWG-Stockton, Calif.
KGEK-Yuma, Colo.
KGEW-Ft. Morgan, Colo.
KFHA-Gunnison, Colo.
KVOS-Bellingham, Wash.
KGY-Lacey, Wash.

***1210 KC, 247.8 METERS**
WJBI-Red Bank, N. J.
WGBB-Freeport, N. Y.
WINR-Bayshore, N. Y.
WCOH-Greenville, N. Y.
S-Yonkers, N. Y.
WOCL-Jamestown, N. Y.
WLCI-Ithaca, N. Y.
WPAW-Pawtucket, R. I.
WDWF-WLSI-
Cranston, R. I.
WMAN-Columbus, Ohio
WLBV-Mansfield, Ohio
WEBE-Cambridge, Ohio
WBAX-Wilkes-Barre, Pa.
WJBU-Lewisburg, Pa.
WTAZ-Richmond, Va.
WMBG-Richmond, Va.
WSIX-Springfield, Tenn.
WRBU-Gastonia, N. C.
WJBY-Gadsden, Ala.
WMBR-Tampa, Fla.
WRBQ-Greenville, Miss.
WGCM-Gulfport, Miss.
KWEA-Shreveport, La.
KDLR-Devils Lake, N. D.
KGCR-Watertown, S. D.
KFOR-Lincoln, Neb.
WHBU-Anderson, Ind.
KFVS-Cape Girardeau, Mo.
WEBQ-Harrisburg, Ill.
WSBC-Chicago, Ill.
WCRW-Chicago, Ill.
WEDC-Chicago, Ill.
WCBS-Springfield, Ill.
WTAX-Streator, Ill.
WHBF-Rock Island, Ill.
WIBA-Madison, Wis.
WOMT-Manitowoc, Wis.
KPQ-Seattle, Wash.
KPCB-Seattle, Wash.

1220 KC, 245.8 METERS
WCAD-Canton, N. Y.
WCAE-Pittsburgh, Pa.
WREN-Lawrence, Kan.
KFKU-Lawrence, Kan.

1230 KC, 243.8 METERS
WNAC-Boston
WBIS-Boston
WPSC-State College, Pa.
WSBT-South Bend, Ind.
WFBM-Indianapolis, Ind.
KYA-San Francisco, Calif.
KFIO-Spokane, Wash.
KFQD-Anchorage, Alaska

1240 KC, 241.8 METERS
WGHP-Fraser, Mich.
S-Detroit, Mich.
KTAT-Ft. Worth, Tex.
WJAD-Waco, Tex.
WQAM-Miami, Fla.
WIOD-Miami Beach, Fla.
WRBC-Valparaiso, Ind.

1250 KC, 239.9 METERS
WGCP-Newark, N. J.
WODA-Paterson, N. J.
WAAM-Newark, N. J.
WLB-WGMS-Minneapolis
WRHM-Fridley, Minn.
KFMX-Northfield, Minn.
WCAL-Northfield, Minn.
KFOX-Long Beach, Calif.
KXL-Portland, Ore.
KILO-Boise, Idaho

1260 KC, 238 METERS
WLBW-Oil City, Pa.
WJAX-Jacksonville, Fla.
KWWG-Brownsville, Tex.
KRGV-Harlingen, Tex.
KOIL-Council Bluffs, Ia.

1270 KC, 236.1 METERS
WEAI-Ithaca, N. Y.
WFBR-Baltimore, Md.
WASH-Grand Rapids, Mich.
WOOD-Furnwood, Mich.
S-Grand Rapids, Mich.
WDSU-New Orleans, La.
KWLC-Decorah, Iowa
KGCA-Decorah, Iowa
KTW-Seattle, Wash.
KOL-Seattle, Wash.
KFUM-Colo. Springs, Col.

1280 KC, 234.2 METERS
WCAM-Camden, N. J.
WCAP-Asbury Park, N.J.
WOAX-Trenton, N. J.
WDOD-Chattanooga, Tenn.
WRR-Dallas, Tex.
WDAY-Fargo, N. D.
WEBC-Superior, Wis.
S-Duluth, Minn.

1290 KC, 232.4 METERS
WNBZ-Saranac Lake, N. Y.
WJAS-Pittsburgh, Pa.
KTSA-San Antonio, Tex.
KFUL-Galveston, Tex.
KLCN-Blytheville, Ark.
KDYL-Salt Lake City

1300 KC, 230.6 METERS
WBBR-Rossville, N. Y.
WHAP-Carlstadt, N. J.
S-New York, N. Y.
WEVD-Woodhaven, N. Y.
S-New York, N. Y.
WHAZ-Troy, N. Y.
KFH-Wichita, Kan.
WIBW-Topeka, Kan.
KGEF-Los Angeles
KTBI-Los Angeles
KFJR-Portland, Ore.
KTBR-Portland, Ore.

1310 KC, 228.3 METERS
WKAV-Laconia, N. H.
WEBR-Buffalo, N. Y.
WSMD-Salisbury, Md.
WNBH-New Bedford, Mass.
WOL-Washington, D. C.
WGH-Newport News, Va.
WRK-Hamilton, Ohio
WAGM-Royal Oak, Mich.
WFDF-Flint, Mich.
WNAT-Philadelphia, Pa.
WFKD-Frankford, Pa.
S-Philadelphia.
WHBP-Johnstown, Pa.
WFBG-Altoona, Pa.
WRAW-Reading, Pa.
WGAL-Lancaster, Pa.
WSAJ-Grove City, Pa.
WBRE-Wilkes-Barre, Pa.
WMBL-Lakeland, Fla.
WKBC-Birmingham, Ala.
KGHG-McGehee, Ark.
WOBT-Union City, Tenn.
WNBJ-Knoxville, Tenn.
KRMD-Shreveport, La.
KTSL-Cedar Grove, La.
S-Shreveport, La.
KFPM-Greenville, Tex.
WDAH-El Paso, Tex.
KGFI-Corpus Christi, Tex.
KFPL-Dublin, Tex.
KFXR-Okla. City, Okla.
WKBS-Galesburg, Ill.
WLBO-Galesburg, Ill.
WEHS-Evanston, Ill.
WCLS-Joliet, Ill.
WKBB-Joliet, Ill.
WKBI-Chicago, Ill.
WHFC-Cicero, Ill.
KWCR-Cedar Rapids, Ia.
KFJY-Ft. Dodge, Ia.
KFGQ-Boone, Ia.
WBOW-Terre Haute, Ind.
WJAK-Marion, Ind.
WLBC-Muncie, Ind.
WIBU-Poynette, Wis.
KFBK-Sacramento, Calif.
KFIU-Juneau, Alaska
KGEZ-Kalispell, Mont.
KFUP-Denver, Colo.
KFXJ-Edgewater, Colo.
KMED-Medford, Ore.

1320 KC, 227.1 METERS
WADC-Akron, Ohio
WSMB-New Orleans, La.
KGIQ-Twin Falls, Idaho
KGHF-Pueblo, Colo.
KGHB-Honolulu, Hawaii
KID-Idaho Falls, Idaho

1330 KC, 225.4 METERS
WDRC-New Haven, Conn.
WTAQ-Washington, Wis.
S-Eau Claire, Wis.
KSCJ-Sioux City, Iowa

1340 KC, 223.7 METERS
WSPD-Toledo, Ohio
KFPW-Siloam Springs, Ark.
KMO-Tacoma, Wash.
KVI-Des Moines, Wash.
S-Tacoma, Wash.

1350 KC, 221.1 METERS
WBNY-New York, N. Y.
WMSG-New York, N. Y.
WCDA-New York, N. Y.
WKBQ-New York, N. Y.
KWK-St. Louis, Mo.

1360 KC, 220.4 METERS
WLEX-Lexington, Mass.
WMAF-South Dartmouth, Mass.
WQBC-Utica, Miss.
WJKS-Gary, Ind.
WGES-Chicago, Ill.
KFBB-Great Falls, Mont.
KGIR-Butte, Mont.
KGB-San Diego, Calif.

1370 KC, 218.8 METERS
WMBO-Auburn, N. Y.
WSVS-Buffalo, N. Y.
WCBM-Baltimore, Md.
WBBL-Richmond, Va.
WHBD-Bellefontaine, O.
WHDF-Calumet, Mich.
WJBK-Ypsilanti, Mich.
WIBM-Jackson, Mich.
WRAK-Erie, Pa.
WELK-Philadelphia.
WJBO-New Orleans, La.
WHBQ-Memphis, Tenn.
WRBT-Wilmington, N. C.
KGFG-Okla. City, Okla.
KCRC-Enid, Okla.
KGCI-San Antonio, Tex.
KGRC-San Antonio, Tex.
KFJZ-Ft. Worth, Tex.
KGKL-San Angelo, Tex.
KFLX-Galveston, Tex.
WFBJ-Collegeville, Minn.
WGL-Ft. Wayne, Ind.
KGDA-Dell Rapids, S. D.
KFJM-Grand Forks, N. D.
KWKC-Kansas City, Mo.
KGBX-St. Joseph, Mo.
WRJN-Racine, Wis.
KGAR-Tucson, Ariz.
KFUR-Ogden, Utah
KOH-Reno, Nev.
KZM-Hayward, Calif.
KRE-Berkeley, Calif.
KGER-Long Beach, Calif.
KOOS-Marshfield, Ore.
KFBL-Everett, Wash.
KKP-Seattle, Wash.
KFEC-Portland, Ore.
KVL-Seattle, Wash.
KFJI-Astoria, Ore.
KGFL-Raton, N. M.
KGGM-Albuquerque, N.M.

1380 KC, 217.3 METERS
WCSO-Springfield, Ohio.
KQV-Pittsburgh, Pa.
KSO-Clarinda, Ia.
WKBH-LaCrosse, Wis.

1390 KC, 215.7 METERS
WHK-Cleveland, O.
KLRA-Little Rock, Ark.
KOY-Phoenix, Ariz.
KUOA-Fayetteville, Ark.
KOW-Denver, Colo.
KWSC-Pullman, Wash.
KFPY-Spokane, Wash.

1400 KC, 214.2 METERS
WCGU-Coney Isl., N. Y.
WSGH-WSDA-Bklyn, N Y
WLTH-Brooklyn, N. Y.
WBBC-Brooklyn, N. Y.
WBAA-W. LaFayette, Ind.
WCMA-Culver, Ind.
WKDF-Indianapolis, Ind.

1410 KC, 212.6 METERS
WBCM-Hampton, Mich.
S-Bay City, Mich.
KGRS-Amarillo, Tex.
WDAG-Amarillo, Tex.
KFLV-Rockford, Ill.
WHBL-Sheboygan, Wis.

1420 KC, 211.1 METERS
WHDL-Tupper Lake, N.Y.
WHIS-Bluefield, W. Va.
WLBH-Patchogue, N. Y.
WHPP-Englewood, N. J.
WMRJ-Jamaica, N. Y.
WLEY-Lexington, Mass.
WTBO-Cumberland, Md.
WSSH-Boston, Mass.
WSRO-Middletown, O.
WIBR-Steubenville, O.
WAAD-Cincinnati, O.
WEDH-Erie, Pa.
WMBC-Detroit, Mich.
WKBP-Battle Creek, Mich.
WQBZ-Weirton, W. Va.
KGFF-Alva, Okla.
KOCW-Chickasha, Okla.
KTAP-San Antonio, Tex.
KTUE-Houston, Tex.
KFYO-Abilene, Tex.
KICK-Red Oak, Iowa
WIAS-Ottumwa, Iowa
KGCN-Concordia, Kan.
WIL-St. Louis, Mo.
WLBF-Kansas City, Kan.
WMBH-Joplin, Mo.
KGFW-Ravenna, Neb.
KFIZ-Fond du Lac, Wis.
KFXY-Flagstaff, Ariz.
KGFJ-Los Angeles, Calif.
KFQU-Holy City, Calif.
KGGC-San Francisco.
KFXD-Jerome, Idaho
KGHD-Missoula, Mont.
KGIW-Trinidad, Colo.
KGCX-Vida, Mont.
KFIF-Portland, Ore.
KORE-Eugene, Ore.
KFQW-Seattle, Wash.
KXRO-Aberdeen, Wash.

1430 KC, 209.7 METERS
WBRL-Manchester, N. H.
WHP-Harrisburg, Pa.
WBAK-Harrisburg, Pa.
WCAH-Columbus, Ohio
WGBC-Memphis, Tenn.
WNBR-Memphis, Tenn.

1440 KC, 208.2 METERS
WHEC-WABO-
Rochester, N. Y.
WOKO-Mt. Beacon, N. Y.
S-Poughkeepsie, N.Y.
WCBA-Allentown, Pa.
WSAN-Allentown, Pa.
WNRC-Greensboro, N. C.
WTAD-Quincy, Ill.
WMBD-Peoria Hts., Ill.
KLS-Oakland, Calif.

1450 KC, 206.8 METERS
WBMS-Fort Lee, N. J.
WNJ-Newark, N. J.
WIBS-Elizabeth, N. J.
WKBO-Jersey City, N. J.
WSAR-Fall River, Mass.
WJAY-Cleveland, Ohio
WFJC-Akron, Ohio
KSBA-Shreveport, La.
WTFI-Toccoa, Ga.

1460 KC, 205.4 METERS
WJSV-Mt. Vernon, Va.
KSTP-Westcott, Minn.
S-St. Paul, Minn.

1470 KC, 204 METERS
WKBW-Amherst, N. Y.
S-Buffalo, N. Y.
KFJF-Okla. City, Okla.
WRUF-Gainesville, Fla.
KGA-Spokane, Wash.

1480 KC, 202.6 METERS
WJAZ-Mt. Prospect, Ill.
S-Chicago, Ill.
WHT-Deerfield, Ill.
S-Chicago, Ill.
WORD-Batavia, Ill.
S-Chicago, Ill.
WCKY-Harrison, O.

1490 KC, 201.2 METERS
WBAW-Nashville, Tenn.
WLAC-Nashville, Tenn.
KPWF-Westminster, Calif.

1500 KC, 199.9 METERS
WMBA-Newport, R. I.
WLOE-Chelsea, Mass.
WMES-Boston, Mass.
WNBF-Binghamton, N. Y.
WMBQ-Brooklyn, N. Y.
WLBX-L. I. City, N. Y. C.
WCLB-Long Beach, N. Y.
WILM-Wilmington, Del.
WWRL-Woodside, N. Y.
WAFD-Detroit, Mich.
WKBZ-Ludington, Mich.
WMPC-Lapeer, Mich.
WMBJ-Wilkinsburg, Pa.
S-Pittsburgh, Pa.
WALK-Willow Grove, Pa.
WHBW-Philadelphia.
WPSW-Philadelphia.
WIBZ-Montgomery, Ala.
KGHI-Little Rock, Ark.
WRBJ-Hattiesburg, Miss.
KGKV-Brownswood, Tex.
KGKB-Brownwood, Tex.
KGDR-San Antonio, Tex.
KGHX-Richmond, Tex.
WKBV-Brookville, Ind.
KPJM-Prescott, Ariz.
KWBS-Portland, Ore.
KWTC-Santa Ana, Calif.
KDB-Santa Barbara, Calif.
KUJ-Long View, Wash.

Alphabetical List of Stations by Call Letters, Location and Frequency

Station Location Frequency
WAAD—Cincinnati, O., 1420
WAAF—Chicago, Ill., 920
WAAM—Newark, N. J., 1250
WAAT—Jersey City, N.J., 1070
WAAW—Omaha, Nebr., 660
WABC-WBOQ—N.Y. City, 860
WABI—Bangor, Me., 1200
WABZ—New Orleans, La., 1200
WADC—Akron, O., 1320
WAFD—Detroit, Mich., 1500
WAGM—Royal Oak, Mich., 1310
WAIU—Columbus, O., 640
WALK—Willow Grove, Pa., 1500
WAPI—Birmingham, Ala., 1140
WASH—Gd. Rapids, Mich., 1270
WBAA—W. Lafayette, Ind., 1400
WBAK—Harrisburg, Pa., 1430
WBAL—Baltimore, Md., 1060
WBAP—Fort Worth, Tex., 800
WBAW—Nashville, Tenn., 1490
WBAX—Wilkes-Barre, Pa., 1210
WBBC—Brooklyn, N. Y., 1400
WBBL—Richmond, Va., 1370
WBFM-WJBT—Chicago, Ill., 770
WBBR—Rossville, N. Y., 1300
WBBY—Charleston, S. C., 1200
WBBZ—Ponca City, Okla., 1200
WBCM—Bay City, Mich., 1410
WBET—Boston, Mass., 1360
WBMS—Fort, Lee., N. J., 1450
WBNY—New York, N. Y., 1350
WBOW—Terre Haute, Ind., 1310
WBRC—Birmingham, Ala., 930
WBRE—Wilkes-Barre, Pa., 1310
WBRL—Manchester, N. H., 1430
WBSO—Wellesley H., Mass., 780
WBT—Charlotte, N. C., 1080
WBZ—Boston, Mass., 990
WBZA—Boston, Mass., 990
WCAC—Storrs, Conn., 600
WCAD—Canton, N. Y., 1220
WCAE—Pittsburgh, Pa., 1220
WCAH—Columbus, Ohio, 1430
WCAJ—Lincoln, Nebr., 590
WCAL—Northfield, Minn., 1250
WCAM—Camden, N. J., 1280
WCAO—Baltimore, Md., 600
WCAP—Asbury Pk., N. J., 1280
WCAT—Rapid City, N.D., 1200
WCAU—Philadelphia, Pa., 1170
WCAX—Burlington, Vt., 1200
WCAZ—Carthage, Ill., 1070
WCBA—Allentown, Pa., 1440
WCBD—Zion, Ill., 1080
WCBM—Baltimore, Md., 1370
WCBS—Springfield, Ill., 1210
WCCO—Minneapolis, Minn., 810
WCDA—Cliffside, Pk., N.J., 1350
WCFL—Chicago, Ill., 970
WCGU—Coney Island, N.Y., 1400
WCLB—Lg. Beach, N.Y., 1500
WCKY—Harrison, O., 1480
WCLO—Kenosha, Wis., 1200
WCLS—Joliet, Ill., 1310
WCMA—Culver, Ind., 1400
WCOA—Pensacola, Fla., 1120
WCOC—Columbus, Miss., 880
WCOH—Yonkers, N.Y., 1210
WCRW—Chicago, Ill., 1210
WCSH—Portland, Maine, 940
WCSO—Springfield, O., 1380
WDAE—Tampa, Fla., 620
WDAF—Kansas City, Mo., 610
WDAG—Amarillo, Tex., 1410
WDAH—El Paso, Tex., 1310
WDAY—W. Fargo, N. D., 1280
WDBJ—Roanoke, Va., 930
WDBO—Orlando, Fla., 620
WDEL—Wilmington, Ind., 1120
WDGY—Minneapolis, Minn., 560
WDOD—Chattanooga, Tenn., 1280
WDRC—New Haven, Conn., 1330
WDSU—New Orleans, La., 1270
WDWF-WLSI—Cn'stn, R.I. 1210
WDZ—Tuscola, Ill., 1070
WEAF—New York, N.Y., 660
WEAI—Ithaca, N. Y., 1270
WEAN—Providence, R.I., 550
WEAO—Columbus, O., 550
WEAR—Cleveland, O., 1070
WEBC—Duluth, Minn., 1280
WEBE—Cambridge, O., 1210
WEBQ—Harrisburg, Ill., 1210
WEBR—Buffalo, N. Y., 1310
WEBW—Beloit, Wis., 600
WEDC—Chicago, Ill., 1210
WEDH—Erie, Pa., 1420
WEEI—N. Weymouth, Ms., 590
WEHS—Evanston, Ill., 1310
WELK—Phila, Pa., 1370
WEMC—Berrien Spgs., Mch. 590
WENR-WBCN—Chicago, Ill., 870
WEPS—Gloucester, Mass., 1200
WEVD—New York, N. Y., 1300
WEW—St. Louis, Mo., 760
WFAA—Dallas, Texas, 1040
WFAN—Philadelphia, Pa., 610
WFBC—Knoxville, Tenn., 1200
WFBE—Cincinnati, Ohio, 1200
WFBG—Altoona, Pa., 1310
WFBJ—Collegeville, Minn., 1370
WFBL—Syracuse, N. Y., 900
WFBM—Indianapolis, Ind., 1230
WFBR—Baltimore, Md., 1270
WFDF—Flint, Mich., 1310
WFI—Philadelphia, Pa., 560
WFIW—Hopkinsville, Ky., 940
WFJC—Akron, O., 1450
WFKD—Philadelphia, Pa., 1310
WFLA-WSUN—Clrw'tr Fla. 900
WGAL—Lancaster, Pa., 1310
WGBB—Freeport, N. Y., 1210
WGBC—Memphis, Tenn., 1430
WGBF—Evansville, Ind., 630
WGBI—Scranton, Pa., 880

