

March 30th, 1929

15 Cents

RADIO

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WORLD

The First and Only National Radio Weekly

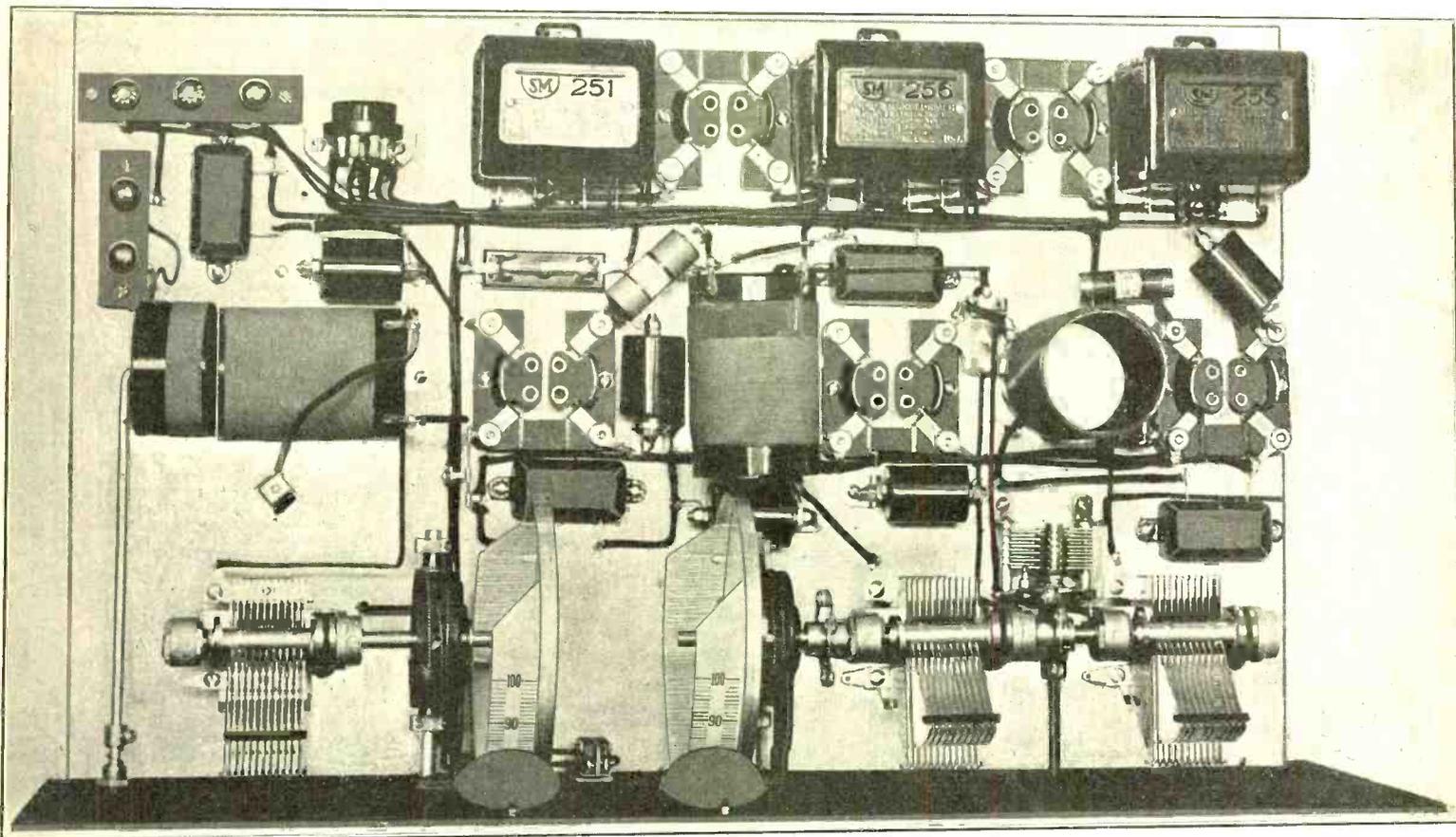
366th Consecutive Issue—Eighth Year

Push-Pull 245s
in Screen Grid Set!

The Four Types
of Filter Circuits!

AC Diamond
Construction!

MOORE-DANIELS 5-TUBE DX-GETTER!



View of the Moore-Daniels. See Page 17 for Article.

456%
MORE AC
SETS SOLD

FULL
PROGRAMS
ON RECORDS

NEW
LICENSES FOR
STATIONS

COURT
WRITES ON
INTERFERENCE



Radiola 28

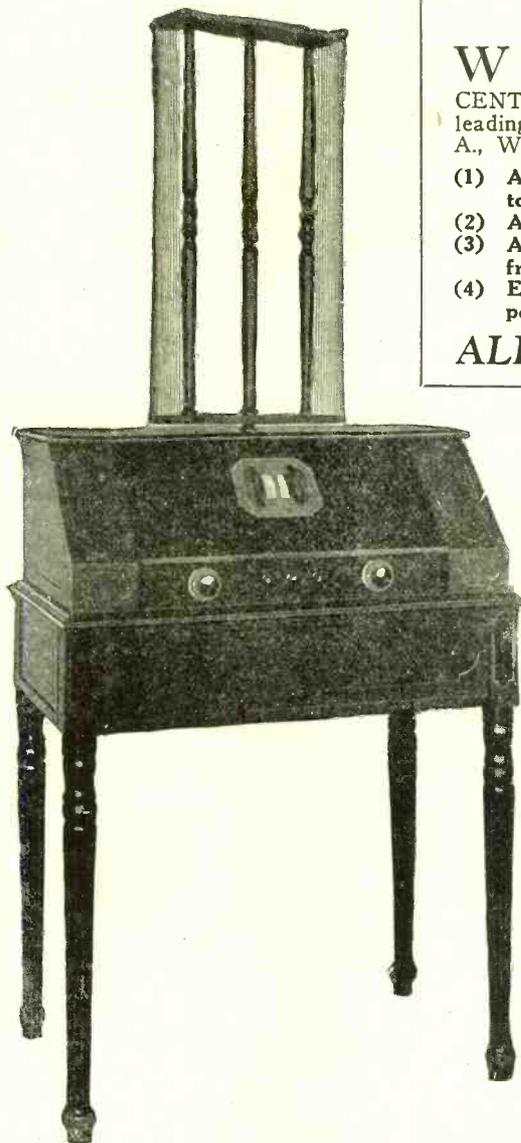
8-Tube Super-Heterodyne,
Always Sold at \$260.00
Our Price While They Last **\$75!**

See All You Get for Only \$75.00

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

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

ALL IN A FACTORY SEALED CARTON!



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

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

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

And when you turn on the set—oh, what a thrill! The most sensitive receiver design is yours, and how proud you are of your smart "buy"! In all the length and breadth of the United States—indeed, all the world over—there is no bigger or better radio bargain than this! A Super-Heterodyne! Eight tubes! Self-contained operation! (No outdoor aerial needed!) You

can move this receiver, with the self-contained A and B sources and speaker you furnish, into any room—so conveniently—and there she plays, beautifully, clearly!

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

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

The Thirteen Lucky Features!

- 1 Radiola 28 uses the famous RCA 8-tube Super-Heterodyne circuit which gives remarkable sensitivity, selectivity, volume and quality of reproduction.
- 2 Unusual selectivity is provided which permits the separation of powerful broadcast stations even when the Radiola 28 is located in their immediate vicinity, this selectivity having been carried to an extremely fine degree by the employment of two stages of tuned radio frequency amplification ahead of the oscillator circuit. Only one control is required for these two tuned circuits, illustrating the extreme manufacturing precision employed on RCA Radiolas.
- 3 The extreme sensitivity of Radiola 28 makes it possible to receive over great and unusual distances under favorable conditions.
- 4 Audio frequency transformers have uniform acoustical properties.
- 5 Ideal for country clubs, lodges, auditoriums or living rooms in the home.
- 6 The "Uni-Control" tuning mechanism has been grouped in the center of the sloping panel, and is surrounded by a bronze escutcheon plate of fascinating appearance.
- 7 The rotating loop gives additional selectivity in that it may be turned at right angles to undesired, interfering signals. The loop fits into a specially designed socket.
- 8 The set is extremely easy to operate. Tuning is accomplished by moving the "Station Selectors," which takes the form of two drums, calibrated in kilocycles. For most purposes, local or distant stations can be tuned in by operating both drums together as a unit, with a finger. The two drums may also be operated separately for extremely fine tuning. Thus we have a radio receiver with true uni-control.
- 9 Radiola 28 can be readily moved from room to room as no external connections for batteries, aerial or ground are necessary.
- 10 Station call letters may be marked on the Station Selector Drums.
- 11 The "Volume Control" provides regulation without detuning.
- 12 All the parts are enclosed and sealed in a strong metal case or "catacomb."
- 13 Radiola 28 is equipped with "straight line frequency" condensers. The figures of the station selector drums are spaced 10 kilocycles apart. Each division on the drums corresponds to a broadcast station.

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

Please send me at once one 8-tube Radiola 28 Super-Heterodyne, in solid mahogany cabinet, with solid mahogany table, fixed RCA loop, seven RCA Radiotrons UX199, and one Radiotron power tube UX120. All in a factory-sealed carton, at only \$75.00.

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

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

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

Name

Address

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

THIS OFFER REVOCABLE WITHOUT NOTICE!

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

GUARANTY RADIO GOODS CO.

145 West 45th St.

Just East of Broadway

N. Y. City

Choose Your Speaker from This Complete Array!

EXPONENTIAL TYPE HORNS

Modern acoustical science is striving to equal the performance of a large air column horn with powerful unit, while the horn enjoys its rightful popularity with trained experts. The larger the horn, the better, hence we offer two models: one with 7 1/2 ft. tone travel, the other (where space permits) with 10 ft. tone travel. The material used is patented Racon. Nozzle is standard size.



Cat. 200
\$7.50 Net

This horn has a 92-inch air column. No resonance peaks. Front, 18"x18" Depth, 13 1/4". Weight, 5 lbs.



Driving motor, the unit needed to work the air column horns. Standard size thread. Cat. 203. Price, \$3.50 net.



Cat. 300
\$10.50 Net

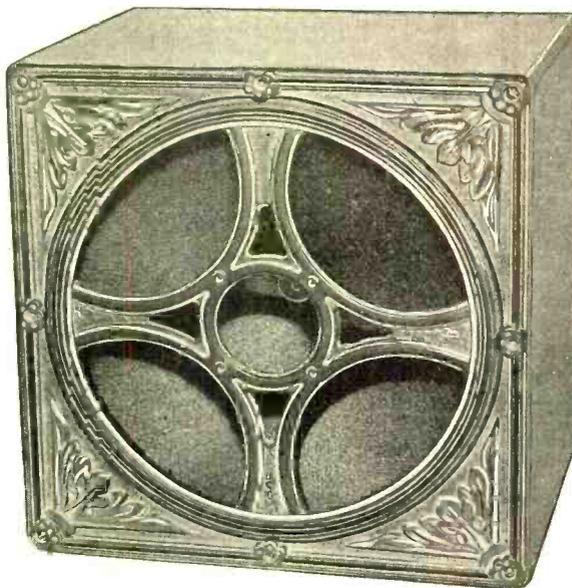
The larger horn is preferable, where space permits. Air column, 120". Front, 18"x18". Depth, 13". Weight, 7 lbs.

DYNAMIC CHASSES and Baffle

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

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

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

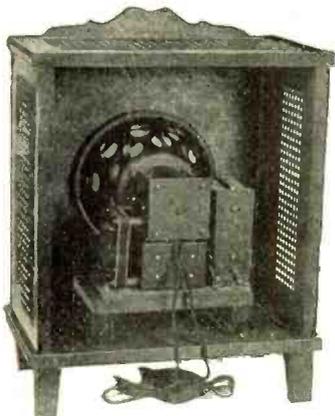


Cat. 113
Price, \$13.50 Net

New Model Polo Speaker, with 1-ply veneer walnut housing, milled, decorated metal front piece, and containing Polo Twin Magnet Unit and Textile Cone. All ready to play. Stands 150 volts without filtering. Will work fine from any output tube, from 201A to a pair of push-pull 20s, without rattling.



