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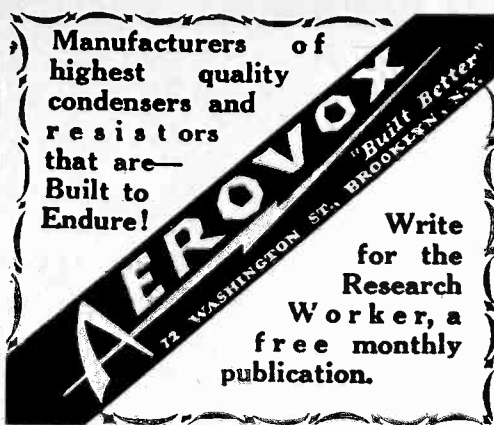
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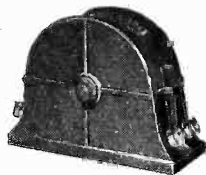
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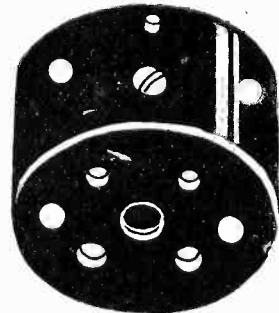
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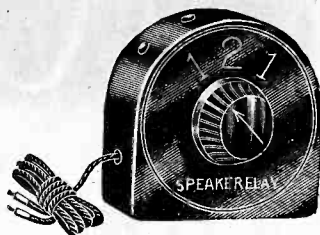
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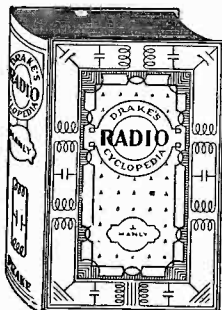
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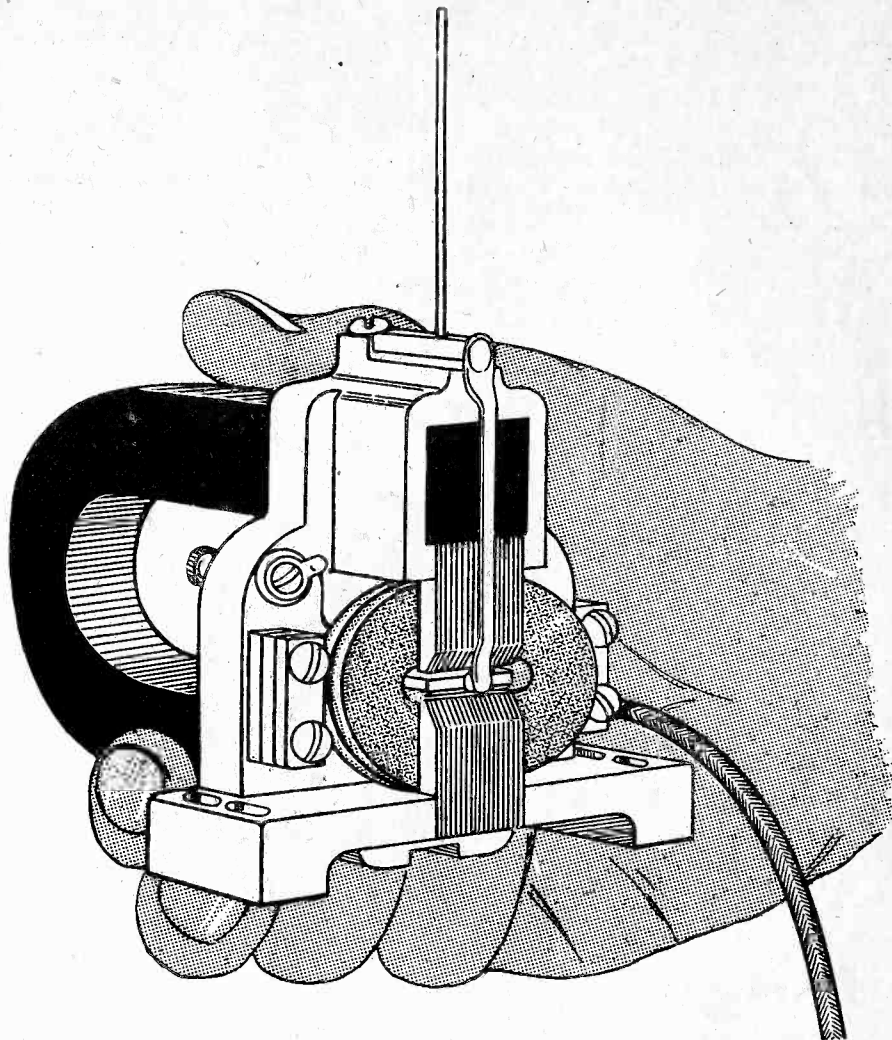
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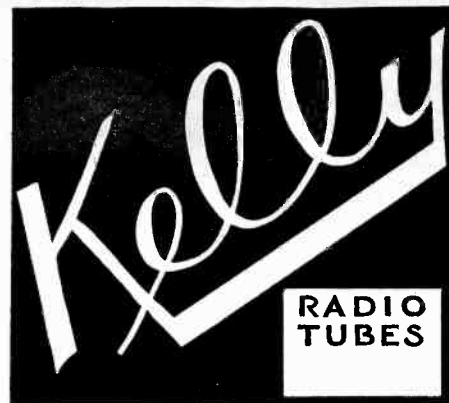
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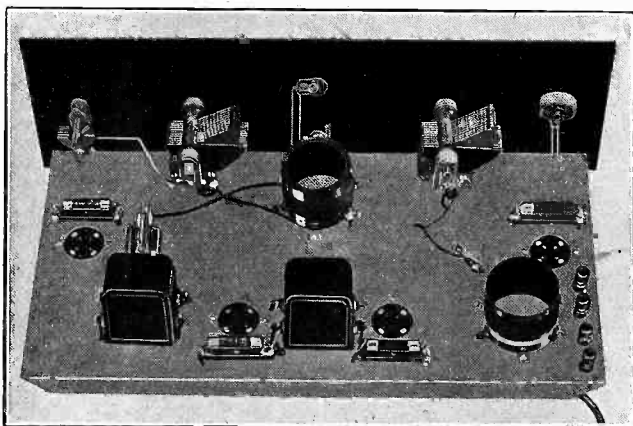
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The screen grid tube is used as a radio frequency amplifier in a new and most efficient manner. Correct circuit design and co-ordinated parts make this circuit outstanding. Build it now!

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Two dials tune in the entire wavelength band, using either .0005 mfd. or .00035 mfd. tuning condensers. The circuit affords all the selectivity you need, separates stations excellently and without "background reception," and despite this fine selectivity, affords more than enough volume, so that you must tune it down with the volume control, even on far-distant stations!

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Screen grid coils especially designed for this receiver permit you to obtain any desired degree of selectivity, but always with a high level of reproduced sound. The primary of the interstage coupler is tuned, while the secondary doubles the voltage by step-up ratio.

The circuit is stable, easy to build, easy to tune. Build it from the official blueprint and the theoretical expression and constructional details in the December 1st, 8th and 15th issues. This blueprint was made directly from the laboratory model of this receiver as constructed by Herman Bernard, the designer. It is a remarkable blueprint, because the wiring that is done on top of the subpanel is shown just as you want it, in the actual manner of its appearance. Also, the wiring underneath the subpanel is shown as it actually appears. Hence there are two separate, clear life-sized views on one sheet, not just one view, made to appear "transparent."

When you turn the subpanel upside down for underneath wiring you don't have to imagine the direction the leads take. Nothing is left to the imagination.

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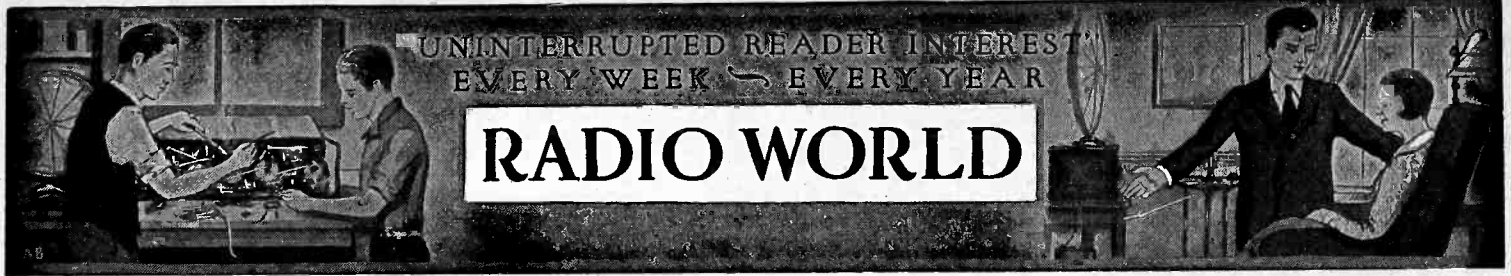
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DILL SAYS HIGH POWER CAUSES INTERFERENCE

Washington.

Senator Dill (Dem.) of the State of Washington has prepared an amendment to the radio law limiting general power of stations to 10,000 watts. He said:

"I have hesitated to urge the passage of legislation limiting the Commission in its discretion as to the power to be used by broadcasting stations, but the increased number of stations allowed to use 50,000 watts of power shows that the public can expect no protection from the Commission against these high powered stations which dominate the dials of most receiving sets within a radius of 150 or 200 miles of the stations using immense power.

High Power Interferes

"Since the Commission will not protect the public, Congress is the only body that can do so. The people for whom Congress passed radio legislation are entitled to conditions under which they can listen to stations other than those of immense power.

"In practice it is found that these high powered stations cannot be separated by 10 kilocycles, but that they extend across 40 and 50 kilocycles, thus dominating a number of channels.

"I hope to have hearings on this amendment before the Interstate Commerce Commission Committee that will show the necessity of such legislation in the interest of radio listeners."

Provisions of Bill

The proposed amendment provides that "no broadcasting station licensed under the provisions of this act shall be permitted to use more than 10,000 watts of power for broadcasting, except for experimental purposes, and only after the hour of midnight and before 6 a. m. of any day for experimental

White of Maine will in-
in the House.

Itinerant Announcer Back Again at WBBM

Chicago

Nate Caldwell, has just returned to WBBM as announcer. Starting out as the announcer at WEEL, Boston, he later joined WBBM. He next made a short stay at KMOX, but returned to WBBM. Next he went to WTMJ, Milwaukee. He returned to WBBM and then left for KOIL, Council Bluffs, Iowa.

"I'm glad to hang my hat up at WBBM again," said he. "This time it is for good."

Pianist's Beads Spoil Broadcast

Oakland, Calif.

KGO has at last put its finger on a reverberation in its studios which has caused no end of trouble to the station staff.

This particular disturbance seemed to arise at the piano, but even after different pianos were tried the elusive noise remained.

An expert piano tuner, trying to catch the noise, finally summoned the KGO pianists. Eva Garcia, the station's stellar artist, was found guilty.

Miss Garcia no longer wears beads, for they vibrated to a note in pitch with them and the microphone picked up the vibrations.

SHORT WAVES IN BIG DEMAND

Washington.

The disposition of the short wave channels is proving a vexatious problem to the radio authorities, said Representative Wallace H. White, Jr., of Maine. His statement follows:

"There are radio problems of great national moment, other than broadcasting, pressing upon us. One of these is the disposition of the short waves.

"These short wave channels are limited in number and are in great demand. They should be allocated as soon as proper applications for them are filed. There are involved in their allocation important questions of public policy.

The short waves are being sought by business houses throughout the United States for private commercial purposes. I am against any license of these short waves to such interests.

"In my view they should be allocated only to those persons or those groups which in the fullest sense are public utilities subject to that character and degree of control which our States assert over public utility agencies, and subject also to the fullest measure of Federal control and regulation.

"There is also present the ever troublesome question as to the uses to which these short waves shall be put. It must be decided whether radio waves in point to point communication within the United States, are to furnish a service competitive with that now provided by telephones and telegraphs, or whether the employment of these waves should be limited to areas and to uses not now cared for or not able to be cared for by wire communication, or shall be allocated to supplementary wire facilities.

"Radio waves do not respect international boundaries. Our broadcasting stations, will seriously interfere with reception within the United States."

DISASTROUS IF WGY SUCCEEDS, COURT IS TOLD

Washington.

The action taken by WGY in trying to force the Federal Radio Commission to give it a cleared channel, on the ground that anything less would constitute seizure of property without compensation, was attacked by Commission counsel as threatening the entire Federal control of radio.

The case is now awaiting decision, following a hearing at which Charles Evans Hughes appeared for WGY and Louis G. Caldwell for the Commission.

Caldwell, general counsel for the Commission, said that if WGY's request for a permanent injunction is granted, "the whole Government control of radio will be impaired."

Justice Van Orsdel, of the Court of Appeals of the District of Columbia, conducting the hearing, said that the question of the validity of the Radio Act and the taking of property rights of broadcasters may be decided in the case.

A Serious Question

He added:

"A serious question arises as to whether Congress can enact legislation which will seriously impair the property rights without due compensation."

Mr. Caldwell replied that the question was before Congress last session during its consideration of radio legislation, and that "Congress refused to enact a law to compensate broadcasters for their property." Mr. Caldwell insisted that the question of the constitutionality of the Radio Act is not before the court.

At present WGY, Schenectady, N. Y., under a stay granted by the Court of Appeals on November 9th, is operating full time on the 790-kilocycle channel, pending a decision on the appeal by the Court. The 790-kilocycle channel was assigned to KGO, Oakland, also owned by the General Electric Company, on full time, with the stipulation that WGY may operate on it until darkness at Oakland, so that no interference between the stations may be caused.

Only Open Violator

Mr. Caldwell, in closing his arguments stated that WGY is the only station which has "openly violated the rules and regulations of the Commission by carrying its case into this court before exhausting all other resources before the Commission. The station, he said, has "refused to play ball" with the Commission.

WGY made two attempts to get a hearing before the Commission, but the petitions were ruled out by the Board as being informal.

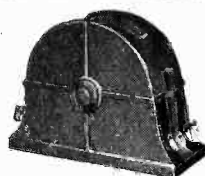
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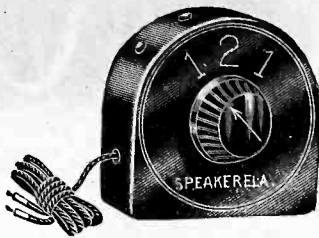
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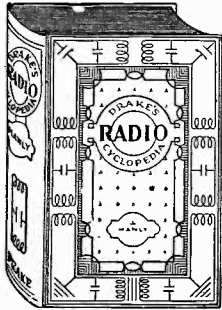
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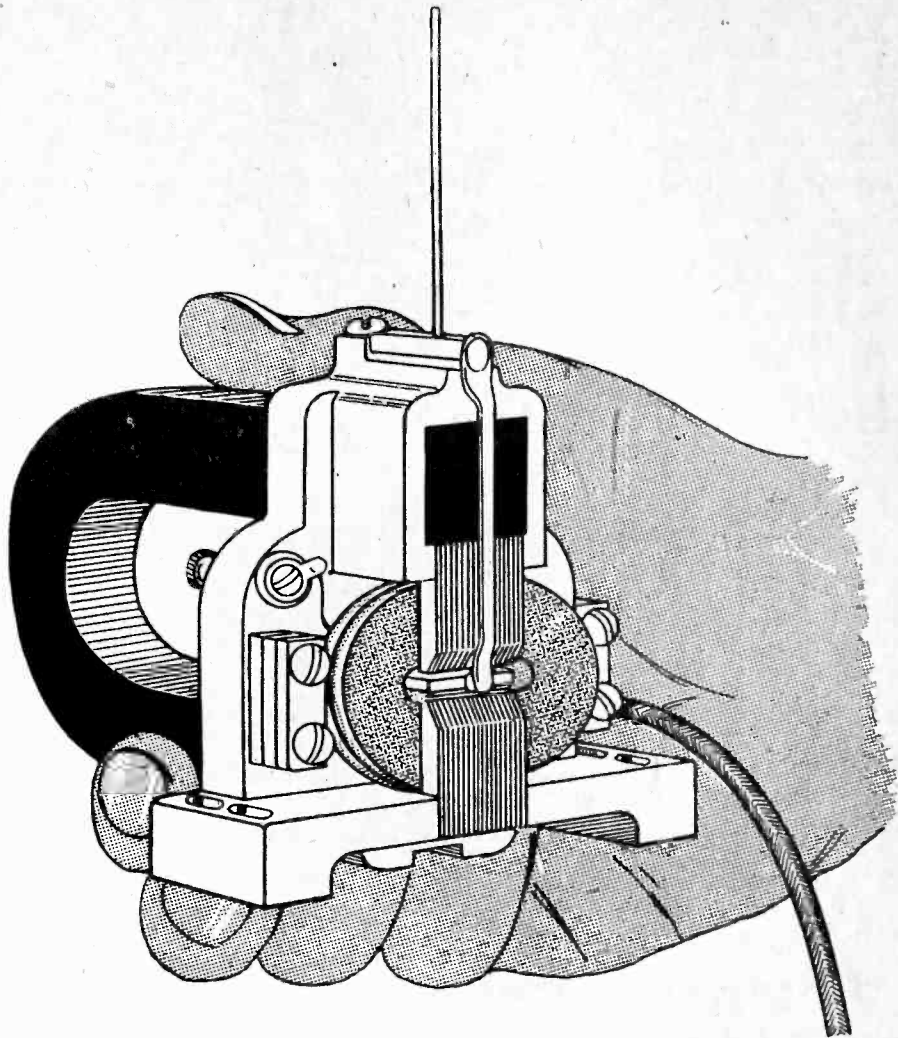
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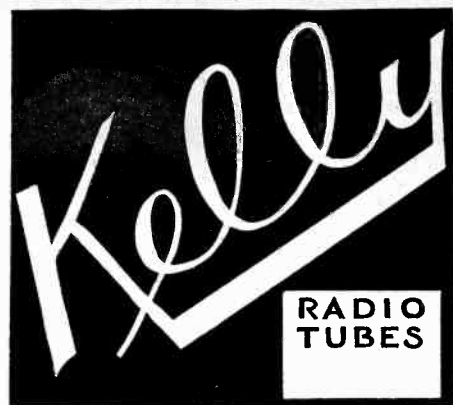
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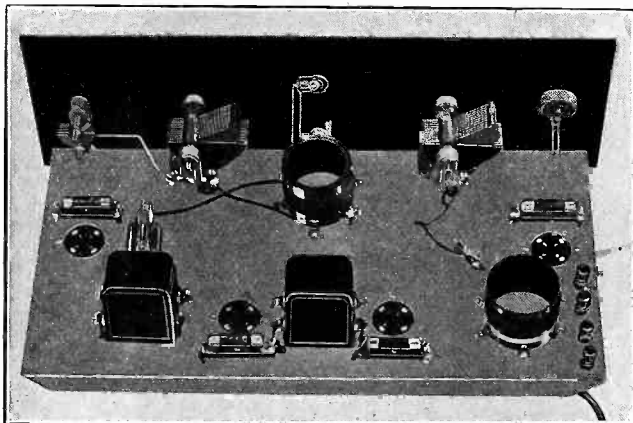


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Two dials tune in the entire wavelength band, using either .0005 mfd. or .00035 mfd. tuning condensers. The circuit affords all the selectivity you need, separates stations excellently and without "background reception," and despite this fine selectivity, affords more than enough volume, so that you must tune it down with the volume control, even on far-distant stations!

