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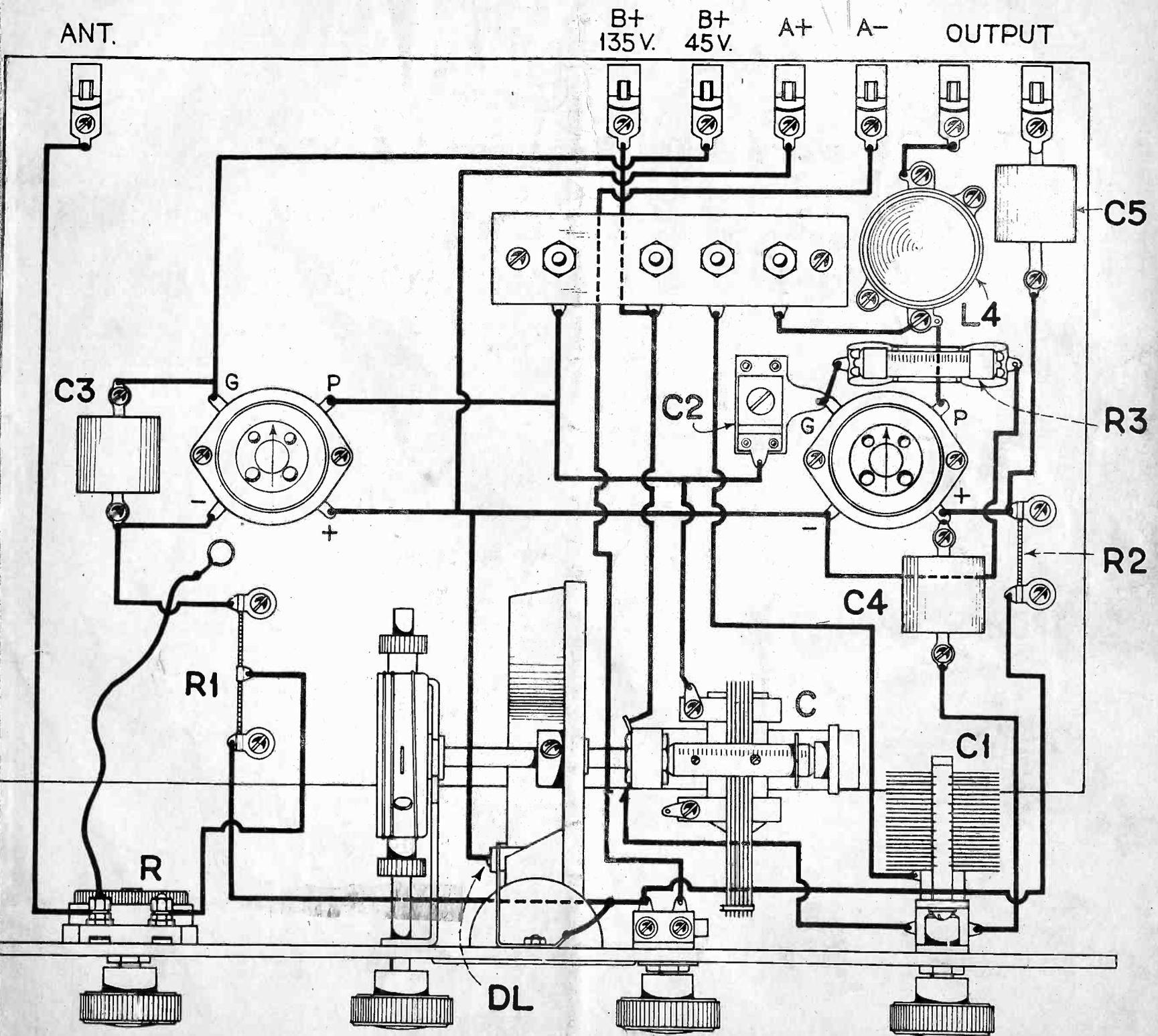
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QUESTIONS ANSWERED ON NEW SG DIAMOND

Revelations About NBC

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Television Favored in Broadcast Band

DISGUIISING OF RECORDS HELD PUBLIC FRAUD

Washington.
 Opposed in principle to the playing of phonograph records by radio stations, whether suitable talent is otherwise available, the Federal Radio Commission has stated its position in the following declaration:

"The Commission, while not condemning the practice of using mechanical reproductions, such as phonograph records or perforated rolls, required that all broadcasting of this nature be clearly described in the announcement of each number. The Commission has felt, and still feels, that to permit such broadcasting without appropriate announcement is, in effect, a fraud upon the public.

Fills Some Need

"It is true that in the smaller communities which do not have adequate original program resources the use of phonograph records may fill a need; it is true also that there may be developments in specially produced phonograph records which can be made use of to advantage by radio.

Where Duplication Exists

"On the whole, however, the Commission is inclined to believe that the use of ordinary commercial records in a city with ample original program resources is an unnecessary duplication of service otherwise available to the public, and the crowded channels should not be wasted in this manner."

A THOUGHT FOR THE WEEK

LOVE as described over the radio is about the same as it has been for ages—redolent of June flowers, symbolic of romance and adventure, surrounded by thoughts of the moonlight, sweet-scented lanes and everlasting devotion. A new lyricist thinks differently, and one of his interpreters announced in ringing tones over the air the other night that "Love is a punch in the nose and a punch in the nose is love." How we do hark back sometimes to the age of the caveman!

Attitude Taken By 11 Conferees

Washington.
 The question of whether television should be permitted in the broadcast band developed the following line-up at the conference recently held here:

FOR

- Dr. Lee De Forest, inventor of the three-element vacuum tube; New York City.
- C. Francis Jenkins, television experimenter and inventor of devices used in television; Washington, D. C.
- Charles E. Huffman, chief engineer, Jenkins Television Corp.; Jersey City, N. J.
- V. A. Schoenberg, chief engineer, WCFL; Chicago.
- John V. L. Hogan, consulting radio engineer; New York City.
- M. B. Sleeper, president, Sleeper Research Corporation; New York City.
- A. J. Carter, president, Carter Television Corporation; Chicago.

AGAINST

- Frank Conrad, vice-president, Westinghouse Electric & Mfg. Co.; Pittsburgh (KDKA).
- C. W. Horn, engineer, Westinghouse Electric & Mfg. Co.
- Julius Weinberger, engineer, Radio Corporation of America; New York City.
- Edgar Felix, National Electrical Manufacturers Association, Radio Division; New York City.
- Harry Sadenwater, engineer, General Electric Co.; Schenectady, N. Y. (WGY).

NEW CORPORATIONS

- Charles Kays, radios—Atty., S. Polk, Corona, Queens, New York.
- United States Radio Equipment Co., Duquesne, Pa.—Capital Trust Company of Delaware, Wilmington, Del.
- Radio Corporation of New Jersey—Atty., Basil M. Ziegler, Camden, N. J.
- Forest Hill Radio Shop, Newark—Attys., Haines & Chanalis, Newark, N. J.
- Midville Radio Stores—Atty., M. M. Turshen, 1421 Sheepshead Bay Road, Brooklyn, N. Y.
- Cook's Radio Shop, Inc., Newark—Atty., L. K. Press, Newark, N. J.
- Radio Talking Pictures, Inc., New York, N. Y.—United States Corporation Company, Wilmington, Del.
- Beebe's Radio Shoppe, White Plains—Atty., J. A. Smyth, 76 Williams St., New York, N. Y.
- Dilco Radio Corp., Harrison, N. J.—Atty., Moriarity & Lenehan, Jersey City, N. J.
- Park Electric and Radio Co., Perth Amboy—Atty., Jacob M. Klein, Perth Amboy, N. J.
- General Television Corp., Wilmington—Corp. Trust Co. of America, Wilmington, Del.

PUBLIC ALONE CALLED BEST JUDGE OF TEST

Strong Opposition to Majority Opinion Develops at Confer- ence of Industry Represent- atives Held with Federal Commission.

Washington.
 At a conference recently held under the auspices of the Federal Radio Commission on whether television should be allowed in the broadcast band of frequencies (1,500 to 550 kc.), most of the conferees favored such permits. There was strong opposition, however.

The alternative under discussion was the relegation of television to the short-wave spectrum.

Because of the 10-kilocycle separation required in the broadcast band, and the question whether 10 kc. is enough for picture work, the conference was called by the Commission.

Thirty-five representatives of the radio industry were present.

John V. L. Hogan, consulting radio engineer, said the art of picture transmission is in a "rather early and transient condition."

Declaring that some notable results have been obtained in facsimile transmission in small band widths, and that some actual television results have been obtained on wider bands, he stated that the technical development of the new art "has little place in the broadcast band." This should be done in the laboratory without radiation, so that no wave transmission would be involved.

After this procedure is concluded to the satisfaction of the experimenters, declared Mr. Hogan, it should be tested in actual wave transmission. The development of program service for visual broadcasting should take place within the broadcasting
 (Continued on next page)

EXPERTS FEAR TELEVISION AS A DISTURBANCE

(Continued from preceding page)

band, he said, because there are so many potential critics available who would be enabled to receive visual transmissions by means of attachments to their audible receiving sets.

Response Would Be Greater

"There would then be far greater response than if the program is developed outside the broadcast band," he declared.

Televisors, or visual receiving devices for the broadcast band, cost from \$50 to \$100, explained Mr. Hogan, and consequently, with this low cost the number of observers would be substantial and the response of the public great. If the program service is limited to waves outside the broadcast band, the cost of the receiver will be from two to three times that of the broadcast receiving televisor "and the audience not only would be restricted by inertia from going into another field, but also the initial costs would make it hard."

Before any picture broadcasting is allowed on the broadcast band there must be shown that it has a "finite value," continued Mr. Hogan.

A More Rapid Route

"I believe that development of picture transmission as a public service will come much more rapidly if the development is carried on under restrictions in the broadcast band, rather than outside of it, because of the benefits of public criticisms," he declared. These tests should be made "at the earliest possible moment and in the largest possible way," he declared.

Restrictions on visual broadcasting within the broadcast band, declared Mr. Hogan, should be such that the public's right to sound reception is protected. In the interest of protecting the sound broadcast service, the Commission should place a limit on the time and the number of stations in a given area.

Dr. Lee DeForest, called upon to make a statement, declared that this new art "should have every advantage," to progress and should not be handicapped as was broadcasting in its early days. The progress of television, he said, should be very much more rapid than was that of broadcasting, because broadcasting had only a few thousand potential listeners, while television has millions of potential "lookers."

DeForest Asks Liberty

"The Commission should deal with this problem with utmost possible liberality," Dr. DeForest advised, adding that "the only jury that can pass on the program value of television is the public."

A summation of his experiments in television was given by C. Francis Jenkins, who conducts the Jenkins Laboratories, in Washington. Explaining that he is now transmitting television shadowgraphs that are received throughout the country, Mr. Jenkins said one of the fundamentals of this transmission is that it must be on schedule. Amateurs, he declared, have been of "most surprising" value in these transmissions.

Mr. Jenkins said there are more than 5,000 people who are reporting to his visual broadcasting station of the results

of his transmission. "It is fair to assume that there are 20,000 amateurs getting our triweekly programs," he declared.

10 Kc. Enough, Said Mr. Jenkins

"It seems to me that picture transmission can be kept within 10 kilocycles, along with sound transmission, said Mr. Jenkins. He explained that radio supervisors have checked his transmissions of "black and white cartoons" and reported that they did not overlap the width of the band.

Frank Conrad, representing the Westinghouse Electric & Mfg. Co., declared that visual transmission should be conducted on wavelengths outside the broadcast band.

"I don't believe you should put experimental freight traffic on tracks that carry extra-fare trains," he said.

Charles E. Huffman, chief engineer of the Jenkins Television Corporation, Jersey City, contended that there is room for television in the broadcast band, and that there is "a real need for it." The broadcast signals from the Jenkins station in Washington, he said, are received all over the country, and his company shortly will put on the market television receivers for such reception.

Answers Three Questions

Julius Weinberger, engineer, Radio Corporation of America, answered in detail three questions raised by the Commission. First, he said, commercial television cannot be accommodated within a 10-kilocycle broadcasting band. It is true, he said, that experiments in transmission of "crude and simple objects" have shown that a 10-kilocycle band would suffice for their transmission.

"Impartial and serious engineering as well as commercial consideration has led to the belief that the very minimum band of frequencies which may be occupied by television in which any public interest of lasting proportions may be expected to be aroused would cover a width of 50 kilocycles, and that with the expected development of the art within a few years the band occupied would be 100 kilocycles."

As to whether visual transmission will result in undue interference with the broadcasting of other stations, Mr. Weinberger declared it is certain that the noise produced either by picture transmission or television "is objectionable to the broadcast listener."

The sound in the loudspeaker is that of an irregular tone or rattle, which the average listener might attribute to trouble to his receiving set, induction from the power lines, amateur interferences, or any of the other possible sources of noise which radio listeners are accustomed to combat.

Fears Effect on Receivers

"It is my opinion that public interest is in the direction of having no transmission take place within the broadcast band other than sound transmission," said Mr. Weinberger.

"A man who has bought a broadcast receiver has bought it for the purpose of listening to programs for their entertainment or educational value, to be heard from his loudspeaker or headphones." Any use of a broadcasting channel for the purpose of transmission of material which his receiver is not equipped to receive constitutes a reduction in the service value of his receiving set."

V. A. Schoenberg, chief engineer of WCFL, American Federation of Labor station at Chicago, favored television on the broadcast band. The station, he declared, has a "Television Club" of 300, which has regularly received these programs with marked success. He disagreed with the views of Mr. Weinberger, but said that he believed the average individual "expects too much of television."

NEMA Opposes Broadcast Band

M. B. Sleeper, of the Sleeper Research Corporation of New York, declared tele-

PLEA IS MADE FOR NIGHT OWL VISION SIGNALS

vision was feasible on a 10-kilocycle band width. If television receiving sets were manufactured now, he declared, many people would buy them.

The National Electrical Manufacturers Association, Radio Division, is opposed to television within the broadcast band, except experimentally, said Edgar Felix of New York, radio consultant. Television, said Mr. Felix, has not yet advanced to the stage where it has entertainment value. "Visual broadcasting should be permitted at obscure hours to demonstrate the service value of the art," he declared.

Harry Sadenwater, engineer of the General Electric Company, explained that after seven months of television experimentation, his company had decided that it is not at this time feasible as an entertainment or commercial venture. WGY, he declared, had transmitted visual signals from Schenectady, N. Y., but with little encouragement from the general listening public.

A plea that television be permitted within the broadcast band during early morning hours, and that it be allowed to develop on waves below the broadcast band, was made by A. J. Carter, of the Carter Television Corporation of Chicago. Manufacturers, he declared, are not placing televisions on the market because they do not know whether the Commission will permit television within the broadcast band.

Chairman Robinson said he knew of no objection to the transmission of visual signals after midnight within the broadcast band. The present regulations, he explained, permits such transmissions between 1 a. m. and 6 a. m.

Until television has progressed to the stage where it can give the public a day-to-day service that it desires it cannot be considered practicable, said C. W. Horn, engineer of the Westinghouse Electric & Mfg. Co. At present the television images "need more detail and more technical development before they can reach the public," he said.

"Much progress has been made but much more is needed before it is here," continued Mr. Horn. "The Commission must protect the listener and the manufacturer. It must restrict television to wavelengths other than the broadcast band."—"United States Daily."

Independent Out With a 145 Tube

The Arcturus Radio Tube Company, of Newark, N. J., has announced two additions to their line of tubes. One of the new tubes is an AC screen grid tube and the other is a power tube for AC operation. The characteristics of the two new tubes follow:

Characteristics	Power Tube (145)	AC Screen Grid (122)
Plate potential.....	250 volts	180 volts
Grid bias.....	-50 volts	1.5 volts
Filament voltage.....	2.5 volts	1.5 volts
Filament current.....	1.5 amperes	1.75 amperes (heater)
Amplification constant	3.5	400 (heater)
Mutual conductance..	1,900	1,000
Plate resistance.....	micromhos	micromhos
Undistorted power...	1,850 ohms	400,000 ohms
Screen grid potential	1.7 watts
	75 volts

5 FULL HOURS OF INAUGURAL TO SET RECORD

The inauguration of Herbert Hoover as President and Charles Curtis as Vice-President on March 4th will be broadcast to the entire world. Acting on the belief that the ceremonies should be universally available, officials of the National Broadcasting Company have laid elaborate plans for covering this most important of national functions.