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



Cat. 111; Price, \$11.00 Net

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

FILL OUT AND MAIL COUPON

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

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

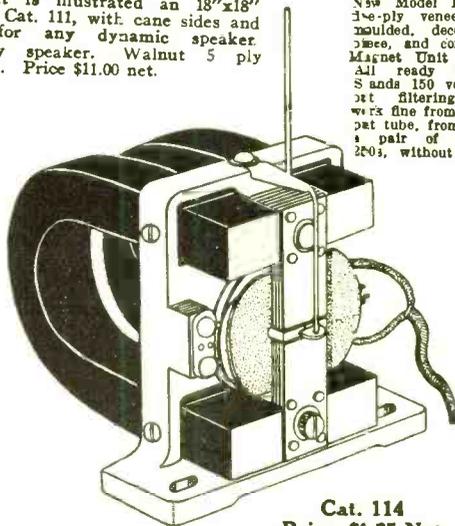
- | | |
|--|---------------------------------------|
| <input type="checkbox"/> Cat. No. 200 | <input type="checkbox"/> Cat. No. 111 |
| <input type="checkbox"/> Cat. 300 | <input type="checkbox"/> Cat. No. 113 |
| <input type="checkbox"/> Cat. No. 110 A.C. | <input type="checkbox"/> Cat. No. 114 |
| <input type="checkbox"/> Cat. No. 110 D.C. | <input type="checkbox"/> Cat. 114A |
| <input type="checkbox"/> Cat. No. 6 D.C. | <input type="checkbox"/> Cat. 115 |
| <input type="checkbox"/> Cat. No. 300 | <input type="checkbox"/> Cat. No. 118 |
| <input type="checkbox"/> Please send C.O.D. | <input type="checkbox"/> Cat. No. 203 |
| <input type="checkbox"/> Remittance enclosed. Please send prepaid. | |

Name

Address

City State

5-DAY MONEY-BACK GUARANTEE



Cat. 114
Price, \$4.25 Net

Polo Twin Magnet Unit—weight, 3 1/2 lbs., or twice as heavy as ordinary unit. Twin magnets double sensitivity. This unit gives more volume, clearer tone, and stands the gaff. Supplied with 10-ft. cord. Cat. 114. Tri-foot molded unbreakable metal mounting bracket and apex constitute Cat. 114A @ \$0.75.



Cat. 115; Price, \$11.50 Net

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

QUIET HAVE PERFECT RADIO RECEPTION WITH **SI-LEN-SER** A TRUTONE PRODUCT

LINE NOISE ELIMINATOR

The SI-LEN-SER makes any electric or any electrified radio play as quietly as any battery operated receiver. It silences all stray line noises which enter the receiver through the power packs of electric sets and eliminators. It eliminates A.C. hum and all knocks and noises that emanate from electric refrigerators, oil burners and other electric household apparatus. When not due to aerial pick-up, it

KILLS LINE NOISES

The SI-LEN-SER is absolutely universal. It may be used on A.C. or D.C., 110 volt, 120 volt or 32 volt farm lighting systems **\$12.50**

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114-16 Worth Street St., N. Y. C.

NEWS to Set Builders

LATEST RADIO GUIDE

Barawik offers set builders bigger bargains — bigger opportunities to make money this season. New sets, new kit ideas, all the leading parts, dynamic speakers, supplies, etc. Lowest rock-bottom prices. Bigger stocks, quicker service. Send for Big Bargain Book today—free.

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Tubadapta prolongs life of power tubes. Used in last stage.

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Moore-Daniels Coils-Kits-Parts-Sets

Blue Prints \$1.00

MOORE RADIO CO.
74 Cortlandt St., N.Y.C. Suite 302

SM Audios—Positively Guaranteed Superior



The same unchangeable purity and fidelity of tone, which has established S-M supremacy even more firmly this year than ever before can be built into any receiver or amplifier by using the new S-M Clough-system audio transformers. Guaranteed absolutely and unconditionally to surpass, in their uniform amplification of all notes from 5,000 down to 40 cycles, any other transformers obtainable on the American market at any price, these unique instruments make use of a principle totally different from anything used in standard transformer construction—built-in resonance to even out the amplification curve in the critical range which ordinary transformers weaken—and a circuit which keeps D.C. plate current entirely out of the transformer winding and thereby avoids the common injurious effect of hysteretic distortion. Amplification obtainable—running as high as 4½ to 1—is far higher than with any standard transformers of comparable tone quality.

255 and 256, for standard use in first and second stage respectively. Each **\$6**

251 Output Transformer..... **\$6**

Also a full line of push-pull transformers and chokes.

SILVER-MARSHALL, Inc.
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N. Y. Representatives: F. Edwin Schmitt, Inc., 136 Liberty St., New York, N. Y.]

NOW ELIMINATE INTERFERENCE

Trans-continental Wave Control



Gets distance by cutting out powerful locals. Will work on any set. Reduces static. Simplicity itself to operate. Ruggedly built.

PRICE \$2.50

Transcontinental coils are used in the Moore-Daniels Receiver.

If your dealer does not stock wave controls or coils, order direct.

Write for data.

TRANSCONTINENTAL COIL, INC.
GOTHAM ENG. & SALES CO.
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VICTOREEN Super Coils



Write for Free Blueprints of New Victoreen Circuits

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2825 Chester Avenue
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"Look for the Green Box"



Radio Tube Long Life Best Tone

Made by Expert Tube

The Only Tubes with 5-Day Money-Back Guarantee in Each Box

222 Screen Grid Tube **\$3.50**



AFTER having tried many screen grid tubes, many specialists have made Kelly 222 their choice. Our 222 stands up! Filament is not critical, but 3.3 volts work best. Plate voltage may be from 90 to 180, but negative bias of 1.5 volts remains the same. The screen grid voltage, G post of socket, may be 22 to 45 volts, depending on how much amplification you want. A working amplification of 60 is easily obtainable (60 mu.).

The plate current is virtually independent of plate voltage in the recommended range, 90 to 180 volts. This aids stability.

The cap at top of the tube is for familiar grid connection.

This tube is for battery or A-eliminator operation.

240 High Mu Tube **\$1.25**

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

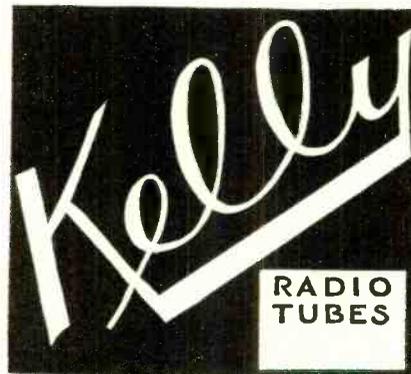
POWER TUBES

250.....	\$6.00	210.....	\$4.50
171A.....	1.50	112A.....	1.50

OTHER TYPES

28J.....	\$2.50	281.....	\$3.50
227.....	2.25	226.....	1.25
201A.....	1.00	199.....	1.25

KELLY TUBE COMPANY
57 DEY STREET, NEW YORK CITY
Suite 6 Tel. BARclay 8659



"Look for the Green Box"

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RADIO WORLD

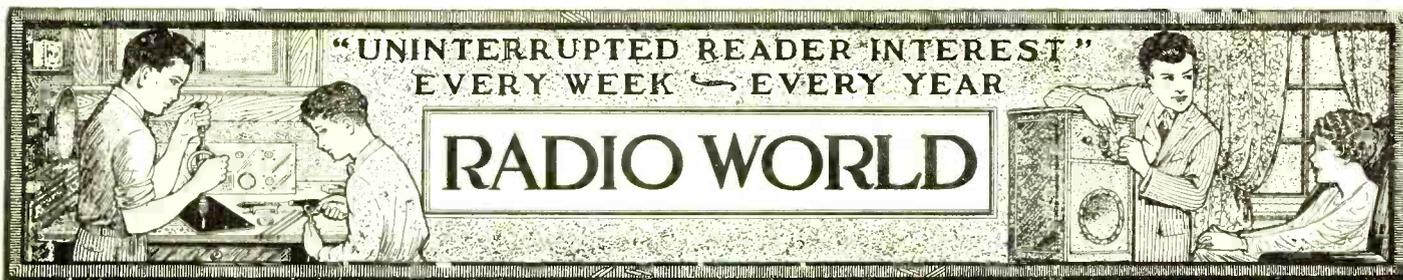
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145 West 45th Street, New York City
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 March 30th, 1929
 15c per Copy, \$6.00 per Year
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Latest News and Circuits
 Technical Accuracy Second to None
EIGHTH YEAR

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

BILL APPROVED FOR FIXING OF RESALE PRICES

The electrical and radio manufacturing industries are heartily in accord with the purpose of the Fair Trade Act legalizing the fixing of resale prices on staple products which Representative Kelly (Rep.), of Edgewood, Pa., proposes to sponsor in the House. Alfred E. Waller, managing director of the National Electrical Manufacturers Association, so stated.

"The vice of predatory price-cutting is undermining the business structure of fair competition and is inimical to the interest of both public and producer," said Mr. Waller.

"In many instances manufacturers have been forced to cheapen their products to lower their costs and thus attempt to meet the ruinously low prices that result from competitive price warfare.

Called Fire Hazard

"The result is a vicious circle of cause and effect which often wipes out the manufacturer's legitimate profit, destroys fair competition and exposes the public to fire and casualty hazards due to the manufacture of merchandise below the accepted safety standards of the industry."

Speaking on behalf of the Radio Division of the Association, Mr. Waller declared that the proposed legislation would be especially beneficial to the radio manufacturing industry by permitting contracts governing the sale of identified goods at a fair and uniform price to the public. The rapid growth of the radio industry has made it difficult to arrive at stability in merchandising, and to avoid the dangers of "dumping" and reckless price cutting.

Sees Improvement

The legalizing of resale price maintenance under the proposed Fair Trade Act would immediately improve the economic condition of the industry and protect the individual purchaser against fraudulent sales, he added.

Schedule of Jenkins Televised Movies

Radio movies are broadcast every Monday, Wednesday and Friday, at 8 p. m., Eastern Standard Time, from the Jenkins Laboratories of Washington, D. C. They are sent out on two channels simultaneously, namely, 6,420 kc (46.72 meters) and 1,650 kc (186.92 meters). The pictures are of the 48 line type and the speed is 15 pictures per second.

Craven Quits Board; Back at Navy Work

Washington.

Lieut. Commander T. A. M. Craven, technical adviser to the Federal Radio Commission on short-wave communications, returned to the Navy for regular duty on March 15. His services had been loaned to the Commission to assist it in the allocation of both continental and transoceanic channels.

In connection with Commander Craven's transfer, it was stated at the Commission that probably he will not be succeeded by another Naval officer because the Commission has specific appropriations for the maintenance of an engineering division made up of civilian personnel.

STATIONS MUST ASK LICENSES

All operators of broadcasting stations have been notified by the Federal Radio Commission that they must file with the Commission applications for renewal of their broadcasting licenses not later than March 30th. The present licenses of broadcasting stations, totalling approximately 600, expire on April 30th, 1929.

The full text of the notice follows:

To all persons holding licenses to broadcast: Your district Supervisor of Radio has been requested to forward you applications for renewal of your broadcasting station license. If you have not received form 37, please advise your Supervisor or this office at once.

The Radio Act of 1927 requires that: "Upon the expiration of any license, upon application therefor, a renewal of such license may be granted * * * The licensing authority may grant station licenses only upon written application therefor addressed to it."

If you desire to continue the operation of your broadcasting station after the expiration of the present license period, i. e., 3 o'clock a. m., Eastern Standard Time, April 30th, 1929, you are, therefore, directed to fill out the renewal applications and submit them in duplicate to the Supervisor of Radio for transmittal to this office.

These applications should be received not later than March 30, 1929.

LACAULT'S LAST CIRCUIT!

R. E. Lacault, designer of the *Ultradyne*, *Strobodyne*, *R. E. L.* and other famous circuits, died recently, just as he completed his latest and greatest circuit. It will be published in *Radio World* next week, issue of April 6th.

LONG PROGRAM ON WAX HELPS SMALL STATION

Syracuse, N. Y.

The Federated Broadcasting System recently brought to the audience of WSYR the first public presentation of complete continuity programs recorded on special records adapted exclusively for broadcasting use. Many broadcast station owners assembled in a banquet room in Syracuse Hotel heard the programs under actual broadcast reception conditions.

The features broadcast were "The Southern Syncopaters," sponsored by Central New York Distributors of Atwater Kent radio receivers, and "Elephant Caves of Bombay," from the "Library of Legend" series.

It was stated over WSYR that this and many other stations would make regular presentations of Federated System programs in the near future as a daily feature.

Favorable Reaction

The programs presented were made under the supervision of William A. Thomas, chief engineer of the Acoustic Products Company, who developed the apparatus and processes employed.

