JANUARY 5th, 1929 15 CENTS

RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

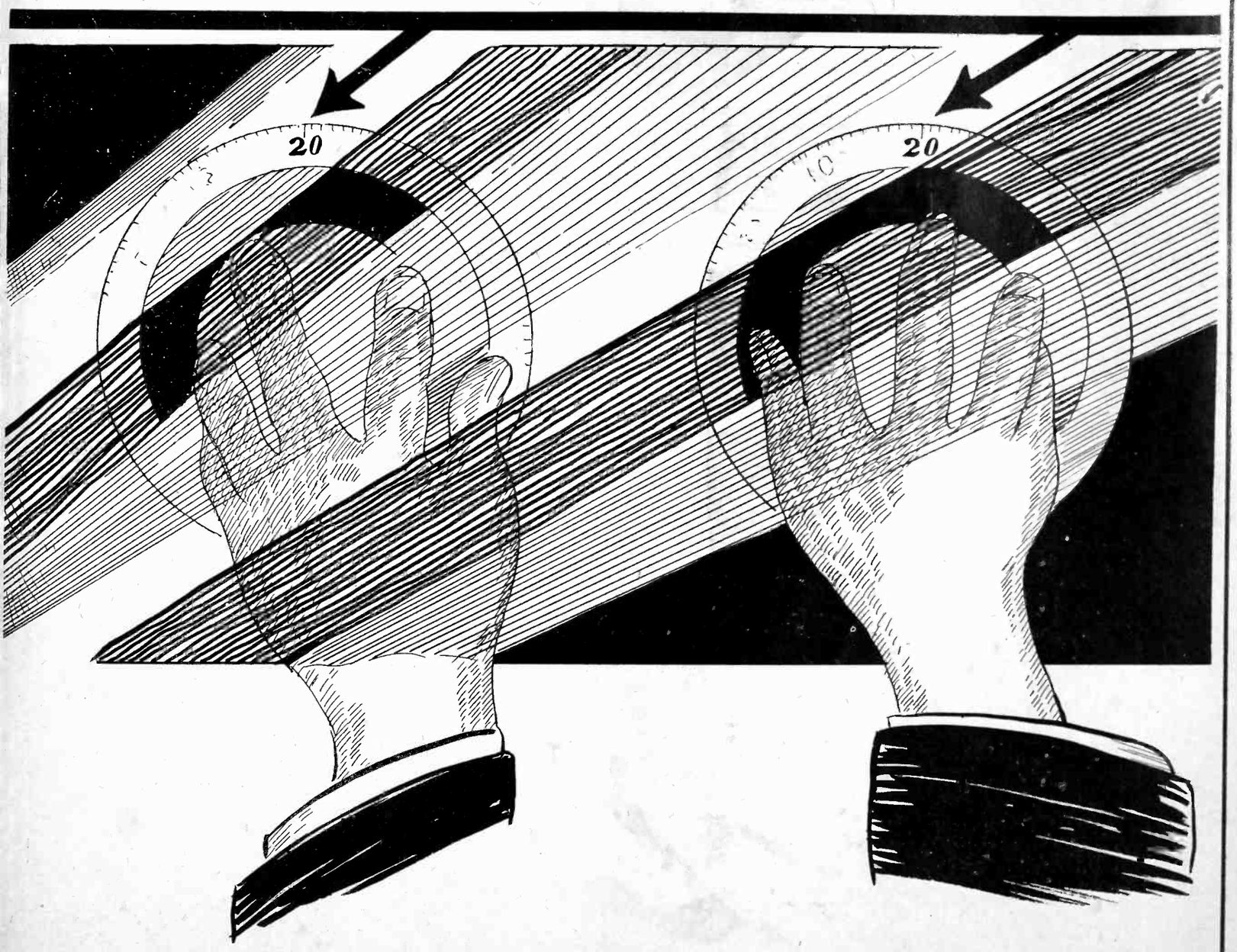
354th Consecutive Issue—Seventh Year

Pointers on AC Set Construction

A Direct Current Electric Receiver

Chains Compete for World's Record

MAKE THOSE DIALS MARCH IN STEP!



What Remedies to Apply to Make Dials "Track" Are Set Forth in an Absorbing Article on pages 12 and 13

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

BLUEPRINT FREE!

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

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

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

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

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

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

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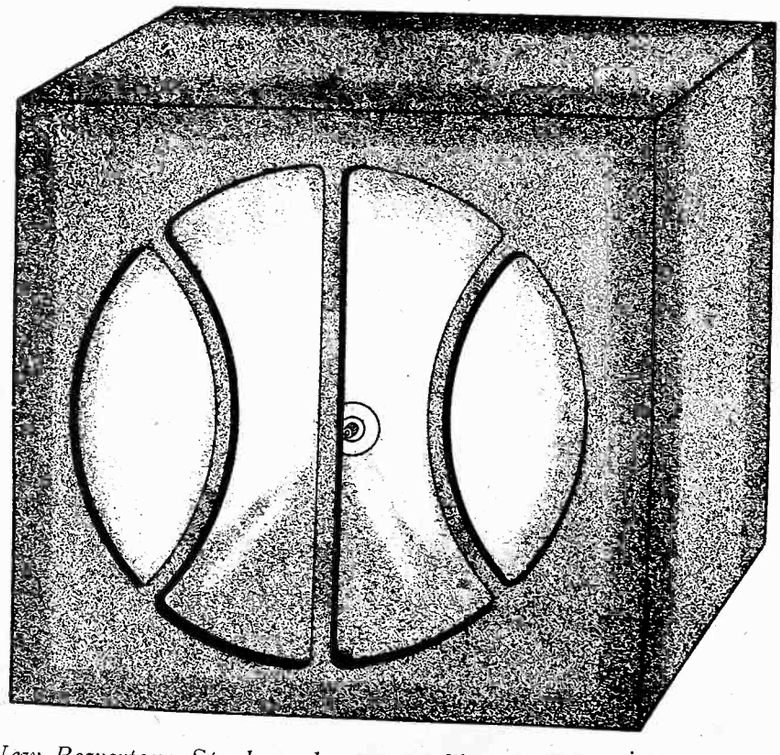
If you are already a mail subscriber for RADIO WORLD you may extend your subscription four weeks and get free blueprint, but put a cross in the square.

POWERTONE SPEAKER $7.50



The New Powertone Speaker, shown one-third scale. All built up, ready to play **$7.50**

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145 West 45th Street, New York City
(Just East of Broadway)

☐ Enclosed please find $7.50, for which please ship at once one new Powertone Speaker, using new Powertone Unit, 1929 model; speaker all built up, ready to play. You will pay cartage.

☐ Please send speaker C.O.D. I will pay $7.50 plus postage.

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TEN-DAY MONEY-BACK GUARANTY

The 1929 model Powertone Unit, built into a decorative brown sprayed finish box, two-tone; with sturdy cone and adjustable armature, makes a dandy speaker. At $7.50 you get more than your money's worth. The speaker stands 150 volts without need of an output filter. Works well out of any final audio tube. Tone is excellent; volume is high. Order one today.

RADIO WORLD, a weekly paper, published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y. Phone: BRYant 0558 and 0559. 15c per copy, $6 per year. This issue is dated January 5th, 1929, and is Vol. XIV, No. 16. Whole No. 354. Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1879.

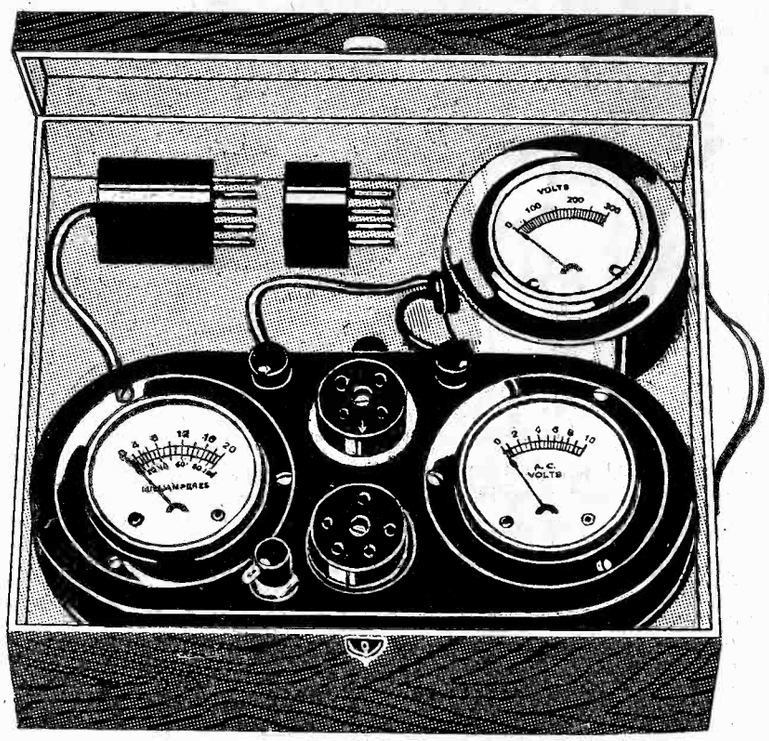
De Luxe Carrying Case FREE

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 Amply 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 milliampere 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 is accurate to 1%). Price.....$15.50
☐ Set of 199 adapters. Price..... $1.00

NAME.....

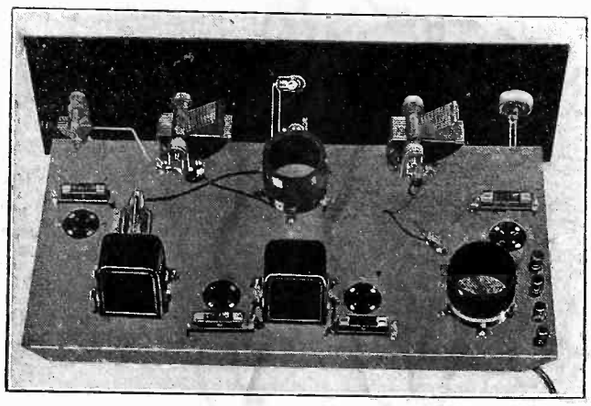
ADDRESS.....

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

5-DAY MONEY-BACK GUARANTY

Build the New

SCREEN GRID UNIVERSAL!



Unusual Results on Four Tubes!

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

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

Very Selective, Yet Lots of Volume!

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

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

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

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

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

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

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

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

Name.....

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

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Please send me RADIO WORLD *for* .....*months, for which please find enclosed*.....

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15c per Copy, $6.00 per Year
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Latest News and Circuits
Technical Accuracy Second to None

A Weekly Paper published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Phone: BRYant 0553 and 0559

HOWLS, SHRIEKS GLUT AIR, SAYS CROSLEY PAPER

Cincinnati.

"Crosley Radio News," a publicity sheet published by the Crosley Radio Corporation, operator of WLW and WSAI, which heretofore has refrained from commenting on the reallocation, in its latest issue contains an attack on the reallocation as the cause of "continual howls and shrieks."

A news article about a rat that bit a fuse holder in a set and was electrocuted, contains the attack. The issue was sent to 12,000 newspapers and periodicals, with the incentive the material be used. It sets forth that "continual pick-up of howls and shrieks, many of them not unlike the nocturnal wails of Thomas cats" are "to be found nightly in the broadcast band since the reallocations of November 11th."

Crosley Personally Silent

Powel Crosley, Jr., president of the corporation, has refused to comment personally on the reallocation, nor has his official organ commented on it, although the denial of night broadcasting to WSAI under the reallocation prompted the extensive publication of protests. The attack therefore is the first comment to come from the Crosley camp.

The condemnation aroused comment, as the general response by the listening public has been a favorable reaction to the reallocation, and reduction of heterodyne interference has been obvious.

Engineer Objects

A marked copy of the issue bearing the attack was sent to the Federal Radio Commission by an engineer who was indirectly connected with the reallocation and who resented "such unscientific discussion of a scientific subject."

KGO Obliges Brides With Timely March

Oakland, Calif.

Fans frequently telephone KGO asking that the station furnish radio music for weddings.

Careful record is made of the time so that the couple may start their married life in step with some favorite wedding march.

Largest Dance Band On Air Each Week

The Freshman-Freed-Eisemann merger, will be on the air Tuesday at 10.30 p. m. for 52 weeks. It began January 1, over the WJZ chain.

The programs will alternate between the Freshman and Freed-Eisemann divisions of the company, and will be known as the "Orchestradians," one of the largest dance orchestras on the air.

N.B.C. Network Now 58 Stations

Nine More Than Columbia's But List is Divided Into Two Groups — Dispute Over Who Really Holds World Record — 2,200 Mile Wire Line in Mountain Region Inaugurated by N.B.C.

Closely following the announcement by the Columbia Broadcasting System that it will have the largest single chain in the world, with a total of 49 stations, effective January 8th, came a jubilant proclamation by the National Broadcasting Company that its total of associated stations has reached 58, or 9 more than the Columbia's. However, the Columbia System prides itself that it is a single chain, and as such claims the world record, while the N.B.C. stations are divided into two groups, served principally by WJZ and WEAF as key stations. The Columbia key stations are WOR and WABC.

The Pacific Coast was permanently linked to the N.B.C. nation-wide network recently when a circuit from Denver to San Francisco was hooked up. Work on establishing this link took a year. Maintenance of this 2,200-mile circuit will cost $220,000 a year.

The new circuit serves two intermediate transmitters, KSL, Salt Lake City, and KOA, Denver, and enables the N.B.C. to provide the entire country with its network programs.

Serves 82.7 Per Cent. of Listeners

The total service of the N.B.C. is now reaching 82.7 per cent. of the radio audience of the United States. The N.B.C. Eastern circuits serve 69.4 per cent. and its Pacific Coast system reaches an additional 12.1 per cent. The new link adds 1.2 per cent. and brings to listeners in the mountain district the same programs heretofore heard only in the East and on the Pacific Coast. Before this link was made, these listeners heard only special network programs and events of national importance.

With the inauguration of this transcontinental circuit practically every major program heard through the N.B.C. System becomes national in fact. Already there are eleven features originating in New York which have signed for coast-to-coast service. These include General Motors Family Party on Mondays; Eveready Hour, Cliquot Club Eskimos, Dolores Cassinelli and Los Sevillanos, and the Sixteen Singers on Tuesdays; Palmolive Hour on Wednesdays; Seiberling Singers on Thursdays; Wrigley Review and Philco Hour on Fridays; the National Orchestra led by Walter Damrosch, and

Announcer Speeds to Wrong Station

Charlie Garland, announcer at WBBM, Chicago, drives a car with four speeds forward, and his favorite alibi to motorcycle policemen is that he was late for broadcasting and had to hurry. Recently this excuse met deaf ears. The policeman suggested that Garland hurry to the station—but not the station Garland meant.

For fifteen minutes Garland used the telephone in the police station for assistance. After it was forthcoming, he vowed to drive slower forever.

Television Discouraged In Broadcast Band

Washington.

In its annual report to Congress the Federal Radio Commission, without defining any fixed policy, discourages television in the broadcast band as follows:

"The recent advances in radio television threaten to create serious problems. The Commission has allowed a few broadcasting stations to experiment with television in the broadcast band on their assigned channels on condition that this form of communication be limited to a small amount of time per day and be so conducted as not to cause interference on adjacent channels.

"There is also a distinct development of television in the high frequency band. It has been urged upon the Commission that it should permit regular television service in the broadcast band as well, because of the fact that a large potential audience is already at hand and in some cases the ordinary receiver can be adapted to receive television by the addition of certain apparatus.

