

Feb. 23d, 1929

15 Cents

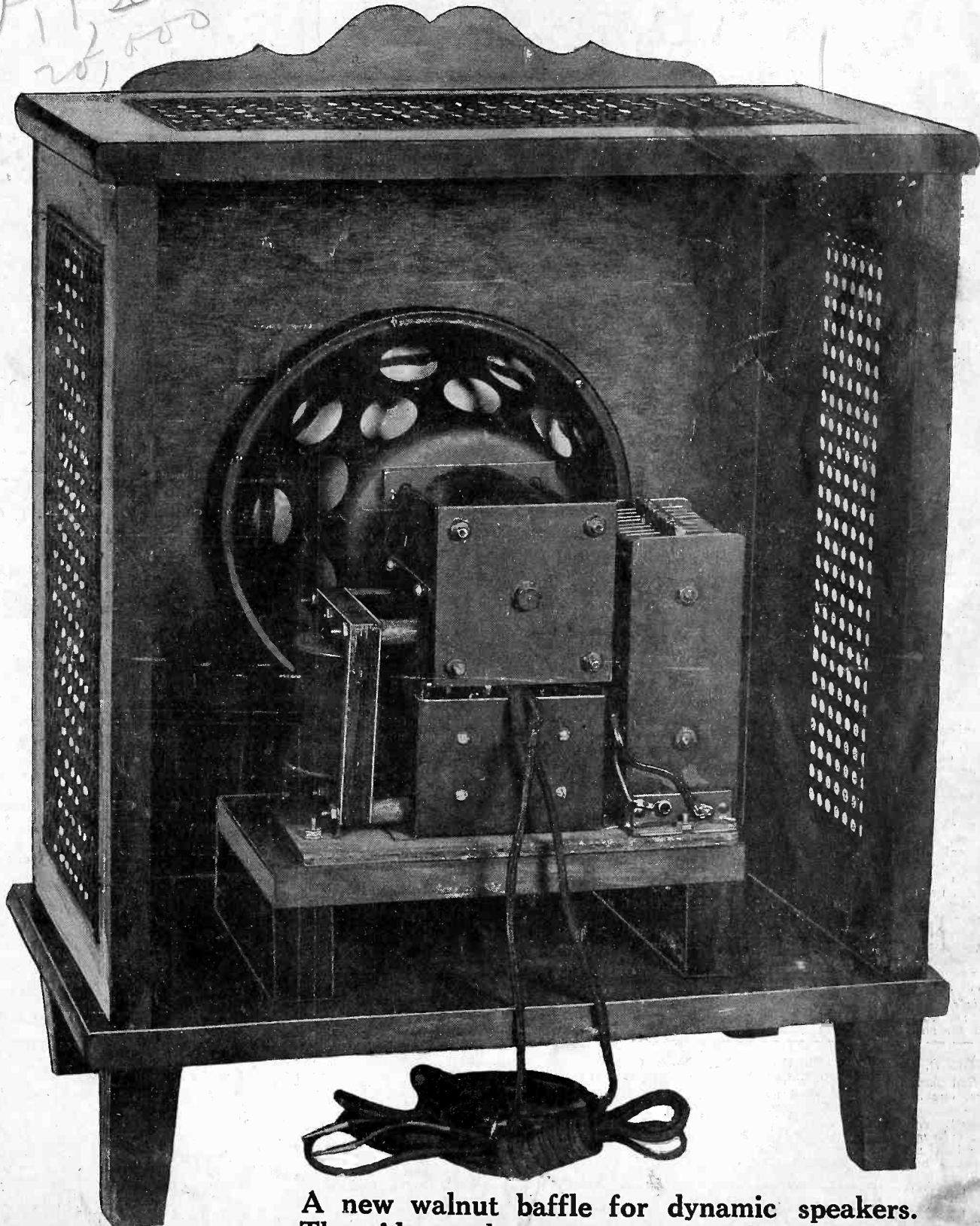
# RADIO

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# WORLD

The First and Only National Radio Weekly  
361st Consecutive Issue—Seventh Year

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 $1,002 \overline{) 22,500}$   
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A new walnut baffle for dynamic speakers. The sides and top are cane and the back is open for best frequency response. See page 8

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 HOOK-UP WIRE  
 "THE BRAID SLIDES BACK"

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

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**FREE** Send us the name and address of your dealer and we will send you a sample package of Braidite **FREE**. Include 10c for Postage.

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One good radio idea may be worth millions. Barawik has thousands of ideas for radio set builders to make more money. Barawik's Big Radio Book will help you while elections are on and big national events stir the world.

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 Real Reception

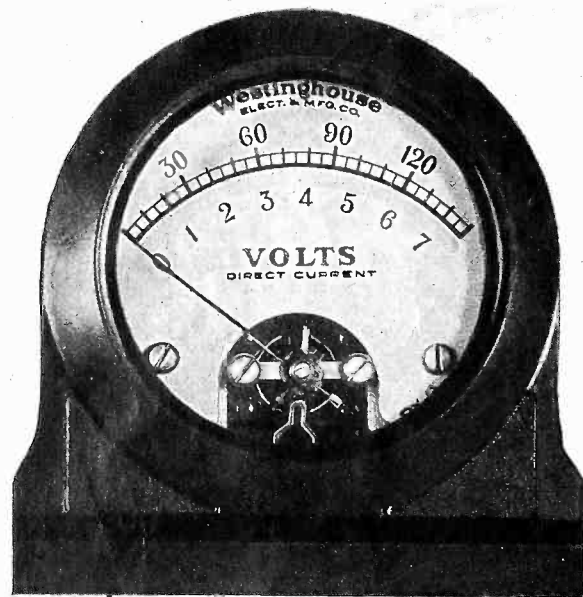
Highest quality heavy duty audio and output transformers for power and general purpose amplifiers and all kinds of speakers.

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**Westinghouse** 0-7 1/2  
 Double Range  
 Table Model Voltmeter **FREE!**  
 0-150 volts



THE Westinghouse double-range (0-7 1/2, 0-150 volts) table model voltmeter, illustrated at left in full size, is a precise and sturdy instrument, a product of the famous Westinghouse laboratories. Each meter bears the imprint "Westinghouse Electric & Mfg. Co.," as illustrated, and is packed in a red box bearing the Westinghouse registered trade mark as well as the Westinghouse Company's name and address, while the box contains an instruction sheet published by Westinghouse.

The meter is contained in a black, highly polished, moulded bakelite casing, tilted back a little, in which natural position the extreme accuracy of reading is obtained. The meter has the attractive appearance of a boudoir clock.

The scale is read through a sturdy crystal.

There is a mirror strip between the low-reading numbers and the base line of the scale, for closest observation. The needle is read in respect to its own reflection in the mirror strip to insure utmost accuracy of reading. The knife-edge pointer is another aid to precise reading.

Double range table model voltmeter; scales, 0-7 1/2 volts and 0-150 volts; made by the Westinghouse Electric & Manufacturing Company. Accurate to 1% plus or minus. Equipped with built-in zero corrector. 34" connecting cable with tip jacks furnished with each meter. Illustration is actual size.

**Meter Employs Dynamic Principle**

THE mechanism consists of a strong, permanent magnet of aged steel, a moving coil (d'Arsonval movement), and a knife-edge pointer counterbalanced in two directions. The needle comes quickly to rest on the silver-etched dial.

End-stops are built in. The low scale (0 to 7 1/2 volts) reads 1/4 of a volt per division, with ample room for closer reading, while the high scale (0 to 150 volts) reads 5 volts per division, with closer definition equally easy.

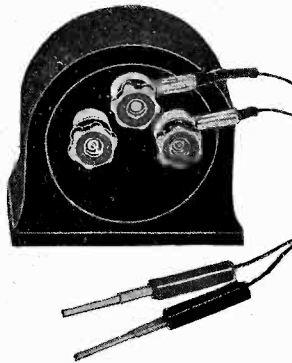
At rear are three binding posts, equipped with lock washers and anchor bevels, so that the lugs of the 34" connecting cable are held tightly in place. The other end of this cable has tip jacks. The cable is external to the meter, but is furnished with each meter.

Due to adequate resistance per volt, the meter may be used to measure any direct current voltage source, up to 150 volts, including B eliminators, B batteries, storage A and B batteries, dry cells, Edison cells, house electric current (110 volts DC) etc. It will not measure alternating current.

Every one should seize at once this remarkable opportunity to own a really fine meter—an instrument that will fill any one with pride of ownership, because of its precision and beauty.

Send \$6.00 now for one year's subscription for RADIO WORLD and this meter will be sent free.

This offer is revocable without notice! Act NOW to avoid disappointment. If we receive your \$6 too late for you to cash in on this offer, we will return the money to you the same day it is received.



Rear view of meter, with connecting cable attached. The center post is always minus. The post at right is for 0-150 volts reading, the one at left for 0-7 1/2 volts. Each post is plainly marked on the casing.

RADIO WORLD, 145 West 45th Street, New York City

Enclosed find \$6.00 for one year's subscription for RADIO WORLD, (52 numbers, one a week) and send as a premium one Westinghouse double scale table model voltmeter (0-7 1/2 and 0-150 volts direct current).

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**NO OTHER PREMIUM WITH THIS OFFER**

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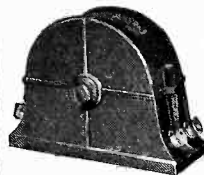
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99RF is useful as an antenna coil where high selectivity is desired and as an inter-stage coupler for all tubes, battery or AC, except screen grid tubes. Tunes with .0005 mfd. only.

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For connecting two speakers by turn of knob so that at No. 1, left, you operate one speaker alone; at No. 2 you operate both speakers together; at No. 1, right, you operate the other speaker alone. Excellent for store demonstrations or home use. Earphones may be substituted for one speaker.

Cat. 1234 for connecting 4 speakers, one to play at a time.....\$2.50

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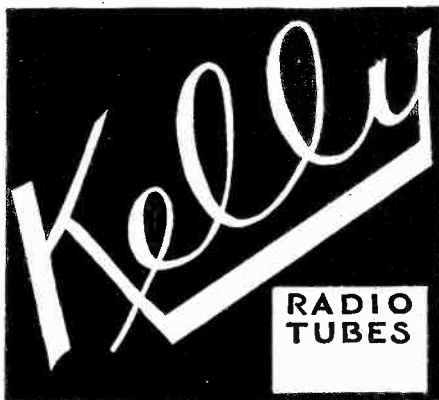
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One screen grid 422.....\$3.50  
Two 410A at \$1.00 each..... 2.00  
One 412A (for 135 volts)..... 2.00  
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Send \$7.50 for set of four tubes for this receiver. Specify whether power tube wanted is 412A or 471A

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## 422 SCREEN GRID

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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.

## Complete Kit of Parts for the Four-Tube Screen Grid Universal

As Specified by Herman Bernard

**What You Get** L1, L2—One Screen Grid two-center-tapped secondary; Model 5RF for .0005 mfd. L3, L4—One Screen Grid high impedance interstage coupler, with center-tapped primary; Model 5TP for .0005 mfd. C1—One .00025 mfd. Aerovox grid condenser, with slip. C2, C3—Two Hammarlund Midline .0005 mfd. tuning condensers. C4—One Hammarlund junior condenser; Cat. No. MC11 (50 mmfd.). R1—One Lynch metallized grid leak, 2 meg. R2—One No. 622 Amperite, with mount. R3, R4, R5—Three No. 1A Amperites with three mounts. Rh—One 50-ohm rheostat. T1, T2—Two National new audio transformers. SW—One filament switch. PL—One pilot light bracket with lamp. Two dials with two dial pointers. Two knobs. Four binding posts (Ant., Gnd., Speaker plus, Speaker minus). One 10x20-inch aluminum self-bracketing subpanel, with sockets affixed, and including hardware and insulating washers. One 7x21-inch drilled Bakelite front panel. One nine-lead battery cable. One Peewee clip.

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### 4-tube SG Universal

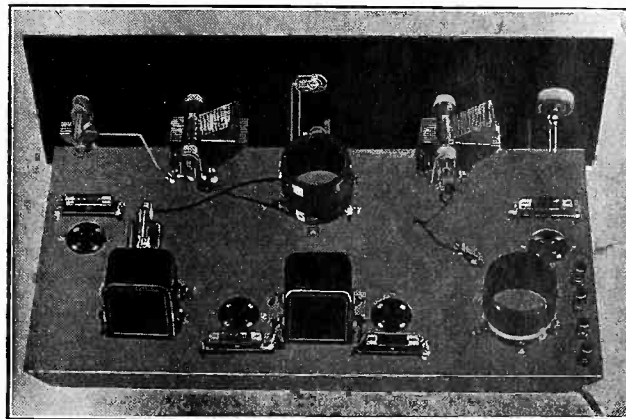
Antenna coil, Model RF5 for .0005 mfd.....**\$1.00**  
Antenna coil, Model RF3 for .00035 mfd..... 1.25  
Coupler, Model TP5, for .0005 mfd. .... 2.00  
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## Unusual Results on Four Tubes!

**H**OW much can one achieve on only four tubes? The new Screen Grid Universal is the answer. It meets all the requirements of the wavelength reallocation, brings in distant stations distinctly, affords exceptional tone, and is easy to build. You'll be surprised at the results. Your friends, too, will admire your receiver. You can sit them down in your parlor and give them loud-speaker reception of distant stations they never heard of—100-watt stations, too!

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!

## Very Selective, Yet Lots of Volume!

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 tone it down with the volume control, even on far-distant stations!

The screen grid RF tube is followed by two -01A tubes, while the output tube may be a -12A or -71A power tube, depending on whether you have 135 volts or 180 volts maximum at your disposal.

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.

**RADIO WORLD, 145 W. 45th St., New York City**  
(Just East of Broadway)

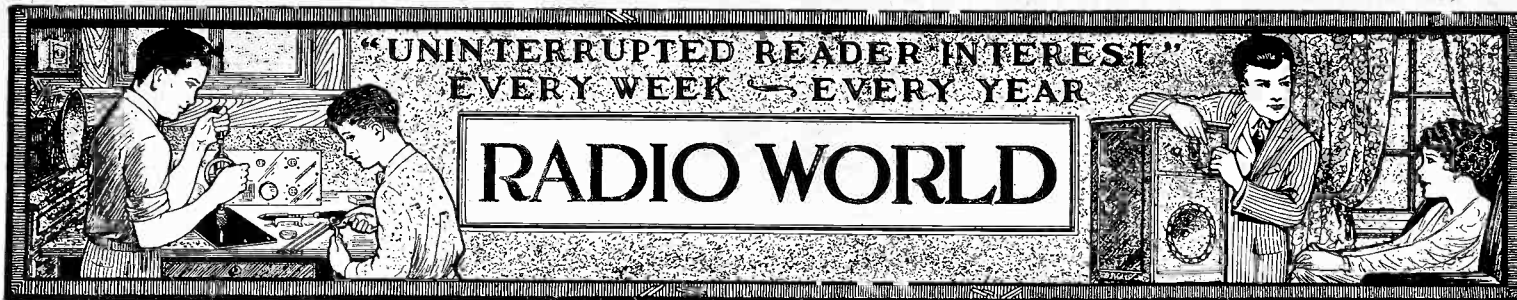
Enclosed please find \$1.00 for which send me at once a blueprint of the 4-tube Screen Grid Universal Receiver, as designed by Herman Bernard.

45c extra for Dec. 1st, 8th, 15th issues of Radio World.

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Vol. XIV, No. 23      Whole No. 361  
 FEBRUARY 23d, 1929  
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 Technical Accuracy Second to None

A Weekly Paper published by Hennessy  
 Radio Publications Corporation, from  
 Publication Office, 145 West 45th Street,  
 New York, N. Y.  
 (Just East of Broadway)  
 Phone: BRyant 0558 and 0559

## N. Y. MUNICIPAL STATION JOLTS WAVE-SHARER

Unable to obtain what it considered as adequate consideration from WMCA its channel-sharer, WNYC, the municipal station of the City of New York (526 meters), has given up all hope of dividing time each day with WMCA and has fallen back on the Federal Radio Commission's alternative of broadcasting every other day.

WNYC issued the following statement through Albert Goldman, Commissioner of Plant and Structures, under whose department the station functions:

"Pursuant to the advice of the Corporation Counsel, I beg to advise you that WNYC will broadcast pursuant to the license dated Nov. 1, 1928, the subsequent order of the commission dated Nov. 13, and the continuation license of Jan. 25, 1929. These licenses and order provide that the city's station shall have full time on alternate days, beginning Monday, Nov. 12, 1928, and Station WMCA full time on alternate days beginning Tuesday, Nov. 13, 1928.