The listener reaction to the programs was entirely favorable, according to a statement by an official of the station. Surface noises usually associated with reproductions of commercial records were at no time in evidence.

By this system records are made exclusively for broadcasting. Each replica of the original is played only once and then destroyed. But one record is made for each station wishing to broadcast the programs. The records contain their own announcements and each record runs continuously for fifteen minutes.

Boon to Small Stations

The system is very flexible in that station managers may select from the best available talent and material suited to the needs and tastes of the locality of their stations. The small stations, it was said, will no longer be handicapped by lack of program material or economic considerations.

D. D. HUGHES APPOINTED

Washington.

The Federal Radio Commission has announced the appointment of Donald D. Hughes, of Dayton, Ohio, a member of its Legal Division, and Paul Segal, of Denver, Colo., as assistants to the General Counsel, Bethuel M. Webster, under the provisions of the White-Watson Act which was passed during the closing days of the last session of Congress.

MUSICIANS GET THIRD OF THEIR PAY FROM AIR

Musicians in the United States owe more than a third of their income to radio.

A report issued by George Engles, director of the National Broadcasting and Concert Bureau and also one of the leading managers in the concert field, shows that out of a total of \$30,000,000 spent on music in the United States during the past year, the broadcasting companies have contributed fully \$11,000,000. These figures do not include what musicians received for recordings.

Highest Point Ever

"Radio expenditures have brought the national total for music up to the highest point in the country's history," Engles states. "The most spent on music previously, exclusive of radio, has been about \$20,000,000 in a year. That amount covers both box-office receipts and subsidies of public-spirited citizens who shoulder the deficits of symphony orchestras and opera companies.

"The distribution of musical expenditures among artists has been made much more democratic by radio. In former years the lion's share has gone into the purses of less than twenty of the first-rank artists. Three of these artists alone totaled \$1,000,000 in box-office receipts last season. But with the broadcasting companies utilizing thousands of musicians, a far greater number of lesser known artists are enabled to earn a comfortable livelihood.

NBC Presents 5,000 Monthly

"The National Broadcasting Company alone presents 5,000 before its microphones monthly. This company and its clients spend over \$4,000,000 annually on talent, nearly half of the grand total of \$11,000,000 contributed to music by the country's broadcasting companies."

Other figures revealed by Mr. Engles in his report show that of the \$20,000,000 spent on music exclusive of radio broadcasting—that is, for concert hall and operatic performances—\$6,000,000 goes to the country's thirteen major symphony orchestras. About four million goes to the two leading opera houses, the Metropolitan and Chicago. The remainder goes to individual artists, Summer concert orchestras, and the few minor opera companies.

British Operators'

Book Is Revised

The official "Handbook for Wireless Telegraph Operators Working Installations Licensed by His Majesty's Postmaster-General," (15c) revised in accordance with the Radiotelegraph Convention of Washington 1927, is now available. It may be obtained by writing The British Library of Information, Room 1003, 5 East 45th St., New York.

The booklet is not only valuable to operators of British ship and land stations but to all operators who have any business relations with these stations. It contains the Morse International code and all the standard abbreviations used in radio telegraphy.

Cabinet Members Heard Weekly

Members of the cabinet of President Hoover are included in the series of programs "Half Hours with the Senate," broadcast each Friday at 10:30 P. M. (E. S. T.) over a coast-to-coast network of the National Broadcasting Company.

Ray Lyman Wilbur, Secretary of the Interior, will be heard March 29th. Also speaking during this program will be Senator T. H. Caraway (Dem.) of Arkansas.

The Attorney General of the United States, William D. Mitchell, will be heard April 19th.

TAFT REFUSES TO STAY WGY

Washington.

Chief Justice W. H. Taft, in United States Supreme Court, denied a motion of the Federal Radio Commission to stay the mandate of the Court of Appeals of the District of Columbia ordering that WGY, operated by the General Electric Company, at Schenectady, N. Y., be given full-time operation, despite a decision of the Commission placing the station on limited-time operation.

The Federal Radio Commission granted to WGY a renewal of its license to operate full time on 790 kc. with 50,000 watts. The action was pursuant to the order of the court of Appeals of the District of Columbia, which directed the Commission to issue to the station a license. WGY has been operating without a license, but under the order of the court.

Channel Kept Clear Even When Not Used

Washington.

The Federal Radio Commission has denied the application of WAAT, Jersey City, N. J., for the use of 1,070 kc after midnight, Cleveland time, when WTAM, Cleveland, signs off. WTAM has been assigned this frequency as a cleared channel, and WAAT is licensed to operate with 300 watts until sunset in Cleveland. WTAM opposed the application on the ground that, while it usually signs off at midnight, it often continues beyond that time with special programs, tests and try-outs of new talent.

WBAL, Baltimore, which operates on 1,060 kc, also opposed the application on the ground that it now suffers cross-talk.

License Is Renewed for Wave Wobbler

Washington.

The Federal Radio Commission granted the application of WSGH-WSDA, Brooklyn, N. Y., for renewal of its broadcasting license.

WSGH-WSDA was cited by the Commission to show cause why its license should not be revoked because of deviation from its assigned frequency in violation of Commission regulations. William A. Leahy, Washington attorney, appearing for the station, declared that modern control equipment has been installed to correct the fault of deviation.

PUBLIC MUSIC TASTE PRAISED BY DAMROSCH

Walter Damrosch in an interview said that his radio audiences are displaying "an amazing intelligence." Their requests for special works, he says, show an appreciation of the finest in symphonic music.

"In fact," he said, "they are exhibiting such a growing appetite that I have decided to perform next Winter a complete symphony once each month in my General Electric series. Portions of symphonies no longer satisfy them.

Marvelous Growth

"The growth of interest and knowledge of symphonic music during the three years that I have been giving radio concerts is little short of marvelous. In the beginning I avoided playing the more intricate compositions, though I have never played anything over the air that I would not perform at Carnegie Hall.

"I felt during those early months that I must throw my crumbs a long way to entice the birds without frightening them. Now these birds of the radio audience are entirely unafraid. They are ready to come, some 8,000,000 of them, more than halfway for any musical fare I offer them. They eat out of my hands and alight on my shoulders as intimately and confidently as the doves of St. Marks. I feel that they are capable of digesting and appreciating practically anything in the symphonic repertoire. They are not even frightened off by modern music.

Encouraging Results

"It is encouraging evidence of what is taking place. From the first I was confident the radio would bring about a new era in the history of symphonic music in this country. But I had no idea the results would become apparent so quickly. Radio audiences, I feel, are equal to exactly the same type of symphonic program that is given in our metropolitan concert halls."

Tone Is Improved by Using Resistor

Many fans with old-time sets have envied the clear, rich tone produced by the newest in modern receivers. Comparing their own output, they find it scratchy, husky, hoarse and muffled. This may be due to many causes, chiefly old-fashioned audio transformers. However, an alert service man reports that he cured a bad case of this kind by simply placing a Volume Control Clarostat across the secondary of the first audio transformer, adjusting the knob for maximum quality and clarity, thus earning the undying gratitude of his customer.

This is a good tip to pass along to fans similarly troubled and those, also, with new sets which may act the same way due to tubes overloading.

FRESHMAN-F.E. IN NEW OFFICE

The Freshman and Freed-Eisemann executive offices are now located on the 16th floor of the new Chanin Building, Forty-second Street and Lexington Avenue, New York City. These offices cover 10,000 square feet.

PERCENTAGE OF AC SETS SOLD GAINS GREATLY

The number of AC receivers sold in 1928 increased 456 per cent over 1927, according to a statement issued by Edgar H. Felix, radio consultant of the National Electrical Manufacturers Association.

This increase is indicated by the January 1st quarterly survey of stocks in the hands of radio dealers and gross sales, prepared by the Department of Commerce in cooperation with the Radio Division of NEMA. The total number of AC, DC and battery sets sold by radio dealers increased from 1,558,040 in 1927 to 2,196,242 in 1928.

Some of the increase in the sale of AC sets is accounted for by the reduced sale of battery powered sets, which sale fell from 1,143,031 in 1927 to 303,435 in 1928, from 73.4 per cent of the total set sales to only 13.9 per cent., all in one year.

Accessories Much Less

This reduction in battery set sales has an important bearing on total retail sales, as each battery receiver requires accessories having a value usually equal to that of the receiver itself.

The reduced sale of accessories, lower price of tubes sold with sets, and the tendency to make receivers complete with loudspeaker and radio furniture, has concentrated most of the sales in the products of receiver manufacturers and greatly reduced the accessory business.

Receiver Prices Lower

Furthermore, the average price of receivers has fallen off so that the retail dealer must sell more sets to make the same profit than he did formerly.

The average sales made per receiving set sold have decreased from \$231 in 1927 to \$158 last year. In fact, the survey shows a retail sale of \$342,536,848 for 1928 as compared with \$360,258,135 for 1927.

Literature Wanted

- A. H. Murray, 873 Dewey Ave., Rochester, N. Y.
- L. H. Willis, care of I. R. Nelson Co., Bond St., Newark, N. J.
- M. J. Letcher, 640 Tulpehocken St., Reading, Pa.
- Fred Burrows, 716 E. Clay St., Shamokin, Pa.
- J. E. Torrence, Greenwood Water & Electric Light Plant, Greenwood, S. C.
- H. A. Griffith, 1611 College St., Knoxville, Tenn.
- R. O. Weaver, 121 Herkimer Rd., Utica, N. Y.
- H. L. Book, 327 E. Main, Newark, Ohio.
- E. Millward, 42 Shannon St., Toronto, Ont., Can.
- C. J. Ott, care of Clarence J. Ott Piano Co., Beaumont, Tex.
- A. F. Grossman, 800 Laurel St., Pottsville, Pa.
- Chas. Slagl, 2317 Glendale Blvd., Los Angeles, Calif.
- Russell New, R.F.D. No. 5, Gallatin, Mo.
- John A. Stang, 30-71-33rd St., Long Island City, N. Y.
- C. E. Russell, 1006 E. 5th St., Coffeyville, Kans.
- E. H. Murray, Newell, Pa.
- H. J. Hoffmann, 305 Chestnut St., Atlantic, Iowa.
- Koploy & Rcss, 1306 Randolph St., Detroit, Mich.
- H. H. Hubbard, Rockford, Iowa
- W. S. Gorham, 408 E. Chilhowie Ave., Johnson City, Tenn.
- J. Willard Clary, Fordyce, Ark.
- L. C. Loomis, 9356 Gorman Ave., Cleveland, Ohio.
- J. A. Johnson, 442 Aquila Court, Omaha, Nebr.
- D. F. Green, Rt. 8, Box 40, Oklahoma, Okla.
- A. M. McPhee, 575 W. 25th St., North Vancouver, B. C., Can.

PLAYS FOR RADIO TO TUNE OF \$1,100



ANDY SANNELLA LIKES RADIO IMMENSELY. IT ENABLES HIM TO BRING HOME \$1,100 A WEEK, AT 27, OR \$1,075 A WEEK MORE THAN HE EXPECTED TO EARN AT 27 WHEN HE WAS 17. FIGURE THAT OUT.

SALE OF TUBES \$110,000,000 HOW ANDY GETS \$1,100 WEEKLY

In 1928 the retail sales of radio tubes totalled \$110,000,000.

Sales of tubes have maintained a steady and rapid rate of increase since 1919 when sales totalled \$300,000. In 1922 tube sales reached \$6,000,000 and jumped to \$17,000,000 the following year. The succeeding years' totals reached \$36,000,000, \$48,000,000, \$58,300,000 and in 1927 the figure was \$67,000,000. The 1928 figure represents a much greater proportional sale of tubes due to lower average cost per tube.

Although there are more than eighty manufacturers of radio tubes in production today the explicit definition of types of vacuum tubes contained in the National Electric Manufacturers Association standards, published as part of the fourth edition of the NEMA Handbook of Radio Standards, has protected the general public and greatly assisted the industry in sales development.

The standards of that section include engineering definitions, vacuum tube bases, measurements, tube characteristics, rectifier tube base connections and rectifier tube characteristics.

A THOUGHT FOR THE WEEK

THE man who can devise a method for disposing of the whole matter of turned-in radio sets can ask of the trade his own price for the formula and be sure of a large niche in the Radio Hall of Fame.

Andy Sannella, whom you see smiling in the picture, has reason to smile. He can play twelve musical instruments, and most of them are in the picture, too. But Andy's asset is not only that he can play them, but that he can easily earn \$1,100 a week working those sound-producers for the radio. (Fill out the coupon and mail NOW!)