Station Location Frequency
WGBS—New York City, 1180
WGCM—Gulfport, Miss., 1210
WGCP—Newark, N. J., 1250
WGES—Chicago, Ill., 1360
WGH—Newport News, Va., 1310
WGHP—Detroit, Mich., 1240
WGL—Ft. Wayne, Ind., 1370
WGMS—See WLB-WGMS
WGN-WLIB—Chicago, Ill., 720
WGR—Buffalo, N. Y., 550
WGST—Atlanta, Ga., 890
WGY—Schenectady, N. Y., 790
WHA—Madison, Wis., 570
WHAD—Milwaukee, Wis., 1120
WHAM—Rochester, N. Y., 1150
WHAP—N. Y. City, 1300
WHAS—Louisville, Ky., 820
WHAZ—Troy, N. Y., 1300
WHB—Kansas City, Mo., 950
WHBC—Canton, Ohio, 1200
WHBD—Bellefontaine, O., 1370
WHBF—Rock Island, Ill., 1210
WHBL—Sheboygan, Wis., 1410
WHBT—Johnstown, Pa., 1310
WHBQ—Memphis, Tenn., 1370
WHBU—Anderson, Ind., 1210
WHBW—Philadelphia, Pa., 1500
WHBY—W. De Pere, Wis., 1200
WHDF—Calumet, Mich., 1370
WHDH—Gloucester, Mass., 830
WHDI—Minneapolis, Minn., 560
WHDL—Tupper Lake, N.Y., 1420
WHEC-WABO-Roch'st'r, NY. 1440
WHFC—Cicero, Ill., 1310
WHIS—Bluefield, W. Va., 1420
WHK—Cleveland, Ohio, 1390
WHN—New York, N.Y., 1010
WHO—Des Moines, Ia., 1000
WHP—Harrisburg, Pa., 1430
WHPP—Englewood, N.J., 1420
WIAS—Ottumwa, Iowa, 1420
WIBA—Madison, Wis., 1210
WIBG—Elkins, Park, Ia., 930
WIBM—Jackson, Mich., 1370
WIBO—Chicago, Ill., 570
WIBR—Steubenville, O., 1420
WIBS—Elizabeth, N. J., 1450
WIBU—Poynette, Wis., 1310
WIBW—Topeka, Kan., 1300
WIBX—Utica, N. Y., 1200
WIBZ—Montgomery, Ala., 1500
WICC—Bridgeport, Conn., 1190
WIL—St. Louis, Mo., 1420
WILL—Urbana, Ill., 890
WILM—Wilmington, Del., 1500
WINR—Bay Shore, N. Y., 1210
WIOD—Miami Beach, Fla., 1240
WIP—Philadelphia, Pa., 610
WISN—Milwaukee, Wis., 1120
WJAD—Waco, Texas, 1240
WJAG—Norfolk, Nebr., 1060
WJAK—Kokomo, Ind., 1310
WJAR—Providence, R.I., 890
WJAS—Pittsburgh, Pa., 1290
WJAX—Jacksonville, Fla., 1260
WJAY—Cleveland, Ohio, 1450
WJAZ—Chicago, Ill., 1480
WJBC—La Salle, Ill., 1200
WJBI—Red Bank, N. J., 1210
WJBK—Ypsilanti, Mich., 1370
WJBL—Decatur, Ill., 1200
WJBO—New Orleans, La., 1370
WJBU—Lewisburg, Pa., 1210
WJBW—New Orleans, La., 1200
WJBY—Gadsden, Ala., 1210.
WJJD—Mooseheart, Ill., 1180
WJKS—Gary, Ind., 1360
WJR-WCX—Detroit, Mch., 750
WJSV—Mt. Vernon Hills, Va., 1460
WJZ—New York, N. Y., 760
WKAQ—San Juan, P. R., 890
WKAR—E. Lansing, Mich., 1040
WKAV—Laconia, N. H., 1310
WKBB—Joliet, Ill., 1310
WKBC—Birmingham, Ala., 1310
WKBE—Webster, Mass., 1200
WKBF—Indianapolis, Ind., 1400
WKBH—La Crosse, Wis., 1380
WKBI—Chicago, Ill., 1310
WKBN—Youngstown, O., 570
WKBO—Jersey City, N.J., 1450
WKBP—Battle Creek, Mch., 1420
WKBQ—New York, N. Y., 1350
WKBS—Galesburg, Ill., 1310
WKBV—Brookville, Ind., 1500
WKBW—Buffalo, N. Y., 1470
WKBZ—Ludington, Mich., 1500
WKEN—Buffalo, N. Y., 1040
WKJC—Lancaster, Pa., 1200
WKRC—Cincinnati, O., 550
WKY—Okla. City, Okla., 700
WLAC—Nashville, Tenn., 1490
WLAP—Louisville, Ky., 1200
WLB-WGMS—Minneapolis, 1250
WLBC—Muncie, Ind., 1310
WLBF—Kansas City, Mo., 1420
WLBG—Ettrick, Va., 1200
WLBH—Patchogue, N. Y., 1420
WLBL—Stevens Pt., Wis., 900
WLBO—Galesburg, Ill., 1310
WLBV—Mansfield, Ohio, 1210
WLBW—Oil City, Pa., 1260
WLBX—L. I. City, N.Y., 1500
WLBZ—Bangor, Maine, 620
WLCI—Ithaca, N. Y., 1210
WLEY—Lexington, Mass., 1420
WLIB-WGN—See WGN-WLIB
WLIT—Philadelphia, Pa., 560
WLOE—Chelsea, Mass., 1500
WLS—Chicago, Ill., 870
WLSI-WDWF—See WDWF
WLTH—Brooklyn, N. Y., 1400
WLW—Mason, Ohio, 700
WLWL—New York, N. Y., 1100
WMAC—Cazenovia, N. Y., 570

Station Location Frequency
WMAF—Dartmouth, Mass., 1360
WMAK—Buffalo, N. Y., 900
WMAL—Washington, D.C., 630
WMAN—Columbus, Ohio, 1210
WMAQ—Chicago, Ill., 670
WMAY—St. Louis, Mo., 1200
WMAZ—Macon, Ga., 890
WMBA—Newport, R. I., 1500
WMBC—Detroit, Mich, 1420
WMBD—Peoria Hts., Ill., 1440
WMBF—Miami Beach, Fla., 560
WMBG—Richmond, Va., 1210
WMBH—Joplin, Mo., 1420
WMBI—Addison, Ill., 1080
WMBJ—Pittsburgh, Pa., 1500
WMBL—Lakeland, Fla., 1310
WMBO—Auburn, N. Y., 1370
WMBQ—Brooklyn, N. Y., 1500
WMBR—Tampa, Fla., 1210
WMC—Memphis, Tenn., 780
WMCA—New York, N.Y., 570
WMES—Boston, Mass., 1500
WMMN—Fairmont, W. Va., 890
WMPC—Lapeer, Mich., 1500
WMRJ—Jamaica, N. Y., 1420
WMSG—New York, N. Y., 1350
WMT—Waterloo, Iowa, 1200
WNAC-WBIS—Boston, 1230
WNAD—Norman, Okla., 1010
WNAT—Philadelphia, Pa., 1310
WNAX—Yankton, S. D., 570
WNBF—Binghamton, N.Y., 1500
WNBH—N'w Bedf'rd, Mass., 1310
WNBJ—Knoxville, Tenn., 1310
WNBO—Washington, Pa., 1200
WNBR—Memphis, Tenn., 1430
WNBW—Carbondale, Pa., 1200
WNBX—Springfield, Vt., 1200
WNBZ—Saranac Lk., N.Y. 1290
WNJ—Newark, N. J., 1450
WNOX—Knoxville, Tenn., 560
WNRC—Greensboro, N.C., 1440
WNYC—New York, N.Y., 570
WOAI—San Antonio, Tex., 1190
WOAN—Lawrenceburg, Tenn. 600
WOAX—Trenton, N. J., 1280
WOBT—Union City, Tenn., 1310
WOBU—Charlestown, W.Va., 580
WOC—Davenport, Ia., 1000
WOCL—Jamestown, N. Y., 1210
WODA—Paterson, N. J., 1250
WOI—Ames, Iowa, 560
WOK-WMBB—See WMBB
WOKO—Poughkeepsie, NY., 1440
WOL—Washington, D.C., 1310
WOMT—Manitowoc, Wis., 1210
WOOD—Gd. Rapids, Mich., 1270
WOQ—Kansas City, Mo., 610
WOR—Newark, N. J., 710
WORD—Chicago, Ill., 1480
WOS—Jefferson City, Mo., 630
WOV—New York, N.Y., 1130
WOW—Omaha, Nebr., 590
WOWO—Ft. Wayne, Ind., 1160
WPAP-WQAO—See WQAO
WPAW—Pawtucket, R.I., 1210
WPCC—Chicago, Ill., 570
WPCH—New York, N.Y., 810
WPG—Atlantic City, N.J., 1100
WPOR-WTAR—See WTAR
WPRC—Harrisburg, Pa., 1200
WPSC—State College, Pa., 1230
WPSW—Philadelphia, Pa., 1500
WPTF—Raleigh, N. C., 680
WQAM—Miami, Fla., 1240
WQAN—Scranton, Pa., 880
WQAO-WPAP—N.Y.C., 1010
WQBC—Utica, Miss., 1360
WQBZ—Weirton, W.V., 1420
WRAF—LaPorte, Ind., 1200
WRAK—Erie, Pa., 1370
WRAW—Reading, Pa., 1310
WRAX—Philadelphia, Pa., 1020
WRBC—Valparaiso, Ind., 1240
WRBJ—Hattiesburg, Miss., 1500
WRBL—Columbus, Ga., 1200
WRBQ—Greenville, Miss., 1210
WRBT—Wilmington, N. C., 1370
WRBU—Gastonia, N.C., 1210
WRC—Washington, D. C., 950
WREC—Memphis, Tenn., 600
WREN—Lawrence, Kans., 1220
WRHM—Friedley, Minn., 1250
WRJN—Racine, Wis. 1370
WRK—Hamilton, Ohio, 1310
WRNY—New York, N.Y., 1010
WRR—Dallas, Tex., 1280
WRUF—Gainesville, Fla., 1470
WRVA—Richmond, Va., 1110
WSAI—Cincinnati, O., 800
WSAJ—Grove City, Pa., 1310
WSAN—Allentown, Pa., 1440
WSAR—Fall River, Mass., 1450
WSAZ—Huntington, W.V., 580
WSB—Atlanta, Ga., 740
WSBC—Chicago, Ill., 1210
WSBT—South Bend, Ind., 1230
WSDA-WSGH—See WSGH
WSGH-WSDA—Bklyn., NY. 1400
WSIS—Sarasota, Fla., 1010
WSIX—Springfield, Tenn., 1210
WSM—Nashville, Tenn., 650
WSMB—New Orleans, La., 1320
WSMD—Salisbury, Md., 1310
WSMK—Dayton, Ohio, 570
WSOA—Deerfield, Ill., 1480
WSPD—Toledo, Ohio, 1340
WSRO—Middletown, O., 1420
WSSH—Boston, Mass., 1420
WSUI—Iowa City, Ia., 580
WSUN-WFLA—See WFLA
WSVS—Buffalo, N. Y., 1370
WSYR—Syracuse, N. Y., 570
WTAD—Quincy, Ill., 1440
WTAG—Worcester, Mass., 580

Station Location Frequency
WTAM—Cleveland, O., 1070
WTAQ—Eau Claire, Wis., 1330
WTAR-WPOR—Norf'lk, Va., 780
WTAW—College Station, 1120
WTAX—Streator, Ill., 1210
WTBO—Cumberland, Md., 1420
WTFI—Toccoa, Ga., 1450
WTIC—Hartford, Conn., 600
WTMJ—Milwaukee, Wis., 620
WWAE—Hammond, Ind., 1200
WWJ—Detroit, Mich., 920
WWL—New Orleans, La., 850
WWNC—Asheville, N. C., 570
WWRL—Woodside, N.Y., 1500
WWVA—Wheeling, W.Va., 1160
KCRC—Enid, Okla., 1370
KDB—Santa Barbara, Cal., 1500
KDKA—Pittsburgh, Pa., 980
KDLR—Devils Lake, N.D., 1210
KDYL—Salt Lake, Utah, 1290
KEJK—Beverly Hills, Calif., 1170
KELW—Burbank, Calif., 780
KEX—Portland, Ore., 1180
KFAB—Lincoln, Nebr., 770
KFAD—Phoenix, Ariz., 620
KFBB—Great Falls, Mont., 1360
KFBK—Sacramento, Calif., 1310
KFBL—Everett, Wash., 1370
KFDM—Beaumont, Tex., 560
KFDY—Brookings, S.Dak., 550
KFEC—Portland, Ore., 1370
KFEL—Denver, Colo., 940
KFEQ—St. Joseph, Mo., 560
KFGQ—Boone, Iowa, 1310
KFH—Wichita, Kans., 1300
KFHA—Gunnison, Colo., 1200
KFI—Los Angeles, Calif., 640
KFIF—Portland, Ore., 1420
KFIO—Spokane, Wash., 1230
KFIU—Juneau, Alaska, 1310
KFIZ—Fond du Lac, Wis., 1420
KFJB—Marshalltown, Ia., 1200
KFJF—Okla., City, Okla., 1470
KFJI—Astoria, Ore., 1370
KFJM—Gd. Forks., N.D., 1370
KFJR—Portland, Ore., 1300
KFJY—Fort Dodge, Iowa, 1310
KFJZ—Fort Worth, Tex., 1370
KFKA—Greeley, Colo., 880
KFKB—Milford, Kans., 1050
KFKU—Lawrence, Kans., 1220
KFKX-KYW—See KYW
KFKZ—Kirksville, Mo., 1200
KFLV—Rockford, Ill., 1410
KFLX—Galveston, Tex., 1370
KFMX—Northfield, Minn., 1250
KFNF—Shenandoah, Iowa, 890
KFOR—Lincoln, Nebr., 1210
KFOX—Long Beach, Calif, 1250
KFPL—Dublin, Tex., 1310
KFPM—Greenville, Tex., 1310
KFPW—Siloam Spgs., Ark., 1340
KFPY—Spokane, Wash., 1140
KFQA-KMOX—See KMOX
KFQD—Anchorage, Alaska, 1230
KFQU—Holy City, Calif., 1420
KFQW—Seattle, Wash., 1420
KFQZ—Hollywood, Calif., 860
KFRC—San Francisco, Cal., 610
KFRU—Columbia, Mo., 630
KFSD—San Diego, Calif., 600
KFSG—Los Angeles, Calif., 1120
KFUL—Galveston, Tex., 1290
KFUM—Colo. Springs, Col., 1270
KFUO—Clayton, Mo., 550
KFUP—Denver, Colo., 1310
KFUR—Ogden, Utah, 1370
KFVD—Culver City, Calif., 700
KFVS—Cape Girardeau, Mo. 1210
KFWB—Hollywood, Calif., 950
KFWC—S. Pomona, Calif., 1200
KFWF—St. Louis, Mo., 1200
KFWI—San Francisco, Cal., 930
KFWM—Oakland, Calif., 930
KFXD—Jerome, Idaho, 1420
KFXF—Denver, Colo., 940
KFXJ—Edgewater, Colo., 1310
KFXR—Okla. City, Okla., 1310
KFXY—Flagstaff, Ariz., 1420
KFYO—Abilene, Tex., 1420
KFYR—Bismarck, N.D., 550
KGA—Spokane, Wash., 1470
KGAR—Tuscon, Ariz., 1370
KGB—San Diego, Calif., 1360
KGBU—Ketchikan, Alaska, 900
KGBX—St. Joseph, Mo., 1370
KGBZ—York, Nebr., 930
KGCA—Decorah, Iowa, 1270
KGCI—San Antonio, Tex., 1370
KGCN—Concordia, Kans., 1420
KGCR—Watertown, S.D., 1210
KGCU—Mandan, N. D., 1200
KGCX—Vida, Mont., 1420
KGDA—Dell Rapids, S.D., 1370
KGDE—Fergus Falls, Minn, 1200
KGDM—Stockton, Calif., 1100
KGDR—San Antonio, Tex., 1500
KGDY—Oldham, S. D., 1200
KGEF—Los Angeles, Calif., 1300
KGEK—Yuma, Colo., 1200
KGER—Lg. Beach, Calif., 1370
KGEW—Ft. Morgan, Colo., 1200
KGEZ—Kalispell, Mont., 1310
KGFF—Alva., Okla., 1420
KGFG—Okla. City, Okla., 1370
KGFH—Glendale, Calif., 1000
KGFI—Corpus Christi, Tex., 1500
KGFJ—Los Angeles, Calif., 1420
KGFK—Hallock, Minn., 1200
KGFL—Raton, N. Mex., 1370
KGFW—Ravenna, Nebr., 1420
KGFX—Pierre, S. D., 580
KGGC—San Francisco, Cal., 1420
KGGF—Picher, Okla., 1010
KGGM—Albuquerque, N.M., 1370
KGHB—Honolulu, Hawaii, 1320