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Screen grid coils especially designed for this receiver permit you to obtain any desired degree of selectivity, but always with a high level of reproduced sound. The primary of the interstage coupler is tuned, while the secondary doubles the voltage by step-up ratio.

The circuit is stable, easy to build, easy to tune. Build it from the official blueprint and the theoretical expression and constructional details in the December 1st, 8th and 15th issues. This blueprint was made directly from the laboratory model of this receiver as constructed by Herman Bernard, the designer. It is a remarkable blueprint, because the wiring that is done on top of the subpanel is shown just as you want it, in the actual manner of its appearance. Also, the wiring underneath the subpanel is shown as it actually appears. Hence there are two separate, clear life-sized views on one sheet, not just one view, made to appear "transparent."

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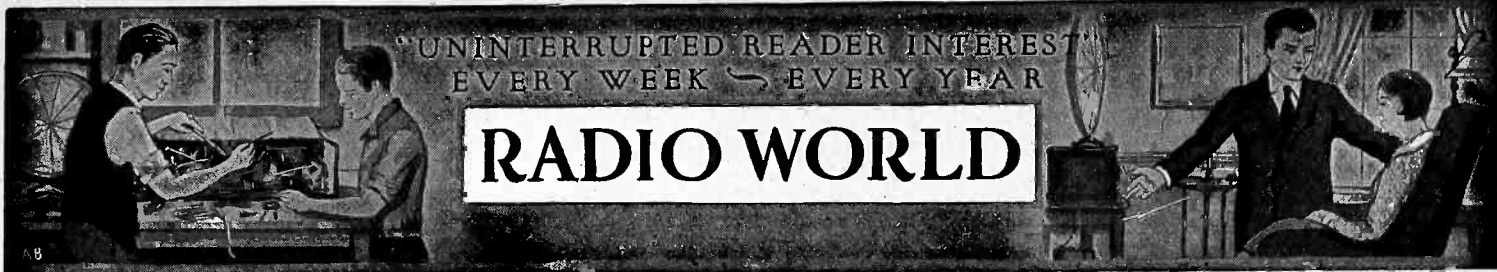
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Vol. XIV, No. 14 Whole No. 352
DECEMBER 22d, 1928
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DILL SAYS HIGH POWER CAUSES INTERFERENCE

Washington.

Senator Dill (Dem.) of the State of Washington has prepared an amendment to the radio law limiting general power of stations to 10,000 watts. He said:

"I have hesitated to urge the passage of legislation limiting the Commission in its discretion as to the power to be used by broadcasting stations, but the increased number of stations allowed to use 50,000 watts of power shows that the public can expect no protection from the Commission against these high powered stations which dominate the dials of most receiving sets within a radius of 150 or 200 miles of the stations using immense power.

High Power Interferes

"Since the Commission will not protect the public, Congress is the only body that can do so. The people for whom Congress passed radio legislation are entitled to conditions under which they can listen to stations other than those of immense power.

"In practice it is found that these high powered stations cannot be separated by 10 kilocycles, but that they extend across 40 and 50 kilocycles, thus dominating a number of channels.

"I hope to have hearings on this amendment before the Interstate Commerce Commission Committee that will show the necessity of such legislation in the interest of radio listeners."

Provisions of Bill

The proposed amendment provides that "no broadcasting station licensed under the provisions of this act shall be permitted to use more than 10,000 watts of power for broadcasting, except for experimental purposes, and only after the hour of midnight and before 6 a. m. of any day for experimental

White of Maine will in-
in the House.

Itinerant Announcer Back Again at WBBM

Chicago

Nate Caldwell, has just returned to WBBM as announcer. Starting out as the announcer at WEEL, Boston, he later joined WBBM. He next made a short stay at KMOX, but returned to WBBM. Next he went to WTMJ, Milwaukee. He returned to WBBM and then left for KOIL, Council Bluffs, Iowa.

"I'm glad to hang my hat up at WBBM again," said he. "This time it is for good."

Pianist's Beads Spoil Broadcast

Oakland, Calif.

KGO has at last put its finger on a reverberation in its studios which has caused no end of trouble to the station staff.

This particular disturbance seemed to arise at the piano, but even after different pianos were tried the elusive noise remained.

An expert piano tuner, trying to catch the noise, finally summoned the KGO pianists. Eva Garcia, the station's stellar artist, was found guilty.

Miss Garcia no longer wears beads, for they vibrated to a note in pitch with them and the microphone picked up the vibrations.

SHORT WAVES IN BIG DEMAND

Washington.

The disposition of the short wave channels is proving a vexatious problem to the radio authorities, said Representative Wallace H. White, Jr., of Maine. His statement follows:

"There are radio problems of great national moment, other than broadcasting, pressing upon us. One of these is the disposition of the short waves.

"These short wave channels are limited in number and are in great demand. They should be allocated as soon as proper applications for them are filed. There are involved in their allocation important questions of public policy.

The short waves are being sought by business houses throughout the United States for private commercial purposes. I am against any license of these short waves to such interests.

"In my view they should be allocated only to those persons or those groups which in the fullest sense are public utilities subject to that character and degree of control which our States assert over public utility agencies, and subject also to the fullest measure of Federal control and regulation.

"There is also present the ever troublesome question as to the uses to which these short waves shall be put. It must be decided whether radio waves in point to point communication within the United States, are to furnish a service competitive with that now provided by telephones and telegraphs, or whether the employment of these waves should be limited to areas and to uses not now cared for or not able to be cared for by wire communication, or shall be allocated to supplement wire facilities.

"Radio waves do not respect international boundaries. Our broadcasting stations, will seriously interfere with reception within the United States."

DISASTROUS IF WGY SUCCEEDS, COURT IS TOLD

Washington.

The action taken by WGY in trying to force the Federal Radio Commission to give it a cleared channel, on the ground that anything less would constitute seizure of property without compensation, was attacked by Commission counsel as threatening the entire Federal control of radio.

The case is now awaiting decision, following a hearing at which Charles Evans Hughes appeared for WGY and Louis G. Caldwell for the Commission.

Caldwell, general counsel for the Commission, said that if WGY's request for a permanent injunction is granted, "the whole Government control of radio will be impaired."

Justice Van Orsdel, of the Court of Appeals of the District of Columbia, conducting the hearing, said that the question of the validity of the Radio Act and the taking of property rights of broadcasters may be decided in the case.

A Serious Question

He added:

"A serious question arises as to whether Congress can enact legislation which will seriously impair the property rights without due compensation."

Mr. Caldwell replied that the question was before Congress last session during its consideration of radio legislation, and that "Congress refused to enact a law to compensate broadcasters for their property." Mr. Caldwell insisted that the question of the constitutionality of the Radio Act is not before the court.

At present WGY, Schenectady, N. Y., under a stay granted by the Court of Appeals on November 9th, is operating full time on the 790-kilocycle channel, pending a decision on the appeal by the Court. The 790-kilocycle channel was assigned to KGO, Oakland, also owned by the General Electric Company, on full time, with the stipulation that WGY may operate on it until darkness at Oakland, so that no interference between the stations may be caused.

Only Open Violator

Mr. Caldwell, in closing his arguments stated that WGY is the only station which has "openly violated the rules and regulations of the Commission by carrying its case into this court before exhausting all other resources before the Commission. The station, he said, has "refused to play ball" with the Commission.

WGY made two attempts to get a hearing before the Commission, but the petitions were ruled out by the Board as being informal.

AC RECEIVERS IN LEAD 4-to-1, TRADE REPORTS

Washington

An increase in number of sales of AC sets during the months of July, August and September is indicated in reports by radio dealers to the Department of Commerce. A total of 6,766 dealers replied to questionnaires sent out by the Department, an increase in the number answering as compared with the preceding quarter the Department stated. This number of dealers represented only 21.4 per cent of all possible dealers in the country.

Text of Statement

The full text of the Department's statement follows:

That 6,766 radio dealers in the United States did \$20,503,666 worth of business, or approximately \$3,030 apiece, during the third quarter of this year, appears to be indicated by a study just made of replies to questionnaires sent out by the Electrical Equipment Division.

"This survey of stocks in the hands of radio dealers, and of the volume of business done by them during the three-month period, is made at the end of each quarter by the Commerce Department, with the cooperation of the Radio Division of the National Electrical Manufacturers' Association, to provide the radio industry in the United States with these statistics.

"The 6,766 dealers to reply to the Commerce Department's queries on this occasion represented 21.4 per cent of the 31,573 queried, or an increase of 3.6 per cent in those answering as compared with the preceding quarter when 5,737 out of 32,216 canvassed, or 17.8 per cent, replied.

"According to these returned questionnaires, these 6,766 dealers sold 23,599 battery sets, and almost 100,000 AC sets during the months of July, August and September. Of battery sets in the hands of these 6,766 dealers on October 1 there were 32,224, and of AC (electric) sets, 58,262, as compared with 28,311 and 24,566, respectively, in the possession of 5,737 dealers on July 1.

AC Stock Higher

"On October 1, these returned questionnaires also show, there were on hand with these dealers 53,180 loudspeakers of the magnetic type and 14,085 of the dynamic type, as compared with 39,675, and 2,483, respectively, in the hands of 5,737 dealers on July 1.

"The number of tubes (receiving) of the AC type in dealers' hands October 1, was 295,448, or more than double the 122,722 on hand July 1. Other questions replied to pertained to batteries, socket power unit, and rectifying tubes on hand."

\$10,000 Pay Proposed for Board's Counsel

Washington

Senator Dill of the State of Washington said he will introduce a bill fixing the salary of general counsel of the Federal Radio Commission at \$10,000 a year.

Louis G. Caldwell, who resigned as general counsel, received \$6,600. The original plan was to pay him \$7,500, but the Government's personnel division fixed the lower amount.

Quality Impossible from Old Receivers

By ORESTES H. CALDWELL
Federal Radio Commissioner

The listening public can itself help improve its own nightly reception by providing itself with adequate and modern receiving sets.

Our broadcasters have spent thousands of dollars to re-equip their stations to transmit music of irreproachable tonal excellence. These clean, perfect, well-rounded tone values are in the ether waves which pervade every home. But whether that home circle actually receives that music in its full beauty and clarity will depend upon the kind of a receiving set that is used.

Altogether too many of our homes still have receiving sets and speakers bought in 1924 or 1925. Such homes are not listening to 1928 radio. What they are hearing without knowing any better is 1924 or 1926 radio or whatever date their sets were built.

SHORT WAVES HELP FIREBOATS

Washington.

The radio service employed by the Boston fire department in its harbor patrol has proved indispensable, the Fire Commissioner of Boston, Eugene C. Hultman, told the Federal Radio Commission in connection with the application of the department for permission to increase the power of one of the stations from 7½ to 50 watts.

Explaining that the three fire boats are equipped with short wave radio equipment, with which they keep in communication with the shore station which gives instructions, Commissioner Hultman declared that the service is "seriously handicapped" because of lack of sufficient power at the shore station. The functions of this service, he declared, is "distinctly for the protection of life and property."

The Boston fire department has had its license for the radio telephone circuit since March, 1924, George L. Fickett, superintendent of fire alarms, told the Commission. The wavelength of 119 meters (2,500 kilocycles) was allocated by the Department of Commerce, and, while it is acceptable, the fire department would like to have a wavelength upon which less interference exists, he said.

Lieut. Commander Tunis A. M. Craven, technical advisor to the Commission, declared that the channel at present used by the department is in the band proposed for aircraft communication, and that, in his opinion, the stations should be shifted to 1,600 kilocycles, a part of the band to be set aside for local marine work. "There would be no chance of aircraft interference," he said, "and this channel will serve the purposes of the fire department even better than at present."

FINANCIAL SERVICE PETITIONS

Washington.

Robert Shields, on behalf of F. X. Eberle of Los Angeles, asked the Federal Radio Commission for a short wave construction permit for sending out a financial service. He asked for 50 watts power and a channel assignment between 2,000 and 3,300 kilocycles.

LEAGUE SEEKS TO REACH U. S. ON SHORT WAVE

Geneva, Switzerland.

The League of Nations has reported on its short wave tests, conducted in May and June, for determining the possibility of communicating with countries outside Europe. Dutch station PTT was used, at Kootwijk, and the League's call was PCLL. The wave length was 18.4 meters. The League announced:

"Ninety-two reports were received at Geneva. These came from the following districts:

- "The European continent and the British Isles..... 7 reports
 - "The Mediterranean Basin, Northern Africa, Asia Minor and Arabia.....11 reports
 - "South Africa, East Africa and the Southern Indian Ocean16 reports
 - "British India 9 reports
 - "The Dutch Indies.....32 reports
 - "Japan and Annam..... 2 reports
 - "Australia and New Zealand... 2 reports
 - "United States and Canada...10 reports
 - "Latin America..... 3 reports
- "The quality of reception can be classified as follows:
- "In 7 cases, **bad**
 - "In 18 cases, **fair**
 - "In 29 cases, **good**
 - "In 38 cases, **excellent**

"In view of the generally favorable nature of these results and with the purpose of investigating further the conditions affecting the quality of radio reception in the different regions, the Secretariat has decided to continue its experiments.

"For these new trials no general broadcasting will be attempted, but the attempt will be made to broadcast to certain specified regions under conditions which seem most favorable for each of those regions. In this way an attempt will be made to reach especially the American continent (North and South), Japan, Australia and New Zealand."

Damrosch Lessons Arouse Big Interest

After an inspection trip to the South and Southwest, Alice Keith, director of the Division of Education, Radio Corporation of America, expressed delight with the response to Walter Damrosch's music lessons broadcast over WJZ's network by the R.C.A. She spent three weeks in Missouri, Texas and Louisiana. She said:

"The response and interest shown in the concerts by Dr. Damrosch were beyond my fondest hope. In Dallas all but two schools out of eighty-six were equipped for reception, and in New Orleans, I found six schools equipped with centralized radio installations. Kansas City, however, had the most advantageous system under which which the children could listen in their own classrooms under the best conditions over individual loud speakers.

"The biggest job is to get schools to become equipped in the proper manner, that is, so children can listen in small groups, hearing the proper part of the program. Too many cases were found where small children were listening to programs meant for the older students, and vice versa, or under disturbing conditions."

WHITE WANTS BOARD TO STAY ANOTHER YEAR

By Wallace H. White, Jr.

Representative from Maine

I have introduced in the House a resolution extending for about a year the original power and authority vested in the Federal Radio Commission by the Act of 1927.

I oppose making this Commission a permanent body. At present the Interstate Commerce Commission has a definite jurisdiction over telephones, telegraphs, cables and radio; the State Department by the Cable Landing License Act was also given a measure of jurisdiction over cables; the Department of Commerce has an authority over radio; and we have the Radio Commission with the powers conferred by the 1927 Act.

Cites Distributed Authority

In addition to these four Governmental agencies, several of the Departments of the Government have their systems of wire and radio communication.

It seems to me that we must ultimately establish a Communications Service in which shall be centered the scattered and conflicting power and authority now exercised by these different Governmental agencies over privately owned facilities and upon which we must place responsibility, so far as the Government is responsible, in the premises.

I think a temporary Radio Commission can hereafter be abolished or merged more easily in the single unit of Government which I have in mind than a Commission designated and regarded as permanent.

Benefit of Experience

The Commission has nearly two years of accumulated knowledge and experience in dealing with our broadcasting problem. The people are entitled to the benefits of this knowledge and experience.

The present organization should be better qualified to make necessary readjustments in the set-up which has been worked out by it than any person or other group who might now be charged with the regulation of broadcasting. This does not mean that I approve altogether the work of the Commission.

In particular I feel, as I did a year ago, that a very serious mistake was made when it relicensed all outstanding stations.

Caused Difficulties

It continued by this action a situation which is responsible for most of the difficulties now confronting us and these difficulties will persist in substantial degree until there are developments in the art not immediately in prospect. Notwithstanding what I conceive to be its past mistakes, I believe the Commission with its trained staff, more likely to improve conditions immediately than a new authority.

HEARST USES WBBM

Chicago.

WBBM has become affiliated with the Chicago "Evening American," one of the Hearst newspapers. Future programs will be broadcast co-operatively.

Public Reaction Pleases Commission

The reaction from the public, as felt directly by the Federal Radio Commission, on the working of the reallocation, was set forth in the following statement by the Commission:

Following the broadcasting reallocation of November 11th, when the wavelengths and dial positions of nearly all the 600 stations were changed (in order to comply with the redistribution of wavelengths according to population by States) it was naturally expected that a large number of complaints and protests would flow into the Federal Radio Commission's offices at Washington.

These complaints have materialized, but analysis of the letters reaching the Commission shows that the complaints have been chiefly centered about five or six specific local cases of station time-sharing or interference, while comparatively little general protest or complaint about the allocation has developed in contrast with what might have been expected from a radio audience numbering 40,000,000 of people.

On the other hand, it has been supposed that little or no favorable or approving comment would find its way into the Commission's mail, on the theory that pleased listeners would not take the trouble to write. Here again a surprise faced those predicting the human reaction, for several hundred telegrams and letters, already received from all parts of the country, tell eloquently of the writers' appreciation of the relief afforded to radio listeners, and particularly to those whose locations away from the large cities force them to depend upon distant stations for their regular programs.

R. C. A. CHANGES ITS PERSONNEL

Personnel changes were made by the Radio Corporation of America.

David Sarnoff, who was vice-president and general manager, was promoted to a new position of executive vice-president. Joseph L. Ray was made vice-president and general sales manager. Dr. Alfred N. Goldsmith became vice-president and remains chief broadcast engineer, while Col. Manton Davis, counsel, was made vice-president and general attorney.

Elmer E. Bucher was made executive vice-president of Photophone, an R.C.A. "talking movie" subsidiary.

The R.C.A. will form a separate company to handle the communications business (radio messages). It is said that sale of this end of the business to Western Union or Postal is contemplated, if legal obstructions can be removed.

Schilling Establishes Counsellor Service

Walter A. Schilling, for six years managing editor of "The Radio Dealer," has resigned to establish his own offices at 10 East Thirty-ninth Street, New York City, where he will serve as public relations counsellor.

On technical work, Mr. Schilling will collaborate with Austin C. Lescarbourea, former managing editor of "Scientific American," now head of a technical advertising and publicity organization.

EQUALIZATION A LEMON, SAYS O. H. CALDWELL

The equalization law, under which the reallocation was made compulsory, was called "a lemon" by Radio Commissioner Grestes H. Caldwell, speaking to the Broadway Association at a recent luncheon in New York City.