### WMCA's Position

Donald J. Flamm, president of WMCA, said:

"WMCA stands ready to offer its entire facilities to the city of New York for the broadcasting of all the civic functions and educational programs that are of importance to the people of the city.

"Both WMCA and WNYC are New York City radio stations, using a New York air channel. WNYC is operated and managed at a cost of \$50,000 per year, thus using \$50,000 of the city taxpayers' money for the broadcast of civic functions and educational features.

"WMCA, on the other hand, is an independently owned and operated station, costing the city nothing.

### Offers Use of Station

"Despite this, WMCA is prepared and stands ready to save the city this \$50,000 cost by offering its transmitter, studios and entire facilities to the city for the broadcasting of these civic functions and educational features."

Mr. Flamm and Marion K. Gilliam, managing director of WMCA, went to Washington about the time division.

WMCA recently went on the air when the municipal station was broadcasting the reception to Capt. J. T. Fried and the other officers and the crew of the America. Previously a speech by Charles Evans Hughes was cut off because WMCA was scheduled to take the air. Several times both stations have been on the air at the same time on the same wave.

## Universal Denies Offer of Stock

Washington

The Universal Wireless Communications Company, Inc., of Buffalo, N. Y., recently granted forty short waves by the Federal Radio Commission for message transmission and reception, while the Radio Corporation of America was granted none, does not at present "intend to make any general public stock offering," said Dr. John Nathansohn, the corporation's eral representative, before a House committee.

"The money will be provided," continued Dr. Nathansohn, "by the directors and the present stockholders and by such additional stockholders as the directors may invite in until the economic soundness of the proposition has been demonstrated, not only to the satisfaction of this company and its officers, directors and stockholders, but to the reasonable satisfaction of persons and corporations having an interest in such a subject."

Bankers had advised the issue of common stock for financing and distribution by national organizations,

## COOLIDGE PICKS THE NEW BOARD

Washington

The Federal Radio Commission will have its full complement of five members if Congress concurs, as President Coolidge has appointed the following:

Arthur Batcheller, to succeed Orestes H. Caldwell (First Zone).

Prof. Cyril N. Jansky, Jr., to succeed Sam Pickard (Fourth Zone).

Mr. Batcheller for years has been Federal Radio Supervisor at New York City. He hails from Natick, Mass.

Prof. Jansky is in charge of the radio study at the University of Minnesota.

Both of the appointees are members of the Institute of Radio Engineers, and both have had wide experience in practical radio affairs.

President Coolidge also nominated for reappointment the following Federal Radio Commissioners:

Ira E. Robinson (present chairman) for two years.

Eugene O. Sykes for five years.  
 Harold A. Lafount for four years.

Arthur Batcheller said in his office in New York City:

"I declined the job of Federal Radio Commissioner, but I do not suppose it will do me any good if they want me to serve. I do not know what steps Washington will take on a letter I sent discouraging the proposed appointment. If they want me to serve as Radio Commissioner I probably will have to do it, however."

## BILL TO EXTEND BOARD WINS IN 2 COMMITTEES

Washington.

Both the Senate Interstate Commerce Committee and the House Committee on Merchant Marine and Fisheries favorably reported to their respective bodies the White-Watson bill to extend the life of the Federal Radio Commission for one year, to March 15th, 1930. Both houses are expected to pass the bill, although preference under the rules would be necessary, and President Coolidge would sign it.

The bill also provides a salary of \$10,000 for chief counsel of the Commission with \$7,500 for each of three assistant counsel.

The testimony, in general, taken before the two committees, developed a favorable attitude toward such continuation. However, Commissioner Orestes H. Caldwell opposed it, as did Col. Manton Davis, general counsel of the Radio Corporation of America, on the ground the Board exercises dual power—administrative and appellate—and might be retained to pass on controversial matters, while the Department of Commerce would handle the administrative work.

### Hoover to Remain Silent

The turn of events, with the likely enactment and signing of the law, changed a proposal for Herbert Hoover to discuss the radio situation in his inaugural address.

The administration of radio is highly technical and should be in the hands of experts, Caldwell said, and the Commission itself should be left free to perform its important appellate and judicial duties of reviewing the controversial cases brought before it, without being overloaded with administrative detail.

The Radio Division of the Department of Commerce he said, is manned with experts and the necessary apparatus, "and is best fitted to take over the work of radio supervision, leaving to the Commission the work originally contemplated for it—that of acting as an appellate or review board, passing upon radio controversies, and so safeguarding the rights of the public and of radio applicants."

### Didn't Know Job Well

He stated that the Commission would have worked to better advantage had it had men acquainted with the technical problems.

"No doubt the allocation would have been finished many months ago and taken effect in July, and would have given a satisfactory arrangement in accordance with the principles of sound radio," he said, in emphasizing that radio is a technical problem from the administrative viewpoint. The reallocation which became effective in November,

(Continued on next page)

# REALLOCATION IS TENTATIVE, HOUSE IS TOLD

Washington  
The House committee, in favorably reporting the bill to extend the life of the Federal Radio Commission one year, which it did unanimously, submitted a report to the House. Extracts from this report follow:

"Your Committee are of the opinion that we should again extend the original authority of the Commission. Its members are intimately acquainted with the problems within the broadcasting band of frequencies. By the legislation of last year there was forced a readjustment of radio throughout the United States. Following long study and exhaustive hearings the new plan of distribution of radio facilities was put into effect not yet three months ago.

### Reallocation Tentative

"The set-up worked out is of necessity tentative in character and must be subject to change from time to time as experience develops defects in the plan or as opportunities for improvement present themselves.

"Your committee believes that the experience and knowledge gained by this Commission during the last three years and in particular during the latter months in perfecting the present broadcasting system should be further availed of. Within the past year has come a new interest in point to point communication by short waves on this continent.

"The allocation of these waves involves the determination of basic questions of policy and the assignment of a limited number of frequencies to an almost unlimited number of applicants."

"To these problems the attention of the Commission has been directed. It seems to the Committee that here again are tasks which should continue to engage the thought and efforts of the Commission; that these responsibilities should not be transferred to a new authority.

"The Commission for nearly two years has been a party to negotiations carried on with the neighboring countries of Canada, Mexico and Cuba, with respect to the use by these nations and by the United States of the frequencies within both the broadcasting bands and the so-called continental point-to-point band. Within a month, members of our Commission have been in Canada in conference with Canadian authorities on this subject.

### Consequences of Failure

"A failure to reach an agreeable understanding with these nations would threaten the most efficient service in all. The Commission should be able to continue these conferences now in process. It is not the part of the wisdom to abandon them or to completely change the representatives of the United States.

"The Committee directs attention to the fact that should we fail to pass this legislation we should be obliged (1) to build up in the Department of Commerce an organization comparable in numbers and in duties with that of the Commission, or (2) the Secretary of Commerce would have nominal responsibility only. Without such an organization he would of necessity be compelled to refer to the Commission every problem of consequence and every matter of controversy. If, therefore, the Commission must face in truth the difficulties of radio regulation, difficulties complex and ever changing, it should be invested with original authority."

## A Thrill in Her Trill



**NINA GORDANI, LYRIC PRIMA DONNA, RECENTLY HEARD IN THE RADIO - KEITH - ORPHEUM HOUR, OVER A NATIONAL BROADCASTING COMPANY CHAIN**

# BILL RUSHED FOR PASSAGE

(Continued from preceding page)

he declared, was a "compromise but against scientific knowledge."

"Radio was handled best and complaints were fewest when the administration of radio was in the hands of the Department of Commerce, under Secretary Hoover," stated Mr. Caldwell.

He pointed out that the Department of Commerce has 135 people in its Radio Division of whom 65 are trained radio men, whereas the Radio Commission has a staff of 82, of whom only four are exclusive radio men.

### Efficiency Retarded

Asked whether the Commissioners worked together, Mr. Caldwell said the delay that comes from five men with different points of view "simply stops all progress." Administrative efficiency, he declared, "will always be retarded where five men have to consider and pass upon each detail in connection with thousands of items, many of them routine. Under such conditions, major issues are often lost sight of. The formulation of progressive or consistent policies is interfered with, and the public interest is not necessarily safeguarded in important cases."

The only technical solution for radio broadcasting, said Commissioner Caldwell is to set aside 50 or 60 cleared channels instead of the present 40. Had this been done many existing situations causing complaint could have been solved, he said.

### THORDARSON APPOINTS HEALD

Chester H. Thordarson, president, has announced the appointment of Merwyn Heald as chief engineer of the Thordarson Electric Manufacturing Company. This appointment is in accordance with the policy of the management to select men for executive positions from within the organization. Mr. Heald previously was the Robertson-Davis Company's chief engineer.

# DAVIS OF RCA TELLS WHY ITS STOCK SOARED

Washington  
Public confidence in the future of radio was responsible for the remarkable rise in the price of Radio Corporation of America stock, Col. Manton Davis, vice-president and general counsel of RCA, told the Senate Committee on Interstate Commerce.

"The rapid rise was a surprise to the officers and directors of RCA, just as it was to investors generally," said Col. Davis.

"The cause of the rise was largely psychological, due to the public's idea of the great future possibilities of radio. The public visualized a repetition of the stock value rise that characterized Ford and American Telephone and Telegraph, where a few hundred dollars made a handsome profit for those who had the foresight to invest and the patience to hold on."

### Brokers Hold Blocks

Col. Davis denied that the rise in RCA stock had anything to do with any fight to gain control of the corporation.

In telling about holders of RCA stock, Col. Davis recounted that blocks are held by brokers for customers. He cited some examples:

J. S. Bache & Co., 10,373 shares of common, 625 shares of preferred; estate of T. H. Given, 8,000 shares of common, 12,500 shares of preferred; H. Content & Co., 31,790 shares of common; Dominick & Co., 18,138 shares of common, 80 shares of preferred; Hornblower & Weeks, 10,506 shares of common, 111 shares of preferred; W. E. Hutton & Co., 13,110 shares of common.

During 1929 RCA common has been low at 345½ and high at 410, and was around 350 when Col. Davis was testifying.

The rapid rise from less than 100 took place since the Spring of 1928. The stock was the market leader and a rise was general throughout the list, due to the bullish effect produced by RCA stock.

President Harbord of RCA recently told a Congressional committee that the extensive rise in price of RCA stock was not justified by earnings and profits. RCA reports have been excellent, but profits were not quadrupled in nine months.

Col. Davis pointed out that there are 18,000 stockholders of RCA in every part of the country. Last year RCA realized an operating profit of \$18,000,000, he said. It has never paid more than a dividend of 7 per cent on its preferred stock, he explained, adding that the executives and directors of RCA are "small stockholders."

### Why Public Is Interested

The public is interested in radio, he continued, because of the "great many things peeping out of the laboratories."

Other developments incident to radio, such as talking machine combinations, and talking motion pictures, which, he said, were developed largely in the radio laboratories, as well as television, which now is in process within the laboratory, but which he said "came out too soon and the people expected too much," were added to the public's interest.

### DISTRICT MANAGERS NAMED

Two new district sales managers announced by DeForest Radio Company. Jersey City, N. J., are Guy C. Kowfeldt, of 529 South 7th Street, Minneapolis, Minn., and E. F. Coghlin, of 10 High Street, Boston.



## VOICE IN SKY STARTLES CITY

From far above the raucous noises of New York's busy streets, there recently came floating down for a few million New Yorkers to hear, a command to smoke a well-known brand of cigarettes, the command being alternated with snatches of music. From above Times Square and the Grand Central Terminal section down to the financial district on the end of Manhattan Island, a huge airplane alternately climbed to a height of 3,000 feet and coasted down by a spiral route toward the peaks and towers of the city.

It was a huge tri-motor Fokker biplane, equipped with Western Electric sound amplification apparatus and carrying a crew of pilot, mechanic, public address system operator, and broadcasters in the persons of a vocalist and two professional radio announcers. The sound of their voices as it struck the microphone was amplified approximately 100,000,000 times and broadcast through three horns inserted in the floor of the fuselage, mouths downward. With the exception of the microphone, all the equipment, including the music reproducer, was located in a compartment directly behind the pilot's cabin. When actually broadcasting, the vocalist or announcer was within a small sound-proof booth, to the rear of the apparatus room.

### Reporters to Sum Up National Politics

"THE Political Situation in Washington Tonight," a weekly feature of the National Broadcasting Company, has been expanded from a one-man job to a general coverage of governmental and political topics through discussions by Washington correspondents.

"It is our intention to offer the country a symposium of national events by the best observers and analysts of those events," said M. H. Aylesworth, president. "We believe that by presenting Washington correspondents for newspapers from various sections of the country we will be able to render a better balanced and more comprehensive service."

"The Political Situation in Washington Tonight" previously was conducted by Frederic William Wile alone.

### Two New Receivers By Atwater Kent

Two new electro-dynamic Atwater Kent radios were announced. Model 46, a table set, uses seven AC tubes and one rectifying tube with double power tube stage. It is priced at \$83. The company also announces an electro-dynamic speaker at \$34.

The second new model set, No. 53, is an "all-in-one" instrument, in the form of a low, metal console. It lists at \$117.

#### WEBER ADDS LINES

Jack Weber, president of the Weber Distributing Company, 90 West Broadway, announces the addition of several new lines. The lines now include Arcturus tubes, Rayovac batteries, Elkon rectifiers, and Knapp A-power.

#### WORTH THINKING OVER

RADIO is a great amusement, any way you take it, but let the late Nat C. Goodwin, the famous American comedian, tell it, although he was talking about something else. A friend once asked Mr. Goodwin if he enjoyed being an actor. To which the star replied: "Oh, yes—but it does cut into one's evenings so."

## Czechs to Erect Largest Station

The International Telephone and Telegraph Corporation made the following announcement in New York City:

"The largest radio broadcasting station in the world has been ordered by the Czechoslovakian Government from the International Standard Electric Corporation. It will have a power of 120 kilowatts in the antenna as compared with 50 kilowatts in the largest of the broadcasting stations now operating in the United States. This should make it audible to radio listeners all over Europe.

"The broadcaster will contain eight vacuum tubes of 20,000 watts each in parallel. It will be designed to provide a very high degree of modulation which will result in the reproduction of music with the greatest fidelity.

"While the location of the new station has not yet been definitely decided, it is probable that it will be built in Prague.

## HOOVER SPEECH TO SPAN GLOBE

The voice of Herbert Hoover, delivering his inaugural address March 4, will be heard around the globe, through rebroadcasts of the National Broadcasting Company's program, M. H. Aylesworth told the New York Electrical Society and the New York section of the American Institute of Electrical Engineers.

A detailed description of the proceedings, including a witness story of the four-mile-long inaugural parade, will be heard by 50,000,000 listeners in the United States, and millions of others in foreign countries, Mr. Aylesworth added.

The day of international broadcasts has arrived, the speaker said, and cited the recent rebroadcast by the NBC's coast-to-coast system when a program from London immediately followed an address by President Coolidge.

### Sweden Has 265,000 Sets and 27 Stations

Sweden, with a population of approximately 6,000,000, has 27 broadcasting stations and 265,000 receiving sets, the operation of which is permitted under Government license. The stations are connected, for purposes of simultaneous broadcasting, by 6,000 kilometers of open wire lines. The service is maintained through the co-operative efforts of the Swedish Government and a private program company called A/B Radiotjänst.

Broadcasting was started in this most densely populated of Scandinavian countries in 1923. At that time one small 500-watt Western Electric transmitter was set up. Now principal stations are to be found in Stockholm, Goteborg, Malmo, Sundsvall, Boden, Ostersund and Motala.

### Shearer and Clifton Join Sleeper Corp.

Hal P. Shearer, formerly general manager of the Splitdorf Radio Corporation of Newark, N. J., has become vice-president and general manager of the reorganized Sleeper Radio & Mfg. Corp. A. N. Clifton, formerly sales manager of the Alden Manufacturing Co., of Springfield and Brockton, Mass., is the new Sleeper sales manager.

Sleeper and the Temple Corp. of Chicago recently merged, but the Sleeper organization functions as an individual entity.

## ASKS CHECK ON SOS POSITION

Washington.

Cross bearings, taken by radio, should be used when any doubt exists as to the position of a ship that sends an SOS, said George R. Putnam, Commissioner of Lighthouses. Often the distressed vessel can not correctly give its own position, as a rescue ship dashes for a point many miles away from the actual position.

"If a ship is in doubt as to where an SOS comes from, it should get in touch with other ships, and define the position of the disabled ship by cross bearings," said Commissioner Putnam. "A navigator thus can plot on his chart the real position."