"Television signals, however, will subject the broadcast listener to objectionable noises. The International Radio Convention limits the broadcasting band to telephonic signals. The Commission has not yet determined its final policy with reference to this subject."

Porto Rican Reassigned

Washington.

Because of interference with the Naval Radio Station at San Juan, the Federal Radio Commission ordered the Porto Rico broadcasting station WKAQ to operate on 890 kilocycles with 500 watts immediately. The International Telephone and Telegraph Corporation, operating the station, requested the change, stating that the Navy had complained of "serious interference" caused by the station after its antenna, which had been swept away by the recent hurricane, had been replaced.

Lucky Strike Dance Orchestra on Saturdays and the Atwater Kent Hour on Sunday evenings.

WKY, Oklahoma City, owned and operated by the Oklahoma Publishing Company, became associated with the N.B.C., bringing the total associated stations to fifty-eight.

"This is a record number of permanent associates for what has been the world's largest radio network since its organization," says the N.B.C.

The Fifty-eight Stations

The N.B.C. list of associated stations and ownership follow:

WEAF, National Broadcasting Company, Inc., New York, N. Y.
WJZ, Radio Corporation of America, New York, N. Y. (Managed and operated by the National Broadcasting Company, Inc.)
WEEI, Edison Electric Illuminating Company, Boston, Mass.
WBZA, Westinghouse Electric and Manufacturing Company, Boston, Mass.
WBZ, Westinghouse Electric and Manufacturing Company, Springfield, Mass.
WTIC, Travelers Insurance Company, Hartford, Conn.
WJAR, The Outlet Company, Providence, R. I.
WTAG, The Telegram Gazette, Worcester, Mass.
WCSH, Congress Square Hotel Company, Portland, Me.
WFI, Strawbridge and Clothier Company, Philadelphia, Pa.
WLIT, Lit Brothers, Philadelphia, Pa.
WRC, Radio Corporation of America, Washington, D. C. (Managed and operated by the National Broadcasting Company, Inc.)
WBAL, Consolidated Gas, Electric Light and Power Company, Baltimore, Md.
WGY, General Electric Company, Schenectady, N. Y.
WGR, Federal Radio Corporation, Buffalo, N. Y.
WHAM, Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y.
WCAE, Gimbel Brothers, Pittsburgh, Pa.
KDKA, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.
WTAM and WEAR, WTAM and WEIR, Inc., Cleveland, Ohio.
WWJ, The Detroit News, Detroit, Mich.
WJR, WJR. Inc., Detroit, Mich. (Owned and operated by Richards-Oakland Company.)
WLW and WSAI, Crosley Radio Corporation, Cincinnati, Ohio.
WGN and WLIB, Tribune Company and Liberty Weekly, Inc., Chicago, Ill.
WENR, Great Lakes Broadcasting Company, Chicago, Ill.
WLS, The Prairie Farmer, Chicago, Ill.
KYW, Chicago Herald and Examiner, Chicago, Ill.
KFKX, Operated by Westinghouse Electric and Manufacturing Company.
KSD, St. Louis Post-Dispatch, St. Louis, Mo.
KWK, Greater St. Louis Broadcasting Corporation, St. Louis, Mo.
WOC, Palmer School of Chiropractic, Davenport, Iowa.
WHO, Bankers Life Company, Des Moines, Iowa.
WOW, Woodmen of the World Life Insurance Association, Omaha, Neb.
WDAF, Kansas City Star, Kansas City, Mo.
WREN, Jenny Wren Company, Kansas City, Mo.
KSTP, National Battery Broadcasting Company, St. Paul-Minneapolis, Minn.
WTMJ, The Milwaukee Journal, Milwaukee, Wisc.
KOA, General Electric Company, Denver, Colo.
WHAS, The Courier-Journal and The Louisville Times, Louisville, Ky.
WSM, National Life and Accident Insurance Company, Inc., Nashville, Tenn.
WMC, Memphis Commercial Appeal, Inc., Memphis, Tenn.
WSB, Atlanta oJurnal, Atlanta, Ga.
WBT, C. C. Coddington, Inc., Charlotte, N .C. (Chamber of Commerce.)
KVOO, Southwestern Sales Corporation, Tulsa, Okla.
WFAA, Dallas Morning News, Dallas, Texas.
KPRC, Houston Post-Dispatch, Houston, Texas.
WOAI, Southern Equipment Company, San Antonio, Tex.
WBAP, Fort Worth Star-Telegram (Carter Publications), Fort Worth, Texas.
WRVA, Larus and Brother Company, Richmond, Va.
WJAX, City of Jacksonville, Jacksonville, Fla.
KPO, Hale Brothers and the San Francisco Chronicle, San Francisco, Cal.
KGO, General Electric Company, San Francisco, Cal.
KFI, Earle C. Anthony, Inc., Los Angeles, Cal.
KGW, Oregonian Publishing Company, Portland, Ore.
KOMO, Fisher's Blend Station, Inc., Seattle, Wash.
KHQ, Louis Wasmer, Inc., Spokane, Wash.
WEBC, Head of the Lakes Broadcasting Company, Duluth, Minn., and Superior, Wisc.
KSL, Radio Service Corporation of Utah, Salt Lake City, Utah.
KWY, Oklahoma Publishing Company, Oklahoma City, Okla.

A THOUGHT FOR THE WEEK

MAY the dreams of the radio dreamers come true in 1929. Without dreams and dreamers there wouldn't be much joy in keeping awake.

Physical Director Ill, Classes Suffer

Ladies, thin and fat, have lost much of the soreness in little used muscles. The morning exercise period of the WBBM. Chicago, was discontinued pending the recovery of the director, Pat Flanagan, confined to his home with illness.

A physical director is usually supposed to be an example of perfect health, so Flanagan good-naturedly expected his share of kidding letters from his audience.

ROANOKE ASKS STATION DENIAL

Washington.

Opposition to the application of the Richmond Development Corporation to establish a radio station at Roanoke, Va., on the ground that the Federal Radio Commission "would establish a dangerous precedent by placing a broadcasting station in the hands of a public service corporation" was expressed before the Commission by Representative Woodrum (Dem.), of Roanoke, Va.

Heading a delegation from the State, Representative Woodrum declared that a new station is not needed, and that the announced intention of the corporation to employ the proposed station "to promote a better understanding between the public and public utilities generally" was against public policy.

The corporation was granted a rehearing on its application for extension of its construction permit to build the station, which originally was denied November 1 by the Commission after opposition had developed at a previous hearing, says "The United States Daily."

Others appearing against the application were former Governor E. Lee Trinkle of Virginia, R. H. Angell and Judge J. W. Price.

Supporting the application of the corporation were King Funkhouser and R. H. Blake, counsel, and F. W. Collins, vice president of the corporation. Mr. Collins denied that the purpose was of the station to "promote public utilities propaganda," saying that the station will have no connections whatever with any public utilities, and that the statement in the application to the effect public utilities would be promoted was a "broad one," and that the station would be merely to further advancement of the community.

Mr. Blake asked permission of the Commission to amend the application so as to remove the objectionable phrase.

TOO BIG A DEMAND

A WOMAN in California was stirring a mess of vegetables that was boiling on an electric stove. To her astonishment the vegetables or the pan or something gave forth the strains of "Ave Maria." She stirred some more—and heard other numbers from a broadcasting station. It is to be hoped—for the sake of radio, if not of husbands—that the Grand Amalgamated Guild of American Housewives will insist that hereafter all their cooking utensils be made with radio reception improvements.

BOARD STUDIES CHAINS UNDER REALLOCATION

Washington.

What effect the reallocation is having on chain broadcasting is being studied by the Federal Radio Commission. A new order relating to chains may be expected, said Commissioner Lafount.

In its annual report to Congress the Commission discusses chain broadcasting as follows:

"With a comparatively few exceptions, the chain stations are independently owned and have no connection with companies owning or interested in the chain broadcasting company other than their arrangements for taking a certain amount of such programs.

"The Commission has never favored chain stations in its assignments because of any affiliations with the chain. It has uniformly selected for the preferred positions such stations as are entitled thereto because of their individual history and standing, their popularity with their audiences, the quality of their apparatus, and their faithful observance of radio rules of the air.

The 300-Mile Rule

"It is interesting to note, however, that in many cases stations which were not affiliated with chains at the time they received favorable assignments from the Commission thereafter entered upon such affiliations.

"An example of this is station WEBC, of Superior, Wis. In order to make it certain that President Coolidge would have good radio reception at his summer home, the Commission on June 4, 1928, temporarily increased this station's power from 250 to 1,000 watts for evening broadcasting during the summer. Soon after obtaining this increase the station on its own volition affiliated itself with one of the large chains.

"By its General Order No. 43, issued on September 8, 1928, the Commission sought to limit the use of cleared channels for chain programs by requiring a geographical separation of 300 miles between stations using such programs, except for one hour each evening.

Allocation Effect Studied

"The order sought to encourage synchronization by making an exception in case two stations operated on the same frequency. It also made provisions for exceptions in cases of programs of extraordinary national interest.

"Nevertheless, the very drastic effect of the order soon became apparent from the storm of protest from the listening public, and the Commission deemed it wise to postpone the effective date of the order from November 11, 1928, to February 1, 1929, in order to give it an opportunity to make further investigation to avoid injustice to listeners.

"The Commission will observe with particular care the effect of its new allocation of broadcasting stations upon chain broadcasting."

Girls Over WLW Give Mothers Tip

Cincinnati.

To make their homes something more than boarding houses for their sons and daughters, mothers in the WLW audience are being given an insight into the successful guiding of the adolscent mind by the adolescents themselves.

Members of Cincinnati's 3000 Girl Reserves present at 4:15 p. m. each Thursday a series of radio plays.

MONOPOLY SUIT IS THROWN OUT BY TRADE BODY

Washington.

The four years of investigation of the "radio trust" by the Federal Trade Commission, which entailed an expense to the defendants of more than $1,300,000, ended recently when the Commission dismissed its own complaint, without the defense having been the subject of any hearings.

The main defendant was the Radio Corporation of America.

E. A. McCulloch was the only member of the Commission who voted against dismissal of the complaint. Chairman Abram Myers noted for the record that he concurred in the action of the majority for the reason that the Commission was without jurisdiction to enter an effective order. The entire Commission participated in the decision.

Commission's Statement

The following statement was issued by the Commission:

"Dismissal of its complaint against General Electric Company, Radio Corporation of America and others, charging unfair competition in monopolizing the manufacture and sale of radio devices and monopolizing radio communication, was announced today by the Federal Trade Commission.

"Prior to the Commission's decision today the last action taken in the case was in June when arguments were heard on motions of respondents to dismiss the complaint because of lack of sufficient proof and because the subject matter of the charges was not in the Commission's jurisdiction.

Who Defendants Were

"Respondents other than General Electric Company and the Radio Corporation were: American Telephone and Telegraph Company, Western Electric Company, Inc., Westinghouse Electric and Manufacturing Company, The International Radio Telegraph Company, United Fruit Company, and Wireless Specialty Apparatus Company.

"Specifically the complaint charged that respondents combined and conspired, with the effect of restraining competition and creating monopoly in the manufacture, purchase and sale of radio apparatus and other electrical devices and monopolizing radio communication."

The dismissal terminated one of the longest monopoly investigations the Commission ever undertook, and one of the costliest. The R. C. A. was particularly hard hit, since it assumed legal leadership. Hearings were held in New York, Washington, New Orleans, Seattle, San Francisco, Chicago and Boston, since 1926. More than 10,000 pages of testimony was taken.

One R. C. A. Case Remains

Another trust complaint, involving the R. C. A., is still before the Commission. It concerns alleged violation of the Clayton act by the clause in the R. C. A. license to set manufacturers requiring them to use R. C. A. or Cunningham tubes. R. C. A. owns 51% of the Cunningham stock.

A recent court decision upheld an injunction obtained against the R. C. A. by independent tube manufacturers concerning this requirement, clause 9 in the license contract.

Independents Ask New Investigation

Washington.

After the Federal Trade Commission had announced the dropping of the radio monopoly suit, Oswald F. Schuette, secretary of the Radio Protective Association, demanded that the Department of Justice proceed against the erstwhile defendants. Said Schuette:

"There is no longer any possible reason why Attorney General Sargent, should not summon these radio manufacturers into the Federal courts. For five years the independent manufacturers who have demanded prosecution of this monopoly have been met by the excuse that so long as the Federal Trade Commission was prosecuting the R. C. A. it would be interfering for the Department of Justice to take the matter into the courts."

SIX ARE CITED FOR WOBBLING

Washington.

Six broadcasting stations have been notified by the Federal Radio Commission that, because of repeated deviations from their assigned frequencies by more than one-half kilocycle, they must appear before the Commission to determine whether their licenses should be renewed.

The stations are: WIBS, Elizabeth, N. J.; KPQ, Seattle, Wash.; WKBO, Jersey City, N. J.; WKBQ, Seattle, Wash.; KPCB, Seattle, Wash.; and KSGM-WSDA, New York.

In each instance the notification read:

"According to information received by the Commission your station has been repeatedly deviating from assigned frequency more than one-half kilocycle in violation of General Order 7. On receipt of your application for renewal it will therefore be set for hearing to determine whether it should be granted or denied and you will be notified of time and place for hearing."

The Commission had previously notified all broadcasting stations that violations of any of the Commission's orders would be the basis for holding public hearings at Washington, and that until such hearing has been held and a decision rendered, the station's license will not be renewed. This notice stated that most violations being reported were of the off-frequency operation order, and of failure of stations to announce call letters every 15 minutes.

The Commission announced its decisions in three cases involving applications for modification of station licenses: WGCP, Newark; WODA, Paterson, and WAAM, Newark, all in New Jersey.

WGCP was notified that the applications of WODA and WAAM for full or half time on 1,250 kilocycles has been granted by the Commission to the extent of three-sevenths time each, while WGCP is granted one-seventh time.

Later three additional broadcasting stations were notified by the Commission that renewal of their licenses will be held in abeyance pending a hearing, because of "repeated deviations" from assigned frequencies, causing interference with other stations.

The stations were KGTT, San Francisco, 50 watts, 1,420 kilocycles; KOL, Seattle, Washington, 1,000 watts on 1,270 kilocycles, and WCLB, Long Beach, California, 100 watts, 1,500 kilocycles.

ADVERTISING PRICES VEXES COMMISSION

Washington.

One of the most difficult problems before the Federal Radio Commission concerns the broadcasting of advertising. The Commission in its annual report discusses this as follows:

"A problem with which the Commission is faced from time to time is the extent and character of advertising which will be permitted by broadcasting stations. There is a tendency to make a distinction between *direct* and *indirect* advertising, but, obviously, there is no sharp line of demarcation between them. By direct advertising is usually meant the mention of specific commodities, the quoting of prices, and soliciting of orders to be sent directly to the advertiser or the radio station. By indirect advertising is usually meant advertising calculated simply to create or maintain good will toward the advertiser.

Big Proposition in Iowa

"In some localities, such as Iowa, direct advertising has assumed very substantial proportions. Soon after the Commission was established many objections to such advertising were received by the Commission from listeners, and in the first allocation certain of these stations were given only limited facilities.

"Hearings were held at the request of these stations, and the mass of documentary evidence submitted seemed to show overwhelmingly that a majority of the public in certain areas favored direct advertising by radio of certain products for farm consumption, having the idea that there were economic advantages in this method.

"One such station submitted evidence showing that it had received over one-half million commendatory letters in one year.

Merchants Complain

"On the other hand, there has been some measure of complaint by competing merchants who do not have broadcasting facilities to the effect that they were placed under an unfair advantage by such use of a Government franchise.

"The problem is far from being solved. It is manifest that broadcasters must resort to some form of advertising to obtain the revenue for the operation of their stations.