Blessing in Disguise

He said:

"While the equalization clause will, as predicted, bring much unnecessary hardship to certain sections of the country and inflict time reductions, while in sections like the Pacific Coast wavelengths stand idle, still its enforcement has presented the occasion for a general clean-up of the radio broadcasting situation by the application of scientific principles.

"So, it may be argued, it has proved a blessing in disguise. The reallocation of November 11th faithfully carried out this redistribution. All parts of the nation now have their proportions of the radio total based on population, in strict compliance with the mandate of Congress.

"Each state and section, moreover, also has its apportionate share of the various positions on the dial.

"The resulting reduction of local radio service in certain parts of the Atlantic Seaboard will cause some inconvenience, as compared with the former excess of broadcasting enjoyed by Eastern listeners.

Expects Self-Immolation

"But I believe that citizens thus deprived will willingly accept this equalization and redistribution, knowing that the facilities thus lost by them are, by act of Congress, being made available to other American citizens in those other parts of the country which formerly had little or no radio service.

"The equalization clause is a lemon that the Radio Commission has undertaken to turn into lemonade."

Ship Hears Returns Across 3,300 Miles

John T. Hockaday, of 296 Knox Avenue, Grantwood, N. J., chief steward of the S. S. Vandyck, has written to Air King Products Co., 216 Wallabout street, Brooklyn, N. Y., telling how the Presidential election returns were received through WGY aboard the ship 3,300 miles southeast of New York. The adapter was plugged into the detector socket of the ship's broadcast receiver. Mr. Hockaday wrote:

"The adapter was used in conjunction with a six-tube set, and the reception was so clear that we kept a tabulated record of the figures as they came in, as broadcast from WGY. The ship was about 3,300 miles southeast of New York and we got splendid volume from 7:15 p. m. local time until the final result.

"I think this is a remarkable performance, considering the conditions on board ship, that is, the many high power motors on the ventilator system and the fact that we got the best results without any Jacob Lieberman, of the Air-King Products Co., displayed a photograph of the passengers taken while they were enjoying the reception.

STATION LIST IS CHANGED IN 20 INSTANCES

Washington.

Twenty changes and additions to the official lists of broadcasting stations published after the reallocation of November 11th, have been made public by the Federal Radio Commission.

The full text of the statement follows:

The following is a list of changes and additions to the call letter list and the kilocycle list dated November 15th, 1928, due to typographical errors, results of hearings, etc.

WBAK.—Pennsylvania State Police, Harrisburg, Pa., transferred to 1,430 kilocycles, 500 watts, sharing **WMBS-WBAK**½ and **WCAH**½.

WDGY.—Dr. Geo. W. Young, Minneapolis, Minn., transferred to 1,390 kilocycles, sharing with **WHDI** temporary.

WFBR.—Baltimore Radio Show, Inc., transferred to 1,270 kilocycles temporary.

WFCI.—Shartenberg & Robinson, Pawtucket, R. I., call letter changed to **WPAW**.

WHB.—Sweeney Auto School Co., Kansas City, Mo., 500 and 1,000 watts LS.

WHDF.—Chas. C. MacLeod, Calumet, Mich., 1,370 kilocycles, 100 watts.

WHOH.—Matheson Radio Co., Inc., Gloucester, Mass., 830 kilocycles, 1 KW daytime.

WHDI.—Dunwoody Industrial Institute, Minneapolis, Minn., transferred to 1,390 kilocycles sharing with **WDGY** temporarily.

WHT.—Radiophone Broadcasting Corporation, Dearfield, Ill., add to call letter list, omitted.

WIL.—Missouri Broadcasting Corporation, St. Louis, Mo., transferred to 1,420 kilocycles, 100 and 250 watts, LS.

WNEW.—Virginia Broadcasting Company, Inc., Newport News, Va., call letter changed to **WGH**.

WRK.—S. W. Doron & John C. Slade, Hamilton, Ohio, to be added to call letter list, omitted.

KFOA.—Rhodes Department Store, Seattle, Wash., call letter changed to **KOL**.

KFWO.—Lawrence Mott, Avalon, California, deleted (effective January 1, 1929.)

KGIW.—Trinidad Creamery Company, Inc., Trinidad, Colo., 1,420 kilocycles, 100 watts.

KGKX.—C. E. Twiss, Sandpoint, Idaho, 1,420 kilocycles, 15 watts.

KMBC-KLDS.—Midland Broadcasting Company and the Reorganized Church of Jesus Christ of Latter Day Saints, reduced to 500 night and 2,500 watts LS.

KOOS.—H. H. Hanseth, Marshfield, Oreg., 1,370 kilocycles, 50 watts.

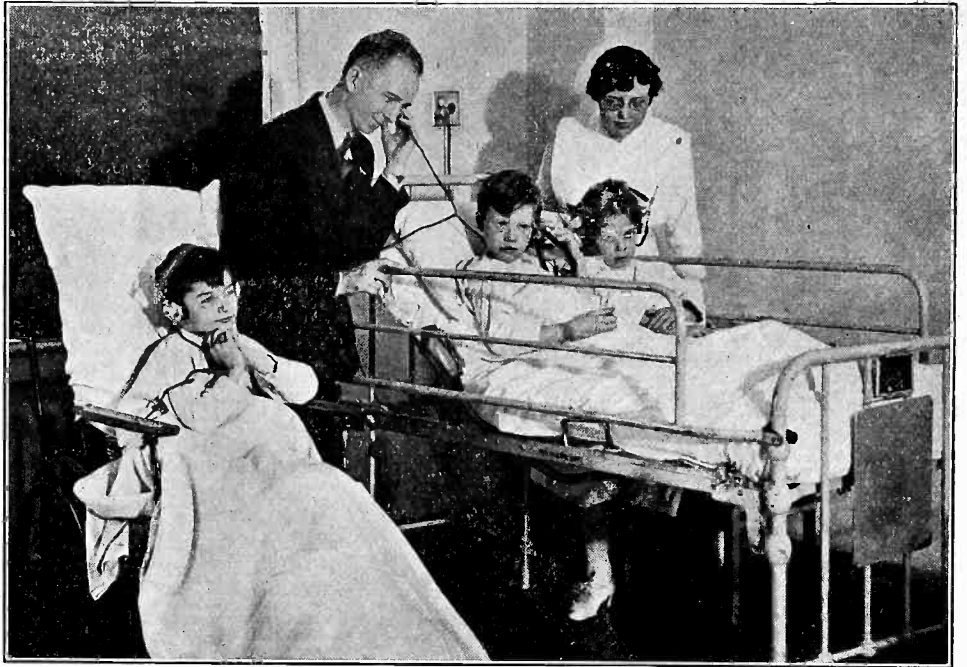
KTAB.—Associated Broadcasters, Oakland, Calif., transferred to 550 kilocycles, 500 watts.

KWK.—Greater St. Louis Broadcasting Corporation, St. Louis, Mo., changed to full time sharing with **WIL**.

SOMETHING TO THINK ABOUT

A MERCANTILE concern that broadcasts to create good will and sales, wants to produce radio playlets and offers \$25 for each accepted manuscript. Writers of sketches or playlets for vaudeville, get from two to four times that amount per week for the use of each accepted, offering—with a chance of the royalties for each one running into four figures. Let the air advertiser who made the offer mentioned, think it over for a couple of minutes.

A HURRIED RETURN TO HEALTH

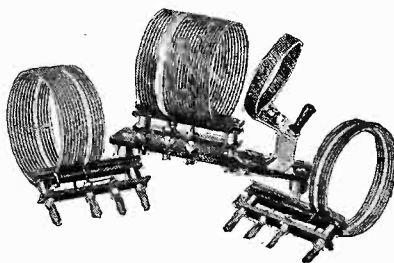


(Underwood & Underwood)

THE HEALING INFLUENCE OF PSYCHOLOGICAL REACTION IS WELL APPRECIATED BY HOSPITALS, WHERE RADIO RECEPTION IS GREATLY ENJOYED BY CONVALESCENTS THUS SPEEDED TO RECOVERY. CLARENCE D. CHAMBERLIN, AVIATOR, IS SHOWN VISITING A CHILDREN'S WARD IN KNICKERBOCKER HOSPITAL, NEW YORK CITY.

Hammarlund Precision In Short Wave Coils

The greatest success with short wave receivers is attained with coils that give the lowest resistance at very high frequencies. An example of such coils are the Hammarlund Short-Wave Plug-in Coils, built around special self-supporting material developed by this concern. The coils have set a new standard for short-wave reception. These coils are exactly wound with a precise, definite space between turns, supported by a thin film of strong, efficient dielectric. The wire is so firmly anchored to the dielectric that short circuits are impossible.



Extreme sensitivity and sharp tuning are inherent qualities of these coils, due to the low distributed capacity and resistance. The coil mounts, supports and plug-in terminals are widely spaced, thus further minimizing losses and serving to keep down stray circuit capacity which would otherwise limit the frequency range of each coil. The standard **SWT-3** kit covers the 15-107 meter range with a .00014 mfd. condenser. There is ample overlap and tuning is very smooth over the whole wavelength range thus meeting present and future conditions. **SWT-20** Coil may be had for the 20 meter band, 15-30 meters; **SWT-40** Coil for 40 meter band, 27-59 meters; **SWT-80** Coil for 80 meter band, 52-107 meters and **SWT-120** Coil for 120 meter band, 100-215 meters. Full information on these and other Hammarlund precision parts may be had from the Hammarlund Manufacturing Co., Inc., 424 West 33rd Street, New York City. Mention **RADIO WORLD**.—J. H. C.

Old Speaker Useful for Balancing Effect

Thousands of fans the country over are buying new dynamic speakers, or building up-to-date magnetic speakers with baffles or airplane type speakers. The old speakers are then left to gather dust in the cellar or attic or thrown into the ashcan. These speakers, no matter what the type, can be put to work to good advantage, and, may be used to improve tone quality. Match both speakers so that one with high note accentuation blends with the other which is bringing out the low notes resoundingly. This can readily be done by means of a duplex Clarostat, a double variable resistance, each resistance of which can be set separately and left at the permanent value which accomplishes the perfect blending. Both speakers should be connected in series through the duplex clarostat across the output of the amplifier or set.—J. H. C.

CIVIL SERVICE

The United States Civil Service Commission has announced open competitive examinations for the positions of Associate Physicist and Assistant Physicist. The applications must be on file with the Commission in Washington, D. C., not later than January 9th, 1929. Applicants will not be required to report at any place for the examination, but will be rated on their education and experience and on publications, reports or theses to be filed by the applicant.

The optional subjects are (1) heat, (2) electricity, (3) mechanics, (4) optics, (5) radio, (6) physical metallurgy, (7) thermodynamics and aerodynamics, and (8) any specialized work in the field of physics not included in any of the above.

The entrance salary for the Associate Physicist is \$3,200 a year and that for the Assistant Physicist \$2,600. Full information may be obtained by writing to the United States Civil Service Commission, Washington, D. C., or to the secretary of the United States Civil Service Board of Examiners at the post office or customhouse in any city.

BOARD TO OUST STATIONS THAT VIOLATE RULES

Washington.

The Federal Radio Commission has warned all broadcasting stations to obey the rules and regulations, for if they do not, their licenses will not be renewed. The following letter was sent to all stations:

"The Federal Radio Commission will within the next few days have before it the applications of all existing broadcasting stations seeking to renew their licenses. It will immediately proceed to examine these applications and determine whether the granting thereof will serve public interest, convenience or necessity.

"In the meantime evidence is reaching the Commission from all parts of the country that a number of broadcasting stations are regularly and persistently violating rules and regulations of the commission.

"The violations are, in most cases, of General Order 7, fixing a minimum of one-half kilocycle as the extreme deviation from authorized frequency which will be permitted; of General Order 8, requiring stations to announce their call letters at least every fifteen minutes; and of General Order 52, having to do with the announcements to be made in connection with the broadcasting of phonograph records and other mechanical reproductions.

"There are also a few instances of reported violations of Section 29 of the Radio Act of 1927, prohibiting the utterance of any obscene, indecent or profane language, and of other provisions of the act. Violations of any Commission order reported to the Commission by Government employes or by numbers of listeners making sworn statements will be the basis for calling a public hearing at Washington. Until such hearing has been held and a decision has been rendered, renewal of license will not be issued."

The Commission has come to believe that some stations are willful violators, hence mock the authority of the Commission.

Boys Advanced Radio, He Says

Buffalo, N. Y.—How the American boy, rather than the adult and scientific engineer, developed radio was detailed here to a radio trade audience by Judge John W. Van Allen of Buffalo, general counsel of the Radio Manufacturers' Association.

That the American boy, through his interest and experiments in radio, was a leading factor in radio progress was asserted by Judge Van Allen.

"The young man who discovered this invention was but nineteen years of age," said Judge Van Allen, "and those who developed it were the small boys in knee breeches.

"Youth has indeed shown us the way. It was these three or four million boys who became obsessed with the idea of developing this strange new vehicle of human contact, who showed us the way, not thinking of a business for themselves, but as an outlet for their energy, their curiosity and their fancy. Unconsciously they promoted and developed the greatest means of communication that the world has ever known.

"Radio is something added to that which the book, the telephone, the telegraph, the printing press, the phonograph, the typewriter and the camera did before. These devices for the transmission of intelligence through the air medium are most remarkable.

CIGARETTE CO. ATTACKED FOR FALSE ADVICE

Washington.

Joseph Burger, president of the United Restaurant Owners' Association, New York City, has protested to the Federal Radio Commission against the broadcasting of certain companies advertising cigarettes. He said:

"If the Federal Radio Commission feels that the people of the United States, in whom the dominion of the air is vested, have no protection under the Radio Act of 1927 from such outrageous propaganda broadcast through the air by stations licensed by the United States Government, the United Restaurant Owners' Association is ready to take steps to secure an interpretation of this act by the highest courts of our land."

The objection is lodged against broadcast advertising, interspersed in musical programs, to the effect that smoking cigarettes is good for the health and a fitting substitute for wholesome food. The complainants state such assertions are false and pernicious.

Not only do the restaurant owners want the Board to stop this type of advertising, but it also seeks to discourage other media from permitting it.

Judge to Arbitrate Dispute in Brooklyn

Supreme Court Justice Stephen Callaghan has been chosen mediator by the Brooklyn stations which had been unable to agree on the division of time. In a letter to Justice Callaghan, Federal Radio Commissioner Caldwell said:

"Since these stations all share time on the same wavelength, the problem involves no radio factors as such, but demands only such a fair assignment of operating time among

the four stations that the 'public interest, convenience or necessity' of the Brooklyn listening audience will best be served.

"As I see it, this means that the best and most popular features of each station shall be preserved and conserved, so far as possible—the whole being combined so that a diversified and valuable program will be presented to Brooklyn and surrounding areas which these stations undertake to serve."

BUILD A 36-INCH CONE—LOWEST COST FOR FINEST TONE!



NEW POWERTONE UNIT
with 5-ft. cord
Designed Front Sheet
Plain Rear Sheet
Radio Cement
Mounting Bracket
Apex
Chuck
Nut
Tri-Foot Pedestal
Instruction Sheet

ALL FOR ONLY

\$6.00

Note: If 24" kit is desired, order Cat. No. 24; same price.

Cat. No. 36

REMARKABLE GUARANTY!

This 36" Cone Speaker Kit is sent complete, as listed, carefully packed. Order one sent C. O. D.

SEND NO MONEY!

Build the speaker. If not overjoyed at results, return the built-up speaker in five days and get ALL your money back!

GUARANTY RADIO GOODS CO.
145 WEST 45TH STREET
N. Y. City Just East of Broadway

\$6.00 a Year. (52 Issues) In Canada \$6.50 Foreign Subscriptions \$7.00

This Christmas Make Radio World for 52 Issues Your Gift to Those Friends. We'll Tell Them the Paper Goes With Your Compliments.

RADIO WORLD, 145 West 45th St., N. Y. C.

Enclosed find \$..... Please send RADIO WORLD for one year (52 issues) to each of the following addresses:

Name
Street
TownState

Name
Street
TownState

Name
Street
TownState

MY NAME
STREET
CITYSTATE

The Condenser Speaker

By Capt. Peter

Contributing

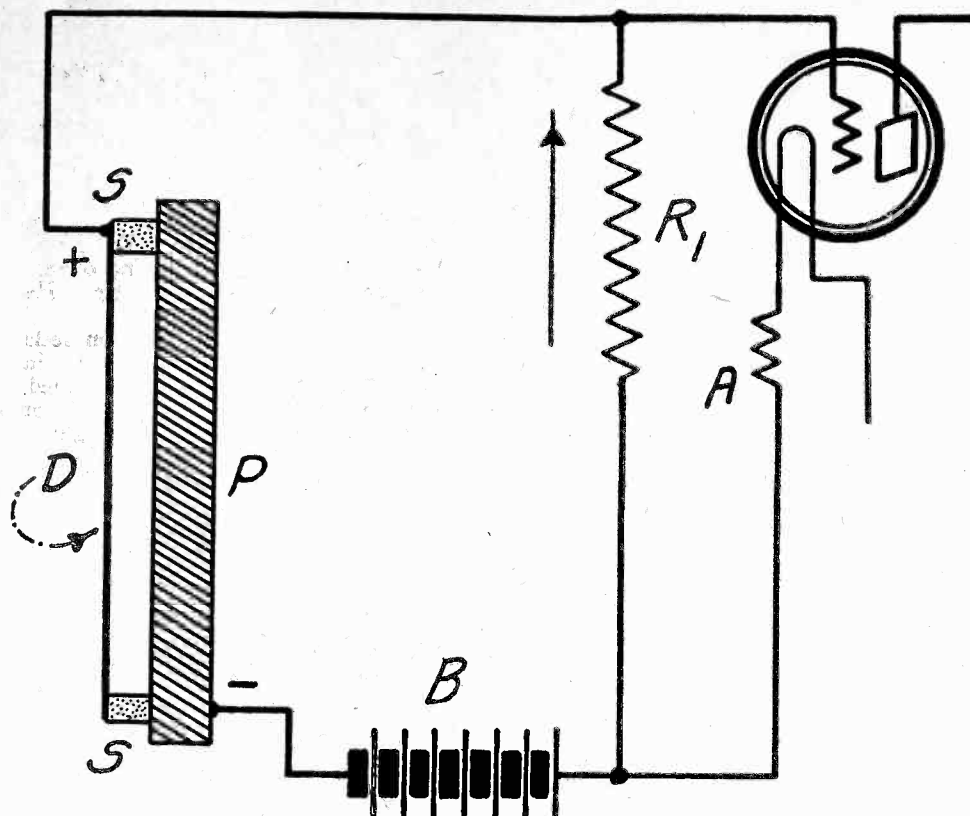


FIG. 1

THIS ILLUSTRATES THE PRINCIPLE OF THE CONDENSER MICROPHONE. A FIXED PLATE P AND A MOVING PLATE D FORM THE PLATES OF A SMALL CONDENSER.

THE condenser microphone is rapidly supplanting all other types of microphone in radio broadcasting. The reasons are that this type is capable of a greater fidelity and is subject to less inherent noise than other types. Part of the great improvement in broadcasting, phonograph music and other forms of sound reproduction is due to the use of the condenser microphone.