He can not only play but he can compose and direct, and he does both equally well, his employers say.

He is 27 and was born in Brooklyn. But you want to know more about the money end of his business. Sing to him the song from a musical show of a few seasons back, "What Do You Do Sunday, What Do You Do Monday?" The answer follows:

Sunday: Director and soloist, Sylvestre Hour, WEAf and chain, 12:30 p. m.

Monday: General Motors Hour, saxophone and guitar specialties, WEAf and Network, 9:30 p. m.

Tuesday: Stromberg-Carlson Hour, saxophone and guitar soloist, WJZ and chain, 8 p. m.

Wednesday: Director and soloist, Smith Bros. Orchestra, 9 p. m., WJZ and chain.

Palmolive Hour, guitar soloist, WEAf and Network, 9:30 p. m.

Sylvania Foresters, soloist, WJZ and chain, 8:30 p. m.

Thursday: Director and soloist, Halsey-Stuart Hour, 10 p. m., WEAf and Network.

Lehn and Fink, saxophone, guitar and clarinet soloist, 8 p. m., WEAf and chain.

Friday: Armstrong Quakers, saxophone and guitar soloist, WJZ and chain 8:30 p. m.

Saturday: Lucky Strike Dance Orchestra, saxophone and guitar soloist, WEAf and Network, 10 p. m.

NOTICE TO SUBSCRIBERS

Look at the date of the label pasted on the wrapper containing your subscription copies. If this date on wrapper is older than the date of the issue received, then your subscription has expired and should be renewed.

NEW BAND PASS FILTER EXPELS INTERFERENCE

By James H. Carroll

Contributing Editor

Just as fundamental as the basic principle of radio and now coming into its own, is the band pass filter. There are many systems called by the name, for in a broad sense any method of passing only one small band of frequency at a time may be designated a band pass filter.

In the band pass system for broadcast tuning the resonant curve should approach the flat top for 10 kc. with sharp cut-off above and below the band width.

As against the average tuned radio frequency stages, the superior characteristics of the band pass filter are obtained by a multiple arrangement of tuned circuits. One set of tuned circuits in the band pass filter governs the lower cut-off frequency and the other set of tuned circuits governs the upper cutoff frequency.

The band pass filter offers many advantages which may be utilized by the set constructor and the fan in many ways.

Invented by Proskauer

Realizing all these facts and recognizing all the advantages of the band pass filter system, Julien J. Proskauer, associate member, Institute of Radio Engineers, inventor of the Si-Len-Ser, the line-noise eliminator that has scored such success, and executive director of the Trutone Radio Sales Co., 114 Worth Street, New York City, makers of that device, has evolved an interference eliminator and static reducer which has been given the trade name of Ce-Lec-Tor. It is made and will be marketed by his concern. This will bring surcease to fans suffering from interference via the aerial, whereas Si-Len-Ser applies to interference via the power line.

The Ce-Lec-Tor is a band pass filter with a novel method of cutting off outlaw frequencies. It will also balance the aerial and tune the first tube.

In many commercial sets the first tube circuit is untuned and selectivity consequently suffers. With the Ce-Lec-Tor this first circuit is made as selective as if another stage of tuned radio frequency were added to the receiver.

This device has another great advantage, in that it puts an aerial in exact resonance with the receiver at all wavelengths, thus giving greater selectivity and volume. The band pass features and advantages of the Ce-Lec-Tor are also many. Not more than the 10 kc. band can be passed at a time. Thus, in actual practice, tuning the Ce-Lec-Tor when two stations are coming in at once, cuts out one completely and brings in the desired station with more volume and clarity.

Economy Feature

Another feature claimed for it is saving an extra tube by increasing the signal and conserving the battery or filament supply because of its ability to increase volume without using extra current. Natural static and aerial pick-up noises are greatly cut down. The inventor does not claim that it does the impossible by cutting out static entirely.

The Ce-Lec-Tor is sturdily constructed, of handsome appearance, cylindrical in form, being 2 3/4 inches in diameter and 4 1/2 inches high. It has two binding posts, one for attachment to the aerial and the other

Biggest Rectifier Bought by Russia

The Radio Corporation of America has announced the sale to the Russian Government of the world's largest high-voltage rectifier, which is now nearing completion in the laboratories of the General Electric Company in Schenectady. The purchase was made by the Electro-Technical Trust of Weak Currents in Russia, a government-owned trust represented in New York by the Amtorg Trading Company.

The giant rectifier operates on the mercury vapor principle, and is capable of a power output of 750 kilowatts and a voltage of 15,000 volts. The rectifier will not be delivered until the early part of April after it has been subjected to a series of tests.

The purchase of the 750-kilowatt mercury vapor rectifier is one of a series of order for radio equipment placed with the Radio Corporation by the Soviet authorities beginning in July, 1928. Thus far the Russian government has purchased from the American company radio transmitting and receiving apparatus having an approximate total value in excess of \$600,000.

A delegation of Russian engineers will arrive here around April 1st for an exchange of technical information under the terms of the contract, and a delegation of RCA engineers will visit Russia in 1930 for the same purpose.

to the ground of any set, electric or battery operated. Until final patents are granted, complete constructional data are not available. There are two variable condensers as follows: One midget 26-plate and the other a specially made .0005 mfd. condenser.

These two condensers are operated from the top of the Ce-Lec-Tor with a novel one-dial arrangement. The dial is numbered and once any particular station which interferes with reception of a desired station is tuned out, exact setting is obtained for the operator, so that the next time the station desired is interfered with, setting the dial to the number previously found takes out the interference.

Fully Shielded

Among the theories used in designing and constructing the Ce-Lec-Tor are the Vreeland band pass filter system with original innovations by Mr. Proskauer, also the old-time tried theory which has been proven successful, i. e., that the oscillating circuit formed by one variable condenser and inductance will present a circuit of infinite impedance to the frequencies to which the receiver is tuned, but will pass all frequencies to which it is not tuned.

The Ce-Lec-Tor, is fully shielded. It will be ready for the trade in April, Mr. Proskauer states, and will be handled by the same distributors who are now merchandising the Si-Len-Ser.

E. L. BRAGDON, editor "The Sun Radio Section" (N. Y.): "Now that Sam Pickard has passed up glory for a good job and better money, the Federal Radio Commission is right back where it started from. Before Pickard announced his plans, Caldwell, the only man of 'the five air czars' who knew the technical difference between a carrier wave and a kilocycle, had decided that the editorial pen is more attractive than the radio board. These moves leave Robinson, Sykes and Lafount to rule, an unusual combination of men for the tasks that face the Commission. Of the two men who left, Caldwell was the only one technically fitted for the work."

COURT WRITES ON 3 TYPES OF INTERFERENCE

Chicago.

In upholding the constitutionality of the radio law, attached by WMBB-WOK, Judge Wilkerson, in the Federal Court, Northern District of Illinois, discussed types of radio interference, as follows:

It appears that in allocating wave lengths, the interference of one station with another must be taken into consideration. There are two principal types of interference.

One is called "heterodyne" and manifests itself in the form of a disagreeable whistle of varying pitches which is reproduced by the receiving set. This results from interaction in the receiver of the carrier waves from two broadcasting stations operating on channels separated by too narrow a margin.

"Cross-talk" Explained

Another type of interference is called "cross-talk" and manifests itself by the reproduction simultaneously of two or more programs at once in the receiver in such a way that neither one may be heard satisfactorily by persons listening to the receiver. A third type, which is known as "blanketing," is really an exaggerated form of "cross-talk" and results in the program of one broadcasting station being completely blotted out by the program of another station.

In making allocations it is necessary to consider the "service area" and "nuisance area" of stations. The carrier wave travels far beyond the area in which the station can give good service to listeners into area where it is still sufficiently strong to cause objectionable heterodyne interference with the broadcasting of other stations.

Conditions Vary

In practice conditions vary to such an extent that the service area and nuisance area can be defined only with approximate accuracy. A definition of the different type of areas under average conditions during the evening hours is shown by the following table.

Power of station, in watts, A; radius (miles) of area of very good service (city dweller), B; radius (miles) of area of good service (suburban dweller), C; radius (miles) of area of fair service (rural listener), D; radius (miles) of nuisance area, E:

A	B	C	D	E
50	2	10	100	300
100	3	15	150	450
500	6	30	300	900
1,000	9	45	450	1,350
5,000	20	100	1,000	3,000
50,000	60	300	3,000

It is apparent from the foregoing table that a station using a power of 5,000 watts will blanket the United States and at times make it impossible for any other station to operate satisfactorily on the same channel.

It is also apparent that the nuisance area of a station using power of 50 watts (the lowest for which a station is licensed) will almost certainly pass beyond the borders of the State in which the broadcasting station is located.

Wide Effect

This may cause interference within the State with radio waves coming into the State from other States; with broadcasting stations within the State whose service area extends beyond the State; with broadcasting across other State lines.

SETS OF WORLD REACH A TOTAL OF 20,000,000

Washington. The remarkable extent to which radio has penetrated to the four corners of the earth is revealed in an analysis of world markets for radio equipment just completed by the Department of Commerce. Broadcasting stations, the report shows, are operating near the Arctic Circle, on the Equator, and far down in the Southern Hemisphere. From Greenland to Ceylon and from Yugoslavia to China radio sets are being tuned-in to catch practically the same type of programs as are given in the United States. Radio has become a universal institution.

National Percentages

There are in use throughout the world today, according to Lawrence D. Batson of the Electrical Equipment Division of the Department, who made the survey, more than 20,000,000 radio sets, nearly half of these being in the United States. Great Britain and Germany have approximately 2,500,000 each; France has 1,250,000; Japan, 550,000; and Argentina, 530,000. The countries next in order of importance are Sweden with 371,000 sets, Austria with 325,000 and Czechoslovakia and Italy each with 250,000.

More than 95 per cent of the radio sets on the Continent of North America are in the United States. Japan has about the same proportion of the total for Asia. Argentina possesses more than half of the sets in South America while in Europe Great Britain, Germany and France together account for 75 per cent of the total. The Union of South Africa has about 90 per cent of all the radio sets in Africa.

Foreign Regulations

Practically every foreign country, the report discloses, has regulations governing broadcasting. In the large European countries, including the United Kingdom and Germany, broadcasting stations are generally owned and operated by the national government; Sweden grants a concession to one company to operate the main stations while the smaller ones are owned by radio clubs; in North and South America broadcasting stations with few exceptions are privately owned and operated; Australia and New Zealand grant concessions but the former country is now preparing to take over the high-powered stations.

Outside of the United States it is the general rule for owners of radio sets to pay a license fee to their respective governments, these taxes ranging from as low as five cents in France to \$18.00 in Salvador. The British tax is \$2.45; the German, \$5.70; the Australian, \$5.85; while the Japanese owner of a radio set must pay in the vicinity of \$9.00.

High Power in Europe

The highest-powered foreign broadcasting stations are all in Europe, the report shows. Russia and Finland each maintain stations of 40,000 watts; Sweden has two stations of 30,000 and 20,000 watts, respectively; France has one of 20,000 while the largest British station is rated as 16,000 watts. There are more than 200 broadcasting stations in Europe; South America has sixty-two; Australia, 25; while Japan has seven.

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

RADIO WORLD,
145 West 45th St., N. Y. City.
I desire to receive radio literature.

