May 11th, 1929 15 Cents

# RADIO WORLD

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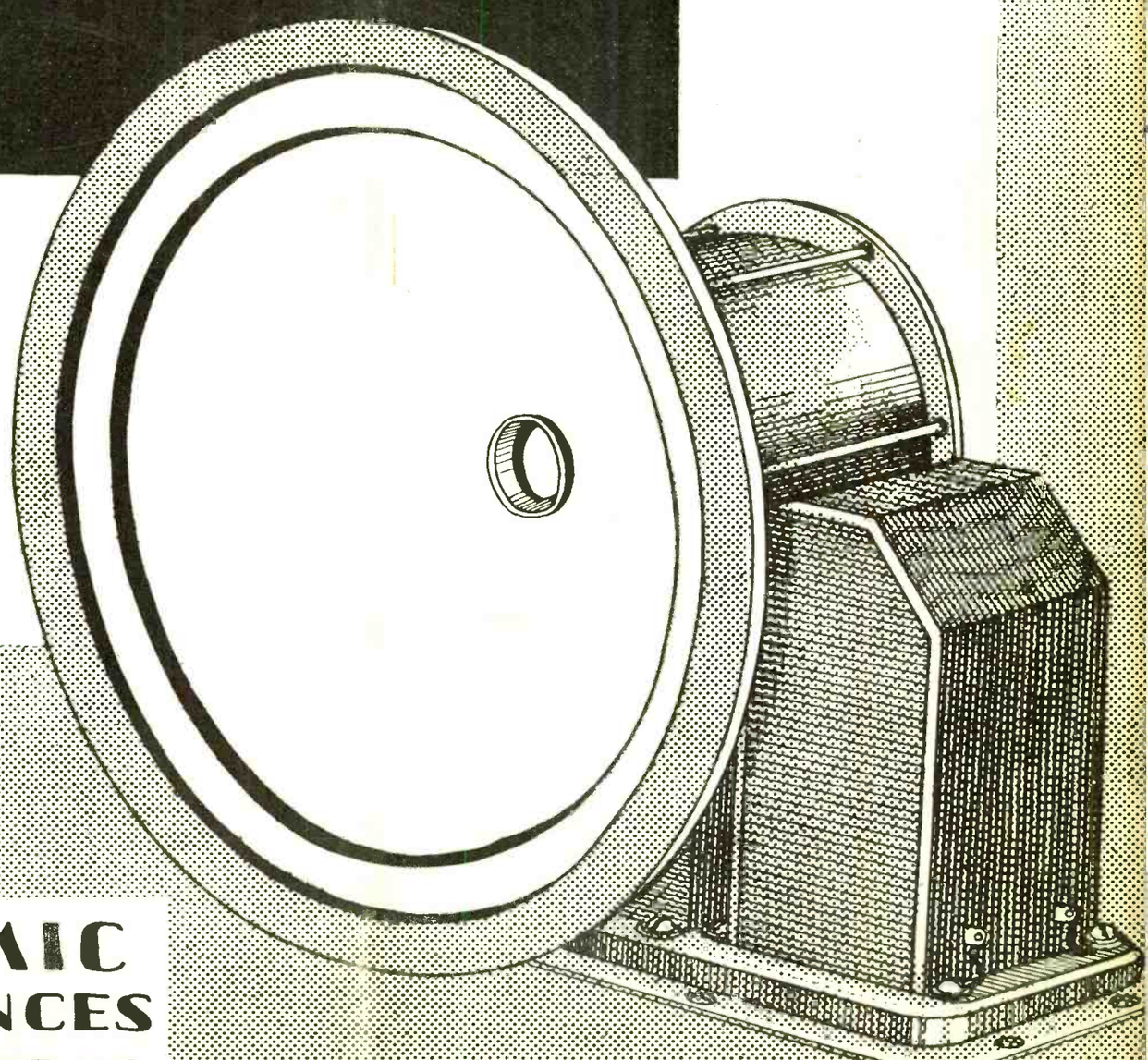
The First and Only National Radio Weekly

*372d Consecutive Issue—Eighth Year*



## DYNAMIC IMPEDANCES

SEE PAGE 17

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This tube is for battery or A-eliminator operation.

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Great for Detector or in audio channels where a resistor or impedance coil is in the plate circuit. Fil. 5 volts DC, plate 90 to 180 volts.

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Here is the circuit of circuits—the design that makes a neighboring cleared-channel, high-power broadcaster snap out of audibility at a slight turn of the dial.

No need to worry about the selectivity requirements imposed on receivers by the reallocation.

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Get the official blueprint of the laboratory model of the new SG 4-tube Diamond, exactly as built by Herman Bernard, the designer.

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145 W. 45th St., N. Y. City
(Just E. of B'way)

☐ Enclosed please find $1.00 for which please send at once the official blueprint of the new, highly selective 4-tube screen grid Diamond of the Air battery model.

☐ 60 cents extra for the February 9th, 16th 23rd and March 2nd (1929) issues of Radio World, containing Bernard's articles on the construction of this receiver.

☐ $3.00 for 6 months (26 numbers) subscription for Radio World. Send Diamond blueprint and four Diamond issues FREE, in addition to 26 current issues.

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## SCREEN GRID COILS for the 4-tube SG Universal

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|---|---|
| Antenna coil, Model RF5 for .0005 mfd. | $1.50 |
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143 West 45th Street
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*Immediate Delivery and 10-Day Money-Back Guarantee*

# RCA Radiola 28

## 8-Tube Super-Heterodyne, Always Sold at $260.00 Our Price While They Last $75!

## *See All You Get for Only $75.00*

WHEN you purchase a Radiola 28 eight-tube Super-Heterodyne, with R. C. A. loop, eight tubes and table included, you are buying at almost 70 PER CENT OFF the previous price of $260, and are buying the product of the world's leading radio and acoustical engineers, a product in which the talents of R. C. A., Westinghouse and General Electric are combined. Here's what you get:

**(1) An 8-tube Radiola 28 Super-Heterodyne, in beautiful solid mahogany two-tone cabniet.**
**(2) A solid mahogany table that is an integral part of the cabinet construction.**
**(3) An R. C. A. loop especially designed for this receiver, with solid mahogany frame.**
**(4) Eight R. C. A. Radiotrons, consisting of seven UX199 tubes and one UX120 power tube.**

***ALL IN A FACTORY SEALED CARTON!***

*Radiola 28, an 8-tube Super-Heterodyne, of the Radio Corporation of America, in solid mahogany cabinet, with RCA solid mahogany loop and eight RCA Radiotron tubes; solid mahogany table is included. Everything exactly as illustrated. Always sold at $260.00. All in factory-sealed cartons at our special price of $75.00.*

EVERYBODY wants a Super-Heterodyne because it is so selective that you do not have to worry about separating stations—10 kc. separation is yours at last.

You are almost ready to demonstrate this set to your admiring family and friends the moment it is received, since only the A and B supplies and the speaker are necessary for operation.

And when you turn on the set—oh, what a thrill! The most sensitive receiver design is yours, and how proud you are of your smart "buy"! In all the length and breadth of the United States—indeed, all the world over—there is no bigger or better radio bargain than this! A Super-Heterodyne! Eight tubes! Self-contained operation! (No outdoor aerial needed!) You can move this receiver, with the self-contained A and B sources and speaker you furnish, into any room—so conveniently—and there she plays, beautifully, clearly!

You will need 135 volts maximum B supply, 22½ volts maximum C bias and a 4½-volt A source, plus speaker, to operate the set. The B supply may be a B eliminator or B batteries. The A supply may be a 4½-volt storage battery. Or you may use a 6-volt storage battery with 5 ohms in series with the negative A battery post. Or you may use six No. 6 dry cells connected three each in series, and the two series pair in parallel. There is plenty of room in the compartment for A battery, dry cells, B batteries and C battery. Another option is a 4½-volt A eliminator and a 135-volt B eliminator to make the set electrified (except for C batteries).

You can check up on the filament voltages by using a 0-6 volt tip jack voltmeter (price, $2 extra). The voltmeter jacks are on the front panel. The filament voltage for the tubes should be from 3 to 3.3 volts.

## *The Thirteen Lucky Features!*

**1** Radiola 28 uses the famous RCA 8-tube Super-Heterodyne circuit which gives remarkable sensitivity, selectivity, volume and quality of reproduction.

**2** Unusual selectivity is provided which permits the separation of powerful broadcast stations even when the Radiola 28 is located in their immediate vicinity, this selectivity having been carried to an extremely fine degree by the employment of two stages of tuned radio frequency amplification ahead of the oscillator circuit. Only one control is required for these two tuned circuits, illustrating the extreme manufacturing precision employed on RCA Radiolas.

**3** The extreme sensitivity of Radiola 28 makes it possible to receive over great and unusual distances under favorable conditions.

**4** Audio frequency transformers have uniform acoustical properties.

**5** Ideal for country clubs, lodges, auditoriums or living rooms in the home.

**6** The "Uni-Control" tuning mechanism has been grouped in the center of the sloping panel, and is surrounded by a bronze escutcheon plate of fascinating appearance.

**7** The rotating loop gives additional selectivity in that it may be turned at right angles to undesired, interfering signals. The loop fits into a specially designed socket.

**8** The set is extremely easy to operate. Tuning is accomplished by moving the "Station Selectors," which takes the form of two drums, calibrated in kilocycles. For most purposes, local or distant stations can be tuned in by operating both drums together as a unit, with a finger. The two drums may also be operated separately for extremely fine tuning. Thus we have a radio receiver with true uni-control.

**9** Radiola 28 can be readily moved from room to room as no external connections for batteries, aerial or ground are necessary.

**10** Station call letters may be marked on the Station Selector Drums.

**11** The "Volume Control" provides regulation without detuning.

**12** All the parts are enclosed and sealed in a strong metal case or "catacomb."

**13** Radiola 28 is equipped with "straight line frequency" condensers. The figures of the station selector drums are spaced 10 kilocycles apart. Each division on the drums corresponds to a broadcast station.

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

Please send me at once one 8-tube Radiola 28 Super-Heterodyne, in solid mahogany cabinet, with solid mahogany table affixed; RCA loop, seven RCA Radiotrons UX199, and one Radiotron power tube UX122. All in a factory-sealed carton, at only $75.00.

☐ Please find remittance of $75.00 enclosed. You are to pay cartage.

☐ Please ship C.O.D. I will pay cartage.

☐ One 0—6 volts plug-in type tip jack voltmeter for Radiola 28, at $2.00 extra.

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City..... State.....

**THIS OFFER REVOCABLE WITHOUT NOTICE!**

If your remittance arrives too late we will return money the day after receipt.

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**145 West 45th St. Just East of Broadway N. Y. City**

RADIO WORLD, a weekly paper, published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y. Phone: BRYant 0558 and 0559. 15c per copy, $6 per year. This issue is dated May 11th, 1929, and is Vol. XV, No. 8. Whole No. 372. Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1879.

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**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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**RADIO WORLD**
145 West 45th St., New York City

Published Weekly

"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

# RADIO WORLD

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15c per Copy, $6.00 per Year
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under Act of March, 1879.]

Latest News and Circuits
Technical Accuracy Second to None

EIGHTH YEAR

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# HOOVER PICKS STARBUCK FOR RADIO BOARD

Washington.

President Hoover has appointed William D. L. Starbuck, patent attorney and engineer, to fill the vacancy in the Federal Radio Commission created on February 23d by the resignation of Orestes H. Caldwell. Mr. Starbuck would represent the First Zone, comprising Maine, New Hampshire Vermont, Connecticut, Rhode Island, New York, New Jersey, Delaware, Maryland, the District of Columbia, Porto Rico, and the Virgin Islands.

Mr. Starbuck, who is forty-three, lives in Sound Beach, Conn., and practices patent law in New York City. He is a friend of Col. William L. Donovan, former Assistant Attorney General, and was a classmate of Donovan's at Columbia University. Col. Donovan is a warm friend of President Hoover and helped manage the Hoover campaign in New York.

The Senate is expected to confirm the appointment of Mr. Starbuck, Democrat, and also that of Maj.-Gen. Charles McK. Saltzman, Republican, named by President Hoover to fill the vacancy caused by Sam Pickard's resignation as Commissioner. Mr. Pickard went with the Columbia Broadcasting System. With these two appointments filled the Board membership of five would be complete again.

### Engineers Preferred

President Hoover by his two appointments to the Board showed a preference for men with engineering training. Saltzman was chief of the Signal Corps, the chief signal officer of the Army, a military engineering post.

Starbuck, born in New York City, attended Drisler and Horace Mann schools and got his master's degree in engineering at Columbia University.

In 1908, Mr. Starbuck began the practice of mechanical engineering in New York, going later to the Middle West, where he continued in that work until December, 1917, when he enlisted in the army as First Lieutenant in the Ordnance Department. He was in France from May, 1918, to March, 1919.

### Specialized in Radio

From 1919 to 1921 Mr. Starbuck was connected with the firm of Starbuck & Clapp, New York, and later with several manufacturing companies. In 1921 he began the study of patent law and was admitted to the Federal, New York City and New York State bars in 1925. Since that time he has been engaged in patent law work, specializing in radio.

He is a member of the American Society of Mechanical Engineers, the Royal Society of Mechanical Engineers, London, and the American Legion.

## *Bill Prohibits Program Piracy*

Washington.

Representative Darrow (Rep.), of Philadelphia, Pa., introduced a bill to amend the Radio Act to forbid interception and re-transmission of radio programs without authority of the originating station. The bill, which also prohibits sending of false distress signals, was referred to the Committee on Merchant Marine and Fisheries.

The full text of the amendment:

Section 28. No person, firm, company, or corporation within the jurisdiction of the United States shall knowingly utter or transmit or cause to be uttered or transmitted any false or fraudulent signal of distress or communication relating thereto; nor shall any such person, firm, company, or corporation intercept in the process of transmission and rebroadcast or in any manner retransmit by wire or wireless or by any means record, for the purpose of reproduction, the program, or any part thereof, of another station without the express authority of the originating station."

# 2 ACTS BECOME CORPORATIONS

Chicago.

WBBM made the following announcement:

"The copyright laws, made to protect the author and artisan of the printed word from having his work stolen by unscrupulous competitors, overlooked radio entirely.

"The broadcaster's spoken word can be repeated at will by other radio announcers, even if an idea or a phrase has been originated and popularized by the first station. There is no protection offered under the copyright laws because they were in existence long before radio was regarded as anything but visionary.

"To protect two very popular features given regularly over the WBBM air Theater, Chicago, they have been incorporated under the laws of the state of Illinois. Officers and a board of directors have been elected for each corporation and they hold regular meetings and must stay on the air in order to maintain their charters.

"The two features are the Nutty Club and the Old Grey Mare Club."

### PROSKAUER BROADCASTS

Over WKBQ, Starlight Park, the Bronx, New York City, every Monday night from 8 to 9 o'clock, a series of interesting talks is given on curing noises and other interference. These talks are by Julian J. Proskauer, Associate Member, Institute of Radio Engineers, head of the Trutone Laboratories, 114 Worth Street, New York City.

# FOUR STATIONS OUSTED AND 29 ON PROBATION

Washington.

Four stations were ordered off the air by the Federal Radio Commission for failing to justify their existence. The stations were WHBW, Philadelphia; WSMD, Salisbury, Md.; WSRO, Middletown, O., and WAAD, Cincinnati, O. The Commission found that public interest, convenience and necessity would not be served by granting a renewal of their licenses.

Fourteen stations were put on probation for forty-six days for serious frequency deviation, and fourteen others were treated likewise because of creating interference.

The twenty-ninth station put on probation was WOBU, Charleston, W. Va., this one for 30 days, for removing its transmitter without first having obtained permission.

All the other stations—about 600—obtained unconditional renewal of licenses for 90 days, or until July 31st. The conditional or probationary renewals carry a threat of license forfeiture if the situation complained of is not remedied or perfect conduct proven to exculpate a past violation.

### Four Cancellations

Licenses were outright refused to:

WHBW, operated by D. R. Kienzle, Philadelphia, Pa., on 1500 kc with 100 watts power, sharing time with WALK and WPSW.

WSMD, operated by Tom Little, Salisbury, Md., on 1310 kc with 100 watts power.