"This method is not necessary if the vessel in trouble knows its correct position," he added, "but there will be instances, as in the recent rescue of the crew of the Florida by the America, when there is so large an error in the supposed position, in this instance, 150 miles, as to cause confusion and the possible loss of valuable time.

"The constant increase in the radio installations on ships and the improvement in radio efficiency are having the effect of saving from the sea the crews of many vessels which before the days of radio often would simply have been reported 'missing.'

"There are now at all times along the traveled steamer lanes sufficient vessels efficiently equipped with radio compasses, and capable of taking accurate bearings at distances of several hundred miles, to permit the determination of the location and distance of any ship capable of sending an SOS."

### N. B. C. Bureau Alone To Book Damrosch

Walter Damrosch's entire professional activities are now under the exclusive management of the National Broadcasting and Concert Bureau, including concert hall as well as radio appearances.

"It will be necessary for me to limit my activities to my radio work and my occasional appearances as guest conductor," said Mr. Damrosch.

"The National Orchestra, with which I shall carry on my radio concerts, already represents a splendid body of musicians. Soon it will be organized as the equal in artistic performance and technique of any major symphony orchestra."

Damrosch began recently a new series of Saturday evening concerts under the auspices of the General Electric Company. His series of RCA Educational Concerts, given for school children on Friday mornings, continues until the middle of May.

### Control of Sensitivity Effected in Two Ways

One way to reduce the signal pick-up, a suitable variable high resistance may be shunted across the antenna and ground connections of a receiver. A table type clarostat will serve this purpose, since it can be installed without any changes in the set wiring and can be put where handiest.

Control of sensitivity of the detector is often advisable. This can be done either by substituting a suitable variable grid leak for the fixed grid leak, or placing a variable high resistance across the grid return terminals of the detector socket. A grid leak clarostat which has a range of 1/10th to 10 megohms is suitable.

# 1928 EXPORTS BREAK RECORD

Washington.

American exports of radio apparatus and equipment in 1928 set a new record, the grand total of shipments being valued at \$12,081,410, according to figures just made public by the Electrical Equipment Division of the Department of Commerce.

The full text of the Department's statement follows:

"The 1928 exports include \$768,728 worth of transmitting sets and parts, \$4,549,825 of receiving sets, \$1,017,560 of tubes, \$3,054,310 of receiving set components, and \$2,670,987 of receiving set accessories, a grand total for the year of \$12,081,410. This is an increase of \$2,157,623 over 1925, the highest year in radio exports, when \$9,903,787 worth of radio goods were shipped. The percentage of increase is 21.8 per cent."

## VALLEE'S NEW SCHEDULE

Rudy Vallée and his Orchestra, recording and broadcasting unit of former Yale Collegians, have come under the management of the National Broadcasting and Concert Bureau and are heard over the NBC chain every Tuesday afternoon beginning from 5:00 to 5:30 o'clock (WEAF); on Thursday beginning from 5:30 to 6:00 o'clock (WJZ); and on Saturdays beginning from 4:30 to 5:00 o'clock (WJZ). The broadcasts are from the Hotel Lombardy, New York.

## ELECTRICAL APPLIANCE STORE

The Electrical Appliance Co. at 145 Greenwich Street, New York City, has just begun business. Among lines carried are Tobe products, including the A eliminator, which operates up to ten tubes, and the Tobe Filterettes, of which there are fourteen different models; Acme Apparatus Co. of Cambridge, Mass., including the new model voltage regulator, the B eliminators and the new replacement transformers.

## A THOUGHT FOR THE WEEK

*NOT long ago theatrical magnates refused to believe radio was anything but a plague sent to spoil the sweet tenor of their dreams. To-day radio is regarded by many of these gentry as the saving grace of a rather bad case of falling arches of the box-office. How have the mighty few fallen into the mental gait of the overwhelming majority.*

# They Say

**DR. JOHN H. DELLINGER**, chief of radio section, U. S. Bureau of Standards; former president, Institute of Radio Engineers: "The constantly increasing percentage of aviation accidents resulting from hazards of weather is due to the slowness with which radio aids to air navigation have been advancing," said Dr. Dellinger. "Radio seems the answer to those hazards, and there is ground for hope that not only this percentage of accidents but the whole number of accidents will become vanishingly small when the present possibilities of radio are realized in practice."

**JOHN V. L. HOGAN**, former president, Institute of Radio Engineers: "There are too many stations. There is not enough room for all good stations, yet new ones are under consideration. There should be at least fifty cleared channels. Sixty would be more like it, and these channels should be allotted to the best stations in the country."

**HUGO GERNSBACK**, editor "Radio News": "No one can foretell at present whether the 'advertising tie-up' broadcasting scheme of today is final, or whether something entirely new will be evolved. The entire broadcasting industry is in constant flux and there is really nothing very much settled about it today; it is too young and too new for that. It is also to be doubted that, ten years from now, broadcasting will be done in the channels between 200 and 545 meters now used. It is frequently predicted that, sooner or later, there will be a stampede down to the lower wavelengths, where there are more channels and other advantages, as well as certain disadvantages."

## AUDIO BULLETIN ISSUED

"Precision Audio Resistance Amplifiers for Television and Laboratory Experimenters," by Joseph Morgan, is a pamphlet issued by the International Resistance Company. Stable resistance-coupled amplifiers capable of handling direct and audio-frequency voltages up to 10,000 cycles are described. In addition to being clearly and completely described, each of these amplifiers is shown schematically, with a list of components, and also with its gain frequency curve.

A free copy is available to Radio World readers. Write to Francis R. Ehle, president, International Resistance Company, 2006 Chestnut Street, Philadelphia.

## NEW KELLOGG DISTRIBUTOR

The Drennen Motor Car Company, of Birmingham, Ala., recently entered the radio business as Kellogg distributor for western Florida and the state of Alabama.

# CROSLEY AHEAD BY \$3,605,973

Cincinnati.

The Crosley Radio Corporation's total net profit for 1928. Federal income tax deducted, was \$3,605,973.78, or \$13.87 per share on the outstanding stock. It was voted to increase the common no-par stock to 600,000 shares, making a two-to-one split. Crosley stock at present is listed on the Cincinnati exchange and it was announced that application would be made to list it on the New York Stock Exchange.

Powel Crosley, Jr., president, stated in his annual report that although the company is essentially concerned in the manufacture of receiving sets, for the past five years it has been the largest manufacturer of loud speakers in the world.

## TICHENOR WITH FRESHMAN

Colonel C. M. Tichenor has been elected vice-president in charge of production for the Chas. Freshman Co., Inc. He has been affiliated with manufacturing for twenty-two years.

Following the war, Colonel Tichenor was assistant general manager of the Pierce-Arrow Motor Car Co., in charge of production; and recently works manager of the Kellogg Switchboard & Supply Co.

## PERRYMAN'S CHICAGO OFFICE

Perryman Electric Company, Inc., North Bergen, N. J., announces the opening of the sales and service office in the McCormick Building, 332 South Michigan Avenue, Chicago. R. B. Lacey, western sales manager, will be in charge. The present policy of distributing Perryman Tubes through wholesale channels will be retained.

## POLYMET EXPANDS AGAIN

The Polymet Manufacturing Corporation was again forced to install additional machinery and to enlarge factory space. A large contract from Stewart-Warner has just been awarded to Polymet. This and other large orders have necessitated this increased capacity.

## 45-PIECE BAND ON AIR

The Pure Oil Band, of forty-five pieces, broadcasts from WJZ and twenty-three other stations of the National Broadcasting Company each Saturday evening, is the largest band on the air. It is directed by Edwin Franko Goldman.

## WHAT RADIO COMPANIONSHIP DO YOU ENJOY?

**A**RE you meeting weekly the best minds of radio? Do you keep abreast of all the new circuits, the intimate details on perfecting existing sets, and get the inside track on sensitivity, distance reception, tonal quality, and how to achieve them? Do you keep fully abreast of the news of radio, technical and non-technical? If not, here is your chance to enjoy the writings of Dr. Lee De Forest, McMurdo Silver, J. E. Anderson, Herman Bernard and a host of other radio engineers who contribute their knowledge to you through the medium of Radio World, the first and only illustrated national radio weekly.

You can find no magazine that better caters to your needs than Radio World, which specializes in most intimate revelations of the ins and outs of the best circuits, with technical accuracy second to none. Enjoy the weekly companionship of Radio World's famous contributors, and glean the news of radio, from the four quarters of the earth.

Short waves? Radio World will tell you all about them. Extremely sensitive broadcast receivers? Their construction and operation are fully discussed with confident regularity. Power supplies—push-pull or otherwise? AC receivers? Screen grid tubes? Large receivers that give a super-abundance of performance—small, economical receivers that give performance out of all comparison to their size? Are you interested in these? Then you're interested in Radio World. Send \$1.00 now for a ten-week subscription for Radio World (regularly \$1.50), and in addition you will be sent FREE any one of the following panel meters:

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- 0-50 Voltmeter D.C.
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- 6-Volt Charge Tester D.C.
- 0-50 Milliamperes D.C.
- 0-100 Milliamperes D.C.
- 0-300 Milliamperes D.C.
- 0-400 Milliamperes D.C.

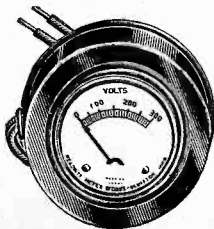
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# A Baffle for Dynamics

## A Scientific Model Radiating Surface Helps Immensely

ALL makers of dynamic loudspeakers recommend the use of a baffle board for the satisfactory reproduction of low notes. The claim that dynamic speakers will bring out the low notes better than other types of speakers will not hold good unless this recommendation is followed. The low note superiority of the dynamic is only potential and becomes actual only when a baffle board of suitable dimensions is used.

A baffle board does not mean a little box housing the speaker, such as is used in many commercial dynamic speakers. It seems that many manufacturers do not follow their own recommendations. For this lack of consistency the manufacturers are not to blame, because they sell the types of speakers which the purchasers want, and they want something very compact and attractive.

The low booming notes heard in dynamic speakers boxed up in small attractive containers are not true low notes. They are resonance notes, and hence a type of distortion. It is true, however, that if these resonance notes occur at suitable points in the frequency scale, and if they are not greatly exaggerated, they will improve the reproduction of the low notes in conjunction with receivers which are weak on these notes.

### Severe Resonances Occur

Unfortunately, in many of these compact and attractive loudspeakers there are one or more frequencies at which the resonance effect is very strong, so that the resulting reproduction becomes unpleasant.

Usually there are simple methods of reducing this resonance effect. But when these are applied the speaker loses some of the apparent effectiveness at the low notes. Actually all that is lost is an exaggerated response at one or two frequencies, which is an overall gain in terms of quality.

One of the methods for reducing resonance in a speaker is the same as that used in improving the acoustic properties of auditoriums. Sound-absorbent material is introduced into the speaker. Any material which will prevent reflection of sound waves, that is, which will prevent echoes, is good for the purpose. It is well known that an empty auditorium may be very bad acoustically, while the same auditorium is good when it is full of people. The clothing on the people present is the sound-absorbing material which stops most of the reflection.

If draperies are hung about the walls and ceiling of an auditorium, the acoustic properties of that place will be greatly improved, both when it is empty and when it is full of people. Again, if the walls and ceiling are finished with a rough surface the acoustics are better than when the surfaces are hard and smooth. If the walls and ceiling themselves are made of a porous material the acoustics will be better than when the material is solid.

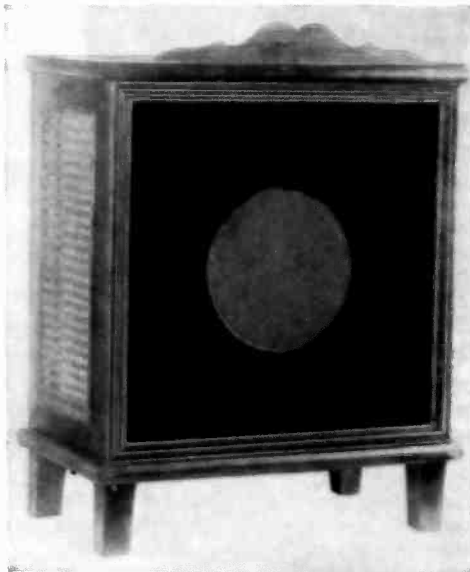
### Improving the Speaker

A dynamic loudspeaker housed in a small box can be improved in the same manner as an auditorium. The thing to avoid is the reflection of sound from the walls inside the box. This may be done in several ways, including the use of porous sides and top.

A further improvement can be effected by leaving the back of the box open.

By *H. B. Herman*

Acoustical Expert



THE BAFFLE IS THE PORTION SHOWN IN BLACK. AIR VENTS PREVENT BOX RESONANCE.

This will eliminate much of the reflection. With the back open the box will be equivalent to short organ pipe open at one end. Such a pipe has a resonance frequency which is just one octave lower than a closed pipe of equal length.

No matter how the box is treated the speaker will not bring out the low notes unless a baffle board is used. And the depth to which the speaker will descend will depend on the size of the baffle board. The effectiveness of a baffle is proved very easily. Suppose an 18-inch cone speaker and a 9-inch dynamic without a baffle board be connected alternately to the same receiver. If there is a speaker-relay by means of which the output of the receiver can be quickly thrown on either speaker, it will be apparent that the 18-inch cone speaker will respond better to the low notes than will the dynamic.

The difference is mainly due to the size of the radiating surface. The cone has a radiating surface four times as great as the dynamic. It also radiates sounds one octave lower than the other with the same intensity. That is, if the cone radiates a note of 30 cycles per second with a given intensity the dynamic radiates a note of 60 cycles with about the same intensity, or the dynamic radiates one-half as much as 30 cycles as the cone.

Now, if the dynamic speaker be placed in the center of an 18-inch square baffle board, and the comparison test be repeated it will be found that there is practically no disadvantage in the low note response of the dynamic. If there is a difference it is very likely the dynamic speaker is better.

If the dynamic speaker is placed in the center of a larger baffle, say one of 36 inches, it will be found that it reproduces the low notes very much better than the cone. As the baffle is increased beyond this point there is no great change in the low note reproduction. This is due to two effects. First, the receiver is not amplifying the low notes so well that the speaker has much to convert into

sound. Second, low audible notes are reproduced so well that even if there is a small increase the ear does not appreciate it. Hence there is little object in increasing the size of the baffle beyond a certain limit. A good size is 18 inches, since larger baffles dominate a room and are awkward in modern homes.

The effect of the baffle is not one of resonance. It is purely an effect of increasing the load on the speaker piston.

The baffle enables the piston to take hold of the air in front of it, and it prevents the waves in front of the piston from flowing around the edges to be neutralized by the waves at the back, which are in opposite phase.

### Room Resonance

Theoretically the best baffle is a plane of infinite extent. The nearest approach to this is a wall with the speaker mounted in the center of it. There should be no obstructing surfaces either back of the speaker or in front of it, because such surfaces, unless draped or porous, will reflect the sound and produce room resonance.

The frequency at which room resonance will occur can be determined from the dimensions of the room. Suppose the distance from the speaker piston to the wall in front of it is 10 feet. Sound travels 1,122 feet per second at ordinary temperatures and pressures. This velocity is equal to the product of the frequency and the wavelength. The condition for resonance is that the distance across the room is one-half wavelength. Hence the wavelength of resonance in the 10-foot room is 20 feet. Therefore, 1,122 divided by 20 gives the resonance frequency. That is, there will be room resonance at 56 cycles per second. Thus in ordinary rooms there will be resonance very close to the frequency of the AC hum in the loudspeaker.

### Cloth Effects

If the speaker is placed in the middle of the room there is likely to be resonance at a much higher frequency. Draperies, curtains, carpets, rugs and overstuffed furniture will help greatly to reduce this resonance, just as similar material will improve the acoustics of an auditorium or the resonance in a small box housing the speaker.

A practical baffle board may be made of thick wood from 18 inches to 36 inches square. The speaker is mounted in its center. If this board is one side of a box housing the speaker, the back should be open or covered with sound-absorbent stuff. And the sides of the box should be open or similarly covered. A frame with cane on top and sides serves well and looks well.

### Striking Example

A very striking demonstration of the effect of the baffle is to tilt the speaker temporarily with reference to the baffle surface. When the speaker is pressed against the board so that none of the sound in front can escape backward the low notes are prominent. As the speaker is tilted backward and away from the board the intensity of the low notes is immediately reduced to a very noticeable extent. The sound becomes thin and weak and similar to that which proceeds from a small horn type speaker.