The inaugural ceremonies will be sent through the air to potentially every home in the United States. They will be sent also on short wavelengths internationally.

The five-hour program, beginning at 11 a. m. and ending at 4 p. m., will be the most ambitious broadcast in radio history. The number of pick-ups, microphones, announcers, and air reporters will exceed that used in any event previously put on the air.

Solemnity versus Gaiety

The solemn moments on the Capitol steps when Hoover takes the oath of office as the thirty-first President, and in the Senate Chamber when Charles Curtis is sworn in will contrast with the lighter moods of the parade. Bands, troops in dress uniforms, dignitaries, flags, bunting, a gamut of color, action and thrills, with Washington as the background!

Microphones, thirty of them, will carry the story.

The National Broadcasting Company has augmented its Washington announcer staff with announcers from New York, including Graham McNamee, Milton J. Cross, John B. Daniel and William S. Lynch. It has enlisted the aid of Washington observers, men familiar with the dignitaries from every part of the country. And it has acquired the talents of air-reporters, men who are master-craftsmen, who wield words pungently and fluently. It has been equally busy in other phases of the broadcast, perfecting the machinery of transmission, endeavoring to make the program a perfect whole, technically as well as artistically.

Perhaps the most interesting mechanical phase of the work is the construction of a special sound-proof booth in the Senate Chamber. For the first time in history that sanctuary of zealously guarded traditions has yielded to modernity. Lest the microphone embarrass the mellowed atmosphere of the Chamber, however, it will be placed in a special booth, constructed in a corner.

Lawrence to Report

In the booth David Lawrence, nationally known political writer and analyst, will take his place before the microphone and describe the proceedings in the Senate Chamber, when the Inaugural broadcast is opened with the swearing in of Charles Curtis and the new Senators.

The program will continue with the Inauguration of the President, the progress of the Presidential party back up Pennsylvania Avenue to the White House, with the parade in its wake. This will be followed by a two-hour review of the parade as it passes the Court of Honor at the White House.

Big Showing by Columbia

The Columbia Broadcasting System will do an equally important piece of work in chain-broadcasting the inaugural, with noted men acting as managers and announcers.

Woman Poisoned But She Sings On

Oakland, Cal.

Annabelle Jones Rose was laid up in the hospital with a bad case of blood poisoning. She was scheduled to sing with the Melodettes, over KGO, a part that could not be substituted. It took a lot of talking on the popular contralto's part for her to get permission to leave the hospital.

Mrs. Rose stood before the microphone with her arm in a sling and though in great pain gave a finished performance. After the broadcast her doctor drove her back to the hospital where she was confined in bed two months. By her singing with the Melodettes, radio listeners were not disappointed in a program being cancelled which had been planned for some time.

7 CANDLES AT WOR BIRTHDAY

On Washington's birthday WOR, the station of L. Bamberger & Co., Newark, N. J., celebrated its seventh birthday. According to WOR statistics, the station has been on the air about 18,800 hours since its beginning. It started with a power of 250 watts, using a continuous wave transmitter converted to speech modulation. This transmitter was soon supplanted by a 500-watt transmitter specially designed for broadcasting. Later this station gave way to a 5,000-watt transmitter of latest design, and this station is used at present.

WOR has made it a specialty to bring celebrities to the microphone and it has introduced many screen stars, actors, authors, and heroes of the hour to the radio audience. The station is one of the most popular, as well as the strongest, in the New York metropolitan area.

Synchronized Wave Permit Is Granted

Washington.

The Federal Radio Commission has granted construction permits to the Continental Broadcasting Corporation of New York for four experimental radio stations in Virginia, to be employed in synchronization experiments designed to prove the feasibility of operating a large number of stations on the same wavelengths simultaneously.

Two of these stations will be located in Richmond and Alexandria for actual broadcasting purposes, with the other two stations operating on short waves, to be located at Fredericksburg, Va. The frequencies assigned to the corporation are 3,257, 3,256 and 4,795 kilocycles, in the short wave band, to be used for producing a heterodyne frequency of 1,539 kilocycles, on which the two broadcasting stations are to transmit during the experiments.

If the experiments are successful the corporation intends to synchronize a large number of small stations now operating in the broadcast band on a single channel created by the beating of the two high frequencies, and to broadcast identical programs throughout the country.

BLAN TAKES FULL CONTROL

Michael Blan, known as "Blan, the Radio Man," has assumed full control of the corporation of which he was president and the radio store at 89 Cortlandt Street, New York City. Blan is staging a celebration sale.—J. H. C.

NBC BOOKS 643 ARTISTS UNDER SOLE CONTRACT

Six hundred and forty-three artists—the pick of the thousands who appear annually before the National Broadcasting Company's microphones—are now under contract to the National Broadcasting and Concert Bureau exclusively.

This automatically classes them as the first rank artists of the NBC studios. Practically the entire group is being used regularly on programs of the company. They are utilized both on commercial and sustaining hours. Carefully selected from some 60,000 who broadcast from these studios during a year, they are given prior consideration in the making up of programs. Their entire artistic destinies—covering the radio, theatrical, sound film, phonograph and concert fields—are in the hands of the concert bureau, of which George Engles is director.

Walter Damrosch and his National Orchestra head the list. He represents for the National Broadcasting Company the field of symphonic music. Edwin Franko Goldman and his band also are under contract to the concert bureau. The third field of orchestral music—the jazz orchestra—has thirty-two of its leading representatives under the management of the bureau, among them Vincent Lopez, B. A. Rolfe, Ben Bernie and Hal Kemp.

There are some sixty-nine soloists, both vocal and instrumental—among them such familiar radio personalities as Gladys Rice, Jessica Dragonette, Vaughn de Leath and Arcadie Birkenholz.

Mr. Engles said:

"The demand for these artists outside of the immediate field of broadcasting is constantly growing and promises eventually to be limitless. The scope of their activities already takes in sound pictures, phonograph records, Radio-Keith-Orpheum vaudeville, concert and theatrical engagements. The artists under the exclusive management of the National Broadcasting and Concert Bureau represent the finest in the field of radio. They are not only talented artists, but also experienced microphone performers—capable of appearing in any emergency and giving a finished performance."

"America's" Operator Joins WABC Staff

Nelson M. Smith, who was chief operator of the S. S. America during the rescue of the crew of the Italian freighter Florida, has joined the technical staff of the Columbia Broadcasting System. He first got the idea of working in a broadcasting station when he spoke over WABC following the arrival of the America with the rescued crew of the Florida. William S. Paley, president of the Columbia, heard of the idea and offered Mr. Smith a position. He gave as his reason for leaving the sea that he wanted to spend more time at home.

It was Mr. Smith who was on duty on the America when the first call for aid was received from the disabled Florida, and it was he who first notified Captain George Fried. The captain praised highly the excellent work of Mr. Smith the radio compass in locating the sinking vessel. It will be recalled that the position given by the ship was in error by 150 miles and that it was the radio compass which gave the correct location which led to the timely rescue.

ATTEMPT MADE TO INCITE NEW TRUST INQUIRY

Washington.

The evidence taken by the Federal Trade Commission, in its investigation of the several corporations that were allied in radio when the inquiry was begun, has been turned over to the United States Attorney-General, said Senator Dill, of the State of Washington.

Attorney-General Sargent refused to comment on the subject.

The Trade Commission conducted an investigation for about five years, and finally dismissed the case, without any defense having been heard. One of the Trade Commissioners believed that the Trade Commission was without jurisdiction, but the case was terminated without reservation, hence "on the merits."

Some Hostile to Companies

Considerable hostility toward RCA and its associates, including Westinghouse and A. T. & T., exists among some members of the Senate and the House, and it is said to be the object of such members to keep the anti-trust investigation alive at all hazards.

However, so far the companies have won a recorded victory, and they are said to believe that the subject-matter was exhausted in the Trade Commission inquiry.

The entire matter was finally held in abeyance until after inauguration of Hoover as President on March 4th. An investigation by the new Attorney-General, or action on his part on the basis of testimony previously adduced, is regarded as one of the subjects to be taken up with the new President.

Two Courses Open

Two possible courses would be open, if the Attorney-General were to take any action: either warning the parties to desist from any methods or combinations deemed objectionable, or dissolution action in the courts. There was no indication of any desire to start a dissolution action, but the testimony was under scrutiny toward the end of the Coolidge administration to determine whether any warning was necessary or justifiable.

Senator Dill introduced a resolution toward the close of the session to instruct the Trade Commission to turn over its evidence to the Attorney-General, and, providing for a Congressional investigation, but no action was taken.

Regulating Line Voltage

Among the many uses of the new power clarostat is for control of line voltage excess. To those who are troubled this way, the insertion of a 25-to-500 ohm power clarostat between the lowest line voltage tap or fuse clip in the AC receiver or radio power unit in series with one side of the 110-volt line will provide a precise means of reducing the line voltage to the proper operating value. Details are obtainable from the Clarostat Mfg. Co., Inc., 291 North Sixth Street, Brooklyn, N. Y. Mention RADIO WORLD.—J. H. C.

Look at the date of the label pasted on the wrapper containing your subscription copies. If this date on wrapper is older than the date of the issue received, then your subscription has expired and should be renewed.
Subscription Dept., Radio World, 145 West 45th St., N. Y. C.

Station on 3 Watts Reaches 1,500 Miles

Hal Smith of Washington, D. C., has reported hearing KLNC, Blytheville, Ark., when that station was operating on 3 watts. He said that the signal strength was about the same as that of KFI, Los Angeles, and that the signals were clear, except when there was fading.

The station had previously been heard at many distant points when it was operating on 7½ watts.

W. D. Terrell of Washington, Federal Radio Supervisor, said that he had never heard of another broadcast band station getting out so far on so little power.

WMCA AND WNYC AGREE ON TIME

At a conference between representatives of WNYC and WMCA, both of New York City, a conciliatory arrangement concerning their time-sharing on the 526 meter channel was effected.

WMCA agreed to drop court action against WNYC which was pending in the New York Supreme Court concerning WNYC'S ultimatum to broadcast on alternate days.

Commissioner Albert Goldman of the city's Department of Plant and Structures, which operates the municipal station, was represented by John F. Fitzpatrick, while WMCA was represented by Donald Flamm and W. K. Gilliam.

The new time arrangement follows: WNYC will be on the air Monday from 10 a. m. to noon and 5 p. m. to 8 p. m.

Tuesday from 1 a. m. to 12 and 3 p. m. to 9 p. m.

Wednesday from 10 a. m. to noon, 4 p. m. to 5 p. m. and 8:15 to 9:30 p. m.

Thursday from 10 a. m. to noon and 4 p. m. to 10 p. m.

Friday from 10 a. m. to noon and 4 p. m. to 5 p. m.

Saturday from 10 a. m. to noon and 3 p. m. to 8 p. m.

Sunday from 2 p. m. to 5 p. m.

WMCA is to have the remaining time.

HAS 250-WATT TUBES

Among the tubes that are hard to get and for which many hams are always seeking is the Radiotron model UV-204, a 250-watt transmitting tube. The normal plate voltage of this tube is 2,000 volts, filament voltage 11 volts and the operating characteristics of this tube are similar to that of the UV-204-A, excepting that the filament current is higher. They are therefore interchangeable. The American Sales Co., 19-21 Warren Street, New York City, has obtained a lot of these tubes.

RAY HEADS A. C. NEON

Oscar Willard Ray has been elected president of the A. C. Neon Corporation, 122 Greenwich Street, New York City. This concern has been manufacturing and merchandising the McCollough tube. Under the able direction of Mr. Ray a nation-wide expansion is planned and a full line of all-purpose tubes will be manufactured. Address the above concern. Mention RADIO WORLD.—J. H. C.

BOARD REVEALS ITS SYSTEM OF STATION RATING

Washington.

That the Federal Radio Commission has a definite method of rating stations, and what that method is, were revealed in a brief filed by the Commission's counsel, Louis G. Caldwell, in the joint cases of WENR, WLS and WBCD, all in Illinois, who appealed to the courts for more time on the air.

Rules Stated

The rules, in substance, are:

1. The station with the longer service record has the superior right, all other considerations being equal.

2. Where the claims are of unequal weight, priority effect diminishes in direct ratio to the inequality of the inferior claim.

3. Broadcasting stations have an obligation equal to that of a public utility and are charged with subscribing to the highest standards of service to the listening public. The right of the program sender always is far subordinate to that of the listeners.

Where Public Interest Ceases

4. The object of a program is to meet the general desires of the public, and a well-rounded program will address itself to the divergent tastes of the public, and not single out some thought or type that is of narrow or limited interest.

5. Stations operated to promulgate some school of thought or which emphasize their own purposes rather than instituting programs that justify the existence of the station as something interesting to all, are engaged in propaganda, and not operated in the public interest.

The radio law provides that licenses shall be granted, and the affairs of the stations be administered, in the light of public interest, convenience and necessity. Therefore the rules laid down by the Commission are its means of gauging whether the station comes within the fair meaning of the law, and also to distinguish between and among contesting claimants, on some recognized basis of measurement.

Keen for Its Rules

Ever since it was created, the Commission has adhered to certain rules, although not all of the Commissioners agreed to the wisdom of all the rules. Enough of them did, however, to make the rules effective. Some litigation has resulted from disappointed stations failing to comply with the letter as well as the spirit of each rule, and Counsel Caldwell has been a stickler for adherence to the letter of the rules. In this he has been sustained by the Commission.

Effect of New Membership

What the rules will be, whether any changes will be made, whether a new method of measurement of a station's value will be devised, with two new members presumably about to take office, is problematical. Although two constitute a minority, since there is absence of unanimity on nearly all of the important decisions of the Commission the two new members, if uniting with a previous dissenter, would change a minority into a majority.

LIMIT ON CHAIN AGAIN PUT OFF THREE MONTHS

Washington.

Scheduled to go into effect finally on March 1st, the chain broadcasting restriction has been postponed again, this time until June 1st. The order provides that no two or more stations on cleared channels may broadcast the same chain program at the same time if the stations are less than 300 miles apart.

The vote was taken when four Commissioners were present. Three voted in favor of the postponement and one against.

Originally the order limiting chain broadcasts was to take effect at the same time as the reallocation, on November 11th, 1928. However, so many protests were received, not only from chain members and the trade, but from listeners as well, and so much technique had to be sifted before the complaints could be adjudicated, that the order's effective date was postponed until February 1st, or more than two and a half months.

Next came the one-month postponement until March 1st, and now the three-month postponement until June 1st, making a total of 6½ months postponement.

Pressed for Time

The Commission has been so deeply engrossed in other matters of importance, including short waves, television, reallocation amendments and international discussions on waves, that not enough time was left for the survey of chain broadcasts that was intended. The same lack of time, plus newly gained insight into the tremendous intricacies of maintaining a chain, as developed before the Congressional committees by Merlin Hall Aylesworth, president of the National Broadcasting Company, caused the latest postponement.

The objections to the chain restriction come from various sources, including not only listeners, of whom there are many thousands who protest against any curtailment of what they term their "best programs," but also from the trade as well, including set and parts manufacturers, who say that nothing ever helped their business so much as chain broadcasts.

Opposition Is Strong

One fact pointed out by set and parts manufacturers is that whenever a station in a given city joins one of the big chains, with this cream of talent made instantly available to the locality, the sale of sets and parts increases at once. Some instances are cited where in one month the sales grew 35 per cent., following the announcement that a local station had joined a big chain.

As the sale of receivers and parts is consistent with increased listening-in, hence greater public interest, the Commission is confronted with the necessity of determining soon whether its own order should be abrogated entirely because it was calculated to be in the public interest, while from some indications now before the Commission the public interest is in the opposite direction.

However, the chains have their opponents, including small stations that encourage opposition to chain broadcasts. The listeners are asked to turn their dials on a given night and determine how many different stations carry the same program from the same source of origin, i.e., "monopolize the dial."

Terrell Backs 2 Appointees

Washington.

William D. Terrell, chief of the Radio Division of the Department of Commerce, testified before the Senate Interstate Commerce Committee in favor of the confirmation of Arthur Batcheller, radio supervisor of the second inspection district, and C. M. Jansky, associate professor at the University of Minnesota.

Mr. Terrell said that both men had been indorsed by the Department of Commerce, and mentioned that Secretary Whiting had expressed the hope that the new commissioners the President would choose would be radio experts.