Name

Address

City or town

State

- Harold Chute, 16 Boynton St., Eastport, Me.
- S. T. White, Cedar Keys, Fla.
- S. R. Stroup, Quincy, Mich.
- Ralph P. Miller, Box 32, Templeton, Pa.
- Otto A. Presser, 5958 S. Halsted, Chicago, Ill.
- O. A. Krebichl, Rossville, Ind.
- James A. Morris, Thomas, Okla.
- Marion Fohrney, Deep River, Iowa.
- Edward Ahel, Shelbyville, Ind.
- G. R. Gilbert, 412 N. 19th St., Birmingham, Ala.
- W. J. Deane, 14th Floor, Cooper Bldg., Tulsa, Okla.
- Roy D. Burnett, South Kent, Conn.
- A. Magnan, Universal Utility Co., 2155 Ocean Ave., Brooklyn, N. Y.
- H. B. Meyers, 220 N. Monroe St, Hartford City, Ind.
- John Fettig, National Radio Service Co., 2305 Grand Ave., Bronx, N. Y. City.
- J. F. Gephert, 14005 Glenside Rd., Cleveland, Ohio.
- Winslow's Radio & Mdse. Co., 311 Center St., Douglas, Wyo.
- F. Bauer Radio Sales Co., 3919 West Pine Blvd., St. Louis, Mo.
- A. L. Runyon, Grand View, Texas.
- G. B. Teal, East Stearns, Temperance, Mich.
- Paul Pasterick, R. D. No. 2, Box 1-A, Tarentum, Pa.
- F. F. Bettis, 910 N. 17th St., St. Joseph, Mo.
- M. Yantecelov, 1925 S. Fairmount Ave., Baltimore, Md.
- Earl E. Hauston, R. No. 1, Salisbury, Mo.
- C. Hubert Anderson, 1004 S. 2nd St., Springfield, Ill.
- E. S. Anderson, 136 Firglade Ave., Springfield, Mass.
- A. J. Foster, 610 W. Beecher Ave., Jacksonville, Ill.
- Edgar Van Gilder, 2407 W. 32nd Ave., Denver, Colo.
- R. H. Meloney, R R No 2, Princeton, N. J.
- W. W. Powell, 151 E. Santa Clara St., at 4th, San Jose, Calif.
- Rev. Jos. A. Kern, Church of St. Luke, Clearwater, Minn.
- K. S. Slingluff, Asst. Mgr., Glendale Theatre, Glendale, Calif.
- C. C. Storm, 1700 N. First St., Merrill, Wis.
- W. J. Cooper, Steep Rock, Man., Can.
- W. M. Smith, Frankfort, N. Y.
- J. J. Cassidy, 90 Thorndike St, Arlington, Mass.
- J. M. Clark, 1305 Houston Ave., Houston, Tex.
- R. C. Alexander, 1504 Dodge St., Room 717, Omaha, Nebr.
- C. W. Hart, Canton, Ohio.
- M. B. Gueninger, 9427 Vanderveer St, Queens Village, L. I.
- H. D. McChesney, 813 1st St., Merrill, Wis.
- R. Fitzsimmons, 625 Loomis St., Los Angeles, Calif.
- Arthur L. Cavar, Lakewood, Ohio.
- C. R. Davis, 312 Elm St., care of Hotel Hayes, Rockford, Ill.
- C. L. Riners Auto Shop, 704 E. Starh St., Portland, Ore.
- R. D. Henderson, 117 Omar Ave., Struthers, Ohio.
- Oscar Magnusson, 208 N Fifth St., Quincy, Ill.
- C. C. Deacon, 3767 19th Ave., W., Vancouver, B. C., Can.
- William Bosse, Essex, Md.
- Bert Griffith, 1224 W Cedar, Denver, Colo.
- A. W. Cargill, Sr., Mgr., Gulf Refining Co., Green St. & Queen Lane, Philadelphia, Pa.
- E. H. Yurth, 101 Crest St., Ann Arbor, Mich.
- Paul Baldwin, 187 E. Bridge St., Berea, Ohio.
- Norman C. Harriet, 42 O'Connell St., Quebec City, Quebec, Can.
- A. Opplenton, 42 Downes, Baldwinville, N. Y.
- W. R. Judv, Bowman, S. C.
- D. S. Loomis, Ionia, Mich.
- Frank Filip, Box 189, Blackstone, Mass.
- Adam Kuhar, 3058 N. Chatham St., Philadelphia, Pa.
- Stanley C. Wenner, Box 205, Latimer Mines, Pa.
- John C. DeSantis, 33-14 Crescent St., Astoria, L. I.
- C. J. Titze-meier, 1649 Ridgefield Rd., Cleveland Hgts, Ohio.
- Antone B. Araupo, 3985 Princeton St., Los Angeles, Calif.

STATIONS GIVE COLLEGE MEN A PREFERENCE

College graduates now find an outlet for their talents in radio. With more than 600 stations in the country, using from one to a dozen announcers, many college graduates are absorbed. In addition to the announcer staff, there are possibilities for college men as continuity writers, as performers, and as advertising salesmen, while the man who claims a degree in electrical engineering and knows radio has an opportunity on the technical staff of a radio station.

Acting and Singing Help

College men whose activities, while in college, have included membership in the dramatic and musical clubs, have the advantage over those who have starred in athletics. The ability to tear off three yards through a stubborn defense wall is less important in a radio station than the talent to sing. "Give a Man a Horse He Can Ride." Training in college dramatic societies will fit the graduate to take a part in those playlets which are gaining daily in public favor.

The announcer of the modern broadcasting station must be a little bit of everything; he must be equipped to double in brass as the old-timers did in the Uncle Tom Cabin shows.

An announcer must have a pleasing voice and a manner of using the voice without giving offense to the listeners. Many a good voice has been spoiled by affectation and a trick of patronizing listeners.

If an announcer must offer elementary information to listeners, he is required to do it inoffensively. The successful announcer knows correct English and accurate pronunciation and he should have some knowledge of foreign tongues—French, German, and Italian particularly, so that if required to announce in those tongues he will do so with familiarity.

Must Think on Feet

It is further required that the announcer have the gift of thinking on his feet. All announcements cannot be prepared in advance and he should be able to "ad lib" on occasions.

Musical training is of first importance. The best equipped announcer is he who plays and sings and knows or strives to know music. Tact and good taste are also essentials, the lack of which may easily mar an otherwise good program.

Because the demands on a radio announcer are so great it has been found that, as a general rule, the college-trained man is best fitted for the job, or at least that such a man most readily adapts himself to the varied requirements. At least, WGY, Schenectady, has found it so.

BULLETIN ON LOUDSPEAKERS

"Loudspeakers," by Joseph Morgan of the International Resistance Company, outlining the functions of the ideal loudspeaker, may be had by addressing the International Resistance Company, 2006 Chestnut Street, Philadelphia, Pa. Ask for Engineering Bulletin No. 5 and mention RADIO WORLD.

KILEY REPRESENTS EKKO

Pat Kiley, 140 Liberty Street, New York City, is representing the Ekko Company of Chicago. Chief in the line is the Ekko Ground Clamp.

The Four Types of

By J. E.

Technical

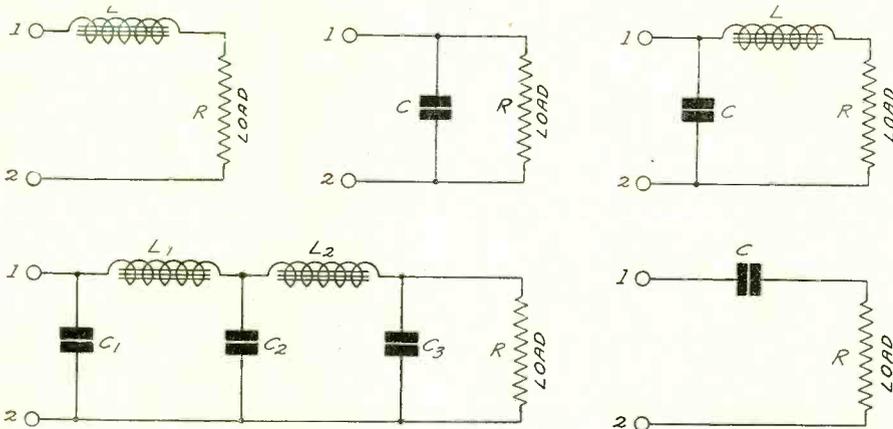


FIG. 1, UPPER LEFT—LOW PASS FILTER WITH A SINGLE SERIES ELEMENT.

FIG. 2, UPPER CENTER—LOW PASS FILTER WITH A SINGLE SHUNT ELEMENT.

FIG. 3, UPPER RIGHT—LOW PASS FILTER WITH ONE SERIES AND ONE SHUNT ELEMENT.

FIG. 4, LOWER LEFT—A FAMILIAR LOW PASS FILTER OF TWO SECTIONS.

FIG. 5, LOWER RIGHT—HIGH PASS FILTER WITH A SINGLE SERIES ELEMENT.

THERE is no radio receiver or battery eliminator which does not use bypass condensers and choke coils. Although these devices are of such frequent use there are many who think they can be dispensed with.

Also, questions indicate that there is some confusion as to the meaning of filters.

The general meaning of filter is an electrical network which discriminates between currents of different frequencies. This means that a filter is composed of inductances or condensers, or both.

A still more general definition of a filter includes attenuation networks which are composed of pure resistances. So it may be said that a filter is a circuit, simple or complex, which consists of inductances, capacities, or resistances, or combinations of two or three of these circuit elements.

There are four types of filters exclusive of the pure attenuator. These are low pass filters, high pass filters, band pass filters, and band elimination filters. Their names tell what they do in a circuit.

Line Elements

Impedances used in a filter are divided into series, or line elements, and shunt elements. The current transmitted to the load must pass through all the line elements. The shunt elements bypass currents of those frequencies which are not desired in the load.

In a low pass filter the line element is a choke coil and the shunt element is a condenser. In a high pass filter the line element is a condenser and the shunt element is a choke coil. A low pass and a high pass filter are complementary. If one is designed to have a given cut-off the other can be given directly for the same cut-off. The cut-off frequency is the limiting frequency between the transmission region and the suppression region of the filter.

In the band pass and elimination filters both the line and shunt elements are composed of inductances and capacities. They are very complex, and as they are not of direct interest in radio, they will not be discussed further. It may be re-

marked, however, that every tuned circuit is a special type of band pass or band elimination filter, depending on its use.

Low Pass Filters

Figs. 1 to 4, inclusive, show four different low pass filters. In the first there is no shunt element and only one line element, the choke coil L. An alternating voltage which may contain all frequencies is supposed to be impressed across the terminals (1) and (2). The coil offers a high impedance to currents of all frequencies, but in direct proportion to the frequency. Therefore this circuit passes direct current to the load without any attenuation or loss. Very high frequencies are almost completely stopped. Hence this is a low pass filter with the cut-off at zero.

The circuit in Fig. 2 has no line element but only a shunt element, the condenser C. As in Fig. 1 direct current reaches the load without loss. The effectiveness of the by-pass is directly proportional to the frequency. Hence the higher the frequency the less will pass on to the load. Hence Fig. 2 also represents a simple low pass filter with the cut-off at zero frequency.

Applications of Filters

The circuit in Fig. 1 is often seen in the plate of a detector tube, L is an RF choke and R is the coupling resistor. In this particular application L has little effect because the load resistance is large. Fig. 2 is familiar in the grid circuit of the detector, and also in the grid return circuit, where R is the grid bias resistor and C is the bypass across it. Fig. 3, also, is very frequently seen in the plate circuit of a detector, where C is the high frequency bypass from the plate to the filament. L serves very little purpose in this position because of the high value of the load R, the coupling resistor.

Fig. 4 is the most familiar filter of all because it is used in nearly all B battery eliminators. It consists of two sections. As these sections are usually designed the sections are not equal and there

is no definite cut-off. But that is not necessary, for the only current that is wanted is the direct.

Objects of Elements

An alternating voltage containing components of 60 cycles and its harmonics is impressed, through a resistance, across the terminals (1) and (2). The rectifier puts a sudden surge of current into the first condenser C1. The voltage across the condenser gradually rises, and as it rises, more and more current begins to flow through the first choke coil L1. When the surge of current is over the coil keeps the current flowing by virtue of its electrical inertia, or magnetic field. It takes this current from the first condenser because that has become charged.

But the first condenser cannot take out all the fluctuation in the current. There is some fluctuation in the current in the first coil. The current charge and discharge, partially, the second condenser. As the voltage across this condenser increases, the current through the second choke increases also, but not as rapidly as the voltage across the condenser. The charge on the condenser gains. As the current supply from the first coil decreases, the second coil maintains the current, and it takes it from the charge on the second condenser. There is much less fluctuation in the current through second choke than through the first.

The fluctuations through the second choke charge and discharge the third condenser, partially. The load resistance R discharges the third condenser without any inertia effect, but the second choke prevents the charge on this condenser from flowing back toward the rectifier and the preceding condensers. Hence there is a practically ripple-free steady current flowing through the load resistor R.

Electrical Tanks

The bypass condensers in the two-section filter may be regarded as electrical storage tanks which receive electricity in surges and which give it up gradually. The choke coils act as governors holding the rate at which the condensers give up the electricity constant.

The high pass counterpart of Fig. 1 is shown in Fig. 5. A condenser C is the line element. This will not pass any direct current but it will pass alternating current. The higher the frequency, the greater the current it will pass. The cut-off is at zero.