[Other illustrations on front cover]



# Greater Meter Range

## Series Resistance Gains the Desired Extension

By Herbert E. Hayden

THERE is much interest in extending the range of a voltmeter so that it will measure higher voltages. How is it done? Simply by connecting an external resistor in series with the meter. If the resistance added is just equal to the total resistance of the meter, the range will be doubled. If the added resistance is twice as great as the total resistance of the meter, the range of the meter will be trebled. If the added resistance is nine times as great as the total internal resistance of the meter the range of the meter will be ten times its dial range.

By adding suitable resistance it is possible to cover any desired range with any meter, provided that the desired range is extension upward.

The resistance added must be reliable. It must be such that its value is definite and does not change much with either current or temperature changes. Good resistors are expensive. But when the voltages do not have to be measured accurately, ordinary inexpensive resistors, either fixed or variable, may be used. In such cases the instrument should be calibrated with the resistor to be used either against a block of dry cell batteries or against a B battery eliminator and another meter.

### Calibrating Meter

The calibration need not be made at the higher voltage. It may be done at a lower voltage which may be measured with the meter itself. This calibration is easily done. Suppose, for example, it is desired to extend the range of a 0-150 voltmeter to 0-750 volts. That is, it is desired to increase the range of the meter in the ratio of 5-to-1. The resistance added must therefore be equal to four times the internal resistance of the meter. Suppose this resistance is known, either from measurements or from its ohms per volt, to be equal to 15,000 ohms. The added resistance should then be 60,000 ohms.

This 60,000-ohm resistance may well be a 100,000-ohm variable resistor such as is used for volume control and other purposes. Connect this in series with the meter and a battery. First note the voltage reading on the voltmeter when the resistor is short-circuited. If this voltage is near the maximum on the scale the calibration will be most accurate. Hence the battery should be chosen so that the deflection is nearly full scale.

When the voltage reading with the external resistor has been noted, remove the short circuit and adjust the variable resistor until the deflection is just one-fifth its previous value. For example, if the short-circuited reading was 135 volts, adjust the external resistor, after having removed the short, until the reading on the meter is 27 volts. Then leave the variable resistor as it is, preferably locking it.

### Using the Meter

The meter is now ready to be used for measuring voltages up to 750 volts. Connect the meter, with the adjusted variable resistance in series, across the unknown voltage source. The deflection on the meter multiplied by five gives the unknown voltage.

If two voltmeters of identical sensitivity, that is, of the same number of ohms per volt, are available they may be used in series across a voltage source which does not exceed the sum of the readings of the two meters. Each of the meters will show a deflection when so connected and the un-

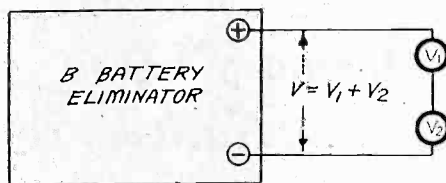


FIG. 1

**TWO VOLTMETERS HAVING THE SAME SENSITIVITY, OR OHMS PER VOLT, MAY BE CONNECTED IN SERIES ACROSS A HIGH VOLTAGE AND THE SUM OF THE TWO READINGS WILL BE THE VOLTAGE ACROSS THE TWO METERS**

known voltage is the sum of the readings of the two meters. But this does not work unless the two meters have the same number of ohms per volt resistance.

It is not at all necessary that the two meters have the same range. One may be a 7.5 volt instrument and the other may be a 750 ohm instrument. If both have the same sensitivity so that the same current will flow through each at full deflection, they may be connected in series and their readings be added together.

## SPECIAL ORGAN MADE FOR AIR

Chicago.

Although possessing one of the first pipe organs constructed with special alterations to fit it for broadcasting needs, the studios of WBBM, Chicago, are soon to be graced with a new and improved instrument.

Broadcasting is a particularly hard taskmaster, especially on certain instruments, like organs. Pleasing tones from a pipe organ in a church or the multitude of imitative effects obtained on theater organs are not always available for broadcasting.

The new organ is being built to incorporate all of the features learned through experience during the past six years in broadcasting organ music. Many of the radio "props" are to be included in the instrument, so that when the realistic humming of an airplane or the rushing of winter gales is required to make a playlet or program more realistic, it can be obtained directly from the organ.

### KITS, INC., HAS NEW CATALOG

Kits, Inc., 135 Liberty Street, New York City, under the direction of John Bole, has issued a new catalog. It covers practically everything worth while in radio, featuring the newest high-class circuits, including the new Victoreen AC, the full Victoreen line, Hammarlund-Roberts Master "Hi-Q," all models; Silver-Marshall, National lines, Newcombe-Hawley dynamics and speakers of all types. Address Mr. Bole and mention RADIO WORLD when requesting a catalog.—J. H. C.

## TRADE SEEKING GOOD SERVICE

The man who comes to fix your radio set in the near future will be an expert who has successfully completed a course of instruction in radio theory and practice, if present plans of officers of the Federated Radio Trade Association are adopted at their Convention in Buffalo, February 18th and 19th.

Michael Ert, of Milwaukee, president of the Wisconsin Radio Trade Association and vice-president of the Federated, is father of the plan, which will be considered by the national radio dealers and wholesalers at their annual meeting. With little change the plan has been in practice in Milwaukee for a year and a half with complete success.

It provides, first, for the examination, grading and registry of all radio service men; and in addition furnishing an opportunity whereby service men may obtain actual training in radio under competent instructors.

"With at least 25,000 radio outlets all over the country, many stores are doing as best they can with untrained men," says Mr. Ert.

"The crying need for technically trained men is obvious. Heretofore service work of necessity has been done by the chaps who have built a few sets but who have little fundamental radio knowledge. Our duty to radio fans is to provide a brand of service which will reach the peak in performance of their radio receivers and I feel sure that such a plan will be operative very soon."

### Short-Wave Facts

#### In Handy Manual

A short-wave manual has just been issued by the Hammarlund Manufacturing Co., Inc. The introduction is an education in short-wave work in itself, containing invaluable data, charts, curves and facts, including the screen-grid tube in short-wave circuits. This is followed by a most complete listing of land stations all over the world working below 100 meters. The call letters, names of stations and wave lengths are given in detail.

A world time chart follows. A frequency wavelength conversion chart is included. This book will be sent upon request, for ten cents to cover the cost of postage and packing, if you mention RADIO WORLD. Address the Hammarlund Manufacturing Co., Inc., 424 West 33rd Street, New York, N. Y.

### WBBM ON COLUMBIA CHAIN

Chicago.

WBBM takes a total of three hours a day of the new daytime sustaining programs of the Columbia Broadcasting System.

### HENDRICKS HEADS BRANCH

Thordarson, of Chicago has opened a branch sales office at 520 Citizens Building, Cleveland. C. M. Hendricks is branch manager.

# Why Harmonics Abound

## Receiver Accounts for Most of the Radio Frequency Type

By Conrad J. Cartwright

THERE is much complaint of harmonics from broadcasting stations, especially from those who are receiving short wave stations.

"The radio spectrum below the 200 meter wave is just alive with harmonics," is the report. "The broadcasting stations should be compelled to transmit on their own frequencies without encroaching on the short wave region."

The Federal authorities have already taken action on the complaints and have ruled against the radiation of short waves by the broadcast stations, that is, against the radiation of higher harmonics of the assigned broadcast frequencies.

That is a commendable action. And there is no doubt that the broadcast stations have complied as far as it is technically possible to do so. And that is all the Federal authorities can expect, and that is all they ever will expect. The fans should be equally reasonable. But are they? Their chorus is that the short wave bands are "alive with harmonics." And something ought to be done about it.

### Something Done About It

And the designers of radio broadcast stations are doing something about it. The Bell Laboratories Journal for August, 1928, reports that the power in the antenna of the carrier wave alone of the experimental transmitter at Whippany, N. J., is 50 kilowatts and that the power in the second harmonic of the carrier is only 5 milliwatts. There is a ratio of 10,000,000-to-1 between the carrier and its second harmonic. Imagine a broadcasting station of 5 milliwatts creating much of a disturbance in the ether!

It is possible that the power in the third harmonic of the same station is as small in comparison with the second as the second is compared with the fundamental. Certainly the fourth, fifth, sixth and higher harmonics contain less power than the second harmonic. It is quite possible that the power in any one of these must be measured in microwatts or micromicrowatts.

On oscillating receiver well shielded against radiation will radiate more power than the higher harmonics of that experimental station. And there are millions of such receivers in use. Yet there are few complaints against them at this time, because they create very little interference.

### Harmonics Received

Reception of harmonics of broadcast stations will not disappear. If a radio receiver is not sensitive enough to pick up a 1,000-watt station 1,000 miles away, how will it pick up harmonics of broadcast stations the same distance away when the power in the transmitted harmonics is of the order of a few microwatts?

"I object," says a fan, "that experimental station is not a fair test for broadcast station. In the first place, it is not on the air regularly, and in the second place no other station has been designed with so nearly complete suppression of harmonics."

The objection is overruled. When that station gets on the air regularly, or an exact or improved copy of it, it will cause just as many harmonics in the average receiver as any other 50,000-watt trans-

## Missionary's Son Reaches Natives, Too

Schenectady, N. Y.

Frank K. Singiser, Jr. is a new announcer at WGY. He also is trying a hand at continuity writing, and WGY's new feature, the Jones Family, is from his pen.

Last June he was graduated from Brown University. As the son of a Baptist preacher and missionary, he traveled from Montevideo, Minn., to Rangoon, Burma, and thence to Providence, R. I. His voice from WGY, carried by short waves, has reached hundreds of natives in territories where his father preaches to one, two or three at a time.

Mr. Singiser is a member of the Delta Upsilon fraternity, Phi Beta Kappa, Delta Sigma Rho and Pi Kappa, the Owl and Ring and the Cammarian Club.

mitter now on the air. That does not mean that the high-power station should not be used, for even a 100-watt transmitter, equally well designed with respect to suppression of harmonics, would create much harmonic interference in its regular service area.

As a matter of fact, if a station could be designed so that it radiated all its power on the fundamental and no power whatsoever on its harmonics, that, too, would create just as much harmonic interference as any existing station. If that station radiated 50,000 watts on its fundamental a sensitive receiver 1,000 miles away could undoubtedly tune it in on any one of its first ten harmonics. A less sensitive set would probably tune it in on the first three or four harmonics. Within a mile of the station any receiver could probably get a squeal out of the first twenty harmonics.

### Station Not to Blame

That is what a perfect station will do in the midst of present receivers. And the experimental station 3XN approaches perfection rather closely. But it will cause the ether to be "alive with harmonics" just the same.

Where lies the trouble if not in the broadcast transmitter? It lies right in the receiver of the person who is complaining. It is the receiver which generates those harmonics.

"I object," says that complaining fan, "on the ground that it is not in accordance with the evidence. My set is sensitive, selective, distortionless and loud. Yet I get the harmonics."

This objection is overruled on the ground that this particular fan is thinking of his broadcast receiver when the trouble from harmonics occurs mainly below the broadcast waves. He just grasped an opportunity for telling what he himself thinks of his receiver. He does not realize that these terms are applied indiscriminately to all things pertaining to radio. If he has experienced any trouble from harmonics it could only have been from the second harmonics of stations between 400 and 546 meters causing in-

terference with stations between 200 and 273 meters.

### He Who Gets Under 200

The fan who gets down below 200 meters with a sensitive set has a real cause for complaint. If he is after code stations and uses an oscillating receiver, which he usually must, he will encounter a million squeals, most of which seem to be due to broadcast transmitters. The more sensitive the receiver is, the more of the harmonics will be heard. The greater the amplification in the audio amplifier is, the more will be heard. The more distortion there is in the RF amplifiers or detector, the more squeals will be heard. And the selectivity of the receiver is of little aid in eliminating the harmonics. If just a little of the fundamental of the interfering station gets into the receiver the distortion in the tubes of that receiver will produce the harmonics and then the tuner will single them out and tune them in just as if they had originated outside the receiver.

Eliminate all the distortion in the tubes of the receiver and there will be no more trouble from harmonics of stations not wanted. But the detector works on the principle of distortion. Harmonics will be generated in this tube. These will be fed back to the tubes ahead of the detector, if any are used, and the tuners will bring them out.

Hence, if harmonics are to be avoided it will be necessary to devise a detector which does not depend for its action on the curvature of the characteristic and to devise amplifier tubes which do not have any curvature in their characteristics.

## Private Brand Sets Get License Benefit

The third edition of the compendium of radio receivers and manufacturers, prepared by General Contract Purchase Corporation, is being distributed to the various offices and subsidiaries of the company throughout the country. This is the only complete list available which gives all the licensed sets, together with their prices, and the number and types of tubes used.

A courtesy copy of the first and second editions was sent to each manufacturer listed some months ago, and the booklet was so useful that from three to six extra copies were requested in nearly every case. The booklet, among other things, discloses the fact that several manufacturers who do not hold direct patent licenses have found it profitable to buy sets from license-holders for sale under their brand name. A few copies are available and will be sent to anyone interested. Address General Contract Purchase Corporation, Graybar Bldg., New York City and mention RADIO WORLD.

### WBBM ON COLUMBIA CHAIN

Chicago.

WBBM takes a total of three hours a day of the new daytime sustaining programs of the Columbia Broadcasting System.



# Where Equality is Vital

## Even Harmonics at AF Suppressed by Balanced Push-Pull

By Brunsten Brunn

IT has been claimed that audio amplifier circuits can be arranged so that the generation of all harmonics can be prevented. The purpose of the push-pull amplifier is to prevent the generation of even harmonics. How this circuit accomplishes this object can be shown very easily. But how about the odd harmonics? Can they also be prevented?

The ordinary push-pull circuit will prevent even harmonics if the circuit is perfectly symmetrical. The two tubes used in a stage must be exactly equal in all their characteristics. The input must be equal on the two grids and the output devices must be absolutely equal. In so far as there is any asymmetry there will be even harmonics in the output.

By a very slight change in a push-pull circuit the odd harmonics can be prevented also, but when this change has been made the even harmonics will be brought out. As far as is known, there is no circuit arrangement which will prevent both the even and the odd harmonics at the same time, and still leave the circuit useful.

### First Harmonic Is Signal

There is an exception in the case when the signal consists of a single frequency. It is then possible to eliminate all harmonics but the first, or the signal. In broadcasting the signal consists of many frequencies. The amplifier must be able to bring them all out without any discrimination. Hence for this type of signal many of the methods available for suppression of harmonics cannot be used. Balancing schemes alone are available, such as push-pull circuits.

We may arrange a push-pull circuit so that the even harmonics are suppressed. We gain in purity of signal to the extent of the suppression. But if we change the circuit so that the odd harmonics are suppressed, we balance out the first harmonic as well as the higher odd harmonics. Since the first harmonic is the signal desired, we balance out that which is desired and retain the even harmonics, or the greater portion of the total distortion.

### Two Sources of Distortion

There are two sources of harmonics in an amplifier. First, the curvature of the grid voltage, plate current characteristic of the tubes. Second, the curvature of the magnetization curve of the iron core in the coupling transformers.

If the circuit is symmetrical the even harmonics arising from the curvature of the tube characteristics are suppressed. But does the circuit also eliminate the even harmonics arising from the curvature of the magnetization characteristic? It does not seem so. Refer to the circuit in Fig. 1, the last stage of which is supposed to be symmetrical.

Assume that the signal delivered to the primary of the input transformer is free of all harmonics except the first. This condition can be approximated closely if the coupling resistance and the impedance of the primary of the transformer are high and if the signal level is low.

### Keeps Out DC

The condenser in series with the primary will prevent direct current from entering the transformer. Hence it will be

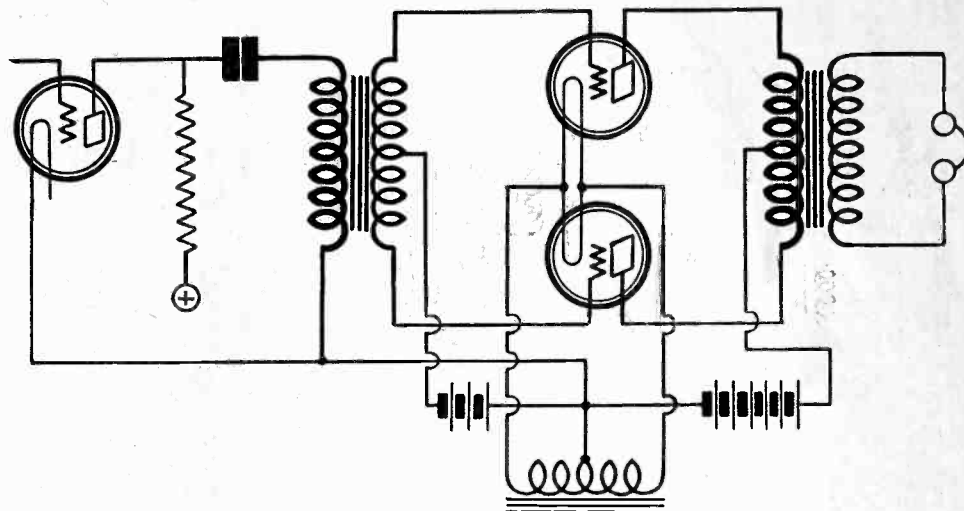


FIG. 1

A PUSH-PULL STAGE DESIGNED SO AS TO REDUCE HARMONIC DISTORTION TO A MINIMUM.