Station Location Frequency
KGHD—Missoula, Mont., 1420
KGHF—Pueblo, Colo., 1320
KGHG—McGehee, Ark., 1310
KGHI—Little Rock, Ark., 1500
KGHL—Billings, Mont., 950
KGHX—Richmond, Tex., 1500
KGIQ—Twin Falls, Idaho, 1320
KGIR—Butte, Mont., 1360
KGIW—Trinidad, Colo., 1420
KGJF—Little Rock, Ark., 890
KGKB—Brownwood, Tex., 1500
KGKL—San Angelo, Tex., 1370
KGKX—San Point, Idaho, 1420
KGKO—Wichita, Falls, Tex 570
KGO—Oakland, Calif., 790
KGRC—San Antonio, Tex., 1370
KGRS—Amarillo, Tex., 1410
KGU—Honolulu, Hawaii, 940
KGW—Portland, Ore., 620
KGY—Lacey, Wash., 1200
KHJ—Los Angeles, Calif., 900
KHQ—Spokane, Wash., 590
KICK—Red Oak, Iowa, 1420
KID—Idaho Falls, Idaho, 1320
KIDO—Boise, Idaho, 1250
KJBS—San Francisco, Cal., 1150
KJR—Seattle, Wash, 970
KKP—Seattle, Wash., 1370
KLCN—Blytheville, Ark., 1290
KLDS-KMBC—See KMBC
KLRA—Little Rock, Ark., 1390
KLS—Oakland, Calif., 1440
KLX—Oakland, Calif., 880
KLZ—Dupont, Colo., 560
KMA—Shenandoah, Iowa, 930
KMBC-KLDS—Ind'p'd'nce, Mo. 950
KMED—Medford, Ore., 1310
KMIC—Inglewood, Calif., 1120
KMJ—Fresno, Calif., 1210
KMMJ—Clay Center, Nebr., 740
KMOX-KFQA—St. Louis, 1090
KMO—Tacoma, Wash., 1340
KMTR—Hollywood, Calif., 570
KNX—Hollywood, Calif., 1050
KOA—Denver, Colo., 830
KOAC—Corvallis, Ore., 560
KOB—State College, N.M., 1180
KOCW—Chickasha, Okla., 1420
KOH—Reno, Nev., 1370
KOIL—Council Bluffs, Ia., 1260
KOIN—Portland, Ore., 940
KOL—Seattle, Wash., 1270
KOMO—Seattle, Wash, 920
KOOS—Marshfield, Ore., 1370
KORE—Eugene, Ore., 1420
KOW—Denver, Colo., 1390
KOY—Phoenix, Ariz., 1390
KPCB—Seattle, Wash., 1210
KPJM—Prescott, Ariz., 1500
KPLA—Los Angeles, Calif., 570
KPO—San Francisco, Cal, 680
KPOF—Denver, Colo., 880
KPPC—Pasadena, Calif., 1200
KPQ—Seattle, Wash., 1210
KPRC—Houston, Tex., 920
KPSN—Pasedena, Calif., 950
KPWF—Westminster, Calif. 1490
KQV—Pittsburgh, Pa., 1380
KQW—San Jose, Calif., 1010
KRE—Berkeley, Calif., 1370
KRGV—Harlingen, Tex., 1260
KRLD—Dallas, Tex., 1040
KRMD—Shreveport, La., 1310
KRSC—Seattle, Wash., 1120
KSAC—Manhattan, Kans., 580
KSBA—Shreveport, La., 1450
KSJC—Sioux City, Ia., 1330
KSD—St. Louis, Mo., 550
KSEI—Pocatello, Idaho, 900
KSL—Salt Lake City, U., 1130
KSMR—Santa Maria, Calif, 1200
KSO—Clarinda, Iowa, 1380
KSOO—Sioux Falls, S. D., 1110
KSTP—St. Paul, Minn., 1460
KTAB—Oakland, Calif., 550
KTAP—San Antonio, Tex., 1420
KTAT—Ft. Worth, Tex., 1240
KTBI—Los Angeles, Calif., 1300
KTBR—Portland, Ore., 1300
KTHS—Hot Springs, Ark., 800
KTM—Los Angeles, Calif., 780
KTNT—Muscatine, Iowa, 1170
KTSA—San Antonio, Tex., 1290
KTSL—Shreveport, La., 1310
KTUE—Houston, Tex., 1420
KTW—Seattle, Wash., 1270
KUJ—Longview, Wash., 1500
KUOA—Fayetteville, Ark., 1390
KUOM—Missoula, Mont., 570
KUSD—Vermillion, S.D., 890
KUT—Austin, Tex., 1120
KVI—Tacoma, Wash., 1340
KVL—Seattle, Wash., 1370
KVOO—Tulsa, Okla., 1140
KVOS—Bellingham, Wash., 1200
KWBS—Portland, Ore., 1500
KWCR—Cedar Rapids, Ia., 1310
KWEA—Shreveport, La., 1210
KWG—Stockton, Calif., 1200
KWJJ—Portland, Ore., 1060
KWK—St. Louis, Mo., 1350
KWKC—Kansas City, Mo., 1370
KWKH—Kennonwood, La., 850
KWLC—Decorah, Iowa, 1270
KWSC—Pullman, Wash., 1390
KWTC—Santa Ana, Calif., 1500
KWWG—Brownsville, Tex., 1260
KWYO—Laramie, Wyo., 600
KXA—Seattle, Wash., 570
KXL—Portland, Ore. 1250
KXO—El Centre, Calif., 1200
KXRO—Aberdeen, Wash., 1420
KYA—San Francisco, Cal., 1230
KYW-KFKX—Chicago, Ill., 1020
KYWA—Chicago, Ill., 1020
KTZM—Hayward, Calif., 1370

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The Filming of Sound

The Two Distinctive Methods Outlined for Novices

By Capt. Peter V. O'Rourke

Contributing Editor

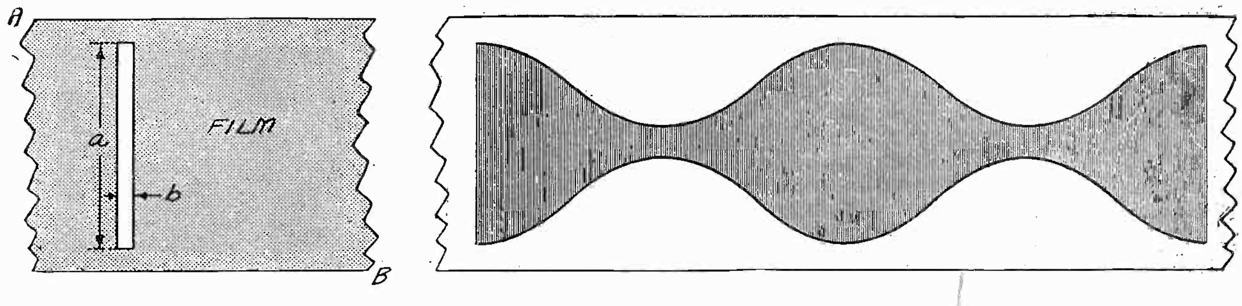


FIG. 1
A section from the sound portion of a talking film showing the scanning slit as used for recording and playing.
Right—A section of the sound strip of the variable amplitude type of record.

THE rapid spread of talking movies in both theatres and homes has aroused much public interest in just how the sound is recorded and how it is reproduced in the theatre.

In those systems of talking pictures in which the sound record is on the film itself a strip of the film one-eighth inch wide is used for the sound and the remaining part of the film for the picture. Since no alteration has been made in the size of the film the picture is just one-eighth inch narrower than the silent film. This makes the picture nearly square.

There are many systems of recording the sound on the film, but they may be divided into two classes, the variable amplitude type and the variable density type.

In the variable amplitude type the transparency of the film is everywhere the same but the width of the record varies from point to point in accordance with the sound recorded. Where no sound is recorded the width of the strip is one-eighth of an inch. Where sound is recorded the strip looks like a saw, that is, there are indentations in the edges. This type of record is illustrated in Fig. 1 at right. This is the shape of the strip when a pure tone is recorded. This strip represents the negative. In the positive the central portion of the strip is transparent and the remaining part is black and opaque.

In the variable density type the width of the strip remains the same but the photographic density varies. This also might be illustrated with the right portion of Fig. 1. Imagine that the figure is a cross-section of the film and that the shaded portion represents the depth of the silver deposit. The amount of light that passes through the film at any point is proportional to the thickness of the silver deposit at that point. Held against a light, the strip would appear banded with light and black bands alternating.

It is clear that in either type the results will be the same, that is, the amount of light that will be transmitted will vary in the same manner, and it is only the variation that counts.

How Films Are Exposed

The question now arises how the film is exposed to produce either of these types of record. Refer to the left portion of Fig. 1. **AB** represents a short piece of the film on which the sound is recorded. Across this strip is an elongated rectangle of length **a** and width **b**. This is an aperture through which light can reach the unexposed film. It is about ⅛-inch long and .001 inch wide. That is, **a** equals ⅛-inch and **b** equals .001 inch.

This slit or aperture is stationary and the film moves under it at a constant speed of about 90 feet a minute, and the slit is exposed to a light.

At this point it is necessary to separate the two cases. Let us first discuss the case of the variable amplitude type of record. In this instance the light on the slit is constant in intensity. But the length of the cylinder varies in accordance with the sound that is to be recorded. When it varies according to a pure tone the resulting exposure of the film is that shown at the right, that is, provided that the length of the slit expands and contracts equally at both ends. If the sound is complex the shape of the shaded portion will be irregular and complex.

Variable Density Type

When the variable density type of record is made, the size of the slit remains constant but the intensity of the illumination on it varies according to the sound to be recorded. The resulting exposure will be the banded effect as explained.

In this instance it is assumed that the exposure is correct to produce a good negative. In the variable amplitude case the exposure is not so important, just so there is sharp contrast between the exposed area and the unexposed.

In both instances development of the negative and the exposure and development of the positive must be correct so as to produce true contrasts.

Third Method

There is a third method of producing a variation of the exposure. This also results in the variable density type of record. The slit is used as before but instead of varying the light or the length of the slit, the width is varied by the sound to be recorded. This variation in the width admits more or less light to the film according to the width. This method produces a certain amount of distortion which is not present in the other methods.

It is difficult to get a clearly defined slit of such small dimensions as are required. To avoid the necessity of making a small slit an optical system is used, illustrated in Fig. 2. The slit **S** is made ¼-inch by .002 inch and a lens **L** is used to reduce the dimensions to the proper value. The lens focuses the image of the real slit on the film **F**.

The light from the source **K** is concentrated on the slit by means of a pair of condensing lenses **C**, so the slit is brightly illuminated.

Type of Light Source

If the variable amplitude record is to be made the light source may be of any

(*Continued on page* 16)

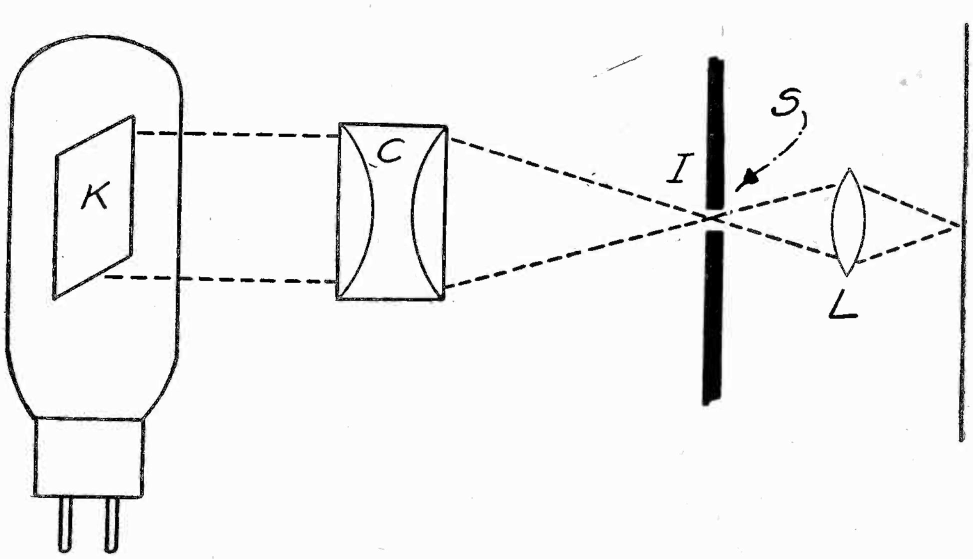
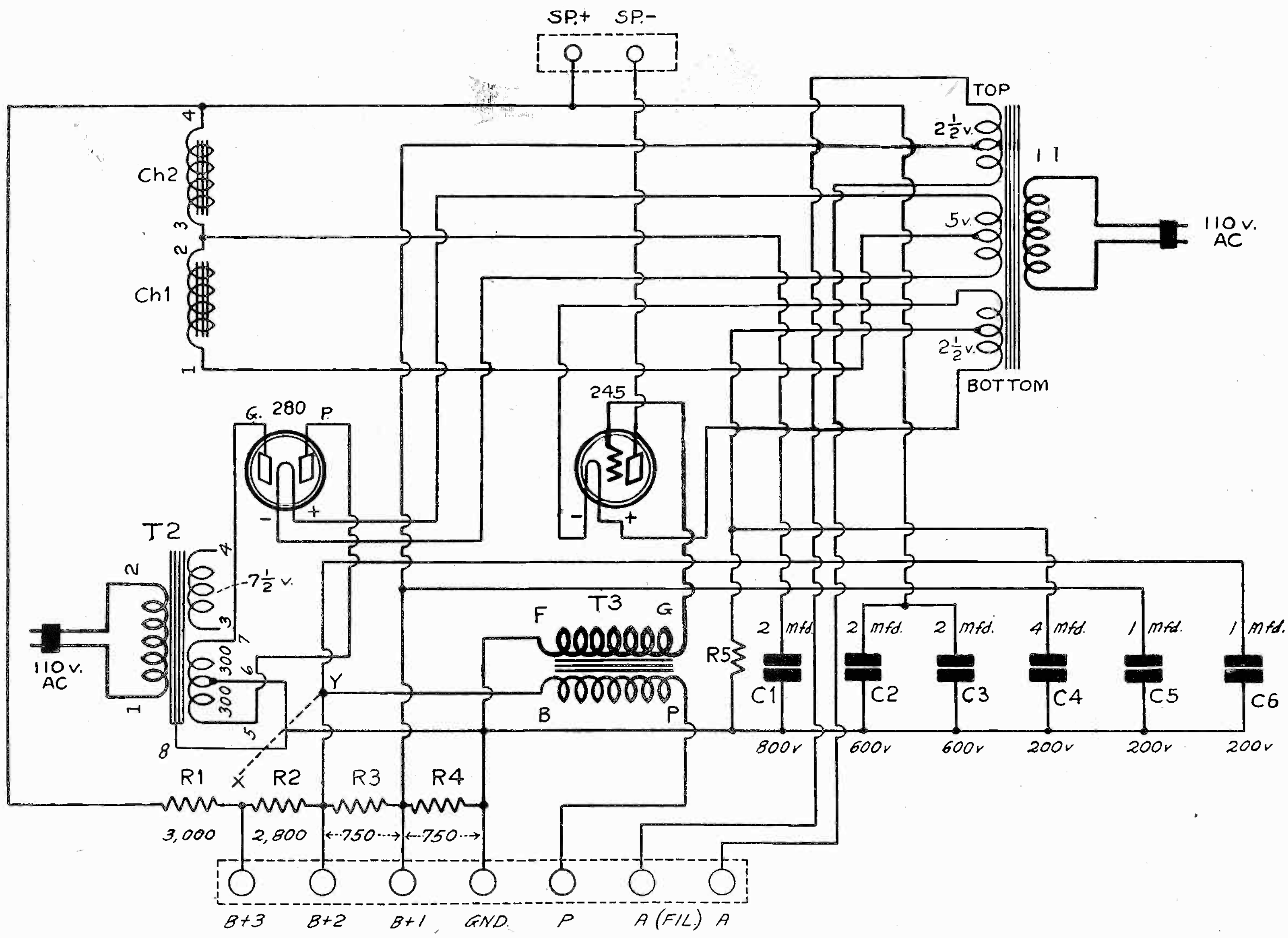


FIG. 2
THE OPTICAL SYSTEM OF A TALKING MOVIE RECORDER SHOWING THE SOURCE OF LIGHT K, THE CONDENSER LENS C, THE SLIT S, THE FOCUSING LENS L AND THE FILM F.