"On the other hand, it is equally manifest that the advertising must not be of a nature such as to destroy or harm the benefit to which the public is entitled from the proper use of broadcasting channels. The Commission has, of course, no power to censor programs and must proceed cautiously in its regulation on this subject."

CENSORSHIP ON SUNDAY MEETS WITH RIDICULE

Washington.

The effort of the Lord's Day Alliance to induce the Radio Commission to prohibit broadcasting on Sundays of anything but purely religious music and oratory is opposed in a letter received by the Commission from the National Association Opposed to Blue Laws, Inc.

The letter, signed by Linn A. E. Gale, national secretary, follows:

"The attention of the National Association Opposed to Blue Laws, Inc., has been attracted by the declaration of the Lord's Day Alliance in its recent annual convention

"We feel, moreover, that the Commission in New York City that it will seek to induce the Federal Radio Commission to prohibit broadcasting on Sundays of anything but purely religious music and oratory.

"We have too much confidence in the enlightened and broad-minded attitude of the Federal Radio Commission and of yourself as its chairman to fear that any such suggestion will receive serious consideration. We feel that, first of all, the Commission has no disposition to attempt to interfere with the broadcasting of any legitimate matter, be it religious or secular.

"We feel, moreover, that the Commission agrees with us that the limitation of broadcasting on Sunday to what is considered the religious by the Lord's Day Alliance would be a highly unjust violation of the principle of religious liberty.

The same freedom by which a citizen may go to one church or to another, or to none at all, surely permits him to listen to church music, jazz, sermons, or lectures on nonreligious subjects.

Orthodox vs. Infidel

"Certainly it would be intolerable if self-constituted censors could bar from the air on one day of the week everything except their kind of broadcasting. 'What is orthodox to you is infidel to me,' said a brilliant young poet.

"In no spirit of conceit, we venture that the National Association Opposed to Blue Laws is perhaps as reliable a judge of what is appropriate broadcasting on Sunday as the advocates of a hard-boiled Sunday. We do not want to write our own choice and preference into law. We object to letting our opponents enact their choice and preference either.

"This letter is, I am sure, unnecessary. However, it will serve as a formal record of the feelings of the vast body of liberal citizens we represent."

12,000,000 Receivers Now in Use in U.S.

Washington.

A nation-wide survey completed in May, 1928, and conducted by "Radio Retailing" in compliance with the request of the Federal Radio Commission, shows a total of nearly 12,000,000 receiving sets in use, serving an audience of more than 40,000,000 persons.

Appeals for all available statistics were addressed to trade bodies, trade publications, and others in close touch with the industry. The figures show that 7,500,000 standard receiving sets with loudspeaker volume are now in use; they do not include crystal or ear-phone receivers of obsolete type.

THE AIR COLUMN

The Federal Trade Commission incurred an expense of $1,300,000 to ascertain it had no jurisdiction over the R. C. A. and associates in the monopoly case, but it was the defendants' money. Higher education is costly.

* * *

Small stations with large wobbles are in danger of losing their licenses. So that the public will be apprised, such stations should serve due notice when they stop all their broadcasting.

* * *

While the Federal Radio Commission is about to effect its order limiting chain broadcasts, the chains add to their station lists and compete for the honor of "largest in the world." Evidently the Columbia and N.B,C. each covers a greater percentage of the listening public than does the Commission.

* * *

The announcer who does not say "Noo Yawk Ciddy" but "Niew Yorrrk Cittty" is Floyd Neale of WEAF et seq.

* * *

The Advancing Art

Gloater: The tone quality of my set is so fine that you can understand every word that the announcer says.

* * *

With all inconveniences fast being eliminated, as exemplified by the AC single dial receiver, somebody may invent something to remove the strain of listening to uplift programs.

* * *

Stock Invitation to Service Men

Come over to dinner Tuesday night. Bring your tools.

* * *

It is less troublesome to ask a man to buy stock in a television company than it is to give a satisfactory demonstration of a television receiver.

* * *

The year 1929 having arrived, it is about time for some one to come out with the first 1930 model radio receiver.

* * *

If a machine will bring in television it shouldn't be much trouble to add a device that will reveal your horoscope.

* * *

Most persons who have battery sets believe AC sets work without aerial.

Hammarlund Units Equalize Accurately

Not all builders realize the importance of using a precise and well-made equalizer and the good results one will give in a circuit calling for it. One of the new Hammarlund numbers is a small neutralizing or balancing condenser, having an exceptionally wide and accurate capacity range. Every set builder will find it extremely useful as a compensator for equalizing the units of ganged condensers. It may be attached directly to socket

binding posts or condensers, thus simplifying wiring connections. Its small size and handy construction permits of use in limited space. It is ruggedly built, with bakelite base mount, mica dielectric and a heavy phosphor-bronze spring plate. There are two sizes, Code EC35 (2 to 35 mmfd.) and Code EC70 (2 to 70 mmfd. A full description of all the Hammarlund precision parts may be had by writing to the Hammerlund Manufacturing Co., Inc., 424 West 33rd Street, New York City. Mention RADIO WORLD.—J. H. C.

1929 BUSINESS IS COUNTED ON TO SET RECORD

A. ATWATER KENT, Philadelphia radio manufacturer and broadcaster: Although 1928 set a new peak in the radio industry, I expect that 1929 will be even greater, There is every reason for optimism and no reason for pessimism. The country is moving forward rapidly in all lines. Prosperity is sound and substantial, and in this situation it is obvious that radio is bound to take a position of leadership in setting the pace. The outstanding feature in radio during the past year has been the all-electric receiver. The quality of broadcast entertainment is getting better and better every day. The problems pertaining to satisfactory reception are receiving attention and will undoubtedly be solved. Leaders in every field of human activity are more and more taking cognizance of radio in shaping their programs and activities. The important part which radio played in the Presidential campaign is only one instance of the application of this new science to an ever-increasing number of new fields. In other words, in the language of modern business, the country is "sold" on radio, which means that it is strictly up to those of us actively engaged in the industry—manufacturers and broadcasters—to meet the country's demands. Our effort to do so is destined to make 1929 the busiest year of our lives.

L. K. MARSHALL, president, Raytheon Manufacturing Company: 1929 will be marked by competitive research and engineering, quite as well as by competitive production and marketing. The day is past when any single organization or group can dictate the technical trends of the radio art. Instead of rigid standards introduced by any organization or group, with little or no opportunity for improvements or innovations, keen rivalry in the development of better radio devices may be expected, even though there may be general standards to insure stability and the necessary foundation for mass production.

POWELL CROSLEY, JR., president, Crosley Radio Corporation: I see no radical changes in 1929 but continued success for those who have always tried to render the best possible service to the greatest number of people. The AC set combined with the power type speaker has made possible the quality of radio reception now recognized as standard and heretofore not only unknown but not even predicted as being possible. The growth of super-power stations with the tremendous investment in broadcasting facilities which has taken place in 1928 has created a new confidence in the quality of broadcasting. The buyer of a radio set is now, more than ever before, assured of good reception of worth while entertainment.

Sign-Talk Used As Studio Necessity

Oakland, Calif.

Necessity has brought forth another invention, the radio sign language!

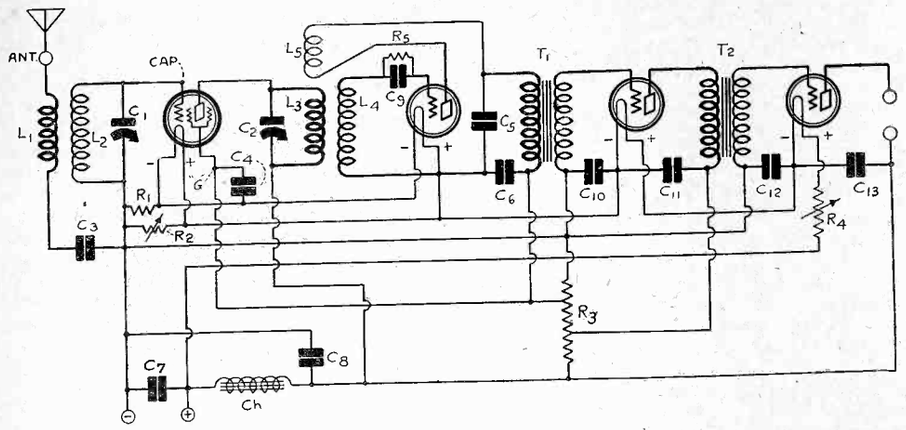
Pantomine as practiced by the Rembrandt trio girls of KGO, who play for several hours at a time at the station, eliminates whispering and confusion.

Technique of conversing with one's fingers, eyes, hands, arms, shoulders and head has been developed for radio by Mme. Berthe Baret, violinist of the trio.

What Circuit for DC?

Author Makes Selection That Avoids Large Power Wastage

By Bramhall Burleigh



IN districts served with direct current there is always a question as to what kind of radio receiver to install. There are three choices possible. The first is operation from storage and B batteries. The second is operation directly from the DC line. The third is operation by the use of a motor generator. Which of the three is most practical?

If battery operation were practical there would be no question which to use. That is the oldest method and most people living in DC districts already have such receivers. If they were satisfied there would be no reason for looking for another method. But they are not, for they are looking for something more convenient, more economical, and less troublesome. They are tired of fussing with storage batteries which require frequent charging, watering, cleaning and inspection. They are tired of dry plate batteries which require periodic renewal at considerable cost.

Motor Generator Method

Let us next consider the possibilities of the motor generator. There are many such generators, and a machine may be chosen for almost any kind of set. For example, we may choose a motor generator which converts 110 volts DC into 110 volts AC. With this machine any set designed to operate on AC may be used without any trouble. It is only necessary to select a machine which delivers enough power for the receiver to be used. Machines of 50, 100 and 150 watts are available. The cost of such a machine would be approximately the same as for an AC set, assuming that the cost of the set was in proportion to the power it required.

Another possibility is to get a motor generator which converts the 110 volt DC into higher voltage DC for the plates and into lower DC for the filaments. Filters would be required both in the low and the high voltage circuits to remove the ripple. In this case any DC set could be used.

Disadvantages of Machine

A variation of this is to get a motor generator which converts the DC into high voltage DC for the plates and AC low voltage for the filaments. A filter would be required for the high voltage circuit. This method would be suitable for home constructed sets which would have to be provided with filament transformers and a power pack. The machine and the filter would take the place of these devices.

It would seem that the motor generator method would be the most satisfactory, and in many cases it is. But a machine is required, which means moving parts. Hence it is necessary to give it close attention. It must be oiled now and then, and its brushes must be kept in good condition. Again, the machine makes a noise and causes vibration. The vibrations might be prevented from causing any trouble but it is not so easy to confine the noise. Of course, reducing the vibration reduces the hum and noise to some extent, but not all.

Another difficulty with the motor generator is that it has brushes which will cause sparks, which in turn will create interference with the radio reception. However, this may be stopped by using spark killers across the brushes. Such devices are now available under the general name of filterettes. The interference from sparks can also be kept down by keeping the brushes in good condition.

Possibly the main disadvantage of the motor generator is its high cost, particularly when it is an addition to the cost of a complete set.

Direct from DC Line

The most attractive possibility is operation directly from the DC line. This requires the least amount of auxiliary apparatus. But it is not always the least expensive to operate. Neither can it be used on high power receivers, for the highest voltage available is only 110 volts. But there are many who are satisfied with the volume obtainable with 110 volts and many more who would rather accept such volume than use batteries or provide themselves with a motor generator. The quality is just as good on 110 volts as on higher voltages, provided that the volume is kept at a reasonable level.

If a regular DC receiver with parallel-connected filaments is connected to a 110 volt DC line with a resistor in series to limit the current to the proper value, considerable power is lost in this resistor. The voltage used is only 5 volts and therefore the efficiency is only 500/110 per cent., that is 4.5. If the circuit contains four .25 ampere tubes the total current is one ampere and the power required is 110 watts. There are very few high power AC sets which take as much as that. The set in question should take only about 5 watts.

Reducing the Power

The only way of reducing this wastage of power is to connect the filaments in series. Suppose the four filaments are connected in series. Then the voltage used is 20 volts out of 110 volts, and the efficiency has been raised to 18.2 per cent. The power required for the filaments is now only 27.5 watts. That is the best that can be done in the case of a receiver using four .25 ampere tubes.

Another objection to direct DC operation is that it requires a heavy duty filter to take out the ripple. If the filter is to be effective it must be very large and then it will be costly. However, the ripple in DC is usually of a high frequency and can readily be removed by condensers alone, except for the plate current supply. If then the filament current is filtered by condensers alone and the plate current by condensers and a choke coil, an inexpensive filter can be used.

Ideas Illustrated

These ideas are illustrated in the circuit shown in Fig. 1 herewith. This circuit uses a screen grid tube for the RF amplifier, a —99 for the detector, —01A for the first audio tube and a —12A for the power tube.

The scren grid tube and the —99 require the same filament voltage, and the two take less current than either of the other tubes. Hence there will be both a power and a voltage gain by connecting the filaments of the screen grid tube and the —99 in parallel. These two filaments, in parallel, are then connected in series with the other two filaments in series. The total voltage required for the filaments will be 13.3 volts. Thus the efficiency of the filament circuit will be 12.1 per cent.

But the screen grid tube requires a grid bias of 1.5 volts. Thus the total voltage required for the filament and the grid bias is 14.8 volts. But the grid bias neither increases nor decreases the efficiency, for the power lost in the grid bias

(*Continued on page* 11)

LIST OF PARTS

L1L2—One Model RF5 screen grid antenna coil.
L3L4L5—One Model 5HT screen grid circuit high impedance tuner.
C1, C2—Two .0005 mfd. tuning condensers.
C3—One .001 mfd. condenser.
C4, C6, C10, C11, C12, C13—Six 1 mfd. condensers.
C5—One .0005 mfd. condenser.
C7—One 4 mfd., or larger, condenser.
C8—One 4 mfd. condenser.
C9—One .00025 mfd. condenser with grid leak clips.
R1—One 7.5 ohm resistor.
R2—One 100 ohm variable resistor.
R3—Two 3,000 and one 1,000 ohm resistors.
R4—One variable resistor to carry .25 ampere, resistance range from 350 to 450 ohms.
R5—One megohm grid leak.
T1, T2—Two audio frequency transformers.
Ch—One filter choke.
Four standard sockets.
Five binding posts.
Two national dials.

Solution of Problems

By Perr

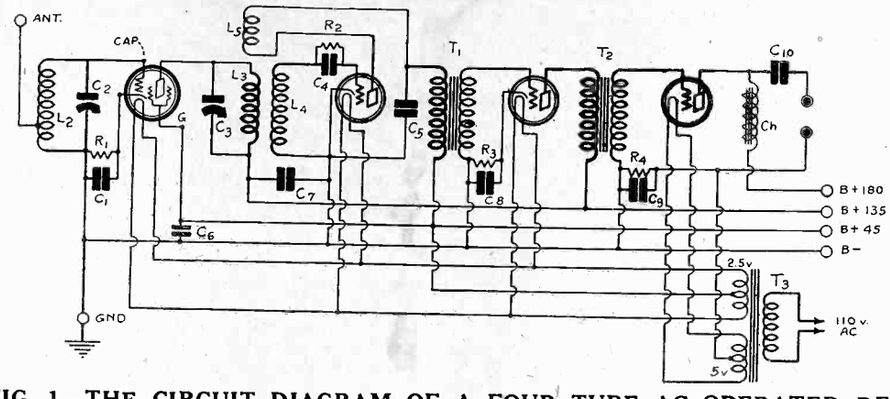


FIG. 1.—THE CIRCUIT DIAGRAM OF A FOUR TUBE AC OPERATED RECEIVER INCORPORATING ONE AC SCREEN TUBE, TWO- —27 TYPE TUBES AND ONE —71A POWER TUBE.