A condenser microphone is relatively very insensitive. For that reason it has not been used much. But the development of high quality, high gain amplifiers has nullified the disadvantage of insensitivity and at the same time has retained the many advantages of the device.

High Notes "Up"

The principal advantage of the condenser microphone is fidelity of a high order. It responds to audio sounds of all pitches in almost the same degree. The inequalities that it does present are advantageous rather than detrimental. For example, it responds a little better to the very low audible sounds than it does to sounds in the middle register. Thus it compensates in a measure for the deficiencies of nearly all other devices, which are "down" on the low notes. Thus also it compensates for the low note suppression caused by series condensers, shunt choke coils, coupling impedances, audio transformers and loudspeakers.

A highly selective tuner is the only other device which operates in the same way. This, too, accentuates the low notes.

The condenser microphone has another peculiarity. It is "up" on the high audio notes relative to the response on the middle notes. The effect is due to a number of causes, one of which is the reflection of the short sound waves from the condenser diaphragm.

When a sound wave is reflected from a surface the sound pressure is just twice

as great as when the wave is not reflected. Part of the sound wave is reflected at any frequency but much more is reflected when the length of the wave is about the same as the diameter of the microphone. Hence the microphone responds better to high frequencies, or short sound waves, than to the others.

Some may regard the greater response at the high notes as undesirable, judging from the precautions they take to suppress such notes. However, we are not discussing individual preferences in the matter but fidelity from an engineering point of view, that is equal overall response over the entire audio scale.

The greater response of the condenser microphone at the higher notes than at the notes in the middle register compensates for many deficiencies in an amplifier and tuner. For example, it partly overcomes the high note suppression in a resistance coupled amplifier caused by the high effective input capacity of tubes in such circuits. It also tends to overcome the suppression of the high notes due to sideband-cutting by over-selective tuners.

It would also tend to overcome the suppression of the high notes in sound reproduced from films due to the use of too wide scanning slit in recording or playing.

Inequalities Small

But the inequalities in response at various frequencies are small. They will not make up totally for the deficiencies in the various devices. The condenser microphone is essentially a "straight line" device, and its main value lies in that fact.

The principle of operation of the condenser microphone is illustrated in Fig. 1. D is a light metallic diaphragm tightly stretched. P is a heavy metal plate, the frame of the device. Usually the heavy plate is perforated so that air may pass freely through it. P and D constitute the

plates of the condenser, which is charged to a high potential by a battery B. Sound waves, indicated by the arcs of circles, impinge on the diaphragm, causing this to vibrate. The movement changes the capacity of the condenser in proportion to the movement of the diaphragm.

When the plates approach each other the capacity increases and allows a current to flow into the condenser through the resistor R1. When the plates move apart the capacity decreases, forcing current to flow out through the resistor R1. Thus the movement of the diaphragm causes an alternating current to flow through R1.

The intensity of the alternating current not only depends on the amplitude of the diaphragm but also on the voltage of the battery B, that is, on the voltage between the plates. The current is proportional to the product of the amplitude of the diaphragm and the polarizing voltage. Hence the sensitivity of the condenser microphone may be increased by increasing the steady voltage across the plates. The sensitivity is also greater the smaller the distance between the plates. But the response will not be true unless the distance between the plates is much greater than amplitude of the swing of the diaphragm.

Good Insulation Required

The insulation of the condenser must be of the highest type if the response is to be equal for all frequencies, and the resistance R1 must have a very high value for the same reason. In good transmitter microphones R1 is 50 megohms. Since this resistance is in parallel with the leakage through the insulation it is clear that the insulation resistance must be very high in order not to cut down the effective resistance R1 in series with the condenser.

When the microphone is coupled directly to the amplifier tube the grid to filament resistance is also in shunt with R1. This further reduces the effective value of R1. However, if the grid is always negative the grid to filament resistance is very large and does not reduce R1 much. The grid is kept negative either by a battery or by the drop in A.

Since the leakage resistance is in shunt with R1, a socket with high insulation must be used, or the tube must be used without any socket at all. Further, the leads to the tube must be short. For that reason the first amplifier is built into the stand containing the microphone.

Condenser Speaker

Any device that is suitable for a microphone is reversible in its action. That is, it can be used as a sound reproducer. The microphone converts sound energy into electric energy. The reproducer converts electric energy into sound energy.

Many reproducers working on the principle of the condenser microphone have been built successfully. Earphone of this type are of about the same size as the microphone. Loudspeakers are greatly enlarged replicas of the earphone unit.

When two plates of a condenser are oppositely charged they are attracted by each other with a force which is proportional to the square of the voltage across the plates. If the two plates are charged with the same potential they repel each other.

Suppose a varying voltage is added to the steady voltage across the plates, as-

Knocks for Admittance

V. O'Rourke

ditor

suming that the two plates are charged oppositely. The force of attraction then will vary. If one of the plates is fixed in position and the other is free to move, the varying voltage will cause the free plate to move toward and away from the fixed plate.

Let the steady potential across the plates be V volts and the varying potential v volts. Then the total pull at any instant is $K(V+v)^2$, since the pull is proportional to the square of the voltage. This expression is equal to $K(V^2+2Vv+v^2)$. The first term KV^2 represents a steady force and this results in a permanent displacement of the movable plate toward the fixed plate. The last term Kv^2 is a variable force which has a frequency twice that of the frequency of the varying voltage. This represents second harmonic distortion. The middle term $2KVv$ is a varying force which is proportional to the steady voltage as well as to the varying voltage. The frequency of this force is the same as that of the voltage v . This term represents the useful force and results in a movement of the free plate of the desired frequency.

Analogous Case

It will be observed that the expression for the total force on the free plate has the same form as the expression for the magnetic force on the diaphragm in a magnetic speaker. In that case the steady magnetic flux gives rise to the permanent displacement and the varying signal flux gives rise to the harmonic distortion. The combined effect of the steady and the varying flux gives rise to the desired movement of the diaphragm. The two cases are exactly parallel.

The magnitude of the steady polarizing voltage V is important from two points of view. Since the useful force $2KVv$ can be increased by increasing either V or v , and as V can be increased to any desired value, the speaker sensitivity can be increased by increasing the steady potential across the plates. Since the distortion term Kv^2 does not contain V , the relative intensity of the harmonic distortion is decreased by increasing V . Thus by making V large compared to the signal voltage v the sensitivity is increased and the distortion is decreased.

When magnetic and electromagnetic units are used to drive the diaphragm in a loudspeaker the force is applied at a point, or over a small area usually near the center of the diaphragm. Thus it is necessary to depend on the elastic properties of the diaphragm material to distribute the motion over the entire diaphragm.

Force Distributed

In the condenser speaker the force is almost uniformly distributed over the surface of the entire diaphragm because the electrification is uniformly distributed over the plates. This is a distinct advantage in that the movement away from the center does not depend on the elastic properties of the material. Better quality can be expected.

But the condenser speaker has the disadvantage that it is less sensitive than the magnetic speaker for any moderately high polarizing voltages. While it will work on voltages as low as 200 volts it will work very much better and be much more sensitive with voltages of 3,000 volts.

The question naturally arises as to

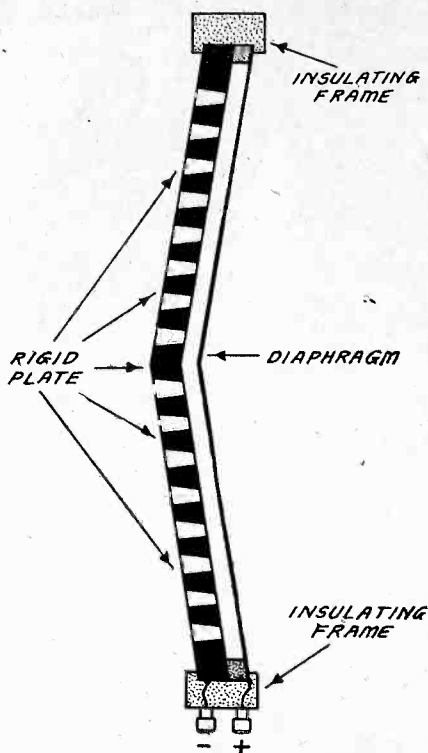


FIG. 2

THE SECTION OF A CONDENSER SPEAKER IN WHICH THE PLATES ARE CONICAL. THE WHITE AREAS IN THE RIGID PLATE REPRESENT PERFORATIONS TO ALLOW THE SOUND TO COME OUT.

where to get the high voltages. Batteries are out of the question. B battery eliminators used for power amplifiers do not give more than about 600 volts maximum. But as soon as the condenser speaker is put on the market there will be high voltage sources as well. There is no problem in making a rectifier-filter arrangement which will give voltages as high as 10,000 volts, if such voltages should be required.

As soon as high voltages are mentioned the question of danger arises. Voltages of only about 3,000 volts are used on the electric chair. Will not the loudspeaker operating on the same voltage be extremely dangerous? Not necessarily. The speaker need not be built so that the high voltage conductors are exposed.

Voltage alone is not dangerous. There

must be much capacity back of it to make it dangerous, or there must be a possibility of much current when contact is made.

We might illustrate the difference between much current and little current. Suppose an airplane 3,000 feet up drops overboard a bird shot and a cannonball. At the beginning of the fall the two are at the same potential. If the bird shot should hit a man below, he might feel an unpleasant sensation. If the cannonball should hit him the unpleasantness would be greatly accentuated.

Condenser Speaker Coming

Great interest is being shown in the possibilities of the condenser speaker at this time, and it seems that the next development in radio will be this type of speaker. As early as July 2nd, 1927 RADIO WORLD explained the principle of the condenser speaker, and in the August 27th issue published an account of the condenser speaker developed by Eugen Reisz of Germany.

Recently the perfection of such a speaker by another German, Dr. Vogt, has been reported. This speaker appears to be about the same as that of Dr. Reisz, except that it is push-pull in action. In this respect it is analogous to the balanced armature type of magnetic speaker. The balanced speaker of either type has the advantage of no permanent displacement of the diaphragm and no second order harmonic distortion. That is, the first and the third terms in the expression for the total pull are eliminated.

Which Will Win?

Whether the condenser type speaker will win out over the magnetic and the electrodynamic depends on whether it can be developed so that it will be equally sensitive for reasonable polarizing voltages and so that it will give more faithful reproduction.

This type of speaker has a high input impedance. In this respect it is much unlike the electrodynamic speaker, which has a very low input impedance, and even the magnetic speaker, which has a moderately high impedance. The condenser speaker therefore would require a step-up transformer between the power tube and the speaker instead of a step-down transformer, or else new tubes would have to be developed, if some of the present output tubes cannot be adapted. For example, it is quite possible that a high mu tube of the -40 type could be used as the last tube in the radio receiver.

PLUG AND CABLE for any SHORT WAVE ADAPTER

Handiest thing for ANY short-wave adapter. Put detector tube of your present set in

socket of any short-wave adapter you build, put plug in detector socket of your broadcast receiver. Cable, 34". Leads identified both by color scheme and tags. 5-prong plug and 5-lead cable for AC short wave adapter. May be used as 5-lead battery cable plug with UY socket. (Cat. No. 21AC) \$1.50. 4-prong extra plug only. necessary addition to adapter for DC short-wave adapter (Cat. No. 21DC) \$0.50. Cat. No. 21AC and 21DC ordered together \$1.75.

The diagram shows a circular cable with five leads extending from it. Each lead is connected to a specific terminal on a plug. The leads are color-coded: PURPLE (A+), BROWN (A-), BLACK (C), GREEN (P), and YELLOW (G). The plug has five pins. Below the main diagram, there are two smaller diagrams showing different plug configurations: one with four pins and one with five pins.

GUARANTY RADIO GOODS CO.
145 WEST 45TH STREET
New York City Just East of Broadway

A Precise Method

By J.

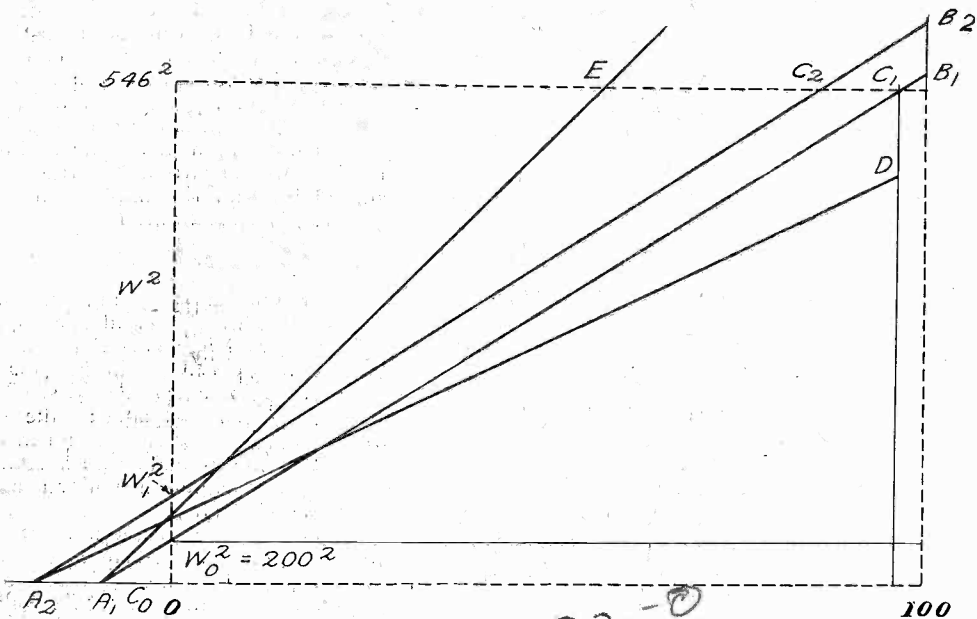


FIG. 1 22-0

A DIAGRAM ILLUSTRATING A METHOD FOR ADJUSTING THE TUNED CIRCUITS SO THAT GANG CONTROL MAY BE USED WITHOUT TRIMMERS. CURVES SHOW THE RELATION BETWEEN WAVELENGTHS SQUARED AND DIAL READINGS.

WHEN two or more tuning condensers are put on one control the tuned circuits must be identical in every respect if the tuning is to be exact and sharp throughout the range of tuning band. But it is very difficult to make two circuits identical and for that reason trimmers are used for taking up unavoidable differences.

There are several reasons for the existence of differences. First, the condensers may not have the same rate of change of capacity. Second, the inductances may not be the same. Third, the zero setting capacities may not be the same. If any one of these conditions is not satisfied the tuned circuits will not tune the same, and trimmers will be necessary.

Condensers Are Alike

Even if the tuning condensers are of the same make and appear to be identical they may not be so in the circuits in which they are used. If the condensers have been made out of parts cut by the same dies and assembled in the same jig under standardized methods, they are usually sufficiently alike to permit gang tuning provided that they are also placed in similar settings.

Variations in the rate of change in the capacity of identical condensers are due to the fact that the surroundings of the movable plates are different. That is, as the plates are moved they come in proximity to various conductors, which changes the capacity, and these conductors may not be the same for all the condensers on the gang, or they may not be arranged the same with respect to the moving plates of all the condensers on the gang. If the various parts are arranged similarly in all the tuned circuits and if no conductors, grounded or otherwise, are closer than two inches at the nearest point, differences arising from this cause will be small, and may be neglected.

Let us assume, then, that the condensers are identical in construction and in setting so that the rate of change of

capacity is the same in all the tuned circuits. There remain two conditions which must be satisfied, namely, the identity of inductance values and of zero setting capacities. To meet these conditions is difficult unless a definite mode of procedure is followed. This involves considerable work but it is worth while as its successful conclusion obviates the need of trimmers.

The theory of the procedure is simple and is based on the formula connecting the wavelength and the capacity and the inductance. This formula is $W^2 = K(C + C_0)$, or in words, the wavelength squared is proportional to the capacity. In the formula, C is the capacity which is varied, C_0 is the zero setting capacity and K is a constant proportional to the inductance.

Those who are familiar with analytical geometry will recognize that this is the equation of a straight line in which the wavelength squared is the dependent variable and C is the independent variable and K the slope. They will also recognize that C_0 is the intercept on the axis of abscissas and $K C_0$ is the intercept on the axis of ordinates. C_0 is the capacity in the tuned circuit when the condenser is set at zero, that is, when C is zero, and $K C_0$ is the square of the shortest wavelength to which the circuit can be tuned.

Graphical Representation

The meaning of this can be made clear by a graphical representation, as shown in Fig. 1. Values of the tuning condensers are laid out along the horizontal and the values of the wavelength squared along the vertical. Now if the condenser used is of the straight line capacity type dial readings may be substituted for capacity. There are 100 divisions on the dial. Of course any other division may be used.

Select a number of broadcast stations the wavelengths of which are accurately known, and which are well and evenly distributed over the dial. Tune in one of them accurately and note the dial reading. On a piece of cross section paper

enter the square of the wavelength against the dial reading. Do the same for the other stations. Use as many stations as can be tuned in. Draw a straight line through the points obtained, or if the points do not fall on a straight line draw a smooth line.

Extend the line until it crosses the horizontal axis at the left and the 546 meter horizontal line at the right. Suppose this is the line A1B1 in Fig. 1. This line crosses the axis of capacity C_0 units to the left of the axis of wavelength squared. Here C_0 is the zero setting capacity, which must be the same for all the tuned circuits on the gang. The line A1B1 crosses the vertical axis at W_0^2 , which is the square of the shortest wave which can be tuned in. If this is less than 2000 all is well, or even if it is exactly 2000

Meaning of Lines

The line A1B1 also crosses the 546 meter line to the left of 100 on the dial. That means that the condenser will cover the range all right.

One such curve, or line, should be prepared for each of the tuned circuits, using the same dial for all. Suppose that two of the other tuned circuits yield the lines A2B2 and A2D. Both of these curves pass through the point A2, indicating that both of these tuned circuits have the same zero setting capacity, which is equivalent to OA2 dial divisions. But both of the curves cross the axis of wavelength squared above the 200 meter point. Therefore neither of these tuned circuits will tune down to 200 meters, and the zero setting capacity must be reduced in some manner.

The line A2B2 crosses the 546 meter line to the left of the 100 mark at the right. Thus this tuned circuit will cover the high end of the range all right but not the low end. The line A2D does not come up to the 546 meter line at 100. Hence the circuit will fall short at both ends.

Significance of Slope

It will be observed that the lines A1B1 and A2B2 are parallel. That means that they have the same slope, which also means that the effective inductances in the two circuits are the same. To make these two circuits identical it is only necessary to make the zero setting capacities the same. This may be done by increasing the zero setting capacity in the circuit represented by A1B1 until A1 falls on A2. But this raises the minimum wavelength above the 200 meter line, which is not practical. The two circuits could also be made alike by reducing the zero setting capacity in the circuit represented by A2B2 until A2 falls on A1. This would be all right, for the line A1B1 covers the tuning range. But it is not always possible to reduce a zero capacity, although it is always possible to increase it.