An AC Operated Plate and One-Stage Audio

By Herman



SCHEMATIC DESIGN OF THE AC PLATE AND FILAMENT POWER SUPPLY AND ONE-STAGE AUDIO AMPLIFIER. THE CAPACITIES OF THE FILTER AND BUFFER CONDENSERS ARE GIVEN, ALSO THEIR MAXIMUM RATED WORKING VOLTAGE. AMPLE SAFETY MARGIN MAKES CONDENSER BREAKDOWN VIRTUALLY IMPOSSIBLE. B PLUS MINIMUM CONNECTS TO MIDPOINT OF ONE 2.5-VOLT FILAMENT WINDING OR TO GROUND (TRY ONE, THEN THE OTHER) AND THUS REMOVES THE LAST VESTIGE OF HUM.

Conservative Drain and Strain Make for Hum-Free, Tone-Pure Reproduction—Circuit a Valuable Addition to Existing Receivers—Some Pointers on General Problems in B Supplies

THE advent of the 245 power tube, which, at 250 plate volts, has about the same maximum undistorted power output as the 210 at 350 volts, makes the inclusion of this new output tube advisable. This is especially true if one uses a dynamic speaker, for the plate resistance of the 245 is about half that of the 210, hence a better efficiency results.

The AC power supply and one-stage audio amplifier diagrammed herewith utilizes the 245, and, since a dynamic speaker is presumed, no output device is shown. All dynamic speakers have such a device built in. But if you want to include an output filter there is room. Therefore a fine B supply is afforded for the receiver proper, and no change need be made in the wiring of the set. An extra stage of audio is added, so that if you now have a 112, 112A, 171 or 171A output, or even a 120 (the companion power tube for the 99 variety), you simply run a lead from the plate output of your receiver to P on the terminal strip of the B supply.

Plate Voltage Connection

The positive B voltage for the last tube of your present receiver is obtained directly in the B supply, by the connection of the primary of the audio transformer (P post) to B plus No. 2. This connection is lettered "Y". A dotted line shows an optional connection to "X". Of course never make both the X and Y connections, only either one. For a 112A or equivalent tube the Y connection is suitable, since the voltage is 90, and is enough in this instance. But for the 171A or equivalent use the X connection, which is 150 volts. The maximum B voltage, used on the 245, is 250 volts, obtained from the left-hand side of R1 in the diagram (extreme lower left). The 300 volts

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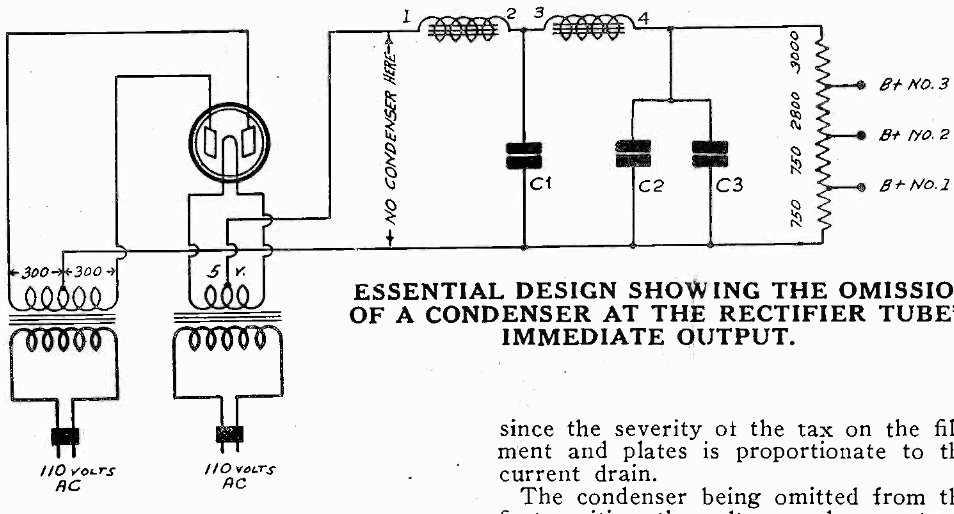
nd Filament Supply with New 245 Tube

nard

LIST OF PARTS

T1—One filament transformer with two separate 2.5 volt windings (one at 10 amperes, other at 3.5 amperes) and one 5-volt winding at 1 ampere. (Merchandised by Guaranty Radio Goods Co. as Model F226A.)
T2—One Silver-Marshall power transformer (S-M Cat. No. 330).
T3—One National audio transformer, Cat. No. A100.
Ch1, Ch2—One Silver-Marshall Unichoke (S-M Cat No. 331).
C1, C2, C3, C4, C5, C6—One Aerovox filter-buffer condenser block, Type No. TH-862.
R1, R2, R3, R4—One Aerovox standard tapped Pyrohm resistor, type A (0, 3,000, 2,800, 750, 750 ohms).
R5—One Aerovox Pyrohm, 1,200 ohms.
Two terminal strips, one with speaker posts on, other with seven binding posts on.
Two standard sockets (4-prong).
One baseboard 10x20 inches.
One 280 and one 245 tube.
Hardware: Four mounting brackets for terminal strips, two for resistors.



ESSENTIAL DESIGN SHOWING THE OMISSION OF A CONDENSER AT THE RECTIFIER TUBE'S IMMEDIATE OUTPUT.

AC of the power transformer is reduced to 250 volts by the rectifier tube resistance and by R5.

The B supply is entirely AC operated, and therefore can be used with a battery operated receiver, an AC receiver that has its own filament supply, or the B eliminator's filament supply at 2.5 volts can be used for a receiver having 2.5-volt heater type tubes throughout, such as the 227 and the imminent AC screen grid tube, which will be known probably as 224 and 324.

The filament transformer T1 has two windings of 2.5 volts each. The upper one will stand 10 amperes drain at a conservative rating. But an overload of 25 per cent. is permissible, since only a little heat would be generated. Thus, if need be, 12.5 amperes can be drawn, enough to run eight 227 or 224 tubes or combinations thereof. It will be noticed that the upper or heavy-current winding, at 2.5 volts, is not used in the B supply at all, hence all eighth tubes, or fewer, may be receiver tubes. The two binding posts marked "A" provide easy access to this voltage.

The 245 may be described as a heavy-duty power tube if it is to be used in the home, since it will handle enough distortionless volume to make reception abundant in every room of a ten-room house. The tube's appearance, along with the AC screen grid tubes soon to be announced, makes for the operation of an entire receiver at a single filament voltage, 2.5 volts. Only the 280 rectifier tube has a different voltage — twice as much — but the rectifier's filament requires an independent winding in any instance, so it makes little difference what that filament requirement is.

Reserve Winding

There is a 7.5 volt winding on the Silver-Marshall power transformer, T2 in the diagram, not used in this circuit, but which may be used in an emergency if you want to use a 210 tube you may have. Put a 15-ohm center-tapped resistor of 1.5 ampere rating across the 7.5 volts at the transformer T2 and move the connections from the lower 2.5 volt winding of the filament transformer T1 to the equivalent positions on the center-tapped resistor. Or, if you want to heat the final 5 volt-filament in an existing receiver from this winding, besides the use of the very same center-tapped resistor, put in two series resistors of 5 ohms each, one resistor in each filament leg. This is for a .25 ampere 5-volt tube. If the old style .5 ampere tube is used at 5 volts, each series resistor should be 2.5 ohms.

The voltage output in full follows: B plus No. 1 is 45 volts, B plus No. 2 is 90 volts, B plus No. 3 is 150 volts and B plus maximum (Sp .+) is 250 volts. Those voltages obtain when the correct bias is used for the last tube (the 245) and when the current drain is as follows: for the 245 tube, 32 milliamperes, for the external drain, 30 milliamperes. This makes a total of 62 milliamperes. Greater than 62 milliamperes drain will lower the output voltages a little. Less drain will increase them.

Obviously all this is well within the most conservative rating of the 280 tube, and you could safely go up to 100 milliamperes without overloading the rectifier.

Gains Recorded

One object of being conservative with the drain is to avoid hum. At the same time, of course, rectifier tube life is lengthened.

This longevity of the tube is aided by the method of connecting the filter condensers, whereby no condenser whatever is used across the immediate output of the rectifier (point 1 of Ch. 1, upper left). The output voltage of the power transformer, when impressed upon the tube, as when you turn the eliminator "on," first encounters a condenser (if the one omitted were included), and this condenser offers virtually no impedance until charged, hence places a sudden and enormous B current strain upon both the filament and the plates of the rectifier tube in these starting circumstances, since the severity of the tax on the filament and plates is proportionate to the current drain.

The condenser being omitted from the first position, the voltage and current encounter instead a series choke, which constitutes a normal load, and which acts in an opposite or protective direction.

It must not be assumed that any less capacity is used simply because the first position in the filter circuit is without a condenser across the line. See the diagram. The first condenser, from the midpoint of the unichoke to ground, is C1. The next pair, consisting of C2 and C3, has twice as great capacity and constitutes the reservoir on which the final audio tube in particular draws for its depth of power, a drain reaching considerable heights when strong low-note passages appear, as they demand heavy plate current. Therefore the capacity that might have been in position No. 1 (upper left in diagram), is used for doubling the capacity at position No. 4. There are some positions in circuits where the capacity can never be too large, and one of these is position No. 4. Before the capacity would be so large as to draw considerable current itself, the drain on the pocketbook would have made the attainment of such capacity impossible.

C1, C2 and C3 are high voltage condensers, while C4, C5 and C6 are medium voltage condensers. Care must be taken not to connect the wrong condensers. Connect the Aerovox TH-862 as follows: black and green wires to B—and ground; two blues, one each to B+ Nos. 1 and 2; orange to 5V. midtap; both browns to 4 on choke; red to 2 and 3 on choke.

C4, by the way, is 4 mfd., which is the minimum capacity ever to use across a resistor biasing any final audio tube.

The schematic diagram is so laid out that it gives a general idea of the location of the parts. R1, R2, R3, R4, however, are one strip, and mounted vertically.

The two transformer AC input cables may be united at a two-way socket-plug, or may be joined to the 110-volt circuit handled by the switch in the receiver. See Radio World last week (issue of March 30th) where this connection was detailed as part of the discussion of the AC Diamond.

[Other phases of this power supply and amplifier will be discussed next week, issue of April 13th.]

Construction Lacault's Last

By R. E.

[A great wave of appreciation swept through the ranks of set-constructors when they read first details of the RE-29, as described by R. E. Lacault in the April 6th issue of RADIO WORLD *(last week). The modulation system that Mr. Lacault used in the Ultradyne, which was the greatest DX set of its time, was adapted to screen grid tube use, in the manner explained so carefully by Mr. Lacault last week. The RE-29 consists of a 6-tube table model receiver including first audio, and 210 push-pull second audio in a power pack which will be published next week. Herewith ends the text on constructing the 6-tube design, the series of receiver and B supply articles having been completed by Mr. Lacault only one day prior to his recent death.—Editor.]*

TWO filters, L6C8, L7C9, are used in the plate circuits of the screen grid amplifiers to prevent currents of intermediate frequency from entering the power supply device, hence serve to stabilize the circuit.

As a further means of stabilizing the intermediate amplifier, two by-pass condensers C6 and C7 are connected between the screen grids and the filaments. Each is .5 mfd.

The grid bias method of detection was selected for the RE29 because this gives better quality on loud signals and improved selectivity all around. The slightly lower detecting efficiency of this type of detector is more than offset by the tremendous amplication that is obtained in the intermediate stages. Part of it is even offset in the tube itself. The negative bias and the absence of a stopping condenser increase the voltage that is applied to the grid of the detector. When the grid bias detector is correctly adjusted its lower effectiveness is more traditional than actual.

High Intermediate Frequency

It will be observed that the effective grid bias on the tube is 5.5 volts. R5 contributes one volt of this and the C battery the rest. A by-pass condenser C11 is put in the plate circuit to satisfy the condition that the load impedance to the radio frequency signal must be low to give high detecting efficiency.

As has already been stated, the intermediate frequency of this amplifier is high compared with that used in earlier circuits of this type, being 120 kilocycles. There are many advantages of such high frequency. As is well known, any Super-Heterodyne will bring in two different stations separated by twice the intermediate frequency, both at the same setting of the oscillator condenser. If the intermediate frequency is low this will cause much interference. For example, suppose the intermediate frequency is 30 kilocycles. Any two stations will then be brought in at the same setting of the oscillator if the carrier frequencies of the two stations differ by 60 kilocycles. Since there is a station for every 10 kilocycles there is practically no chance of getting any station free of interference.

Effective Practicality

The radio frequency tuner discriminates between the two carriers so that one will be very weak, but this does not prevent squealing, because the squeal intensity is proportional to the strong signal to which the set is tuned. And furthermore, the RF tuner cannot discriminate sufficiently well between two frequencies only 60 kilocycles apart.

Cross Talk Reduced

When the intermediate frequency is 120 kilocycles the carrier frequencies which might interfere are 240 kilocycles apart. Even an ordinary RF tuner is sharp enough to suppress one of these when the circuit is tuned to the other. And when the RF tuner is very sharp the interfering carrier is so weak by the time it gets to the modulator that it cannot produce an audible disturbance.

And that is not all. When a high intermediate frequency is used there will be a wide band in which there cannot be any crosstalk at all between broadcast stations. Hence the two main advantages of using a high frequency are effectiveness of the RF tuner in suppressing any interfering station and the absence of all crosstalk in a certain band.

However, there is a practical limit to the increase in the intermediate frequency. The higher it is the less will be the amplification and the selectivity and the lower will be the stability. The frequency selected, namely 120 kilocycles, is an optimum compromise between the two sets of opposing factors.

Shielding Necessary

Whenever more screen grid tubes than one are used it is necessary to shield the stages, and it is desirable to shield the screen grid tubes as well. Three shields are

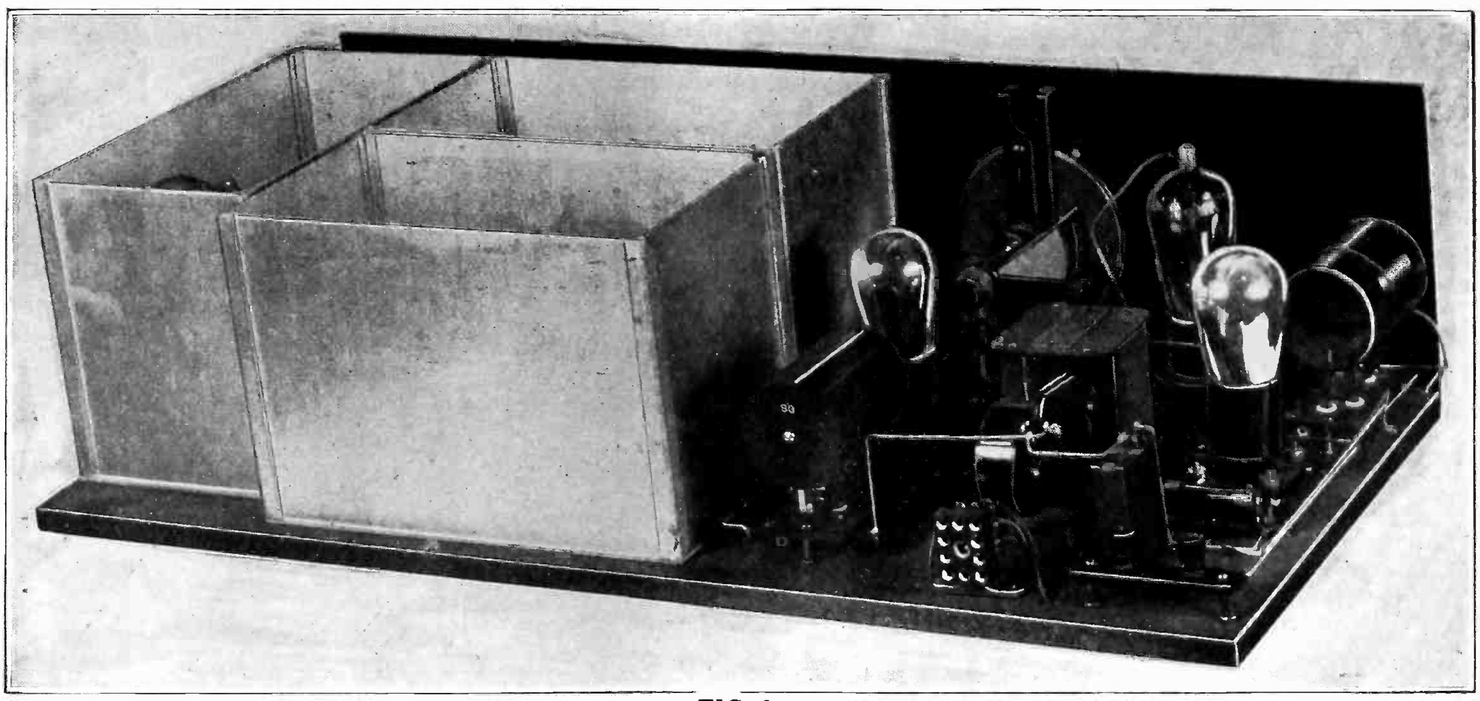


FIG. 3

THE SCREEN GRID TUBE IN VIEW IS USED AS A THREE-ELEMENT MODULATOR TUBE. THE LACAULT SYSTEM OF MODULATION, THAT PRODUCED THE GREATEST DX RECEIVER OF ITS TIME, IS EMPLOYED.

of the RE29 and Best Circuit

,acault

used in the RE29. One surrounds the oscillator, another the first screen grid amplifier and the third the second screen grid amplifier. Each of the compartments should have six aluminum sheets, and all leads entering the compartments should go through small holes.

The three shields should be connected metallically to one another and to the negative side of the filament circuit. It is also well to connect the shield to A minus.

Two dial lights, DL1 and DL2, are connected across the filament supply line. These lights are associated with the National tuning dials. A switch Sw in the negative side of the line controls the filament current supply.

The strip of binding posts is joined to a similar binding post strip in the B battery eliminator which has been designed especially for this circuit. This also contains the power tube.

Tubes Used

The first three tubes are of the 222 type, although the first is used in a special way. the next three tubes, including the oscillator, are—01A type.

Builders of Super-Heterodynes expect the construction to be a somewhat complicated task. They will be surprised when they learn how simple it is to assemble the RE-29. There is not as much work involved in building this outstanding receiver as there is in building many four- and five-tube circuits.

This fact is seen clearly in the photograph of the top view of the receiver. (Published on the front cover last week. —Editor.)

The circuit begins in the left-hand rear corner with the antenna and ground binding posts. These posts connect straight to the antenna coil, and are in plain view. The antenna coil is just back of the panel at the extreme left. Then follows the first screen grid tube, or modulator, which is followed by the Hammarlund antenna tuning condenser.