CAN one build an AC set which does not hum at all, or which hums so little that special attention is necessary before it is noticeable? It is quite possible and is being done every day. The absence or presence of hum in such a receiver is largely a matter of design, of the use of suitable AC tubes and the judicious use of by-pass condensers.

Question of Sensitivity

Are AC operated sets as sensitive as similar DC operated sets? That question is equivalent to asking whether AC tubes are as good amplifiers as DC tubes, for coils, condensers and resistors have the same properties in an AC set as in a DC set.

AC tubes have practically the same characteristics as to amplification and detection as DC tubes. For example, the AC screen grid tube performs about the same as a DC screen grid tube. The —27 heater type tube performs about the same as the 112A tube, and the power tube performs practically the same when heated with AC as with DC.

There remain the question of voltages. Sometimes an AC set behaves differently from a DC set because the various voltages are not the same. The plate voltages may be different because part of the available voltage is taken for the grid bias without making any allowance for the division. The filament voltages may be different because the supply line voltage is too low or too high. The grid bias may be different because improper adjustments have been made.

Now that inexpensive meters are available there is no reason why adjustments should not be made right. Also, the AC tubes have been on the market long enough to allow manufacturers of the tubes themselves to correct the early faults and the makers of power equipment to make such equipment right. Furthermore, the tubes have been out long enough to give designers a chance to learn which of the AC tubes are suitable and which are not. For example, the heater type of tube exemplified by the —27 has gained considerably in popularity over the filament type tube, because when the heater tube is used the hum question is a very minor one.

Four Tube All-Electric

A four tube set having two tuners, regeneration in the detector, and two stages of transformer coupled audio, has always been one of the most popular because of its simplicity, inexpensiveness, sensitivity and tone quality. Such a receiver is particularly suitable for an AC receiver. The diagram of one of this type is given in Fig. 1.

It is assumed that an AC screen grid tube is used as RF amplifier. This tube is available. It has the same cathode and heating arrangement as the —27 type tube and the same amplification characteristics as the regular DC screen grid tube.

Any screen grid tube is somewhat critical in regards to voltages. A grid bias of about 1.5 volts is required. In a DC tube this is obtained from the drop in a 10 ohm resistor in the filament circuit. This method is not available in an AC tube. And since grid batteries cannot be used in an all-electric set, the only alternative is to obtain the grid bias from a drop in the plate circuit. Fig. 1, R1, is provided for that purpose. This should have a value of about 750 ohms. If precise adjustment is necessary R1 might be made variable, having a range from zero to 2,000 ohms, although a fixed value will give good results. The resistor should be by-passed by a condenser C1 of .001 mfd. or larger.

When the grid bias on the tube is 1.5 volts the plate voltage should be 135 volts and the screen grid voltage 45 volts. It is well to use a B battery eliminator having variable voltage taps in order that the best combination of voltages may be obtained. The adjustment is best done experimentally, striving for loudest signals.

Humless Detection

For detector a —27 heater type is used, because that is the only AC tube which gives humless detection. The grid condenser and grid leak method of detection is used because that is more sensitive than grid bias detection and is more suitable in a four tube receiver. The customary values of .00025 mfd. and 2 megohms should be used for C_4 and R_2, but the resistor should be of the metallized type. The grid return is to the cathode thus giving zero bias tot he grid.

The first audio amplifier is also a —27 heater type tube. It is used because it is a good amplifier and it does not contribute any hum to the signal. It is coupled to the detector by means of a transformer T1. It is also coupled to the final tube by a transformer, T2. If these transformers are selected from among the modern high grade transformers, the quality of the output will be excellent.

The first audio tube requires a grid bias of about 7.5 volts when the plate voltage is 135 volts. This bias is provided by the drop in R3. Since the plate current will be about 6 milliamperes the value of R3 should be about 1,250 ohms. Either a 1,000 or a 1,500 ohm resistor may be used as the value is not critical. But the resistor should be by-passed with a condenser C8 which should not be smaller than 1 mfd.

LIST OF PARTS

L2—One Model 5A screen grid antenna coupler.
L3L4L5—One Model 5HT three circuit high impedance tuner for screen grid tube.
T1, T2—Two National audio frequency transformers.
ChC10—One National output filter.
T3—One Victoreen 327 filament transformer (with two 2.5 volt windings).
C1—One Aerovox .001 mfd. condenser.
C2, C3—Two Hammarlund .0005 mfd. midline condensers.
C4—One Aerovox .00025 mfd. grid condenser with clips.
C5—One Aerovox .0005 fixed condenser.
C6, C7, C8—Three Tobe 1 mfd. by-pass condensers, 200 volt test.
C9—One Tobe 4 mfd. by-pass condenser (200 volt test).
R1—One 2,000 ohm variable Frost resistor.
R2—One Lynch metallized grid leak.
R3—One 1,250 ohm fixed resistor (1,000 or 1,500 may be used).
R4—One 2,150 ohm resistor.
One National type 3580 B battery eliminator.
Three Y type sockets.
One X type socket.
Eight binding posts.
Two National Velvet vernier dials.

Power Tube Adjustment

A —71A type power tube is recommended. This requires a plate voltage of 180 volts and a bias of 43 volts when used with AC on the filament. The bias is provided by R4, which should have a value of 2,150 ohms. The circuit will work on a 2,000 ohm grid resistor but it will not stand quite so much volume. This resistor should be shunted with a condenser C9, which should not be smaller than 4 mfd.

The filter in the plate circuit of the power tube should consist of a 4 mfd., or larger, condenser C10 and a 30 henry choke Ch, the coil being designed for a plate current of 50 milliamperes or more. The speaker should be returned to the mid-tap of the filament transformer in order to reduce as much as possible the feed-back of signal current through the power supply.

Efficient By-passing

There are three by-pass condensers which have not yet been mentioned. One is C5, .0005 mfd., which must be used to make regeneration and detection efficient. The next is C6. This is connected from the grid post on the socket of the screen grid tube to ground. If this condenser is made 1 mfd. or larger it will not only serve effectively to maintain the screen grid voltage constant with respect to signal voltages but it will also serve to by-pass the plate supply of the detector, since these are connected to the same tap on the voltage supply.

It is true that there is a condenser across this tap in the voltage supply but it does not by-pass the leads. Hence the

in an AC Receiver

andolph

extra condenser is an exceptionally helpful adjunct.

The same thing applies to condenser C7, which serves to by-pass the 135 volt tap. Its main purpose, however, is to maintain the rotor of C3 at ground potential with respect to radio frequency, and hence to eliminate body capacity.

Tuned Primary

Each of the two tuning condensers C2 and C3 should have a capacity of .0005 mfd., and the two tuning coils L2 and L3 should be wound for this capacity. The first coil is an auto-transformer. That is, the antenna is conductively coupled to the coil.

The primary L3 of the three circuit coil is tuned in order to couple the screen tube effectively to the succeeding tube. Both an antenna and a three circuit tuner especially designed for this circuit are available.

A filament transformer having one 2.5 volt winding capable of delivering 6 amperes and one 5 volt winding capable of delivering ½ ampere is necessary. Both of the windings should be center-tapped. The mid-tap on the 2.5 volt winding is connected to the 45 volt tap as a means of reducing hum.

Reducing Ground Hum

The ground should be connected to B minus.

All the hum that is heard in a receiver operated partly or entirely on AC is not due to lack of filtering or balancing of the filaments. Some of it comes from the power line, and this hum carries with it clicks and crashes and various line noises.

It has been found that this noise may be reduced by connecting a 25 watt lamp between the ground on the set and one side of the power line. Actually, the ground side of the line should be connected to the ground on the receiver by a heavy wire. But if this is done there is danger of blowing fuses. Hence the lamp is used as a partial ground connection, and as an indicator of a possible wrong connection. If the plug of the power transformer is inserted into the outlet in the wrong direction the lamp lights up. If in the right direction it remains dark. Only when dark does it serve the purpose for which it was intended.

Double Socket Needed

Since there are two transformers in the circuit described here, both should be on the lamp. This means that an extension cord provided with a two-way socket should be used. One side of this extension cord should be connected to the lamp. Then there is litle chance of blowing fuses. If the extension cord plug is inserted into the outlet in the wrong way the lamp lights up but nothing else will happen. If it is plugged in the right way the lamp will not light up. The plug should be left that way. A lamp larger than 25 watts will be more effective.

Use a Fuse Block

For the lamp and the two-way adapter a two-socket fuse block may be used, the lamp being inserted in one of the sockets and the two-way adapter in the other. The wiring of the arrangement is shown in Fig. 2.

The filament and power transformers are identified, also the 25-watt lamp and the ground connection, which is also B—.

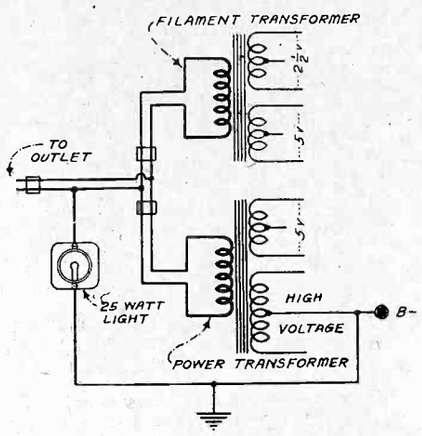


FIG. 2
HOW TRANSFORMERS, THROUGH A TWO-WAY PLUG THAT HAS A MALE PLUG FOR THE CONVENIENCE OUTLET.

Design for a DC Electric Receiver

(*Continued from page* 9)

resistor would have to be expended elsewhere if no bias were used.

The grid bias is obtained from the drop in R1. Normally the current through this resistor is .198 ampere, the sum of the filament currents of the first two tubes. This current is to cause a drop of 1.5 volts. Hence R1 should be 7.5 ohms. This assumes that the current is actually .2 ampere.

The current required for the other tubes is .25 ampere. This is 50 milliamperes more than the current for the two first tubes. Hence a variable resistor R2 is connected in parallel with R1 and the 3.3 volt filaments. This variable resistor is adjusted so that 50 milliamperes flow through it when the voltage across it is 4.8 volts. That is R2 should be set at 98 ohms or a little less. This resistor can also be used as volume control because if it is set at zero no filament current at all flows through filaments of the first two tubes. The resistance should never be made greater than 100 ohms for then the filaments of the two first tubes will get too much current. This means the resistance should be so arranged that it cannot be opened.

Bias Adjustment

The grid of the detector is returned to the positive end of the filament, since the grid condenser and grid leak method of detection is used. The grid return of the first audio is connected to the negative end of the line. Thus the bias on the tube is 4.8 volts for normal adjustment of R2. The grid return of the power tube is returned to the same point, thus giving tube a normal bias of 9.4 volts. If that bias should prove to be too high the return may be made to the negative end of the filament of the first audio tube, when the bias will be 5 volts.

The variable resistor R4 is put in the positive end of the line to drop the excess voltage. Since the current is .25 ampere and the xcess voltage is 95.2 volts, the value of R4 should be 381 ohms. Also since the voltage of the line may rise as high as 125 volts, when the excess voltage will be 110.2 volts, provision for increasing the value of R4 up to 441 ohms. The resistance must be able to carry .25 ampere continuously. There is no regular rheostat which will meet the conditions imposed on this resistor. Hence it must be improvised. A 40 watt electric light has a resistance of about 300 ohms, and this may be used as part of R4. A 30 watt lamp has a resistance of about 400 ohms.

The most probable value of the line voltage is 115 volts, and for this voltage the value of R4 should be 400 ohms. The most suitable lamp should be selected for the main resistor and then the highest rheostat which will carry .25 ampere should be connected in series for the final adjustment.

Besides lamps there are various commercial resistors which fit into standard lamp sockets, and of these there are many different fixed values.

All the plate current passes through the choke coil Ch. This coil should have an inductance of at least 30 henries and a current carrying capacity of 35 milliamperes. Practically any filter choke will meet the conditions.

The available plate voltage is divided by R3, a voltage divider having two taps, one at 45 and another at 90 volts. For practical purposes the voltage will be divided accurately enough if two 3,000 ohm resistors and one 1,000 ohm resistor be connected in series with the taps placed at the junctions. The 1,000 ohm unit should be placed on the positive side.

All the line voltage available after the filter is put on the plates of the first and the last tubes.

Thorough by-passing is a necessary condition for the success of a circuit of this type. The first by-pass condenser is C7, and this is also the most important as it not only by-passes the plate supply but also the filament supply. It should not be smaller than 4 mfd, and it need not be rated at more than 250 volts on DC. C8 is next in importance. It should be a 4 mfd. of the same voltage rating as C7.

The other by-pass condensers need not be so large. In fact 1 mfd. will suffice for C4, C6, C10, C11, C12 and C13. C5 should be .0005 mfd.

Transformer coupling is used in the audio amplifier because this is more successful in series connected circuits than any other.

The tuner portion of the circuit is like that in four tube Diamond of the Air for screen grid tubes, descriptions of which have appeared in RADIO WORLD.

Single Switch Control

In constructing an AC receiver, for use with a B battery eliminator that was made separately, either in a factory or at home, the switch on the front panel, if of the AC type, may go directly to the 110-volt main. The receiver side of the switch goes to the filament transformer and the power transformer.

A three-way plug serves an excellent purpose in enabling single switch control. One pair of leads goes from one of the three receptacles to the line. The two cables from the transformers (power and filament) go into the two remaining sockets. The switch makes and breaks one of the panel cable leads going to the line.

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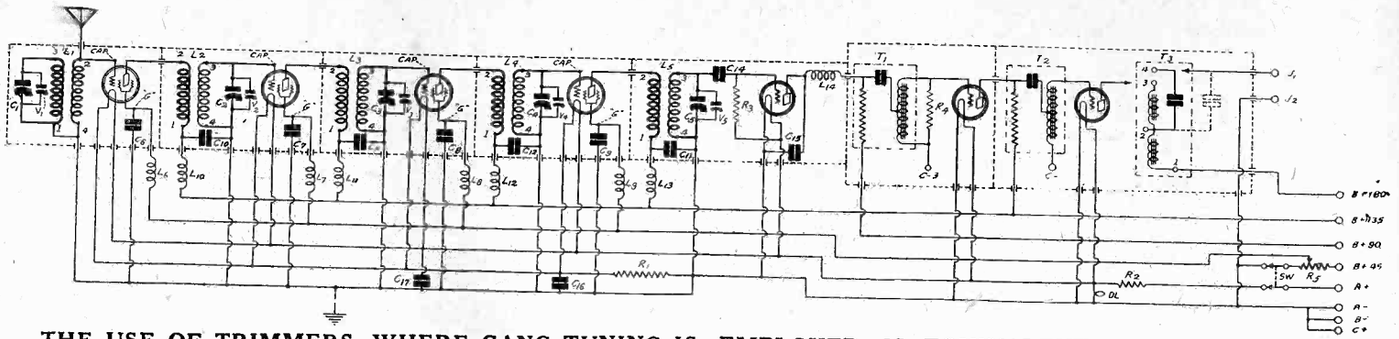

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IF you have two or more tuning dials on your receiver, do they tune alike? If not, can you make them do so?

You can. It is often quite easy to accomplish this result, although other times considerable pains must be taken, due to circuit complexities.

A general understanding of why the differences arise, helps immeasurably to create the solution.

Let us assume a two-dial receiver. The dial A at left tunes the antenna coil's secondary. The other dial, B, tunes either the primary or the secondary of an interstage coil, for instance an RF transformer or a three-circuit tuner.