If a tuning condenser of .0005 mfd. is used the necessity for reducing the zero setting capacity will rarely arise.

The line A2D has a smaller slope than the other two lines. This means that the tuning coil does not have enough inductance. Turns should be added to the coil in this circuit until the line is parallel with the other two lines. Since this line passes through A2, the line A2D will cover

Hum Elimination in Vari

By Herman



A SQUARE BOX RESONATES BADLY, IF OF THE COOPED-UP TYPE, BUT A ROUNDED BOX (ABOVE) IS AN IMPROVEMENT, ESPECIALLY IF THE BACK IS OPEN ACOUSTICALLY.

THE frequency of the alternating current and voltage of the lighting main is such that the power derived from that source has a large audible component. So any installation served by this power source will hum unless the hum is removed or at least reduced to tolerable limits. There may be a little hum under any circumstances, but not enough to be bothersome.

When B eliminators began to replace batteries for plate voltage supply there was considerable complaint about hum, a few years ago, but with the increased use of these devices better filter circuits were designed and soon the B supply was rid of this vice.

Then came extraordinary current drain and voltage amplification at audio frequencies, and more recently at radio frequencies, as well, large fields at both frequencies being set up in the receiver. These fields were easily able at audio frequencies to penetrate the shields, since the shields are effective only at high or radio frequencies.

Magnetic coupling between speaker and the audio amplifier produced increased hum, or microphonic effects were introduced anew, due to acoustical coupling.

The Humming Dynamic

Now dynamic speakers of the AC type, which have a built-in rectifier and filter, introduce a new source of hum, especially under peculiar circumstances that magnify a small hum to disturbing intensity. One of the most productive amplifiers of hum is the small and square baffle box, closed in all around except for front and back, and used for decorative effect. It is a good resonator. One of the frequencies at which it is likely to resonate worst is around 120 cycles, the frequency of the hum you hear. Therefore a small hum becomes a loud and intolerable one.

"My AC dynamic speaker hums terribly," is an occasional complaint.

Usually the filter is able to eliminate enough of the hum to insure excellent reproduction of a radio program. You can prove that to your own satisfaction, if you have an AC dynamic speaker, by removing the chassis from the box. The small hum you hear when listening to the chassis is something you will not object to, any more than you object to the rushing sound characteristic of life in a receiver when no station is tuned in, but when the set is turned on. Not only does

the program drown out both the rushing sound and the small hum, but you can turn on the set without hearing a signal and yet find nothing objectionable in the stray sounds that are audible.

Consoles and Baffles

Consoles that have room provided in them for a dynamic speaker usually are less offensive as hum accentuators than are the small baffle boxes of such fetchingly attractive design that they win your eye, later to lose your confidence.

Still, the enclosure in the console is sealed except for the front opening, or maybe the back besides. The top is there, also the walls are there, and box resonance and boomy accentuation must be present.

There is no remedy for the avoidance of hum amplification when using an AC dynamic speaker in a square, closed box except to get rid of the box.

The baffle may be a large front board, with circular opening, against the periphery of which is pressed the cone of the dynamic, while the sides and back should be open. Air should circulate. It would be better still if the top were open, also. It is not necessary that there be utter absence of sides, top and back, for a thatched framework or a grill of cane constitutes an opening in the acoustical sense. Enclosure consists of solid construction other than that of the front board.

What a real baffle needs is size, as well as freedom from obstruction to sound waves and freedom from hollow sound effects caused by echo and re-echo. A good minimum for the front is 24x24 inches, if the flat type of baffle front is used.

The Case in Big Cities

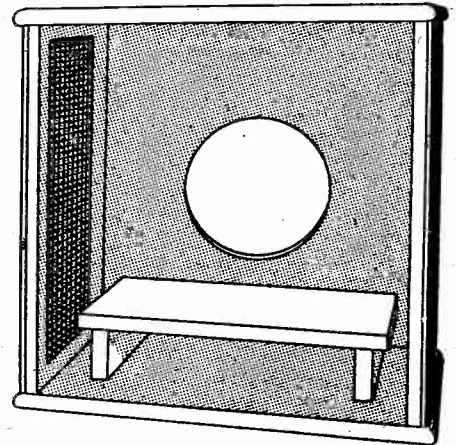
A great deal of the mischief attending radio reception is due to a desperate effort to serve the eye first and the ear last.

As a merchandising problem it is necessary to produce a result that will have aesthetic appeal and will conserve space in these days of limited housing facilities in large centers of population, with small rooms in large apartment houses at high rent.

It can be fairly said that the folk who live in urban localities and have more commodious quarters can get better acoustical results, for their rooms are large enough to make even a 24x24 inch baffle seem lost, whereas in a 16x22 foot room in an apartment house such a baffle may dominate the entire interior decoration.

One compromise possible, if one still has a hankering for excellent acoustical results, is to make the baffle round and smaller, while retaining good looks. Still, the baffle would be large enough to command a price more than what a man might be willing to pay, if it is made of walnut or mahogany. For such a baffle \$20 would not be a high price. To keep the price down it is possible to use cheaper wood, with just as good results, and decorate it with spray or other fancy effects, to gain the welcome of the eye.

An excellent baffle that has not received the attention it deserves is one which functions as a horn, with a nozzle about the size of the diameter of the dynamic cone, and then flares, approximately on the exponential basis. One such is manufactured with a front opening, at the flare, of 21 inches wide by 18 inches high,



A LARGE BAFFLE, THAT IS, FRONT BOARD, IS DESIRABLE. THIS ONE IS 24 x 24 in. THE SIDES AND BACK ARE OPEN. THE PLATFORM SUPPORTS THE DYNAMIC.

and if you have room for such, it is well to use it. At the nozzle or beginning of the opening there is a small board, almost square, against which the dynamic cone is placed, and where the flare begins, until it ends at the "oblong bell."

Such a baffle preserves the advantages of the dynamic motor with those of the exponential theory and costs \$9. As stated, room must be available for such a device, and of course some decorative front may be provided through which air will pass freely.

Approximately equal frequency response characterizes such a baffle, hence there is no accentuation of the 60 cycle hum or the second harmonic of that frequency, 120 cycles, which is the real source of trouble in most instances.

A Frequency Test

It is generally supposed that 60 cycles produce the most trouble, but actually it is twice this frequency, because full-wave rectification is commonly used.

As a rough test you may listen to any given hum produced by a radio installation and try to do some humming yourself of exactly the same frequency. If you can readily simulate the note it is 120 cycles, because it is virtually impossible for the average human vocal chords to produce 60 cycles. Therefore try to produce a note one octave lower than the simulated one. You will fail, because 60 cycles is an octave lower than 120 cycles.

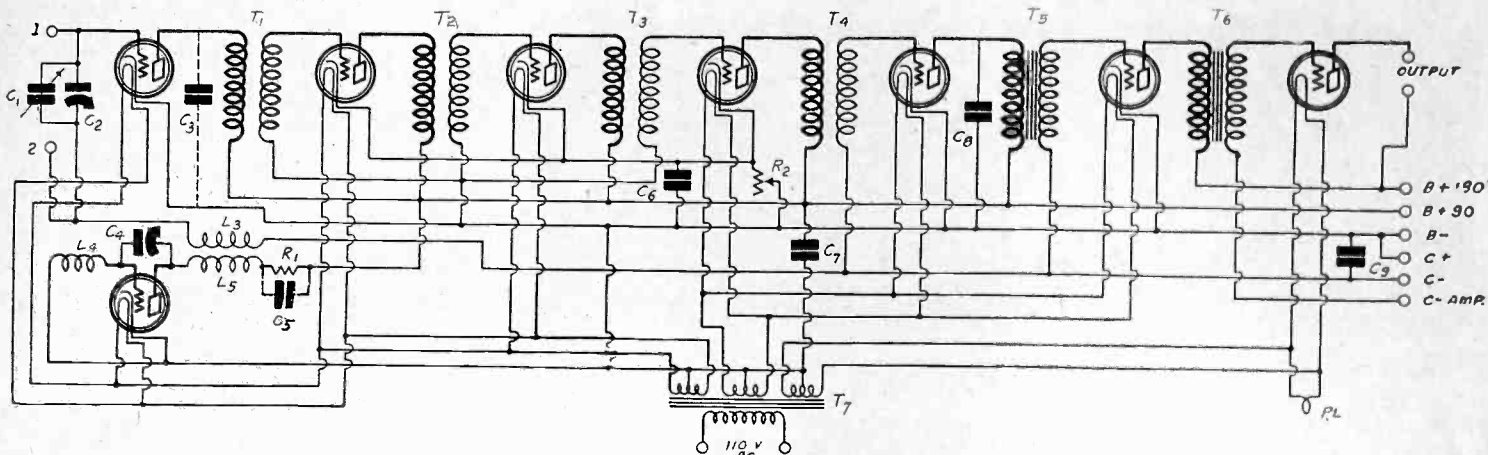
When complaints are made about hum they are usually directed against some particular device. A man will say that his set worked all right until he added an extra stage of audio, when the hum became severe. Or he will report that since he put two screen grid tubes in his receiver, instead of the -01A tubes used as radio frequency amplifiers, the hum has become pronounced. Therefore he blames either the extra audio stage or the screen grid tubes, although strictly speaking the hum has become accentuated due to coupling with the AC cable running to the convenience outlet or to coupling between speaker and receiver, or both, or some other cause may contribute directly to this hum magnification.

Some Gain Permissible

It is well indeed to appreciate the amplification limits imposed by AC operation, whether merely a B eliminator is

ous Types of Installation

Bernard



THE AC RECEIVER PROPER IS THE FIRST TARGET OF SUSPICION WHEN HUM IS PRESENT, SINCE AC IS FED DIRECTLY TO THE FILAMENT OF SOME OF THE TUBES. THE FILAMENT TRANSFORMER THAT DELIVERS THE POWER HAS UNFILTERED VOLTAGE AND CURRENT. BUT OTHER CAUSES MAY ACTUALLY PRODUCE THE HUM, AND THE RECEIVER BE INNOCENT, AS THE AUTHOR EXPLAINS.

used, or an all-electric receiver with AC tubes, or either or these in combination with an AC dynamic speaker.

A cure, of course, is to reduce the amplification. Why reduce it when the very cause of the newly enlarged hum was the device calculated to increase the amplification? Simply this: considerable extra amplification, above what was originally obtained, may be possible before that stage is reached when the hum becomes acute. You can have more amplification, in other words, without running into hum trouble, but not so much as you expected.

Of course any change made in a receiver that causes an extra heavy drain of current from a B eliminator or that overtaxes a filament transformer, power transformer, choke or condenser, adds to the hum. The filtration is effective in a given circuit because the current drain is limited, hence when high current is drawn the filtration becomes ineffective in rapid ratio.

Extra large chokes all commonly used in powerful B supplies, as where a 250 output tube, or a pair of 250 tubes in push-pull, is used. These chokes and the power transformer must be so large and have such heavy cores that not only will they weigh fifteen or twenty pounds, but they will reach large physical dimensions. Hum trouble is not only likely but almost inescapable if one uses too small power transformers.

Function of Amplification

Due to the incessant warfare of price against performance some such power packs do not have large enough coils, and hum results.

The stray coupling that gives rise to microphonic effects and increase of hum are a function of the amplification, whether that amplification be at radio or audio frequencies. The load on the detector tube, for instance, is higher when much RF amplification is used, but with average RF amplification, the overload simply is transferred to some other tube, and the strong field arises somewhere in the audio channel under either set of circumstances.

If audio transformers are used, and amplification reduction is found necessary, this can be accomplished by putting a .5 meg. leak across the secondary of an audio transformer, preferably the first, or one across the secondaries of all the audio

transformers. Still greater reduction is possible by using lower values of resistors. It will surprise many to find that this simple device often eliminates objectionable hum completely, where the hum is engendered by an over-amplification. Of course, if the hum is accentuated by a resonating baffle box, the leaks will do little good, although they will help, at that.

Circular Shape Helps

The square or oblong box of the airtight type is the worst offender, especially if small, yet if the shape of the container is round, the box resonance will not be present, even if the box is small, provided, however, the back is open. The grill at the front opening has only slight resonance features.

In this way manufacturers are able to produce a small housing for the dynamic chassis, appealing to the eye, and yet not robbing the purchaser of the very thing he thought he was buying—excellent reproduction. But even the rounded little box, open front and back, does not produce as good results as the large open box or the exponential type baffle, which is really a horn superimposed on the front of a cone.

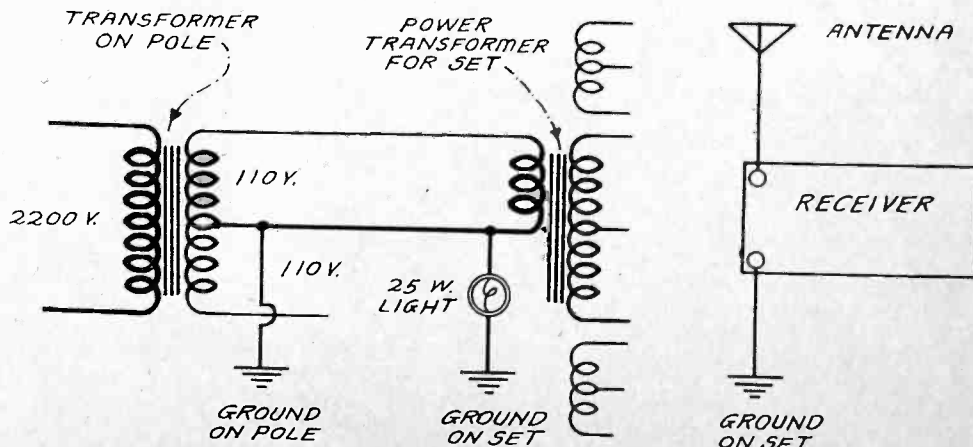
Where a Lamp Helps

Sometimes a hum may be introduced due to the potential difference between the ground to which the receiver is connected and the secondary of the AC house supply line that is grounded to another point. For instance, the power

transformer on a pole in your back yard steps down the high voltage of the AC line to 110 volts average, and this is what you get from your convenience outlet. The primary of this large power transformer is not grounded.

Considering the power company's transformer on the pole in your back yard, or maybe is under ground, the primary may be connected to the generator output at the plant, or to some other transformer at the power house. Across this primary there may be an alternating voltage of 2,200 volts, assuming the stepdown to be 10-to-1. Now, the secondary of the power company's transformer on the pole may be 220 volts, with the center tap grounded. One group of consumers uses one half of the secondary, another group the other half. Therefore the convenience outlet voltage is 110 volts.

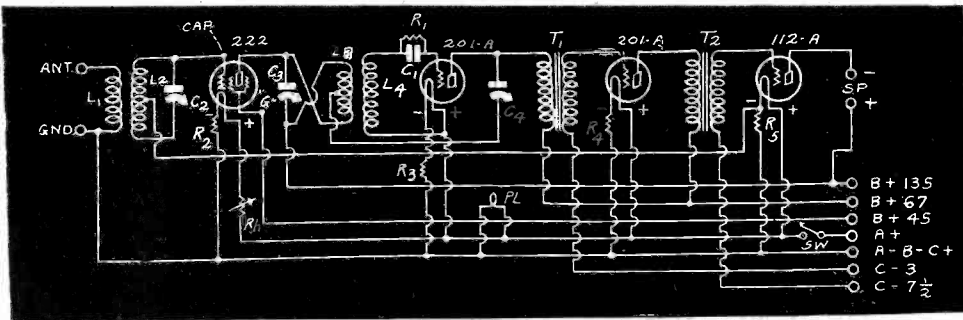
Your receiver may be grounded at a different potential than is the midtapped secondary of the "pole" transformer. Hum will result. This may be reduced, if not eliminated, in many instances, by connecting a 25-watt lamp between the grounded side of the convenience outlet and the ground used for your receiver. Connected one way the lamp will light. This denotes the wrong method of connection, so simply reverse the plug in the convenience outlet. The lamp will not light now, and the filament of the lamp acts substantially as a short to ground. The difference of potential has been greatly decreased, hence the hum has virtually lost one stamping ground.



HUM ARISING FROM DIFFERENCE IN GROUNDED POTENTIALS MAY BE ELIMINATED BY A LAMP.

Questions Answered on The SG Universal

[This receiver was described in the December 1st, 8th and 15th issues of
RADIO WORLD.]



CIRCUIT DIAGRAM OF THE FOUR-TUBE SCREEN GRID UNIVERSAL

MY UNIVERSAL with .0005 mfd. tunes with the left-hand or antenna dial 20 degrees behind the other or detector dial. Why?

ADAM FORSHEW,
Beloit, Wisc.

You have a .00035 mfd. coil in the antenna circuit instead of a .0005 mfd. coil. The other coil is O.K.

VERY FINE RESULTS are being obtained with the Screen Grid Universal, which I completed three days ago. I am wondering, however, if I can improve reception still further by using some other antenna coupling method. At present I have the small fixed winding of the antenna coupler in the antenna circuit and am not using the midtap.

WALTER HEMSTREET ADAMS,
Palm Beach, Fla.

What method of antenna connection should be used depends largely on your location, and absence of information on this prevents any specific advice. The general rule is that the aperiodic primary in the antenna circuit works out best. However, if greater selectivity is required, a series condenser of about .00005 mfd., connected between aerial and the midtap of the antenna coil, will provide the remedy. In that instance the small winding is not used. See the December 8th issue of RADIO WORLD for a complete discussion of the optional antenna coupling methods and the difference in performance when each one is used.

I AM USING a B eliminator and I am having a little trouble from hum. I do not think the B eliminator hums to prove it is happy but for some more scientific reason. At present I am using the Universal Screen Grid Four, so I thought you'd give me some advice.

ROBERT RORKE,
Bangor, Maine.

Put a .25 or .5 meg. grid leak across the secondary of the first audio transformer to reduce hum. This is usually helpful where the degree of audio amplification is very high, and it is likely to be in a two-stage transformer coupled audio system with relatively high plate voltages.

IN LOOKING OVER the blueprint of the Screen Grid Universal, I notice that it is marked in some places "solder to subpanel," but as the subpanel is aluminum, and one can't solder to aluminum, I was wondering how you expected your directions to be followed. Merry Christmas, nevertheless.

PHILIP J. BRADDOCK,
Spokane, Wash.

The legend "solder to subpanel" is merely indicative and not directive. You

will notice that the legend appears with arrow pointing to a lug that is tightened with nut and screw to the subpanel that the screw pierces. Therefore metallic contact between lug and subpanel is provided. Strictly speaking you solder to the lug, not to the subpanel. If this is all that's worrying you, Merry Christmas and Happy New Year, besides.

IN MOUNTING the Hammarlund tuning condensers onto the front panel of the Screen Grid Universal, I notice that the leads would not come up directly through the subpanel holes to the lugs on the condensers. The holes are a little to one side. Is there any harm in that?

PERCY BLAKE,
Chicago, Ill.