This is a compact arrangement which conserves leads and which keeps the antenna coil away from the metal shields and the other radio frequency coil.

Oscillator Shielded

The oscillator is completely inclosed in the metal compartment just back of the right-hand National dial. In this compartment will be found only the oscillator condenser C2, the oscillator coil L2 and the 201A oscillator tube with its socket.

The first screen grid stage of intermediate frequency amplifier is found in the compartment at the extreme right. Plainly evident are the tube, the coil system L3 and the bypass condenser C6. Closer observation will also reveal the two condensers C3 and C4, placed at the ends of L3.

The second screen grid stage is practically a repetition of the first and it is placed in the compartment directly behind the oscillator. This compartment contains the filter circuit L8C6 in addition to L4, C5, C7 and the tube. The final intermediate frequency transformer L5 is placed outside the shield because there is no other coil operating at the intermediate frequency outside the shielding.

What's Outside

The parts belonging to the audio frequency amplifier are placed outside the shielding just back of the modulator. Here also is found the second filter L7C9. Note that the audio frequency transformer is placed as far as possible from the two tuned coils, L1 and L5, along the diagonal of the unshielded space. Thus the metal parts in this transformer do not affect the selectivity of either of these coils. Tubes are placed next to both coils which do not absorb any energy. The exception is that the intermediate coil is near the shield, but the field of the coil is parallel with the metal surface so that there is only inappreciable loss.

Skeleton View

Another view of the receiver is shown in Fig. 3. The sides and partitions of the shields have been removed the more clearly to show the arrangement of the parts. This also shows some of the parts not visible in Fig. 2.

In place of a binding post strip a Jones Multiplug socket with ten tip sockets is used. This can be seen next to the antenna and ground binding posts. All the filament, plate and grid return leads are connected to this plug socket. The battery supply unit which goes with this receiver is provided with a plug which fits this socket. This plug fits into the socket in only one way. Hence there can be no mistake when connecting up the receiver, and all the connections are made in one operation. This is important when it becomes necessary to test the receiver for any reason.

Simple to Operate

The operation of the circuit is extremely simple. There are only two dials to manipulate and they are independent of each other. This allowed very fine adjustment of the tuning of both the oscillator and the antenna coils. Fine tuning adjustment is indispensable in a highly selective circuit like this Super-Heterodyne. The volume control is in the power pack.

There are no features in the set which will change the tuning in any way. If a station has been tuned in once, it will always come in at the same points on the dials provided that the frequency of that station does not wander. In fact, the receiver can be used to keep a check on the frequency stability of the various stations.

Attractive Panel Layout

Simplicity and symmetry of the layout of the panel make the front of the receiver very attractive. The color scheme is silver and black. This will be appreciated by the women of the house. And they will also appreciate the ease with which this sensitive receiver can be operated.

The builders of this receiver will be as much interested in the wiring as in the final operation of the circuit. If the builder's interest is complicated wire entanglements he will be disappointed with this circuit, but if his interest is in simplicity he will find this circuit to his liking. Look at either Fig. 2 or Fig. 3. Count the leads. Does it seem like there is enough? Surely a Super-Heterodyne should have more wire than shown in these pictures. Of course, no more connecting leads should be used than are necessary, and the pictures show all that need be in the circuit. And it must be admitted that wire has been used sparingly. It is the careful arrangement of the parts that has made this possible.

In both pictures the shield cans are open. When the set is in use there will be lids on all the shield compartments, so that the shielding will be complete. No dust can settle into the compartments. This is further prevented by the cabinet which incloses the entire receiver. Carbon dust usually affects the operation of a set adversely. It is partially conducting, but the conductivity is irregular. With a lot of dust sprinkled over the set the receiver is likely to be noisy.

Plug-in Inductances

As was previously stated, the antenna and the oscillator inductance coils are provided with terminal plugs to fit into special receptacles, the object of which is to change wavelength range of the receiver. A set of these coils can be used to cover practically the entire occupied frequency range from 550 kc to 20,000 kc. To change from one range to another is just a moment's work.

Even the intermediate frequency coils are provided with the same kind of receptacles, as can be seen clearly on Fig. 3. This makes replacement very simple should this ever be necessary, and it also allows the removal of the coils so as to render other parts of the circuit accessible for testing.

The wiring of the receiver is done for the most part with round No. 16 bus bar. No insulation is put on the bus bar except where it is necessary to guard against a short circuit. Note that wherever a lead runs through the shielding insulation is used generously. It is best to make the hole in the shielding so large that the insulation on the wire does not come in contact with the shielding. This is not only for protection against short circuit but also for minimizing the capacity effects between the high potential lead and the grounded shield.

The grid leads on the three screen grid tubes are of heavy, stranded and flexible wire. It should be insulated up to the clip.

[*Detail construction drawings of the 6-tube, and illustrated text on the power pack next week, issue April 20th.*]

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TWO filters, L6C8, L7C9, are used in the plate circuits of the screen grid amplifiers to prevent currents of intermediate frequency from entering the power supply device, hence serve to stabilize the circuit.

As a further means of stabilizing the intermediate amplifier, two by-pass condensers C6 and C7 are connected between the screen grids and the filaments. Each is .5 mfd.

The grid bias method of detection was selected for the RE29 because this gives better quality on loud signals and improved selectivity all around. The slightly lower detecting efficiency of this type of detector is more than offset by the tremendous amplification that is obtained in the intermediate stages. Part of it is even offset in the tube itself. The negative bias and the absence of a stopping condenser increase the voltage that is applied to the grid of the detector. When the grid bias detector is correctly adjusted its lower effectiveness is more traditional than actual.

High Intermediate Frequency

It will be observed that the effective grid bias on the tube is 5.5 volts. R5 contributes one volt of this and the C battery the rest. A by-pass condenser C11 is put in the plate circuit to satisfy the condition that the load impedance to the radio frequency signal must be low to give high detecting efficiency.

As has already been stated, the intermediate frequency of this amplifier is high compared with that used in earlier circuits of this type, being 120 kilocycles. There are many advantages of such high frequency. As is well known, any Super-Heterodyne will bring in two different stations separated by twice the intermediate frequency, both at the same setting of the oscillator condenser. If the intermediate frequency is low this will cause much interference. For example, suppose the intermediate frequency is 30 kilocycles. Any two stations will then be brought in at the same setting of the oscillator if the carrier frequencies of the two stations differ by 60 kilocycles. Since there is a station for every 10 kilocycles there is practically no chance of getting any station free of interference.

Effective Practicality

The radio frequency tuner discriminates between the two carriers so that one will be very weak, but this does not prevent squealing, because the squeal intensity is proportional to the strong signal to which the set is tuned. And furthermore, the RF tuner cannot discriminate sufficiently well between two frequencies only 60 kilocycles apart.

Cross Talk Reduced

When the intermediate frequency is 120 kilocycles the carrier frequencies which might interfere are 240 kilocycles apart. Even an ordinary RF tuner is sharp enough to suppress one of these when the circuit is tuned to the other. And when the RF tuner is very sharp the interfering carrier is so weak by the time it gets to the modulator that it cannot produce an audible disturbance.

And that is not all. When a high intermediate frequency is used there will be a wide band in which there cannot be any crosstalk at all between broadcast stations. Hence the two main advantages of using a high frequency are effectiveness of the RF tuner in suppressing any interfering station and the absence of all crosstalk in a certain band.

However, there is a practical limit to the increase in the intermediate frequency. The higher it is the less will be the amplification and the selectivity and the lower will be the stability. The frequency selected, namely 120 kilocycles, is an optimum compromise between the two sets of opposing factors.

Shielding Necessary

Whenever more screen grid tubes than one are used it is necessary to shield the stages, and it is desirable to shield the screen grid tubes as well. Three shields are

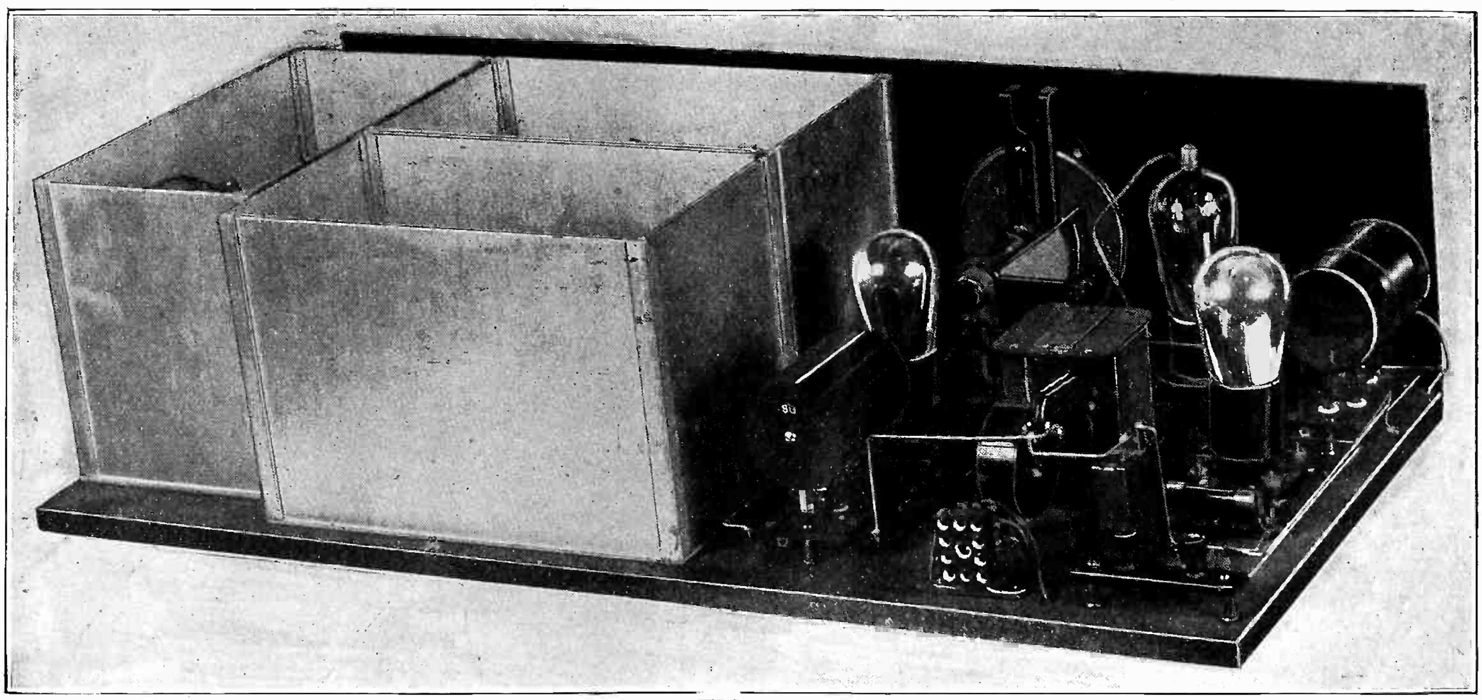


FIG. 3

THE SCREEN GRID TUBE IN VIEW IS USED AS A THREE-ELEMENT MODULATOR TUBE. THE LACAULT SYSTEM OF MODULATION, THAT PRODUCED THE GREATEST DX RECEIVER OF ITS TIME, IS EMPLOYED.

of the RE29 and Best Circuit

acault

used in the RE29. One surrounds the oscillator, another the first screen grid amplifier and the third the second screen grid amplifier. Each of the compartments should have six aluminum sheets, and all leads entering the compartments should go through small holes.

The three shields should be connected metallically to one another and to the negative side of the filament circuit. It is also well to connect the shield to A minus.

Two dial lights, DL1 and DL2, are connected across the filament supply line. These lights are associated with the National tuning dials. A switch Sw in the negative side of the line controls the filament current supply.

The strip of binding posts is joined to a similar binding post strip in the B battery eliminator which has been designed especially for this circuit. This also contains the power tube.

Tubes Used

The first three tubes are of the 222 type, although the first is used in a special way. the next three tubes, including the oscillator, are—01A type.

Builders of Super-Heterodynes expect the construction to be a somewhat complicated task. They will be surprised when they learn how simple it is to assemble the RE-29. There is not as much work involved in building this outstanding receiver as there is in building many four- and five-tube circuits.

This fact is seen clearly in the photograph of the top view of the receiver. (Published on the front cover last week. —Editor.)

The circuit begins in the left-hand rear corner with the antenna and ground binding posts. These posts connect straight to the antenna coil, and are in plain view. The antenna coil is just back of the panel at the extreme left. Then follows the first screen grid tube, or modulator, which is followed by the Hammarlund antenna tuning condenser.

This is a compact arrangement which conserves leads and which keeps the antenna coil away from the metal shields and the other radio frequency coil.

Oscillator Shielded

The oscillator is completely inclosed in the metal compartment just back of the right-hand National dial. In this compartment will be found only the oscillator condenser C2, the oscillator coil L2 and the 201A oscillator tube with its socket.

The first screen grid stage of intermediate frequency amplifier is found in the compartment at the extreme right. Plainly evident are the tube, the coil system L3 and the bypass condenser C6. Closer observation will also reveal the two condensers C3 and C4, placed at the ends of L3.

The second screen grid stage is practically a repetition of the first and it is placed in the compartment directly behind the oscillator. This compartment contains the filter circuit L8C6 in addition to L4, C5, C7 and the tube. The final intermediate frequency transformer L5 is placed outside the shield because there is no other coil operating at the intermediate frequency outside the shielding.

What's Outside

The parts belonging to the audio frequency amplifier are placed outside the shielding just back of the modulator. Here also is found the second filter L7C9. Note that the audio frequency transformer is placed as far as possible from the two tuned coils, L1 and L5, along the diagonal of the unshielded space. Thus the metal parts in this transformer do not affect the selectivity of either of these coils. Tubes are placed next to both coils which do not absorb any energy. The exception is that the intermediate coil is near the shield, but the field of the coil is parallel with the metal surface so that there is only inappreciable loss.

Skeleton View

Another view of the receiver is shown in Fig. 3. The sides and partitions of the shields have been removed the more clearly to show the arrangement of the parts. This also shows some of the parts not visible in Fig. 2.

In place of a binding post strip a Jones Multiplug socket with ten tip sockets is used. This can be seen next to the antenna and ground binding posts. All the filament, plate and grid return leads are connected to this plug socket. The battery supply unit which goes with this receiver is provided with a plug which fits this socket. This plug fits into the socket in only one way. Hence there can be no mistake when connecting up the receiver, and all the connections are made in one operation. This is important when it becomes necessary to test the receiver for any reason.

Simple to Operate

The operation of the circuit is extremely simple. There are only two dials to manipulate and they are independent of each other. This allowed very fine adjustment of the tuning of both the oscillator and the antenna coils. Fine tuning adjustment is indispensable in a highly selective circuit like this Super-Heterodyne. The volume control is in the power pack.

There are no features in the set which will change the tuning in any way. If a station has been tuned in once, it will always come in at the same points on the dials provided that the frequency of that station does not wander. In fact, the receiver can be used to keep a check on the frequency stability of the various stations.

Attractive Panel Layout

Simplicity and symmetry of the layout of the panel make the front of the receiver very attractive. The color scheme is silver and black. This will be appreciated by the women of the house. And they will also appreciate the ease with which this sensitive receiver can be operated.

The builders of this receiver will be as much interested in the wiring as in the final operation of the circuit. If the builder's interest is complicated wire entanglements he will be disappointed with this circuit, but if his interest is in simplicity he will find this circuit to his likng. Look at either Fig. 2 or Fig. 3. Count the leads. Does it seem like there is enough? Surely a Super-Heterodyne should have more wire than shown in these pictures. Of course, no more connecting leads should be used than are necessary, and the pictures show all that need be in the circuit. And it must be admitted that wire has been used sparingly. It is the careful arrangement of the parts that has made this possible.

In both pictures the shield cans are open. When the set is in use there will be lids on all the shield compartments, so that the shielding will be complete. No dust can settle into the compartments. This is further prevented by the cabinet which incloses the entire receiver. Carbon dust usually affects the operation of a set adversely. It is partially conducting, but the conductivity is irregular. With a lot of dust sprinkled over the set the receiver is likely to be noisy.

Plug-in Inductances

As was previously stated, the antenna and the oscillator inductance coils are provided with terminal plugs to fit into special receptacles, the object of which is to change wavelength range of the receiver. A set of these coils can be used to cover practically the entire occupied frequency range from 550 kc to 20,000 kc. To change from one range to another is just a moment's work.

Even the intermediate frequency coils are provided with the same kind of receptacles, as can be seen clearly on Fig. 3. This makes replacement very simple should this ever be necessary, and it also allows the removal of the coils so as to render other parts of the circuit accessible for testing.

The wiring of the receiver is done for the most part with round No. 16 bus bar. No insulation is put on the bus bar except where it is necessary to guard against a short circuit. Note that wherever a lead runs through the shielding insulation is used generously. It is best to make the hole in the shielding so large that the insulation on the wire does not come in contact with the shielding. This is not only for protection against short circuit but also for minimizing the capacity effects between the high potential lead and the grounded shield.

The grid leads on the three screen grid tubes are of heavy, stranded and flexible wire. It should be insulated up to the clip.