Fig. 6 shows the high pass counterpart of the circuit in Fig. 2. The shunt element is a choke coil. This circuit will pass all frequencies, including direct current. But the shunt is more effective on the low frequencies. The high frequencies will be passed without attenuation. The low will be attenuated considerably, particularly if L has a low inductance and negligible resistance.

High Pass Filter

Fig. 8 is the counterpart of Fig. 3. The circuit in Fig. 8 combines the effectiveness of both Fig. 5 and Fig. 6.

The circuit in Fig. 5 appears in many receivers as the stopping condenser and grid leak. Since this is a high pass filter which suppresses the lower frequencies more than the higher it is obvious that C must be large if the circuit is used in the audio end of the receiver. Just what value C must be depends on the value of

Filters and Their Uses

Anderson

Editor

R. The product of the two in farads and ohms should be not less than .02.

The Speaker Filter

The circuit in Fig. 8 has been made familiar in receivers as the loudspeaker filter. L is the choke coil, C the stopping condenser in series with the speaker and R is the resistance of the speaker.

Fig. 7 shows the counterpart of the circuit in Fig. 4. All the line elements are condensers and all the shunt elements choke coils. This circuit has no particular application to a radio receiver.

Terminations of Filters

The simplest section of a low pass or high pass filter consists of a condenser and a choke coil. There are several methods of connecting these with respect to other sections or to other apparatus. These are classified as terminations of the filter. There are four principal terminations, namely, full shunt, full series, mid-shunt and mid-series.

The termination of the filter in Fig. 3, looking from the input, is full shunt, because the current from the input terminals encounters the full shunt element without passing through any of the series element. Looking from the load the termination is full series, because if an AC voltage source were substituted for the resistance the resulting current would have to flow through all of the series element L before reaching the shunt element.

The section in Fig. 8 terminates in full shunt looking from the input and in full series looking from the load.

But these two terminations are not so important as the mid-series and mid-shunt terminations, because they are not symmetrical. The midsection terminations are symmetrical, that is, they look the same from either side.

T and Pi Sections

A filter section with mid-series termination is shown in Fig. 9. It is called a T section. The series element has been divided into two equal parts and the full shunt element has been connected between them. It is clear that this section is symmetrical. It is called mid-series because the current from either side has to pass through one-half of the series element before reaching the shunt element.

Fig. 10 shows a filter with mid-shunt termination. It is clear that this also is symmetrical as it looks the same from either direction. It is called a pi section. In this section the series element is in one unit. The shunt element has been broken up into two equal parts which are placed across the line on at the ends of the series element.

A word of explanation may be necessary regarding the division of the shunt element, in view of the fact that each of the two condensers is twice as large as the whole shunt element. It is not the condenser which has been divided into two equal parts, but the impedance of the condenser. The impedance of 2C is just half the impedance of C.

The T and pi sections in Fig. 9 and Fig. 10 are both low pass. To make high pass sections the series half elements in Fig. 9 would be 2C and the shunt element would be L, and in Fig. 10 the full series element would be C and the half shunt elements would be $\frac{1}{2}L$.

Matching of Impedances

If a filter section, such as that in Fig. 9 or Fig. 10, is to retain its properties in

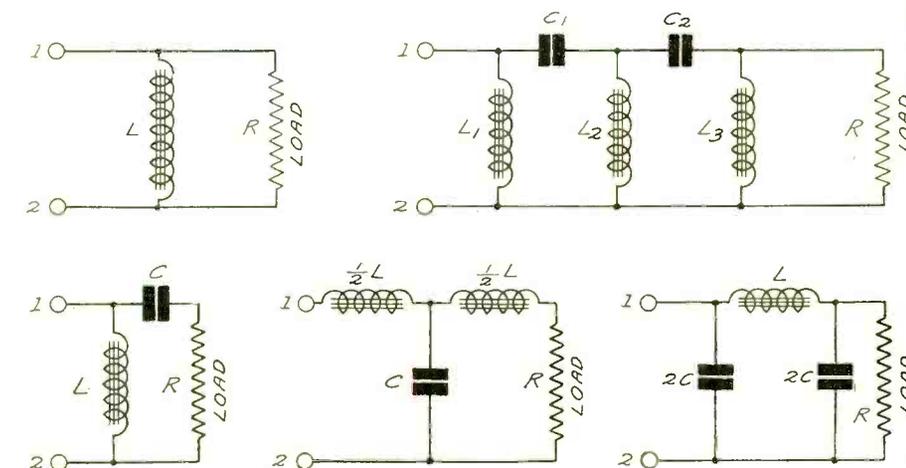


FIG. 6, UPPER LEFT—HIGH PASS FILTER WITH A SINGLE SHUNT ELEMENT.

FIG. 7, UPPER RIGHT—A HIGH PASS FILTER OF TWO SECTIONS.

FIG. 8, LOWER LEFT—A HIGH PASS FILTER OF ONE SERIES AND ONE SHUNT ELEMENT, FAMILIAR AS THE LOUDSPEAKER FILTER.

FIG. 9, LOWER CENTER—A MID-SERIES TERMINATED, OR T SECTION, LOW PASS FILTER.

FIG. 10, LOWER RIGHT—A MID-SHUNT TERMINATED, OR PI SECTION, LOW PASS FILTER.

a circuit, it must be placed between impedances equal to its own termination impedance. For example, if the impedance of the filter in Fig. 9, looking from the input is 6,000 ohms the impedance of the transformer or other device delivering current to the filter must be 6,000 ohms also. And the load resistance or impedance must be 6,000 ohms. When the section is placed between any two impedances which are equal to the impedance of that section, there is no change in the circuit except that produced by the attenuation of the filter.

For special purposes other than the four principal terminations may be used. For example, the termination may be $\frac{2}{3}$ series. Such fractional terminations are usually introduced to compensate for lack of matching, or to overcome the effects of current reflections due to improper load.

Many similar sections may be connected in series, provided that their impedances are equal. When they are so connected the attenuations add up. It is also possible to use half sections or other fractions of a filter, if that is necessary to secure a specified attenuation.

Role of Filters

Filters play a very important role in many branches of electrical science, and particularly in communication. They are used in carrier current telephony and telegraphy to separate channels. A special type of filter is called an equalizer, the purpose of which is to insure that currents of all the frequencies over a given channel are equal in magnitude. They account for the high quality of broadcast transmission from the pick-up stations to the transmitter. A high quality line, whether that line be a few feet long, or 3,000 miles long, is one which has been equalized carefully.

The process of equalizing a line is now relatively simple. The transmission characteristic of the line is measured. From the curve obtained the attenuation char-

acteristic of the equalizer is determined. The filter is constructed to meet the specifications thus determined, and when this filter is put into the line the overall characteristic has the desired shape. The equalizer is essentially a "losser." Hence when the filter is inserted into the line it is necessary to amplify the signal to make up for the loss.

Sensitive Paper

Expedites Facsimiles

A new process for recording and transmitting facsimiles by radio which increases the speed of operation and the definition of the recorded image was described by Captain Richard H. Ranger, of the Radio Corporation of America, at a dinner of the alumni of Brooklyn Polytechnic Institute.

The process is capable of a speed four times greater than that attained with other processes, and it is capable of reproducing the picture in the original colors. The process is based on a heat-sensitive, wax-coated paper, developed by Frank G. Morehouse, of the RCA engineering staff.

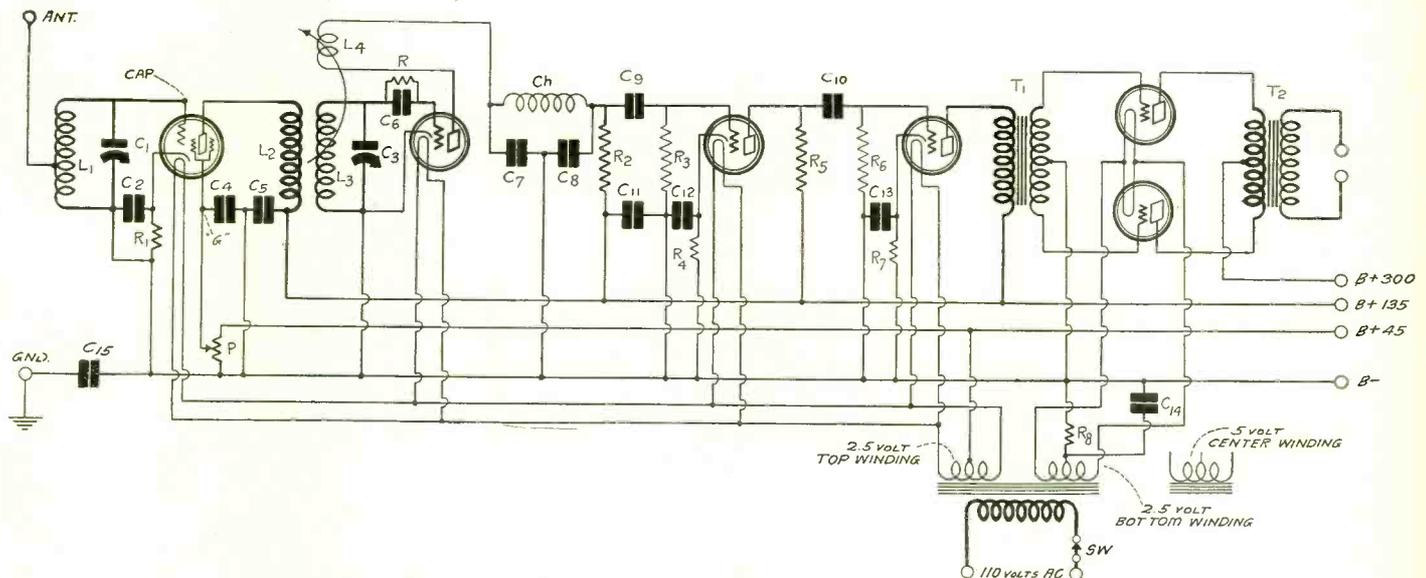
The waxed paper repels water ink. The radio signal carrying the image controls a tiny jet of hot air, which burns the wax away where it hits the paper. When the paper is inked, the image appears, because the ink is absorbed by the paper where the wax has been burned away and is repelled by the unburned paper. The record is permanent without further treatment.

A WEALTH OF GOOD STUFF was published in the Seventh Anniversary Number, dated March 23d (last week). Send 15c for copy to Radio World, 145 W. 45th St., New York City.

Push-Pull 245s in

By Capt. Pete

Contributing



THE SCREEN GRID AC TUBE AND THE 245 OUTPUT TUBE, BOTH NEW, ARE USED IN THIS RECEIVER.

UNTIL AC high mu tubes come we shall have to get along with 227 type heater tubes in AC resistance coupled amplifiers. And we shall get along very well, indeed, for the amplification is ample. One of these tubes in a properly designed resistance coupled amplifier will give a voltage step-up of 7.5 volts, and one of them followed by a push-pull transformer will give more.

A very fine receiver may be built of one screen grid tube, one 227 detector followed by resistance coupling, one 227 amplifier also followed by resistance coupling, one 227 followed by a push-pull input transformer, and two 245 power tubes in push-pull. There will be volume aplenty in this circuit, selectivity to meet more than the average requirements, and sensitivity that will delight the most enthusiastic DX hunter.

Amplification Required

The maximum grid bias on the new 245 AC power tube is 50 volts. Thus a signal voltage of about 45 volts can be impressed on the tube without any danger of driving the grid positive. Of course, all this voltage is not necessary, for the output volume would be too great. But it may be required occasionally on very low notes and loud passages.

If the input voltage to each power tube is to be 45 volts, the signal voltage across the secondary of the transformer must be 90 volts. We may select a transformer which has a 1-to-6 step-up ratio with a very large primary impedance. The voltage in the primary then must be 15 volts, which will be about three-fourths of the total effective voltage in the plate circuit. That is, the input to the tube ahead of the power tubes should be such that the output will be 20 volts.

Gain in Resistance Stage

Since the amplification factor of the tube in question is 8, the input must be 2.5 volts. The bias on this tube may be

at least 10.5 volts, so an input of 2.5 volts is well within the limits of the tube.

The voltage gain in the resistance stage is about 7.5, and the input should be 1/3 volt. This can be obtained very easily from the 227 detector without appreciable distortion, particularly when the detector works into a high resistance, as in this circuit.

In order to obtain this high audio output from the detector there must be a high radio frequency amplification ahead of it and in it. In this circuit this is secured by using regeneration in the detector and a screen grid tube ahead.