Mr. Terrell said he had known Prof. Jansky for five or six years, that Jansky had attended the four radio conferences called by Herbert Hoover, as Secretary of Commerce, and that he had also worked with the Bureau of Standards.

Mr. Jansky, testifying before the committee in his own behalf, said that he was graduated from the University of Wisconsin and that since 1920 had been associate professor of Radio at the University of Minnesota. Replying to a question by Senator Dill, he denied that he had ever made a statement that small stations should be taken off the air.

The radio law provides that not more than three of the commissioners shall be from the same political party. Since two of the confirmed members are Republican, only one more from that party may be appointed. Professor Jansky said that he had voted both the Republican and the Democratic ticket. His confirmation seems to hinge on his ability to qualify as a Democrat.

Demand for Si-Len-Ser Is Now Country-wide

It is doubtful if ever in the history of radio has any piece of radio apparatus leaped into such sudden popularity as the Si-Len-Ser, the device recently placed upon the market by the Trutone Radio Sales Co. under the direction of Julien J. Proskauer. This device absorbs line noises and electrical disturbances that interfere with electrically operated receivers.

Among the newest users and indorsers are light and power companies, oil burner corporations and refrigerator manufacturers all over the country. To meet this growing demand, the Trutone Company has had to open new factories and is booked with orders that will carry it all through the Summer at full production.

Leading jobbers, both electrical and radio, from coast to coast, are demanding territories, and service men everywhere are awakening to the fact that the Si-Len-Ser is opening to them a new field of profitable endeavor. Many of them, skeptical at first, after test and cure in the worst cases, have rushed in their orders and are asking for exclusive territory with the coming Summer business in mind.

Set manufacturers are realizing that the Si-Len-Ser will enable them to put out a noiseless set and are placing big orders for next season's sets, advance models of which soon will be shown.

Many instances of its value and utility have been reported. A service man for the Charles Freshman Company installed one near a pent house generator, clearing up the noise and interference which had been stubborn before, saving the dealer's good will and enabling him to hold his customer. Another report to the manufacturer was that the department store of John Wanamaker in New York, saved an \$1,100 sale by the use of the Si-Len-Ser.—
T. H. C.

JANSKY AND BATCHELLER IN SENATE JAM

Washington.

The three reappointed Federal Radio Commissioners—Ira E. Robinson, Eugene O. Sykes and Harold A. Lafount—were favorably reported to the Senate by its Interstate Commerce Committee, but the two proposed new members, appointed by President Coolidge, were called for examination. They were Arthur Batcheller, representing the First Zone, and Prof. Cyril M. Jansky, representing the Fourth Zone.

While the Senate committee was seeking more information on these two, trade bodies, broadcasting associations and other organizations interested directly in radio, voiced approval of the selections, since Mr. Batcheller has had abundant experience as Radio Supervisor in the New York area, and Prof. Jansky is one of the country's leading lights in radio technique.

Jansky Conducts Course

He conducts the radio course at the University of Minnesota and has been foremost as an expert on interference and its elimination.

Some opposition has developed to the confirmation of Batcheller and Jansky although what the reasons were could not be learned.

When the Commission is finally organized it will elect its own officers. Whether Robinson will remain chairman has not been decided. The Commission may vote to have him stay as such, or may elect one of its other members as Chairman, since this particular body does not adhere to the rotary system that obtains in other Commissions, where each Commissioner serves for one year as chairman.

Craven to Leave

Some personnel changes in the Commission's staff are imminent. It is said that Lieut. Commander T. A. M. Craven, N. S. N., who was loaned by the Navy as a short-wave expert, is to resume his work with the Navy. This resumption is expected to take place in two weeks. Hence this position would have to be filled, particularly as short waves present one of the most serious problems.

Also Louis G. Caldwell, who has been general counsel to the Commission, is leaving, to resume the private practice of law. Bethuel M. Webster, of Denver, Col., an Assistant United States Attorney-General, is mentioned as Caldwell's likely successor.

Other Changes Due

There have been reports that other changes in the Commission's administrative and technical personnel are imminent. A statement on the subject is expected soon after the inauguration of Hoover as President.

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

The President's of Human S

By Merlin

President, National

ABOUT two years and two or three months ago Mr. Owen D. Young sent for me and asked me if I was willing to undertake the presidency of an organization that would build programs on the radio, to be offered to leading stations of the country through either a wire hook-up to these stations or by relaying through the air, if the engineers were able to make such a policy possible, so that radio broadcasting might not become a fad and the people of the country no longer use their radio sets, and so that the radio industry could sell sets and tubes, better sets and better tubes, in the years to come.

He said he did not know how this company could pay for itself or how it could be financed, but if I would be willing to undertake the job that he felt I would have the support of the entire radio industry, and he asked me to take it.

Formation of N. B. C.

Mr. Young knew that I was not an engineer. I told him very frankly that I was just learning how to turn on a radio set at that time, and he said it made no difference; that he had some confidence in my ideas of public policy, and would like to have me undertake it.

Whereupon the National Broadcasting Company was organized. We purchased Station WEAJ from the Radio Corporation of America, which in turn had purchased that station from the American Telephone and Telegraph Company for \$1,000,000 in cash, while the National Broadcasting Company paid the Radio Corporation for its bill of sale.

One of the stipulations that I made when I took the office was that no one of the three owners of this company should control the stock. I did that for a purpose, which I am very frank to tell.

Bitter Competitors

The Westinghouse and the General Electric companies are very bitter competitors in the field of electrical machinery and electrical equipment. I felt that, with active representatives from both of these companies on my board, that my policies, if good, would be followed, and the policies of my company would not be made for the purpose of helping any one company in the radio industry.

It was not long until the Radio Corporation, which had operated WJZ, with studios in New York, and WRC, in Washington, asked us to manage those stations. They made figures of the cost of the operation of the stations in the past and paid me as president for my company \$300,000 the first year to run them for them.

RCA Pays for "Time"

After that first year these stations were given to us to manage without any payment from the Radio Corporation, but the Radio Corporation paid a much larger amount to us for the hours which they sponsor on the air over our system, one of which is the now famous Damrosch hour of lectures in musical appreciation to the schools of this country, on Friday mornings.

Hints of Waves to Connect Stations

The American Telephone and Telegraph Company has no interest in the National Broadcasting Company and has no ownership in its stock; it does not sit in our councils, and the only time we hear from it, is at the end of each month when it sends its bills. It may be, at some time in the future, that our engineers will find a way to repeat these programs from station to station, through the air.

When that time comes, we will use no wires, telephone, telegraph, or otherwise; but, until that time does come, we must find a way to pay for this important wire service.—Merlin Hall Aylesworth.

We never have had a general system of contracting with our stations, but have offered programs to them relying on their confidence in us in the building of good entertainment, features, and notable events which would interest the radio audience.

The first year of our operation we lost about \$800,000.

We were financed originally by the Radio Corporation, the General Electric Company and the Westinghouse Company paying into our treasury slightly more than \$3,000,000 and, from that, we built our studios in New York City, in the National Broadcasting Company building, which we do not own but which is named for us, at No. 711 Fifth Avenue.

N. Y. Center of Talent

I came out of Iowa as a youngster and most of my life I was in Colorado and Utah. I have always had the feeling, and it has been borne out by my experience in the last two years, that New York is naturally the center of talent. It is not my fault, or yours, or the fault of New York that the great talent in this country goes to New York and there centers, even if it does go back to the country at times at a much higher price than it previously sung or played for in the section where it came from.

There is a concentration of talent in New York and that talent we have made available and tried to bring into the homes of the people, rich and poor alike—for that is one thing which radio does.

Result of Concentration

People who have never been to New York, who may have never heard a great symphony, who have never heard a great opera, who may not have wished to hear opera, because they did not know what it was, who never heard a great scientist's speech, who never heard the President make an address, or who may have never heard a great statesman in Congress, get those addresses over our net-work.

People who have never known what great music really meant, unless they

heard it on a phonograph record, now have through this national net-work programs 16 hours a day, made up of the great talent centered in New York City. Then we established studios in Chicago, with the idea we would broadcast from that city the best talent produced in Chicago, both musical and cultural.

But I found great difficulty in originating programs for my clients in Chicago, because not so much talent was to be found in Chicago as in New York City. The booking agencies are in New York City and they book out of New York City. Consequently the talent flows in there and is there and can be counted on, whereas the talent from Chicago comes to New York for booking. So we have that concentrated development in New York.

Then coming, as I did, from Denver, and I am very proud of that city, living there most of my life, I always felt we had very great talent in Denver; but I did not realize we did not have enough there until radio started.

Got Denver Out Of Hole

In Denver the General Electric Company created its station KOA, which was first hailed as a blessing and finally as a pest because the people got tired of listening to the church choir and to the same hotel orchestra and demanded something different.

So, Denver being my home town, I tried to give them a variation of service, and on the opening night of our first program of our Denver station, all of the educators of Denver and leaders in education in the State were present and the next day and for a week, the Denver newspapers, on their front pages, carried the praise by the musical critics of the city, and the heads of the schools of music in the public schools and colleges, of the great cultural development, which I think it was.

The newspapers, editorially, expressed their appreciation of this service and what they characterized as the bringing of the best things to Denver. That is why a man like Major Cohen, of the "Atlanta Journal," sat in New York for three months until he could get service for his station through the National Broadcasting Company.

They all want the talent from New York. That is because the people who entertain their customers or readers know it is a good investment for them and a good advertisement for their newspapers.

We have no contract for these stations; we do not demand that they take any particular numbers of our programs. They take them generally as we offer them. I shall tell of the strangest experience I think any of us who had to do with Radio has had.

A Political Dilemma

We went into broadcasting the National political campaign with fear and trembling, because when we came into the campaign three months ago, I knew full well that many of the Democratic newspapers in this country had never printed a Republican speech, and many Republican papers had never printed a Democratic speech.

Intimate Revelations Inside of the NBC

Merlin Hall Aylesworth
Broadcasting Company

I knew that radio was going to reach the whole country over these very stations owned by the newspapers that were going to carry the messages of both parties into every home in this country and I thought that would necessitate the newspaper printing, the next day, the full speech of either party.

We do not know whether they would accept them. We thought, perhaps, the papers would refuse to take our programs through their radio stations. But every one accepted. There was free speech over the radio for all of the parties. I even had the Communists on one night, after which I received some letters.

And I wish to say also that Norman Thomas wrote us stating that we had been very fair with him and the Socialist party in broadcasting their speeches in the campaign, and I have letters from Governor Alfred Smith and Mr. Raskob and Dr. Work, all expressing appreciation for the fair way in which we handled a most delicate situation; and it was delicate.

Murphy Is Interrupted

Now, to go back a little: At the Republican convention in Kansas City, a delegate, a Mr. Murphy, I think, was attacking the Republican platform dealing with agriculture and was in the midst of a bitter speech dealing with his own party, and the wire went out.

Of course, I was perturbed and very much irritated, because I was positive no one had done it maliciously although I felt some engineer might have made a mistake.

We immediately investigated and we found that all the radio stations in the Midwestern District had not been cut off, for which I was duly thankful, for that was essentially the heart of the discussion of agriculture. Second, we found it was the stations of the East that had been cut off, and what do you suppose happened?

Mystery Explained

Three boys, youngsters over near Pittsburgh, were out hunting for some wire for a cage and they selected the particular one which carried Mr. Murphy's speech and used it for a chicken coop, or whatever it was. They were brought into court the next day and sentence was suspended.

On the night of Senator Curtis's acceptance speech as candidate for Vice President, a call came into our control room. I constantly have young men changing, coming in and going out of the engineering force. It so happened that our Chief Engineer was present that night. The call came directly into the control room.

"Important! Rush!" it said. "Inspector So-and-So speaking! Have not you men heard the SOS?" As you know we all go off the air when there is an SOS. "WEAF is the only station running. Cut off at once."

During the Campaign

As the youngster reached out his hand to cut off, this engineer said, "Wait." He tested all the stations and found every one of them running and that there was no SOS or otherwise Senator Curtis would

City and Country Tastes Different?

I have been told by my friends in the cities that the people in the country enjoy a different kind of a program than the people in the city, but I do not believe that.—Merlin Hall Aylesworth.

have been cut off right in the middle of his speech. So, you see, there are hazards in the business.

Most of the time of the political parties for use during the campaign was taken with us when we had the so-called commercial accounts scheduled to go on the air, that is, sponsored programs. We felt, all of us who had control for the National Broadcasting Company, that every commercial account should give way whenever the Democratic Central Committee, or the Republican Central Committee, or the Socialist Central Committee wanted to use the radio for either an outdoor speech or a studio speech.

Election Night

It was part of our editorial job, so to speak, to see that our commercial broadcast gave way when the Government was speaking, as we looked at it, when the parties in the campaign were speaking to the people, for the first time, over the air. That meant we turned back to all clients the money they had paid us for the use of the air at that time, and we also had to pay talent which they had contracted for, and which put on their program before a dummy microphone just as though they were broadcasting.

In some cases we paid back as much as \$5,000 or \$6,000 talent costs to some clients. Besides, we had to pay our own talent in every case, and they were paid for services which they never performed.

On the night of the election we had a most unusual experience. We offered the Associated Press, the United Press and the International News Service, the three great news associations, the opportunity of bringing each of their organizations into our studios with their wires and tabulating machines, to put on a program at no cost to our stations or to the public.

Bias Charged

We felt it was their duty to furnish the election news on that evening to the great radio public. I am very glad to say that not one of those services refused, but were very happy to do it. They all took separate rooms, each with a natural suspicion of the others. We set up an organization, handled by David Lawrence, of Washington, to handle the dispatches as they came from the various rooms, and the election returns kept going out to the whole country throughout the night.

We did get complaints on that evening. We had complaints from the Hoover people asking us to stop, saying that it was all

over and to cut it out. We had complaints from the Smith people, who said we were all too favorable to Hoover; we had complaints from Republicans that we were trying to hold up the election of Governor Smith to late in the night. But we knew that they were evenly balanced, from Republicans and Democrats alike.

Industry's Growth Is Traced in Book

"The Radio Industry, the Story of Its Development," published by A. W. Shaw Company, Chicago (\$5.00), is a new book based on a series of lectures by leaders of the industry before the students of the Graduate School of Business Administration, George F. Baker Foundation, Harvard University.

The book contains lectures by E. E. Bucher, assistant vice-president, Radio Corporation of America; General J. G. Harboard, president, Radio Corporation of America; David Sarnoff, executive vice-president, Radio Corporation of America; Dr. F. B. Jewett, vice-president, American Telephone and Telegraph Company; E. P. Edwards, manager, radio department, General Electric Company; Judge Stephen B. Davis, New York City; H. P. Davis, vice-president, Westinghouse Electric and Manufacturing Co.; Merlin H. Aylesworth, president, National Broadcasting Co.; J. L. Ray, general sales manager, Radio Corporation of America; Pierre Boucheron, Southern sales representative, Radio Corporation of America, and H. C. Weber, Massachusetts Institute of Technology.

As the name of the book indicates, the subject matter is mainly historical and should be of general interest. Each contributor is especially well versed in the subject which he has treated.

RCA Reduces Price on Ten of Its Tubes

The Radio Corporation of America announced price reductions on ten of its tubes, ranging from 10 cents to \$1.00. The prices follow:

Tube	Old	New	Reduction
226	\$2.75	\$2.00	\$0.75
227	4.00	3.00	1.00
280	4.25	3.50	0.75
281	7.50	7.25	0.25
112A	2.75	2.50	0.25
250	11.50	11.00	0.50
199	2.25	2.00	0.25
171A	2.75	2.50	0.25
200A	4.00	3.50	0.50
201A	1.50	1.40	0.10

NEW TESTER DESIGNED

John J. Orysik, technical man with Blan, the Radio Man, at Blan's radio store on Cortlandt Street, New York City, has designed an original tube tester.