[*Detail construction drawings of the 6-tube, and illustrated text on the power pack next week, issue April 20th.*]

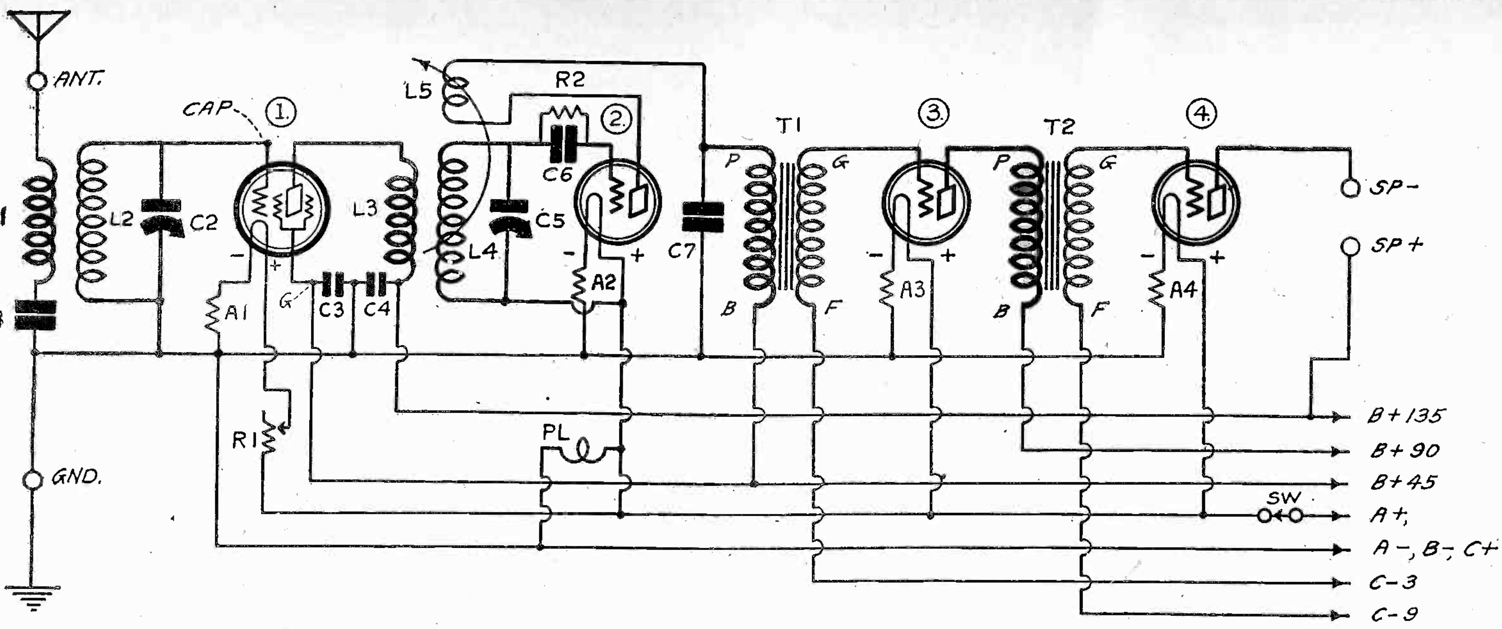


FIG. 740
THIS CIRCUIT IS ONE OF THE MOST SENSITIVE AND SELECTIVE FOUR TUBE RECEIVERS. IT IS THE NEW SCREEN GRID DIAMOND. REQUESTED BY CARL MERRILL.

Radio University

QUESTION and Answer Department conducted by RADIO WORLD, by its staff of experts, for University members only.

When writing for information give your Radio University subscription number.

WHAT IS the principle of automatic volume controls? I have heard that a commercial Super-Heterodyne employs such a control and that it keeps the volume constant regardless of strength of the station tuned in. Is this a fact?

(2)—Is such a device simple enough for the amateur to build into his receiver?

(3)—If possible please publish a circuit showing such a control.

CECIL HOWARD,
Fort Worth, Texas.

(1)—The principle is as follows: The radio frequency signal at the point where it is strongest is impressed on the grid of the volume control tube. The plate current in this tube is made to flow through a resistor, the drop in which is used to bias radio or intermediate frequency amplifier tubes. The greater the signal, the greater the bias, and hence the less the amplification. Thus is an equilibrium established, the volume at which is determined by the adjustment. It is used in one commercial Super-Heterodyne.

(2)—The device has not yet been reduced to a simplicity which justifies experimenters building the automatic volume control.

(3)—The circuit will be published in RADIO WORLD just as soon as it can be arranged.

* * *

CAN A two-and-a-half ampere battery charger be used directly to supply the filament current for a battery set if a filter is used in connection with it?

(2)—What type of filter would you recommend? Would an electrolytic condenser be enough to take out the ripple?

ELLIS CRUMP,
Omaha, Neb.

(1)—Yes, provided that the set requires less filament current than two and a half amperes.

(2)—You should have at least some inductance in series with the line, say one-tenth to one-fourth henry. This coil must be large enough to carry the total current without heating and without saturation of the core. One electrolytic condenser of 4,000 mfd. or more should be connected across the line on each side of the choke.

* * *

PLEASE PUBLISH a circuit diagram of a four-tube receiver employing one screen grid tube, a regenerative detector and two stages of transformer coupled audio.

(2)—If you do not give the values please refer me to an issue of RADIO WORLD in which I may get them. I have all the issues for a year back.

CARL MERRILL,
Superior, Wisc.

(1)—See Fig. 740.

(2)—Look up the February 9th issue in which all the parts and values are given.

* * *

I HAVE a tuned radio frequency receiver with three tuned circuits tuned by a three section condenser. Although all the tuning coils are of very good quality the circuit is not selective. What is the cause?

(2)—Can you suggest other tuning coils which would make the set more selective?

(3)—Would I gain selectivity by putting in trimmer condensers? If so, where should I put them and how many are necessary?

WILLIAM ATHERTON,
Scranton, Pa.

(1)—The trouble is lack of synchronization of the tuned circuits.

(2)—No. Better coils would probably make the condition worse.

(3)—You should use two trimmer condensers. Just where to put them will have to be determined by experiment, but it is probable that the two second tuned circuits require them. Put them first across the second sections of the condenser.

* * *

I HAD considerable noise in my receiver and the signals were not very loud. Then I interchanged the antenna and the ground leads on the set with the result that noise was much reduced and signals increased. Please explain?

MERLIN MOORE,
Chicago, Ill.

Such a condition often happens in apartment houses where the set connected to the power lines. The "ground" is a better antenna than ground in such cases. When the reversal has been made the antenna becomes a counterpoise. The reduction in noise may be partly attributed to the increased sensitivity. The pick-up has become greater than the background noise.

* * *

DOES AN AC screen grid tube take the same filament, plate, grid and screen grid voltages as the DC screen grid tube? If not, please give the voltages.

(2)—Which is the better amplifier, the DC or the AC screen grid tube?

ORRIN BAILEY,
Denver, Colo.

(1)—The AC screen grid tube takes the following voltages: Grid bias, 1.5 volts; screen grid voltage, 75 volts; plate voltage, 180 volts; filament voltage, 2.5 volts.

(2)—The AC screen grid tube is the better amplifier.

* * *

MY SET CONTAINS three tuned circuits, all tuned by a single control. It is neither as selective nor as sensitive as I think it should be. Will the sensitivity and the selectivity be increased by adding two stages of untuned RF stages?

(2)—What tubes should be used in the added stages?

(3)—Which is better, to use one untuned stage of screen grid tube amplification or two stages of three element tubes?

IVOR PETERSON,
Rockford, Ill.

(1)—The sensitivity may be increased considerably if you can keep the circuit stable, but the effective selectivity will not be so good.

(2)—Tubes of the same type that you now have in the set.

(3)—One screen grid tube is better all around than two three element tubes. The addition of an untuned stage is not recommended.

* * *

I AM PLANNING to construct a Super-Heterodyne receiver employing two screen grid tubes in the RF level, three stages of intermediate amplification, and two stages of transformer coupled audio, the last of which will contain two UX-245. Will such a circut be practical?

(2)—What would you recommend for the intermediate frequency?

(3)—Is it practical to use AC tubes throughout? If so, what types of tubes do you recommend for the various stages?

FRANK WILSON,
Baltimore, Md.

(1)—There is no reason why such a circut should not be very good. It would require careful shielding in the RF level to prevent oscillation.

(2)—No one freqency is best for the intermediate channel, but it should be considerably higher than 45 kilocycles. One of the best supers now employs an IF channel of 180 kc. Such a frequency has many advantages, one of which is reduction in repeat tuning points.

(3)—AC tubes are practical. Two AC screen grid tubes and two 245 tubes should be used. All the rest should be —27 type tubes.

* * *

THERE IS a peculiar buzz in my dynamic speaker which I cannot trace. I know it is the speaker because a magnetic speaker sounds all right. The noise appears on loud signals, particularly, but sometimes also on weak signals. What could cause it?

ROBERT SIMMONS,
Spokane, Wash.

The noise may be due to particles of dust between the moving coil and the field pole faces or to actual contact between the voice coil and the pole faces. Again, it may be due to a defective contact in one of the windings, especially the moving coil, or to a broken wire. Still another cause may be a ruptured condenser in the equalizing filter.

* * *

WHAT WOULD be gained by adding two stages of untuned RF ahead of the four-tube screen grid Diamond?

(2)—I wish to add two stages of screen grid amplification to this circuit. Is it practical?

(3)—Which is better, to add two stages of RF or one stage of AF to get greater volume?

RONALD ANDREWS,
Grand Rapids, Mich.

(1)—Instability, squeals, broad tuning and disappointment would result.

(2)—No.

(3)—Instability will result if you add either.

* * *

I AM PLANNING to build a new Super-Heterodyne and want one which tunes in each station at one point only on the oscillator. Please tell me whether to use the upper frequency point or the lower on the oscillator.

(2)—What should be the intermediate frequency in such a circuit?

(3)—Is it possible to built a one-spot Super?

(4)—Would you recommend ganging the RF and the oscillator condenser together?

HUMBERT DATO,
New Haven, Conn.

(1)—It is better to use the higher point on the oscillator because this is usually louder and it requires a smaller oscillating coil.

(2)—Any frequency from about 100 kc. to 200 kc. A frequency of 180 kc. is used in a commercial Super-Heterodyne of this type.

(3)—Not entirely. Only approximately so.

(4)—No. Not unless you provide a trimmer on the oscillator.

* * *

I WISH to build two equal resistance coupled amplifiers and combine the outputs of the two in push-pull fashion without the use of transformers. Is this possible?

(2)—If so, please indicate how it may be done?

(3)—Would you use two separate B battery eliminators, one for each side, or a common eliminator?

JAMES MOREHOUSE,
Tulsa, Oklahoma.

(1)—It is theoretically possible, but it has not been done successfully.

(2)—You would have to use two identical amplifiers and detectors, with two tuning coils. Or else you may tune the primary on the RF transformer feeding the detectors, using two identical secondaries, one for each detector. They should be connected in opposite directions. The loudspeaker may be connected from the plate of one output tube to the plate of the other output tube, the plates being fed through a center-tapped choke.

(3)—Either method may be used. The eliminators or eliminator must be well bypassed. The circuit would be an experimental one.

* * *

IS IT REALLY necessary to use an output filter when power tubes like the 171A, 245, 210 and 250 are used, or may the loudspeaker be connected directly in the plate circuit?

(2)—If one is necessary, which is the better, a transformer or a choke and condenser?

ROYAL BURTON,
Cincinnati, Ohio.

(1)—Whether an output device is necessary between any one of these tubes and the loudspeaker depends on the speaker. If the speaker will stand the total plate current no device is necessary. Usually the speaker will not carry the current if it has been wound to match the impedance of the tube. Also, some speakers (dynamics) have transformers built in, and these do not require any output device.

(2)—Most dynamic speakers have output transformers built in so they do not require any additional output device. Magnetic speakers may be used with either type of output device. In some circuits it is preferable to use the choke and condenser method.

* * *

IS THERE any practical advantage of using a full-wave rectifier over a half-wave rectifier?

(2)—I have been told that the first bypass condenser in the filter shortens the life of the rectifier tube and that it is better to omit this condenser. What do you say?

(3)—What is the effect of the omission of this condenser on the hum in the receiver served by the eliminator?

(4)—If the condenser next to the speaker is removed from that position and put across the voltage divider, does not that produce the same filter action as if the condenser were left next to the rectifier tube?

(5)—If the life of the rectifier tube is shortened by the condenser please explain why.

OLOF LUNDGREN,
Minneapolis, Minn.

(1)—The full-wave rectifier is better because it delivers a pulsating current which is much more easily filtered.

(2)—It is true that the condenser next to the rectifier tube shortens the life of the tube.

(3)—It increases the hum a trifle, but this may be compensated in other ways.

(4)—It does not produce the same effect.

(5)—When the condenser is next to the tube the rectifier is called on to supply very heavy current pulses which do more damage than smaller pulses even when the average current is the same. The damage is done by heating of the elements and the heavy pulses heat them more than the smaller.

* * *

I HAVE a five-tube receiver in which the first four tubes are of the 201A type and the power tube is a 171 tube. The set does not bring in any signals any more. I know the tubes are all right because they all light brightly. What do you think is the matter?

ARNOLD FOX,
Jacksonville, Florida.

(1)—The tubes are probably dead. Have them tested and replace those which are exhausted. The fact that the filaments light does not mean anything except that the filament current is on.

* * *

WHAT IS MEANT by the characteristic curve as applied to vacuum tubes, transformers, filters, rectifiers and other devices?

(2)—What is meant by mutual conductance of a vacuum tube?

(3)—What is the approximate capacity between the plate and the control grid of a screen grid tube?

FRED SYKES,
Montreal, Canada.

(1)—A characteristic curve is a graphic representation of the relationship between variables of the device. For example, the grid voltage-plate current characteristic of a vacuum tube is the relationship between the grid voltage and the plate current.

(2)—The mutual conductance of a vacuum tube is the ratio of a small change in the plate current and the change in the grid voltage that produces that change. Or it is the change in the plate current in amperes produced by the change in the grid voltage of one volt. For example, if the mutual conductance of the tube is 1,000 micromhos, a change of one volt on the grid changes the plate current by 1,000 microamperes (one milliampere).

(3)—The capacity is about .02 micro-microfarads.

* * *

I HAVE a filament transformer having two 2.5-volt windings and one 5-volt winding. One of the 2.5-volt windings delivers nine amperes and the other four amperes. Can I use the 5-volt winding for a 280 rectifier tube?

(2)—On the smaller 2.5 volt winding I want to put two 227 tubes and on the larger three of the same type tubes. Is it necessary to use resistors in series with the windings to compensate for the difference in current? If so, how many ohms?

GEORGE LEWIS,
Bristol, Conn.

(1)—It is all right to put the restifier tube on the 52 volt winding.

(2)—No resistors are necessary.

The Rule of Push-Pull

Effective Voltage is Different Between Two Opposite Points

By J. E. Anderson

Technical Editor

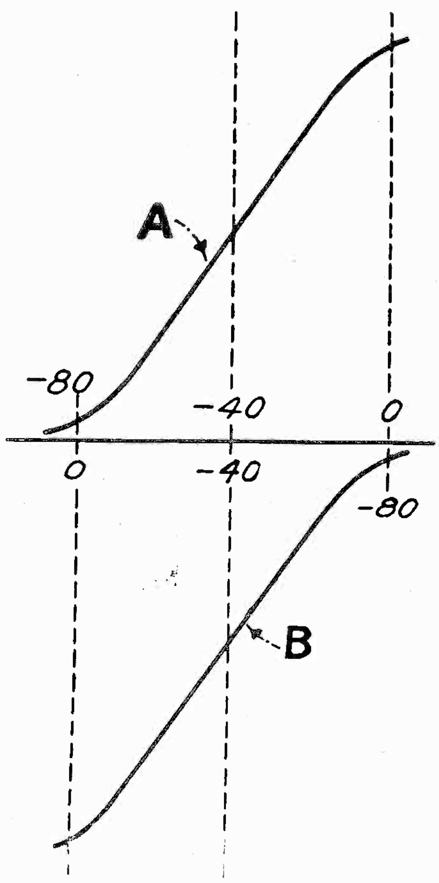


FIG. 1
THE CHARACTERISTIC CURVES OF THE TWO TUBES IN A PUSH-PULL STAGE PLOTTED SO AS TO SHOW THE RELATIVE VOLTAGE AND CURRENT VARIATIONS OF THE TWO TUBES.

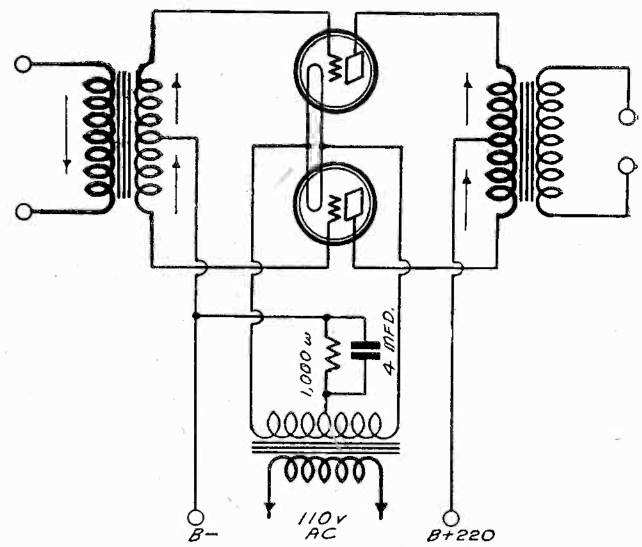


FIG. 2
The circuit diagram of a push-pull stage of which the voltage and current relations are shown in Fig. 1.

THERE is always a great deal of interest in push-pull circuits. Fans realize that such circuits are capable of high output and almost distortionless quality. Some of them realize it because they understand the principle of the push-pull circuit and others because they have confidence in oft-repeated statements.

The outstanding characteristic of the push-pull amplifier is that it eliminates the even harmonics which are generated in the tubes of the push-pull stage. Odd harmonics are not eliminated.

It is difficult to show except mathematically just how the even harmonics are eliminated and how the odd are not. But some idea may be gained from Fig. 1 herewith. This sketch shows two characteristic curves, **A** and **B**, of two equal tubes supplied with equal plate, filament and grid voltages and working under identical conditions.

Curves Displaced

These two curves are plotted to the same scale, but not with reference to the same set of axes. **A** is the curve of one tube in the push-pull stage and **B** is the curve of the other.

The curves are identical in form but they have been plotted in opposite directions, one upside down with respect to the other. They have also been displaced sidewise by the amount of the grid bias on either tube. The bias is assumed to be -40 volts.

The distances from the horizontal axis to either curve is the plate current in the corresponding tube. It will be noted that the currents in the two tubes are exactly equal when the bias is -40 volts. This means that when no AC signal is impressed the two plate currents are equal. These currents produce equal and opposite effects in the output transformer, Fig. 2.

First Even is Out

Hence DC effects are balanced out of the transformer. But DC is the zeroth harmonic, which is even. Hence the first even harmonic is balanced out. It can be shown that all even harmonics are eliminated.