## Equal Pairs of Balanced Transformers, as Well as the Standard Push-Pull Type, Afford Superb Tone Quality—Some Problems in Audio Amplification

operated at the zero point on the magnetization curve. There will be no steady flux in the core, and the transformer will be operated at the best point. But the magnetization curve is not straight over the range of operation. There will therefore be harmonics in the flux resulting from the signal. These harmonics, both odd and even, will appear across the secondary. The fact that the secondary is center tapped will not alter the case. All the harmonics introduced by the core will be impressed as a signal across both the tubes in the push-pull stage. There is no way of getting rid of them.

### Harmonics in Output

The secondary is accurately center tapped by assumption. So is the primary of the output transformer. Hence the even harmonics produced in the tubes will be balanced out.

The direct current in the primary of the output transformer has no effect in producing a steady magnetization of the output core, because two currents of equal magnitude flow in opposite directions. That is the way the even harmonics are balanced out, for the steady current is the zeroth harmonic.

We started out with a single signal frequency, but the first transformer introduced all the harmonics. So the signal current in the primary of the output transformer contains all the harmonics. The only thing gained by the push-pull stage was to prevent the transmission of the even harmonics generated in the tubes.

Let us select one of the signal frequencies present, the original signal frequency. How does this fare in the output transformer? Although the output transformer operates at the zero point by virtue of the balancing out of the effect of the steady current, there will be harmonics in the flux in the core just as there was in the core of the input transformer, because the signal current flows through the primary

of the output transformer as a whole just exactly as it flows through the primary of the input transformer.

### Separate Coupling Transformers

It is possible to build push-pull amplifiers with ordinary coupling transformers. In that case two input and two output transformers are necessary for each stage. If these transformers are equal in pairs, the circuit will be balanced and even harmonics will be suppressed, provided that the connections are made properly. But the steady current will be effective in producing a steady flux in each of the transformers. Hence the distortion in the cores will be greater. But it will be no greater than it would be in unsymmetrical circuits.

### Small Harmonic Distortion

The total harmonic distortion due to the cores in properly designed transformers is very small, and the total harmonic distortion due to the tubes can be made very small by operating the tubes well below the overloading point.

## Soloist is Passe, Says One, Reformed

Chicago.

Soloists are "played out" over the radio, said Larry Shay, veteran radio songster and member of the team, Larry and Freddie, heard regularly over WBBM.

After playing a lone hand for more than five years, Larry met Fred Fisher in the WBBM studio one night. They decided to constitute themselves a harmony team.

"Radio listeners run away from soloists, for they have heard so many, good and bad," said Shay. "When a solo is announced the dials begin to turn."

# Band Pass Filter Increases

## High Selectivity Without Sideband

By Capt. Peter

Contributing

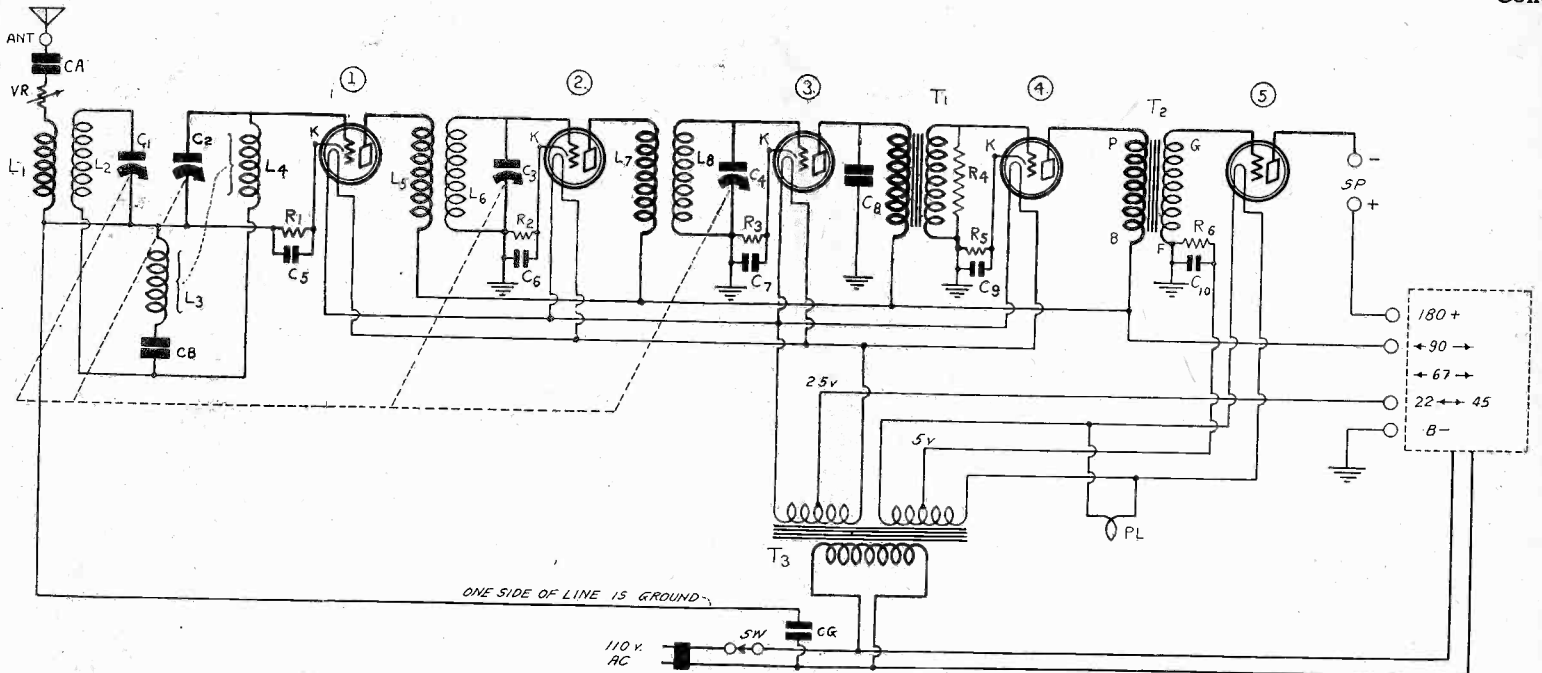


FIG. 1.

A band pass filter is incorporated at the input to the BP5, while the two radio frequency stages are standard TRF. This all-electric AC receiver affords exceptionally realistic tone. The tone value of the band pass filter is preserved by grid brass detection and high-class transformer coupled audio.

THE intense interest in tone values in radio reproduction has brought into popular use with kit-set constructors the band pass filter, which admits a certain band of radio frequencies limited to the width of the modulation imprint. Thus full sideband acceptance is made possible, with retention of selectivity. And it is the only known method of getting both high selectivity and quality.

There are numerous band pass filter circuits. All of them are filters because they are tuned, while the band-pass feature arises, of course, from the fact that only a specified and pre-determined band of frequencies is admitted.

The simplest form of the band pass filter is that incorporated in Fig. 1, where the secondary L2 is tuned by one variable condenser and the secondary L4 is tuned by another condenser, the two circuits being made common by virtue of joiander through L3 and CB.

### High Volume Level

In actual physical makeup, coil L1L2 consists of a radio frequency transformer and L3L4 another coil exactly like it. L3 is common to both tuned circuits and is in inductive relationship to L4, hence couples more strongly to that secondary than to the other. This method of strengthening the delivery to the first tube was worked out so that the volume level would be kept as high as possible without sacrifice of essential selectivity.

Some difficulties arise in the usual form of common coil or condenser coupled filter, as this one is, the absence of ground potential of the rotor being the most serious, since it creates body capacity effects, disastrous to any receiver. Maladjustment of tuning is another, since the circuits would be dissimilar from succeeding ones, which likely would be tuned by sections of the same multiple capacity unit, in these days of single control.

The design of the BP5 was studiously

### LIST OF PARTS

L1L2, L3L4, L5L6—Three radio frequency transformers, model AC5, for .0005 mfd. condensers, or model AC3 for .00035 mfd. condensers; coils manufactured by Screen Grid Coil Co.

C1, C2, C3, C4—One Hammarlund .0005 mfd. four-section battleship model tuning condenser, code number BSQ50. (For .00035 mfd. code number is BSQ35)

VR, SW—One Electrad Royalty volume control variable resistor, 0-5,000 ohms, with 110-volt AC switch attached.

R1, R2—Two Electrad 1,500-ohm type B 150 wire-wound resistors.

R3, R4—Two Electrad 50,000-ohm type B5000 wire-wound resistors.

R5—One Electrad 500-ohm type B50 wire-wound resistor.

R6—One Electrad 3,500-ohm type B350 wire-wound resistor (see text).

CA, CB, C8—Three Aerovox .00025 mica fixed condensers, type 1450.

C5, C6, C9—Three Aerovox .02 mfd. condensers, type 1450.

C7, C10—Two Aerovox .5 mfd. condensers, type 207.

T1, T2—One Victoreen 112 Audio Unit (two transformers in one casing).

T3—One Victoreen No. 327 filament transformer.

(1), (2), (3), (4)—Four five-prong sockets for 227 type tubes.

(5)—One 4-prong socket.

Ant., Speaker plus, Speaker minus—Three binding posts

One 7x24-inch front panel.

One 11 $\frac{3}{4}$  x 23-inch baseboard.

One Hammarlund drum dial, Code No. SDB1 (which includes pilot light), with pilot light PL.

One extra Hammarlund knob for volume control, SDBK wire.

Hardware.

One National Velvet-B model 3580.

created so as to get rid of these two principal nuisances in the best possible manner. The common rotor of the four-section condenser goes to ground, which is established through a capacity connected to the AC line (since this receiver is all-electric). Hence the radio frequency potential increases in all instances away from ground and the equivalent potential of your hand.

The input to the first tube is selective and pure according to the law of the band pass filter. The two succeeding stages are familiar as straight TRF. There is no sideband cutting in two simple stages of TRF, hence with a band pass filter input the tone proportion is well maintained by the two succeeding standard stages.

Detection is obtained in tube 3 by the grid bias method, which is better for tone purity. There follow two stages of transformer coupled audio frequency amplification, which, if the coupling media are unwisely chosen, will upset the entire tone gain.

### Layout of Receiver

It is quite practical, in these days of well-made, expertly-designed audio transformers, to obtain splendid realism from this method of coupling, but it is a sad mistake to use cheap transformers. All good ones cost money, because of the large amount of wire used for high primary impedance and step-up ratio, the size and quality of material in the core, the care taken in manufacture and the sturdy, attractive casings that popular taste requires.

Now as for the physical layout of the receiver, the front panel has a combination volume control and switch at left, drum dial escutcheon at center, and dial knob at right. The Hammarlund drum dial permits location of the knob at any point required by the projection of the condenser shaft—either close to the dial,



# Tone Quality Remarkably

## and Cutting in a 5-Tube AC Circuit

V. O'Rourke

Editor

for conventional layout, or at the opposite end of the condenser. Since a 24-inch front panel was used, the hole for the knob is 1 1/16 inches from right, while symmetry compels the volume control to be located an equal distance from left. Only by using a larger width front panel can these two knobs be kept farther in from the panel sides.

### Conforms to Letter U

Behind the panel are the condenser, stretching from center to right; to the left of the dial scale the filament transformer and B supply, while the usual left-to-right wiring for radio frequencies is preserved because the antenna input is taken almost at the center at rear of the baseboard layout. The audio channel takes a reverse course, so that the RF and AF construction represent the letter U.

The confinement of front panel to the absolute minimum made possible by modern devices—a scale to read, a knob to rotate the scale, and a combination switch and volume control — makes for most simplicity.

A factory-built B supply is easily incorporated, affording a maximum voltage of 180. Only the 90-volt post need be used for the intermediate voltage. B minus is connected to the ground provided by CG in Fig 1, and all grid returns are made to ground, the plate current for each tube being sent through an individual resistor to provide negative bias.

The greater the value of resistance, the greater the bias, for given plate current. That is why the same method provides bias for amplification and for detection. In the case of the detector the biasing resistor, R3, is 50,000 ohms, whereas the RF biasing resistors are 1,500 ohms (this relatively high value being chosen for the increased selectivity, and stability that dispenses with neutralization), while the last tube is biased through a resistance of about 1,800 ohms, by use of about half of a 3,500 ohm resistor.

### Circuit Performs Well

This receiver is by no means "another five-tube set," but something remarkable in its tone realism, tuning ease, volume and sensitivity and, of course selectivity. As for performance, a favorite test in and around New York City is to determine whether a receiver brings in WLW, Cincinnati, through WOR and WEA, without any background from either of those two powerful locals. The BP5—so-called because it is a band pass filter circuit using five tubes—does all of that, and does it well. Also it brings in many other distant stations without difficulty. Notice that no trimmers are used, but remember that this advantage can not be obtained from cheap ganged condensers. If you use cheap condensers in any circuit you must tune each stage separately—no multiple tuning permitted—unless you want to throw away desired sensitivity.

The primaries on the coils are of low inductance, and all identical, so that one tuned circuit is just like another, even unto the band pass filter circuit (consisting of two tuned parts), because of the special means provided through the balancing condenser CB. If the condenser

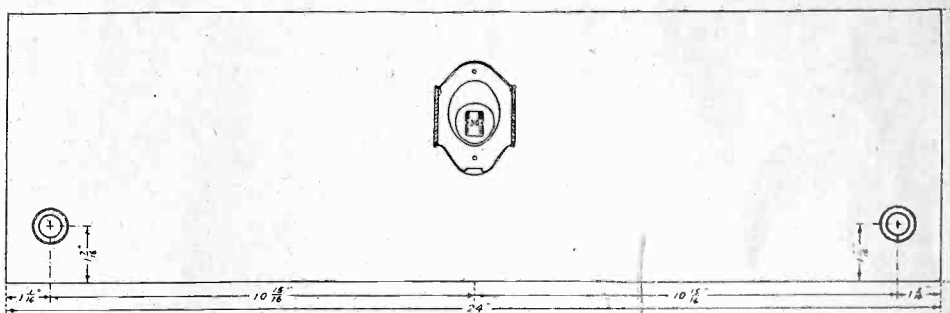


FIG. 2.

The front panel dimensions of the BP5. See the text for an explanation.

CB were not used, the common coupling coil L3 would add a little to the inductance of each of the united tuned circuits—enough to throw the resonance point several degrees lower than that for the succeeding TRF stages, and you would have a three-station set, instead of one that tunes in thirty or forty stations with ease any night in New York City, and up to fifty, or maybe more, if you have the patience and the inclination.

### Gain Aided by Bypass

There is nothing non-essential in the list of parts. You could not omit the plate bypass condenser in the detector circuit, for instance, without lowering the detection efficiency. Nor could you omit a bypass condenser across the detector biasing resistor without obtaining only thin, tinny reproduction, instead of the marvelous quality you are assured of, with that condenser included.

Volume would be much lower if the bypass condensers across the biasing resistors in the two RF tubes were omitted, and also low notes would suffer badly, and self-oscillation would be rampant from 380 meters down. The coupling effect—an undesired one—otherwise produced by any biasing resistor, since the grid and plate circuits are made common, is nullified by the bypass condenser. The impedance to radio frequencies is made low by relatively small values of condensers, but to audio frequencies it is made low only by large capacities. As there is an audio component in the detector circuit, at least 0.5 mfd. should be used, while the first audio tube's bias has a condenser across it of the same value. In the last stage, however, nothing less than 4 mfd. will do. Low notes are attenuated with 3 mfd., shattered by 2 mfd., and lost by 1 mfd. across the resistor that biases the last tube. Yet 6 mfd. does not produce any improvement over 4 mfd. that is noticeable to this human ear. Even the oscillograph tells you that 4 mfd. is enough, although theory will dictate that the capacity never can be high enough!