If there is dissimilarity in the tuning, most likely the left-hand dial gives lower readings on the low wavelengths than does the other. Assuming that lower dial numbers denote lower capacity of the tuning condenser, likely the antenna capacity effect, reflected in the secondary of the antenna coil, contributes the capacity that would cause the difference between the two readings.

Smaller Numerical Difference

Now, if the same dials are tuned for a high wavelength station, say, 492 meters, they may read almost identically. This is on account of the construction of the tuning condensers. They are straight frequency line, or a modification thereof, which means that the rate of capacity change is rapid. At the lower capacity settings the rate of capacity change is small. Therefore a small difference in capacity at the low wavelengths will show up as a large difference numerically—say, 7 to 10 degrees difference between the two dials, even more. But at the higher wavelengths, where the stray capacity, that makes the difference in tuning, is only a small percentage of the total capacity in the tuned circuit, the dials tend to read together.

The same capacity difference exists, as in the tuning of lower wavelengths, but the dial spread representative of this difference is highly contracted, just as the capacity change is highly enlarged. The rule of opposites prevails. The higher the dial reading, the less the apparent capacity difference between the two circuits. The actual capacity difference is the same in both instances.

It is assumed that the inductances in the tuned circuits are equal. Then to bring in any particular frequency, the capacity must be equal in each circuit. If the capacity must be equal, why are the dial readings unequal? Because some stray capacity is in one circuit to a far greater extent than it is in the other, and that capacity is ever present. The tuning capacity is simply in addition to the stray capacity. Hence less capacity need be supplied by the tuning condenser in that circuit that has the greater stray capacity. Thus the dissimilarity in dial readings arises.

Needs Accurate Gang Condenser

In constructing a single dial receiver it is necessary to match up the inductances and capacities, so that equal inductance is obtained, and, at any given dial setting, equal capacity. The equality of inductance is the task of the coil manufacturer. The equality of capacity depends on the matched accuracy of the ganged tuning condenser and the circuit components. The type of tubes used has much to do with capacity equality or difference.

It is really hard to obtain equal capacity at any given setting of a dial which actuates ganged condensers. The troublesome antenna effect must be overcome. This introduces capacity into the secondary of the antenna coil of such a high order that unless some means of overcoming the difficulty is provided, the receiver may not be sensitive or selective.

Hence, where single control is used, identical capacity for identical frequency is necessary, the tolerance being 1 per cent. A ganged condenser of this accuracy costs money. The makers of factory-manufactured receivers now realize the need for using fine condensers, therefore the home constructor and the custom set builder should do no less.

Where each stage is separately tuned, or where the antenna stage is separately tuned and two or three succeeding stages are ganged, an additional convenience is afforded when both dials tune alike. You then know at a glance when you are at or near resonance, the accuracy being valuable when tuning in weak, far-distant signals particularly. Hence the desire to have dials "track" is due to a preferance for convenience in tuning.

From the foregoing the rule may be easily understood that the stage affording the lower dial setting for a given frequency has more inductance than the other or more capacity.

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Tune in a station near the low end of the dial, say, around 250 meters, and note the dial readings. Then remove turns from the coil that has across it the tuning condenser that gives the lower reading.

The diminished inductance will require higher capacity. The objective is to make both dials read alike, therefore simply turn the lower reading dial until it reads exactly the same as the other, and remove a turn at a time from the tuned coil until the signal comes in loudest.

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This disposes of inductance equalization, but does not confine it more narrowly than to unit turns. Of course, any who so desire may remove fractional turns. Since home-made coils alone are the ones affected, even this split-turn adjustment will not prove onerous.

By far the greater number of divergences arise from capacity difference. There is the antenna capacity reflected in the secondary of the first coil, but which is not a ratable factor in the successive stages. Also, the length of the leads in different stages, and the method of coil connections, have some bearing on any difference that may creep in. The

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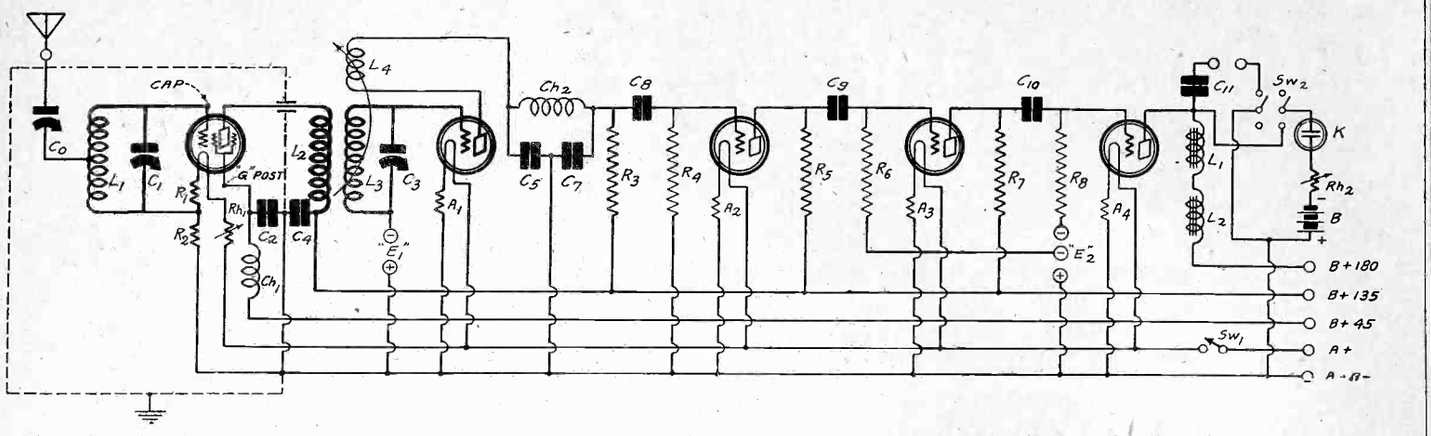

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types of tubes contribute their share. The screen grid tube has a low input capacity (grid to filament) and if a different sort of tube follows, e.g., —01A, then at the lower wavelengths the tuning dials will read differently, although the inductances are equal. Also, coils with a large number ofturns on primary and secondary will give lower dial readings, due to the distributed capacity and to the reduction in inductance caused by a high mutual. Also the way a tube is worked affects the grid-to-filament capacity actually present, it being higher in detector circuits than in amplifier circuits.

Therefore if your circuit uses screen grid tubes and the dial readings obtained thereon contrast with the reading of the detector input dial, the detector may show a lower reading than the others, even than the antenna coil's circuit, for the reflected capacity of the antenna may be less than the difference in input capacity between the screen grid tube and the detector.

Price of Single Control

The first test to make in any instance arising under use of dissimilar tubes is to determine whether the detector tuning covers the entire wavelength band, 200 to 545 meters, (1,500 to 550 kc.). Next determine whether the screen grid circuit does likewise. The likelihood is that if either fails to cover the whole band, the absent part will be small and, if both miss, will be in opposite directions.

The screen grid circuit may not tune high enough and the other not low enough.

Therefore you may take it for granted that some extra fixed capacity is needed across the secondary tuned circuit that has a screen grid tube in it. That may be a midget or junior condenser, 9 plates or so, connected across the tuning capacity, but not placed on the front panel, since it will not be varied.

Remove turns from the detector coil until it tunes low enough, then adjust the junior condenser in the other circuit until a given low wavelength gives identical readings on both dials. The other settings of the dials will track nicely.

Where circuits are individually tuned there is no advantage in using triming condensers or inductive trimmers. Where gang tuning is resorted to, trimming is the only way to obtain maximum sensitivity all over the dial.

Many like the convenience of strictly single dial tuning, and are entitled to enjoy it, but must realize that there is some sacrifice of sensitivity, and perhaps selectivity. Roughly, the strictly single dial receiver is about 25 per cent. less sensitive than where individually tuned circuits are used, even when strict single control is at its best. Trimmers are the equivalent of individually tuned circuits.

There is one serious effect that has not even been broached. That is shielding. The size of the shield and of the coil diameter is important. If the coil is too large in respect to the shield, or the shield too small for a large coil, there will be an almost incredibly high reactance drop. It may be capitative, in the main, if the coil terminals are so located that the high potentials are close to the grounded shield.

Wherever there is a voltage difference there is a capacity effect.

More than likely, if dwarfed shields or too-large coils are used, the reactance drop is considerably inductive, due to the interference the flux encounters.

Instead of the coil field having a free path it is confined by the shield, against which it strikes.

The Boy and the Air Rifle

When you were a boy you probably fired an air rifle at a factory window on a Sunday afternoon and watched the pellets bounce off. Naturally, if you fired into open space the bullet would travel farther. Hitting the window pane, not only was the bullet's progress interrupted, but the bullet came a small part of the way back again. Contrast the point where the unimpeded ball would drop with the point where it fell after the rebound.

With the flux in the undersized "can" the rebound is much more serious. At all hazards, you have less inductance. Therefore if you can not tune in the entire wavelength band when you clamp on a falsely chosen shield, better get a large shield, or at least add more turns to the tuned part of the coil.

The addition of turns in this instance may cheat you out of some of the lower wavelength stations, due to high distributed capacity, the capacity effect still obtaining in the shield, and the inductive drop, so anything other than excellent choice of shield and coil is a makeshift.

For a given diameter of tubing the shield should be no closer to the nearest part of the coil than the full diameter of the coil. There would be still some refraction of flux, but to no harmful degree.

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About as big a problem in equalization of dial readings as any you could encounter is the one of crossed curves. A curve is drawn for each of two dials, for instance, where frequency or wavelength is plotted against dial settings. If the curves cross it means that the dials differ in opposite directions on opposite sides of the intersection.

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If the two log curves cross beyond the upper limit they approach each other as the wavelength increases, that is, as the dial readings approach 100. If the lines cross beyond the lower limit they diverge as the wavelength is increased, but converge as the wavelength is decreased.

These facts suggest what to do when certain readings are obtained when these do not track along. For example, if 550 kc tunes in at 100 on one dial and at 95 on the other and if the dials tune together at 1,200 kc., inductance should be added, by increasing the turns, on the coil which tunes in at 100. Turns should be added until both tune in at 95. This may not be enough to make the two curves parallel, but it may be enough to make the tuning characteristic satisfactory.

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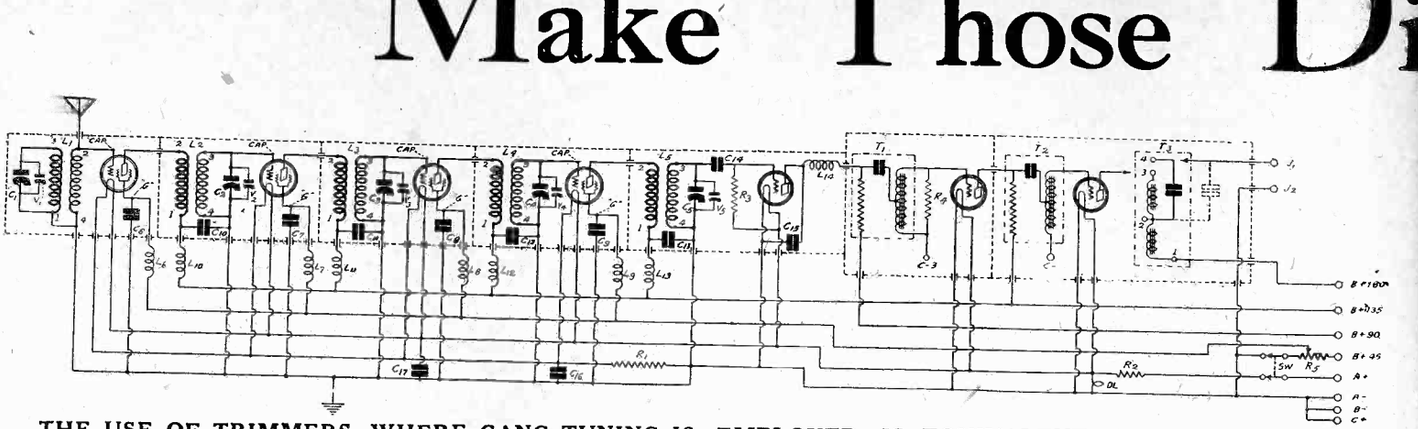

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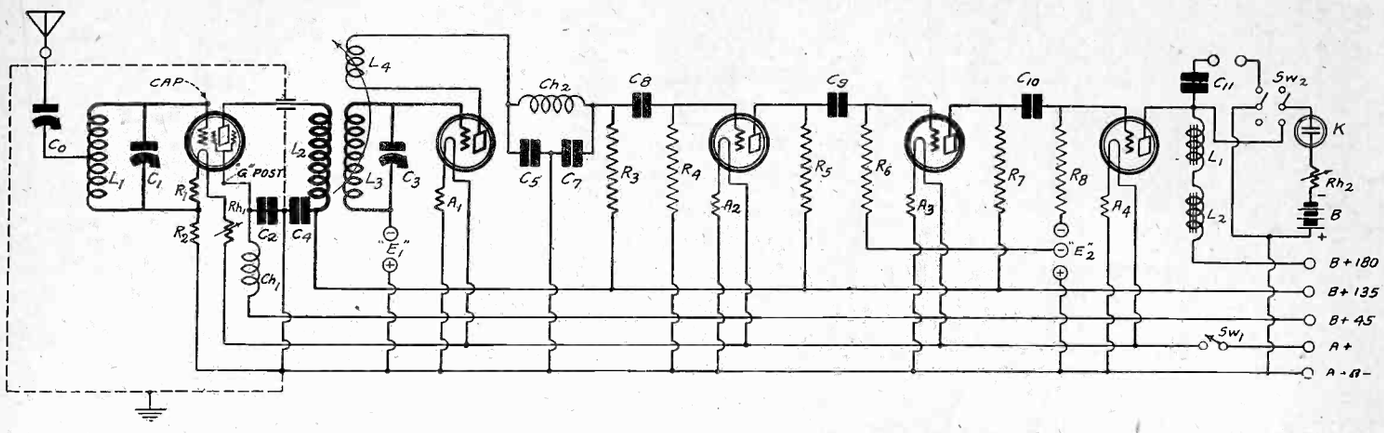

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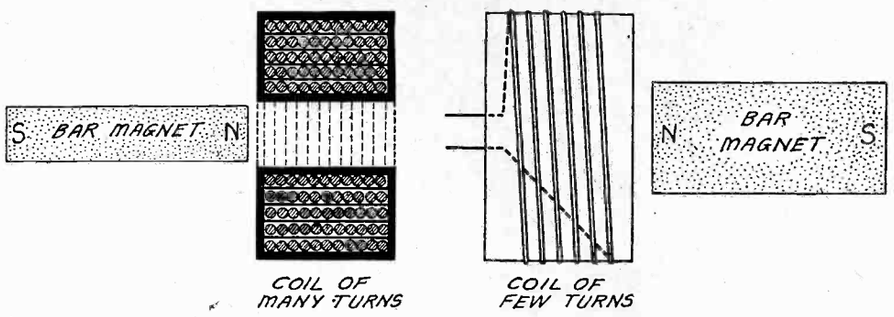
Nobody Knows; All We Can Do Is Use and Measure It

By J. E. Anderson

Technical Editor



THIS ILLUSTRATES HOW THE INDUCTANCE OF A COIL MAY BE SENSED. AT LEFT IS A COIL OF MANY TURNS AND HIGH INDUCTANCE. AT RIGHT A COIL OF SMALL INDUCTANCE. RESISTANCE IS FELT WHEN THE MAGNET IS THRUST INTO THE LARGER COIL.