The screen grid tube is of the AC type, which even now may be obtained and which will be plentiful later in the spring. If this tube is followed by a suitably wound three-circuit tuner it will afford tremendous amplification.

Of course, this discussion centers on the circuit shown in Fig. 1. Let us consider the details of that circuit. The antenna is connected to a tap on the first tuning coil. This is done for its simplicity as well as for its effectiveness in extracting signals from the air. How many turns should be included in the antenna to ground circuit for best results is a question often asked. That depends entirely on what is meant by best results.

Connection of Antenna

If sensitivity is the main consideration, the antenna should be connected at the top of the coil, or to the grid. If selectivity is the main consideration, the antenna should be connected at the bottom. If the antenna is connected at the top the selectivity will be wholly unsatisfactory, and if the antenna is connected to the bottom there will be no signal. So the particular spot where the antenna should be connected depends on what selectivity is required with satisfactory sensitivity. It also depends on how long the antenna is. A long one should be connected lower down than a short one. There is no best point.

However, for average conditions the an-

LIST OF PARTS

- L1—One Screen Grid antenna coupler Model A5.
- L2, L3, L4—One Screen Grid three-circuit tuner Model STG5.
- Ch—One Hammarlund 85 millihenry RF choke coils.
- T1—One National push-pull input transformer type P-50.
- T2—One National push-pull output transformer type P-10.
- C1, C3—Two Hammarlund Midline, .0005 mfd. tuning condensers.
- C2, C15—Two Aerovox .001 mfd. fixed condensers.
- C4, C5, C9, C10—Four Aerovox .01 mfd. fixed condensers.
- C6—One Aerovox .00025 mfd. grid condenser with resistor clips.
- C7, C8—Two Aerovox .0005 mfd. fixed condensers.
- C11—One Tobe 2-mfd. bypass condenser.
- C12, C13—Two Tobe 1-mfd. bypass condensers.
- C14—One Tobe 4-mfd. bypass condenser.
- R1—One Clarostat 750-ohm strip resistor.
- R2, R5—Two metallized .25 megohm resistors with mounting clips.
- R3, R6—Two metallized 1 megohm resistors or grid leaks with clips.
- R4—One 3,000 ohm Clarostat strip resistor.
- R7—One 1,000 ohm Clarostat strip resistor.
- R8—One 1,000 ohm variable resistor, 5 watt rating or higher.
- R—One 2 megohm metallized grid leak.
- P—One 25,000 ohm. Carter wire-wound potentiometer.
- Sw—One line switch to break 110 volt line.
- One Guaranty Radio Goods Co. filament transformer type F226A.
- Eight binding posts.
- Two National type dials.
- One tickler knob to match knob on potentiometer.
- One B battery eliminator.

Screen Grid AC Set

V. O'Rourke

Editor

tenna circuit should include from 10 turns to one quarter of the total turns on the coil.

The screen grid tube requires a grid bias. It cannot be operated with just any bias or none at all. In an AC circuit there is only one simple method of getting it, and that is by a resistance drop. R1 is the resistance in this case, and 750 ohms is its value. There must be a condenser C2 across it, not smaller than .001 mfd. There is no upper limit to the size.

Screen Grid Voltage

The screen grid voltage on the tube should be about 45 volts. But in view of the fact that the grid bias is not definite it is best to provide a variable for the screen grid voltage. This is desirable also from the fact that the applied plate voltage is not definitely known when a B battery eliminator is used. So a 25,000-ohm wire-wound potentiometer P is connected across the 45 volt source and the screen grid lead is connected to the slider. Thus any voltage from zero to 45 may be applied to the screen grid.

This potentiometer also serves as the main volume control, and for that reason it should be mounted on the panel. It is one of the very best volume controls suitable for AC receivers.

A condenser C4 must be connected from the screen grid post to ground or there is likely to be oscillation when none is wanted. We shall set the lower limit of this condenser at .01 mfd. with the understanding that the larger it is the better.

The same thing applies to the condenser next to it, C5, which is connected from ground to the B plus terminal on L2. Place these condensers so that no unnecessary wire is used in connecting them.

The indicated plate voltage for the screen grid tube is 135 volts. It will do no damage to try somewhat higher and lower voltage on this while in search for greater sensitivity. A little careful research on a particular set will often lead to surprising results.

Three-Circuit Tuner Design

It will occur to many, no doubt, that the old three-circuit tuner obtained for some pet circuit away back in the beginning of the radio boom will do for this screen grid tube circuit. If the thought occurs in the form "Can I," the answer is yes. If it occurs in the form "Should I," the answer is NO. It would be better by far to use an ordinary tube instead of a screen grid tube if economy dictates that the old coil must be kept.

The three-circuit tuner must be designed for the screen grid tube. But the difference between the redesigned coil and the old is not great. Anybody wishing to rewind the primary L2 of the three-circuit coil may fit it to the screen grid tube by simply adding many more turns. Count the turns on the secondary L3 and put about as many turns on the primary. It is best to use fine wire, but there is no best wire.

The Tickler May Stand

It is quite probable that the tickler coil will do just as it is. But that, too, may have to be increased in many cases. And if it must be increased it is best to rewind it completely and to use fine wire.

Whether or not to rewind the tickler is determined by testing the circuit for oscillation. If no oscillation can be induced at the 550 k.c. frequency when the tuned circuits are adjusted to that, take the tickler out of the circuit and put on more turns.

Of course, it is easier to start with a new coil that has been designed for the screen grid tube.

As between .0035 and .0005 mfd. tuning condensers, C1 and C3, the preference should be for the larger value. That condenser covers the broadcast band better and leaves some to spare at the ends. The other condenser may not cover the band at all. The two coils L1 and L3 should be wound for the condenser actually used. For winding data see the March 16, 1929, issue of Radio World.

Detection Method

Let us say just a few words about the detector. The grid return connects directly to the cathode since there is no plus or minus to choose between. The preferred combination of grid leak and condenser is 2 megohms for R and .00325 mfd. for C6.

A pi section filter consisting of RF coil Ch and two condensers C7 and C8 is put in the plate circuit. Ch may be a 60 or 85 millihenry coil and the condensers may be .0005 mfd. or .00025 mfd. units. Of course, the object of the filter is to separate the audio from the radio frequency currents in the output of the detector. Besides, C7 aids the tickler do its work and C8 helps Ch do its work. Without C8 the choke serves very little purpose.

There is little to say about the resistance coupled stages. The stopping condensers C9 and C10 should be .01 mfd. or larger, with mica dielectric. The grid leaks R3 and R6 might well be 2 megohms. Lower values should be tried if the circuit should motorboat when first turned on. The coupling resistors R2 and R5 should be .25 megohms. Except, that if the detector will not oscillate the value of R2 might be reduced to .1 megohm. All the resistors should be of the metalized type.

Final Stage Push-pull

The output stage is push-pull with suitable input and output transformers. The novel feature of the circuit is that it has been designed for the new 245 type tubes. These take a bias of 50 volts, a plate voltage of 250 volts and a filament voltage of 2.5 volts. Of course, the applied voltage between the B plus and B minus should be 300 volts. Of this voltage 50 volts drop in R8, which supplies the bias to the grids. The value of this resistor, for two tubes, should be 800 ohms, which is best obtained by a variable wire-wound resistor. This is particularly desirable because the tubes may be operated with a plate voltage of 180 and a bias of 33 volts, when the value of R8 should be 634 ohms. A 1,000-ohm variable resistor is recommended.

Filtering Necessary

It is necessary to use filter condensers. C11 should be 2 mfd. or more. Each of C12 and C13 should be 1 mfd. C14 should not be smaller than 4 mfd. These condensers aid quality and stability.

R4 and R7 are bias resistors. R4 should be 3,000 ohms and R7 1,000 ohms.

The condenser in series with the ground lead is there for protection. It need not be larger than .001 mfd. In most cases it may be omitted.

A special filament transformer is used. It has been designed especially for the new 245 power tubes. It has two independent windings so that the power tubes and the other tubes may be isolated. There is also a 5-volt winding on the transformer for use on 071A tubes or a rectifier tube. All the windings are accurately center-tapped. The heater tube winding is connected to plus 45 volts to eliminate hum.

Voltage Supply

The voltage supply should have taps for 45, 135 and 300 volts. If a B battery eliminator is used it should be able to deliver at least 75 milliamperes at the rated voltages, and it should have plenty of by-pass condensers in it.

Special power packs for the new power tubes have not been made yet, but undoubtedly it will not be long before all the makers of power transformers will have them. In the meantime the circuit may be operated with —71A tubes with rated maximum voltage, or with 245 power tubes with 180 volts on the plate. Or a power supply designed for larger tubes and higher voltage may be used by cutting down the high voltage with a potentiometer.

If the circuit is operated with B batteries a switch must be connected on one side of the potentiometer P, and this switch must be opened when the set is turned off. If not, the battery will discharge slowly through P. This precaution, of course, is not necessary when a B battery eliminator is used.

Clarostat's Latest is the "Hum-Dinger"



The latest addition to Clarostat family is the Hum-Dinger, an adjustable center-tap resistance of extreme compactness, simplicity and convenience. A positive contact slides over the center portion of the winding, actuated by a slotted shaft which is turned by an ordinary screwdriver. It may be mounted on a panel or sub-panel by means of a single hole, or on the baseboard by wood screws slipped through holes in the end lugs. Connections are made to the three soldering tabs. The standard resistance value for the usual AC set is 30 ohms, but other resistance values in the Hum-Dinger, from 6 to 500 ohms, are available. This device is made by the Clarostat Mfg. Co., Inc., 291 North Sixth street, Brooklyn. Further information may be had by addressing this concern. Mention RADIO WORLD.—J. H. C.

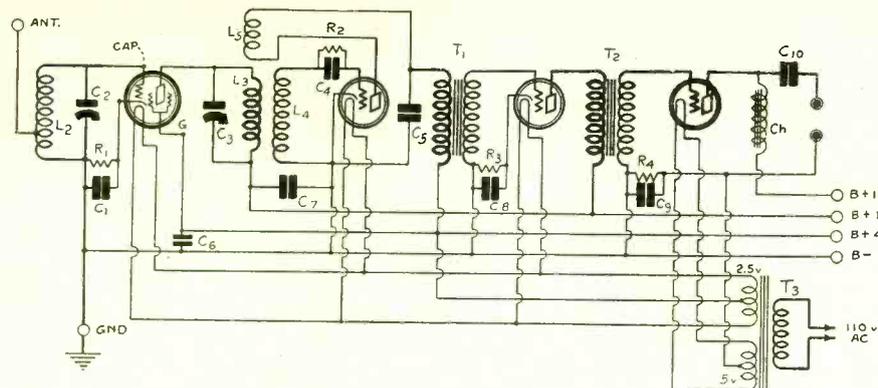


FIG. 737

DESIGN FOR A 4-TUBE ALL-ELECTRIC AC RECEIVER, WHEREIN A SCREEN GRID TUBE, TWO 227 TUBES AND A 171A POWER TUBE ARE USED. THE ANTENNA IS CONDUCTIVELY COUPLED, FOR STRONG PICKUP, BUT THE TWO TUNED CIRCUITS SHOULD BE TUNED INDEPENDENTLY. GANGING IS NOT PRACTICAL WITH THE CONDUCTIVELY TUNED ANTENNA CIRCUIT.

Radio University

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

When writing for information give your Radio University subscription number.

I HAVE a three-tube receiver consisting of a regenerative detector and two stages of transformer couple audio. I want more volume. What is the best way of getting it?

(2)—Would you recommend another audio stage or a power tube in the last stage?

CHARLES EMORY,
Nashville, Tenn.

(1)—What you need most is radio frequency amplification and selectivity. So the best thing is a tuned RF stage ahead of the detector.

(2)—Another audio tube will probably make the circuit unstable. A power tube is advisable if you add the RF stage.

I AM BUILDING a receiver having three stages of screen grid tube RF amplification. Will it be necessary to shield the stages and to use filters in all the screen grid and plate leads?

(2)—Is it necessary to use individual shields for the three screen grid tubes?

(3)—Which is better in this case, to tune the primaries or the secondaries of the RF transformers?

(4)—Please suggest a suitable volume control.

JAMES ELLSWORTH,
Dover, Del.

(1)—It is necessary to shield each stage from the rest and also to use filters.

(2)—No, not if the stages are shielded.

(3)—Tune the secondaries.

(4)—A rheostat in the filament circuit of the three screen grid tubes makes a satisfactory volume control. Use a 10-ohm rheostat and put it in the positive lead common to the three tubes. Another method is to vary the B voltage on the screen grids (G posts of sockets).