### Some Quirks Discussed

There are some peculiarities in the circuit and its construction.

The Hammarlund battleship condenser should be rigidly mounted, also it must be precisely mounted in respect to the front panel, so that the scale which is at center is absolutely aligned, while the bushing and setscrew to secure the opposite end of the condenser shaft, which is part of the

tuning knob mechanism, must be in just the right place.

If you miss up on any of these things you can see for yourself that the knob mechanism won't engage the condenser, or the scale at center will be off register. It is true there is tolerance, due to the length of the shaft projections from either end of the condenser. The condenser may be shifted in respect to the dial drum and scale, and the bushing of the driving mechanism at right. But if you exercise anything less than real care you may spoil your front panel by misplacement of holes, simply because the condenser frame will stop at the bushing at right or dial drum at left.

### Front Panel Dimensions

The dimensions for the front panel are given in Fig. 2. The front panel is ever so important when the tuning knob is attached to the far end of the condenser, since each different type of condenser—double, triple, quadruple etc.—and each different make requires a different knob position, whereas a knob centered on a dial assumes the same position no matter what are the length, breadth, thickness and price of the condenser!

It is obvious that the elevation of the escutcheon determines the horizontal plane which the tuning knob shaft must pierce, since the upright distance between this shaft and shaft of the condenser (hence any given point on the condenser) is always the same.

In the laboratory model of the BP5 brackets 1/2x2 inches were used to secure the front panel to the baseboard, and the front panel cleared the baseboard a little by forward extension. This raised the front panel relative to the baseboard up 7-16", that is, by the thickness of the baseboard.

Selectivity without sideband cutting.  
Realism to the utmost attainable today.  
Sensitivity.  
Ease and simplicity of control.  
High volume, adjustable to a whisper.  
Excellent appearance.

All-electric operation, for alternating current, without hum, since four 227 tubes and one 171A tube are used.

These are the things you get when you build the BP5, a circuit that affords all anyone can reasonably expect from a five-tube receiver—and somewhat more than reason would demand.

\* \* \*  
[Constructional layout and treatise will be published in next week's issue, dated March 2d.]

# Literature Wanted

**T**HE 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 bottom may be used, or a post card or letter will do instead.

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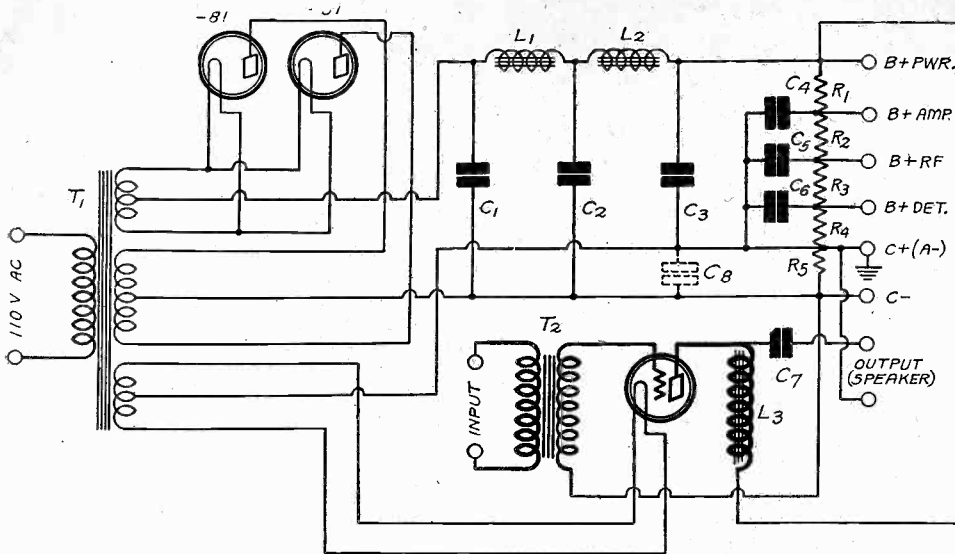


FIG. 731  
THE DIAGRAM OF A FULL-WAVE RECTIFIER USING TWO TYPE -81 TUBES, WITH A 250 AMPLIFIER STAGE BUILT IN.

Most dynamic speakers will work to better tonal advantage if the popular types of baffle board are not used, for these are simply decorative cabinets to contain the speaker, and produce boom frequencies of disgusting strength, sometimes called "box resonance." This drummy effect is avoided in part by keeping the back open, but really the board should be just that without sides or back, except for a grill covered by silk or such acoustically non-effective material.

\* \* \*

PLEASE PUBLISH a circuit diagram of a full-wave rectifier using two type -81 tubes and incorporating a 250 amplifier stage.

(2)—Show clearly how the loudspeaker should be connected for best operation.

JOHN HOWARD,  
Pittsburgh, Pa.

(1)—See Fig. 731 for such a diagram.

(2)—Return the speaker to the midtap on the 7.5 volt winding as shown.

\* \* \*

WHAT IS MEANT by the natural wavelength of a radio frequency choke coil?

(2)—How can it be determined from the data on the coil supplied by the manufacturers of the coils?

(3)—Is the distributed capacity in ordinary coils large enough to bypass considerable radio frequency current?

JOSE ALMA,  
San Francisco, Calif.

(1)—The natural wavelength of a coil is that which resonates with the inductance and the capacity of the coil.

(2)—First calculate the frequency in kilocycles and divide this into 300,000. The result is the natural wavelength of the coil. Approximately the wavelength may be obtained by taking the square root of the product of the inductance of the coil in millihenries and the distributed capacity in micromicrofarads and multiplying this by 60. The result is in meters.

(3)—Yes, the ordinary chokes are condensers throughout the broadcast band. But still they offer a high impedance to these frequencies.

DO filter condensers often break down?  
A. J. SCOTT,  
Zanesville, Ohio.

Condensers used in high voltage circuits such as that in Fig. 731 above often break down in service. The break-down often occurs during warm weather and after prolonged periods of operation. This indicates that the temperature of the condensers has much to do with the life of them. An alternating current through a condenser causes much heating.

It would seem that the condenser next to the rectifier tube would break down first, for it is apparently subjected to the highest peak voltages. But it does not always work out that way. The condenser next to the voltage divider seems to break down first. The voltage fluctuation across this condenser is mainly caused by the signal. The next condenser to break down is that in series with the speaker.

Perhaps these conclusions are based on a series of consecutive breakdowns due to defective condensers, but that is not likely. Surely the condensers which broke down were defective, but all of the condensers in the high voltage circuit were of the same defectiveness. Yet those that were expected to break down first have stood up for a long time whereas the others did break down a number of times.

In selecting condensers for the high voltage circuit, and that includes C1 in Fig. 731, condensers of 1,000 volts guaranteed rating should be picked. Condenser break-down may result in a burnt-out rectifier tube as well. Condensers suggested are Tobe, Acme or Flechtheim, 1,000-volt rating.

A useful precaution against condenser breakdown is to see that at no time the filament current in any of the tubes is turned off before the power to the transformers is turned off. If all are broken simultaneously no harm will result.

\* \* \*

CAN A RADIO frequency tuner be stabilized by putting a short circuited turn around the tuning coils?

(2)—What effect does this turn have on the tuning?

MILTON AKELY, Rockford, Ill.

(1)—A short circuited turn has a stabilizing effect, it introduces a resistance into the tuned circuit.

(2)—It lowers the selectivity of the tuned circuit and it reduces the effective inductance of the tuning coil. In a strong field it will stop all signals if closely

coupled. To make up for this it is necessary to use a little more capacity.

\* \* \*

I HAVE a radio set with a dynamic speaker built in, mounted on the front of the console. It is necessary or desirable to use a baffle board? What is the best material for a baffle board?

DOUGLAS SCOTT,  
Superior, Wis.

When the electro-dynamic cone is on the front wall of a cabinet no other baffle than that provided by the cabinet is required, provided this is considerably larger than the cone. A suitable material for a baffle is one that is not only stiff but which is porous so that it will not reflect any sound.

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# How to Compute Bias

by the Plate Current Flowing in a Resistor

By Ed. C. Hall

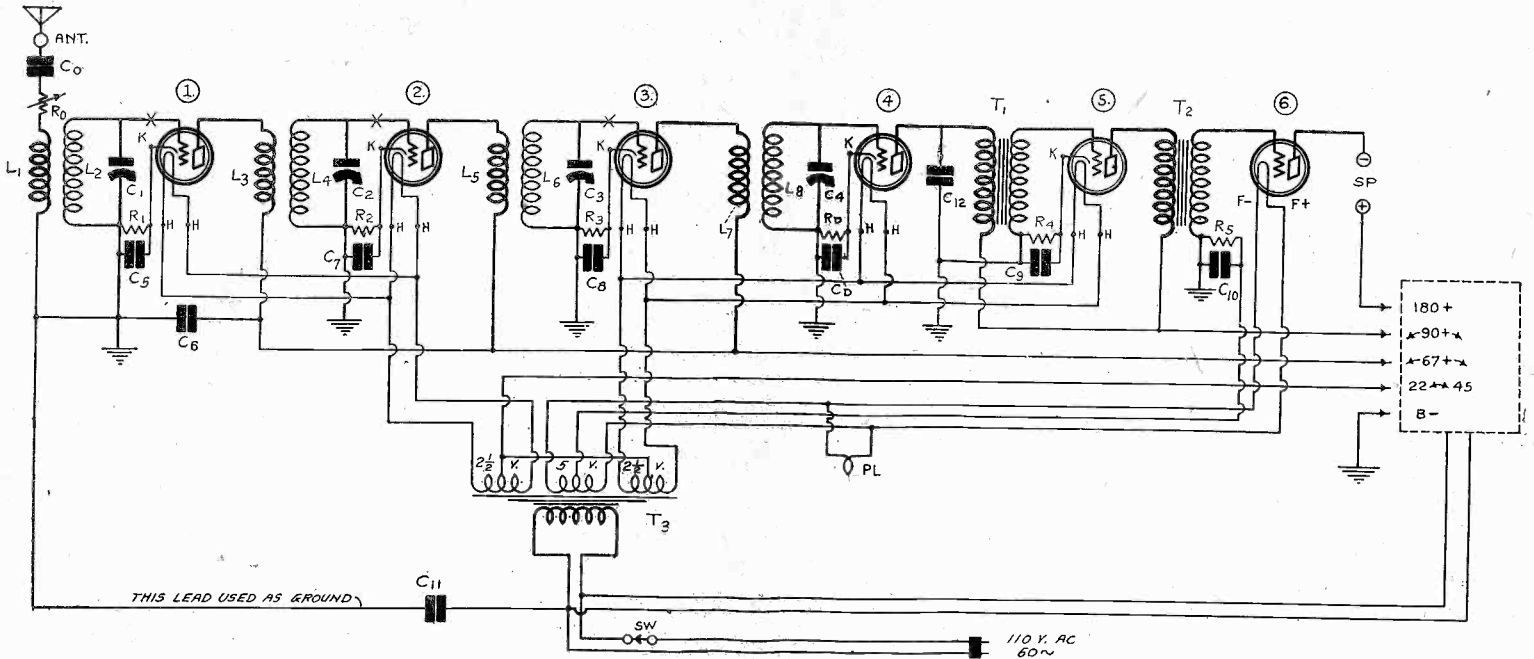


FIG. 1

AN INDIVIDUAL GRID BIAS RESISTOR FOR EACH TUBE IN A CIRCUIT IS PREFERABLE TO USING ONE RESISTOR FOR TWO OR MORE TUBES, EXCEPT WHEN THE TUBES ARE IN PUSH-PULL. EACH RESISTOR SHOULD BE BYPASSED TO PREVENT FEEDBACK.

THE question often arises as to how to obtain a grid bias for 227 tubes and AC operated power tubes by means of a resistor in the plate return circuit. It is known that for a -71A tube the grid bias resistor should be 2,000 ohms approximately. This resistance is calculated on the assumption that the plate current in the tube is 20 milliamperes when the effective plate voltage is 180 and the grid bias is 40 volts. But the plate current is not 20 milliamperes in all cases.

Suppose the plate voltage on the tube is 180 volts and the plate current is nearer 60 than 20 milliamperes. If the applied voltage is 180 and the 2,000 ohm resistor is inserted it will be found that the current is less than 20 milliamperes. Thus the plate current depends on the grid bias and the grid bias depends on the bias resistance and the plate current.

The proper resistance to use in any case may be obtained in the following manner. Apply the rated voltage to the plate, making allowance for the drop in the output choke or transformer. Then apply the rated bias for the voltage used on the plate, and apply this bias by means of grid batteries. Measure the plate current. Divide the rated grid bias by the current thus obtained and the result is the resistance that should be used.

### Voltage Drops

But it will be found that the plate current will be less than it was when the grid battery was used. This does not mean that the grid bias is wrong for the effective plate voltage. It is just right, because the grid bias is no longer the rated bias. In order to bring the grid bias and the effective plate voltage up to rated values the applied voltage should be increased by the amount of the rated grid bias, or until the plate current is the same as it was when the grid battery was used.

In the case of a -71A tube it will be found necessary to increase the total applied voltage to 220 volts in order to have 40 volts on the grid and 180 volts on the plate. This assumes that the voltage drop in the output circuit is negligible. It may not be for it may be as high as 10 volts. To make up for this the total applied voltage should be increased to 230 volts.

Of course the adjustment is not critical. There may be wide variations both in plate and grid voltages. If this were not so it would be very difficult to get the proper adjustment. It is accurate enough to take the normal current for specified grid and plate voltages and divide this into the specified grid bias to get the resistance. Then when this resistance is used the grid bias will automatically adjust itself to the correct value of the plate voltage that is used, whatever that may be.

### Case of 250 Tube

This method is used in figuring the grid bias resistor for the 250 power tube. The normal current with 450 volts on the plate and 84 volts on the grid is 55 milliamperes. The resistance is obtained by dividing 84 by .055, which gives 1,527 ohms for the grid bias resistor. The nearest commercial size resistor is 1,500 ohms, so that is used. The total voltage that must be applied is 450 plus 84 plus the drop in the output circuit. Thus the total may have to be as high as 550 volts. But if only 500 volts are applied the bias will be correct because both the plate voltage and the grid voltage will be lower than normal, and they will divide themselves in the proper proportion.

When two equal tubes get their bias from the same resistor, and when the plate current of both flows through that resistor the value of the resistance should be only half as large as the resistance for

one tube. That is important to remember when hooking up a push-pull stage. If the two equal tubes are not in the same stage they should not be biased by the same resistor because there will be feedback through it which will distort the signal or cause oscillation.

### Practical Example

A practical example of the use of separate grid bias resistors is shown in Fig. 1 herewith. R1, R2 and R3 provide the bias for the radio frequency tubes. For these tubes it is not necessary to use the rated value but only enough to maintain the grids negative no matter what the RF signal may be. About three volts will be enough. The current will be about 3 milliamperes when the plate voltage is 67.5 volts. Thus each of the resistors should be 1,000 ohms. It is quite necessary to put a bypass condenser across each one as shown. The larger the condenser the better, and it should not be less than .002 mfd.

Rd provides the bias for the detector. Its value should be much higher than the resistance of any of the preceding resistors because the plate voltage is higher, a higher bias is needed for detector and the plate current will be much less. If the bias is 10.5 volts the current will be about one half milliampere, so that resistance should be about 21,000 ohms. Since the value is not critical either a 25,000 or a 20,000 ohm commercial resistor will do.

The plate voltage on the next tube is 90 volts. The bias should be about 4.5 volts, for which the plate current will be 4 milliamperes. The resistance should therefore be 1,125 ohms, the value of R4.

R5, the bias resistor in the last stage has already been given as 2,000 ohms because it is assumed that the last tube is a -71A.

# Diamond Construction

## Correct Placement of Parts Makes Wiring Easy

By Herman Bernard

[This series of articles on the new, highly selective screen grid Diamond of the Air, was begun in the February 9th issue, continued last week, February 16th, and progresses to its conclusion this week. Questions will be answered next week.]

IN constructing the new model of the Four-Tube Screen Grid Diamond, the most selective yet presented, it is well to adhere to the dimensions of a 7x21-inch front panel and a 10x20-inch subpanel. This gives you plenty of room. You may infer that good results will be obtained in smaller space, which is true, and that compression may be utilized, if necessary, e.g., to accommodate the receiver in a phonograph cabinet. These are special examples. The general run of constructors, left free in their choice, should select the standard 7x21 inch front, and that enables utilization of the self-bracketing aluminum subpanel.