Gain on Short Waves

Hammarlund Adapter-Receiver Uses Screen Grid Tube Well

By Lewis Winner

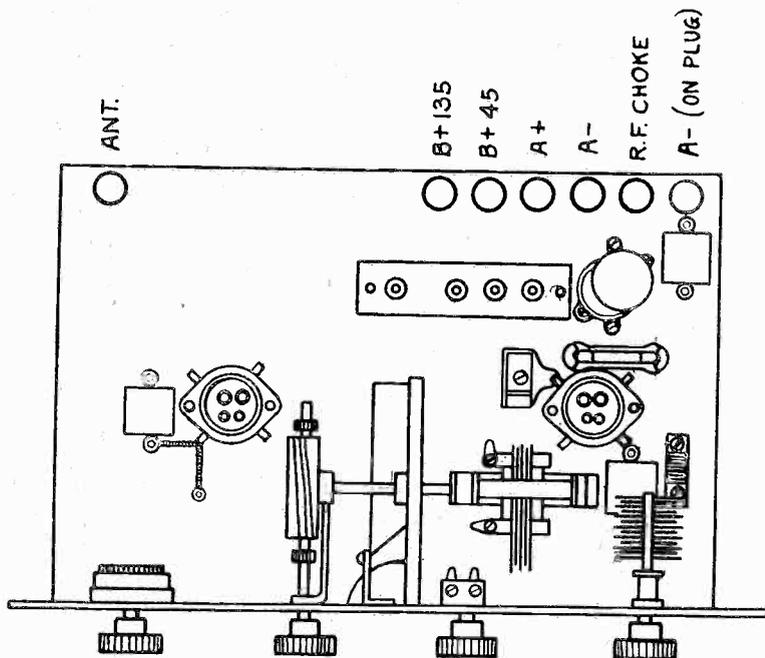


FIG. 2

LAYOUT OF THE TWO-TUBE MODEL SHORT-WAVE ADAPTER-RECEIVER

ONE of the objects of designing the screen grid tube was to permit high amplification at high radio frequencies. But most applications of the screen grid tubes has been to broadcast receivers. The Hammarlund screen grid two-tube Adapter-Receiver combination is one of the exceptions. This circuit incorporates the screen grid tube as radio frequency amplifier. The tube's use insures high sensitivity on the short waves.

There are many refinements of design in this combination which make it an outstanding receiver for short waves. What these refinements are will become evident on studying the wiring layout on the front cover.

A positive volume control is a necessity in a sensitive receiver intended to cover the whole earth. This is provided by a variable resistance in the antenna circuit and in the grid circuit of the screen grid tube. This resistor appears at the extreme left on the panel. By means of this variable resistor the full range of sensitivity may be covered.

Single Tuner Used

Since the volume control is in the antenna circuit and in the input circuit of the first tube no extra tuner is required. The required selectivity is obtained by a highly selective circuit between the screen grid tube and the detector as well as by regeneration in this tuner.

The coupling arrangement is that which is known as tuned impedance, which admittedly is the most effective way of coupling the screen grid tube to the detector in a short-wave receiver. This arrangement requires a minimum of wire in the tuner, and hence the least losses in the wiring. It also puts the highest possible load on the screen grid tube, and thus forces the tube to deliver the highest amplification.

A small variable grid condenser is used in the circuit, which allows the adjustment of the detector to the point of highest detecting efficiency for any frequency range desired. The condenser is mounted

next to the grid of the detector and no knob for it is provided on the panel. It is mounted so that the capacity may be changed by a screw driver.

The grid leak R3, which should have a value between 2 and 9 megohms, is also mounted close to the grid to enable the shortest possible leads. And as will be seen from Fig. 2 it is placed so that it is readily accessible for changing the value of the leak. The leak is returned to the positive side of the filament battery as this connection gives the highest detecting efficiency.

Smooth Regeneration Obtained

The parallel method of feedback is used because that gives the smoothest regeneration. Oscillation does not come in with a plop and there is no "drag" or "hang-on" when regeneration is reduced to stop oscillation. Since the feedback increases gradually it is possible to approach critical regeneration very closely and thus to get maximum sensitivity out of the set.

The feedback is controlled with a condenser C1, which may be seen on the panel at the extreme right in Fig. 2. The feedback coil L3 is wound on the same form as the tuning coil L2, so that for each tuning range the proper number of tickler turns is used.

The circuit is tuned with a .00014 mfd. condenser of the "Midline" type, and its rotor is driven by a Hammarlund drum dial, the knob of which may be seen at left center on Fig. 2. The long dial of the drum, the vernier movement, and the absence of all back-lash make extremely fine tuning a possibility and a pleasure. The importance of this is realized when it is known that the lack of fine tuning adjustment has made many otherwise fine circuits a failure. Complete control of the tuner is a necessity in short wave receivers for without it many stations will be missed entirely.

Rotors Grounded

The rotors of both the variable condensers C and C1 are grounded to radio

LIST OF PARTS

- C—One Hammarlund .00014 mfd. ML-7 condenser.
- C1—One Hammarlund MC-23 midget condenser.
- C2—One Hammarlund EC-70 equalizer condenser.
- C3, C4, C5—Three Sprague Type F .1 mfd. condensers.
- L2 L3—One set of Hammarlund SWC-3 short wave coils.
- L4—One Hammarlund RFC-250 radio frequency choke coil.
- R—One Electrad Type P Tonatrol
- R1—One Yaxley No. 820 C, 20 ohm mid-tapped resistor.
- R2—One Yaxley No. 804 4 ohm resistor.
- R3—One Durham metallized grid leak, 2 to 9 megohms.
- One Yaxley No. 10 midget battery switch.
- One Hammarlund SDW Knob control drum dial with light.
- Three Hammarlund SDWK walnut knobs.
- One Hammarlund SWAP adapter plug and cable.
- Two Eby No. 12 sockets.
- One Westinghouse Micarta 7x14 inch panel.
- One package containing necessary hardware.

frequency currents through the fixed condenser C4. The value of this condenser is .1 mfd. and therefore there will not be the slightest hand capacity on either the tuning or the tickler condenser. The value of this in bringing the circuit up to critical regeneration and precise tuning is appreciated by all who have worked with short wave circuits or who have tried to tune in the shorter waves in a broadcast receiver, as more fully set forth in the Hammarlund Short Wave Manual (10c).

Another important feature of the circuit is the large value of condenser C3 connected from the screen grid to the negative end of the filament. Note in Fig. 2 (next week) how this is connected to the left of the first socket. It is mounted so that the leads are the shortest possible. Thus the condenser, the value of which is .1 mfd., effectively grounds the screen grid to radio frequencies. There can be no feedback through fluctuations of the direct voltage applied to the screen grid.

The .1 mfd. bypass condenser C5 is useful when the circuit is plugged into detector socket of a broadcast receiver for utilizing the audio amplifier therein. The plug to which the plate lead and C5 is connected is for making the transfer. This is not shown in Fig. 2 but it should be connected to the two Fahnestock clips at the extreme right. C5 may be seen connected to one of these and the choke coil L4 to the other.

In the negative filament lead to the screen grid tube is a mid-tapped resistor R1, the total value of which is 20 ohms. The drop in the upper 10 ohms of this resistor is used for the bias on the control grid of the first tube. This bias is about 1.3 volts, which is the correct value. This resistor may be seen in Fig. 2 running from the first socket toward the panel.

[Part II Next Week]

(Other Illustration on Front Cover)

Resistance AF in AC

Finest Tone Quality in Simple 5-Tube Design

By Herbert E. Hayden

SOMEbody may want to build a receiver in which convenience is a feature, a circuit that is entirely AC operated, with single tuning control, and from which circuit exceptional tone quality is obtained. The circuit is Fig. 1.

It consists of five tubes, of which first, second, third and fourth are 227 and the last a 171A. A factory-made B eliminator supplies the plate current and voltage.

The circuit's principal novelty is the use of resistance coupled audio amplification with type 227 tubes. So far as I know there is not a single licensed manufactured receiver on the market that has resistance coupled audio amplification, nor have I seen an AC type in the radio press revealing the construction of such a circuit.

Where Resistance Audio Stands

It is worth noting that the growing interest in audio amplification for television—where the frequency response has to be excellent, otherwise the image will appear blurred—centers upon resistance coupling. Even the set manufacturers who use audio transformers in their broadcast receivers are experimenting with television models that use resistance coupling.

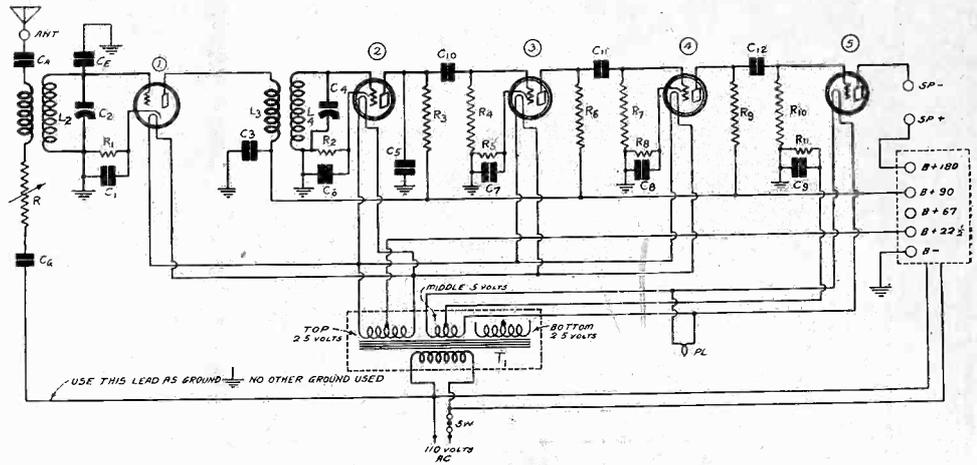
Although audio transformers of the finest grade certainly do produce excellent results for the ear, resistance coupling is necessary for the eye, which is quicker to detect distortion. But resistance coupling has a risk—motorboating. The put-put sound that sometimes accompanies direct coupled audio circuits spoils the entire operation, but a good B eliminator, with correct voltages for the tubes and grid returns, will avoid this nuisance and afford a circuit that will thrill you with its tone. Besides, you get good amplification—better gain than from 201A tubes used in battery operated circuits—because the μ is a little higher, about 9 per cent. per stage. For one stage of audio this means little, for two stages it becomes a ratable factor, and for three stages it is something decidedly noticeable.

Single control is made easy, because the rotor of the double condenser connects to ground for both circuits, and because the first tube has enough plate to filament capacity, reflected in the tuned secondary that follows, to enable justification of the two tuned circuits by adding a permanent capacity to the antenna coil's secondary. This is done with an equalizing condenser, set once, then left thus.

Watch Filament Transformer

All the parts used in this circuit are easily obtainable, the only special mention required being that the double condenser be absolutely accurate to a fraction of 1 per cent. at any setting, that the coils have exactly the same inductance, and that the filament transformer be able to stand the load. This load requirement refers particularly to the heavy filament drain made by the four heater type tubes, a total of 7 amperes at 2.5 volts. Very few transformers on the market enable such a heavy drain to be taken, therefore be certain that the filament transformer is designed for such a load, otherwise it will get hot, cause erratic filament voltages and possibly burn out.

You will see from Fig. 1 that the filament transformer used in the laboratory model of this receiver has a primary winding and three secondary windings,



TONE QUALITY THAT THRILLS IS PRODUCED BY THIS RECEIVER. THE VOLUME IS GREATER THAN THAT PROVIDED BY TWO TRANSFORMER-COUPLED AUDIO STAGES, SINCE THE END OF THE 227 TUBE IS HIGHER THAN THAT OF THE 201A, AND THIS INCREASE IS PARTICULARLY CAPITALIZED BY A RESISTIVE PLATE LOAD. CE MAY BE PUT ON THE OTHER TUNED CIRCUIT IF A SHORT ANTENNA IS USED

and that two of these secondaries are 2.5 volts while the third secondary winding is 5 volts. The transformer is connected to enable use of the tubes previously described, but when power tube (245 and 345) of RCA and Cunningham appears, after April 1st this may be put in the last socket. Just disconnect the 5-volt winding (so it supplies the pilot light only), heat the final audio filament from the winding marked "bottom 2.5 volts," and use its center tap instead of the other.

The designations "top," "middle" and "bottom" refer to the position of the terminals on the filament transformer merchandised by the Guaranty Radio Goods Company.

The plate voltage of 180 may be increased to 250 when and if the 245 tube is used instead of the 171A.

How to Suppress Squeals

So we are making a little dip into the future, while providing a circuit that can be worked well with tubes now available, and which tubes are now at the lowest price ever, due to the recent price reductions.

While the circuit is not super-sensitive, it is a good performer, selective enough for all needs, except extreme cases, and not inclined toward self-oscillation at radio frequencies, unless the B voltage on the first tube is held too high. As a corrective, a grid suppressor may be used, at the first grid, and of a resistance of 800 ohms or more, the resistance being as low as possible while still maintaining the effect of squeal-suppression.

The circuit is very much like the AC4, recently published in RADIO WORLD, but instead of two transformer coupled stages of audio, resistance coupling is used.

The B supply is a National Velvet-B, which is 7½ inches wide, 7½ inches long and 6½ inches high, very compact. Its high capacity filter condensers—total 16 mfd. of Mershons and 2 mfd. of the paper type—help avoid the nuisance of motorboating.

The ground lead is taken from the AC line. Hence no external ground connection is made and no ground binding post provided. Do not connect any other ground to the set.

A single switch turns the filament and plate power supply on and off. Remove the plug from one end of the B supply's AC cable, and connect one of its leads to the set side of the switch SW, the other B supply cable lead to the oppositely polarized cable of the filament transformer.

When the B supply is put in place the distance its cable leads must travel is measured, and the cable cut to size.

LIST OF PARTS

- L2, L3L4—Two AC5 coils (manufactured by Screen Grid Coil Co.).
- C2, C4—One Hammarlund two-section tuning condenser, .0005 mfd. for each section (MLD23).
- CA, CG, C5—Three Aerovox .0005 mfd. fixed condensers.
- C1, C3, C6, C7, C8, C10, C11, C12—Eight Aerovox .02 mfd. fixed condensers.
- C9—One Aerovox ¼ mfd. bypass condenser.
- R1, R5, R8—Three Electrad 1,500-ohm resistors (B150)
- R2—One Electrad 1,000-ohm resistor, B100.
- R11—One Electrad 2,000-ohm resistor, B200.
- CE—One Hammarlund 70-mmfd. Equalizer.
- T1—One AC filament transformer (Guaranty Radio) Ant., Speaker plus, Speaker minus—three binding posts.
- R3, R6, R9—Three Lynch 0.1 meg. metallized resistors.
- R4, R7, R10—Three Lynch 5 meg. metallized resistors.
- 1, 2, 3, 4—Four five-prong sockets.
- 5—One four-prong socket.
- RSW—One Electrad 5,000-ohm Royalty variable resistor with 110-volt AC switch attached.
- One 7x24-inch front panel.
- One 11x23-inch baseboard.
- One Hammarlund drum dial with pilot light PL.
- One National Velvet-B, 180 volts maximum, type 3580.

Only Low Resistance

As the Amplification per Stage Selectivity

By Brun

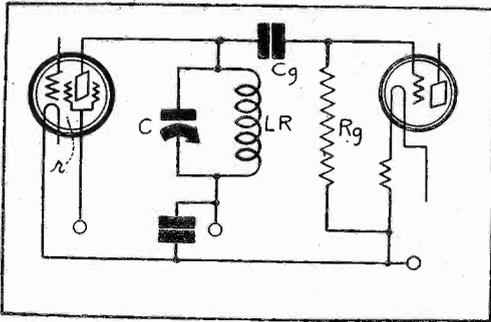


FIG. 1

A tuned impedance coupler is not selective because it has two resistors in shunt with the tuning coil, but it has a high gain, that is, the amplification is high.

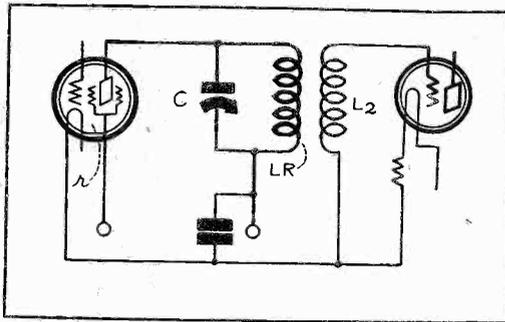


FIG. 2

An exceptionally high gain may be obtained with a tuned primary coupler in the plate circuit of a screen grid tube and regeneration may be used to provide selectivity.