WSRO, operated by Harry W. Fahrlander, Middletown, Ohio, on 1420 kc with 100 watts power, sharing time with WAAD.

WAAD, operated by Ohio Mechanics Institute, Cincinnati, Ohio, on 1420 kc with 25 watts power, sharing time with WSRO.

### 14 Wave Wobblers

Serious deviation from frequency, with failure to correct after warning, brought a conditional renewal for 46 days of the licenses of the following:

KFWI, Radio Entertainments, Inc., San Francisco, Calif.
KGFJ, Ben S. McGlashan, Los Angeles, Calif.
KFQW, Inc., Seattle, Wash.
KGER, C. Merwin Bobyns, Long Beach, Calif.
KGGC, Golden Gate Broadcasting Co., San Francisco, Calif.
KOL, Seattle Broadcasting Co., Seattle, Wash.
KMO, Inc., Tacoma, Wash.
KPQ, Archie Taft & Louis Wasmer, Seattle, Wash.
KGA, Northwest Radio Service Co., Spokane, Wash.
WAGM, Robert L. Miller, Royal Oak, Mich.
KWTC, Pacific-Western Broadcasting Federation, Santa Ana, Calif.
WICC, Bridgeport Broadcasting Station, Easton, Conn.
WOKO, Harold E. Smith, Mt. Beacon, N. Y.
KFBL, Leese Bros., Everett, Wash.

# POLL OPPOSES USE OF TAINTED TESTIMONIALS

The National Better Business Bureau has conducted a poll among national advertisers and advertising agencies regarding the use of purchased testimonials. These indorsements are not only used in printed advertisements but in occasional instances are read over the air. The advertising agencies arrange those parts of the program having to do with the reading of purchased testimonials, and also place the contract for time on the air, for which they are paid a commission by the stations that receive the contract.

The poll gave the following results:

| | Against | For |
|---|---|---|
| National advertisers..... | 700 | 41 |
| Advertising agencies..... | 149 | 14 |
| Totals ..... | 849 | 55 |

**Practice Widespread**

An analysis by the Bureau showed that purchased testimonials were widely used through the scope of advertising and were not limited to one advertiser or to a single industry.

"The promptness of reply and the large percentage of returns from our questionnaire," says the Bureau, "very definitely demonstrated the seriousness with which the abuse of purchased testimonials was criticized.

"A summary shows an overwhelming percentage who disapprove. The opinion as expressed is added to by trade and newspaper comment, supplemented by cartoons and wise cracks from professional jesters.

"Add to that the sleeve-laughing that is going on by many well-paid testifiers who, from their own experience, must believe that the advertising business is dependent upon deception for success and supplies these insincere testifiers with a lucrative 'racket.'"

**Food Men Attack Practice**

The National Food Protective Committee recently petitioned the Federal Radio Commission to revoke the licenses of thirty-eight stations on the National Broadcasting Company's chain that broadcast the "Lucky Strike" program each Saturday night, one ground being that "tainted testimonials" were read over the air, the testifiers being heroes and heroines in the eyes of youth, and their testimonials being calculated to make young boys and girls become cigarette addicts.

The petition also said that lists of names of famous persons are available, with the price of a testimonial after each name, and that all an advertiser has to do is to pay the price and obtain a testimonial for any product. It was hinted Lucky Strike cigarette manufacturers simply bought indorsements in this way.

**RCA QUITS VICTOREEN SUIT**

Cleveland, O.

The injunction suit of Radio Corporation of America against the George W. Walker Company, of 2825 Chester ave., Cleveland, merchandisers of Victoreen products, alleging infringement of patents involving the Super-Heterodyne ufactures parts for use in a circuit which is famous as the Victoreen.

The George W. Walker Company manufacturers parts for use in a circuit which is famous as the Victoreen.

## *Esquimo Wants Arctic Shoe Store*

Chicago.

A shoe company broadcast programs from WBBM and asked listeners to answer the question: "Why I want a store in my neighborhood," intended for Chicago people.

Out of 8,000 letters from listeners there were some from practically every State in the Union, and some from Canada. Also, an Esquimo asked where the nearest store was, so he could buy a pair of snow shoes.

# 50,000 WATTS GIVEN TO WTAM

Washington.

Authority to construct a broadcasting station capable of using the maximum allowable power of 50,000 watts was granted by the Federal Radio Commission to WTAM, at Cleveland, Ohio.

The Commission, it was stated, has granted the station a construction permit to erect the new station outside of Cleveland, and to "reconstruct," and "move" as well as to increase its power. WTAM, operated by WTAM & WEAR, Inc., at present is authorized to use 3,500 watts on the 1,070 kilocycle channel. Station WEAR, which it also owns, operates on the same channel with 1,000 watts.

There are now only half a dozen 50,000 kilowatt stations in operation in the United States, it was explained, although construction permits have been issued to a number of stations to build transmitters of this output. The authority to WTAM to construct a transmitter of 50,000 watts does not include authorization to broadcast with this power. Under Commission regulations, a separate order must be issued.

Ohio has one 50-kilowatt transmitter in operation. WLW, operated by the Crosley Radio Corporation at Cincinnati. Commission records show that since this station has used the maximum power it has been heard practically throughout the country, says "The United States Daily."

Commission regulations also specify that the maximum actually allocated power to a broadcasting station must be 25,000 watts but provides that additional power up to 25,000 watts may be authorized experimentally.

## Victor-RCA Merger Goes Into Effect

The Radio-Victor Corporation of America has been formed as a wholly-owned subsidiary of the Radio Corporation of America.

The new company, incorporated under the laws of Maryland, will take over the sales activities of the radio corporation and the Victor Talking Machine Company.

More than 99 per cent of the common stock of the Victor Talking Machine Company has been deposited by Victor stockholders pursuant to the unification plan announced last January.

On the board of directors are representatives of the General Electric Company, Westinghouse Company, and Radio Corporation of America, including H. P. Davis, General Harbord, Owen D. Young, Gerald Swope and David Sarnoff.

**MOVES CHICAGO OFFICE**

The Chicago office of the DeJur-Amsco Corporation has been moved from 77 West Washington Street to the Wrigley Building. William E. Burgoyne is in charge.

# 9 MORE SEEK LICENSES FOR NEW STATIONS

Washington.

Applications as follows were received by the Federal Radio Commission, including nine applications for new stations:

New station. Idris J. Jones, Birmingham, Ala. Requests authority to erect a station using 6,000 or 5,000 kilocycles (short waves) with 15 to 150 watts power.

New station: Proffer Bros. Battery Station (H. R. and C. R. Proffer), Dexter, Mo. Requests authority to erect a station using 967 kilocycles, 75 watts power and daylight hours only specified.

New station, Abe Cohen, Lynchburg, Va. Requests authority to erect a station using 1,000 kilocycles with 100 watts power and to operate from 1 p. m. to 12 p. m.

New station, Harold Ralph Jones, Chanute, Kans. Requests authority to erect a station using 250 watts power, 1,200 kilocycles and unlimited time.

**College Seeks Station License**

New station, Radio College of California, Los Angeles, Calif. Requests authority to erect a station using 1,500 kilocycles, 250 watts and unlimited time. (Radio College of California, owned by H. A. McGougal and J. A. Finney).

WRBJ, Woodruff Furniture Co., Inc., Hattiesburg, Miss. Requests change in frequency from 1,500 kilocycles to 1,420 kilocycles, increased power from 10 watts power to 100 watts power.

WREN, Jenny Wren Company, Lawrence, Kans., requests permission to move from Lawrence, Kans., to outskirts, and increased power from 1 kilowatt to 5 kilowatts.

New station, Robert Allyn Sapp, Denton, Texas. Requests authority to erect a station using 100 watts power, 1,240 kilocycles, and unlimited time.

New Station, Symons Broadcasting Company, Great Falls, Mont. Requests authority to erect a station using 1 kilowatt power, 570 kilocycles, full time for day, divide with KXA after sunset each half hour.

New Station, The Gas Engine & Elec. Co., Inc., Columbia, S. C. Requests authority to erect a station using 1,310 kilocycles with 150 watts power and daytime hours specified. This station filed a previous application in the name of Station Radio Distributors Radio Branch of the Gas Engine & Electric Co., Charleston, S. C.

**Alabama Petition**

New Station, Reynald's Music House Co., Mobile, Ala. Requests authority to erect a station using 1,200 kilocycles with 50 watts power and four hours daily and one evening hour.

WIOD, Isle of Dreams Broadcasting Co., Miami Beach, Fla. Requests increase in power from 1 kilowatt to 2½ kilowatts on 560 kilocycles and unlimited time were granted on April 12, 1929, also I kilowatt day, 500 watts night and 500 watts night additional for experimental purposes.

KIDO, Boise Broadcasting Station, Boise, Idaho. Requests change in frequency from 1,250 to 1,220 kilocycles.

## Stations Barred from the Argentine Cities

A decree passed in Argentina prohibits broadcasting stations within city limits.

Stations now within cities must move outside within nine months. Special provisions regarding wavelengths and other changes have also been adopted.

# A. P. TO PROBE SENDING NEWS OVER STATIONS

Newspaper publishers are at odds over the broadcasting of news. Some think it should be prohibited, as the public learns the latest news more quickly by radio than from the press, and, satisfied that it has been sufficiently informed, is discouraged from reading newspapers.

Other publishers contend that the broadcasting of news merely whets the appetite for complete details, which the stations do not furnish, but which are published in the newspapers.

**Discussed at Meeting**

The question came up at the twenty-ninth annual business meeting of the Associated Press. On motion of Josephus Daniels, of the "News and Observer," Raleigh, North Carolina, the directors of the Associated Press were called on to make a general survey of conditions and report to the 1930 meeting. Mr. Daniels was Secretary of the Navy in the Wilson administration.

Victor F. Ridder, speaking as publisher of the "St. Paul Dispatch," moved that the directors, who had authorized limited chain broadcasting, be asked to eliminate from the chain all stations in any city in which an Associated Press member objected to the broadcasting. This motion was lost and Mr. Daniels' motion, offered as an amendment, was carried.

**Public News-Hungry**

The afternoon newspapers were particularly interested in the subject, as they feature "flash" news in many instances as circulation pullers, these "flashes" or "bulletins" often not being much more comprehensive than the broadcast details of the same news.

Kent Cooper, general manager of A. P., said there had never been such a hungering for news on the part of the public as there is to-day.

## Two New Volumes by Rider Published

Two books by John F. Rider for the radio service man are announced by the Radio Treatise Co., 1440 Broadway, New York City. They constitute a series entitled "The Service Man's Manual."

The first volume entitled "The Mathematics of Radio" explains radio phenomena in a practical manner, with examples of calculation.

The second volume, entitled "The Trouble Shooting Manual," contains the diagnosis of receiver systems, RF amplifiers, eliminators, etc. Trouble shooting in these systems with commercial set testers and analysis of symptoms.

## It Can't Be Accidental!

Radio World sells each month more copies than are sold in the same period of time by any other radio publication in the world—bar none.

Radio World's subscription list has increased faster during the past four months than during any other period of its existence.

One company controlling a few hotel and railroad newsstands in the West has added 495 copies to its order.

## *Son Born as Papa Plays Piano on Air*

San Francisco.

Lon Protteau, one of "The Three Boys of KGO," learned he had just become a father while playing over the station the other morning. He became so excited when Charles Park, KGO announcer, whispered the glad tidings to him that he didn't know which end of the piano was the bass.

"I'm Walking Around in a Dream" was played over the air by Protteau for his wife, who was separated from her husband by the San Francisco Bay. A loudspeaker along the side of the bed at home enabled mother and son to listen in.

# NO MISTAKES BY ANNOUNCER?

The National Broadcasting Company will expand its efforts to perfect the art of announcing.

George Engles, vice-president, director of the Program Department, said that experts in various specialized subjects will be called in to assist in this effort. Authorities on art, music, science and the like will supplement the general knowledge of announcers, so that absolute accuracy in the use and pronunciation of technical terms may be insured.

"The requirements of the company in engaging its announcers are extremely stringent," said Engles. "All of the announcers have more than the average amount of information on many subjects covered by broadcasting. The company demands a high standard of education and culture, as well as the ability to speak correctly.

"However, with the spotlight of public attention focused so strongly upon radio announcers, particularly by the American Academy of Arts and Letters, we realize that absolute perfection is necessary. Radio announcers are now expected to set the standard of public usage. If they are to be entirely worthy of public confidence they must never make a mistake.

"We realize that no one person can be infallible on every subject. It takes an authority on music to know the exact use and pronunciation of all terms relating to music. The same is true in the case of art and science. Even so, authorities themselves sometimes disagree. There must be someone to have the deciding word. Such experts will be engaged to act in an advisory capacity to the announcers."

Engles said that the company has recently inaugurated an intensive training course in speech for its announcers. Each week the entire staff of announcers meets with Miss Vida Sutton for advanced coaching in diction and the use of the voice. Miss Sutton is director of the speech department at the Theater Guild's School for the Young Actor.

"The course," said Engles, "is designed to do away with localisms, individual mannerisms and the metallic quality often existing in American speech. In this connection announcers will be given the opportunity to hear how their voices come over the air—to see just how the quality is recorded by the microphone and loudspeaker. They are given special exercises for resonance, articulation and breath control. Bodily exercises supplement the vocal exercises since coordination of body and voice are so interrelated."

Milton J. Cross, NBC announcer, recently won the Academy's diction medal.

# RADIO AFFORDS $400,000,000 ANNUAL WAGES

Washington.

The status of the radio industry has been assayed by a Commission appointed by President Hoover. It has been found that the industry is, in general, in a healthy condition, that close to 350,000 persons are employed in it, and that the annual turnover is around a billion dollars.

The Department of Labor has made a separate survey that includes the radio industry. The average wage in the industry has been put at $25 a week. Multiplying the 350,000 employes by the average wage, the total wage for the industry amounts to $8,750,000 per week, or more than $400,000,000 a year.

**Receivers Popular**

The receiving set has become vastly pop ular. Starting in 1921 with 50000, the number has increased to around 10,000,000.

The employment in the industry is analyzed on the general basis of activities in or association with radio, and includes not only the factory workers and their executives, but also persons employed in studios, even if in a clerical capacity, and of course includes service men and others employed by retail stores, jobbers, etc.

**Greater Stability**

In some branches of the radio field the demand is greater than the supply, it has been found, while in other branches a condition of overcrowding exists.

A general trend toward better stability is noted, particularly associated with continued activities during the Summer. Many factories will continue in operation during 1929 without interruption for the first time in their history.

## Ce-Lec-Tor Is Newest Station Separator

The Ce-Lec-Tor, the newest and most modern type of station separator, embodying the band-pass filter system together with the best principles heretofore known for the cutting apart of interfering stations, is now ready for immediate shipment. Factory facilities have been expanded to take care of the Ce-Lec-Tor output and there will be no slackening on this account in the production of the Si-Len-Ser, which is in greater demand than ever.

These two devices were designed by Julian J. Proskauer, head of the Trutone Radio Sales Company and director of their laboratories. Further information may be had from this concern by addressing their main office at 116 Worth Street, New York City. Mention RADIO WORLD.—J. H. C.

## Lynch Appoints O'Neil

Arthur H. Lynch, Inc., 1775 Broadway, New York City, announced that J. F. O'Neil has become general manager.

Mr. O'Neil was for eight years Superintendent of Agencies for the Curtis Publishing Company before going with a tube company. O'Neil will have charge of a group of Lynch sales experts in all parts of the country.

Mr. O'Neil is well known among New York, New Jersey and Pennsylvania jobbers.