The sketch shows the arrangement of parts. The aluminum subpanel is drilled to receive these parts in the correct position. Moreover, the sockets are built into the aluminum subpanel. These positions coincide exactly with those shown on the official blueprint, which every constructor should obtain, especially as the wiring done below the subpanel is shown in the blueprint in the same absolute position that such wiring takes, and is not reversed, as in blueprints that treat the subpanel as a fictitious transparency.

### Avoid These Errors

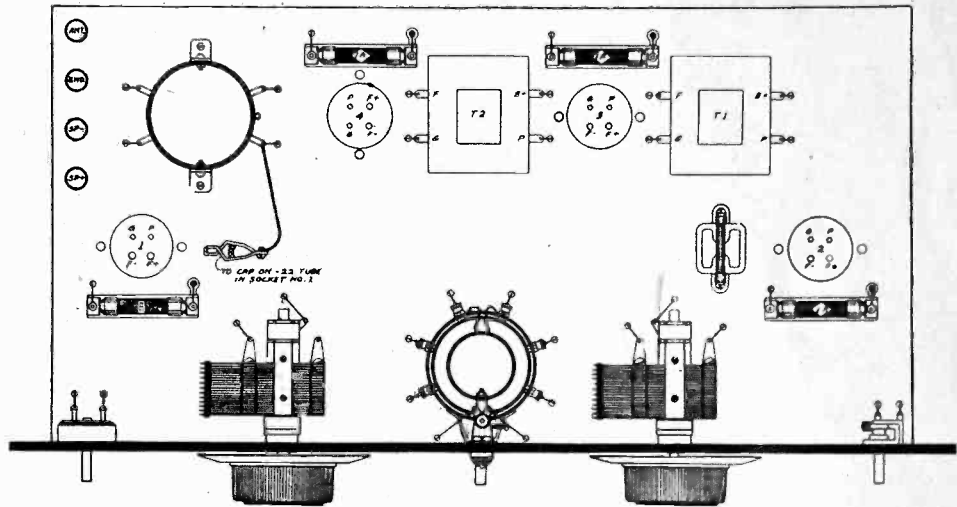
Only two possibilities of mistake arise in regard to the subpanel: the first or antenna coil may be mounted with the wrong binding posts facing the subpanel posts (Ant., Gnd., etc.) and the audio transformers also may face the wrong way. Therefore look at the AC5 coil (L1 L2 on the schematic diagram previously published) and trace the terminals of the respective windings. It will be found that the green primary winding of the commercial coils terminate in two posts at one side of the coil form and the blue secondary in two posts on the other side of the form. Simply take care that the terminals of the primary face to the left as you view the front of the receiver, that is, face the Ant. and Gnd. posts on the subpanel. The respective polarities of this coil and of the tuner (three-circuit coil) are correctly established by following the blueprint, without need of examining the coils. These polarities make the low potentials (A minus and B plus 135) adjoin. "Low" refers to radio frequency potentials. The "high" RF potentials are grid and plate.

The two audio transformers have their P and B posts at right, their F and G posts facing the antenna coil.

Every other part is correctly positioned automatically if the tuner is mounted with binding posts at bottom. If any doubt ever arises, follow the blueprint which, by the way, contains the top and bottom views of the subpanel, full size, with all wiring in plain view; a dimensional plan of the front panel; a schematic diagram of the circuit and a list of official parts. Also, this blueprint is free from "bug."

### Hard Work Dispensed With

The hardest job about building a set is not the wiring. That is easy and pleasant. It is the layout of parts. If you have to scheme it all out yourself you must spend



**BOTH COILS ARE MOUNTED IN AN UPRIGHT POSITION, WITH BINDING POSTS AT BOTTOM FOR SHORT LEADS. AN ALUMINUM SUBPANEL IS USED FOR GREATER SECURITY, EASE OF CONNECTIONS AND GOOD APPEARANCE.**

more time on getting the proper electrical effects and physical balance than on the wiring, since poor placement causes inefficiency in set operation. Here all the physical design work has been done for you, and you capitalize the time and thought conscientiously bestowed by some one else. And you cash in on the more than abundant results just as well as the first man to enjoy them.

The subpanel, being metal, dispenses with a separate A minus lead to the Amperites and the first tuning condenser, C2. If you use an insulated subpanel be sure to establish ground and A minus through an extra lead to the necessary points, as the blueprint assumes the use of a metal subpanel. Thus the A minus cable lead is soldered to a lug that is held tight against the subpanel by a nut (the hardware, plus insulating washers, being furnished with the subpanel). Hence any time you desire to pick up A minus, all you need do is tighten a nut against a lug through a subpanel hole and solder to the lug. Otherwise you would have to carry the extra lead previously mentioned from the "gnd." post to the desired point of electrical contact.

The commercial front panel supplied for

this receiver has holes to accommodate the self-bracketing front elevation of the subpanel. The rheostat, tickler knob and switch holes are on one line, 2 inches up from bottom, an extra knob being affixed to the switch (at right) to replace the gavel-shaped front fixture that comes with the switch. This is to provide balance. The jewel window of the pilot light is above the tickler knob, since the tuner is mounted upside down.

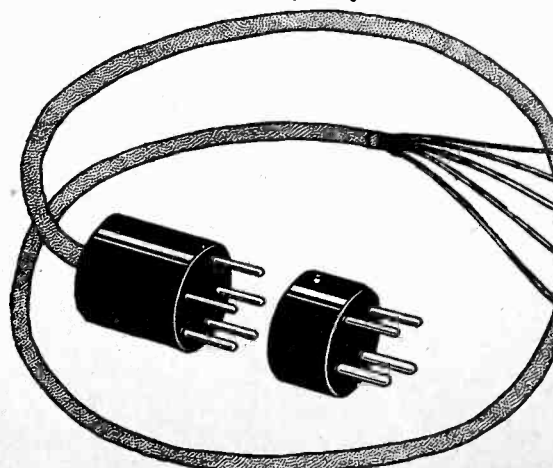
### Reconciliation

The series condenser C1 is .0005 mfd., as given in the list of parts February 9th. The text stated this value as .00025 mfd. last week.

The bypass condenser C7 in the detector plate lead is under the second tuning condenser. The audio transformers, when seen from "below," for underneath wiring of the subpanel, are reversed in respect to the top view. These two points represent a mistake and an omission in respect to the picture diagram published last week. These corrections have been made in the blueprint, which therefore is free from any omission or error, and should be consulted freely in building this most remarkable receiver.

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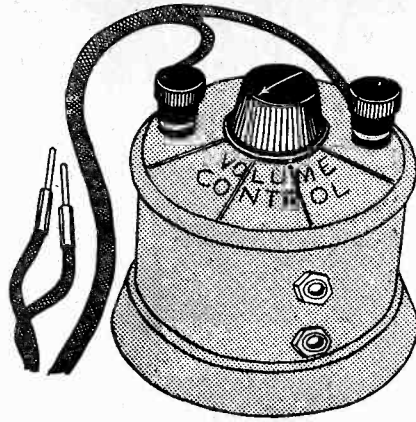
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With Motor, Neon Lamp, Two Scanning Discs, Daven Television Amplifier. Special price \$34.00.  
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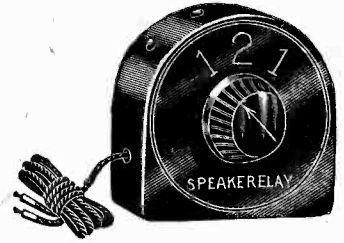
CONTROL THE VOLUME OF ANY SET AT OUTPUT!



Connect the cord tips of the Volume Control to your receiver output (speaker) posts. Connect your speaker cords to the tip jacks of the Volume Control. Vary volume by turning the knob. Price \$3.00.

**Acoustical Engineering Associates**  
145 West 45th Street, New York City

**\$100.00 WORTH**  
of Pleasure and Convenience  
for Only **\$2.00**



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

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

Another fine advantage is that anybody hard of hearing can listen to any program on the earphones, while the others hear it from the speaker—all simultaneously, remember!

Or you might want to listen in late at night on earphones alone, so as not to disturb anybody. Your set may have no detector listening post. Simply cut out the speaker—by a mere turn of the Speakerelay knob—and adjust the volume control of your receiver until reception is just comfortably loud on earphones.

Get one of these Speakerelays today, at only \$2. It is sturdily built in a molded bakelite casing, only 2 3/4" high. Positive, unerring contact affords dependable results. It offers instantaneous convenience. There is no loss in volume when this device is used.

Members of the trade, service men, salesmen, etc., use the Speakerelay to compare two speakers in a store or in the home.

You can get \$100 worth of service out of one of these \$2 products  
Cat. No. 121 (illustrated).....\$2.00

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

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

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

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

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for the  
**4-Tube Screen Grid**  
Universal; also

**\$5.00**

**DIAMOND OF THE AIR - -**  
Five-Day Money-Back Guaranty

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

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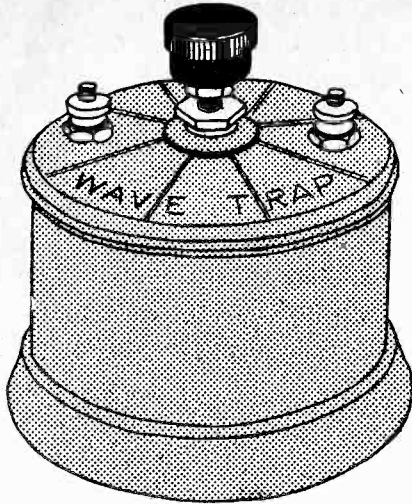
NEW YORK, N. Y.

**BLUEPRINT OF SCREEN GRID 4-TUBE UNIVERSAL - - \$1.00**

Connections Doubly Clear Because Wiring Done on Top of the Subpanel is Shown Separately, and wiring done underneath the subpanel is shown separately. All leads shown in the same direction in which they are physically connected. You don't have to reverse the blueprint mentally to visualize the practical connections. Crystal-clear blueprint safeguards against error. Order your print today. Prompt delivery. Price of complete kit, \$35.00 (less tubes, cabinet and speaker).

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### Reallocation Requires Greater Selectivity



Use a Wave Trap. Spend \$1.50 to get clear reception.

How to hook up wave trap: disconnect aerial lead from set. Connect aerial to either post of the trap, other trap post to "Ant." post of set. Turn trap knob until interference disappears. Each different wave requires a different adjustment.

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**1929 EDITION**  
BY NEWMAN

### Fourteen Circuits

Each Shown in Colored Picture Diagram, Colored Schematic Diagram and Front Panel Layout

Get This FREE Book!

Complete AC electric receivers, with B eliminators included, also AC receivers without B eliminators, also battery operated models, all easy-to-build circuits, using your own parts.

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Red lines are used in all the diagrams to denote filament leads, light blue lines for grid connections, green lines for plate leads and heavy and light black lines for the rest. You can't make a mistake if you let the colors be your guide.

The Radio Blueprint Library of AC and Battery Hookups, one volume, in FOUR COLORS, is a veritable encyclopedia of tested DX hookups, with 45 illustrations of fourteen different circuits, and a textual explanation of each circuit. Besides, the booklet contains the Story of Radio, lists of parts for all fourteen circuits, and a Station Log Chart on which to record the stations you receive and the dial settings.

This is the very volume you've been wanting for a long time, and you can get a copy of the latest edition (1929), just off the press.

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Gentlemen: Enclosed please find \$1.00 for which please send me Radio World each week for eight weeks (regular price, \$1.20) and besides send me a FREE copy of the 1929 edition of The Radio Blueprint Library of AC and Battery Hookups.

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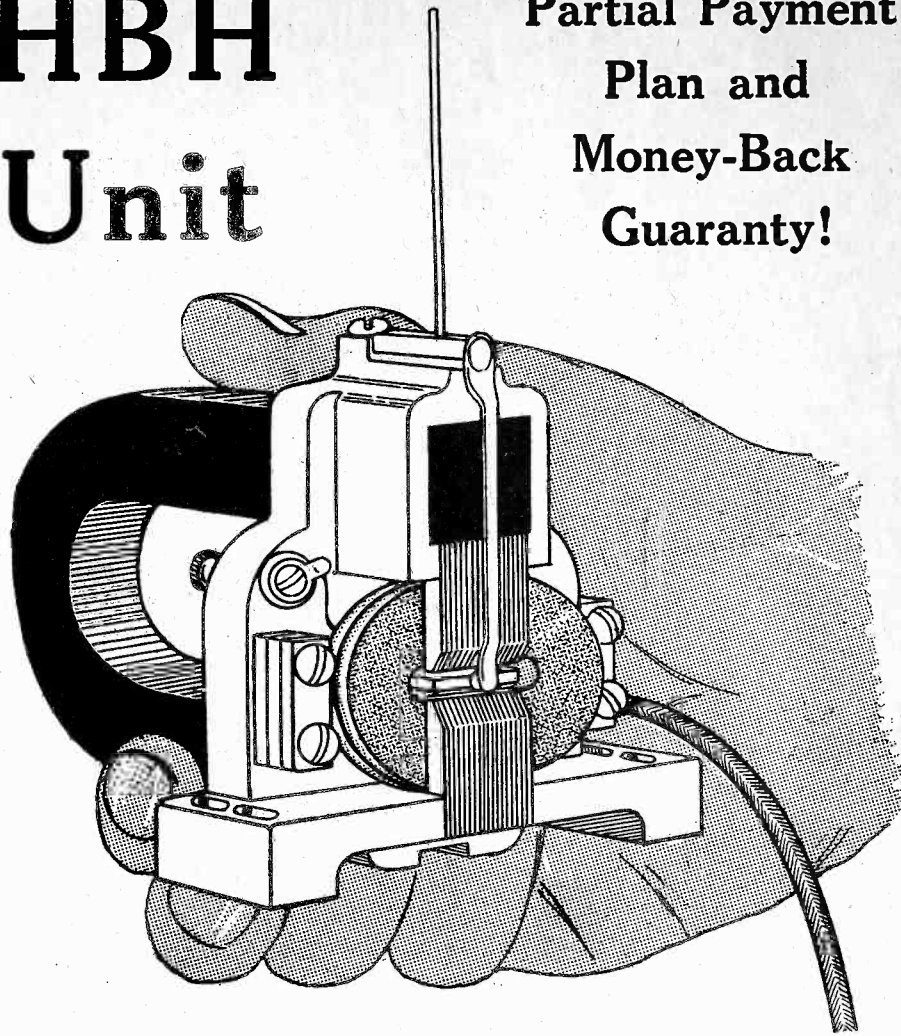
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Check off proper squares below:

- Please ship AT ONCE on 10-day money-back guaranty one HBH unit with 10-ft. cord.
- 65c extra for moulded metal tri-foot mounting bracket.

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If you are looking for a unit that gives you MOST volume, NO trouble, FINEST frequency response and MOST rugged construction, order an HBH Unit (illustrated). This is supplied with 10-ft. cord. Price \$5.95. Pay postman only \$4, plus little extra for postage. Try this unit for 10 days. If not delighted, return it in that time and get your \$4 back promptly. If you keep the unit pay the balance of \$1.95 in 90 days.

**10-DAY MONEY-BACK GUARANTY**

## SOCKET WRENCH

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.

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**RADIO WORLD**

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

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Complete Kit of Parts for the AC4, less B eliminator .....\$36.75  
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**Front and Subpanel for the AC4**

Front panel, drilled for National Drum Dial, volume control switch, and for "dummy".....\$2.35  
 Subpanel, 6x19", cut milk ladel shape, to permit room for B eliminator; 4 sockets built into subpanel; other holes drilled.....\$3.65  
**SPECIAL:** We carry National Velvet B (type 3580) in stock, also 280 tube. Get our prices on these. Blueprint for AC4.....\$1.00

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Two AC5 (for .0005 mfd.) @ \$1.50 each....\$3.00  
 Two AC3 (for .00035 mfd.) @ \$1.75 each.... 3.50

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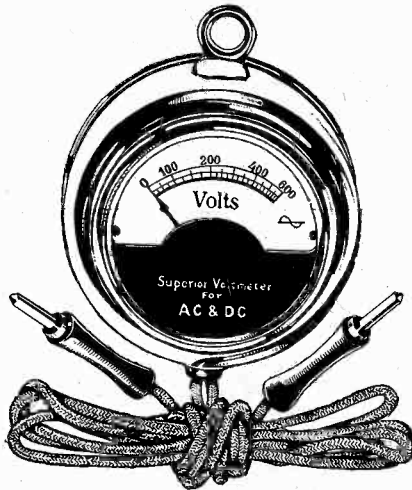
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Same Meter Reads Both  
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The O-600 volt AC and DC meter (Cat. No. 600), with 3-ft. cord, de luxe tips and hanger \$7.00.