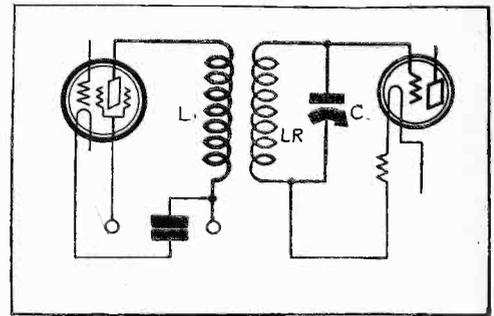


FIG. 3

A tuned secondary coupler is more selective than either a tuned impedance or tuned primary coupler, but it has a lower gain. The primary L1 should have 24 turns or more on 2½-inch diameter.

“MY SET is wonderful on tone quality but it is not selective enough. Will its selectivity be improved if I put a resistor in the tuned circuit?”

That is one of the questions received from a fan, and it is a typical question. Selectivity seems to be the most desired quality in a radio receiver, and countless changes have been proposed for improving it. Most of these proposed changes have nothing whatsoever to do with selectivity or broadness of tuning.

Selectivity and Resistance

Fidelity of reproduction should be the first consideration in any receiver, but it is not, for most radio fans are perfectly satisfied with the tone. In fact most of them think that their own receivers rank first on this point, unless something has developed in the sets to cause the quality to change appreciably. Even if that change is an improvement as measured by instruments the fans may be inappreciative of the change and deem it due to some kind of distortion.

Selectivity has nothing to do with that part of the receiver which follows the detector. It has practically nothing to do with the voltages applied to the tubes, except the grid bias in the radio frequency tubes and the detector. It has extremely little to do with what type of tuning condenser used, as long as this is one of air dielectric. It also has little to do with what the shape of the tuning coil is. That is, it does not depend much on whether a solenoid coil or a spider web coil is used. Either type of coil may be very good or it may be very poor with respect to selectivity.

Selectivity of the Receiver

The selectivity of a tuned circuit dissociated from tubes and auxiliary apparatus mainly depends on the resistance to radio frequency currents in that coil. The selectivity of a tuned circuit associated with tubes, shields by-pass condensers, and resistors depends on the actual resistance in the coil under the conditions in which the coil is used. And the selectivity of a circuit is always less when the coil is in the receiver than when it is

dissociated from all parts except the tuning condenser. There is one exception, and that is when there is regeneration.

The selectivity of a complete receiver depends on the selectivity of each tuned circuit in it, on the number of tuned circuits, on the accuracy with which all the tuned circuit may be tuned to the same frequency, and on the amount of regeneration without oscillation.

Tuners alone produce selectivity. Tubes provide the amplification. The apparent selectivity in a circuit depends on the ratio between the actual selectivity and the amplification. When the amplification is high the actual selectivity must be higher in order to suppress interference which appears only when the set is adjusted to high sensitivity.

Resistance in the tuning coils decreases the selectivity. Regeneration reduces the effective resistance, so that in considering selectivity it is only necessary to consider resistance.

The resistance in a coil depends on many factors. If a resistance is connected in series with the coil the selectivity decreases in direct proportion to the resistance. If a resistance is connected across a coil the selectivity of the coil decreases inversely as the resistance. These two cases cover all variations of selectivity in a coil, because any increase in the actual resistance in a coil can be regarded as either a change in the series resistance or in the shunt resistance.

At any one frequency the shunt resistance can also be reduced to an equivalent series resistance. Hence for any given frequency there is only one resistance to consider, but it is a complex one, or it arises from many causes.

Resistance in Direct Coupling

Consider first a direct coupled circuit with tuned impedance, Fig. 1. What factors contribute to the lack of selectivity? Assume that no shielding is used and that no regeneration takes place because of this omission. Also assume that the tuning coil is not affected by any apparatus placed near it. It will also be assumed that the grid bias on the second tube is high enough so that no grid cur-

rent flows, and hence so that the grid-to-filament resistance in the tube may be neglected.

The coupler then consists of three impedances in parallel. There are the impedance of the tuning condenser C, that of the tuning coil L and that of the grid condenser Cg and Rg in series. The plate-to-filament resistance r of the first tube is also in parallel with these impedances, and this also affects the selectivity.

The resistance R of the coil L is very small in a well designed coil. If that were the only resistance the circuit would be very selective. This is a series resistance. It is not constant but increases quite rapidly with the frequency. Hence the circuit is less selective at the higher frequency end of the broadcast band than at the lower end. That is unfortunate, because three times as great selectivity is necessary at the high end as at the low in order to separate channels equally well.

Grid Leaks Adds Resistance

A certain current flows through the grid leak on the grid condenser. If it did not there would be no signal impressed on the second tube. But Rg is in shunt with L and hence it adds resistance to the tuned circuit. And the smaller Rg is, the more resistance it puts into the tuned circuit. Therefore it is necessary to use a high resistance for grid leak in order to maintain a high selectivity. The effect of the grid condenser and grid leak in increasing the resistance of the tuned circuit is greater the lower the frequency. This is mainly due to the stopping effect of Cg.

Since the plate resistance r is also in shunt with the tuning coil it has essentially the same effect in adding resistance to the tuned circuit as the grid leak. If r is smaller than Rg, which it is likely to be, its effect is greater. The value of r cannot be changed like that of Rg, so the plate resistance of the tube is likely to produce the greater decrease in the selectivity. It is well known that this particular method of coupling is non-selective. The advantage of the coupling is

Produce Selectivity

As Is Increased, the Apparent
Is Diminished

Brumm

that it gives higher amplification than transformer coupling.

Other Sources of Resistance

But these two shunt resistance and the series resistance are not the only sources of poor selectivity. The coil will necessarily be near the tuning condenser. Eddy currents are set up in the condenser and these are equivalent to a series resistance in the coil itself. Then if there are other pieces of metal, such as shields, panel, sub-panel and other coils and condensers, the eddy current losses will be increased. The equivalent series resistance in the coil will be increased and the selectivity will be decreased.

The effect of eddy currents in metal parts depends on how close the tuning coil is to these parts, and how the coil is placed in relation to them. The closer the coil is to the metal parts the greater the losses. Also if the coil is placed so that its magnetic field is at right angles to the larger dimensions of the metal pieces, the greater are the losses.

The only way to reduce the effective resistance in the coil is to introduce regeneration. This may be done with a small tickler.

Tune Primary Circuit

In Fig. 2 is a similar circuit with tuned primary transformer coupling. It is clear that the plate resistance r is still in shunt with the tuned circuit, and that it exerts the same influence on the selectivity. But the grid leak has been removed. It would seem therefore that one of the sources of resistance has been removed. That is true, but only to introduce another to take its place. The secondary winding L2 consists of a conductor in the field of the tuned coil, and it is coupled very closely.

Eddy currents are set up in this winding, and if the wire in the secondary is heavy these eddy currents may easily introduce more resistance into L than was introduced by the grid leak in Fig. 1. Again, there is considerable capacity between the two windings, and the dielectric in the equivalent condenser is not always of the best. Hence there will be considerable losses from this effect.

If the wire in L2 is fine, both the eddy current losses and the distributed capacity will be small. Whether the losses due to the presence of the secondary be large or small, they can be reduced by employing regeneration, and the reduction may be carried to almost any desired extent.

Degree of Influence

The degree of influence of the secondary on the tuned circuit depends on the looseness of coupling between the two coils and on the size of L2. If the coupling is loose both the eddy currents and the capacity currents will be small and the added resistance will be small. But this reduces the amplification. This cannot be built up by regeneration because when the selectivity is high the circuit will oscillate more quickly. In designing a circuit it is always necessary to compromise between selectivity and amplification,

and it appears to be preferable to use close coupling and build up both the signal and the selectivity by regeneration.

Selective Circuit

The tuned secondary method of coupling is used more frequently than any other. This method is shown in Fig. 3. It is not to be supposed that the plate resistance of the first tube produces no effect just because the tuned circuit is in the secondary. If the coupling between the primary L1 and the secondary L is close, the influence of the plate resistance is almost as great as in either of the two previous instances. Only by virtue of loose coupling is this circuit more selective. And, as always, loose coupling means low amplification.

The circuit in Fig. 3 does not have as much amplification as either of the other two circuits. This is particularly the case when the first tube is a screen grid tube, which is shown in all the circuits, because it is impossible to obtain high enough impedance in the primary to take advantage of the high amplification of the screen grid tube.

More Eddy Currents

Since the primary must be a coil of many turns coupled closely to the secondary there will be considerable eddy current losses in the primary, which will add to the resistance of the secondary. And the distributed capacity will add more just as in Fig. 2.

The greater selectivity of the circuit in Fig. 3 is due to the fact that the coupling is far below that which gives maximum amplification. And when that is the case the selectivity is always greater. This does not mean that the circuit is not a desirable one. It is very good both as to selectivity and amplification. The comparison is relative when the same type of tube is used before the coupler. Very much sensitivity may be gained by the use of a screen grid tube when used in any one of these circuits.

The circuit in Fig. 3 is just as much subject to eddy current losses in surrounding metal parts as either of the other circuits, and the same precautions must be taken to reduce them.

Effect of Feedback

The selectivity of a complete receiver, even if tuned very accurately, is not necessarily the products of the selectivities of the separate tuned circuits in it. There is interstage coupling which alters it. The change may be either an increase or a decrease in the overall selectivity. These effects are reduced by choke coils in the plate leads, condensers across the leads and by shielding.

In each of the three circuits shown there is one bypass condenser across the plate voltage supply. There should be another across the supply to the screen grid. And each of the plate and screen grid leads might well have an 85-millihenry choke coil. While these filters are not absolutely necessary in all instances, they are always helpful and sometimes make a poor circuit a good one.

Judicious shielding also helps to reduce the interstage coupling and therefore improves the selectivity. But any shielding should not be placed too close to any tuned coil. Several inches, if possible, should separate the shielding from the coil. If more than two screen grid tubes are used shielding and filtering are necessary.

Power Tube Output Compared with Original

How much power is really required in the output of a radio or phonograph amplifier, for home entertainment? George Lewis, vice-president of Arcturus Radio Tube Company, asks this question and gives an answer.

He estimates that the maximum power output of a strong singer, such as Caruso was, is probably in the neighborhood of .01 watt. A violin solo, at fortissimo, represents an acoustic power of about .001 watt. Symphonic orchestras and bands send out much more sound, but even at the strongest passages the power is much less than one watt, measured in electrical terms.

The power required in the last tube depends on the type of speaker and the location of that speaker. Speakers have efficiencies ranging from about 5 per cent. to 10 per cent., the dynamic being the most efficient.

Suppose the sound required is .01 watt and the efficiency of the speaker is 10 per cent. Then the power output required is .1 watt. A loudspeaker having an efficiency of 1 per cent. would require a power of one watt.

The undistorted power output of a 71 type tube is about .7 watt, that of a 210 is 1.7 watts and that of a 250 is 4.5 watts. Thus it appears that a 71 tube will give enough power when a dynamic speaker is used and almost enough when one of the less efficient speakers is used. A 210 will give ample power on all types of speakers and a 250 will give more than enough.

It should be realized that not all the original volume of a good singer or an orchestra can be used in a small home. The sound would be intolerably loud and it would interfere with the neighbors.

De Forest Hour Adds List of Noted Artists

In addition to the programs now being broadcast every Sunday evening during the DeForest Audions' Hour by Arthur Pryor and his concert band, the DeForest Radio Company of Jersey City, N. J., has arranged for several artists to be heard during the DeForest Audions' Hour over the Columbia Broadcasting System, including Feodor Chalopin, Richard Bonelli, Alma Gluck, Charles K. Hackett, Rudolph Ganz, Mary Garden, Anna Case and Frances Alda. The Russian Symphonic Choir will also be featured.

A Band Pass Filter

How to Apply It and Still Get Best Signal Strength

By Capt. Peter V. O'Rourke

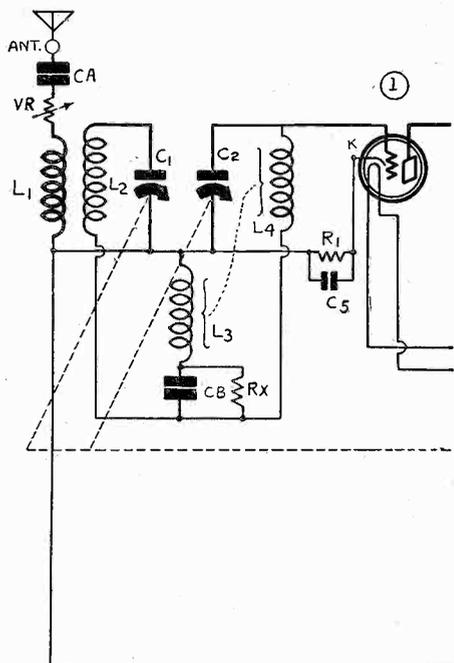


FIG. 3

A RESISTOR RX MAY BE CONNECTED ACROSS THE CONDENSER CB TO MAKE THE GRID MORE NEGATIVE. OTHERWISE THE GRID IS FREE, HENCE ONLY A LITTLE NEGATIVE.

THE coupling in the band pass filter part of the full diagram of the five-tube circuit published last week, issue of February 23d, is obtained jointly through a small winding on one of the RF transformers, and through a condenser CB, these two being in series.

The operation is good when the grid is left free, which really amounts to a small negative bias, but if it is desired to increase the negative bias on the first tube, this may be done by incorporating a fixed resistor, RX in Fig. 3. The value of this resistor is not critical. Due to its position it may be of small resistance, around 400 ohms, although much larger values may be used, since the plate current does not flow through it.

The parts are laid out with the filament transformer near the left-hand side of the front panel, the B supply directly behind the filament transformer, and the circuit proper built from about the center of the baseboard to the extreme right-hand side. The RF tubes go in the usual order. The antenna coil is placed near the front panel, at right angles to the real input coil, L3L4. Each coil is at electrical right angles to the succeeding coil, to minimize coupling.

Layout Next Week

The audio channel is developed "backwards." That is, it starts at right rear and goes left. The Victorian 112 audio unit goes between the first audio and second audio tubes. Thus all the space on the subpanel is occupied. A layout, expected for this week, will be shown next week instead.

There are two possible sources of trouble; first, the band pass filter, since it is assumed that most radio constructors are not very familiar with the working of this device, and, second, the negative grid bias on the detector.

The absence of approximate resonance

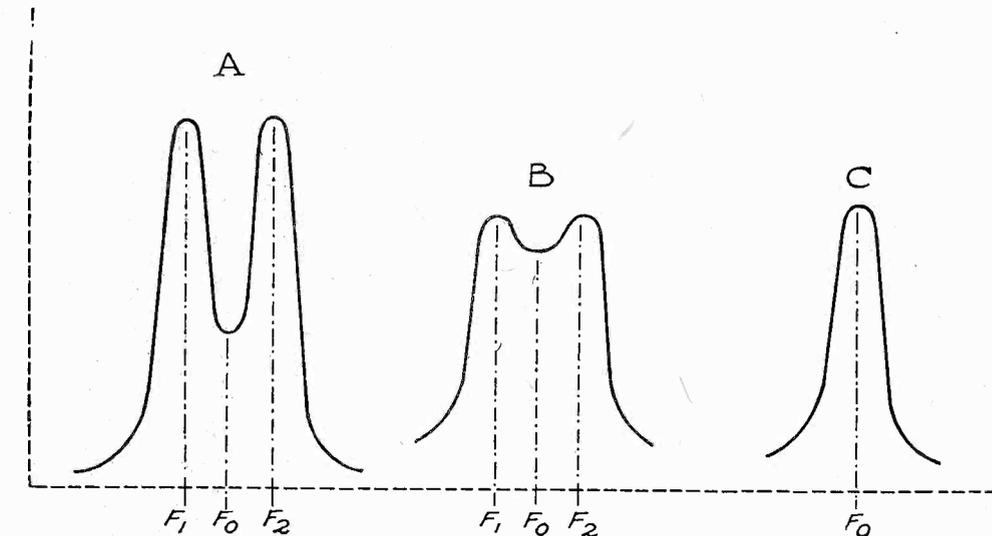


FIG. 4

THREE CURVES SHOWING THE CHARACTERISTICS OF BAND-PASS FILTERS WITH VARIOUS DEGREES OF COUPLING BETWEEN THE TWO CIRCUITS. THE CURVE AT THE LEFT (A) REPRESENTS CLOSE COUPLING, THE CURVE IN THE MIDDLE (B) MEDIUM COUPLING AND THE CURVE AT RIGHT (C) VERY LOOSE COUPLING.

will kill signal strength, but this can be corrected at the coupling source, either through the introduction of the fixed resistor RX or its omission, depending on whether you get fine results or poor results.