No harm whatever. You can bring the leads directly under the lugs of the Hammarlund condensers, if you like, simply by drilling the holes in the desired position. Aluminum is comparatively easy to drill. It is better to use a breast drill and bear down heavily, then to use a small hand-drill of the egg-beater type. However, there is no difficulty drilling in either fashion. Support the aluminum by a piece of wood under the point where the hole is being made, as when the bit pierces the metal it does so with suddenness, not slowly, as with bakelite or particularly hard rubber.

ALTHOUGH the diagram of the Screen Grid Universal shows the leaky-condenser method of detection, I prefer to use grid bias. Can this be done without depriving the circuit of its inherent sensitivity?

CORT BLAINE,
Covington, Ky.

You may use grid bias detection. This requires increasing the detector plate voltage to the maximum allowable for the type detector tube you are using. For an -01A tube this would be 135. The negative bias should be of the order of 15 volts. In that even omit the grid leak and condenser and connect grid return of the detector to C minus. The sensitivity will be somewhat decreased, but there'll be plenty left.

THE 622 AMPERITE in series with the negative filament of the screen grid tube reduces the 6-volt battery voltage to 3.3 filament volts, but you have a 50-ohm rheostat in series with the positive filament of the same tube, and this could cut down the filament voltage to less than one volt. Is 50 ohms correct?

MARSHALL COMBERT,
Ontario, P.Q., Canada.

Yes, 50 ohms is correct where the

screen grid tube is worked at such high gain, as you have to attenuate the filament current considerably to reduce the volume of a loud local station to just above audibility. This wide range should be accorded by any volume control. The circuit is so loud that the usual 20 ohm rheostat will not do.

WILL the Screen Grid Universal motorboat on an eliminator? I tried some circuits that did motorboat, and I would want assurances before trying another. Some factory-made sets motorboat on this eliminator and others do not.

JAMES H. CARSON,
Salt Lake City, Utah.

It is unlikely that the Screen Grid Universal will motorboat. Transformer coupled audio circuits usually are not subject to that vice. Motorboating is due to common coupling between circuits and stages in a given installation. It arises from the combination of the receiver and the eliminator and is not directly attributable to either alone. However, the Universal has been worked from eighteen different makes of B eliminators, including the most popular factory-constructed ones, and the best types of home-constructed B supplies, and it did not show the least sign of motorboating on any of them.

BOTH COILS are mounted perpendicularly in the Screen Grid Universal. Does any harmful interstage coupling result?

GOODNOW EDGE,
Atlantic City, N. J.

No.

I BUILT the Screen Grid Universal and it works fine, with the single exception that the regeneration is too intense. It starts when the condenser plates of the Hammarlund junior are half way in, but a slight increase of capacity makes the set spill over. What is the remedy?

AUGUST HAUSER,
San Francisco, Calif.

The voltage on the screen grid is not properly adjusted. It should be about 45 volts. If you have a high resistance voltmeter that accurately reads such a low voltage, adjust the voltage to 45. Or, if you use B batteries, simply connect to the 45-volt tap. You probably use a B eliminator, and without a high resistance voltmeter there is no ready means of determining what screen grid voltage you are getting. If the voltage is too low the set will squeal, as you say, and the same way happen if the voltage is too high. Generally, the screen grid voltage (G post of socket), when the tube is worked at high gain, is critical to within about 5 volts. Your B eliminator does not provide a sufficiently fine adjustment. This you can obtain by putting a 25,000-ohm maximum variable resistor (clarostat) in series with the screen grid lead and turning this until you get high gain without squealing. Bypass the resistor by putting a .006 mfd. fixed mica condenser across it.

WHAT RANGE of meters will the Screen Grid Universal tune in?

(2)—Will both dials approximately track?

(3)—What is the greatest distance received from New York City on this set?

ROGER ABERCROMBIE,
San Antonio, Tex.

(1)—190 to 595 meters.

(2)—Yes.

(3)—100-watt station in Wisconsin, on the laboratory model, although others who built the circuit report reception of Denver, and one man says he got KFI, San Francisco. The circuit gets DX consistently. It provides about all the distance that is obtainable from a four-tube design.

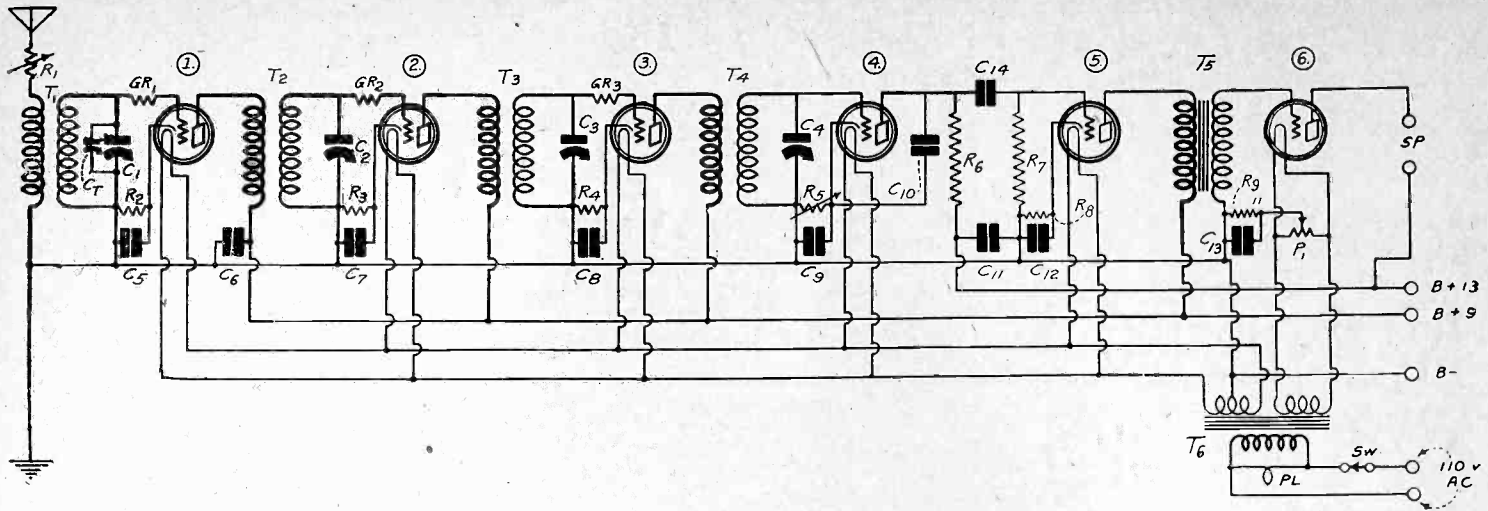


FIG. 721

CIRCUIT DIAGRAM OF A SIX TUBE ALL-ELECTRIC RECEIVER EMPLOYING —27 TYPE TUBES AND FOUR TUNED CIRCUITS

Radio University

A 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 meaning of decibell when used in telephone and radio literature?

(2)—What is the meaning of TU when used in conjunction with amplification measurements?

(3)—Why are performance curves of audio amplifiers plotted on logarithmic scales instead of frequency scales?

FRED OLAND,
Bridgeport, Conn.

(1) The decibell is a new name for the transmission unit. It is the same unit as the TU and it is one-tenth of a bell.

(2)—The TU, as well as the decibell, is defined as one-tenth of the common logarithm of the amplification, or of the attenuation. For example, if signal voltage in the second stage is 10 times that in the preceding stage, the amplification is $10 \times \log_{10}$ decibells or TU, which is equal to 10 transmission units or decibells. If the voltage step-up is 100, the amplification is $10 \times \log_{10} 100$, or 20 TU. Again, if the amplification is 50 at 100 cycles and 100 at 1,000 cycles, the difference in the amplification at these two frequencies is $10 \times \log (100/50)$, or $10 \times \log 2$. This is 3.01 TU or decibells. The amplification is down 3 units at 100 relatively to that at 1,000.

(3)—Curves are plotted on a logarithmic scale of frequency because that gives equal importance to equal musical intervals. They are also plotted on logarithmic scales, or in TUs, in the vertical direction because the ear appreciates as equal intensity ratios rather than equal absolute differences.

* * *

I HAVE a filament transformer giving 1.5, 2.5 and 7.5 volts on the three secondary windings. I wish to use this transformer for heating the filament of a 171A tube. Can it be done?

(2)—Is it possible to connect the three windings in series to get 11.5 volts?

(3)—Is it possible to connect the 7.5 and the 1.5 volt windings so as to get 5 volts? If so, can these two windings thus connected be used to heat the filament of a 171A tube?

WILFORD DAVIS,
Butte, Mont.

(1)—Yes. Connect a 5 ohm resistor in each leg of the 7.5 volt winding.

(2)—Yes, if there is no other connection between the three windings. They

can also be connected so as to get 8.5 volts and 6.5 volts.

(3)—No, but so as to get 6 volts.

* * *

I HAVE a six-volt battery which has given good service for several years. Now I can charge it for 24 hours at a .75 ampere rate and the charge will not last more than five minutes. What is the trouble?

ELMER HIGGINS,
Superior, Wisc.

(1)—The plates in the battery have either become short-circuited or sulphur. It is time to get a new battery or to have the old one overhauled.

* * *

I HAVE heard that there is a new tube out called the pentode. Where can this tube be obtained and what are its characteristics?

WILLIAM SODERMAN,
Minneapolis, Minn.

(1)—The pentode is a new tube on the European market. It has three grids. One of the grids is used for controlling the output by the variation of the input voltage. The other two are shield grids, one of which is connected to the midpoint of the filament and the other to the positive voltage applied to the plate of the tube. The tube combines a high ampli-

fication factor with a high mutual conductance.

* * *

PLEASE PUBLISH a diagram of an AC receiver using five —27 type tubes and one —71A tube and four tuned circuits.

(2)—Please give values of resistors and bypass and tuning condensers.

SOLOMON DAVIDSON,
New York, N. Y.

(1)—See Fig. 721.

(2)—C1, C2, C3, C4, .0005 mfd.; C5, C6, C7, C8, .001 mfd.; C9, C11, C12, 1 mfd.; C13, 4 mfd.; C10, .0005 mfd. C14, .01 mfd.; Cr, 50 mmfd.; R1, 2,000; R2, R3, R4, R8, 750; R5, 100,000 variable; R9, 2,000; R6, .1 megohm R7, 2 megohm; GR1, GR2, GR3, 750 ohm grid resistors; P1, 50 ohm potentiometer.

* * *

MY SET WORKS even when I disconnect the grid battery and leave the transformer return leads open, and it seems to work much better that way. Why is that, and why is it necessary to use a grid battery?

(2)—Why should the quality be better when the grid bias is removed and the grid return leads are left open?

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(1)—The signal voltage is impressed between the grid and the filament even when the grid returns are not connected anywhere. Hence the tube amplifies as long as grid of the tube remains at an approximately correct potential. But the potential is very uncertain and hence the amplification is uncertain. The B drain is altogether too high with disconnected grid return.

(2)—It is not.

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TELEPHONES: BRYANT 0556, 0559

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)

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Los Angeles: Lloyd Chappel, 611 S. Coronado St.

European Representatives: The International News Co.,

Breams Bldg., Chancery Lane, London, Eng.

Paris, France: Brentano's, 8 Avenue de l'Opera.

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Fifteen cents a copy. \$6.00 a year. \$3.00 for six months. \$1.50 for three months. Add \$1.00 a year extra for foreign postage; Canada, 50 cents.

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WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

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Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities, 10 cents per word. \$1.00 minimum.

Entered as second-class matter March 23, 1923, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

Photo Cells Tested

Like Human Eyes

The ability of electric eyes to see has become a matter of definite routine test which does not differ much from the testing of human eyes. Otherwise known as photo-electric cells, these electric eyes are tested by measuring the variation in current passed through a given cell from absolute blackness to a known light intensity. The source of light, in the form of an electric lamp of known candle-power, can be moved nearer or farther away from the cell, by means of a holder moving on a calibrated slide, while the response of the cell is measured by delicate meters.

The output of the cell is connected with a vacuum tube amplifier, which in turn operates a sensitive relay or other devices which is to be controlled by the varying light intensity.

Legacy of 1928

THE waning year 1928 will be remembered by radio constructors as the one in which the AC receiver far outstripped the battery-operated type, and as the year that brought the dynamic speaker into popular use.

For the AC receiver it can be said that it represents greater convenience, and nothing more, with a single exception—the possibility of economically utilizing voltages of a much higher order, hence power tubes of greater maximum undistorted output.

The flamboyant advertisements of some set manufacturers, hailing the AC tube as marvelous, were mere sales talk, of doubtful propriety. Except that the higher voltages were economically available for the output tube, the general rule—even at the time when this cry of marvelous was at its height—was that the AC tubes were not as good as the others. The problem has been to make them equal in performance to the battery-heated type. This has been accomplished only this year, and the permanent success of the AC circuit is the result.

The year made the AC set and circuit safe for the buyer or builder.

As for loudspeakers, the trend has been toward the dynamic and away from the magnetic, the only two direct-drive types now in production in this country. The third type of speaker is the horn, exponential or otherwise.

The dynamic immediately put the speaker into the higher priced class. For little money the magnetic type or the horn is still the best buy, but the dynamic will stand more of a load and give, in general, a better frequency response, if properly baffled, as few dynamics are. The models enclosed in small boxes, however ornate, are usually no better than a fair direct-drive unit operating a piece of cone paper or doped cloth. The box resonance spoils the good qualities of the speaker.

There looms now the condenser type, otherwise known as the electro-static speaker. A few factories in Germany have produced them, but not of such models as would be practical in conjunction with American transmitters and receivers, unless the newest of these speakers, made by Dr. Vogt, answers the purpose.

While the dynamic is the rage to-day, its throne may be menaced soon by the condenser speaker. Several American concerns have actually produced experimental models of the condenser speaker, but whether they will offer them for sale in 1929 has not been decided.

As is often the case in radio merchandising, whenever anything becomes quite a go, something else pops up to displace it.

nels in each zone on the basis of population. Hence, the zonal classification is geographical, without direct regard to population or number of stations, while the distribution within any such arbitrary zone is on the basis of population, without regard to the number of stations to be served. Hence in some instances where the demand is greatest the facilities are least.

Confidence in President Hoover as a man who thoroughly knows the radio situation, and who has had years of administrative experience in this very field, may bring about a better situation.

A Commission of five, consisting of two members who know their business, a petulant chairman and two others, is of rather indifferent complexion. Perhaps Mr. Hoover as President may recommend the abolition of the Commission, as some of his friends have said he will do, but if the Board is retained five aces would not be an illegal hand in this game.

WGY Talks Money

WGY struck a bold blow in declaring that the reallocation order, as it affected that station, was unconstitutional because it deprived the station of enjoyment of full-time transmission, which in substance had been its lot for a long time, hence the order constituted seizure of property without compensation. Thus came into court the outstanding legal question in connection with the reallocation.

If this complaint is sustained finally, any station that had full time prior to the reallocation, but was deprived of that privilege under the new order of things, could resort to the same claim. There are few such stations, nevertheless, the Federal Government's authority over assignments of wavelengths, power and time on the air suffers considerable curtailment under any such limitation.

A fact often lost to sight in the administration of any great licensing function is that the licensees have to spend enormous amounts to be able to enjoy the license. Broadcasting is a notable example. A station once given full time has to use it or soon have a lesser license wished on it. Therefore the station relinquishes its privilege or spends hundreds of thousands of dollars to enjoy it.

If thereafter the station is kept off the air at night, as was proposed for WGY, it finds it has put up five times as much money as would have been necessary to meet the new situation. The amount of money invested in a station is representative of the service rendered by that station, therefore any reallocation plan should be sound enough to give full time to the stations having the best installations, and not require the government to buy in a \$1,000,000 plant for the bare privilege of denying full time to a first class plant.

Eyes on Hoover

MUCH interest attaches to what Herbert Hoover can do as President to improve radio conditions. Perhaps he can get a better break from Congress than was obtained through the enactment of the Davis amendment, the so-called equalization law.

Clamoring sections of the country that received no redress of their grievances at the hands of the Federal Radio Commission brought about the enactment of the Davis amendment, but perhaps confidence in a more responsive and authoritative personnel might induce Congress to repeal the awkward amendment.

The difficult task of proper apportionment of the radio bounty is made impossible of scientific achievement because the amendment compels an equal number of channels for each of five geographical zones, and an equal distribution of chan-

Announcer Must Tell

ANNOUNCERS are again reminded to give the station's call letters more frequently. The public is thus served in establishing the dial location of the stations under the reallocation. The Federal Radio Commission threatens punishment this time if the long-standing order is not obeyed.

Some of the announcers are so greatly absorbed in their own cleverness that they forget to give some attention to the station they are working for, and even the public that makes the announcer's job possible. The radio supervisors, checking up deviation from wavelengths assigned under the reallocation, now know how a DX fan feels when he hears half an hour of poorly played jazz, with no hint of whom to blame for this noise.

Literature Wanted

THE names and addresses of readers of RADIO WORLD who desire literature on parts and sets from radio manufacturers, jobbers, dealers and mail order houses are published in RADIO WORLD on request of the reader. The blank at right may be used, or a post card or letter will do instead.

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Especially Those Made of Molded Wood

EVERYBODY who uses a horn loud speaker of the latest type, consisting of an air column design, with long tone travel, agrees that the tone is splendid. Our Model 595 has a travel distance of 8 feet from the unit to the large end of the "bell." If you must economize on space, use Model 570, with a 6-foot tone travel, with not quite as strong reproduction of low notes. But No. 595 is better and, if you've the room (21 1/4" high, 18" wide, 15" deep), choose that one. Every purchaser is a delighted customer. Order one of these specially moulded wood horns. Try it for 90 days. If not delighted, return it and get back your money, including any shipping charges you paid! (Note: Not a single one of these horns has ever been returned to us, though we've sold many hundreds!)

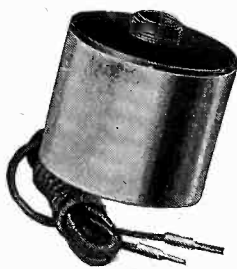


Model 595 (illustrated above) Baffle board (not shown) FREE with each order. List price \$18.00. Our price (40% and 2% off list price) —

\$10.58

Model 570, size 15" high by 12" wide by 12" deep, 6-foot tone travel. FREE baffle board. List price \$13.00. Our price (40% and 2% off list price) — \$7.64

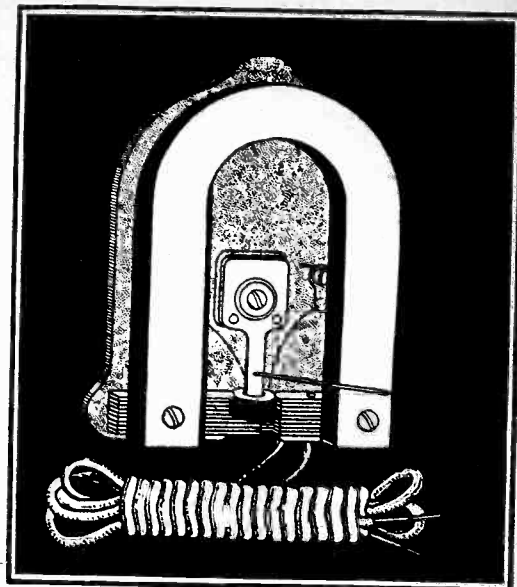
Model 112 horn motor stands 250 volts without filtering (illustrated at right). List price \$6.00. Our price (40% and 2% off list price) — \$3.53



ACOUSTICAL ENGINEERING ASSOCIATES, 143 West 45th St., New York City. (Just East of Broadway)

- Please ship me at once the following (check off):
- One No. 595 at \$10.58, plus a little extra to defray shipping costs; send it already mounted in FREE baffle board.
- One No. 570 at \$7.64, plus a little extra to defray shipping costs; send it already mounted in FREE baffle board.
- One No. 112 horn motor (universal pozzle) at \$3.53, plus a few cents extra for shipping.