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

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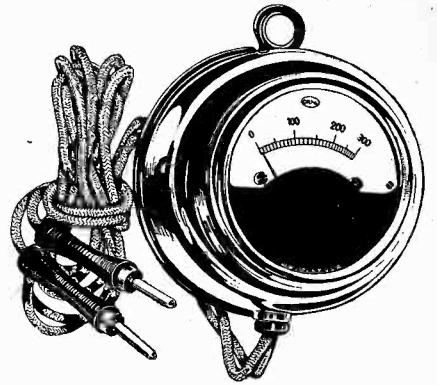
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High resistance 0-300 Voltmeter, accurate to 1%. Measures any DC voltage to 300, including B eliminators. Provided with 30" cord, with luxurious jack tips and hanger. Meter full nickel de luxe finish. No. 348F.  
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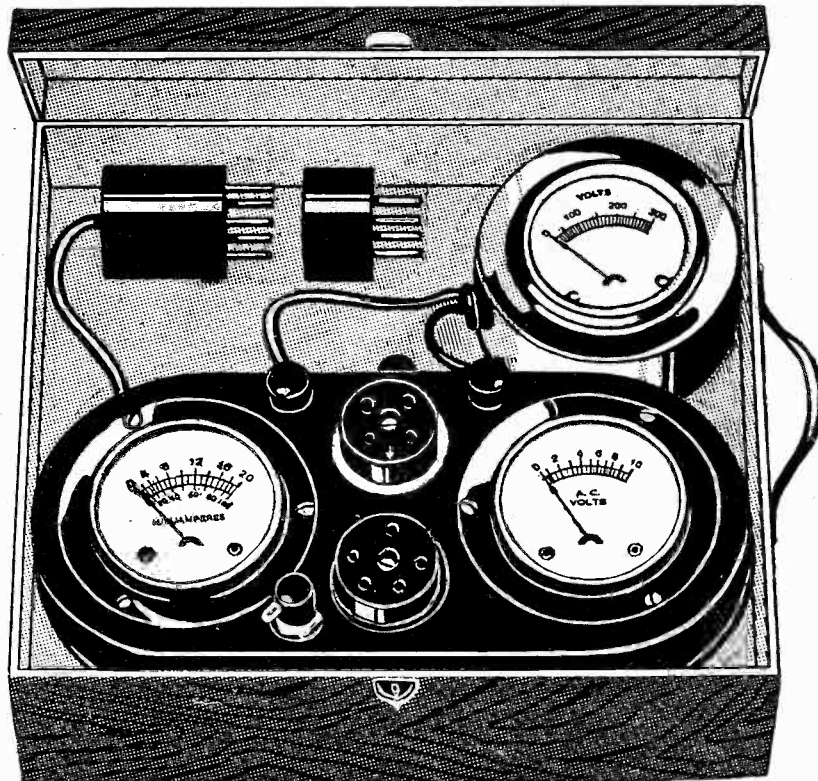
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**This Meter Outfit Makes Thirteen Vital Tests in Only 4½ Minutes!**

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.

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## 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**

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## 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;
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- (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.]

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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.  
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 (3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.  
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 (5) One grid switch to change bias.  
 (6) One 5-prong socket.  
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 (8) Two binding posts.  
 (9) One handsome moire metal case.  
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 (11) One de luxe carrying case.  
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 [Note—A pair of adapters for UV199 tubes, Cat. No. 999, at \$1.00 extra. These are not sold except with Jiffy Tester Combination.]

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Please ship at once your Jiffy Tester Combination for which I will pay post-man advertised prices, but no shipping charges. (Check off below.)  
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 One Jiffy Tester Combination C (same as A, except 0-500 voltmeter replaces 0-300). Price \$14.50  
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 Set of 199 adapters. Price \$1.00

NAME.....  
 ADDRESS.....  
 CITY..... STATE.....

5-DAY MONEY-BACK GUARANTY

# Coils Built for Abundant Results!

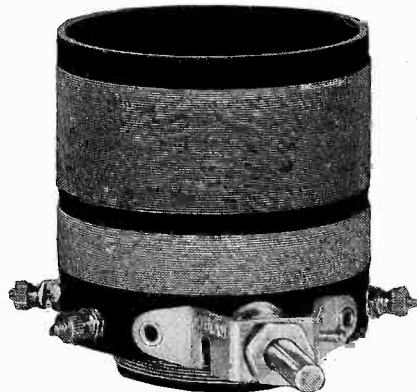
They Meet the Needs of Battery-Operated or AC Screen Grid Tubes, and General Purpose Tubes of Battery or AC Types.

Fascinating Color Adorns the Bakelite Form as Well as the Wire Insulation

## The DIAMOND Pair



**AC5 . . . . \$1.50**  
Highly selective antenna coil for any circuit, and interstage coil for AC circuits. Step-up ratio is 1-to-8. Tunes with .0005 mfd.  
Model AC3, for .00035 mfd. . . . . \$1.75



**SGT5 . . . . \$2.75**  
Tuner to work out of a screen grid tube. The large primary is fixed and is connected in the plate circuit of the screen grid tube. Tunes with .0005 mfd.  
Model SGT3, for .00035 mfd. . . . . \$3.00

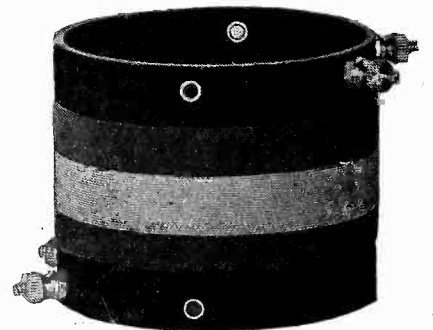
**C**OILS with a purpose, like people with a purpose, succeed best. For a highly selective four-tube receiver, as great selectivity as you can command on four tubes with ample speaker volume, the two coils, AC5 and SGT5, make an unbeatable combination. Dials will track nicely. Distance will come in easily and loud. Full sensitivity is readily attained.

The AC5 coil is used in the antenna circuit and has a small primary—six turns—while the secondary has 48 turns, a step-up ratio of 1-to-8.

The radio frequency tube is a screen grid which requires a high impedance load on the plate circuit, provided by SGT5 having a 24-turn fixed, untuned primary. The secondary is tuned.

Selectivity is what you need, especially with a high-gain circuit, such as one using a screen grid tube, and this combination of coils not only gives you that but permits retention of ample—even more than ample—volume.

And, remember, the dials track nicely!



**A5 . . . . \$1.75**

Conductively coupled antenna coil, for maximum pickup, where selectivity is not the main consideration. Continuous winding in two colors. Tunes with .0005 mfd.

Model A3, for .00035 mfd. . . . . \$2.00

The maximum volume is obtained by conductively coupling the antenna to the grid. This coil, with a continuous winding, delivers the antenna current and voltage to the grid without inductive transfer or through a condenser. The volume is so great that you think you added another stage of audio. However, the selectivity is less. Also the length of the antenna affects the tuning. So two taps are provided—both brought out to binding posts—and you connect the coil as follows: Select either terminal of the winding, and connect it through the binding post to the grid. Connect the opposite terminal, through its binding post, to ground. Then connect the antenna to either of the two remaining binding posts—the one that makes the dial readings more nearly correspond to those of the next tuned circuit.

### Data on Coils

The coils are wound on blood-orange bakelite, with tuned windings in blue silk insulation, untuned windings in strawberry silk insulation and tickler in Litzendraht, with gold insulation.

The outside diameter is 2½ inches.

All tuners (i. e., three-circuit coils with rotor winding) have single hole panel mount.

All other coils have holes for perpendicular or horizontal mounting, and hardware to accomplish this.

All tuned windings are center-tapped.

All coils are sold on a five-day money back guarantee. If you're not delighted with them, for any reason, send them back in five days and get your money back.



**HT5 . . . . \$3.00**

Tuner to work out of a screen grid tube, like TP5, only tickler is added. Tunes with .0005. Model HT3, for .00035 mfd. \$3.50.

## The UNIVERSAL Pair



**RF5 . . . . \$1.50**

Excellent selective antenna coil for any circuit, and interstage coil for any battery operated receiver, excepting output of screen grid tube. Tunes with .0005 mfd. Model RF3, for .00035 mfd. . . . . \$1.75



**TP5 . . . . \$3.00**

Interstage coupler to work out of a screen grid tube, where the primary in the plate circuit is tuned, the secondary, in the next grid circuit, untuned. Tunes with .0005. Model TP3, for .00035 mfd. . . . . \$3.25

Enormous amplification, with more than moderate selectivity, is achieved by circuits using these two coils—RF5 and TP5. The primary of the interstage coil, TP5, is on the outside and is tuned. It is center-tapped. The secondary, on the inside, is untuned.

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Please send to  
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WHAT YOU GET:

- L1L2—Antenna coil (AC5).
- L2L3L4—Screen grid tuner (SGT5).
- C1—Aerovox .0005 fixed.
- C2—Hammarlund .0005 mfd. Midline.
- C3, C4—Two Aerovox .006 mfd.
- C5—Hammarlund .0005 mfd. Midline.
- C6—Aerovox .00025 mfd. with clips.
- C7—Aerovox .0005 mfd. fixed.
- A1—622 Amperite with mount.
- A2, A3, A4—Three 1A Amperites, three mounts.
- R1—50 ohm Frost rheostat.
- R2—5 meg. Lynch metallized leak.
- T1, T2—Two National A100 audios.
- Ant. Gnd., Sp., Sp. + posts.
- PI—Jewel window and lamp.
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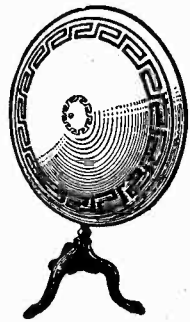
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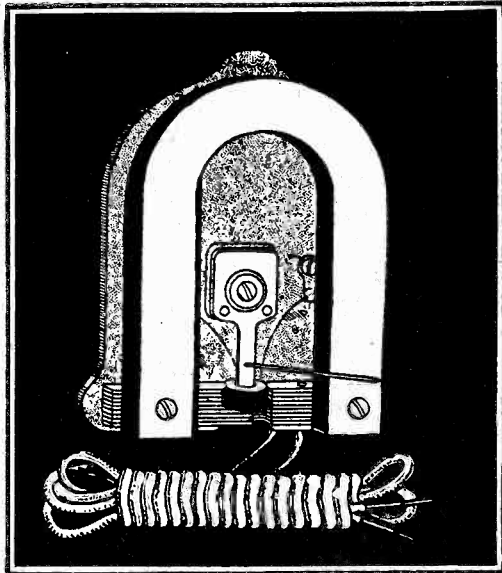
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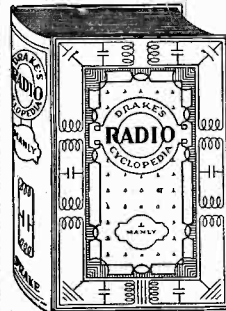
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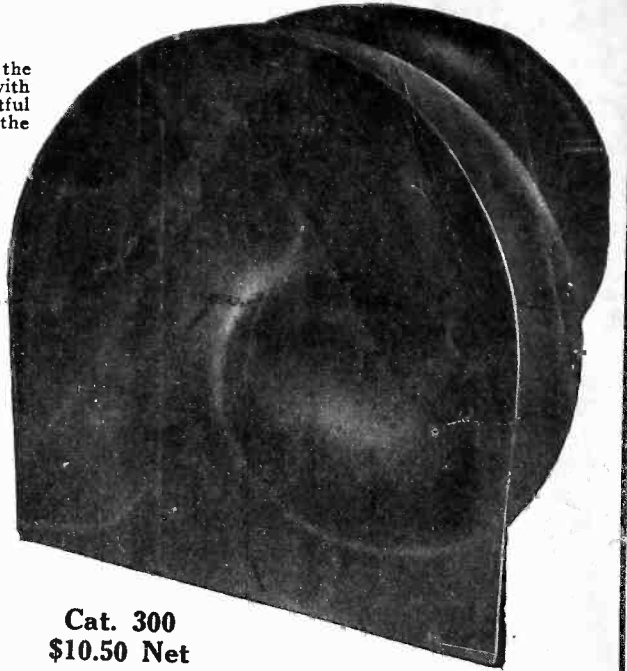


**Cat. 200**  
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This horn has a 92-inch air column. No resonance peaks. Front, 18"x18". Depth, 13½". Weight, 5 lbs.

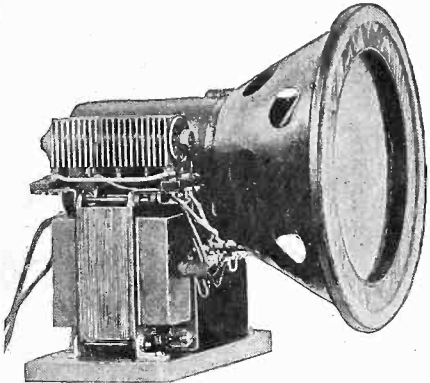


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The larger horn is preferable, where space permits. Air column, 120". Front, 18"x18". Depth, 13". Weight, 7 lbs.



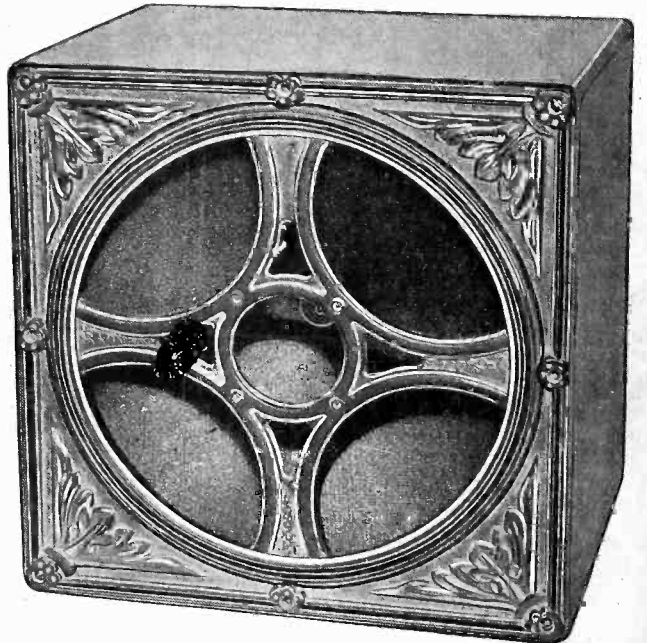
**Cat. 110 A.C.; Price, \$20.50 Net**

## DYNAMIC CHASSES and Baffle

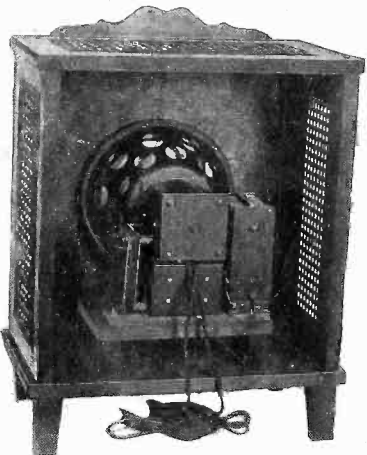
The dynamic speaker is the most popular one by far, and here is your opportunity to get a real fine chassis at a low price. Cat. 110 A.C. operates directly from the 110-volt A.C. (alternating current) lamp socket, to which built-in plug is connected, while the tipped cords go to your receiver output. Dry rectifier and output transformer built in this model.

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**Cat. 113**  
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Cat. 110 A.C., shown inside, \$20.50 extra.

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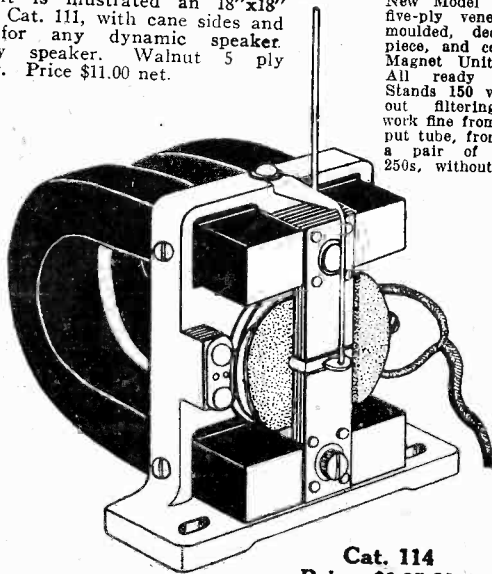
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