Of course, if you get great signal strength right away your two tuning coils, L1L2 and L3L4, are approximately resonant.

Antenna Condenser Effect

It is assumed you are using a first-class ganged condenser, for anything other than the best will make good operation of this or any other singly tuned multiple circuit impossible.

The presence or absence of the series antenna condenser CA, has a slight effect on the resonance of the first tuned stage, so try this condenser in and then out and note the difference, if any. If your aerial is very long, say, around 150 feet, you may get much better results with the condenser inserted. But as your aerial is a mystery to this writer, you can make the simple test yourself and adhere to whichever method provides the better results.

As for the detector, it is surprising how much detection, if one may put it that way, is obtainable from negative grid bias of the 227 tube. You may use a resistance of such value as to give you too strong detection, that is, the detector will overload before any part of the audio chain.

The value of this detector biasing resistor suggested last week was 50,000 ohms when the detector plate voltage was 90 at the source. However, you can get louder signals, if they are desired, by increasing the plate voltage on the detector to considerably more than 90; or, leaving it at 90 or even increasing it, but using a lower value of biasing resistor. The 50,000 ohms operate the tube at one part of the flat portion of the characteristic, but you can swing to the other part by using 500 to 1,000 ohms for detection. This suggestion is made likewise on the assumption that grid bias detection is not so very well understood, and a constructor who may get no signals whatever will wonder what is the cause, only to find

out eventually that if he increased or decreased the detector plate voltage he'd fare all right.

The lower value of resistor for R3, therefore, may appeal to some, since from about 500 ohms to 1,000 ohms you get from fair to very strong detection, when the plate voltage is anything from 45 to 180, hence there is detection all along the line, which is not true when 50,000 ohms is used. The object in specifying 50,000 ohms is that it is a good compromise between volume and quality—not the most volume is obtained but nearly the best quality. Since you may escape detection with the 50,000 ohm value, try the lower resistance.

There may be some oscillation, whereupon you may introduce a grid suppressor, at the G post of the offending socket, connecting the grid lead to the other end of the suppressor. Values of resistance from 800 to 1,500 ohms are suggested, but no definite value can be stated, since one can not be sure what plate voltage and negative bias you are using. In general, the resistance should not be any greater than necessary to circumvent the negative resistance introduced by self-oscillation in the tuned circuit. In the absence of expensive measuring equipment, therefore, the correct value must be found by experiment. After it is reached it is found that slightly increasing the resistance of the grid suppressor sharply reduces volume.

The band pass filter is something that should appeal to many, not only because it is a novelty this season, but because it is conceived in the interest of tone quality—something that fascinates everybody. The circuit, as diagramed, provides extra selectivity, above the usual three tuned stages, even though the fourth tuned stage is maintained at slightly different frequency, or is a little off resonance, to produce band pass filter effect.

What this effect is, may be determined from Fig. 4, where the center diagram, B, shows a portion of the top of the tuning characteristic relatively flat. By keeping inside the ends, the carrier operates on the relatively flat portion that affords, for the first stage, selectivity without side-band cropping.

Radio University

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

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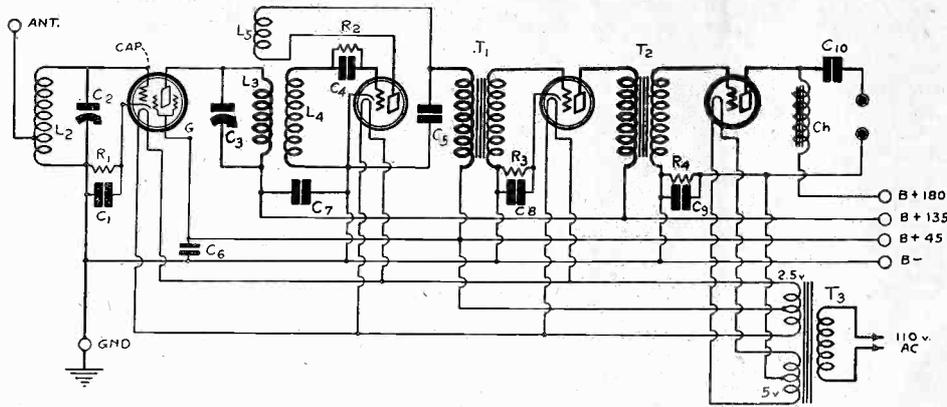


FIG. 732

THE DIAGRAM OF A FOUR-TUBE AC RECEIVER EMPLOYING AN AC SCREEN GRID TUBE IN THE FIRST STAGE. IT IS VERY SENSITIVE AND SELECTIVE ENOUGH FOR MOST PLACES. REQUESTED BY ERNEST WILLIAMS

PLEASE PUBLISH a circuit diagram of a four-tube receiver consisting of an AC screen grid tube, two —27s and one —71A type tubes. Show the connections of the filament transformers.

(2) Can such a receiver be operated without C batteries? If so, show how the bias can be obtained.

(3) Will this circuit be selective enough for use in the city?

ERNEST WILLIAMS,
Brooklyn, N. Y.

(1) See Fig. 732.

(2) Yes, the grid bias resistors take care of the grid voltage. Use following values: R1, 750 ohms; R3, 1,000 ohms; R4, 2,000 ohms.

(3) Yes, it is selective and sensitive.

PLEASE GIVE a brief explanation why a baffle board makes a loudspeaker bring out the low tones without any change in the radio set.

(2) Does the baffle board have the same effect as a long horn with a wide mouth?

(3) Is there any simple relationship between the size of baffle that should be used and the lowest frequency which the speaker will bring out?

CARL SEASTROM,
Minneapolis, Minn.

(1) That cannot be done briefly. Suggest you read the article by H. B. Herman in the February 23d. issue.

(2) It has a similar effect. It aids the speaker to take hold of the air in front of the diaphragm.

(3) There is no simple relationship, but a very complex one. However, the baffle should be of about the same dimensions as the quarter wavelength of the sound wave corresponding to the lowest frequency desired. For example, if the lowest frequency is 60 cycles per second the size of the baffle should not be less than 4 feet 8 inches, because the wavelength is approximately 18 feet 10 inches.

I HAVE NOTICED that when my loudspeaker is working I can hear a high-pitched sound in certain positions of the room while I cannot hear it at all in other places. The sound is not unlike the buzz of a mosquito, but much higher in pitch. I cannot hear it near the speaker. What causes this sound and why can it not be heard everywhere in the room?

ERIC HALLEN,
Chicago, Ill.

The sound may be a beat note between the station to which you are listening and

another station nominally 10 kc away. Or it may be caused by a beat note between any other two electrical vibrations of suitable frequency. Again, it may be due to a high frequency oscillation in the receiver itself. Such high-pitched sounds often cannot be heard except in places where the direct sound and a reflected sound reinforce. Perhaps some curved surface in your room concentrates the sound at one or more points.

I HAVE READ articles in which the term interference was used when the signals were intensified by certain effects. Is this an erroneous use of the term, or is there some technical meaning of the term?

(2)—I have also seen the terms constructive interference and destructive interference. It seems to me that all interference is destructive. Please explain.

(3)—Has this interference, so-called, anything to do with fading?

PHILIP AIRES,
Omaha, Nebraska.

(1)—No, this use of the term interference is not erroneous. It is a technical term describing certain effects in wave motion.

(2)—Constructive interference and destructive interference are two phases of

the same phenomenon, if two waves of equal length approach a point from two directions. If the crests of the two waves reach the point at the same time there is constructive interference at that point, because the effects add up. If the crest of one wave reaches a point at the same time that the trough of the other does, there is destructive interference at the point, because the effects partially or wholly neutralize each other.

(3)—Some forms of fading may be explained on this principle. At first it was thought that all fading was due to interference. Two stations operating on exactly the same frequency, at some distance apart, would create an "interference pattern," or an interference field. An airplane equipped with a radio receiver would experience a fading effect, that is, a rise and fall of the composite signal. Of course, the signals will be garbled. That is the usual type of interference.

WHAT IS meant by armature in connection with loudspeakers and electrical machinery?

(2)—What is meant by field in similar devices?

ALBERT FOWLER,
White Plains, N. Y.

(1)—The armature is that member of a device which is acted upon by the electrical and magnetic forces. Usually it is the moving member, for example, the rotor in a motor.

(2)—The field is the electric or magnetic force which acts on the armature. In a magnetic loudspeaker the field is set up by the permanent magnet. In a dynamic speaker the field is set up by an electromagnet. In some machines the field is rotating and the armature is fixed. The field then is set up by a rotating electromagnet.

I HAVE HEARD that there is an altimeter used by airplanes which operates on the principle of beats between two oscillators. Can you give me a brief statement of the principle of operation?

WILLIAM ANDERSON,
Dayton, Ohio.

The device consists of two approximately equal oscillators. In one of them the earth forms a part of one of the condensers determining the frequency. The lower the plate is, or the closer to earth, the greater is the capacity. As the plane rises and falls the frequency of one oscillator changes and therefore the beat frequency between the two oscillators changes. It is possible to tell by the pitch of the beat note how high the plane is above the terrain.

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Answers to Questions

On the New Screen Grid Diamond

By Herman Bernard

CAN THE NEW, highly selective Screen Grid Diamond of the Air be used with dry cells? I notice you use storage battery tubes.

WILLIAM FUND,
Milwaukee, Wis.

Yes. The screen grid tube filament draws .132 ampere at 3.3 volts. That is a low enough drain to enable use of dry cells. The other tubes used in the laboratory model draw one-quarter ampere each, and as there are three of these, the total drain of .882 ampere would be too great for dry cells, hence the detector and the first audio tubes may be 199, while the output tube may be a 220. The only changes necessary would be to have A1 a 120 Amperite, A2 and A3 be 4-volt 199 Amperites and A4 another 120 Amperite, while the negative grid bias for the last tube would be $22\frac{1}{2}$ volts. The pilot light may be omitted for current economy. It is assumed that a $4\frac{1}{2}$ -volt source is used, i.e., three $1\frac{1}{2}$ -volt No. 6 dry cells in series. It would be well to use two such sets of dry cells, connecting one series set in total parallel with the other. Of course B batteries and C batteries may be used, so that your set would be operated entirely by dry cells.

IS IT possible to determine arbitrarily how to connect the tickler coil L5 of the new Screen Grid 4-Tube Diamond so that regeneration will result?

ADAM FORLEIGH,
San Antonio, Texas.

Yes. The regenerative action results from the effect of the tickler upon the secondary, and those two windings should be in mutual inductive aiding relationship. Thus, if you assume two windings, one the secondary, the other the tickler, and trace out their terminals, the grid condenser and the plate of the detector tube are connected to the same relative terminals of the windings, granting that the windings are in the same direction. Therefore if the coils are regarded as parallel to each other, windings in the same direction, if the lower terminal of the secondary goes to grid, the lower terminal of the tickler coil goes to plate, or if the lower end of the secondary goes to grid return, the lower end of the tickler goes to B plus. Aside from this, the tickler connection may be made either way, and then, if necessary, the tickler leads reversed to obtain regeneration. The only thing that will defeat regeneration in both instances is a bad tube, that is, one that will not oscillate.

IS IT PRACTICAL to use push-pull audio in the new Screen Grid Diamond?

BRUCE HAZEN,
Niagara Falls, N. Y.

Yes. This makes the circuit a five-tube, of course. The change is in the final audio stage. The output of the first audio stage is made by connecting the primary of the push-pull input transformer in the plate circuit of the third tube (first audio), and connecting the extreme ends of the secondary to the grids of the two tubes to be used as the push-pull output stage. The midtap of the secondary goes to the grid return, minus C voltage. Then the output of the push-pull stage must be taken from a special output transformer for dynamic speakers, or a midtapped impedance coil for other speakers. The midtapped impedance coil has the center tap going to B plus maximum, while the speaker terminals are connected to the plates of the two

push-pull tubes. Of course, instead of an impedance coil an output transformer may be used even for the magnetic (non-dynamic) type speakers.

YOU SHOW a 112A as the final audio tube in the four-tube Screen Grid Diamond. The negative grid biasing voltage is marked "9." Is this enough?

EDGAR BRANCH,
Los Angeles, Calif.

It is. There is a drop of one volt in the Amperite A4, and this is additive to the negative grid bias supplied by the C battery, hence the total is 10 volts negative on the final grid, at 135 volts on the plate, which is sufficient, especially if the speaker is connected directly in the plate current, hence drops some of the B voltage. If you have a 180-volt B eliminator, of course you may use a 171A tube. This requires no change in the Amperite, but does require a higher negative bias, of about 40 volts, and necessitates use of an output filter such as the National tone filter.

C7 IN THE NEW DIAMOND is specified as .0005 mfd. This condenser connects from plate of the detector tube to grounded A minus. I have often seen the capacity .001 mfd. specified for this condenser. Is .0005 mfd. better?

ABRAHAM KOPLIN,
Detroit, Mich.

The effect on the audio frequency response is a little better if the lower capacity is used. A good value is .0005 mfd. because of its small effect on attenuation of the higher audio frequencies. Doubling the capacity would simply increase the high audio frequency cutoff, without improving much the action of providing a relatively high impedance to radio frequencies while maintaining a low impedance to audio frequencies. The impedance of .0005 mfd. to audio frequencies is indeed low. The condenser aids the detecting action of the tube in whose plate circuit it is connected.

HOW MUCH CURRENT does a pilot light draw?

PIERRE BARRIRE,
Ottawa, Canada.

Usually the 6-volt type draws about .22 ampere.

NO RADIO FREQUENCY CHOKE coils or audio by-pass condensers are shown in the new Diamond. Would it help any to include them?

ARNOLD BROSS,
Seattle, Wash.

If you have radio frequency chokes on hand you may use them. One may be connected in series with the B plus 45-volt lead, right near the screen grid socket G post, while a condenser of .006 mfd. may be connected across this choke. In the detector plate lead the same connections may be made for another RF choke. The RF chokes are not useful in the audio circuit. If bypass condensers are to be used in the audio circuit they should be .5 mfd. or larger, and connected from the B plus post of the audio transformer to ground and from the C minus (F) post to ground. These condensers and the chokes are refinements and you may add them if you desire.

DOES THE VOLUME CONTROL in

the Diamond govern both the screen grid tube and the detector tube?

MANSFIELD BROOKS,
Duluth, Minnesota.

No. It is a 50-ohm rheostat connected in the positive leg of the screen grid tube filament only.

WHAT IS THE VALUE of the grid condenser used in the detector in the Diamond?

ARMSTRONG PHILLIPS,
Nashville, Tenn.

It is .00025 mfd. and is provided with clips so that the Lynch grid leak may be inserted. The condenser is Aerovox Code 1475.

HOW MANY cable leads should emerge from the Diamond?

WALTER BRODERICK,
Evansville, Ind.

That depends on how you make the connections to the power source. For instance, if you connect A minus, B minus and C plus together at the batteries, then only one lead is run to the set for these three, making a total of seven leads: (C minus 9) (C minus 3) (common A minus, B minus, C plus) (A plus) (B plus 45) (B plus 90) and (B plus 135 or other maximum B voltage). If you do not make the interconnections at the batteries, then instead of the single common lead emerging from the receiver for A minus, B minus and C plus, there are three leads, or a total of two more than seven, hence nine.

DOES IT MAKE any difference whether A minus is connected to B minus or A plus is connected to B minus?

J. M. BURKE,
Boston, Mass.

It makes a difference principally in the safety factor, but virtually no difference in operation. The set will work as well one way as another. If you connect B minus to A plus you add approximately the voltage of the A battery to the voltage of the B supply for any tube. A closer way of figuring this is that as filament minus is the starting point or datum for voltage calculations as affecting a vacuum tube, you add the voltage drop across the filament to the voltage of the B source. That would add 3.3 volts to the B voltage for the screen grid tube and 5 volts for each of the three remaining tubes. Such small addition is hardly worthy of notice. But one serious possibility is that a short across the B supply, if A plus and B minus are interconnected, would introduce the B voltage across the filaments and blow out the tubes, whereas with A minus and B minus common, a short of the B supply or batteries would be effective upon them only, and not upon the tube filaments. Hence the common practice of using A minus rather than A plus for the B minus junction.

WHAT IS the easiest way to build the new Diamond?