WHAT is inductance? That is a question often asked by students of electricity. The answer that is always ready is that inductance is the total magnetic flux associated with a circuit when the current flowing in that circuit is unity. For example, the inductance of a ring is the total magnetic flux threading the ring when one unit of current is flowing in the ring. If the unit is the ampere the inductance is measured in henries.

But that definition does not tell what inductance is. It merely tells that it is a coefficient of some kind—the ratio of magnetic flux to current. Hence the definition raises two questions:

What is magnetic flux? What is electric current? There is no ready answer to either of these questions.

Another Definition

Another definition is in terms of energy. Inductance is equal to twice the energy stored in the circuit, or about the circuit, when one unit of current flows in that direction. That definition, perhaps, is more elucidating, for energy is the same no matter what form it is in. And we are more or less familiar with mechanical energy. It is work in its technical sense. From the energy point of view, then, the inductance of a circuit is twice the work which must be done on the circuit to establish unit current in that circuit.

Suppose a circuit has an inductance of one henry and one ampere flows in that circuit. It required one-half erg to establish that current. Let us compare that with the kinetic energy of a moving body. Take a pebble weighing one gram—about 15 grains. Let this fall one meter, or 39.37 inches. At the end of its fall it has a kinetic energy of 98,000 ergs, or 196,000 times as much as the energy necessary to start a current of one ampere in a circuit having an inductance of one henry.

Similarity of Form

There is a very close analogy between the formulas for electrical energy and mechanical energy. Suppose the inductance of a circuit is L henries and the current flowing in the circuit is i amperes. The energy stored in the magnetic field is then $\frac{1}{2}Li^2$ ergs. Suppose also that a mass of M grams is moving with a velocity of v centimeters per second. The energy associated with the moving mass is then $\frac{1}{2}Mv^2$ ergs. Thus the two formulas have identical form. The inductance corresponds to mass and current to velocity.

Mass has the property of inertia, that is, the property of resisting changes in velocity. A mass is just as reluctant to stop if moving as it is to start if at rest. Inductance has a similar property with respect to current. It resists equally both increases and decreases in current. For this reason inductance is called electric inertia.

But this comparison between the electric and the mechanical formulas does not say what inductance is. It merely calls attention to the similarity between the properties of inductance and mass, between current and velocity.

As a matter of fact we know no more what mass is than what inductance is. True, we can put a massive body on scales and weigh it. We say it is heavy. But what is that which is heavy Not the material, but the mass. We can measure an inductance just as easily as a mass. And when we get through we don't know what either is. We just know a certain property of each, and that is all we can know about anything.

Every time the question "What is inductance?" comes up, it would be well to supplement it by asking "What is mass?" It is no more difficult to think independently about inductance in terms of its properties than to think of mass in terms of its properties.

Other Similarities

The product of mass and velocity is called momentum. Similarly the product of inductance and current is called electric momentum, or flux. In one case we have Mv and in the other Li for the momenta. Time rate of change of momentum is the electromotive force with which the inductance resists changes in current.

If the mass remains constant, the force is just the rate of change in the velocity, or the acceleration, times the constant mass.

Similarly, if the inductance in a circuit remains constant, the electromotive force is simply the product of the constant inductance and the rate of change of the current.

Thus the time rate of change of the current in a circuit might be called the electric acceleration.

There is a direct way of determining when a certain body has much mass, one that affects the muscle sense. Take a block of light wood of such size and shape that it can he held conveniently in the hand. Swing it back and forth as rapidly as possible. There is not much resistance to the swinging and no great stress on the muscles is experienced. The block of wood is called light. It has a small mass.

Take another block of the same size and shape but made of lead or some other dense metal. Swing that likewise. It is not possible to swing that back and forth so rapidly as the piece of wood, and a great stress is felt on the muscles. That block is called heavy. It has much mass.

Cannot Sense Inductance

There is no such test for inductance, for we cannot take inductance in the hand and swing it. There is no direct way it can affect the senses. But we can observe its effect on an electric current read on an ammeter.

Suppose an inductance coil with air core is connected in series with a meter and a battery. Close the circuit. The current comes up to full value almost instantly. Now put an iron core in the same coil and again close the circuit. The current increases gradually. It takes an appreciable time before it reaches its final value. The inductance is now greater. And the longer it takes for the current to come to maximum value, the greater is the inductance.

Indirectly the inductance may be felt. Suppose an air core inductance coil of many turns be connected with its terminals together. Take a magnetized rod of steel—a very strong magnet. Thrust this suddenly into the coil. A distinct force of resistance is felt. Likewise a resistance is felt when the magnet is suddenly withdrawn. The faster the magnet is moved the greater the force. This is somewhat analogous to the swinging of the heavy lead weight. If the magnet is thrust into a coil of only a few turns the resistance would be much smaller. This would correspond to the swinging of the light block of wood.

Inductance is merely a property of an electric circuit which is analogous to the property of mass in a physical body. Although it is defined as the total magnetic flux in a circuit when unit current flows in that circuit, it is not magnetic flux. It is no more flux than the mass of a body is momentum.

Length or Not?

It is said that the unit of inductance is a length. But that is only in the magnetic system of units. In the electric system of units it is something else. It is also said that a unit of capacity is a length But that is only in the electric system of units. In the magnetic system the unit of capacity is something else.

Both capacity and inductance are simply properties of an electric circuit, and these properties are such that the square root of the reciprocal of the product of the inductance and capacity in any one system of units of measurements gives the frequency with which that circuit oscillates if excited. The properties give us just a little more knowledge if the behavior of electricity itself. And what that is we don't know, either. We only know how it behaves.

HOW CIRCUIT, TWICE TUNED, IS SELECTIVE

A very high voltage gain may be obtained per radio frequency stage if both the primary and the secondary are tuned. But the selectivity under these conditions is very poor, unless the mutual inductance M, in the upper circuit herewith, is very small, when the selectivity is very good. If the mutual inductance, that is the coupling between the two coils, is moderately large, the two tuned circuits form a band pass filter.

The lower circuit in the figure is practically an electrical equivalent of the upper. In this case the coupling between the two circuits is by means of a coil M in place of a mutual inductance.

It is easy to determine the frequencies at which the signal is greatest in the lower circuit. Suppose the circuits K1 and K2 are identical, having inductance L and capacity C. Let M be the inductance of the common coil.

Then one maximum falls at a frequency determined by L and C, adn the other falls at a frequency determinde by L+2M and C. It will thus be seen that presence of M causes a second resonance peak a little below the normal peak. The amount by which this peak comes below the normal peak is determined by 2M.

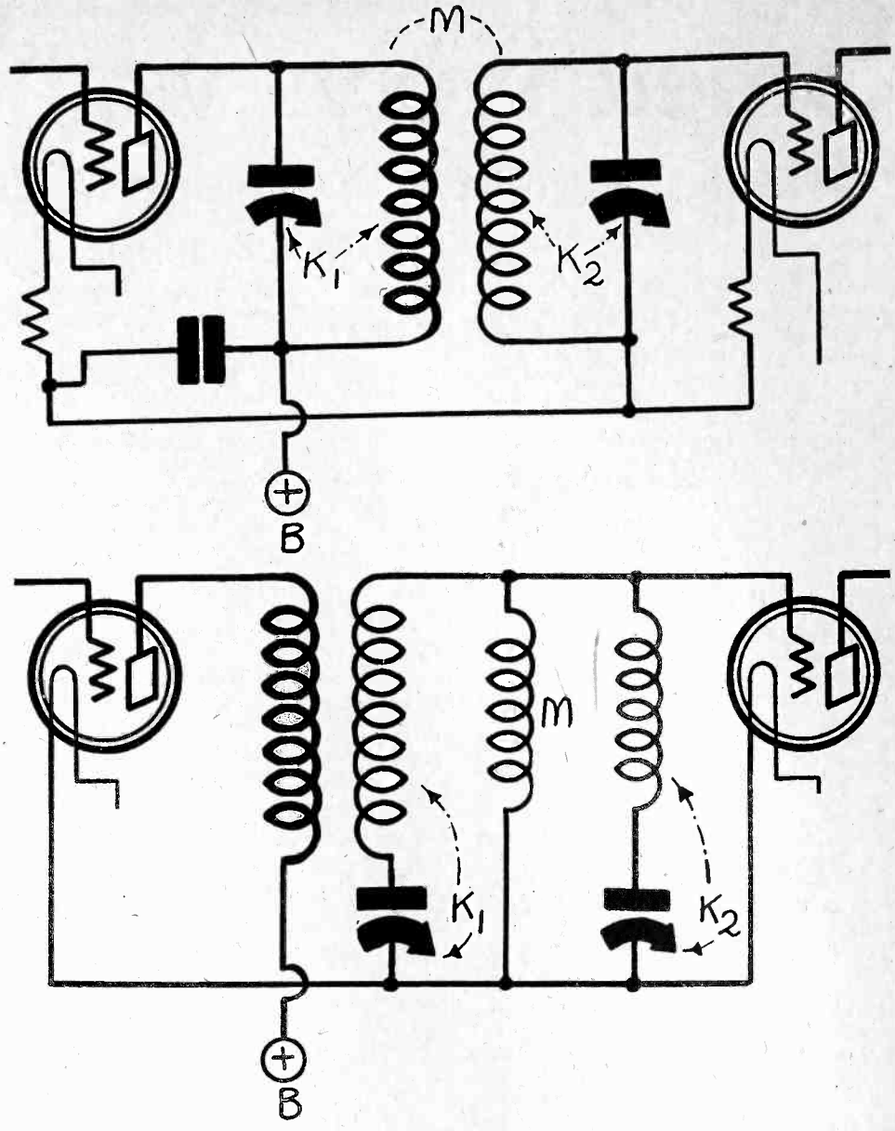
When such a tuning system is used the value of M should be adjusted so that the two peaks come at about 10,000 cycles apart, and the condensers should be set so hat the carrier frequency desired falls half way between the peaks.

When this is done the circuit will be very selective and still it will not cut sidebands. That is, it will retain the quality, although the effective selectivity is greatly increased.

The behavior of the two circuits illustrated is the same, so that the statements concerning frequencies of the peaks apply to both.

The upper circuit is more practical. It consists of two identical circuits placed sothat they are loosely coupled. To vary M between the two equal coils the coils may be placed with their axes parallel and the distance between them altered until the circuits tune satisfactorily.

In connection with the lower circuit it should be pointed out that the grid circuit of the tube should not be connected across circuit K2 but the grid should be coupled by means of another winding. In other words, the coupler should consist of two transformers and a small coupling coil.



AT TOP, PRIMARY AND SECONDARY ARE TUNED. BELOW THERE ARE TWO SECONDARIES, EACH TUNED.

Pointers on Detection By Grid Bias Method

Negative grid bias detection makes for pure tone quality, but this method is more difficult to get working properly than is the leaky-condenser system of detection.

The negative bias for detection always is critical, so that within a couple of volts you may get fine detection or sheer amplification, that is, no rectification. Once the proper point is found, results are excellent. What the negative bias should be will depend on the type of tube, the plate voltage and the plate load—the load being a resistor or an audio coil. With most tubes negative bias detection reduces sensitivity a little, but with the screen grid tube the voltages may be so proportioned that no sensitivity is lost.

Selectivity vs. Volume

How the Search for the Happy Medium is Conducted

By Herman Bernard

A RADIO receiver circuit may be regarded as something that has a certain total weight, in general composed of selectivity and amplification. The disposition of these two principal components is within the control of the circuit designer.

Assuming the same total stages, as the selectivity increases the amplification at radio frequencies decreases. As the amplification at audio frequencies is not affected, greater selectivity always means less volume.

Circuits, of course, will differ. Some will provide more than average selectivity at average volume; others will show a great depression in selectivity and more than average volume. The physical manipulation of the circuit, represented in the tuning device, affects both volume and selectivity. Single tuning control is an example.

Simplicity Reigns

While four years ago many knobs on the front panel were the fashion, the era of convenience was ushered in at about the time the AC tubes appeared, in 1926, and the rage for single tuning control was born.

In factory-made receivers, especially of the tuned radio frequency type, controls are usually limited to three or two.

Where a drum dial knob is centered there are likely to be two extra controls. One may be a trimmer in the antenna coupler stage, the other a combination switch and volume control. Where the tuning knob is off center, the trimmer is likely to be omitted, so that only two controls exist. It is not the accidental placement of the drum knob that determines the number of controls, but the circuit design determines the selection of the dial.

The same choice is afforded to home constructors and custom set builders in the array of circuits now available. For instance, the National drum dial has a center knob, hence calls for two other controls for proper balance, these being necessary in many circuits. The Hammarlund drum has its knob off center, so lends itself gracefully to two-control, where the drum knob is the tuning device and the combination volume control and switch is the other control.

Choice in any instance arises from one's requirements and aversions. Some builders are interested in obtaining the maximum amount of distance. These would use a single dial for each tuned stage, or, if common shaft condenser tuning or other gang system is used, as in the Sargent-Rayment, each stage should be provided with its own trimmer. Only in that way can the full gain be obtained from gang tuning. The rule then resolves itself into single control tuning for locals, and independent adjustment of each trimmer for distance.

Where a Sacrifice Is Made

The trend in factory-made sets is to avoid trimmers, although the drain on selectivity is heavy. To avoid the necessity for independent tuning of the antenna coupler, this is often of a fixed type, so that all the tuned circuits will be almost identical, and free of the effect of the antenna capacity upon the tuning.

Failure to tune the first stage, of course, is a sacrifice of the selectivity that could be gained by tuning with the additional help of a trimmer, but the localized method will bring in the locals, all right, and some distance, as well, at points on the tuning scale where resonance happens. More or less, it just happens in spots, under such conditions, and the low selectivity is due to antiresonance. So even three stages of radio frequency amplification, with first stage not tuned, but the two succeeding stages and the detector input tuned, do not give a very high order of selectivity in some factory-made examples.

Just what choice to make often is puzzling. It is all right to use an untuned antenna input, if the selectivity is provided in the subsequent stages. It is more economical to use a tuning control and trimmer in the antenna stage, since the selectivity will be at least as high with one tube less, due to the helpful tuning of the first stage. The vice of untuned coupling is that it provides amplification without selection. Atonement in the succeeding stages is another way of saying that one tube is devoted to a makeshift chosen for its convenience, and the cost of the tube and its operation is defrayed for the sake of a better equalization of tuning in the other stages.

A Fine Advantage

Just how much selectivity to use and how much amplification, depends on one's desires and on one's location. For areas crowded with stations, higher selectivity is necessary. Hence, with a given number of tubes for RF and detection, the amplification may be balanced against the selectivity to attain a happy medium.

One strong advantage enjoyed by the home constructor and custom set builder is that he can build his circuit to particular needs. In factory-made models a certain result is obtained for a predetermined location condition, as this may be at variance with the actual condition.

One device used for shapening the tuning is a small number of primary turns of the radio frequency transformers, including an antenna coil. This tends to lower the amplification at the lower frequencies—higher wavelengths—hence, the first stage, if untuned, may be broadly peaked at a high wavelength, around 400 meters, to help to level the response over the tuning spectrum. But in the region of the peak the tuning will be broad.

In the audio channel 400 is a fair average of amplification. Not all audio notes are equally amplified, but this has no effect on selectivity, but only on tone quality. The audio notes that are best amplified occur so often in musical and spoken passages that, as to volume, the ear is deceived into accepting the amplification as even. Only individual and sustained strains in the feeble regions impress themselves on the ear as being subnormal.

A long sweep of the bow on a bass viol in slowly descending scale may bring to the ear the realization that the lower the frequency the less the amplification.