# Why Neutralize Audio?

## Prevents Plate-Grid Capacity Cutting High Notes

*By Herbert E. Hayden*

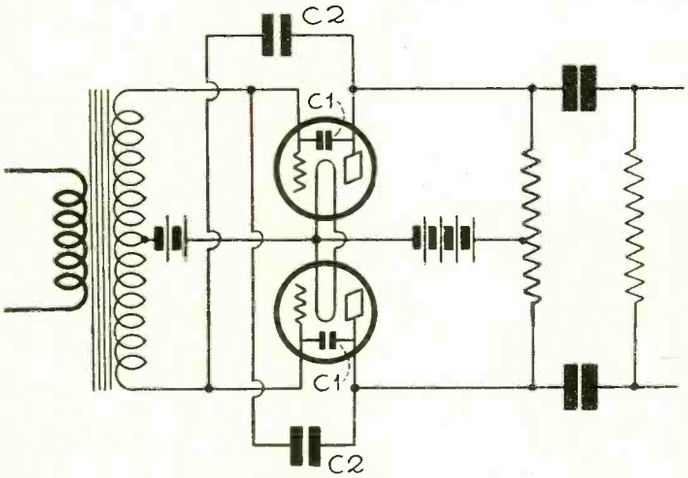
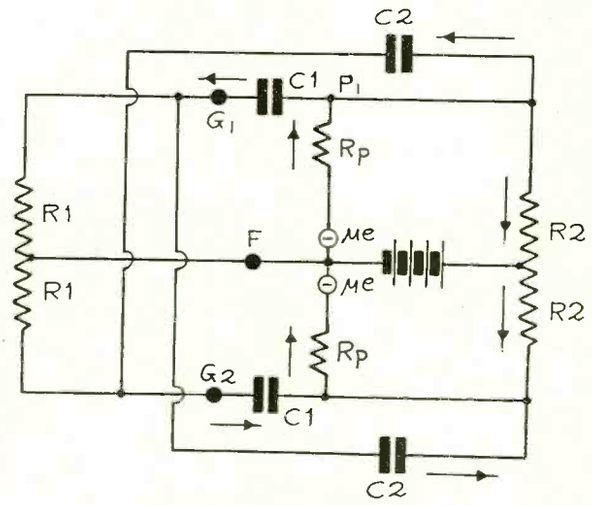



FIG. 1

**A PUSH-PULL STAGE USING RESISTANCE COUPLING IN WHICH NEUTRALIZING CONDENSERS C2 ARE USED TO COUNTERACT THE FEEDBACK THROUGH THE GRID-TO-PLATE CAPACITIES C1.**




**A SIMPLIFIED CIRCUIT DIAGRAM OF A PUSH-PULL RESISTANCE COUPLED AMPLIFIER. MID-TAPPED RESISTOR IS USED FOR INPUT IN PLACE OF THE PUSH-PULL TRANSFORMER SECONDARY.**

RESISTANCE coupled amplifiers are said to amplify signals of all frequencies equally well. Of course, this is only relatively true. There is a certain amount of discrimination at both ends of the audio scale. At the low frequencies the stopping condensers reduce, and at the high frequencies the plate to grid capacity reduces the amplification.

It is not difficult to design a resistance coupled circuit so that it will amplify the low frequencies as low as required. It is only necessary to increase the size of the coupling condenser, or, for a fixed value of coupling condenser, to increase the resistance value of the grid leak which follows the condenser.

It is not so easy to bring up the amplification at the high frequencies, for the cause of the suppression is not controllable. For a high voltage step-up the plate resistance in the output of the tube should be large. But as this resistance is increased the effective value of the input capacity increases greatly, and the greater is the suppression on the high notes. That is, the increase of the plate output resistance increases only the amplification on the low and medium notes. Hence the larger the value of the plate resistance, the poorer will the quality be.

What happens is that the amplified signal is reflected back from the plate to the grid in such phase as to oppose the input voltage on the grid. The feedback takes place through the grid to plate capacity.

### Neutralization in Push-Pull

If the circuit has two tubes or more it is possible to neutralize the feedback by a method used in the early resistance coupled radio frequency amplifiers. A small condenser is connected between the grid of the first tube and the plate of the second. The potential of the plate of the second tube is in the same phase as the grid of the first. Hence the feedback through the grid to plate capacity may be counteracted by the feedback from the second plate to the grid of the first. This condenser must be smaller than the grid to plate capacity, since the signal has been amplified by two tubes. In fact, the condenser would have to be extremely small to prevent oscillation.

If the audio amplifier is push-pull, it is possible to neutralize the plate to grid capacity in a single stage. This has been done in many short wave receivers, but not in audio amplifiers. Perhaps the reason is that push-pull resistance coupled amplifiers have not gained much popularity.

Fig. 1, left, shows the first stage of a resistance coupled push-pull amplifier. It is supposed to be adjusted so that it is perfectly symmetrical with respect to the filament. This means that the tubes are exactly the same and that the voltages and the corresponding coupling impedances are equal.

Each tube has its own plate to grid capacity indicated by C1. These capacities work in both tubes so as to reduce the amplification on the high notes. Now, the grids at any instant are at the same absolute potential but in opposite phase. That is, when one is V volts positive with respect to the operating point, the other tube is V volts negative with respect to the same point.

### Plates in Opposite Phase

Since the grids are in opposite phase the plates are also in opposite phase. But the potential of the plate of one tube is in the same phase as the potential of the grid of the other. Therefore if two small condensers C2 be connected diagonally across the circuit from grid to plate the effect of the feedback through the plate to grid capacity in either tube will be neutralized.

For example, the plate of the upper tube feeds a certain amount back to the grid of that tube through the upper C1 and at the same time the plate of the lower tube feeds an equal amount to the upper grid through the lower C2. The amounts of voltage fed back to the upper grid are equal, or may be made so, but opposite in phase. Hence the feedback does not change the signal voltage on the grid of the upper tube.

The same applies to the lower tube. In this case the upper C2 and the lower C1 feed voltage to the lower grid.

### Simplified Circuit

It will be observed that as far as the feedback is concerned the plate of each tube is connected through a small condenser to both sides of the input device. Therefore there can be no feedback.

The right hand diagram in Fig. 1 shows the same circuit in a simplified form. In this circuit the tubes have been replaced by equivalent elements, namely, the fictitious voltages ue, the internal plate resistances Rp and the plate to grid capacities C1. Grid-to-filament resistances and the inter-element capacities other than C1 have been omitted. Also the secondary of the transformer has been replaced by a center-tapped resistor having a total value of 2R1.

When this type of input is used, another resistance enters into the circuit in parallel with 2R1, and that is the plate resistance of the tube ahead. But that resistor is balanced with respect to the feedback as well as is the center-tapped resistor.

The arrows in the lower circuits indicate the directions of the various currents which establish the potentials across the impedances. When arrows point to an element, such as the grid G1, the potential at that point may be considered to be rising, and when the arrows point away from a point the voltage may be considered as falling. It will be seen that on grid G1 the arrow for C1 points to the grid and the arrow for C2 points away. Thus if the two condensers involved pass the same current, there is no tendency for the potential to change as far as the feedback is concerned.

The push-pull amplifier does not suppress the high notes so much as a single-sided circuit composed of similar elements because the equal grid-to-plate capacities are in series, and therefore only one-half as great, effectively, as in the single tube stage. Hence it is not necessary to neutralize the capacities except when the high audio and superaudible notes must be amplified as well as the low audio notes. Receivers used for television reception require a band about 50,000 cycles. This is much wider than any ordinary audio amplifier is able to cover.

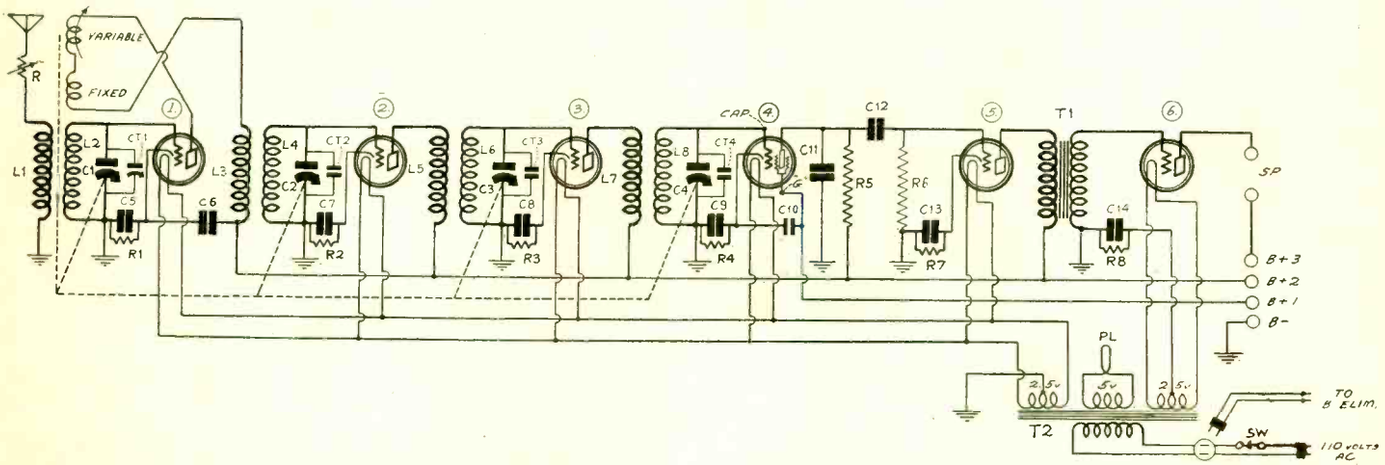
When the neutralizing condensers are used they should be small variable condensers such as are used for trimming tuning circuits in broadcast receivers. The plate-to-grid capacity in an ordinary high mu tube is of the order of 10 mfd., so that the neutralizing condensers should be of this size. That is, condensers which has a lower minimum than this should be used.

# A New Self-Stabilizer

## Oscillation in RF Channels Efficiently Controlled Automatically

*By Herman Bernard*

**Managing Editor**




**AN AC CIRCUIT, USING THREE STAGES OF TUNED RADIO FREQUENCY AMPLIFICATION, STABILIZED BY MEANS OF NEGATIVE FEEDBACK, VARIED AUTOMATICALLY BY MECHANICALLY COUPLING THE TICKLER SHAFT TO THE CONDENSER SHAFT. IF FEEDBACK IS TOO GREAT IN EITHER POSITIVE OR NEGATIVE DIRECTION THE TICKLER COIL MAY BE ADJUSTED TO COMPENSATE FOR THIS, OR AN EXTRA WINDING MAY BE PROVIDED (MARKED "FIXED"), AND MADE NEGATIVE OR POSITIVE, AS CIRCUMSTANCES REQUIRE.**

THE advisability of using multiple stages of tuned radio frequency amplification, for the resultant sensitivity and selectivity, is generally recognized, but some means must be introduced to stabilize the receiver. Every such means introduces some loss, no matter what system of neutralization is used, but it is a gainful loss, since otherwise the receiver would be virtually inoperative. A parallel example is that of a driver of an automobile when he reaches the top of a steep hill with railroad tracks ahead. He puts on the brakes, to avoid nearing the tracks at an uncontrollable speed that might render him and the automobile permanently inoperative. This braking is a loss, but the kind of a loss one is glad to endure, since it enables life. The same is true in the receiver. Without stability it is as good as dead.

Various methods of stabilizing a receiver at radio frequencies work out satisfactorily, including grid suppressors connected from stator of a tuning condenser to grid of a socket, neutralizing condensers that establish a capacity equal to the self-capacity of the tube, but with negative feedback to neutralize the positive feedback caused by that internal capacity, high negative bias on radio amplifiers, and the like.

### Interesting Subject

As self-oscillation is usually most troublesome on the higher broadcast frequencies, and as some method of increasing the resistance is always employed, it follows that a receiver balanced for the troublesome frequencies will be a little less sensitive on the lower frequencies (higher wavelengths). Therefore some method that changes the resistance in the right direction, lowering it for the lower frequencies, is an interesting subject of investigation.

The method proposed is a new one, and consists of using a rewound three-circuit coil, so that the primary is in the antenna circuit, the secondary in the grid circuit, and the tickler in the plate circuit of the first tube, but the tickler is used at least in part for reverse feedback. Either the tickler alone may be used, or a small extra winding may be put on the coil form at the end opposite to the one accommodating the primary or on a separate inside form, and this small winding may be connected in series with the tickler

The control of self-oscillation becomes complete when the inductances are properly proportioned and the shaft of the rotating coil is coupled to the shaft of the gang tuning condenser. A Hammarlund flexible coupler will do this, if the tuning condenser has a part of its shaft protruding from the far end.

### How It Works Mechanically

The mechanical operation then is as follows: As the tuning dial is rotated from lowest to highest frequency in the broadcast band, that is, from 100 to 0 on most dials, the tickler coil turns with the condenser. If the phases are correctly established, by exercise of knowledge and care in connection of coil terminals, the positive feedback will decrease as the frequency increases, due to automatic rotation of the tickler. This change is accomplished through the tuning mechanism itself.

The results will differ depending on how the tickler is originally positioned. If at lowest frequency (100 on the dial) the coupling is made full positive, by paralleling the tickler with the secondary and having equal potentials in relatively the same position, there will be positive feedback. Under some circumstances this will work out well. If the circuit is not keyed up too high, that is, has not a terrific attribute of feedback, the positive regeneration will be useful. As the higher frequencies are tuned in the feedback reverts to zero, at the numerical center of the dial, and then turns negative in the region where the greater incurred resistance is needed.

If this arrangement is properly proportioned, there will be positive feedback to aid the sensitivity and volume on the lower frequencies, thus tending to atone for the rising characteristic of tuned radio frequency amplification where the amplification is greater the higher the frequency, and at the same time contributing a variable resistance factor that spares the loss introduced on the high frequencies from affecting the low frequencies where it is not wanted. In fact, as explained, instead of the loss being merely eliminated for the low frequencies, a gain is actually provided. However, this almost ideal condition is hard to attain, since critical regeneration is a function of both the frequency and the volume, and satisfaction of both requirements introduces technical difficulties of a high order.

### Simpler Method

Therefore a simpler method may be used by anybody, and good results obtained, since if the first tube is prevented from oscillating there is seldom any trouble from subsequent tubes in the cascaded chain. This simpler method is to put the tickler in a parallel position with the secondary, when the condenser plates are totally out of mesh, and to join the coil terminals to their destinations in reverse feedback fashion. This consists of noting where the grid is connected on the secondary and then connecting the plate of the first tube to that terminal of the tickler which occupies exactly the opposite position. Assuming both windings in the same direction, this means that if the beginning of the secondary goes to grid, the end of the tickler goes to plate. The other terminal of the tickler may be connected experimentally to the terminal of L3 that otherwise would have gone to plate.

*[Further discussion of this interesting method of introducing stability in the radio frequency amplifier without incurring undue losses will be published next week in the May 18th issue.]*

# New Theory Propoun Calls for Infinite

*By J. E.*

**Technical**

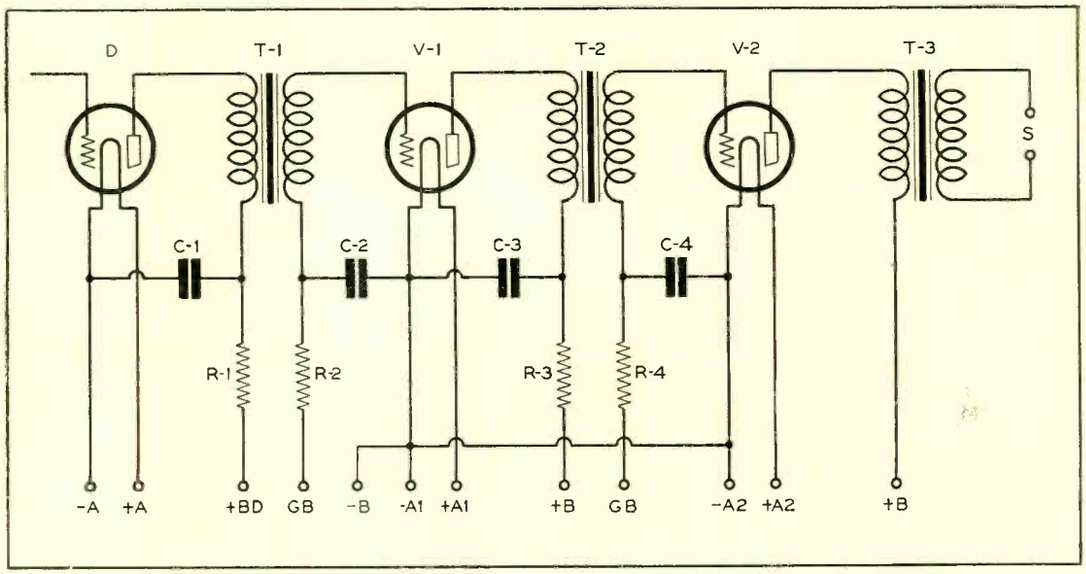



**FIG. 1**
**A DIAGRAM OF A FERRANTI AUDIO AMPLIFIER SHOWING HOW RESISTANCE-CAPACITY FILTERS SHOULD BE USED TO PREVENT REGENERATION.**

WHAT are the conditions for obtaining maximum *power* output from a tube when the speaker is coupled to the tube by means of a transformer? Should the primary impedance of the transformer be equal to the plate resistance of the tube, as has been asserted countless times? Should the primary impedance be equal to twice the value of the plate resistance of the tube, which is asserted to be the condition for maximum *undistorted* power output? Or should the primary impedance of the transformer be as large as possible, as is asserted by Ferranti engineers? The assertion of these engineers is rather startling and the question is whether it works out in practice.