JASPER CROIX,
Palm Beach, Fla.

Use an aluminum subpanel with sockets affixed and follow the wiring as shown life size in the official blueprint.

THE PICTURE DIAGRAM of the Diamond showed confused connections at the final output. What is the correct connection?

ARMSTRON BATTLE,
Washington Court House, Ohio.

Yes, there was an offset on the engraver's negative that made the connections seem confused. Plate of the last tube goes to the "speaker minus" binding post, grid to one side of the secondary of the last audio transformer (B post), while the filament posts go respectively to Amperite and A plus. This is cleared up entirely in the official blueprint.

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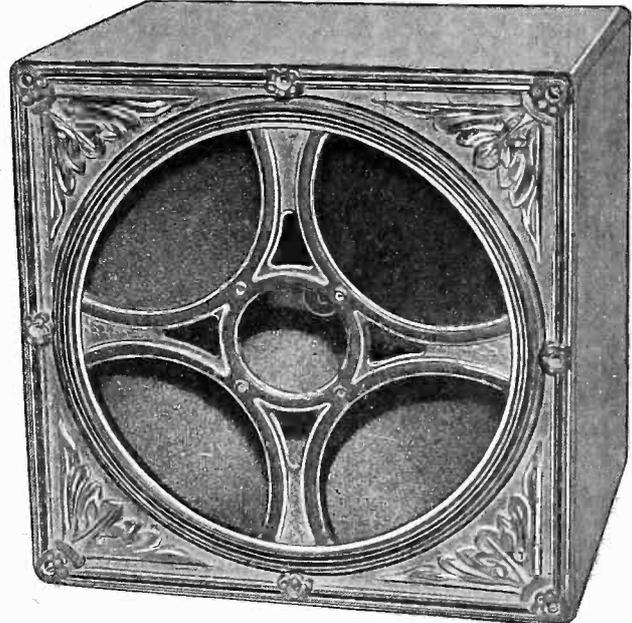
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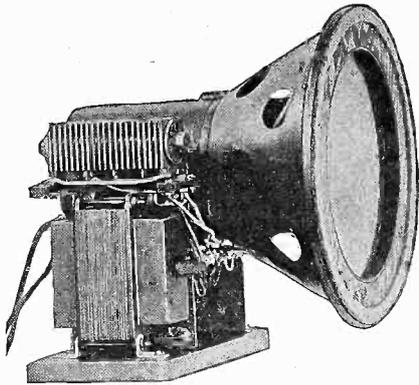
Those whose place is wired with 110-volt D.C. (direct current) should use Cat. 110 D.C. @ \$17.50 net. Those who have no electricity should use the model that works from a 6-volt storage battery. Cat. 6 D.C. @ \$14.75 net.

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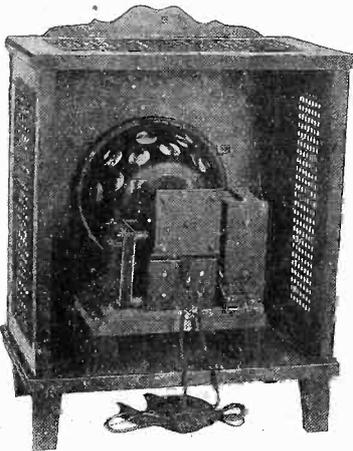


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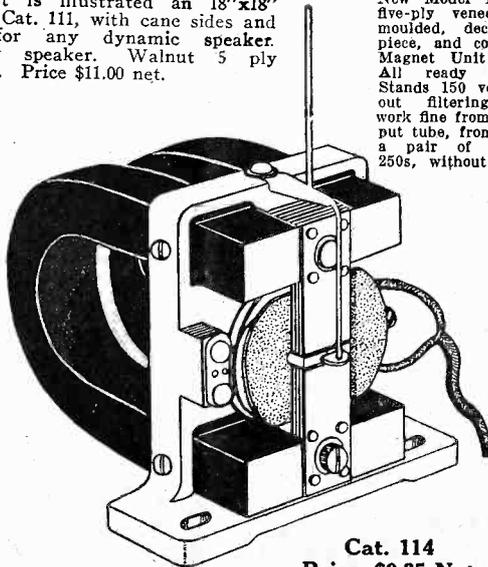


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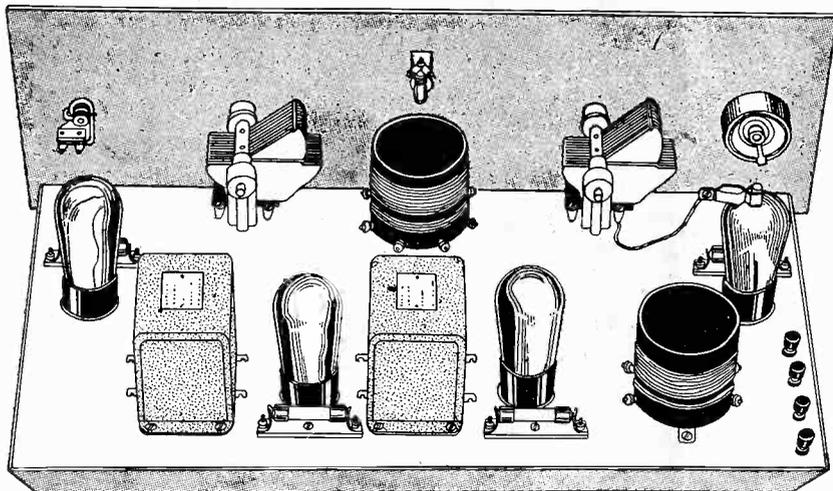
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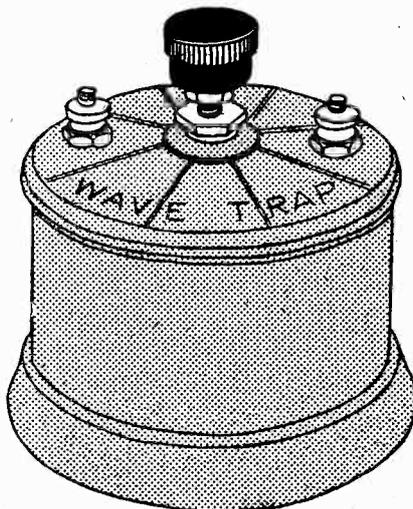
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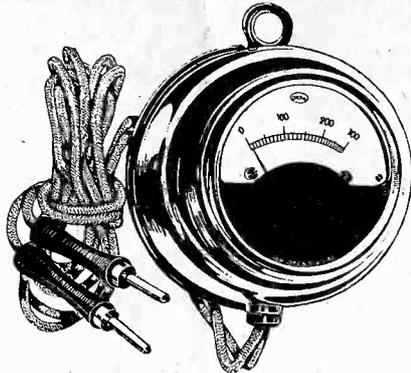
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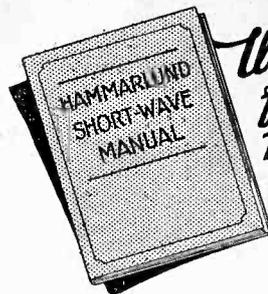
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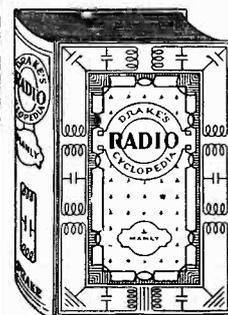
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Gentlemen: Please mail me at once the new (second) edition of "Drake's Radio Encyclopedia," by Harold P. Manly, just published, with all the latest technical information in it. I will pay the postman \$4.00 plus a few cents extra for postage. If I am not delighted, I may return the book in five days and you will promptly refund my purchase money.

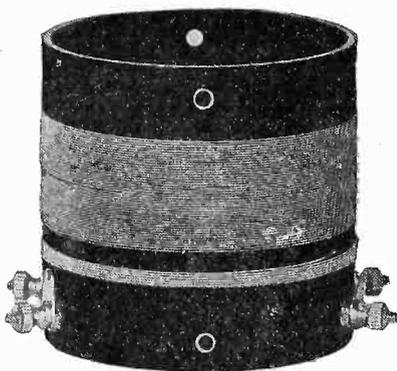
Name
Address
City State

Coils Built for Abundant Results!

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

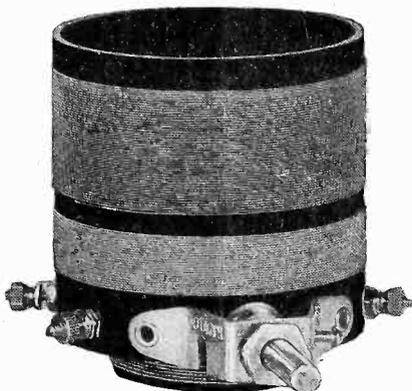
Fascinating Color Adorns the Bakelite Form as Well as the Wire Insulation

The DIAMOND Pair



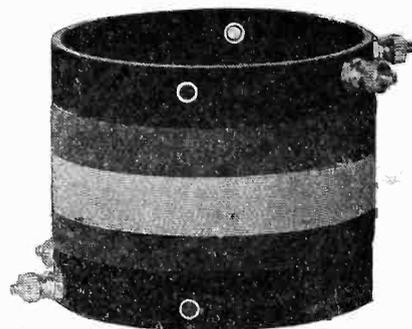
AC5 \$1.50

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



SGT5 \$2.75

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



A5 \$1.75

Conductively coupled antenna coil, for maximum pickup, where selectivity is not the main consideration. Continuous winding in two colors. Tunes with .0005 mfd. Model A3, for .00035 mfd. \$2.00

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

COILS with a purpose, like people with a purpose, succeed best.

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

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

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

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

And, remember, the dials track nicely!

Data on Coils

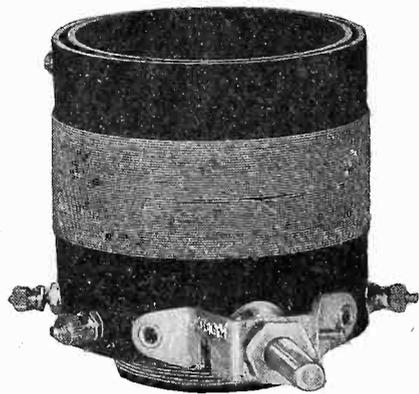
The coils are wound on blood-orange bakelite, with tuned windings in blue silk insulation, untuned windings in strawberry silk insulation and tickler in Litzendraht, with gold insulation.

The outside diameter is 2 1/4 inches. All tuners (i. e., three-circuit coils with rotor winding) have single hole panel mount.

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

All tuned windings are center-tapped.

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



HT5 \$3.00

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

The UNIVERSAL Pair



RF5 \$1.50

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



TP5 \$3.00

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

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

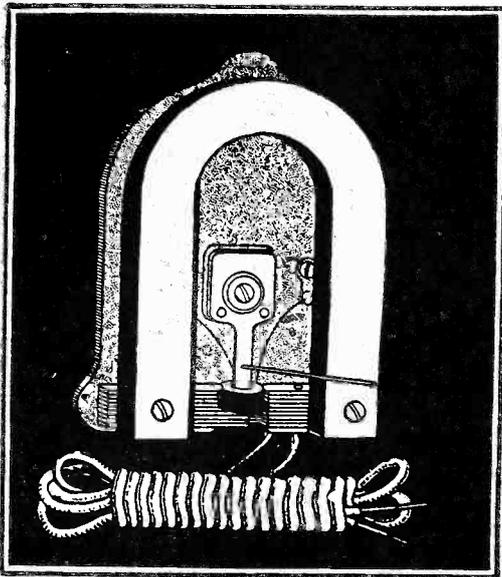
Screen Grid Coil Co., 143 W. 45th St., N. Y. City (Just E. of B'way).
Please send to
Name _____
Address _____
City _____ State _____
the following coils:
Model _____
Model _____

New Powertone

Cone or Cloth Diaphragm Speaker

Unit

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



New Moulded tri-foot bracket, fits Powertone, Polo, B.B.L., Brielle, Paratone and other units. Cat. BA.....65c
Apex, Thumbscrew and Chuck. Cat. AA.....10c
(Note: Cat. AA not sold alone.)

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

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

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

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

Name

Address

City State.....

PARTS FOR THE AC 4

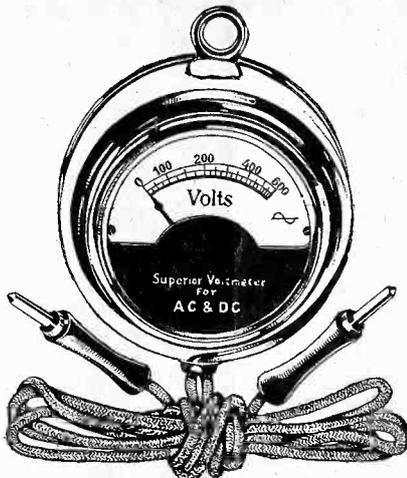
- Complete Kit of Parts for the AC4, less B eliminator\$36.75
- Complete Kit of Parts for AC4, with National B eliminator (180 v.) including 280 tube\$54.75
- Complete Kit of Parts for AC4, with National B eliminator, 280 tube, cabinet, three 227 tubes, one 171A tube and Table Model Polo Speaker (nothing else to buy)\$75.00

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

LYNCH
Tubadapta improves radio reception and prolongs life of power tubes.
ARTHUR H. LYNCH, INC.
1775 Broadway New York City
Send for free Lynch radio manual

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

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

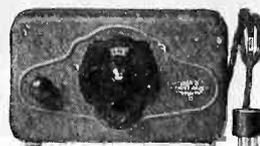
Please ship at once one 0-600 volts AC and DC high resistance voltmeter, accurate to 1% plus or minus (Cat. No. 600); meter equipped with 3-ft. cord, moulded tip receptacles, tips and hanger.
[Put cross in proper square below.]

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

Name

Address

City State.....



New

"Aero-Call" Short-Wave Converter

Factory-Built, Ready to Plug Into Your Present Radio Set

The Aero 1929 Converter is a compact factory-built short-wave adapter equipped with special short-wave coils. It is designed for both A.C. and D.C. sets. Operates perfectly without motorboating, by an auxiliary filter system control, an exclusive feature (patent applied for) that overcomes the difficulties found in other converters. It can be plugged into any regular radio set. This amazing radio instrument now makes it possible for you to reach 'round the world—England, Germany, Holland, Australia, Panama, Java and many foreign countries are some that are tuned in regularly on short-wave. Permits you to enjoy international programs and many others from coast to coast that your regular receiver cannot get. What a thrill it is to plug this into a tube socket on your regular set, and instantly be in another world. No change or wiring required. All complete, ready to operate, tubes and coils hidden, no apparatus in sight, except the neat, golden-brown, compact metal cabinet in crackle finish. Size, 9 x 5 1/2 x 2 1/2 in.
The only converter we know of that really works on all sets. Two models—A.C. and D.C. Write for Catalog and literature, or send \$25.00 and name of your dealer.

- Model A, without tube, for A.C. sets.....
 - Model D, without tube, for D.C. sets.....
- \$25.00**

At Leading Dealers and Jobbers

AERO PRODUCTS INCORPORATED

4611 E. Ravenswood Ave. Dept. 1239
CHICAGO, ILL.

COILS FOR THE NEW AC 4

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

SCREEN GRID COIL CO.
143 West 45th Street
N. Y. City
(Just East of Broadway)

Cash in on This Offer Now!

ONE full year's subscription for any TWO of the following magazines given to you—**RADIO NEWS** or **SCIENCE AND INVENTION** or **RADIO** (San Francisco) or **BOYS' LIFE**.

Select any TWO of these four publications, each of which will be sent to you (at only one address, however) each month for twelve months—in other words, 24 issues—if you will send in now your subscription for **RADIO WORLD** for two years (104 numbers) at \$10.00. **RADIO WORLD'S** subscription price for one year is \$6.00, so you gain the extra 2 dollars by taking advantage of the liberal offer for two-year subscriptions; and, besides, you get a subscription for each of the TWO other magazines selected from the enumerated list, making a total of 128 numbers for \$10.00.

If you want to select only one from among the four other magazines, you may obtain this one for TWO years, so that you will be subscribing for **RADIO WORLD** for two years and for the other magazine for TWO years, all for only \$10.00 (both mailed to one address only).

These offers are rightly regarded as among the most liberal ever made, but as they are limited as to expiration date (see notice below) you must act now.

Please use the attached coupon.