However, these immediate considerations pertain to tone quality. Their only incidental concern with selectivity arises when the selectivity is too high, so that the side bands are unduly suppressed at the upper ridges, resulting in drumminess, and absence of the hissing sounds in speech and their equivalents in music.

Due to reasons already explained, side band cutting is not an offense in many modern receivers, for the trend toward simplicity and convenience has been somewhat at the expense of selectivity, hence tuning has small detrimental effect upon the tone in manufactured sets of the TRF type.

The growth in the number of tubes in a set has been due largely the desire to afford sufficient selectivity, rather than greater amplification, although both are obtained, because each extra tuned stage not only increases amplification, but selectivity as well.

Amplification is amplification no matter where it arises, at radio or audio frequencies, hence it increases the volume. By tuning, the selectivity may be increased simultaneously. Therefore, an audio channel amplifying 1,600 times, instead of only 400, makes greater selectivity more practical, since the reduced volume by greater selectivity at radio frequencies is atoned for in the audio channel.

The discussion of the radio frequency amplifier and detector did not take into consideration regeneration. This may be defined as back coupling that reduces the radio frequency resistance of the circuit. The resistance may be reduced to less than zero, but long before that arises the squealing is ungovernable. When the regeneration is accidental it is due to stray feedback and is commonly referred to as oscillation. All three-element tubes have a tendency to oscillate, when the amplification is high, or the circuit arrangement or disposition of parts such as to encourage back coupling. The only such tubes free from oscillation trouble are bad tubes. Therefore, damping devices are introduced, either capacitative, inductive or resistitive, or a combination of these.

The recent suit of the Hazeltine Corporation against Atwater Kent developed that some models of the Ardmore manufacturer have not only capacity neutralizers, but grid suppressors in them, as well.

All neutralizing devices decrease selectivity, even if only a little, and decrease volume, so that much dissipation may take place, but it is in a good cause. Without stability the receiver would be inoperable.

The use of deliberate feedback or regeneration, requiring an adjustable control on the front panel, makes the four-tube receiver practical.

Requirements of Today

Under present conditions merely two tuned stages, even if independently tuned, are not selective enough for even suburban use, much less for use in large cities where stations abound. Nor is such a circuit sensitive enough for the rural districts, where several hundred miles may separate the listener from the nearest station.

Therefore, regeneration, or deliberate feedback control, is used. It increases both sensitivity and selectivity and is the only method for increasing both at the same time without adding another tuned stage. If no regeneration is used, there should be three tuned stages, at least the conventional five-tube set, for instance, with two RF, detector and two audio.

The four-tube circuit, with regeneration, is therefore the most economical of all. Some skill in adjustment of the tickler is necessary, but this is not hard to acquire. Home constructors of radio receivers are well able to get the maximum out of regeneration and can teach others.

Literature Wanted

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

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Selectivity vs. Volume

How the Search for the Happy Medium is Conducted

By Herman Bernard

A RADIO receiver circuit may be regarded as something that has a certain total weight, in general composed of selectivity and amplification. The disposition of these two principal components is within the control of the circuit designer.

Assuming the same total stages, as the selectivity increases the amplification at radio frequencies decreases. As the amplification at audio frequencies is not affected, greater selectivity always means less volume.

Circuits, of course, will differ. Some will provide more than average selectivity at average volume; others will show a great depression in selectivity and more than average volume. The physical manipulation of the circuit, represented in the tuning device, affects both volume and selectivity. Single tuning control is an example.

Simplicity Reigns

While four years ago many knobs on the front panel were the fashion, the era of convenience was ushered in at about the time the AC tubes appeared, in 1926, and the rage for single tuning control was born.

In factory-made receivers, especially of the tuned radio frequency type, controls are usually limited to three or two.

Where a drum dial knob is centered there are likely to be two extra controls. One may be a trimmer in the antenna coupler stage, the other a combination switch and volume control. Where the tuning knob is off center, the trimmer is likely to be omitted, so that only two controls exist. It is not the accidental placement of the drum knob that determines the number of controls, but the circuit design determines the selection of the dial.

The same choice is afforded to home constructors and custom set builders in the array of circuits now available. For instance, the National drum dial has a center knob, hence calls for two other controls for proper balance, these being necessary in many circuits. The Hammarlund drum has its knob off center, so lends itself gracefully to two-control, where the drum knob is the tuning device and the combination volume control and switch is the other control.

Choice in any instance arises from one's requirements and aversions. Some builders are interested in obtaining the maximum amount of distance. These would use a single dial for each tuned stage, or, if common shaft condenser tuning or other gang system is used, as in the Sargent-Rayment, each stage should be provided with its own trimmer. Only in that way can the full gain be obtained from gang tuning. The rule then resolves itself into single control tuning for locals, and independent adjustment of each trimmer for distance.

Where a Sacrifice Is Made

The trend in factory-made sets is to avoid trimmers, although the drain on selectivity is heavy. To avoid the necessity for independent tuning of the antenna coupler, this is often of a fixed type, so that all the tuned circuits will be almost identical, and free of the effect of the antenna capacity upon the tuning.

Failure to tune the first stage, of course, is a sacrifice of the selectivity that could be gained by tuning with the additional help of a trimmer, but the localized method will bring in the locals, all right, and some distance, as well, at points on the tuning scale where resonance happens. More or less, it just happens in spots, under such conditions, and the low selectivity is due to antiresonance. So even three stages of radio frequency amplification, with first stage not tuned, but the two succeeding stages and the detector input tuned, do not give a very high order of selectivity in some factory-made examples.

Just what choice to make often is puzzling. It is all right to use an untuned antenna input, if the selectivity is provided in the subsequent stages. It is more economical to use a tuning control and trimmer in the antenna stage, since the selectivity will be at least as high with one tube less, due to the helpful tuning of the first stage. The vice of untuned coupling is that it provides amplification without selection. Atonement in the succeeding stages is another way of saying that one tube is devoted to a makeshift chosen for its convenience, and the cost of the tube and its operation is defrayed for the sake of a better equalization of tuning in the other stages.

A Fine Advantage

Just how much selectivity to use and how much amplification, depends on one's desires and on one's location. For areas crowded with stations, higher selectivity is necessary. Hence, with a given number of tubes for RF and detection, the amplification may be balanced against the selectivity to attain a happy medium.

One strong advantage enjoyed by the home constructor and custom set builder is that he can build his circuit to particular needs. In factory-made models a certain result is obtained for a predetermined location condition, as this may be at variance with the actual condition.

One device used for shapening the tuning is a small number of primary turns of the radio frequency transformers, including an antenna coil. This tends to lower the amplification at the lower frequencies—higher wavelengths—hence, the first stage, if untuned, may be broadly peaked at a high wavelength, around 400 meters, to help to level the response over the tuning spectrum. But in the region of the peak the tuning will be broad.

In the audio channel 400 is a fair average of amplification. Not all audio notes are equally amplified, but this has no effect on selectivity, but only on tone quality. The audio notes that are best amplified occur so often in musical and spoken passages that, as to volume, the ear is deceived into accepting the amplification as even. Only individual and sustained strains in the feeble regions impress themselves on the ear as being subnormal.

A long sweep of the bow on a bass viol in slowly descending scale may bring to the ear the realization that the lower the frequency the less the amplification.

However, these immediate considerations pertain to tone quality. Their only incidental concern with selectivity arises when the selectivity is too high, so that the side bands are unduly suppressed at the upper ridges, resulting in drumminess, and absence of the hissing sounds in speech and their equivalents in music.

Due to reasons already explained, side band cutting is not an offense in many modern receivers, for the trend toward simplicity and convenience has been somewhat at the expense of selectivity, hence tuning has small detrimental effect upon the tone in manufactured sets of the TRF type.

The growth in the number of tubes in a set has been due largely the desire to afford sufficient selectivity, rather than greater amplification, although both are obtained, because each extra tuned stage not only increases amplification, but selectivity as well.

Amplification is amplification no matter where it arises, at radio or audio frequencies, hence it increases the volume. By tuning, the selectivity may be increased simultaneously. Therefore, an audio channel amplifying 1,600 times, instead of only 400, makes greater selectivity more practical, since the reduced volume by greater selectivity at radio frequencies is atoned for in the audio channel.

The discussion of the radio frequency amplifier and detector did not take into consideration regeneration. This may be defined as back coupling that reduces the radio frequency resistance of the circuit. The resistance may be reduced to less than zero, but long before that arises the squealing is ungovernable. When the regeneration is accidental it is due to stray feedback and is commonly referred to as oscillation. All three-element tubes have a tendency to oscillate, when the amplification is high, or the circuit arrangement or disposition of parts such as to encourage back coupling. The only such tubes free from oscillation trouble are bad tubes. Therefore, damping devices are introduced, either capacitative, inductive or resistitive, or a combination of these.

The recent suit of the Hazeltine Corporation against Atwater Kent developed that some models of the Ardmore manufacturer have not only capacity neutralizers, but grid suppressors in them, as well.

All neutralizing devices decrease selectivity, even if only a little, and decrease volume, so that much dissipation may take place, but it is in a good cause. Without stability the receiver would be inoperable.

The use of deliberate feedback or regeneration, requiring an adjustable control on the front panel, makes the four-tube receiver practical.

Requirements of Today

Under present conditions merely two tuned stages, even if independently tuned, are not selective enough for even suburban use, much less for use in large cities where stations abound. Nor is such a circuit sensitive enough for the rural districts, where several hundred miles may separate the listener from the nearest station.

Therefore, regeneration, or deliberate feedback control, is used. It increases both sensitivity and selectivity and is the only method for increasing both at the same time without adding another tuned stage. If no regeneration is used, there should be three tuned stages, at least the conventional five-tube set, for instance, with two RF, detector and two audio.

The four-tube circuit, with regeneration, is therefore the most economical of all. Some skill in adjustment of the tickler is necessary, but this is not hard to acquire. Home constructors of radio receivers are well able to get the maximum out of regeneration and can teach others.

Literature Wanted

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

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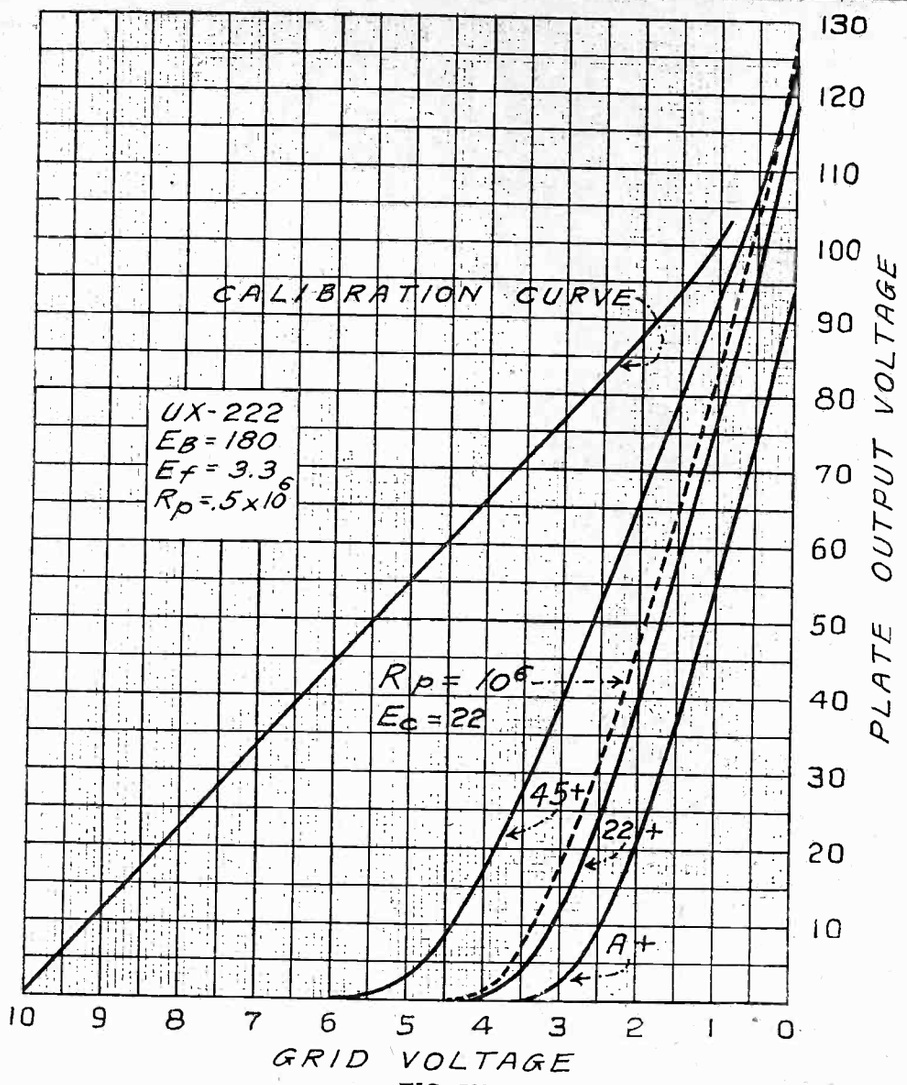

FIG. 720

PERFORMANCE CHARACTERISTICS OF A SCREEN GRID TUBE FOR VARIOUS SCREEN GRID VOLTAGES WHEN WORKING INTO A HIGH RESISTANCE LOAD. CURVES SHOW THE VOLTAGE DROP ACROSS THE LOAD RESISTORS FOR VARIOUS GRID VOLTAGES. REQUESTED BY ARNOLD MOSER.

PLEASE PUBLISH curves showing the output voltage of a screen grid tube when working in a high resistance, space charge fashion.

(2) Would you recommend the use of space charge tubes in a resistance coupled amplifier of high gain?

(3) What, if any, are the disadvantages of this tube when used in a resistance coupled circuit?

(4) Can the tube be used effectively as a grid bias detector when a high resistance load follows the space charge tube?

ARNOLD MOSER,
San Francisco, Calif.

(1) You will find the curves in Fig. 720.

(2) No, not if an even response is essential. The high notes will be suppressed.

(3) The effective input capacity is too high.

(4) No. Particularly not if the tube is preceded by a tuned circuit. The high effective input capacity is in shunt with the tuning condenser and this throws the tuning off. It is also almost impossible to cover the broadcast band because of the excessive zero setting capacity.

* * *

I HAD A SHORT CIRCUIT which blew out all my tubes in an AC set. I suspected that it was one of the condensers which shunted a grid bias resistor.

(2)—What could cause such a blowout? I connected a meter in series with a low voltage battery across this condenser. I got nearly the full voltage reading of the battery. Does not that show that the condenser is short-circuited?

(3)—Is the voltage applied to the heater with respect to the cathode a source of danger?

(4)—Is there any danger of burning out the cathode? FRANKLIN GATES,
Paterson, N. J.

(1)—No, it does not show a short, because the current which was indicated by the reading flowed through the grid bias resistor. To test the condenser the bias resistor should be disconnected before an observation is made.

(2)—A sustained surge of line voltage much in excess of the normal 110 might cause a blowout.

(3)—Yes, it is a constant source of danger if the voltage is too high. Even 45 volts might be much too high for tubes which are slightly defective. If the voltage between the cathode and the heater is too high a current may be established between the two and that current would flow through the heater.

(4)—There is little danger of ruining the cathode.

* * *

I HAVE a four-tube Universal Screen Grid Receiver which is very selective on most stations, but at times there is interference on WEAF. I cannot tune it out because it is loudest when WEAF is tuned in and it tunes in and out with that station. Could you explain this peculiar behavior of the set?