### Problem Complex

The problem is not at all simple, because there are so many factors that enter into the determination of the optimum conditions. Many assumptions have to be made regarding the properties of the transformers, and they are only approximately true. Also, there is much doubt about the impedance of the loudspeaker, for it varies not only with the frequency but also with the electrical location of the speaker.

It may be shown that the total power, that is, both the active and the reactive, may be expressed $(u\ E\ M\ w)_2Z^2/(Z_1Z_2+M^2w^2)$, in which **u** is the amplification constant of the tube, **E** the effective value of the input voltage on the grid, **M** the mutual inductance of the coupling transformer between the tube and the speaker, **w** the frequency multiplied by 6.28, and $Z_2$ the total impedance of the secondary circuit.

Assume that there is no leakage inductance, an assumption justified for most

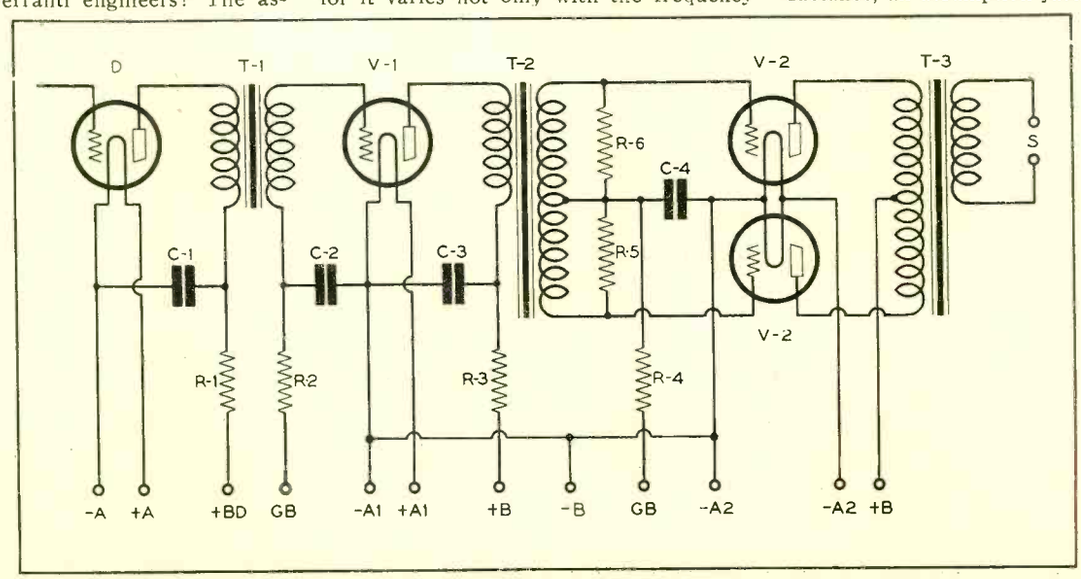



**FIG. 2**
**FERRANTI AUDIO AMPLIFIER CONTAINING A PUSH-PULL STAGE, SHOWING HOW THE RESISTANCE-CAPACITY FILTERS SHOULD BE CONNECTED TO STOP REGENERATION.**

# ded for AF Transformer Load Impedance

*Anderson*

**Editor**

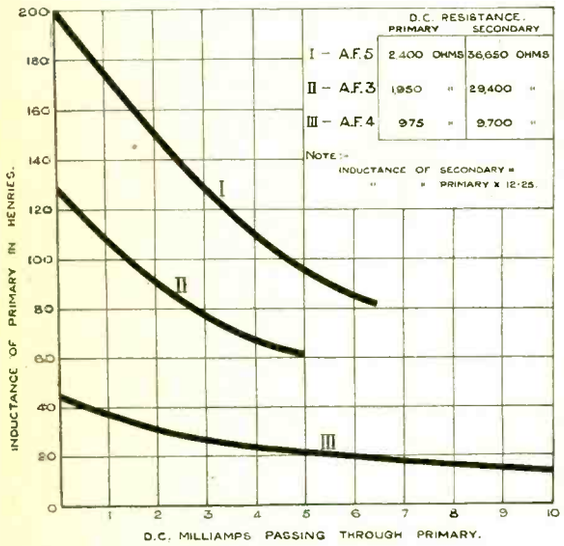



**FIG. 3,**
**HOW THE INDUCTANCE OF THE PRIMARY OF THE FERRANTI TRANSFORMERS VARY WITH THE AMOUNT OF DC.**

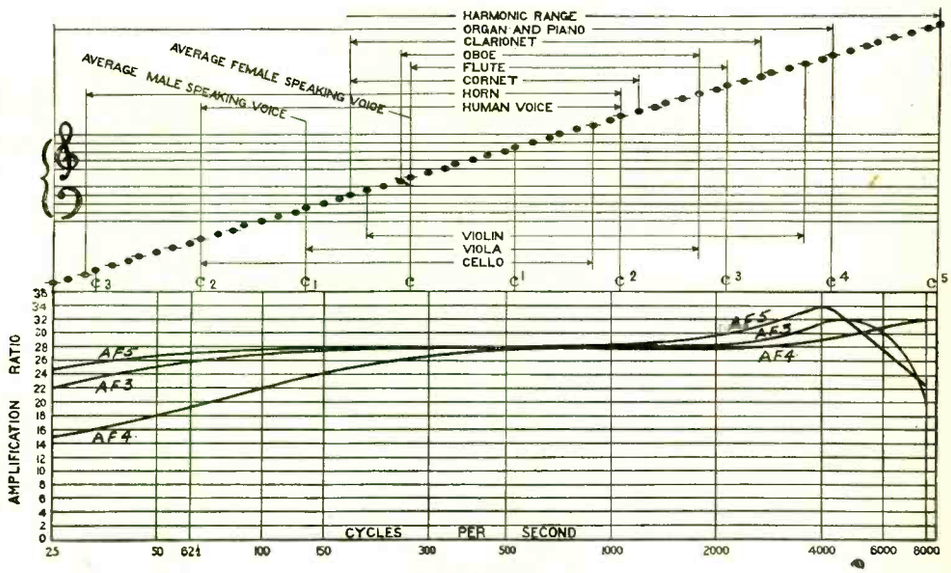



**FIG. 4**
**PERFORMANCE CURVES OF THE FERRANTI TRANSFORMERS COMPARED DIRECTLY WITH THE MUSICAL SCALE.**

transformers. Then $M_2$ may be expressed as $L_1L_2w^2$, where $L_1$ and $L_2$ are the primary and the secondary inductances. When this value is substituted in the above expression for the power, and noting that $Z_1$ equals $R_1+jwL_1$, it will be seen that the power increases as $L_1w$ increases. This is because as $L_1w$ increases it becomes large compared with $R_1$.

The larger the primary impedance of the transformer, the smaller is the primary current. Thus the losses in the plate resistance decrease, and a greater proportion of the total available power is delivered to the transformer to appear as useful power in the secondary.

### Lower Power Loss

As the primary current decreases by virtue of the increase of the primary impedance, the losses in the transformer decrease rapidly, thus leaving more for useful work in the secondary circuit.

A sample of the results obtained by the Ferranti engineers on a dynamic speaker at 50 cycles will suffice to show how the power increases with the increase in the primary impedance. The tube used had a plate resistance of 2,000 ohms, the speaker resistance was 4 ohms and the transformer ratio was 25-to-1. The results at 50 cycles are given:

| Primary impedance in ohms | Secondary impedance in ohms | Speaker power in milliwatts |
|---|---|---|
| 2,000 | 3.2 | 128 |
| 4,000 | 6.4 | 135 |
| 19,000 | 30.2 | 136 |
| Infinite | infinite | 100 |

Of course, the infinite impedance condition cannot be obtained, but it is not necessary, for at 19,000 ohms the power is less than one per cent lower than the theoretical maximum.

The ratio of turns also affects the power output. This is due to matching of the loudspeaker impedence with the secondary of the transformer. In the example cited above the ratio of turns is 25-to-1 and the power is 135 milliwatts. If the ratio of turns be decreased to 20-to-1 the power is reduced to 131 milliwatts and if the ratio be increased to 30-to-1 the power drops to 128 milliwatts.

### Filtering Well Done

The Ferranti engineers have also delved into the question of regeneration in audio frequency amplifiers and devised methods for rendering it ineffective. One of the circuits recommended by them is shown in Fig. 1. This circuit is for battery operated tubes. It will be noted that there is a resistance-capacity filter in every grid and every plate circuit. The condenser in each instance goes direct to the filament, while the resistor is placed in series with the plate or grid return lead below the condenser. This effectively reduces feedback to a point where it will not cause oscillation or even slight frequency distortion.

While no filter is shown in the last stage, it will not hurt to put a large condenser from the B plus terminal of the output transformer to the negative end of the filament.

In Fig. 2 is shown the filtering treatment given a circuit having a push-pull output stage. The arrangement of the resistors and the condensers is the same.

Condenser C4 serves both the tubes in the last stage. So does resistor R4. In a push-pull stage which is well balanced the need of a filter either in the grid or the plate circuit is not so great as in a single-sided circuit. But it is well to use filters just the same, for there is often a considerable unbalance in a push-pull stage.

### Effect of DC

Coupling transformers having iron cores do not have the same impedence under all conditions. For example, if a direct current is flowing in the primary, the resistance drops to a much lower value than when no direct current is superposed on the alternating current. Fig. 3 shows how the primary inductances of three Ferranti transformers vary with the DC through the winding.

These curves indicate that for low impedance tubes AF-4 is suitable because its inductance does not decrease rapidly with the current. Its low impedance is offset by the low impedance of the tube with which it is used.

For tubes of higher impedance, and for circuits in which the plate current is low, the AF-3 and the AF-5 are superior. The amplification will be much greater than when the AF-4 is used, especially on the bass notes. These facts are clearly shown on the experimental curves in Fig. 4.

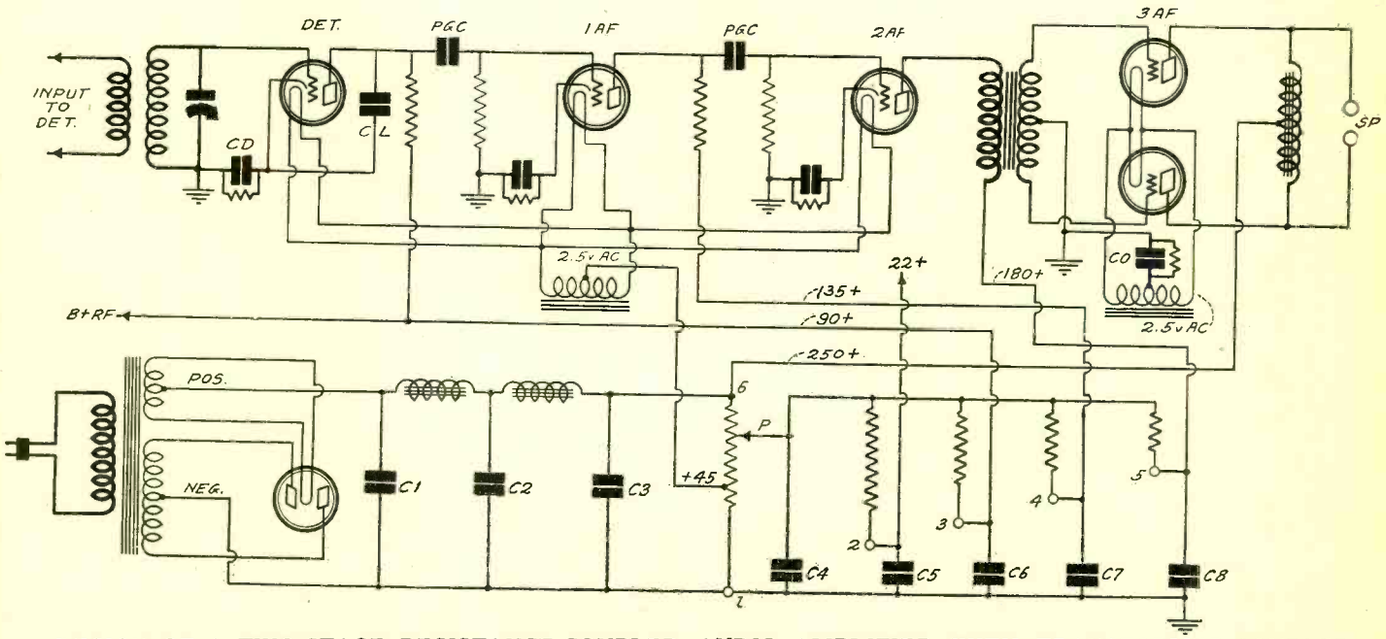
The curves are plotted on an octave scale and directly above the curves is plotted the musical scale and the frequency ranges of the various musical instruments. Note that the transformers have practically straight lines over the entire musical scale. The curve for AF-5 is particularly attractive. It shows an amplification of nearly 25 at 25 cycles and a little over 22 at 8,000 cycles. The peak at 4,000 cycles shows an amplification of 34, which is only about .8 decibel above the amplification at 1,000 cycles. The smallest intensity difference the human ear can distinguish is about 1 decibel.

# A Quality A
# a Sound Investm

*By H. B.*

THE choice of an audio frequency amplifying channel is something deserving of thoughtful attention, because no matter how excellent may be the radio frequency channel of a receiver, the reproduction may be impaired or ruined in the audio circuit. No matter how the radio amplifier is made, nor what circuit it is, it can not improve quality of tone. If improperly made, voltaged or operated, it may injure tone quality. It can harm tone, never help it. Therefore if any succor is to be had, it must be in the audio channel.

For selectivity and sensitivity we depend on the radio amplifier. For tone values we look alone to the audio channel. Since all of us are supremely interested in




**DESIGN OF A TWO-STAGE RESISTANCE-COUPLED AUDIO AMPLIFIER WITH TRANSFORMER-COUPLED PUSH-PULL THIRD STAGE. THE B SUPPLY IS EMBODIED. THE FILTRATION IS ESPECIALLY WELL GUARDED AND STABILITY RESULTS. THIS AMPLIFIER IS TO BE WORKED WITH THREE STAGES OF RADIO FREQUENCY AND DETECTOR, OR LESS.**

fidelity of reproduction, we choose whatever *radio* amplifier and detector is to our liking, or suits our needs best, and proceed to an intense study of the *audio* amplifier for the safeguarding of what the detector delivers.

In a very real sense the best audio amplifiers are merely the best safeguards and protectors of the detector output. Correct design permits a distortionless detector output, in the sense that audio frequency response is virtually impartial throughout the entire range.

### Double Wrong

If there are shortcomings in the radio amplifier, as where too great selectivity injures the high notes, a compensating effect may be introduced in the audio circuit for reducing the intensity of the low notes. But this is a makeshift. It proceeds on the basis of an acknowledged error, and instead of correcting the original error, commits another one, perhaps on the theory that two wrongs make a right, a philosophy unacceptable since Caesar stormed Gaul. And in the audio channel the subduction of low notes to offset the injury previously done to high notes may be in obedience to a theory alone, and not a practical feat, since more than mere balancing of missing high notes against missing low ones is necessary. The result may be simply the absence or deep attenuation of both extremes, to the utter predominance of the middle register. That, indeed is not tone quality. It is the acknowledgment of one mistake by the commission of another. The net result may be less notorious, but it is still far from that perfection which all of us desire at least to approach in our own home installations.

### Can't Progress Much More

The quality of the audio amplifier is determined by complex conditions, including the nature and value of constants used for coupling, the voltages and means of providing them, the tubes and, of course, the speaker. That this quality can approach perfection is indeed a fact in this advanced state of the radio science, and that much improvement ever will be made is impossible, since the margin between the present condition and perfection is too small, and better than perfect it means distortion!