NAME.....
 ADDRESS.....
 CITY..... STATE.....
90-DAY MONEY-BACK GUARANTEE!



New Powertone Unit

Cone or Cloth Diaphragm Speaker

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

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. Both the tone and the appearance are brilliant! You may order a new model Powertone Unit with perfect safety. It's a pippin, say those who use it. If you don't agree with that, return the unit ten days after receipt and get your money back promptly. No questions asked—but all questions gladly answered. Immediate shipment guaranteed.

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.....
 Address.....
 City..... State.....

DYNAMIC BAFFLE

Completely built up, for any type dynamic chassis. State what make dynamic you want it for. Cane sides, open back. De luxe finish. Size, 24x24 inches. **\$12.00**

GUARANTY RADIO GOODS CO. 145 West 45th Street, New York City

AC DYNAMIC CHASSIS

110 volt 50-60 Cycle Model, with Built-in Rectifier and Output Transformer

YOU simply must get a dynamic speaker. There's nothing more important to your radio installation. Everybody's getting one. Why deny yourself the advantages of most superior tone realism? Your set can't overtax a dynamic speaker. You can't buy anything at anywhere near our prices that will give you such satisfaction. All you need is the chassis. It plays splendidly just as it is. You may put it in a baffle box, or in a cabinet, if you like. If your home is wired for electricity of the alternating current type, 110 volts, 50 to 60 cycles, then get the AC model at \$23.52. It has a plugged cord for connection to the lamp socket or convenience outlet. The two extra leads, with tips on, go to the output posts of your receiver—the speaker posts. The AC model has a built-in rectifier that changes the AC (alternating current) to DC (direct current) and filters it. The rectifier is

shown at right in the illustration. Also there is a built-in output transformer, (at left in illustration). Your receiver therefore needs no output transformer—there is one in the dynamic chassis.

For best results use as the output tube of your receiver any of the following power tubes—120, 171, 171A, 210, 250, or two in push-pull. If your set has a 112 power tube put in a 171 and increase the negative grid bias. If your set has a 112A or a 201A for the output tube, put in a 171A and increase the negative grid bias. No other changes are necessary.

Remember that the dynamic is this year's supreme contribution to radio, and you must share in this fine advantage to enjoy the best and be thoroughly up-to-date.

6-VOLT MODEL

If you have a 6-volt storage battery to heat the filaments of your tubes you may use the 6-volt model dynamic chassis with equal results. The current drain is low. But if you have AC house supply of electricity, even if you use a storage battery, the AC model dynamic chassis is recommended, because if you decide at any time to have an AC set you'd have to retain the storage battery just to run the 6-volt model. If you have no electricity in your home, then you must use the 6-volt model. It looks exactly like the other model, except that the rectifier is omitted as unnecessary. The current used is already direct. The output transformer is built-in, however. Both models perform alike.

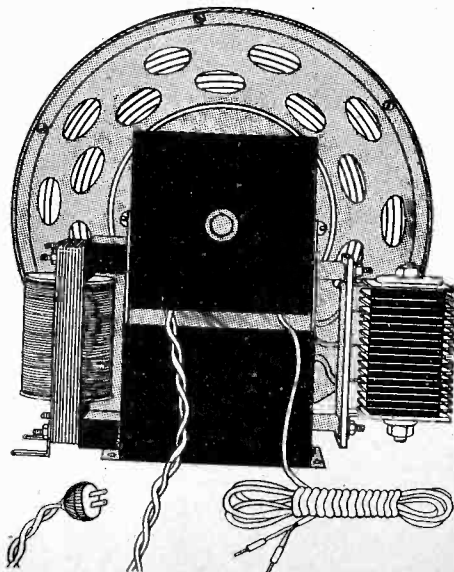
\$17.64

Acoustical Engineering Associates, 143 West 45th Street, N. Y. City (Just East of Broadway)

- Please ship C.O.D. at once.
- One 110 volt, 50-60 cycle AC Model dynamic speaker chassis at \$23.52, plus cartage cost.
- One 6-volt Model dynamic speaker chassis at \$17.64, plus cartage cost.

Name.....
 City..... State.....
 Address.....

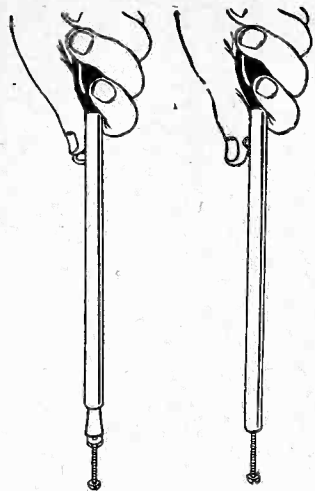
\$23.52



The AC model, 110 volts, 50 to 60 cycles, is illustrated. It has built-in rectifier and filter and built-in output transformer. Price, \$23.52

SOCKET WRENCH

FREE



Push out control lever with knob (as at left) and put wrench on nut. Push down on handle only (at right), then turn nut left or right.

ONE of the handiest tools for a custom set builder, service man or home constructor is a BERNARD socket wrench.

It consists of a 6 1/2" long metal tubing in which is a plunger, controlled by a knob. The plunger has a gripping terminal (called a socket, hence the name "socket wrench") that may be expanded or contracted to fit 6/32, 8/32 and 10/32 nuts, the most popular sized nuts in radio.

Use the knob to push out the plunger, press down on the handle to grip the nut, then turn the nut to left for removal or to right for fastening down. Total length, distended, including stained wooden handle, 10". Gets nicely into tight places. Send \$1 for 8 weeks' mail subscription for RADIO WORLD and get this wrench FREE.

No other premium with this offer. Present subscriber may extend subscription by stating he is one, and entitle himself to this FREE premium, making \$1 remittance.

RADIO WORLD

145 WEST 45TH ST., N. Y. CITY
A few doors east of Broadway

BLUEPRINT FREE!

4-Tube Screen Grid Diamond of the Air Blueprint, full sized picture wiring diagram; also schematic diagram and panel layout.

At 15c per copy RADIO WORLD costs you 60c for four weeks. But if you send 50c NOW you get the first and only national radio weekly for four consecutive weeks and this handsome official blueprint FREE!

This blueprint is life-sized and shows in easy picture diagram form how to mount parts and wire this super-sensitive receiver. One screen grid tube is used as radio frequency amplifier. The rest of tubes are two-01A and one 112A.

This circuit gives you distance, tone quality, ease of performance. No shielding, no neutralizing required!

Radio World, 145 West 45th Street, New York City

Enclosed please find 50 cents (stamps, coin, check or money-order) for which send me RADIO WORLD for four weeks, and free Diamond S. G. blueprint.

Name

Address

City State.....

Renewal.

If you are already a mail subscriber for RADIO WORLD you may extend your subscription four weeks and get free blueprint, but put a cross in the square.

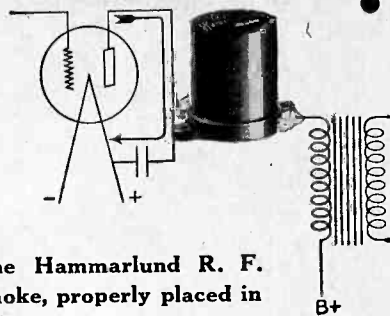
BUILD YOUR OWN DYNAMIC SPEAKER

Complete set of blueprints and instructions for building your own Dynamic cone speaker. Easy and inexpensive to build at home with few tools. Guaranteed to work; thousands now enjoying Dynamic reproduction. Mail \$1.00 today and you will receive complete set, postpaid.

FANSPEAKER RADIO COMPANY
74 Dey Street - - - New York, N. Y.

LIST OF STATIONS EFFECTIVE NOW
The fully corrected list of reallocations of stations effective Sunday, November 11th, appeared in RADIO WORLD dated November 3d. The call letters, frequency, owner and location are given by States. Fifteen cents a copy. Or send \$1.00 for trial subscription of eight weeks, and this issue will be sent FREE.
Radio World, 145 W. 45th St., N. Y. C.

IMPROVES Your Radio!



The Hammarlund R. F. Choke, properly placed in your receiver, prevents interaction between radio-frequency and audio-frequency currents. It aids stability and improves tone quality. Easily installed. Ask any radio engineer.

Diagram shows Hammarlund R.F. Choke in the Detector plate circuit of a radio receiver to prevent R. F. Currents entering audio-trans-former.

Two sizes—35 and 250 millihenries

Write Dept. RW22 for Folder

HAMMARLUND MANUFACTURING COMPANY

424-438 W. 33rd St. New York

For Better Radio
Hammarlund
PRECISION PRODUCTS

Recent Issues of RADIO WORLD, 15 cents each. Any number published in 1928 available for a short while. Six issues 75 cents, 10 issues \$1.00. Send stamps, coin or money order NOW, before the issues are sold. RADIO WORLD, 145 West 45th Street, New York City.

SUBSCRIBERS! Look at the Expiration Date on Your Wrapper

Please look at the subscription date stamped on your last wrapper, and if that date indicates that your

subscription is about to expire, please send remittance to cover your renewal.

In this way you will get your copies without interruption and keep your file complete.

SUBSCRIPTION DEPARTMENT

RADIO WORLD 145 WEST 45TH ST., N. Y. CITY

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

10 cents a word — 10 words minimum — Cash with Order

MARTHUR'S SHELL TALLIES for scoring at bridge parties or for bridge favors. A beautiful, dainty, unusual and useful gift utterly unlike anything else you have ever seen. When you use them at your next bridge party, all your friends will want to know where you got them. \$3.00 a dozen (for twelve place cards and tallies), postpaid. C. McArthur, 620 Plaza Place, St. Petersburg, Florida.

FREE BLUEPRINTS! GET YOUR SHARE! National Short Wave Circuit blueprint, exact circuit used by James Millen for tuning in television, voice, code, music, programs. National Screen Grid Five (broadcast receiver circuit) blueprint FREE also. John F. Rider's B Eliminator blueprint free. Send separate request for each of the above-free blueprints you desire. Custom Set Builders Supply Co., 57 Dey Street, N. Y. City.

EIGHTEEN microfarads of capacity, using Mer-shon condensers that will not ruin, because they're self-healing in case of puncture. This large capacity gives stability and humless quality in a marvelous new B eliminator, using the -80 full-wave rectifier tube on 50-60 cycle 105-120 v. AC maximum output voltage at 35 milliamperes is full 180 volts for -71 or -71A power tube, or lower voltage may be used for -12 or -12A power tube. The voltages are (B-) (B+23 to 45 variable) (B+67 to 85 variable) (B+90 to 135 variable) (B+180). Size 6 1/4 inches high by 7 inches wide. Equipped with finger-tip adjusters and insulated binding post strip. Price, all built up in de luxe metal housing with crackled gloss finish, including tube, \$18.00. Immediate shipment. Send remittance and we pay cartage. Order C.O.D. and you pay cartage—Custom Set Builders Supply Co., 57 Dey Street, N. Y. City. Tel., Barclay 8659.

CAMFIELD Super-Heterodyne. Cost \$120—Cash \$50. Acme K1A Speaker, \$10.—Harold Mantz, West Bend, Iowa.

POSITION WANTED by licensed radio operator. Ivan Fry, Minerva, Ohio.

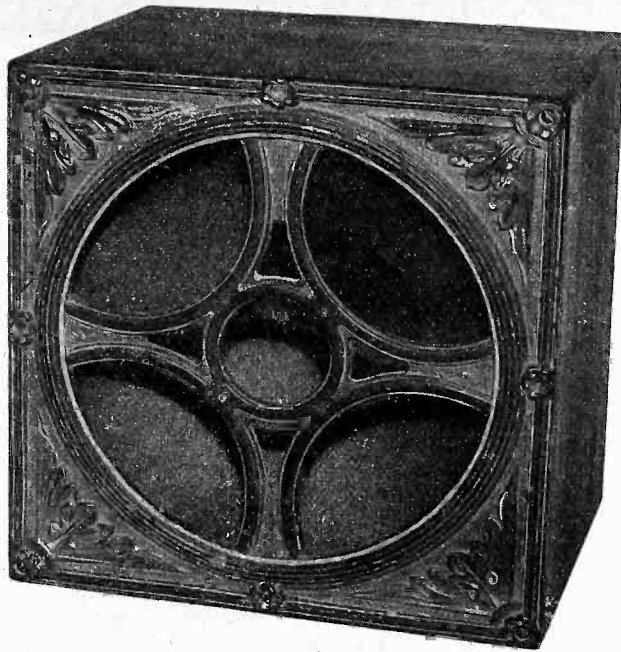
TAKE Your Choice of 4 Other Publications for New Radio World Subscribers Ordering Now. Radio World has made arrangements to offer, with one year's subscription for Radio World, a year's subscription for any one of the following publications FREE: Radio News or Science and Invention or Boys' Life or Radio (San Francisco) or Radio Engineering. Send \$6.00 —now. State which other listed publication you desire. Radio World, 145 W. 45th St., N. Y. City.

An Extraordinary Speaker

THE super-sensitive and acoustically faithful twin magnet POLO UNIT in a deluxe housing, with moulded metal front piece, makes a first-class table model speaker. It will stand the heaviest load — even two 250 tubes in push-pull without rattling—yet is so sensitive it will work well from any output tube, even a 201A!

Compact and handsome, this table model graces any living room or parlor, is inconspicuous to the eye but alluringly predominant to the ear.

The unit is mounted on a special bracket that makes it impossible for the unit to get out of adjustment. The table model, of the free-edge cone type, is furnished completely built-up, ready to play.



The Table Model Polo Speaker, an outstanding example of the magnetic type of speaker, is shown one-third actual size.

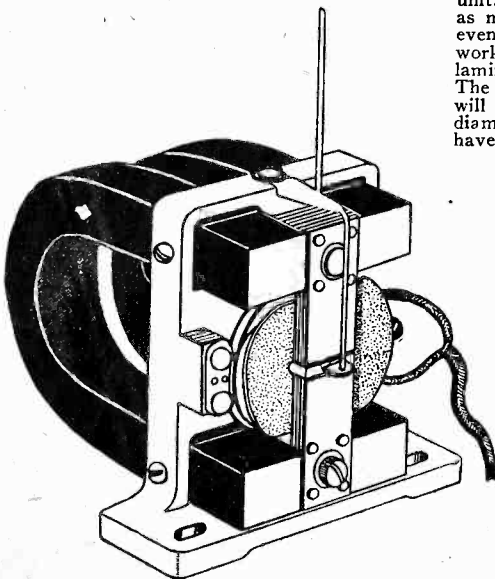
The grill or front piece is moulded, while the rest of the housing is wood. Both grill and housing are furnished in rich, conservative two-tone brown spray.

Table Model Polo Speaker, Cat. TMP, consisting of de luxe housing and moulded grill, with sprayed finish; mounted Polo Unit, with cone and special bracket; also 10-ft. cord. All built-up, ready to play.....\$13.50

[Note.—Those who possess a Polo Unit and desire the housing, special bracket and cone, may obtain these by ordering Cat. HO at \$5.00.]

THE Polo Unit, using two magnets, to double sensitivity, is regarded by many experts as the best magnetic unit. It weighs three full pounds—almost three times as much as an average unit—and will stand the strain of even two 250 tubes in push-pull without rattling. It works well out of any type tube. The pole pieces are laminated and the armature can't get out of adjustment. The two magnet coils are housed in bakelite. This unit will stand 180 volts without filtering, due to the large diameter wire used on the special coils. All Polo Units have a bronze-green casing and black twin magnets.

Polo Unit, shown one-half actual size. Furnished complete with unit, apex, chuck, nut, 10-ft. cord, bracket and hardware. Cat. PU\$10.00



Acoustical Engineering Associates,
143 West 45th Street, N. Y. City.
(Just East of Broadway)

Please ship at once C.O.D.:

- One Cat. TMP at \$13.50.
- One Cat. PU at \$10.00.
- One Cat. HO at \$5.00.

[Put cross in proper square above.]

Name

Address

City State.....

Ten-day Money-back Guarantee.

Bakelite Front and Aluminum Subpanel

for the
4-Tube Screen Grid
Universal; also

\$5.00

DIAMOND OF THE AIR . . .

Five-Day Money-Back Guaranty

Finest eye appeal results from construction of the 4-tube Screen Grid Diamond of the Air when you use the official panels. The front panel is bakelite, already drilled. The subpanel is aluminum, with sockets built-in, and is self-bracketing. Likewise it has holes drilled in it to introduce the wiring, so nearly all of it is concealed underneath set. Make your set look like a factory job.

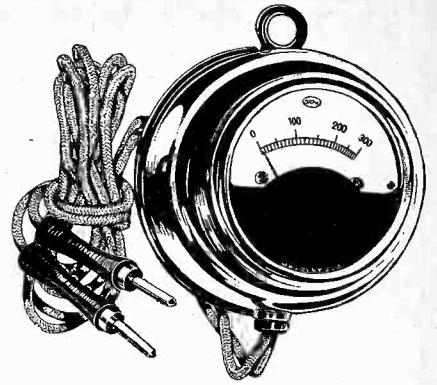
Front panel alone, bakelite, drilled.....\$2.35
Aluminum subpanel alone, drilled, with sockets built-in..... 3.00

GUARANTY RADIO GOODS CO.

145 WEST 45TH STREET

NEW YORK, N. Y.

Individual METERS For Portable or Panel Use



High resistance 0-300 Voltmeter, accurate to 1%. Measures any DC voltage to 300, including B eliminators. Provided with 30" cord, with luxurious jack tips and hanger. Meter full nickel de luxe finish. No. 846. **\$4.50**
No. 847, same as above, but 0-500 volts, \$6.00

POCKET AND PORTABLE VOLTMETERS

- No. 8—For testing A batteries, dry or storage, 0-8 volts DC scale.....\$1.00
- No. 10—For testing A batteries, dry or storage, 0-10 volts DC scale..... 1.00
- No. 13—For testing A batteries, dry or storage, 0-16 volts DC scale..... 1.00
- No. 50—For testing B batteries, dry or storage, but not for B eliminators, 0-50 volts DC scale..... 1.00
- No. 39—For testing B batteries, dry or storage but not for B eliminators, 0-100 volts DC scale..... 1.25
- No. 40—For testing A and B batteries, dry or storage, but not for B eliminators; double reading, 0-8 volts and 0-100 volts DC scale.. 1.75
- No. 42—For testing B batteries, dry or storage, but not for B eliminators; 0-150 volts DC scale..... 1.50
- No. 348—For testing AC current supply line, portable, 0-150 volts..... 4.00

PANEL AC VOLTMETERS

- (Panel meters take 2-5/64" hole)
- No. 351—For reading 0-15 volts AC.....\$2.25
 - No. 352—For reading 0-10 volts AC..... 2.25
 - No. 353—For reading 0-6 volts AC..... 2.25
- (See No. 348 under "Pocket and Portable Voltmeters.")