(2)—The interfering signal, although very loud, is not intelligible. Hence I have been unable to identify the interfering station. Could it be a short wave signal which in some way is carried in with the WEAF wave? The trouble does not occur often. WALTER SINCLAIR,
Bronx, New York.

(1)—It may be that one of your neighbors tunes in the interfering station at the time the interference occurs and that your antenna and his are closely coupled. It may also be that a neighbor has a trick receiver using an intermediate frequency equal in frequency to WEAF. This receiver may radiate the intermediate frequency.

(2)—Yes, it may be a short wave signal. This short wave signal may be tuned in with the trick receiver mentioned above.

* * *

WILL YOU kindly explain the following phenomena? I set up an oscillator the frequency of which happened to be around 10,000 cycles. I could hear the oscillation although I used no loudspeaker or headset. How did the sound get into the air? WILFORD BAILEY,
Chicago, Ill.

(1)—The oscillating tube often acts as a loudspeaker at such high audio frequencies. Also many other parts of the circuit may vibrate, such as transformer and choke laminations and cases.

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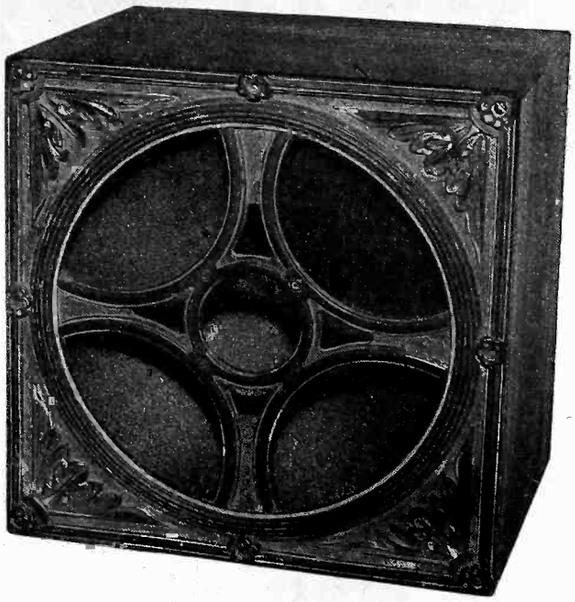
THE super-sensitive and acoustically faithful twin magnet POLO UNIT in a de luxe housing, with moulded metal front piece, makes a first-class table model speaker. It will stand the heaviest load — even two 250 tubes in push-pull without rattling—yet is so sensitive it will work well from *any* output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

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

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



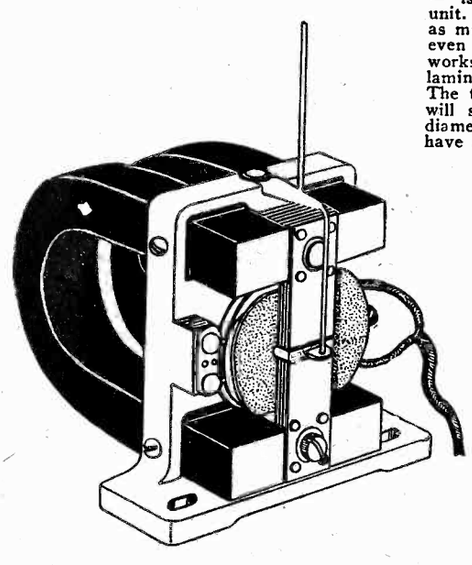
The Table Model Polo Speaker, an outstanding example of the magnetic type of speaker, is shown one-third actual size.

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

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

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

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



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

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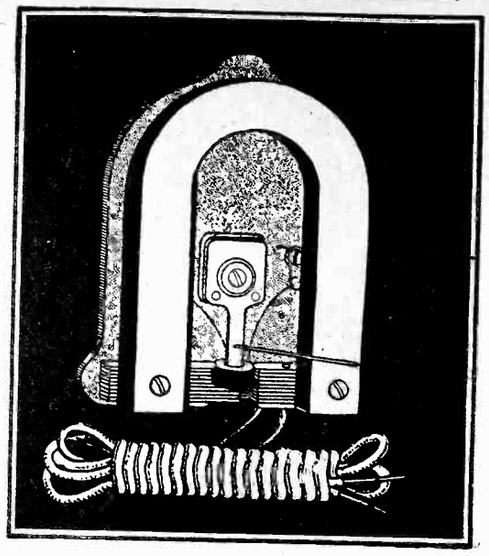

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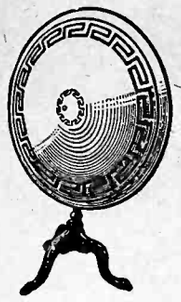

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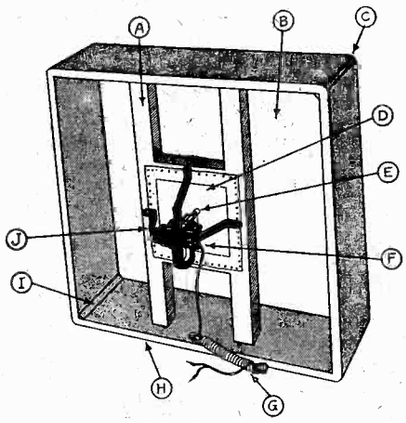

The HBH Speaker has imported Irish sheer linen front diaphragm for best tone and an HBH unit that is the most sensitive.

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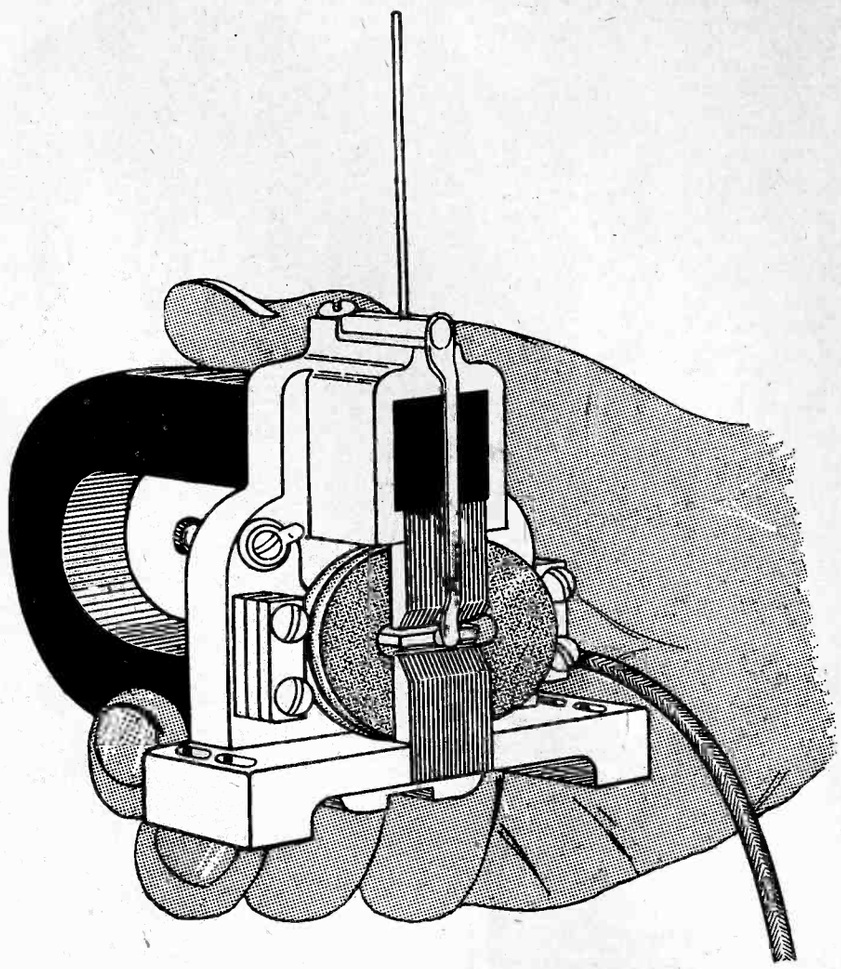

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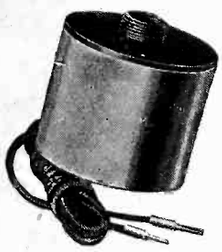

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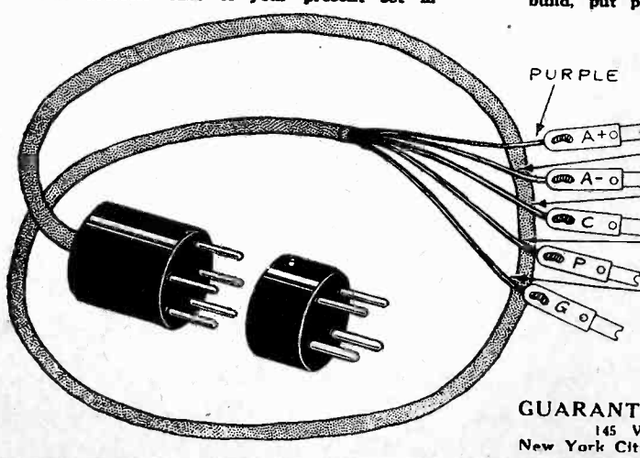

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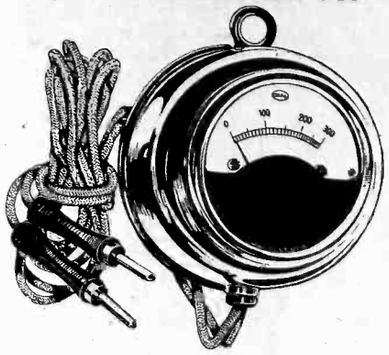

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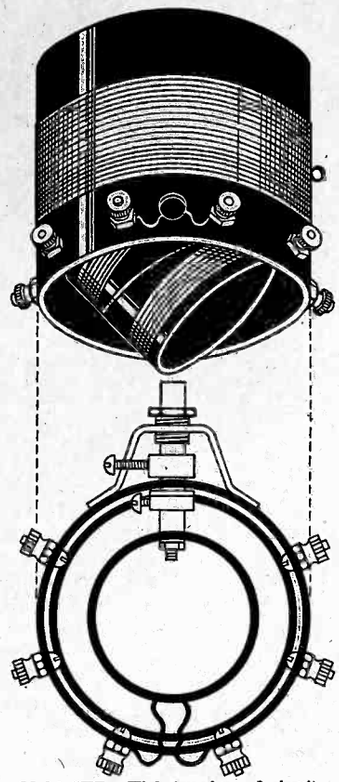
HOW TO USE SCREEN GRID COILS



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

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

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

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

Model 5TPS Interstage coupler to screen grid tubes, with inductive trimmer. For .0005 mfd. $2.25

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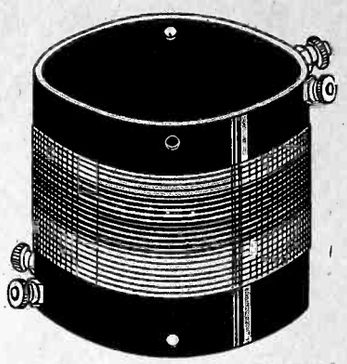
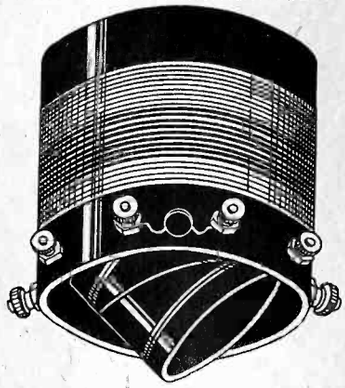
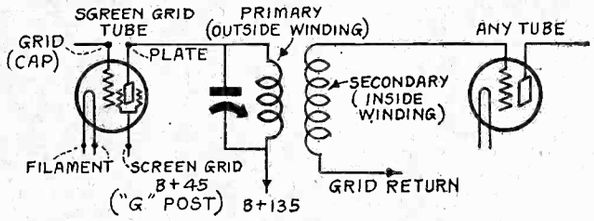


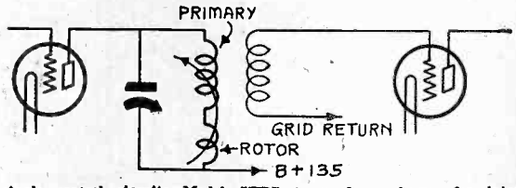
Model 5A. Conductively coupled antenna coil for input to screen grid radio frequency amplifier. For .0005 mfd. condenser. Price $1.75
Model 3A. Same as above, but for .00035 .....$2.00



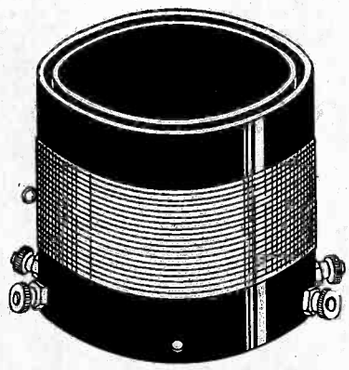
Model 5AS. Conductively coupled antenna coil for single tuning control screen grid sets. Rotor is an inductive trimmer. For .0005 mfd. $2.75
Model 3AS, same as above, but for .00035 .....$3.00



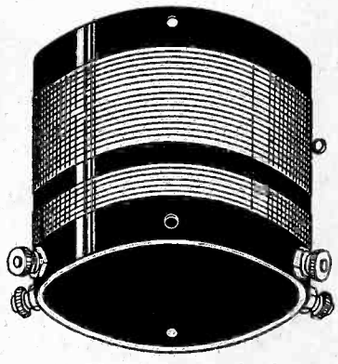
How tuned primary in plate circuit is wired for a screen grid tube. This illustrates the use of Model 5TP or 3TP, also Model 5HT and 3HT, except for the rotor coil connections.



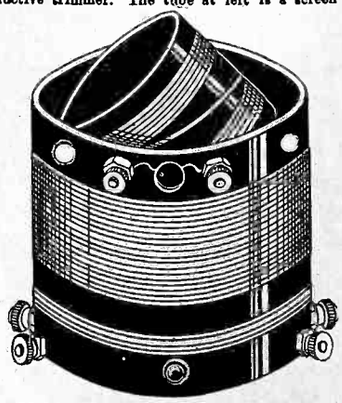
In single control circuits Model 5TPS is used as shown, for interstage coupling. The rotor is an inductive trimmer. The tube at left is a screen grid.



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



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



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

Coils for Other Than Screen Grid Tubes

When any tubes other than screen grid tubes are used as radio frequency amplifiers, standard coils are used, for instance Models T5 and T3, the three-circuit tuner shown above at right.

For the antenna coil in such a circuit use one with two separate windings, the familiar radio frequency transformer, with about 14 turns on the primary. This RF transformer is therefore used as antenna coil and as an interstage coil.

The resultant loose coupling of antenna reduces the capacity effect of the antenna and thus the standard TRF coils, with 201A, 112A, 226, 227, 199 or 240 tubes, providing the same RF tubes are used throughout, may be used in single control sets without trimming devices. This is true if the coils are absolutely matched, as Models RF5 and RF3 are.

The small winding (primary) is connected in the antenna-ground circuit, or, for interstage coupling, in the plate circuit. The large winding (secondary) is tuned and is put in the grid circuit.

Model RF5. Antenna coil or interstage coupler for any and all tubes, excepting only screen grid tubes. For .0005 .....$1.00

Model RF3, same as above, but for .00035 .....$1.25

Model T5, standard 3-circuit tuner for .0005 .....$2.25

Model T3, standard 3-circuit tuner for .00035 .....$2.50

USE THIS COUPON

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

(Specify Quantity in the Squares)

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

☐ Model..... ☐ Model..... ☐ Model..... ☐ Model..... ☐ Model.....

Name .....

Address .....

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

SEND NO MONEY!