With such an abundant opportunity, therefore, to obtain results that will be approximately standard for all time, it is certainly fitting that the wisest choice be made.

Just what to choose is a subject on which unanimity, fortunately, never can exist. Taking perfection as the theoretical criterion, it is fair to state that any one of the three main methods of coupling —by transformer, impedance or resistance —or combinations thereof may accomplish this. Transformers are few indeed that are excellent, and always the excellent ones are not cheap in price, because costly to manufacture. The Ferranti AF5, for instance, one of the best transformers in the world, lists at $14. An audio amplifier consisting of a pair of these transformers, with proper B supply, well filtered, makes as excellent an audio amplifier as one would want.

### Gives Great Enjoyment

If 250 tubes in push-pull are desired as the output, with a built-in B supply, there is something to win any man's heart. There are other good transformers, although probably none quite so good. Even one with an acoustically trained ear will get plenty of enjoyment out of the resultant reproduction.

It is, in general, harder to get as good results from impedance coupling, due to the limitations imposed by coil-winding. The distributed capacity should not be so high across the coil terminals as to bypass the higher audio frequencies, for this would be the same effect as produced by sideband-trimming in an over-selective tuner. Yet the impedance of the coil should be as high as possible—infinity, in fact. The limitations that distributed capacity and excessive DC resistance place upon the coil that should be of infinite impedance are obvious. By a predetermined method of tuning the coupling circuit, that is, introducing regeneration effective at the desired frequencies, a good response may be obtained.

### Stability Always Possible

The third method, resistance coupling, is as good as there is, since the resistance equals the impedance at all frequencies

# udio Amplifier ent in Happiness

*Herman*

(whereas coil impedance depends on frequency), although it has proven harder to obtain stability in a resistance-coupled audio amplifier than in any other, with impedance coupling a close second on this score, and transformer coupling last. However, roughly speaking, any audio circuits of the three different types, or combinations thereof, if equally true in reproduction, will give about equal trouble from self-oscillation. This regeneration, taking place at audio frequencies, is due to a common coupling, often through the common impedance of the B supply or batteries, or the unison of plate and grid circuits such as always takes place when biasing resistors are used. However, properly filtered and bypassed, any audio circuit worked within reasonable limits of amplification, may be made stable.

Resistance coupling never has achieved great popularity. Transformer coupling always has been the overwhelming favorite. Most transformers in use are distorters, and the general run of transformers in factory-made receivers, nearly all of which have transformers, is poor indeed.

### 83 Cents for Audio Transformer

While it is amusing to read advertisements of set manufacturers extolling the tone of their receivers. in only a few instances does realism prove out on actual test, because 83 cents is a fair price for a manufacturer to pay for an audio transformer, or, if he makes his own, the same transformer usually will cost him more. In a two-stage amplifier you therefore get $1.76 worth of one quality (manufacturers' price), and the advertising copy writers can coin all the fancy tone phrases they want, but they can not thereby change the laws of nature, one of which is the law of magnetic circuits pertaining to effect of the structure upon he frequency response and wave form.

It is pertinent to ask why one manufacturer lists one single audio frequency transformer at $14 and why another manufacturer, this one a set producer, lists an entire table model receiver for $60. If it is pertinent to ask the question, it is not impertinent to answer it.

Radio is being robbed of its very birthright of brightest enjoyment by the dissemination of bad receivers and the miseducation of the public that these distorting devices deliver tone quality.

### Does Deception Hurt?

A small percentage of the total population has a deep appreciation of musical values and acoustical science, and if distorting contraptions are established as the criterion of real tone, the victim will be none the worse off for the deception, if it is true that the ignorant are none the worse off for their lack of education, or the poverty-stricken none the worse off for their lack of money. If price alone is the consideration, then why do not the manufacturers catering to the low-price market, instead of arguing that a low-priced radio set of merely passable or even inferior tone is better than none at all, make a low-priced receiver of excellent tone realism? Rather than cheap transformers of bad quality they could use cheaper resistors of much better tone quality! But that would require solution of the problem of proper filtration, to avoid motorboating or other manifestations of incipient or advanced self-oscillation. A proper distribution of the voltages and currents derived from the B supply, suitable bypass condensers, often not many more of them than are now used in cheap, poor sets, would help a great deal, and the engineering department could complete the work along special lines that a particular manufacturers' receivers might require.

### Amplifier of Happiness

But it isn't done that way. The world is being made safe for distortion. You hear it at proud demonstrations of sales-excited manufacturers, you hear it from demonstration receivers operated at radio stores, particularly music stores that are rather proud of these noise boxes, and you come across it in almost every home that you visit.

There is no need to ask a man why he should go to the pains of building an audio amplifier, or purchasing one of the built-up models that cost more than an ordinary, fully-equipped receiver. He has a good reason, the best reason: he knows tone quality when he encounters it, and knows distortion when he doesn't encounter tone quality. No number of misleading assertions in advertisements can dissuade him. He enjoys realism, not fairy tales. And as knowledge adds to the enjoyment of life, he is willing to go to the pains and expense of obtaining the audio amplifier that will make his life happier.

### Realism Starts Blinks

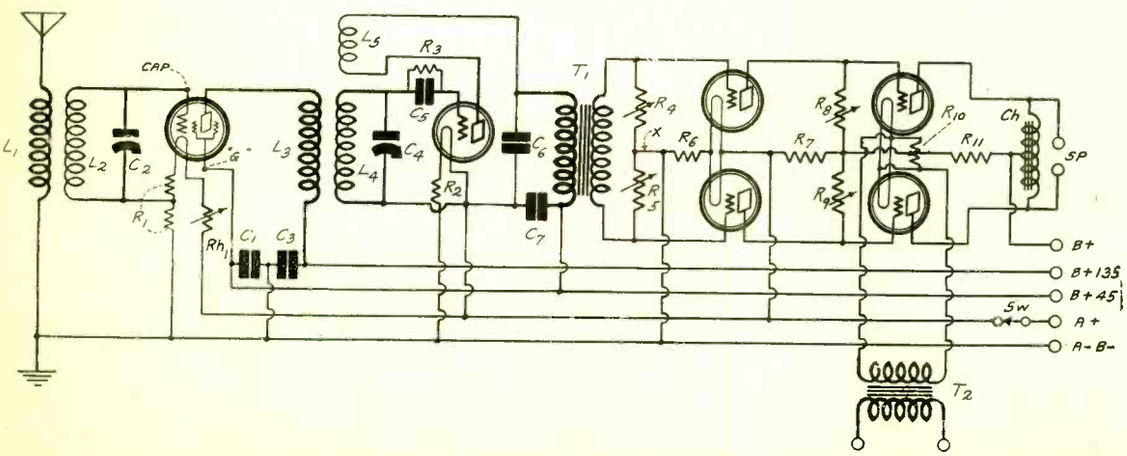
While it is true that many thousands of persons calmly listen to distorted reproduction, and refer to it as realism, tone quality, perfect reproduction, clear, faithful, it is also true that they have ears, and that ears are not so dull as some persons would have them. The opportunity to compare one's distorting receiver with the reproduction of a distortionless amplifier is seldom enjoyed—not one-half of one per cent. of the time.

Even lacking this direct comparison, there is something about realism that sort of makes a startled hearer blink. Listening to a fine amplifier under home conditions has been one of the greatest influences leading otherwise unversed persons to adopt excellent audio as their maxim.

The construction of the audio amplifier, for the heretofore unapproachable results obtainable, should be along lines laid down by those thoroughly familiar with the quality branch of this work—circuits and parts being used such as are recommended in the better-grade technical press, by editorial writers of sound knowledge and practical experience. Every such author will provide excellent filtration, will reduce the common coupling as much as practical, both in circuit formation and in bypassing and filtration, and will spread greater delight than ever among those whose interest and confidence he courts. He will present an audio amplifier designed for quantities of undistorted power output and will consider whether the output of the detector is to be of a high or low order of volume—will provide much greater audio-amplified volume for a simple little tuner than for a multi-stage radio frequency circuit that often feeds as much as 5 or 6 volts to a detector, and, that done, will have served his public well.

* * *

[*Audio amplifier and B supply circuits for best toned reproduction will be published in subsequent issues, following designs laid down by the author. One design is diagrammed on the opposite page in advance.—Editor.*]




**An interesting attempt to have a push-pull resistance-coupled last stage of audio. This circuit is purely experimental, since the accurate balancing of the resistors is a technical feat.**

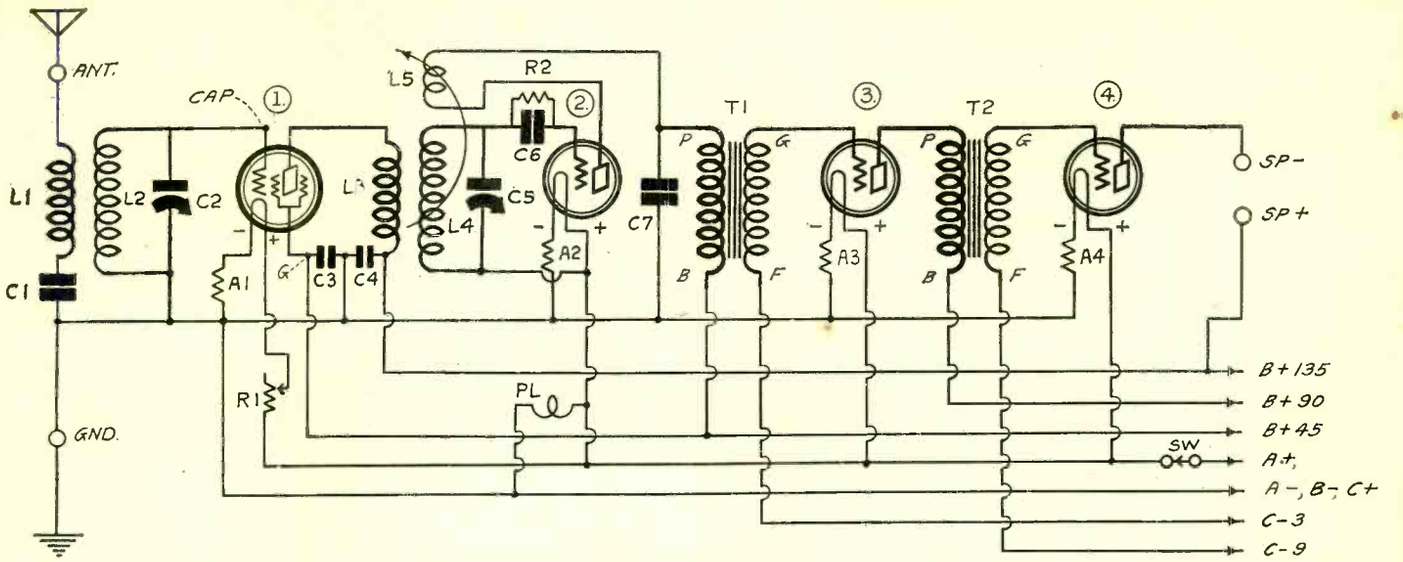



**FIG. 751**

**TO SECURE RADIO FREQUENCY STABILITY WHEN USING ONE OR MORE SCREEN GRID TUBES, BOTH THE SCREEN GRID AND THE PLATE SUPPLY LEADS SHOULD BE BYPASSED, AS SHOWN IN THIS DIAGRAM. C3 AND C4 ARE THE BYPASS CONDENSERS. EACH MAY BE .1 MFD. OR LARGER.**

# Radio University

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

**When writing for information give your Radio University subscription number.**

**PLEASE SHOW** a circuit diagram indicating how to measure the plate and grid voltages in a receiver using AC tubes.

(2)—Also please show a simple method of measuring the grid bias in a resistance coupled circuit.

AMOS BURT,
Nashville, Tenn.

(1)—See Fig. 750, left. Voltmeter 1 measures the grid bias, meter 2 measures the plate voltage, while meter 3 measures the sun. A high resistance meter must be used.

(2)—The right hand figure in Fig. 750 shows an arrangement for measuring the grid bias on a resistance coupled tube. Throw the grid to the upper point and note the reading on the plate milliammeter. Then throw the grid down to pick up the battery Eg. Adjust this battery until the plate milliammeter reads the same as it did before. The reading on the voltmeter across Eg is the bias sought.

* * *

**I HAVE** a power tube in which there is a blue glow at all times. Is this harmful to the tube and to the operation of the circuit?

(2)—What is the cause of the glow? How can it be removed?

(3)—If the tube can not be used safely as a power tube could it be used to advantage in some other part of the circuit?

VINCENT LATIMER,
Toledo, Ohio.

(1)—It is not harmful to the tube because that is already defective. It should not be used in the power stage, or in any amplifier stage.

(2)—The glow is caused by residual gases in the tube. It usually appears when the plate voltage is too high. Get a new tube.

(3)—It may be used as a detector. But if the amplification factor of the tube is low it will not function well as a detector.

* * *

**CERTAIN BYPASS** condensers are provided with spark gaps. What are they for?

(2)—Why are by-pass condensers rated at different operating voltages for alternating and direct voltages?

(3)—Why is the continuous operating voltage lower than the flash voltage?

(4)—What is the difference between a condenser rated at 200 and one rated at 1,000 volts? Why is the size of the 1,000 volt condenser larger than the 200 volt condenser when both have the same capacity?

WILFORD TODD,
Omaha, Neb.

(1)—The spark gap is for protective purposes. When the voltage across the condenser rises above a certain value determined by the insulation, the condenser discharges across the spark gap and this prevents the condenser itself from breaking down.

(2)—The direct voltage rating is higher because it is steady and contains no peaks. The alternating voltage varies between zero and a value 1.41 times the effective voltage. Hence the alternating voltage rating must be only about .7 of the direct voltage rating.

(3)—A voltage is a stress on the condenser. If this exists for a long time the condenser gradually weakens. When the voltage is alternating there is an alternating current through the condenser. This heats it up and weakens it further.

(4)—The difference between these condensers lies in the thickness of the insulation between the two plates, or between the two layers of tin foil. A low voltage condenser may have a single layer of treated paper beteen the two plates. Another may have two. A high voltage condenser may have from six to eight layers of the same paper. Usually a condenser has at least two layers in order to minimize short circuits from defects in the paper, such as holes and metal particles. The size increases rapidly with the voltage rating because not only is much more paper used but more tinfoil has to be used to make up for the greater separation of the plates.

* * *

**WHAT IS MEANT** by the decrement of a radio frequency wave?

(2)—Has the decrement anything to do with the quality of broadcast programs?

(3)—Is the decrement a property of the wave or of the circuit in which the wave is produced?

SEYMOUR EVERTS.
Lexington, Ky.

(1)—The decrment is the rate of decrease of the amplitude of a damped wave, and depends on the amplitudes of two consecutive maxima in the same direction.

(2)—The waves used in broadcasting have no decrement. They are undamped. As long as it is unmodulated the amplitude remains constant.

(3)—The decrment is strictly a property of the wave but is caused by a property of the circuit, its effective resistance.

* * *

**I HAD** a battery-operated receiver that I built myself and operated with much pleasure for two years. Then I moved into a neighborhood that has alternating current, and I decided to build an AC re-

# Right or Wrong?

[Answers on page 15]

1. —The apparent quality of a radio receiver depends on the volume intensity even if the tubes are large enough to handle the volume without overloading.

2. —In order to get the maximum volume out of a power tube the primary impedance of the transformer between the tube and the speaker should be equal to the plate resistance of the tube.

3. —For maximum power output the impedance of the loudspeaker should be equal to the impedance of the secondary of the coupling transformer.

4. —The impedance of the dynamic speaker is simply the DC resistance of the voice coil winding.

5. —A low resistance voltmeter does not give the correct voltage when used to measure the output of a power pack because of the drop in the resistors in the network.

6. —The pleasant timbre of music from a harp or a piano is due to the fact that the harmonics produced are exact multiples of the fundamental.

7. —The sound from a drum is not musical because the harmonics are missing.

8. —The harmonies of a carrier frequency produced by overloading of the tubes are exact multiples of the carrier frequency.

9. —The impedance of the primary of an audio transformer or that of a choke coil with iron core does not depend on the amount of direct current in the winding.