Now let an AC signal voltage be impressed across the two grids of the push-pull stage. Let it be an increase of the voltage on the grid of **A**. There will be an equal decrease in the grid voltage on **B**.

Graphical Representation

When the signal is applied to the transformer the effect is the same as if the long vertical line in Fig. 1 oscillated about the position shown. An increase in the voltage on **A** and a decrease on **B** is equivalent to moving the line toward the right. Thus the two tubes take turns delivering current.

The total current drawn from the B battery at any instant is the distance between the two curves. It is obvious that this does not change appreciably with changes in the signal voltage, because the distance between the lines does not depend much on the position of the long vertical line.

When one tube demands more current the other demands less in the same proportion. This is one of the most valuable properties of a push-pull stage.

Difference Is the Effective

The effective current in the primary of the output transformer at any instant is the difference between the two currents. And this difference depends both as to direction and magnitude on the signal voltage, or on the position of the long vertical line in Fig. 1.

FILMING SOUND

(*Continued from page 9*)

type provided it is constant in intensity. This type of light may also be used if the variable density record of the third type is to be recorded. If the variable density record of the second type is to be made the light source may be a neon lamp, or any other the intensity of which may be varied instantaneously.

If it can be assumed that the photographic processes are distortionless, there are still several other sources of distortion. One is the fact that the slit is of finite width and rectangular in shape. This will cause a blurring of the edges. It is applicable to the variable amplitude type of record. Since the width of the slit is very small compared to its length, even when the length is shortest, this source of distortion is negligible. It is smaller for low notes than for high.

The greatest source of distortion is due to the fact that the slit is of appreciable width. And this applies to all the types of recording. The low notes are recorded with full volume but the higher are reduced in strength. There is a frequency, depending on the width of the slit and the speed of the film, at which nothing is recorded. The cut-off is rather sharp. By making the width of the slit .001 inch or less and running the film at normal speed, it is possible to place the cut-off at a frequency higher than any essential audio frequencies.

In playing the film record an optical system similar to that in Fig. 2 is used, but in the reverse direction. A bright steady light is concentrated on the narrow slit and the film is moved in front of it. A certain amount of light is passed through the film, depending on the photographic density or the amplitude of the record strip at the point where the light falls on the film. The light that gets through the film is passed into a photoelectric cell which changes the light variations into equivalent electrical variations. These are amplified and impressed on a loudspeaker.

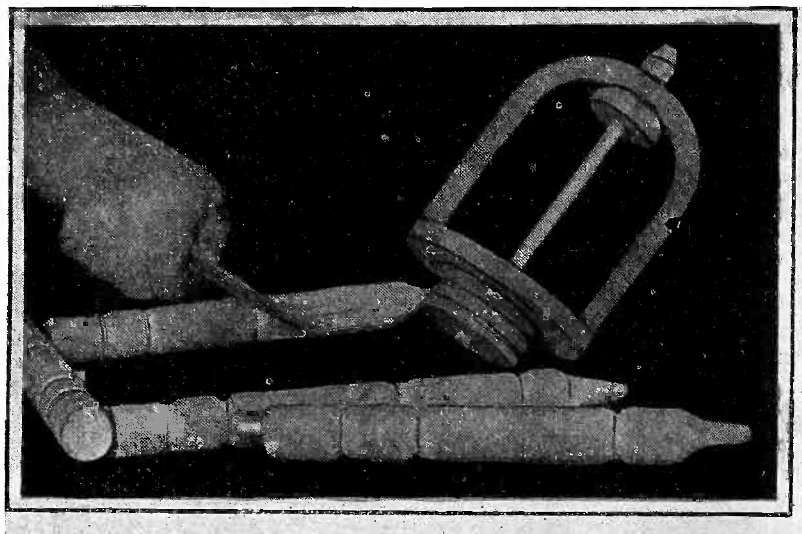
The requirements for the slit used in playing the record are the same as those for the slit used in recording, and the playing slit will introduce the same distortion as the recording slit.

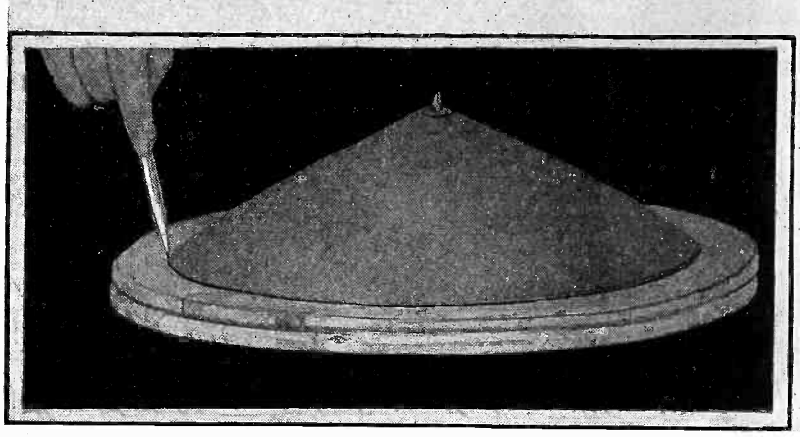
A Period Speaker

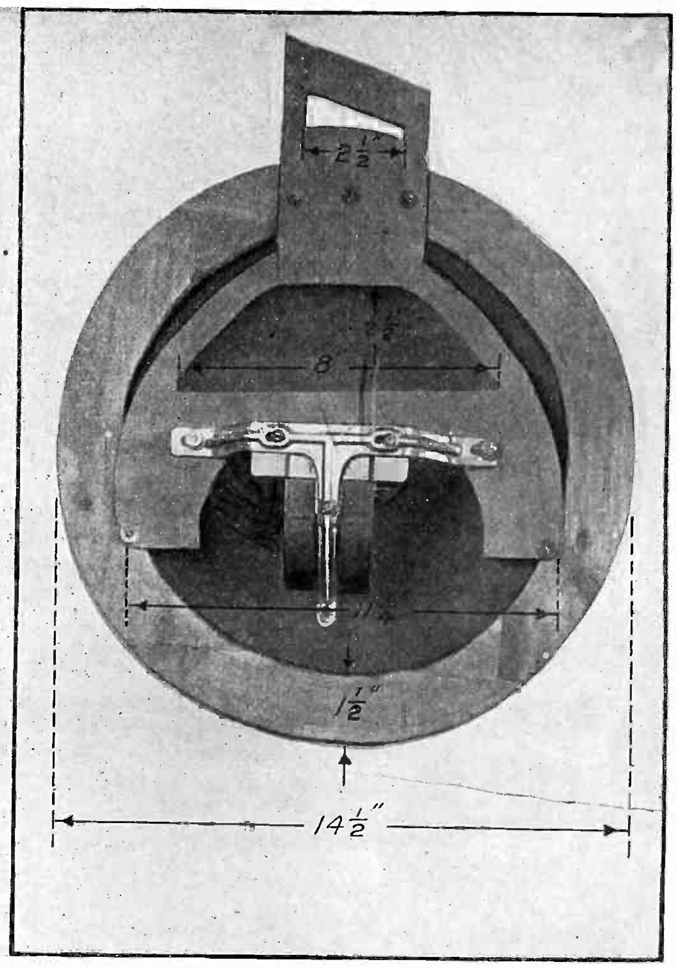
Spinning Wheel is Model for Home-Made Colonial Design

By Herbert E. Hayden

Illustrations by the Author







UPPER LEFT—THE SMALL PARTS OF THE SPINDLE AND ITS SUPPORTS OF THE SPINNING WHEEL. LOWER LEFT—THE CONE AND THE MOUNTING RINGS WHICH FORM THE WHEEL OF THE SPEAKER. RIGHT—THE BACK OF THE CONE OF THE SPEAKER SHOWING HOW THE UNIT IS MOUNTED.

MANY persons are fond of collecting Colonial furniture and early home utilities such as churns, clocks and spinning wheels. To these the loudspeaker described herewith will prove decidedly attractive.

As you will note from the front cover illustration, the speaker is built in the form of a spinning wheel. Most of the features of this relic of home industry are there, the tuft of flax, the spindle, the belt, the wheel and the sloping stand. The treadle and the driving mechanism are simulated.

Details of Construction

The principal member of this device is the wheel, which is nothing but a cone speaker. The paper cone is set in a frame consisting of two rings made of ply wood. The edges of the two sides of these rings which face each other are beveled slightly to form a groove for the belt. This is clearly shown in the lower left photograph in Fig. 2.

This photograph also shows how the rings are cut out to fit the size of cone used. The cone, trimmed to the proper size, is placed on the circular piece of ply wood and centered. Then a pencil is run along the edge of the cone. Then the cone is removed and another circle is described inside the one previously drawn. Then the inner circle is cut out with a scroll saw. After trimming the inside edge of the circle the cone is mounted in place and glued to the ply wood.

The back of the cone speaker is shown in the photograph at the right. A suitable piece of ply wood is cut out for holding the Polo unit, which is employed for driving the cone. A three-cornered, die-cast metal bracket is used for strengthening the unit support.

Note that the back ply wood board extends beyond the edge of the cone at one point. This wood lug is for holding the cone to the inclined board on the stand shown on the front cover. The lug is cut off so that it will match the sloping board and hold the speaker in the correct position.

Vertical Support

There is an additional support for the cone which is clearly shown in the assembled unit. This is a vertical dowel securely mounted in the sloping board at the low end. One end of this dowel is attached to the back plate of the cone.

The spindle of course is not a necessary part of the loudspeaker, but is necessary to complete the spinning wheel. The spindle and its supports are shown in the upper left portion of Fig. 2. This is self-explanatory so that any one wishing to construct the spinning wheel loudspeaker can do so without any difficulty. All the work can be done with simple tools. While some of the work appears to have been done on a wood lathe, it has actually been done with a file. Of course, any one who has access to a lathe can do this work better and with less labor on the machine.

The tuft of "flax," which is hung on another pointed dowel mounted on the upper end of the sloping board, is made of wrapping cord, torn up and beaten until it is fine and fluffy. The belt also is made of wrapping cord, preferably hard twisted.

The "spokes" on the back of the cone are simply painted on the cone for effect.

As nothing in this spinning is supposed to revolve, it is not necessary to provide any bearings.

(Other Illustration on Front Cover)

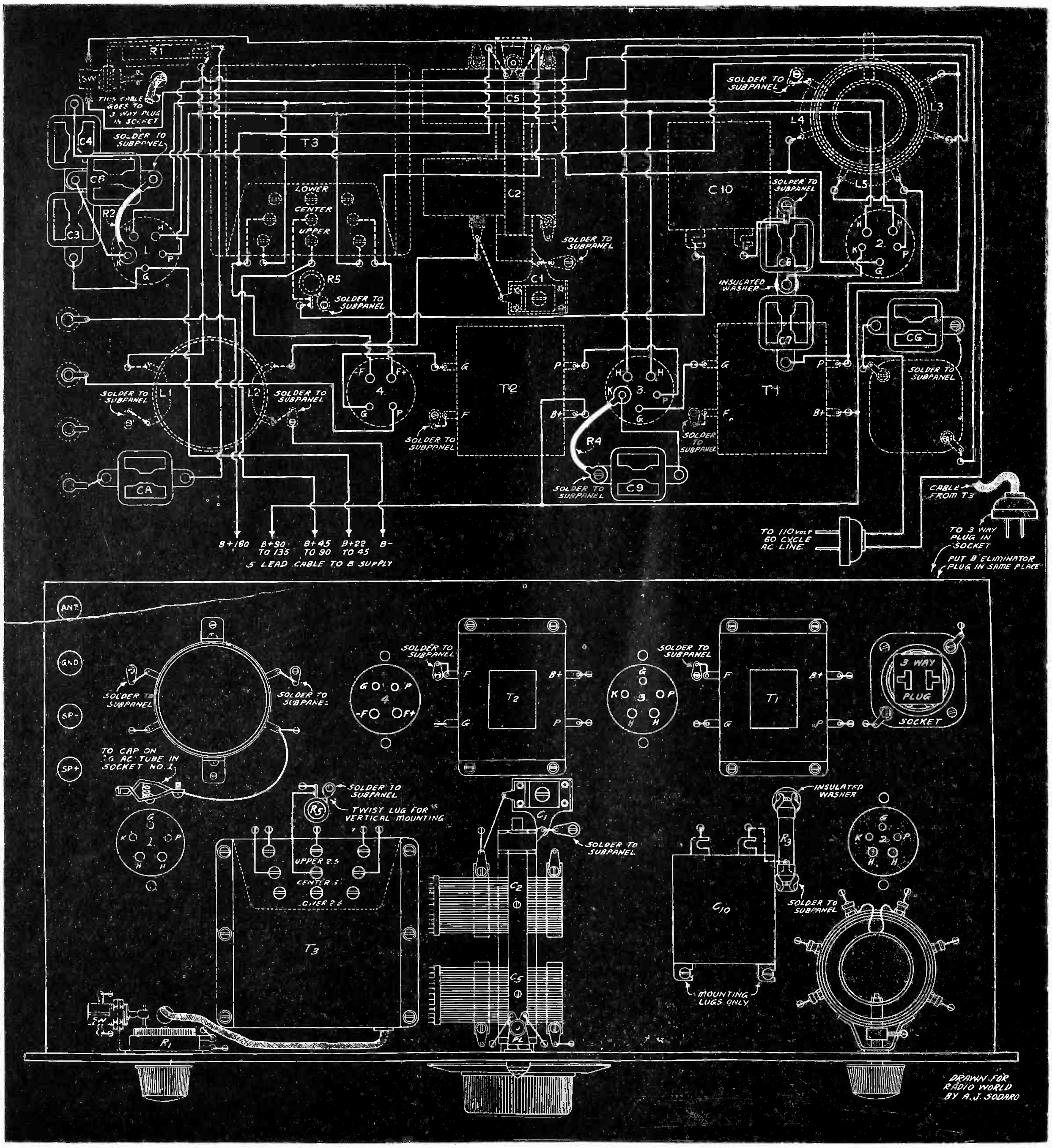
German Listeners Up 31% in One Year

Washington.

The number of paying radio subscribers in Germany increased from 2,009,842 in 1927 to 2,635,567 last year, a gain of 625,-725, or 31 per cent., according to a report of the German Federal Broadcasting Company, the organization which controls the various German broadcasting companies. The Department of Commerce has been so informed by the Commissioner at Berlin, James E. Wallis, Jr.

AC Diamond Wiring

Layout of Parts Revealed and Four Points Are Stressed



THE TOP VIEW OF THE AC SCREEN GRID DIAMOND SHOWN IN THE LOWER SECTION, JUST AS IT APPEARS WHEN YOU LOOK AT THE TOP. ABOVE IS THE BOTTOM VIEW, JUST AS IT APPEARS, AS TO WIRING AND ALL, WHEN YOU TURN THE SUBPANEL UPSIDE DOWN.

THE theory and construction of the new, highly selective AC Screen Grid Diamond were described in the March 23d, March 30th and April 6th issues. Now that the layout and wiring are shown pictorially any doubts as to placement or connection are dispersed.

Four points must be borne in mind:

1—**The B voltages are obtained through five leads, soldered at one end to convenient points under the subpanel, and** pressure—connected at the independent B supply. A 5-lead cable may be used or five separate wires.

2—**"Solder to subpanel," as marked on the pictorial diagram, is not literal.** The subpanel is aluminum and you can't solder to aluminum. Through a subpanel hole put a ½-inch machine screw, slip a lug over the screw and tighten a nut against the screw from the other side. Solder to the lug.

3—**The switch on the set turns everything on or off, since it controls the** porcelain socket (right top in lower drawing). The filament transformer and B eliminator inputs are from a socket-plug in this socket.

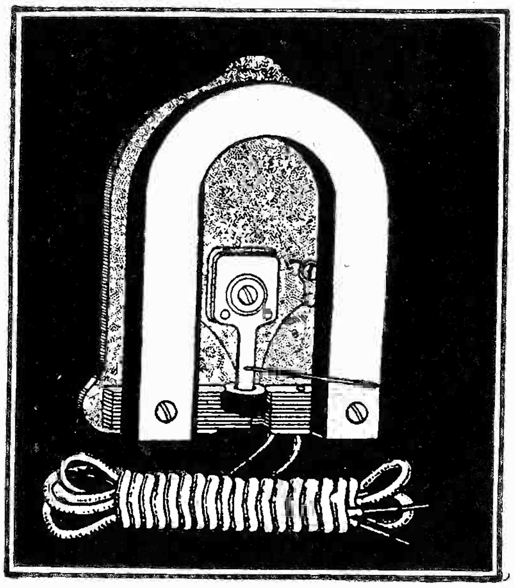
4—**The aluminum subpanel is B minus. Otherwise use a wire to connect points** marked "solder to subpanel," and join this wire to B minus on the B battery eliminator

New Powertone

Cone or Cloth Diaphragm Speaker

Unit

With 5-foot cord, less bracket, apex, chuck and nut. Cat. PA. **$3.00**



New Moulded tri-foot bracket, fits Powertone, Polo, B.B.L., Brielle, Paratone and other units. Cat. BA..65c

Apex, Thumbscrew and Chuck. Cat. AA........10c

(Note: Cat. AA not sold alone.)

You Cannot Buy a Better Unit at Anywhere Near This Price!

The 1929 Model Powertone Unit, that drives any cone or similar type speaker, is an extremely sensitive and faithful reproducer. The magnet coil (the black ring under the pin in illustration) is wound to higher impedance than is ordinarily encountered. Volume is greater. The unit has an adjustable armature.

Guaranty Radio Goods Co.
145 West 45th Street, N. Y. City
(Just East of Broadway)

Please mail me at once C.O.D. (Check off).
- ☐ One Powertone Unit alone, Cat. PA. @ $3.00.
- ☐ One Tri-foot Bracket, Cat. BA @ 65c.
- ☐ One Apex, one Chuck, one Thumbscrew, Cat. AA. @ 10c.

Name ....