SPECIAL TWO-FOR-PRICE-OF-ONE COUPON

RADIO WORLD, 145 West 45th Street, New York City (Just East of Broadway):
Enclosed please find \$10.00, for which send me **RADIO WORLD** each week for two years (104 numbers), and also send me, without extra cost, each month for one year each of the following TWO magazines—total, 24 issues—grand total, 128 numbers:

- RADIO NEWS**
- SCIENCE AND INVENTION**
- RADIO** (San Francisco)
- BOYS' LIFE**

If you want one of each, put a cross in a square next to the name of each of the two other magazines. If you want a two-year subscription for ONE of the above magazines, with the two-year subscription for **RADIO WORLD** (same grand total of 128 numbers), put two crosses before the name of one magazine.

If you prefer to pay \$6.00 for only one year's subscription for **RADIO WORLD** (52 numbers) and get one of the other magazines for one year, without extra cost, put one cross in one square in front of the name of one magazine.

Present **RADIO WORLD** subscribers may renew under this offer. If renewing, put a cross here

Name.....

Street Address.....

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

THIS OFFER EXPIRES AT NOON ON MARCH 30TH, 1929

Raytheon Kino-Lamp



for
Television
Reception

This lamp is made in numerous types and styles, which provide suitable light sources and light-sensitive relays for all systems.

List Price, \$7.50

Foto-Cell
for
Television
Sending



This is an extra-sensitive broadcasting tube, supplied in either hard vacuum or gas-filled types, and in two sizes of each.

Information and prices on application

RAYTHEON MFG. CO.
CAMBRIDGE, MASS.

HBH Unit

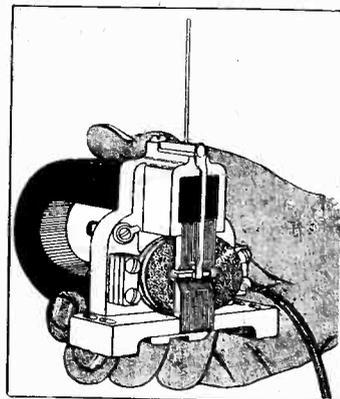
ALL acoustical and radio engineers agree that the balanced armature type of loudspeaker unit is the best, the most sensitive and the most faithful of all magnetic units. But it is only in the HBH unit that superior designing skill, scrupulous care in the selection of the best materials, and extreme accuracy of manufacture have been combined and co-ordinated so as to bring out all the possibilities of the principle of the balanced type unit.

Any magnetic speaker requires a strong permanent magnet for its operation. The strength of the HBH unit is assured by the use of a long magnet of large cross-section, made of specially selected, high coercive-force steel, forged under the lowest heat possible, scientifically tempered in oil and aged.

The making of a permanent magnet requires a highly specialized skill. It must be forged, cut and tempered with as few heatings as possible, and no heating must exceed a certain temperature if the magnet is to retain its strength and permanence. Another important feature of the magnet which enhances its strength and permanence is that NO HOLES ARE CUT IN IT. The magnet is one solid piece of steel and the pole pieces are clamped firmly to the steel by screws in the die cast harness holding the pole pieces and the armature.

The sensitivity and efficiency of the unit are enhanced by the use of laminated, properly tapered silicon steel pole pieces. Eddy current losses are thus reduced to a vanishing minimum and all the force is concentrated on the ends of the armature.

The armature itself is made of carefully annealed soft iron, thus eliminating any residual magnetization and reducing eddy currents and hysteresis losses to a very small percentage of the energy involved in the operation of the unit. The armature is made short and heavy to enhance its effectiveness in translating electro-magnetic energy into sound.



The HBH Unit, representing the most skillful and sturdiest magnetic unit design. Mfgd. under BBL License.

Price \$5.95
Moulded bracket (extra) 65c

This Armature Stays Put

THE armature is firmly mounted on a steel spring of great permanence, which in turn is mounted rigidly on the die-cast harness. At one end of the suspension spring is a rocker arrangement provided with two set screws, one on each side of the fulcrum, by means of which the armature quickly and accurately may be adjusted, to the neutral position between the pole pieces. This is one of the fine improvements which determine the usefulness and efficiency of a loudspeaker unit. An accurate and permanent adjustment of the armature between the pole pieces is necessary for both sensitivity and great volume. This armature is permanently adjusted at the factory and stays put!

Two large armature coils, mounted so that they cannot interfere with the movements of the armature and the spring, surround the armature. These coils are connected in series aiding and are proportioned so that they afford the proper impedance for the regular power tubes employed for loudspeaker reception. The armature coils have bakelite ends and cores and are rugged and provide adequate insulation for the armature coils.

The armature is connected to the reduction lever by means of an extremely light yet rigid coupling rod. Two points of flexure are provided on this rod so that the armature and the reduction lever may move freely. The central portion of which often give rise to false sounds in units. This eliminates local resonance and vibration.

The reduction lever is provided with a single point of flexure, near its pivot. The rest of the lever is rigid but extremely light. It cannot bend except at the point provided for flexure.

The steel driving rod connecting the reduction lever with the apex of the cone is short and stiff, yet light in weight, so that it cannot vibrate at right angles to its length. It is attached to the reduction lever to the center of gyration, which is a requirement for transferring most efficiently the power to the cone.

The die-cast harness which holds the entire unit together is rugged and holds the parts without any chance of parasitic vibrations. It is provided with four elongated mounting holes for attaching the speaker to the frame of any cone speaker. Two binding posts for the terminals are also mounted on the harness. These are insulated from the practice.

The HBH unit is the most sensitive and hence gives the greatest volume for a given input. It is the most efficient and hence does not waste any power but gives it all out as sound. It is capable of great output power and will work on any tube, from a 199 to two 250 tubes in push-pull. Its impedance is correct for the usual power tubes used in sets.

It does not give out any false tones or rattles and therefore it produces the best quality, purest tone. Nobody ever returned an HBH unit because of dissatisfaction with its performance! It stands up and delivers and continues to deliver. You can put 150 volts right through the magnet coils, steadily, without danger of the coil breaking. You don't need any extra power to operate this unit—as you do with dynamics—but get full efficiency at lowest cost and greatest economy.

Put this unit in your cone or cloth speaker in place of the unit now there and marvel at the difference! You will then recognize the technical superiority of this unit in terms of tone value and volume. It produces so much more volume than most other units that it makes distant stations sound like locals.

Order a unit today! Send \$4.00. Try the unit ten days. If not overjoyed, return it for full refund. Otherwise take 90 days to pay the extra \$1.95.

10-day money back guaranty!
90 days to pay in full!

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

Please ship one HBH Unit only on 10-day money-back guaranty; at \$4.00 down, balance of \$1.95 in 90 days, unless I return the unit in 10 days for full refund of \$4.00.

Please ship moulded bracket also at 65c.

Name

Address

City

State

SUBSCRIBERS!

Look at the Expiration
Date on Your
Wrapper

Please look at the subscription date stamped on your last wrapper, and if that date indicates that your subscription is about to expire, please send remittance to cover your renewal.

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

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

Quick Action Classified Ads

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

RADIO INFORMATION
Reliable, prompt, accurate, in every-day language, 25c per question. Radio Information Bureau, 1426 South Clifton Park, Chicago.

SEEDS FOR SALE
ALFALFA SEEDS, hardy common varieties \$8.40, \$10.20, \$12.60, bushel; Grimm variety Alfalfa seed \$18. Scarified sweet clover \$3.90, \$5.20; Alsike or red clover \$15. Bags Free. Send for samples and catalogue. Kansas Seed Co., Salina, Kan.

PATENT YOUR IDEAS. Easy terms. Booklet Free. Established 25 years. H. Sanders, Rand McNally Building, Chicago, Ill.

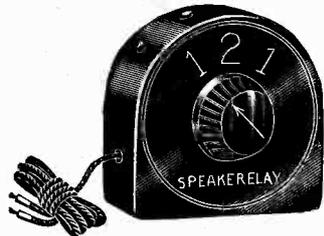
\$5 STARTS YOU in printing business. Five hundred cards printed in three colors. Samples FREE.—Frank B. Ashley, Room 1517, No. 461 Eighth Avenue, N. Y. City.

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

WHO HAS a 350-meter loose coupler formerly made by William Duck of Cincinnati? This coil had five taps and the primary had a sliding connection across bare wires. Address Tom W. Searle, Cascada, Mont.

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

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



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

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

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

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

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

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

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

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

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

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

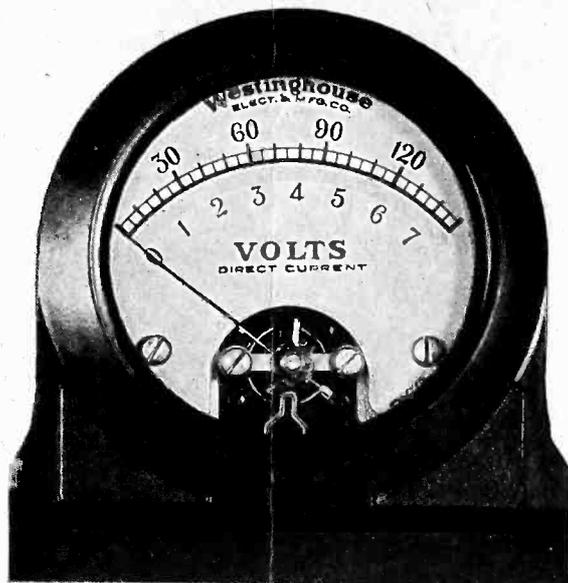
We stock the Speakerelays in quantity and sell them singly or in multiple lots, on an immediate delivery basis. We also have them on display at our office, so, if convenient, come in and see them.

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

Guaranty Radio Goods Co.
145 West 45th Street
New York City

(A few doors East of Broadway)

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



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

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

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

The scale is read through a sturdy crystal.

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

Meter Employs Dynamic Principle

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

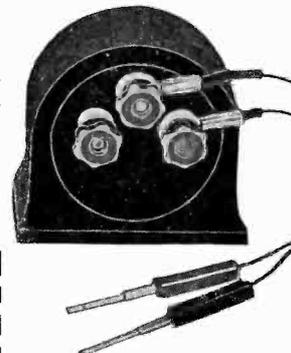
End-stops are built in. The low scale (0 to 7 1/2 volts) reads 1/4 of a volt per division, with ample room for closer reading, while the high scale (0 to 150 volts) reads 5 volts per division, with closer definition equally easy.

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

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

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

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



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

RADIO WORLD, 145 West 45th Street, New York City
 Enclosed find \$6.00 for one year's subscription for RADIO WORLD, (52 numbers, one a week) and send as a premium one Westinghouse double scale table model voltmeter (0-7 1/2 and 0-150 volts direct current).
 Present subscribers may take advantage of this offer by putting a cross in the square above, remitting \$6 and signing coupon. Subscription will be extended one year.

Name

Address

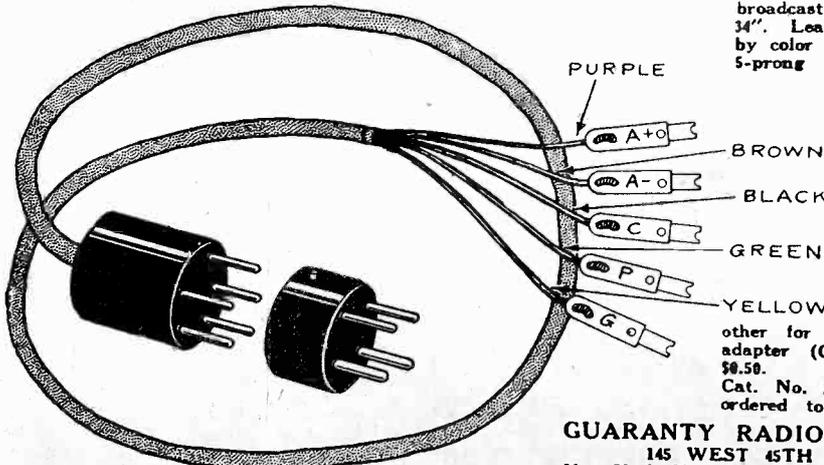
City State

NO OTHER PREMIUM WITH THIS OFFER

PLUG AND CABLE for any SHORT WAVE ADAPTER

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

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



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

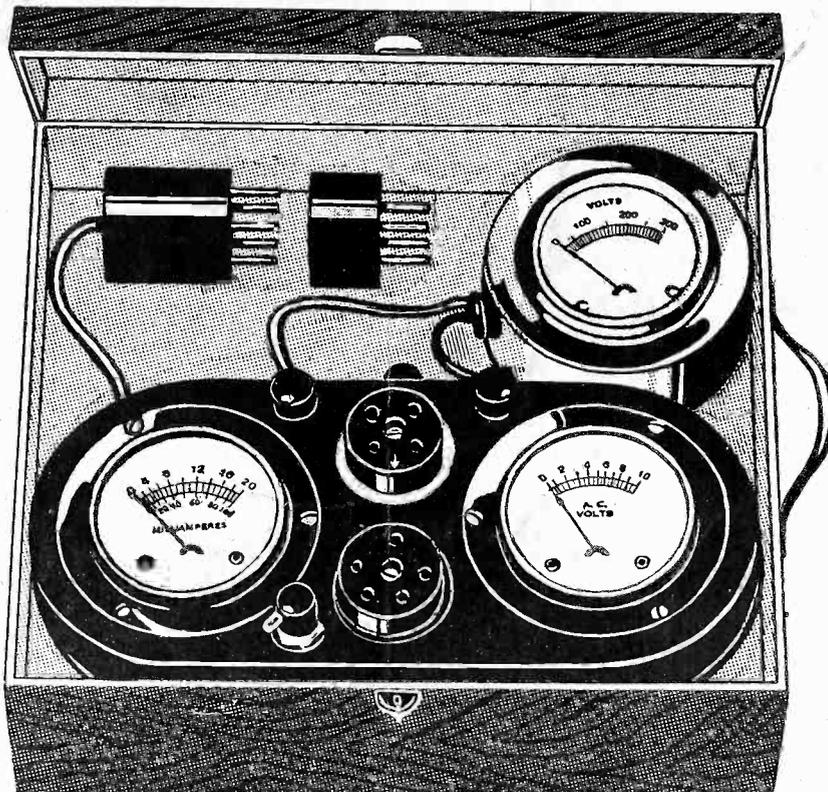
De Luxe Carrying Case **FREE**

With Each Jiffy Tester Combination!

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

INSTRUCTION SHEET GIVES FULL DETAILS OF THESE THIRTEEN TESTS

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



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

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

Jiffy Tester a Scientific Trouble Shooter

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

\$13.50

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

\$14.50

Here Are the Thirteen Vital Tests!

- (1) to measure the filament voltage, up to 10 volts, of AC and DC tubes;
- (2) to measure the plate current of any one tube, including any power tube, from less than 1 milliamperes up to 100 milliamperes;
- (3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more);
- (4) to measure the B voltage applied to the plate of tube; the voltage across B batteries or B eliminators, up to 300 volts;
- (5) to determine the condition of a tube, by use of the grid bias switch;
- (6) to measure any tube's electronic emission;
- (7) to regulate AC line, with the aid of a power rheostat, using a 27 tube as guide;
- (8) to test continuity of resistors, windings of chokes, transformers and circuits generally;
- (9) to find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally;
- (10) to read grid bias voltages, including those obtained through drops in resistors;
- (11) to determine the presence of distortion and overloading;
- (12) to test for correct bias;
- (13) to determine starting and stopping of oscillation.

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

Note All That You Get!

For \$13.50 you receive:

- (1) One Two-In-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
 - (2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.
 - (3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.
 - (4) One 5-prong plug with 30" cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
 - (5) One grid switch to change bias.
 - (6) One 5-prong socket.
 - (7) One 4-prong socket.
 - (8) Two binding posts.
 - (9) One handsome moire metal case.
 - (10) One instruction sheet.
 - (11) One de luxe carrying case.
- If 0-500 volt 5% accuracy high resistance meter is preferred to 0-300 volts, add \$1.00, and order Combination C at \$14.50.
If 0-500 volt 1% accuracy high resistance meter is preferred to 5% accuracy 0-500 voltmeter, add \$2.00, and order Combination D at \$15.50.
[Note—A pair of adapters for UV199 tubes, Cat. No. 999, at \$1.00 extra. These are not sold except with Jiffy Tester Combination.]

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

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

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

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

5-DAY MONEY-BACK GUARANTY