10. —Motorboating in a receiver is simply a periodic charging and discharging of the stopping condenser which results when the grid of the tube goes positive.

ceiver. My output tube is a 171A. I used grid biasing resistors all through, including one in each stage of radio frequency, one in the detector and one each in the two audio stages. The bypass condensers across all these resistors are .006, mfd., as a friend recommended this large capacity. My complaint is that the circuit does not reproduce the low notes as well as did the battery-operated receiver, although many of the same parts are included in the new outfit, including tuning condensers and radio coils. How can I get the same fine quality out of my new receiver?

ADAM J. MORCHAND,
Rye Beach, N. Y.

The capacity of the condensers used for bypassing the resistors is not large in any sense. For the radio frequency tubes it is passable, although louder signals might result if you increased the capacity to .01 mfd. or .02 mfd. In the detector stage and first audio the biasing resistors, bypassing condensers should be at least .5 mfd., and preferably much larger, say 4 mfd., while the final audio stage never should have anything less than 4 mfd. Above 4 mfd. the improvement in any audio circuit is not noticeable to the ear. The reason for the large capacity of 4 mfd. is that the impedance to audio frequencies of the biasing circuit is reduced greatly, thus improving the general amplification, and particularly the low-note reproduction. With these precautions taken, your AC receiver will give you just as fine tone as did the other.

* * *

**IS IT TRUE** that a baffle for a dynamic speaker must be large, and that the popular types of cabinets that house them, e. g., walnut, mahogany, spruce, etc., in modernistic and other shapes and finishes, tend to make the loud speaker sound boomy? I am looking for the best reproduction possible, but hesitate to buy one of those good-looking cabinets if tonal results will not be good.

ADOLPH MENGES,
Detroit, Mich.

A baffle for a dynamic speaker should be large, say, three-feet square, and should be well ventilated, preferably consisting of nothing but the baffle board and a bottom on which to rest the speaker. However, this is not attractive to the eye, no matter how made up, hence a box should be simulated, which can be done by using cane for the top, sides and back, or leaving the back open and having the sides and top cane. Still, three feet is quite a size, and the common expert practice is to compromise in favor of appearances, using an 18-inch or smaller baffle. This will give good results. The small box type, although the most handsome and does not give the best tonal results, still affords quality satisfactory to many. The chief objection is not so much boominess all through the audio lower frequencies but to very strong and false accentuation of certain few low frequencies, particularly one to which the box structure itself is resonant. Therefore the expression "box resonant" has arisen. The speaker may rattle at this resonant frequency. You may compromise, as many others have done, on an 18-inch or 24-inch baffle, acoustically open, but imitating a box in appearance, and will be well satisfied.

* * *

**I LIVE** in the heart of New York City. My complaint is that WOR comes in so strongly that I have difficulty tuning it out, even 15 dial divisions off resonance. I have tried all kinds of aerials. If I make the aerial short the volume on the high wavelength stations is too low, and WOR is still troublesome. If I make the aerial long, WOR is more troublesome than ever. I like to listen to this station, but I do hate to suffer crosstalk from WOR when listening to WJZ or WEAF, which often have programs I prefer. What remedy do you propose?

HAL BREEN, New York City

Your receiver is not selective enough and there is little you can do to make it more selective, except to introduce regeneration, say, in the detector or stage, if you haven't a regenerative feature already. Even this, however, is unlikely to do you much good, since your case is a severe one. Not only do you need a selective receiver but one that must be ultra-selective to meet an unusual situation. The strength of WOR's signals in parts of the Boroughs of Manhattan and Brooklyn is so great that this ultra-selectivity becomes imperative. You should build a circuit having four tuned stages—three stages of tuned RF and a tuned detector unit. Put a trimming condenser across the first tuning section of the gang condenser, or tune the first circuit independently of the others, if you want two main tuning controls. By using as a volume control a variable biasing resistor that affects one, two or three RF tubes you will increase selectivity when you reduce volume, which will be another aid in the general direction you desire. With the receiver suggested, a 50-foot aerial will be ample, WOR will be tuned out readily (in about 3 divisions), and still WEAF and other stations on lower frequencies will come in with plenty of volume. Put permanent trimmers across each section of the gang condenser for utmost practical selectivity.

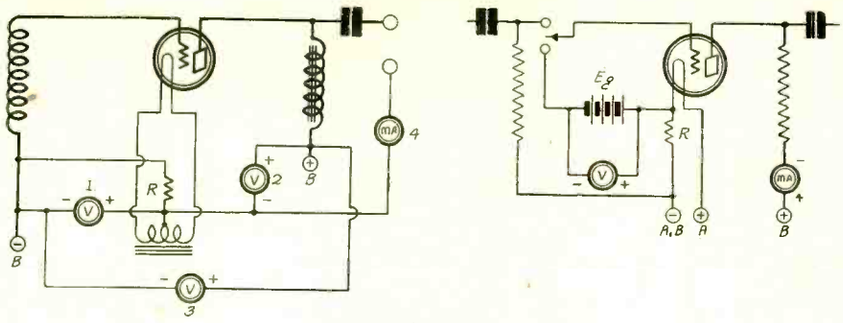



**FIG. 750**
**AT LEFT IS A CIRCUIT SHOWING HOW TO CONNECT VOLTMETERS FOR MEASURING THE PLATE AND GRID VOLTAGES IN AN AC TUBE. AT RIGHT IS SHOWN A CIRCUIT ARRANGEMENT FOR ACCURATELY MEASURING THE GRID BIAS ON A RESISTANCE COUPLED TUBE.**

# Right or Wrong?

[Question on page 14]

1. —Right. As the volume is decreased the high and the lower frequencies disappear because they are then not strong enough to affect the ear. The ear is more sensitive to sounds in the middle register.

2. —Wrong. The impedance of the primary should be higher than the plate resistance.

3. —Right. This is the only point in the circuit where there should be matching. If the speaker is connected in the plate circuit directly the speaker impedance should be equal to the plate resistance of the tube.

4. —Wrong. The resistance of the voice coil to DC is only a small part of the total effective resistance of the speaker. The resistance of the air against the diaphragm constitutes the greater part, and the only useful part.

5. —Right. The resistors are equivalent to external resistors in the voltmeter, and hence the readings obtained are too low.

6. —Wrong. The harmonics are not true multiples of the fundamental but only approximately so. However, the peculiar timbre of each instrument is due to the harmonics.

7. —Wrong. The sound is not musical because there are too many and too strong harmonics and because they are discordant.

8. —Right.

9. —Wrong. The impedance of an iron core inductance of any kind depends very much on the direct current flowing through the winding. The inductance decreases as the current increases.

10. —Wrong. Motorboating is due to feedback from one tube to preceding tubes through the B battery eliminator or the B battery. It is a form of incipient or advanced oscillation, usually of low frequency.

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# The Reduction of Hum

## As Applied to the Giant 6-1 AC Circuit

AS for hum, there is little indeed from this receiver, but if you desire to make it almost zero you can do so by using a smaller resistor in the detector plate circuit (R10), provided stability is thereby maintained, and by putting a condenser across the immediate output of the rectifier tube (one side to choke lead going to midtap and other side to ground). The condenser was eliminated from this point and the extra capacity put at the end (C21, C22) to prolong considerably the life of the rectifier tube, but if you'd rather have a little less hum, with shorter rectifier tube life as the price, move the schematic connection at top of C21 over to the choke point previously specified.

### Midtap Connection

Hum is kept very low by connecting the midtap of the heater winding to plus 22 volts, more or less. Do not make the mistake of connecting the wrong 2.5 volt winding to B plus. The filament transformer has three windings. The top one at 2.5 volts is used for the heater tubes. The midtap of this goes to the positive B voltage. The middle winding is 5 volts and heats the pilot light PL1, which illuminates the dial. The bottom winding, the second 2.5 volts, does not go to a heater tube but to the power tube, hence if you put the B voltage at that center tap you'd be applying B voltage to the filament.

### Tips on 227 Tube

The heaters of the 227 tubes are diagrammed like the filaments of any other tubes. The two terminals on the sockets are marked H and H. The cathode, or electron emitter, is shown schematically as a hooked element over the heater, and on the socket is marked C or K. Grid and plate are standard. The heater tubes require five-spring sockets.

As there is no guiding pin on the base of the tube, and usually none on the socket, either, and as five prongs are to be accommodated, some familiarity must be gained in inserting these tubes or you'll spend some awkward moments trying to fit them in place. An easy way out is to learn the respective positions of the terminal receptacles on the sockets. These constitute a triangle between K, G and P (cathode, grid and plate). The apex of the triangle is G. See the pictorial diagram. So when you pick up a 227 tube, look at the prongs. Immediately you can locate this apex of the equilateral triangle. Put your finger on it. Your eye will tell you then the G post of socket. Insertion can then be made quickly and without error. The only error possible is that you couldn't insert the tube.

### Data on Parts

The layout of parts and the schematic diagram give you sufficient information so you will not require a blueprint. However, some extra information about the parts will assist you.

All four coils are identical. The primary has six turns, ¼-inch space is left, and then 48 turns are wound for the secondary. The wire is No. 24 silk (single or double insulation) and the diameter 2½-inches. The ends of the windings that adjoin go to B plus and ground respectively.

The SM-331 choke is connected with (1) to center tap of the 280 filament, 2 and 3 united, with C20 here, and 4 as the rectifier's maximum output. On the SM 330 power transformer (1) and (2) represent the AC cable, already built in; (3) and (4) are the 7½-volt winding and (5) and (7) go to grid and plate posts of rectifier socket. (8) is the frame and is grounded and joined to (6). The voltage across (5) and (6) is 300 volts, also across (6) and (7), so (5) to (7) will read 600 volts AC. If the 7½-volt winding has no center tap, provide one by putting a 10-ohm center-tapped Clarostat "humdinger" across posts (3) and (4) of the 330.

The condenser bank, Aerovox TH862, has three high voltage condensers of 2 mfd. each (C20, C21, C22) and three of medium voltage (C23, C24, C25). Connect the black wire lead of the bank to B minus and ground, the two blues (respectively to points (2) and (3) of the resistor Ro, the orange to point (4); red to the center of Ch1 Ch2, and both browns to (4) on Ch1.

The Pyrohm resistor Ro has a resistance of 7,300 ohms. The 750-ohm end goes to B minus in this circuit.

### LIST OF PARTS
#### For The Amplifier

**T2—One Silver-Marshall power transformer (S-M Cat. No. 330).**
**F-One 1 Ampere fuse, 110v.**
**Ch1, Ch2—One Silver-Marshall Unichoke (S-M. Cat. No. 331).**
**C20, C21, C22, C23, C24, C25—Aerovox filter-buffer condenser block, Type No. TH-862.**
**Ro—One Aerovox standard tapped Pyrohm resistor, type A (0,3,000, 2,800, 750, 750 ohms).**
**One standard sockets (4-prong).**
**One baseboard 34x18 inches.**
**One 280 tube.**
**One dynamic AC speaker.**

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

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# Dynamic Impedances

## How the Speaker Compares with Magnetic Type

*By James H. Carroll*

Contributing Editor

WHY are two coils needed in a dynamic speaker? What is the function of the voice coil? What does the field coil do? Why is it necessary to have a step-down transformer between the power tube and the voice coil in the dynamic speaker? These are some of the questions asked by fans who have dynamics who who are planning to get them.

In all speakers it is necessary to have a field and an armature. In magnetic and dynamic speakers the field is magnetic. It may be set up by a permanent magnet or by an electro-magnet. While in so-called magnetic speakers the field is usually set up by strong permanent magnets, some of this type have been constructed with electro-magnets. Also, while most dynamic speakers are constructed with electro-magnets, some have also been constructed with permanent magnets.

Only those speakers of either type which employ electro-magnets need a field winding. The difference between the permanent magnet and the electro-magnet is simply in the type of core used. The permanent magnet is made of steel which retains magnetization put into the material by means of an electro-magnet. The electro-magnet is made of iron or steel which does not retain its magnetization. In this type it is necessary to have a current-carrying coil around the core to maintain the magnetization.

In both the magnetic and the dynamic speakers the motion of the armature is due to an interaction between two magnetic fields, the steady field set up by the permanent magnet or the electro-magnet, and the field set up by the current in or around the armature.

In the magnetic speaker the armature coil carrying the signal is fixed. The armature is a little electro-magnet which alternates in polarity. In the dynamic the armature is simply the voice coil which is free to move. It, too, is an electro-magnet, but its core is fixed and is a part of the steady field core. The polarity of this electro-magnet alternates also under the influence of the voice current through the moving coil.

Hence the essential difference between a magnetic and a dynamic speaker is that in one the armature core moves and its coil is fixed, and in the other the coil moves and the core is stationary.

### Is Small Coil Essential

Why are dynamic speakers made with a very small armature coil? Could not this coil be made so large as to eliminate the need of a step-down transformer? It has been done. But if the moving coil is made so large that its impedance matches that of a power tube, it will be very heavy. The speaker then would not respond to high frequencies. And if it were wound with very fine wire so that it would be light, it would not carry the current. It would burn out. Even if the direct current were kept out of the coil, it would not carry the voice current without burning out, because there would not be the necessary ventilation of the turns.

So dynamic speakers are generally made with a small voice coil requiring a step-down transformer between the power tube and the speaker. The transformer automatically keeps the direct plate current out of the voice coil.

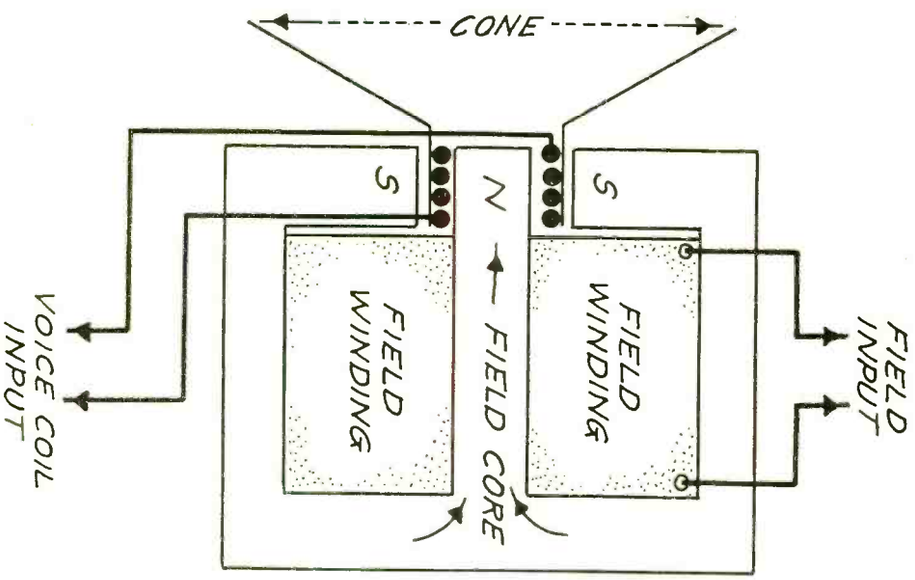


FIG. 1
DIAGRAM OF A CROSS SECTION OF A DYNAMIC SPEAKER STRUCTURE, SHOWING THE VOICE COIL, THE CORE AND THE FIELD COIL SPACE.

An important consideration is the proper matching of the speaker and the tube. It may be shown that for maximum undistorted output the ratio of the step-down transformer should be the square root of the ratio 2R1/R2, where R1 is the plate resistance of the power tube and R2 the effective resistance of the speaker. This does not mean the resistance of the speaker as measured with DC methods, or with AC methods with the speaker armature clamped down. It means the resistance of the speaker measured with AC methods while the speaker is sounding normally.

### Transformer Ratio

Suppose the tube used has an AC resistance of 1,800 ohms in the plate circuit, and that the effective resistance of the speaker is 25 ohms. The above ratio is then 3,600/25, the square root of which is 12. This should be the ratio of turns of the step-down transformer used.

The ratio 2R1/R2 was derived on the supposition that the primary resistance is negligible in comparison with the plate resistance of the tube and that the secondary winding resistance is negligible in comparison with the effective resistance of the speaker.

The effective resistance of the speaker is not a definite quantity for it varies with the frequency and with the position of the speaker with respect to other objects in the room. Hence it is not possible to match the impedances for all frequencies. But there is a very simple way of attaining the best adjustment.