PANEL VOLTMETERS

- No. 335—For reading DC voltages, 0-8 volts, \$1.00
- No. 310—For reading DC voltages, 0-10 volts, 1.00
- No. 316—For reading DC voltages, 0-16 volts, 1.00
- No. 326—For reading DC voltages, 0-6 volts, 1.00
- No. 337—For reading DC voltages, 0-50 volts, 1.00
- No. 339—For reading DC voltages, 0-100 volts, 2.25
- No. 342—For reading DC voltages, 0-150 volts, 2.25
- No. 340—For reading DC voltages, double reading, 1-8 volts, 0-100 volts..... 1.50

VOLTA MMETERS

- No. 18—For testing amperage of dry cell A batteries and voltage of dry or storage A batteries, double reading, 0-8 volts, and 0-40 amperes DC.....\$1.25
- No. 35—For testing amperage of dry cell A batteries and voltage of B batteries (not B eliminators); double reading, 0-50 volts, 0-40 amperes DC..... 1.50

PANEL MILLIAMMETERS

- No. 311—For reading 0-10 milliamperes DC..\$1.75
- No. 325—For reading 0-25 milliamperes DC.. 1.00
- No. 350—For reading 0-50 milliamperes DC.. 1.00
- No. 390—For reading 0-100 milliamperes DC.. 1.00
- No. 393—For reading 0-300 milliamperes DC.. 1.00
- No. 394—For reading 0-400 milliamperes DC.. 1.00

VOLTAGE REGULATOR

- No. 218—For preventing excess voltage on the filament and cathode of AC tubes, by compensating for excess line voltage.....\$5.00

POCKET AMMETER

- No. 1—For testing dry cells, 0-50 ampere DC scale pocket meter.....\$.75

6-VOLT A BATTERY CHARGE TESTER

- No. 23—For showing when 6-volt A battery needs charging and when to stop charging; shows condition of battery at all times.....\$1.00

PANEL AMMETER

- No. 338—For reading amperage, 0-10 amperes DC.....\$1.00

Immediate Shipment

GUARANTY RADIO GOODS CO.,
145 West 45th Street, New York City.
Just East of Broadway

Send me the following individual meters (quantity in square):

- Cat. No. Cat. No. Cat. No.
- Cat. No. Cat. No. Cat. No.

NAME

ADDRESS

CITY..... STATE.....

TEN-DAY MONEY-BACK ABSOLUTE GUARANTY!

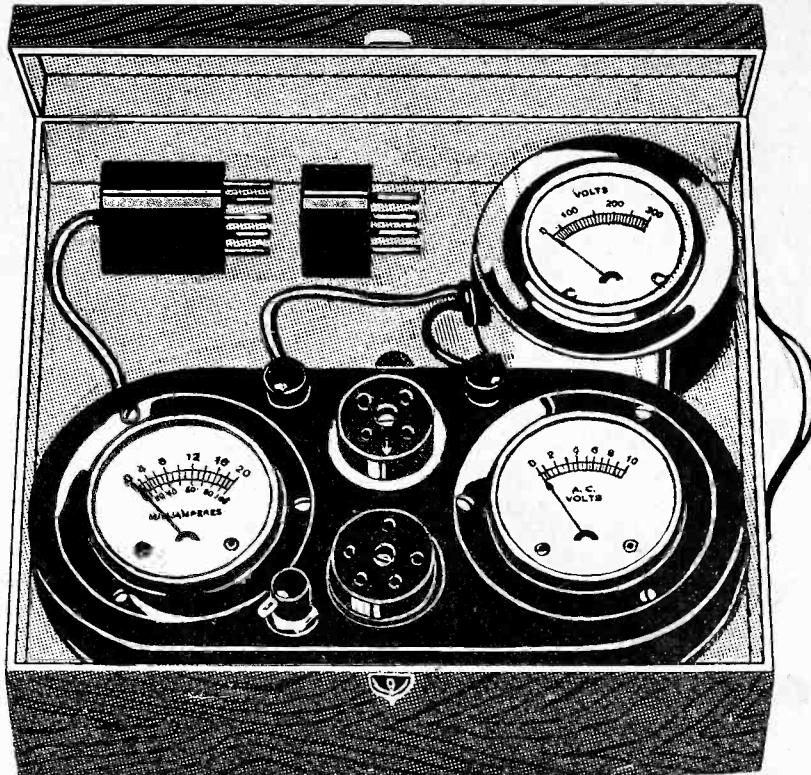
De Luxe Carrying Case **FREE**

With Each Jiffy Tester Combination!

This Meter Outfit Makes Thirteen Vital Tests in Only 4½ Minutes!

INSTRUCTION SHEET GIVES FULL DETAILS OF THESE THIRTEEN TESTS

The Jiffy Tester in its Case is a Testing Laboratory All by Itself. Leave the meters in the case. Simply lift out the plug, attaching the four-prong adapter, if testing a four-prong tube. Put plug in socket of receiver to be tested; put tube in Tester socket. The B voltmeter automatically connects to the proper points when its tipped leads are inserted in the two binding posts at rear.



This housed Jiffy Tester, with high resistance voltmeter for measuring B voltages, including those of eliminators, is a service kit of the highest value. The case is furnished in a de luxe finish, with handle. A patented snaplock makes it impossible for the lid to open accidentally. The Tester and high resistance meter fit so snugly in place that they will not jar in transportation. A 5-day money-back guaranty attaches to each sale.

Jiffy Tester Combination, shown one-third size, includes 0-10 voltmeter reading AC or DC (same meter reads both); 0-20, 0-100 milliammeter, with change-over switch; cord and plug with 4-prong adapter; 0-300 high resistance voltmeter. Price \$13.50. Complete instruction booklet and de luxe carrying case FREE with each order.

Jiffy Tester a Scientific Trouble Shooter

Every service man, custom set builder, home experimenter, student or teacher needs one of these Jiffy Tester Combinations. Ample accurate for this class of work. You will be well satisfied with assured 5% plus or minus accuracy. Jiffy Tube and Set Tester, consisting of 0-20, 0-100 combination milliammeter, 0-10 AC and DC voltmeter and 0-300 high resistance voltmeter. De luxe carrying case and instruction booklet FREE with each order. **Jiffy Tester Combination A. \$13.50**

The 0-300 high resistance voltmeter in "Jiffy Tester Combination A" is accurate to 5% plus or minus, so that at maximum reading it is not more than 15 volts off. Those desiring a more accurate 0-300 high resistance meter, never more than 3 volts off, at maximum reading, should order "Jiffy Tester Combination B," which has a 0-300 meter accurate to 1%, at a cost of \$1 extra. Order "Jiffy Tester Combination B." De luxe carrying case and instruction booklet FREE. **\$14.50**

Here Are the Thirteen Vital Tests!

- (1) to measure the filament voltage, up to 10 volts, of AC and DC tubes;
- (2) to measure the plate current of any one tube, including any power tube, from less than 1 milliamperes up to 100 milliamperes;
- (3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more);
- (4) to measure the B voltage applied to the plate of tube; the voltage across B batteries or B eliminators, up to 300 volts;
- (5) to determine the condition of a tube, by use of the grid bias switch;
- (6) to measure any tube's electronic emission;
- (7) to regulate AC line, with the aid of a power rheostat, using a 27 tube as guide;

- (8) to test continuity of resistors, windings of chokes, transformers and circuits generally;
- (9) to find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally;
- (10) to read grid bias voltages, including those obtained through drops in resistors;
- (11) to determine the presence of distortion and overloading;
- (12) to test for correct bias;
- (13) to determine starting and stopping of oscillation.

[Note—Instruction booklet fully informs you how to make each and every one of these tests in a jiffy.]

Note All That You Get!

- For \$13.50 you receive:
- (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 changeover switch. This reads plate current, which is always DC in all sets.
 - (3) One 0-300 volts high resistance voltmeter, No. 346, 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 molre metal case.
 - (10) One instruction sheet.
 - (11) One de luxe carrying case.
- If 0-500 volt 5% accuracy high resistance meter is preferred to 0-300 volts, add \$1.00, and order Combination C at \$14.50. If 0-500 volt 1% accuracy high resistance meter is preferred to 5% accuracy 0-500 voltmeter, add \$2.00, and order Combination D at \$15.50. [Note—A pair of adapters for UV199 tubes, Cat. No. 999, at \$1.00 extra. These are not sold except with Jiffy Tester Combination.]

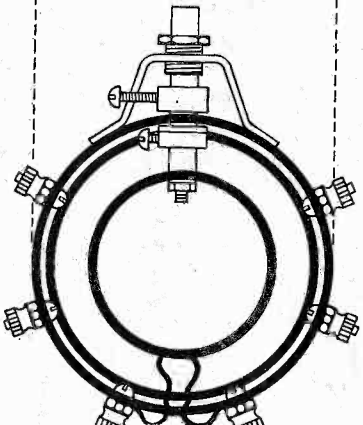
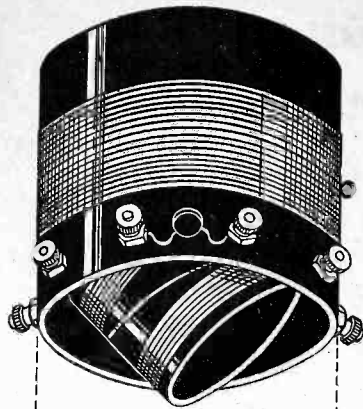
GUARANTY RADIO GOODS CO.
145 West 45th Street, New York City.
(Just East of Broadway.)

Please ship at once your Jiffy Tester Combination for which I will pay post-man advertised prices, but no shipping charges. (Check off below.)

- One Jiffy Tester Combination A (0-10 v., 0-20, 0-100 m. a., 0-300 v., carrying case, instruction booklet FREE).....Price \$13.50
- One Jiffy Tester Combination B (same as above, but with 0-300 voltmeter accurate to 1%). Price.....\$14.50
- One Jiffy Tester Combination C (same as A, except 0-500 voltmeter replaces 0-300). Price.....\$14.50
- One Jiffy Tester Combination D (same as C, except 0-500 voltmeter is accurate to 1%). Price.....\$15.50
- Set of 199 adapters. Price.....\$1.00

NAME.....
ADDRESS.....
CITY..... STATE.....
5-DAY MONEY-BACK GUARANTY

HOW TO USE SCREEN GRID COILS



Model 5HT. High impedance 3-circuit tuner, to work out of a screen grid RF tube. For .0005 mfd.\$3.00
Model 3HT. Same as above, but for .00035\$3.25

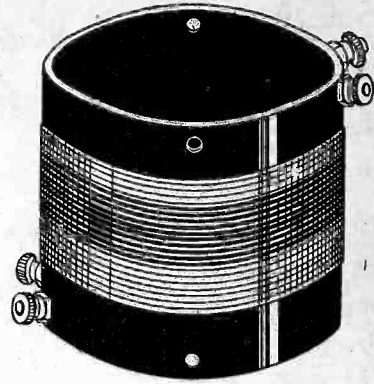
WHEN a screen grid tube is used as a radio frequency amplifier, the maximum gain, the best amplification, the most volume and the most DX are obtained by tuning the plate circuit. Then this enormous amplification is itself doubled by providing a secondary with twice as many turns as the primary has. The secondary is not tuned. The high impedance 3-circuit tuner at left (Model 5HT) is an example, as is the two-winding coil (Model 5TP) at lower left. The primary in these two instances is the outside winding and the tuning condenser goes across it. The secondary is wound on a separate form that is riveted inside the primary form. Preferably mount coils with binding posts at bottom for short leads. Then the connections for Models 5HT, 3HT, 5TP and 3TP are, from right to left as you look at the back of the coil: B+135, near front panel; plate of screen grid tube; two rotary leads (for tuner only); grid and (next to panel) grid return.

The antenna coil to use in screen grid circuits is 5A or 3A (upper right), because it is so designed as to equalize tuning. The low, almost zero, capacity between grid and filament of the tube is compensated by extra turns of wire, so that if the tube following the screen grid is of another type, for instance a regular detector, the elemental capacity difference is nullified. The antenna coupler has a continuous winding in shaded colors. The end with the larger number of distinctive turns goes to grid, the opposite end to ground. Either of the two remaining binding posts goes to antenna.

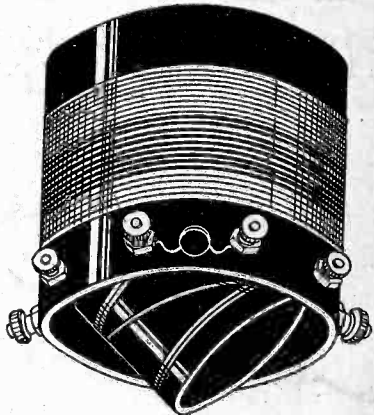
For single control screen grid sets the inductive trimmer type of antenna coupler (Model 5AS or 3AS, at right) should be used. The inductive trimmer coil for interstage coupling is Model 5TPS or 3TPS (not illustrated), but its connections are shown in the diagram at lower right. An inductive trimmer adds to or subtracts from the reactance, which is very important for resonance in single control sets. Trimming condensers only increase reactance, hence fail where decrease is needed.

Model 5TPS Interstage coupler to screen grid tubes, with inductive trimmer. For .0005 mfd.\$2.25
Model 3TPS, same as above, except it is for .00035.....\$2.50

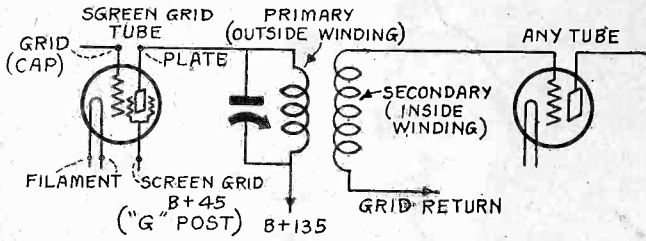
ALL ROTOR COILS HAVE SINGLE HOLE PANEL MOUNTING FIXTURE



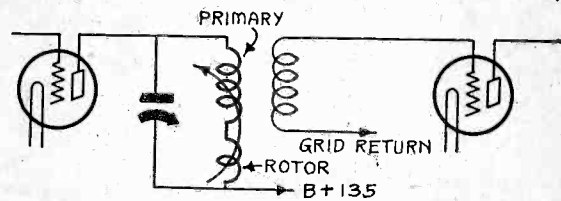
Model 5A. Conductively coupled antenna coil for input to screen grid radio frequency amplifier. For .0005 mfd. condenser. Price\$1.75
Model 3A. Same as above, but for .00035\$2.00



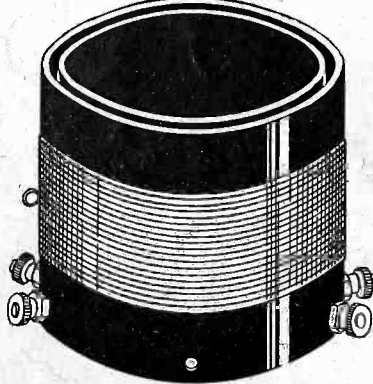
Model 5AS. Conductively coupled antenna coil for single tuning control screen grid sets. Rotor is an inductive trimmer. For .0005 mfd.\$2.75
Model 3AS, same as above, but for .00035\$3.00



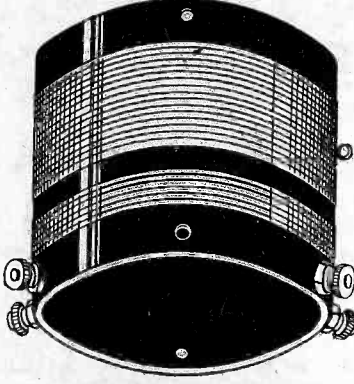
How tuned primary in plate circuit is wired for a screen grid tube. This illustrates the use of Model 5TP or 3TP, also Model 5HT and 3HT, except for the rotor coil connections.



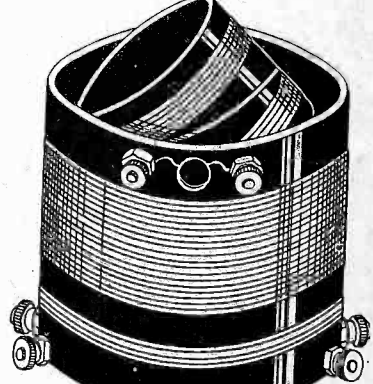
In single control circuits Model 5TPS is used as shown, for interstage coupling. The rotor is an inductive trimmer. The tube at left is a screen grid.



Model 5TP, the wiring of which is shown in the diagram directly above, is an interstage coupler for screen grid tubes. For .0005 mfd.\$2.00
Model 3TP. Same as above, but for .00035\$2.25



Model R5. Interstage coupler for replacing present coil in existing receiver when screen grid tube is substituted. For .0005\$1.50
Model R3. Same as above, but for .00035\$1.75



Model T5, standard 3-circuit tuner, not for screen grid tubes, but for all others. For .0005\$2.50
Model T3, same, but for .00035.....\$2.75

Coils for Other Than Screen Grid Tubes

When any tubes other than screen grid tubes are used as radio frequency amplifiers, standard coils are used, for instance Models T5 and T3, the three-circuit tuner shown above at right.
For the antenna coil in such a circuit use one with two separate windings, the familiar radio frequency transformer, with about 14 turns on the primary. This RF transformer is therefore used as antenna coil and as an interstage coil. The resultant loose coupling of antenna reduces the capacity effect of the antenna and thus the standard TRF coils, with 201A, 112A, 226, 227, 199 or 240 tubes, providing the same RF tubes are used throughout, may be used in single control sets without trimming devices. This is true if the coils are absolutely matched, as Models RF5 and RF3 are.
The small winding (primary) is connected in the antenna-ground circuit, or, for interstage coupling, in the plate circuit. The large winding (secondary) is tuned and is put in the grid circuit.
Model RF5. Antenna coil or interstage coupler for any and all tubes, excepting only screen grid tubes. For .0005\$1.00
Model RF3, same as above, but for .00035\$1.25
Model T5, standard 3-circuit tuner for .0005\$2.25
Model T3, standard 3-circuit tuner for .00035\$2.50

USE THIS COUPON

Screen Grid Coil Co., 143 W. 45th St., N. Y. C. (Just East of Broadway)
(Specify Quantity in the Squares)

Please mail me at once your following coils, for which I will pay postman the advertised prices, plus a few cents extra for postage.

Model..... Model..... Model..... Model..... Model.....

Name

Address

City State

SEND NO MONEY!