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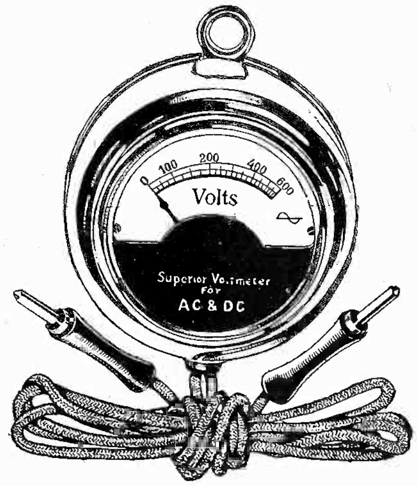
0-600 V. AC and DC High Resistance Meter

Same Meter Reads Both AC and DC
Accurate to 1 per cent.



The 0-600 volt AC and DC meter (Cat. No. 600), with 3-ft. cord, de luxe tips and hanger $7.00.

THE output voltages of all B eliminators, the voltages of all B batteries, as well as the house current line voltage, whether AC or DC, and the voltage across power transformer secondaries, can be accurately measured by this meter. The full scale is 0-600 volts, and this same meter measures both AC and DC. Since it is a high resistance meter, of extraordinary range, and accurate to 1% plus or minus, it is advisable to get this meter for your testing purposes, since it is like two meters in one—AC and DC. You can find trouble more quickly. Without it you can't tell if a power transformer secondary is delivering voltage. 10-day money-back guaranty.

GUARANTY RADIO GOODS CO.,
145 West 45th Street, N. Y. City.
(Just East of Broadway)

Please ship at once one 0-600 volts AC and DC high resistance voltmeter, accurate to 1% plus or minus (Cat. No. 600); meter equipped with 3-ft. cord, moulded tip receptacles, tips and hanger.
[Put cross in proper square below.]

- ☐ $7.00 enclosed.
- ☐ I will pay postman $7.00 plus few cents extra for postage.

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Let's not discuss that painful experience when company arrives and the A-C set lies down on the job. A voltmeter in the line would show sagging voltage. Why not insert a 25-500 ohm POWER CLAROSTAT in the low-voltage primary tap? CLAROSTATS are aids to better radio. No matter what your set, you can make it more enjoyable.

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Safe as insulated wire and as convenient as bare wire. You cannot scorch or burn Braidite with a soldering iron. Use Braidite in your next set.

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SET Builders FREE

Elections have brought back Custom Set building. Business is booming. Thousands of old-timers are cleaning up. Let **Barawik** show you the way to bigger profits, more sales. Send today for **Barawik's Big Bargain Book** — the radio man's bible.

BARAWIK CO. 134A Canal Sta., CHICAGO, U. S. A.

RADIO WORLD, published every Wednesday, dated Saturday of same week, from publication office, Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y., just east of Broadway. Roland Burke Hennessy, President, M. B. Hennessy, Vice-President; Herman Bernard, Secretary. Roland Burke Hennessy, Editor; Herman Bernard, Managing Editor; J. E. Anderson, Technical Editor; Anthony Sodaro, Art Editor.

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CASH FOR YOUR PROPERTY, farm, business or residence. No matter where located. Free information. International Realty Co., Ford Bldg., Detroit.

RADIO RECEIVING TUBES, by Moyer and Wostrel, first edition just off the press. No radio service man, experimenter or student of radio should be without this authoritative book on the principles and applications of vacuum tubes. It answers all your questions relating to receiving, amplifying and rectifying tubes. Price postpaid, $2.50 Radio World, 145 W. 45th St., New York.

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LATEST KNAPP A-ELIMINATOR. New $16.00. D. L. Currens, Owensboro, Ky.

ARTISTS and Art Students are printing 250 signs or pictures an hour without machinery. Sample and particulars 10c. Straco, 1014 Mulberry, Springfield, Ohio.

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THORDARSON 210 power compact—Tobe condenser block; both for $19.50. CeCo 281-210 tubes tested, both for $9.75. C.O.D.—Rome Tire Co., 772 Pacific Ave., San Francisco, Calif.

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THE CRAFTSMAN Dollar Speaker Filter is guaranteed to relieve speaker of the plate direct current, up to 250 volts. $1.00 postpaid. Refund if not satisfactory. Attach dollar to This Ad and receive FREE Solid-molded grid-leak, 1 to 5 megohm. Craftsman Radio Products, 351 Halsey St., Newark, N. J.

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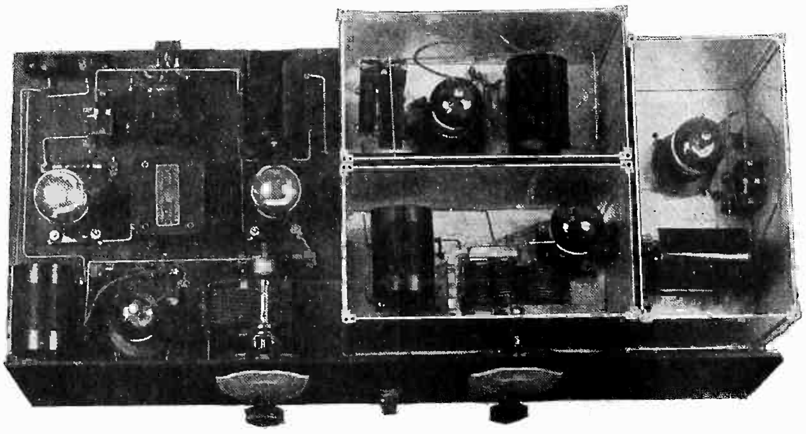
PRODUCTS THAT ENDURE

Build the Greatest Circuit—RE 29!



The neat and efficient arrangement of parts in R. E. Lacault's RE29.

Lacault's Last and Best Receiver!

FOR sheer sensitivity the screen-grid receiver, the RE29, surpassed any circuit he ever tried, R. E. Lacault said, just before his death. So that this extreme sensitivity could be utilized properly, Mr. Lacault spent many trying months until he developed the circuit to a remarkably high point of selectivity, with utter stability. That done, he knew he had a wonderful receiver, one that his large following, eagerly awaiting a screen grid adaptation of his original modulation system, would build with delight and operate with ecstacy! The RE29, successor to a long line of successful Lacault receiver designs, is here. His last circuit, his best circuit, may now be duplicated by constructors!

THE receiver consists of six tubes (including first audio) in the table chassis and two tubes (a push-pull output) in the B supply and power amplifier. Hence the receiver proper uses eight tubes. Two 281 tubes are used as rectifiers. So well are each independent stage and the group of stages designed that abnormally high amplification prevails. Distant stations "roll in" easily, with volume to spare. The master designer of DX circuits took good care of that!

Build this receiver and the Push-Pull Power Amplifier B supply from the official blueprints.

Send for your free copy of the Builders' Information Sheet today!

Mrs. R. E. Lacault, 1931 B'way, N. Y. City (65th St.)

☐ Enclosed please find $1.50 for which please send at once blueprint of the 6-tube RE29 Receiver.
☐ Enclosed please find $1 additional for blueprint of the Push-Pull Power Amplifier B Supply.
☐ 50c for construction article.
☐ Please send FREE copy of the Builders' Information Sheet on the complete RE29.

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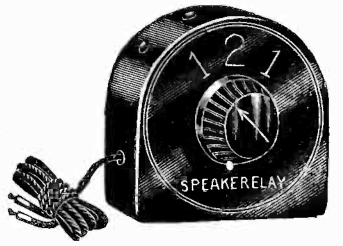
All Parts in Stock for Receiver and Amplifier.

$100.00 WORTH of Pleasure and Convenience for Only $2.00



IF you have two loudspeakers and want a convenient method of playing both at the same time, or one at a time, the Speakerelay gives you that service at the turn of a knob. Simply connect the Speakerelay cord tips to the output (speaker posts) of your receiver, and put the cord tips of one speaker in the first two holes (shown on top in illustration) and the cord tips of the other speaker in the remaining two holes (not shown). Then point the knob to "1" at left to play the speaker whose cords are at left, or point the know to "1" at right to play the other speaker. Or, to play both together, point the knob at "2".

Instead of using two speakers you may use one speaker and one pair of earphones. This is a great asset when tuning in DX, for with earphones you may readily discern the call letters that might not be so plain on the speaker. Also, any weak station may be tuned in with more accurate sharpness with earphones—and remember the speaker may be going all the while!

You can get $100 worth of service out of one of these $2 products

Cat. No. 121 (illustrated)............$2.00

If you desire a Speakerelay that enables comparison of four different speakers so any one may be played at a time, but all connected in the casing, then order Cat. No. 1234.

Cat. No. 1234.......................$2.50

We stock the Speakerelays in quantity and sell them singly or in multiple lots, on an immediate delivery basis. We also have them on display at our office, so, if convenient, come in and see them.

A five-day money-back guaranty attaches to each purchase of a Speakerelay.

Guaranty Radio Goods Co.
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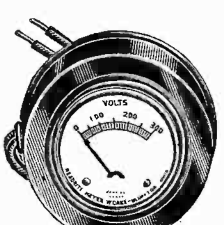

0-300 v., in portable type, full nickel finish, 30" tipped cord (illustrated at left). (Cat. No. 346) $4.50

0-500 v., Tests ALL power packs, B eliminators, etc. Same casing as above. (Cat. No. 347) $5.00

Just the thing for service men, custom set builders, home experimenters.

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145 West 45th St., New York City

Published Weekly

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST, 24, 1912.

Of Radio World published weekly at New York N. Y., for April 1, 1929.
State of New York,
County of New York, ss:

Before me, a Notary Public, in and for the State and county aforesaid, personally appeared Roland Burke Hennessy, who, having been duly sworn according to law, deposes and says that he is the Editor of the Radio World, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor and business managers are: Publisher, Hennessy Radio Publications Corp., 145 West 45th St., N. Y. C. Editor Roland Burke Hennessy, 145 West 45th St., N. Y. C. Managing Editor Herman Bernard, 145 West 45th St., N. Y. C. Business Manager Herman Bernard, 145 West 45th St., N. Y. C.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of the stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) Hennessy, Radio Publications Corp., 145 West 45th St., N. Y. C. Roland Burke Hennessy, 145 West 45th St., N. Y. C. Mrs. Mary J. McArthur, 1940 East 82nd St., Cleveland, O.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent, or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers, during the six months preceding the date shown above is .... weekly. (This information is required from daily publications only.)

ROLAND BURKE HENNESSY

Sworn to and subscribed before me this 26th day of March, 1929.

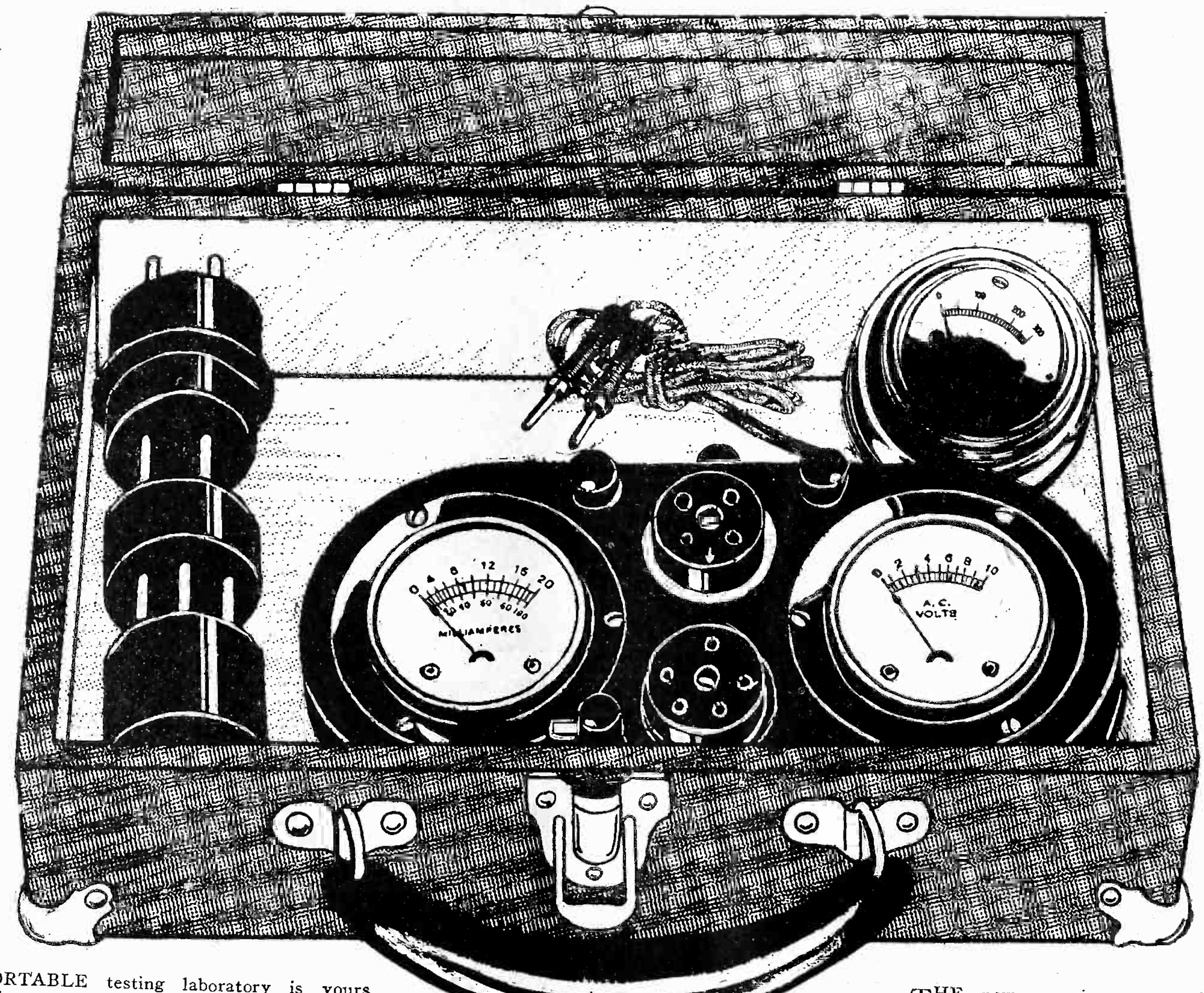
HARRY GERSTEN.

Notary Public, Kings Co. Clks. No. 136, Reg. 247. N. Y. Co. Clks. No. 528, Reg. No. 0-364. My commission expires March 30, 1930.

Note.—This statement must be made in duplicate and both copies delivered by the publisher to the postmaster, who shall send one copy to the Third Assistant Postmaster General (Division of Classification), Washington, D. C., and retain the other in the files of the post office. The publisher must publish a copy of this statement in the second issue printed next after its filing.

New Style DeLuxe Leatherette Carrying Case FREE with each Jiffy Tester!

This combination of meters tests all standard tubes, including the new AC screen grid tubes and the new 245 tube, making thirteen tests in 4½ minutes! Instruction sheet gives these tests in detail.



A PORTABLE testing laboratory is yours when you possess a combination Jiffy Tester, for then you can measure the filament and plate voltages of all standard tubes, including AC tubes, and all standard battery-operated or AC screen grid tubes; also plate voltages up to 500 volts on a high resistance meter that is 99% accurate.

The Jiffy Tester consists of a 0-20, 0-100 milliammeter, with changeover switch and a 0-10 volt AC and DC voltmeter (same meter reads both), with two sockets, one for 5-prong, the other for 4-prong tubes; a grid bias switch and two binding posts to which are attached the cords of the high resistance voltmeter; also built-in cable with 5-prong plug and 4-prong adapter, so that connections in a receiver are transferred to the Tester automatically. Not only can you test tubes, but also opens or shorts in a receiver, continuity, bias, oscillation, etc. The instruction sheet tells all about these tests.

In addition you can test screen grid tubes by connecting a special cable, with clip to control grid (cap of tube) and other end of special cable to the clip in the set that went to the cap before the tube was transferred to the tester.

THE new carrying case, which is furnished FREE with each order for a Combination Jiffy Tester, contains the entire outfit, including the three meters, cable and plug, and three adapters (one for 4-prong tubes, two for 199 tubes). This case is 10½x7¾x3½" and has nickel corner pieces and protective snap-lock. The case is made of strong wood, with black leatherette overlay.

To operate, remove a tube from the receiver, place the cable plug in the vacant receiver socket, put the tube in the proper socket of the Tester, connect the high resistance meter to the two binding posts, and you're all set to make the thirteen vital tests in 4½ minutes!

The Combination Jiffy Tester is just the thing for service men, custom set builders, experimenters, students, teachers and factories. Order "Jiffy 500." The price is only $14.50.

If a 0-600 AC and DC high resistance meter (99% accurate) is desired, so house electricity line voltage and power transformer voltages can be measured, as well as plate voltage, instead of the 0-500 DC voltmeter, order "Jiffy 600" at $15.50.

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☐ Please ship at once on 5-day money-back guaranty one "Jiffy 500," at $14.50, consisting of
(1) One Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with change-over switch. This reads plate current.
(3) One 0-500 volts high resistance voltmeter, 99% accurate; with tipped 30" cord to measure B voltages.
(4) One 5-prong plug with 30" cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome moire metal case.
(10) One instruction sheet.
(11) One de luxe carrying case.
(12) One screen grid special cable.
(13) FREE carrying case and instruction sheet.
☐ If 0-300 DC high resistance 99% accurate voltmeter is preferred to 0-500, put check here. Price is same, $14.50.
☐ Same as above, except substitute a 0-600-volt AC and DC high resistance 99% accurate voltmeter (same meter reads both) for the 0-500 DC meter. Price $15.50.

NAME ....

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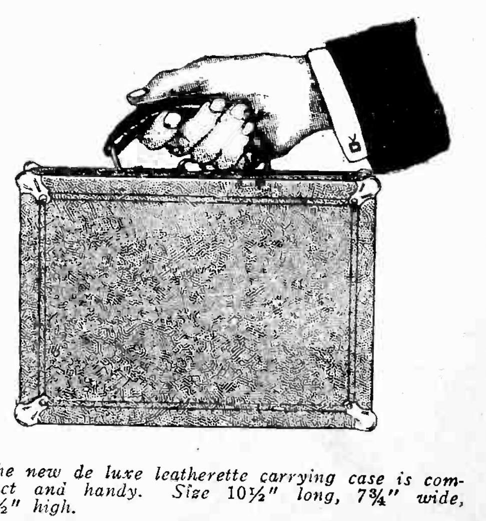
FIVE-DAY MONEY-BACK GUARANTY



The new de luxe leatherette carrying case is compact and handy. Size 10½" long, 7¾" wide, 3½" high.

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