There are output transformers available which have taps on the secondary winding. By connecting the voice coil across various taps a variation of the output will be obtained. That tap which gives the loudest response combined with the most pleasing tone should be used.

The output transformer which is found in a dynamic speaker may not be the best for the tube and speaker. If it is desired to substitute another, all that is necessary is to disconnect the voice coil from the transformer built in and to connect them to the external transformer. The voice coil leads are usually connected directly to the cone where access to them may be gained.

### Built-In Filter

Practically all dynamic speakers also have low pass filters built in to cut off the high notes, that is, to reduce the tube and battery noises and the excessive response of the speaker on the high notes. The effect of this filter may not be the best from the point of view of the user of the loudspeaker. When the external transformer is connected to the voice coil in place of the built-in transformer, the filter is disconnected also. It is then possible to try other filter combinations, or no high frequency suppressor at all.

There are other reasons why an external transformer may improve the results. Some dynamic speakers have rather small output transformers. They are not built to carry the heavy primary currents which will occur with high power output tubes. When the core of the output transformer is saturated, good quality is impossible. If the external transformer is used, one large enough to handle any requirements may be selected. There is no sense in building a high quality audio amplifier only to have the quality ruined in the output transformer.

Fig. 1 shows a cross section of a dynamic speaker. The shaded portion is the space for the field coil and the white portion is the core. The voice coil is shown by dots in the narrow space between the N and S poles of the magnet.

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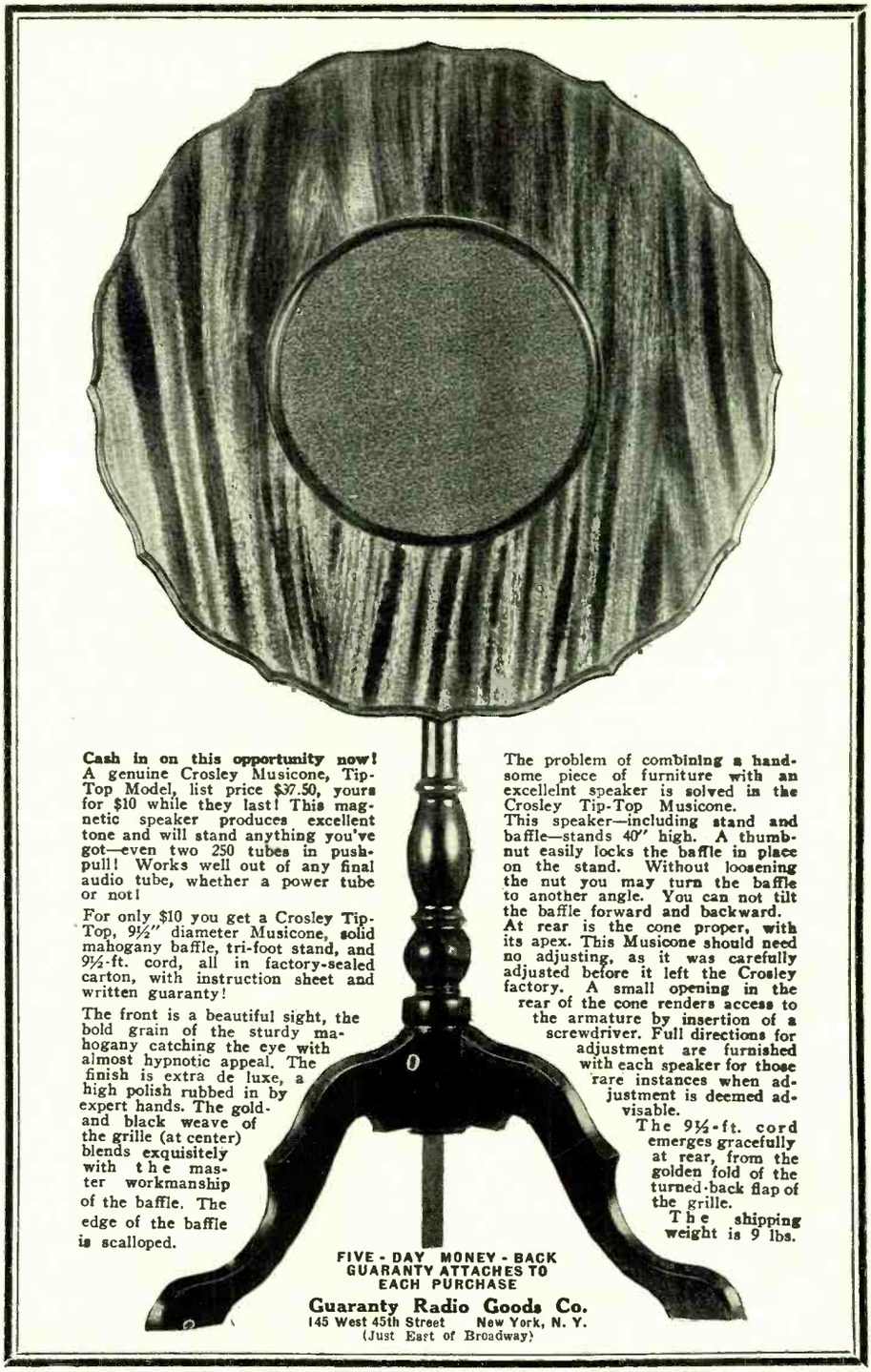

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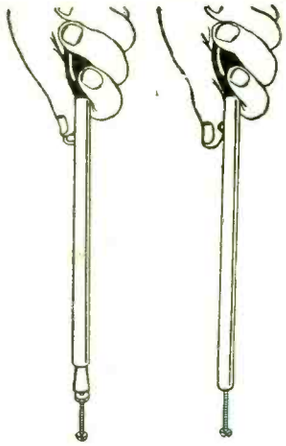

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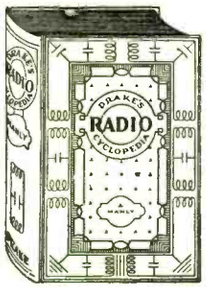

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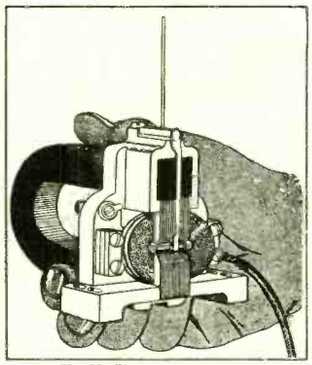

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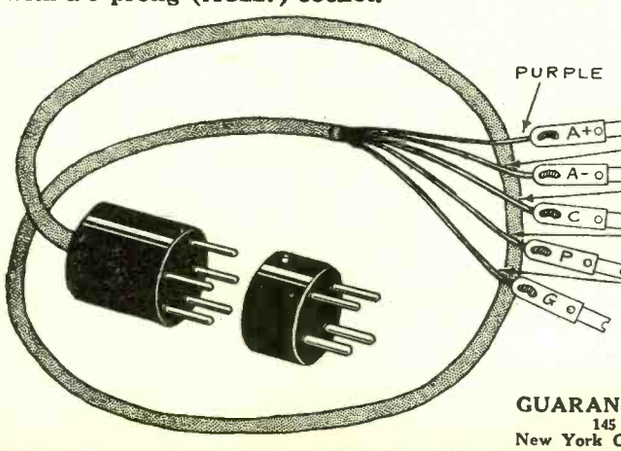


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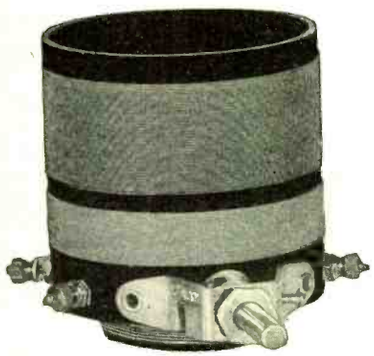

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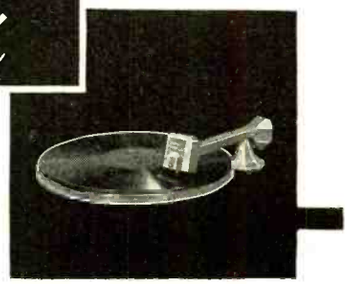
# PACENT Super Phonovox

THE newest and most scientifically accurate and practical pick-up on the market. . . . Plays records through a radio receiver with amazing fidelity and naturalness — and with a tone quality never before equalled. Easily attached—switches instantly from radio to records—absolutely trouble-free. Hear one. At good radio shops everywhere. **$12, $15 and $25.**



No rubber bearings to wear out and cause variation, perfectly balanced tone arm, hinged head for easy insertion of needle and special 36% English cobalt magnets —are a few Phonovox advantages.

## PACENT ELECTRIC CO., INC.,

**91 Seventh Avenue** **New York**

**Pioneers in Radio and Electric Reproduction for Over 20 Years**

**Manufacturing Licensee for Great Britain and Ireland: Igranic Electric Co., Ltd., Bedford, England**
**Licensee for Canada: White Radio Limited, Hamilton, Ont.**

# New Diamond

## (AC or Battery Model)

### PARTS FOR THE AC DIAMOND

| | |
|---|---|
| CA, CG. C7—Three Aerovox .0005 mfd. mica fixed condensers, moulded, @ .25 | $0.75 |
| C3, C4, C8—Three Aerovox .006 mfd. mica fixed condensers, moulded, @ .50 | 1.50 |
| C6, C9—Two Aerovox .02 mfd. mica fixed condensers, moulded, @ $1.00 | 2.00 |
| C10—One Aerovox 4 mfd. condenser | 2.50 |
| C1—One Hammarlund Equalizer, 70 mfd. | .40 |
| C2, C5—One Hammarlund Midline double condenser, each section .0005 mfd. (MLD23) | 6.00 |
| R1, SW—One Electrad Royalty volume control (0-5,000 ohms) with 110-volt Hart & Hegeman AC switch built in | 1.50 |
| R2—One Electrad 900-ohm resistance strip (grid suppressor type) | .20 |
| R3—One Lynch 50,000-ohm resistor, with clips | .20 |
| R4—One Electrad 2,000-ohm resistance stub | .20 |
| R5—One Electrad 2,000-ohm type B resistor (B20) | |
| T1, T2—Two National A100 audio frequency transformers @ $5.70 | 11.40 |
| T3—One filament transformer; one winding 2.5 volts at 9 amperes or more, one winding 2.5 volts at 3.5 amperes or more, one winding 5 volts at 2 amperes or more (merchandised by Guaranty Radio Goods Co.) | 6.00 |
| PL—One Yaxley pilot light bracket with green jewel and lamp | .55 |
| Ant., ground, speaker —, speaker +, four binding posts @ .10 | .40 |
| One roll Braidite wire | .30 |
| One 7 x 21-inch front panel | 2.35 |
| One 10 x 20-inch official AC Diamond aluminum subpanel, self-bracketing, with three five-prong sockets and one four-prong socket built in | 3.25 |
| Front and subpanel together | 5.25 |
| Porcelain AC socket, screw plug 3-way plug, cable (lamp cord) and wall plug | .75 |
| One dial | .90 |
| Two knobs (one for tickler, the other for volume control) @ .20 | .40 |
| Note: The optional condenser, CX, is .006 mfd. @ | .50 |

### PARTS FOR BATTERY MODEL DIAMOND

| | |
|---|---|
| C1—Aerovox .0005 moulded fixed | .25 |
| C2—Hammarlund .0005 mfd. Midline | 3.30 |
| C3, C4—Two Aerovox moulded .006 mfd. @ .50 ea. | 1.00 |
| C5—Hammarlund .0005 mfd. Midline | 3.30 |
| C6—Aerovox .00025 moulded fixed with clips | .30 |
| C7—Aerovox .0005 moulded fixed | .25 |
| A1—622 Amperite with mount | .85 |
| A2, A3, A4—Three 1A Amperites, three mounts @ .85 | 2.55 |
| R1—50-ohm Frost rheostat | 1.00 |
| R2—5-meg. Lynch metallized leak | .40 |
| T1, T2—Two National A100 audios @ $5.70 ea. | 11.40 |
| Ant., Gnd., Sp. —, Sp. + posts @ .10 ea. | .40 |
| P1—Yaxley jewel window bracket .35 with pilot lamp .20 | .55 |
| Sw—Yaxley No. 10 A battery switch | .35 |
| 7 x 21-inch front panel | 2.35 |
| 10 x 20-inch official battery Diamond subpanel, self-bracketing, with four sockets affixed; subpanel hardware, insulated bushings, washers | 3.00 |
| Front panel and subpanel together | 5.00 |
| Two dials with pointers | 2.00 |
| Two knobs @ .20 | .40 |
| One roll stranded Braidite | .30 |
| Hammarlund 70 mmfd. Equalizer | .40 |
| Four Kelly tubes: one 222, two 201A, one 112A or 171A | 7.00 |

**GUARANTY RADIO GOODS CO.**
**145 WEST 45th STREET**
**(Just East of Broadway)**
**NEW YORK CITY**

# Aluminum Subpanel

**for the New, Highly Selective**

# SG Diamond

**Battery or AC Model (specify which)**

The best appearance of the New Diamond of the Air results from using the official aluminum subpanel, 10 x 20 inches, with the four sockets built in, and with self-bracketing front. Hardware and insulating washers supplied with each sub-panel. The aluminum sub-panel is exactly the same as the one used in the laboratory models of the battery operated and the AC Screen Grid Diamonds. Holes are drilled for mounting parts, but as this aluminum drills like bakelite you can drill any holes you want.

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

☐ Enclosed please find $3.00 for which please send one aluminum subpanel 10x20" for the new battery model 4-tube SG Diamond of the Air, with sockets built in, and with self-bracketing front and side and rear supports; also send hardware and insulating washers.

☐ Enclosed please find $2.35 for which please send 7x21" drilled Bakelite front panel for the new battery model Diamond.

☐ Enclosed please find $3.25 for the 10x20" aluminum subpanel, etc., for the new AC Screen Grid Diamond.

☐ Enclosed please find $2.35 for the 7x21" drilled Bakelite front panel for the new AC Screen Grid Diamond.

☐ Enclosed please find $5.00 for both the aluminum subpanel, etc., and the drilled Bakelite front panel of the battery model.

☐ Enclosed please find $5.25 for both the aluminum subpanel, etc., and the drilled Bakelite front panel of the AC model.

Name .....

Address .....

City..... State.....

# KELLY TUBES

**Prescribed for the**

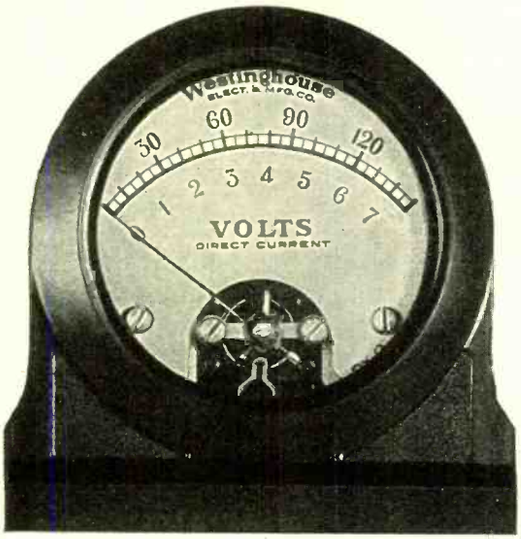
## Screen Grid Diamond

| | |
|---|---|
| One screen grid 422 | $3.50 |
| Two 410A at $1.00 each | 2.00 |
| One 412A (for 135 volts) | 2.00 |
| or One 471A (for 180 volts) | 2.00 |

**Send $7.50 for set of four tubes for this receiver. Specify whether power tube wanted is 412A or 471A**

**KELLY TUBE COMPANY**
**57 Dey Street New York City**
***10-Day Money-Back Guarantee***

# Westinghouse 0-7½, 0-150 VOLT-METER FREE!

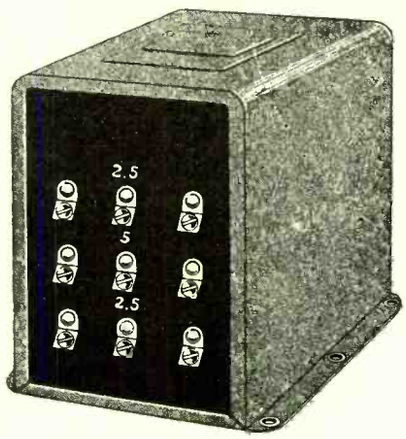



This beautiful Westinghouse meter given FREE! Read generous offer!

Double range direct current meter, O-7½ volts legible to ¼ volt, and O-150 volts, legible to 5 volts. The d'Arsonval Movement (dynamic principle) is used. Resistance is about 100 ohms per volt. A mirror strip, for observing the needle so as to hide its own reflection, facilitates closest reading, in conjunction with knife-edge. End-stops are built in. So is a zero corrector. The casing is moulded bakelite. The meter is illustrated full size. At rear are three posts—the common minus and the two positive posts. A connecting cable is furnished with each meter, lugs at one end, tip plugs at other. Send $6 for year's subscription for Radio World (52 numbers) and get this genuine Westinghouse table model meter FREE! Present subscribers may renew under this offer by stating subscription expiration date and enclosing $6.

*Radio World, 145 W. 45th St.*
*New York City*

# Filament Transformer




The heater type tube draws 1.75 ampere at 2.5 volts. If several such tubes are used a heavy-duty filament transformer is necessary. The top 2.5-volt winding of this filament transformer easily carries **NINE AMPERES**, or enough current for five heater type tubes. The bottom 2.5-volt winding stands four amperes, or enough current to heat **TWO MORE** such tubes, a total of **SEVEN TUBES!** The power tube, if of the 5-volt type, may be heated from the 5-volt central winding. 5-volt power tubes in push-pull may be heated from this winding.

All three windings are tapped at the exact electrical center. This precision location, made with the aid of an impedance bridge, accounts for absence of hum otherwise caused by the last tube when heated directly with AC. The heater type tubes are *indirectly* heated by AC, since the filament that glows is fed by AC but communicates heat to the cathode or electron emitter.

The heater type tube is represented by the *227*, excellent as radio amplifier and audio amplifier, and the exclusive type of AC detector tube. Also the new AC screen grid tubes, with the same filament voltage and current, are of the heater type.

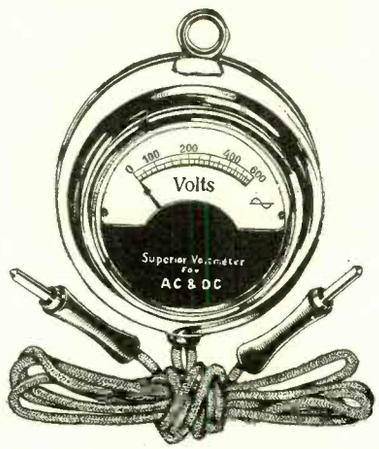
The transformer is beautifully finished in crackled glossy black, with bakelite front, and comes equipped with 52-inch AC cable with plug. Six riveted mounting holes for baseboard or subpanel. Size, 3¾ in. high, 2⅝ in. wide, 3 in. deep. Shipping weight, 6 lbs.

Cat. F226A, for 50-to-60 cycles, 105-to-120 volts AC, Net Price .....$6.00

**Guaranty Radio Goods Co.**
**145 West 45th St.**
**N. Y. City**

## O-600 V. AC and DC
# High Resistance Meter

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




**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 resistsnce meter, of extraordinary range, and accurate to 1% plus or minus, it is advisable to get this meter for your testing purposes, since it is like two meters in one—AC and DC. You can find trouble more quickly. Without it you can't tell if a power transformer secondary is delivering voltage. 10-day money-back guaranty.

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

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

☐ $7.00 enclosed

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

Name .....

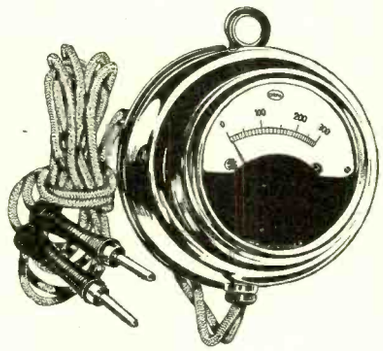
Address .....

City ..... State.....

*Individual*

# METERS

**For Portable or Panel Use**



High resistance 0-300 Voltmeter, accurate to 1%. Measures any DC voltage to 300, including B eliminators. Provided with 30" cord, with luxurious jack tips and hanger. Meter full nickel de luxe finish. No. 346F. **$4.50**
No. 347F, same as above, but 0-500 volts, $6.00

**POCKET AND PORTABLE VOLTMETERS**

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

**PANEL AC VOLTMETERS**

(Panel meters take 2-5/64" hole)

No. 351—For reading 0-15 volts AC.....$2.25
No. 352—For reading 0-10 volts AC..... 2.25
No. 353—For reading 0-8 volts AC..... 2.25
(See No. 348 under "Pocket and Portable Voltmeters")

**PANEL VOLTMETERS**

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

**VOLTAMMETERS**

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

**PANEL MILLIAMMETERS**

No. 311—For reading 0-10 milliamperes DC..$1.75
No. 395—For reading 0-20 and 0-100 ma. DC.... 1.50

**VOLTAGE REGULATOR**

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

**POCKET AMMETER**

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

*Immediate Shipment*

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

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

☐ Cat. No. ☐ Cat. No. ☐ Cat. No.
☐ Cat. No. ☐ Cat. No. ☐ Cat. No.

NAME .....

ADDRESS .....

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

TEN-DAY MONEY-BACK ABSOLUTE GUARANTY!

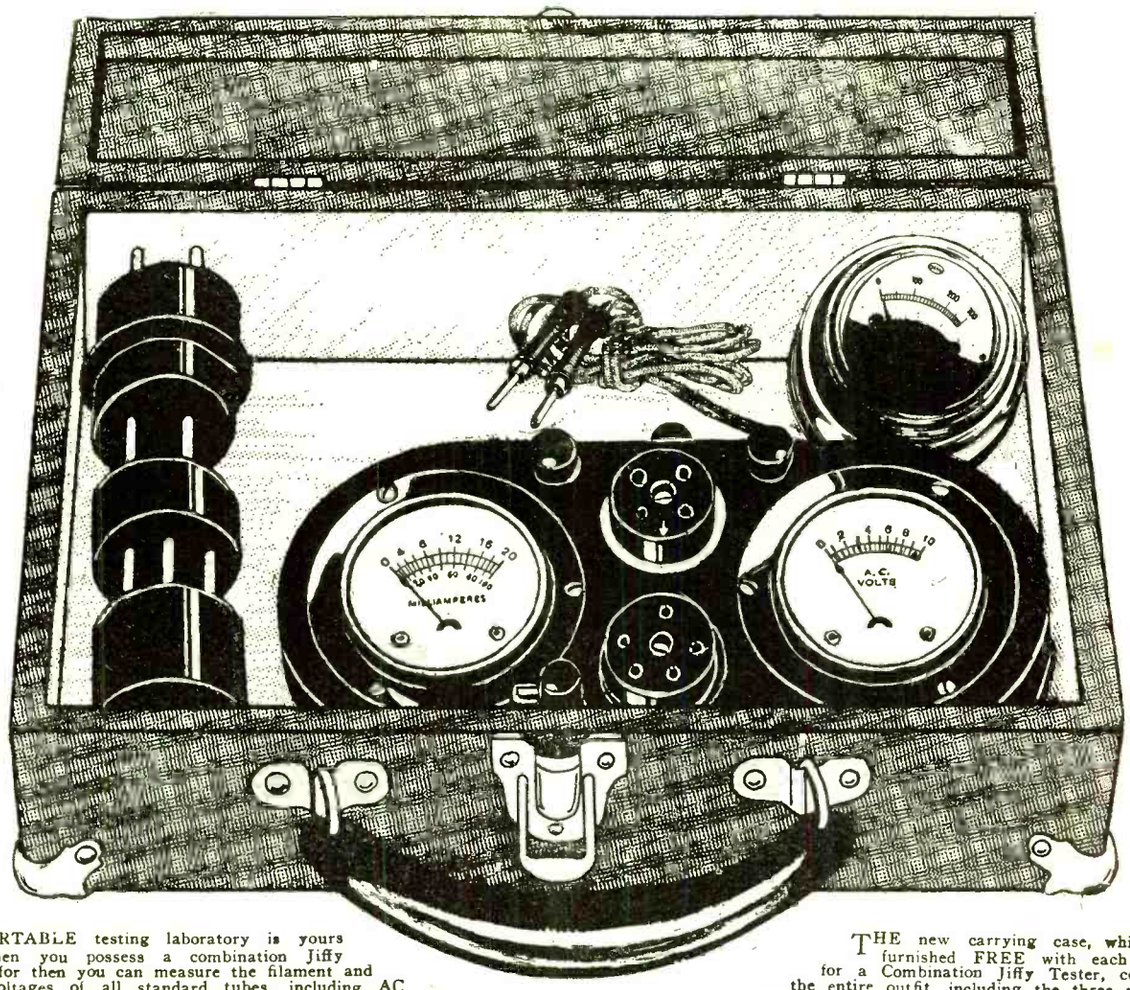
A COMPLETE CATALOG containing detailed information on condensers and resistors may be had free on request.

**AEROVOX**
**BUILT BETTER**
**CONDENSERS AND RESISTORS**
74½ Washington St., Bklyn., N. Y.

THE RESEARCH WORKER will keep you abreast of developments in radio. It may be had free on request.

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

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




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

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

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

THE new carrying case, which is furnished FREE with each order for a Combination Jiffy Tester, contains the entire outfit, including the three meters, cable and plug, and three adapters (one for 4-prong tubes, two for 199 tubes). This case is 10½x 7¾x3½" and bas nickel corner pieces and protective snap-lock. The case is made of strong wood, with black leatherette overlay.

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

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

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

**GUARANTY RADIO GOODS CO., 145 W. 45 St., N. Y. City. (Just East of Broadway).**

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

☐ If 0-300 DC high resistance 99% accurate voltmeter is preferred to 0-500, put check here. Price is same, $14.50.

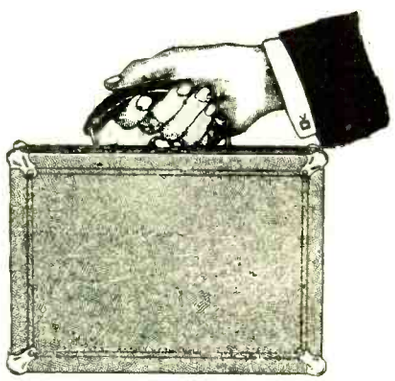
☐ Same as above, except substitute a 0-600-volt AC and DC high resistance 99% accurate voltmeter (same meter reads both) for the 0-500 DC meter. Price $15.50.

NAME .....

ADDRESS .....

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

**FIVE-DAY MONEY-BACK GUARANTY**



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

# Choose Your Speaker from This Complete Array!

## EXPONENTIAL TYPE HORNS

Modern acoustical science is striving to equal the performance of a large air column horn with powerful unit, while the horn enjoys its rightful popularity with trained experts. The larger the horn, the better, hence we offer two models: one with 7⅞ ft. tone travel, the other (where space permits) with 10 ft. tone travel. The material used is patented Racon. Nozzle is standard size.

**Cat. 200**
**$7.50 Net**

This horn has a 92-inch air column. No resonance peaks. Front, 18"x18". Depth, 13⅜". Weight, 5 lbs.

Driving motor, the unit needed to work the air column horns. Standard size thread. Cat. 208. Price, $3.50 net.

**Cat. 300**
**$10.50 Net**

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

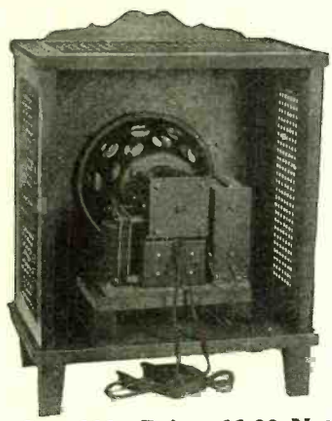
## DYNAMIC CHASSES and Baffle

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.

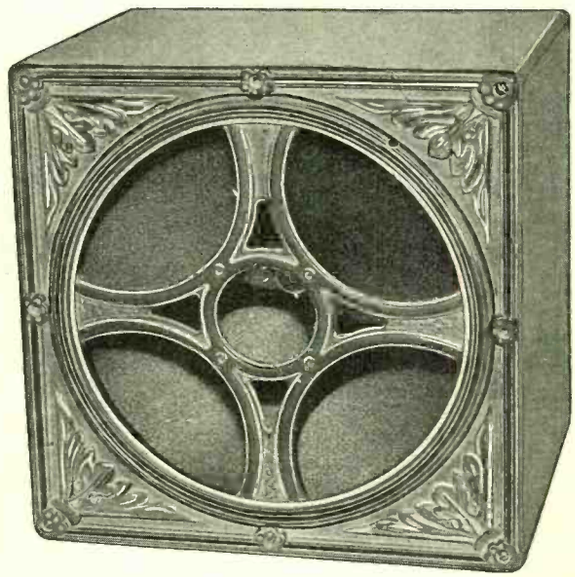
Those whose place is wired with 110-volt D.C. (direct current) should use Cat. 110 D.C. @ $17.50 net. Those who have no electricity should use the model that works from a 6-volt storage battery. Cat. 6 D.C. @ $14.75 net.

At left is illustrated an 18"x18" baffle, Cat. 111, with cane sides and top, for any dynamic speaker. Specify speaker. Walnut 5 ply veneer. Price $11.00 net.

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

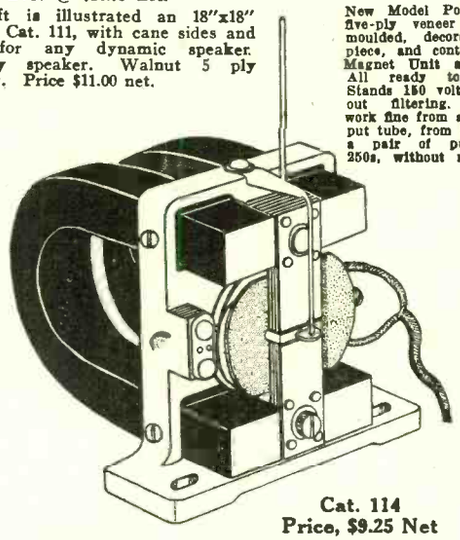


**Cat. 111; Price, 11.00 Net**



New Model Polo Speaker, with five-ply veneer walnut housing, moulded, decorated metal front piece, and containing Polo Twin Magnet Unit and Textile Cone. All ready to play. Stands 150 volts without filtering. Will work fine from any output tube, from 201A to a pair of push-pull 250s, without rattling.

**Cat. 113**
**Price, $13.50 Net**



**Cat. 114**
**Price, $9.25 Net**

Polo Twin Magnet Unit—weight, 3½ lbs., or twice as heavy as ordinary unit. Twin magnets double sensitivity. This unit gives more volume, clearer tone, and stands the gaff. Supplied with 10-ft. cord. Cat. 114.
Tri-foot molded unbreakable metal mounting bracket and apex constitute Cat. 114A @ $0.75.

**Cat. 115; Price, $11.50 Net**

Molded 9" spider, unbreakable metal, with Textile cone and felt ring and apex, and Polo Unit mounted on the assembly, which stands on own feet. Cat. 115.

Cat. 110 A. C., shown inside, $20.50 extra.

## FILL OUT AND MAIL COUPON

ACOUSTICAL ENGINEERING ASSOCIATES,
143 West 45th Street, N. Y. City
(Just East of Broadway)

Please send me at once on 5-day money-back guarantee the following (check off):

- ☐ Cat. No. 200
- ☐ Cat. 300
- ☐ Cat. No. 110 A.C.
- ☐ Cat. No. 110 D.C.
- ☐ Cat. No. 6 D.C.
- ☐ Cat. No. 300
- ☐ Please send C.O.D.
- ☐ Remittance enclosed. Please send prepaid.
- ☐ Cat. No. 111
- ☐ Cat. No. 113
- ☐ Cat. No. 114
- ☐ Cat. 114A
- ☐ Cat. 115
- ☐ Cat. 116
- ☐ Cat. No. 203

Name .....

Address .....

City ..... State .....

5-DAY MONEY-BACK GUARANTEE

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