WHICH IS better, to use RF amplification to obtain sensitivity or to use AF amplification for that purpose?

(2)—Are three stages of AF amplification practical?

(3)—If three or more audio stages are used, what difficulties are likely to be met?

CHESTER MERRILL,
Springfield, Ill.

(1)—It is better to use RF amplification to get sensitivity, for this can be done without increasing the distortion in the receiver.

(2)—If the circuit is direct coupled it is better to use no more than three audio stages. If transformer coupled it is better not to use more than two. By taking

special precautions in filtering and isolating the circuits, three stages may be used.

(3)—The greatest difficulty is motorboating, either active or incipient. If the circuit does not actually motorboat the condition may be there, causing sharp peaks and blasting. The second difficulty is that the more audio stages that are used the more distortion there will be.

IN MY 1929 MODEL highly selective Diamond of the Air, the left-hand or antenna circuit tuning dial reads about six points higher than the right-hand dial. Should this be? Can the situation be corrected, as I would like the dials to read more nearly alike?

HAMILTON MAYSON,
Dubuque, Iowa.

Yes, a difference of five or six points on the dials will result, due to the capacity effect between plate and filament of the screen grid tube and the size of the winding on the primary in the plate circuit of this tube, these effects being reflected into the tuned detector circuit. The subject was fully discussed in the series of articles on the new, highly selective Screen Grid Diamond, 4-tube model, published February 9th, 16th, 23d and March 2d. To equalize the tuning put a 70 mmfd. Hammarlund equalizer across the first-stage condenser. Tune in a low wavelength station at the dial settings as they happen to come when the equalizer movable plate is out. Then arbitrarily turn the first dial until it reads exactly like the second dial. Adjust the equalizer with a sharpened dowel until the station comes in at full volume. Your dials then should track within one degree. See the February 9th issue, wherein Dr. Val H. Hinsel, of 943 St. Johns Place, Brooklyn, N. Y., who used this method, got a difference of one-half degree or less all through the scale.

CONSIDERING the various methods of antenna coupling, such as transformer, auto-transformer and impedance, which do you consider the best, and why?

(2)—Please show a 4-tube circuit design for AC operation, wherein a conductive antenna coupler is used, but the set ought to have only a single tuning dial; that is, use a two-section condenser.

RALPH HOMPERT,
Saginaw, Mich.

(1)—It is impossible to state which is the "best" method of antenna coupling, as you do not give the conditions. For gen-

eral use the transformer method is most suitable, but for particular uses other forms might be preferable. The main consideration are desired degree of coupling and frequency response. The conductive method, whether by auto-transformer or by simple impedance, usually provides stronger signals, but at lowered selectivity. Simple impedance has the objection of not only being abnormally broad but of making it impossible to tune in the entire broadcast band with other than a large capacity tuning condenser, say, .002 mfd, since the antenna-ground capacity and the coil capacity are added to the large enough minimum capacity of the tuning condenser.

(2)—Fig. 737 shows a 4-tube AC circuit, using one AC screen grid tube, a 227 detector and a 227 first audio, with a 171A last audio. The antenna coupling is conductive by the auto-transformer method. The degree of coupling is determined by the elevation of the tap for the aerial. The nearer this tap is to ground the weaker the coupling and the greater the selectivity. An average coil would consist of 50 turns on a 2½-inch tubing, tapped at the tenth turn, one end going to grid, the aerial to tap and the other end—the one nearer the tap—to ground. This circuit should not be operated with a ganged condenser as by the conductive coupling method the antenna-ground capacity is larger in the tuned circuit than otherwise. You want maximum sensitivity, hence tune each circuit separately in this instance.

I HAVE a dynamic chassis and would like to connect it up in good style so as to enjoy the performance of which I assume it is capable. I have a 90-volt so-called DC model, that is, I must energize the field coil with 90 volts DC, which will produce 40 milliampers of current. My B supply is not quite capable of giving all this extra current without strain. Is there any way I can salvage the current used elsewhere, that is, still energize the field coil while not depriving any other part of the circuit of its rightful amount of current, and not drawing any more current than previously? My tubes are of the AC type and the last one is a 171A operated at 180 actual plate volts.

J. WARREN CAMBRIX,
Pensacola, Fla.

Your problem is solvable, since your field coil has a resistance of 2,500 ohms. Use the field coil in place of the resistor biasing of the last tube. Put a center-tapped resistance across the field coil—about 25,000 or 50,000 ohms—and connect the grid return of the last tube to the center tap. The voltages will not be absolutely orthodox, but will be reasonably right. The field coil will drop about 80 volts under the operating conditions, and your last tube will get a bias of about 40 volts negative, only a trifle high, considering a 35-volt plate voltage reduction involved in the process.

MY SET WORKS fine on all stations except one. On that the volume is terrific and the volume control will not handle it. The circuit also hums badly on that station. What is the cause of the trouble?

(2)—Do you think that this is due to the B battery eliminator?

(3)—Please suggest a remedy for the hum.

ROY ADAMS,
Boston, Mass.

(1)—The circuit regenerates too much at the frequency corresponding to the loud station. Both the volume and the hum are due to this.

(2)—While the hum comes from the B battery eliminator this is not the direct cause, for otherwise the set would hum at all stations.

(3)—Introduce a rheostat in the detector filament circuit, or in the filament circuit of the preceding tube.

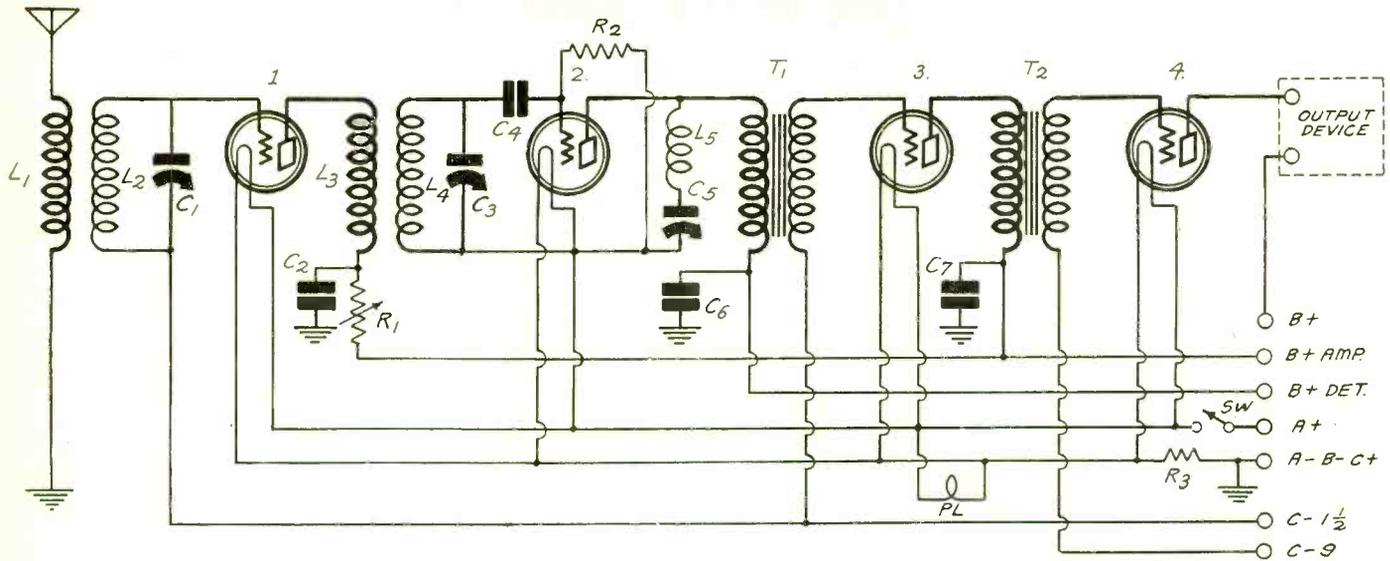


FIG. 738

WHERE HIGH SELECTIVITY IS NOT NECESSARY A CIRCUIT LIKE THE ABOVE GIVES GOOD RESULTS, INCLUDING FINE TONE AND FAIR SENSITIVITY

I WISH to measure the power output of my receiver. What kind of meter is necessary?

(2)—Is a vacuum tube voltmeter across the loudspeaker suitable, and if so, does that give the power?

(3)—Can you suggest any direct reading current meters for measuring the current flowing in the loudspeaker?

HOWARD SWEENEY,
Council Bluffs, Iowa.

(1)—Primarily you need an AC milliammeter. Measure the AC that flows through a resistance equal to that of the loudspeaker. This is not easy to get, since the effective motional resistance is required. The best way is to get a resistance equal to twice the resistance of the power tube and then to measure the current in that. The power is obtained by squaring the current in amperes and multiplying by the resistance substituted for the speaker. You cannot depend on the radio signal but must have a local source of tone.

(2)—Yes, you may use a vacuum tube voltmeter for measuring the AC voltage across the speaker, but it is of little aid. However, you may use the vacuum tube voltmeter for measuring the voltage across the substituted resistance. The power then will be the product of the root mean square voltage and the current.

(3)—Get a 0-100 milliammeter either of the hot wire type or of the thermo-couple type.

I LIVE 50 miles from the nearest broadcasting station. Please show a diagram of a 4-tube set that produces good tone and will bring in a fair number of stations. Battery operation is desired.

THOMAS CURK,
Randolph, Wis.

Fig. 738 will suit your needs. The values of constants are not critical. L5 is an RF choke and C5 is 50 mfd. The combination will get rid of squeals on low waves.

HOW MANY TURNS should be put on a 2½-inch diameter tubing, so that the coil can be tuned with a .0005 mfd. condenser?

DENNIS O'MEARA,
Pawling, N. Y.

Use 48 turns of No. 24 double silk covered wire for the winding that is to be tuned. This winding should go in the grid circuit, in a standard TRF or regenerative set. But if a large primary or other winding is near the one you will tune, as if both are on the same form, more than 48 turns would be required, due to losses.

HOW MANY TURNS of wire are required on a 2-inch diameter to make a coil for a .0005 mfd. condenser to cover the broadcast band?

(2)—For a .00035 mfd. condenser

(3)—Please state what size of wire is suitable.

(4)—What should be the number of turns in each case if the coil is to be used between a screen tube and a detector?

RALPH OTIS,
Fort Worth, Tex.

(1)—Use 55 turns to start with and then reduce in case the distributed capacity is so large as to make this coil too large.

(2)—Begin with 64 turns, reducing as required to compensate for the distributed capacity.

(3)—No. 28 DSC is suitable for this size of coil.

(4)—Use about the same number on the primary as on the secondary, but use much finer wire. As fine wire as No. 40 is suitable.

WHAT ARE EDDY currents and what causes them?

(2)—In what manner do eddy currents increase the resistance of a coil when these currents are not in the coil?

(3)—What is the difference between eddy current losses and hysteresis losses in an iron core transformer

(4)—What precautions are taken to reduce eddy currents and hysteresis?

PATRICK REILLY,
New Bedford, Mass.

(1)—Eddy currents are electric currents induced in metals when they are in an alternating or varying magnetic field. They are produced the same way as sec-

ondary currents in transformers, but they run wild.

(2)—It takes energy to keep electric currents circulating, no matter where they are. If this energy comes from the magnetic field of a coil the energy left to produce currents in the coil is smaller. Hence the current in the coil is smaller, and since there has been no change in the voltage in the coil the effective resistance must have been increased.

(3)—Eddy current losses in a transformer core are due to the losses accompanying the circulation of the eddies in the core as a metal. And these eddies are caused by the varying magnetization of the iron. Hysteresis losses are due to the energy required to magnetize and demagnetize the core.

(4)—To prevent eddy currents the core is laminated so that the eddies are broken up and reduced in magnitude. Hysteresis losses are reduced by selecting core material which is easily magnetized.

HOW IS the selectivity of a tuned circuit measured?

FRANK OVERTON,
Baltimore, Md.

(1)—There is no one method used for expressing selectivity of a circuit, but the most common is the ratio of the inductive reactance to the resistance. That is, Lw/R , where L is the inductance of the tuning coil in henries, w is 2 pi times the frequency at resonance and D is the radio frequency resistance of the coil. This ratio is called the Q of the circuit. For high selectivity this Q should be large. Hence the expression Hi-Q.

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Name
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Stability is Assured

By Doubly Protective Measures in AC Receiver

By Herbert E. Hayden

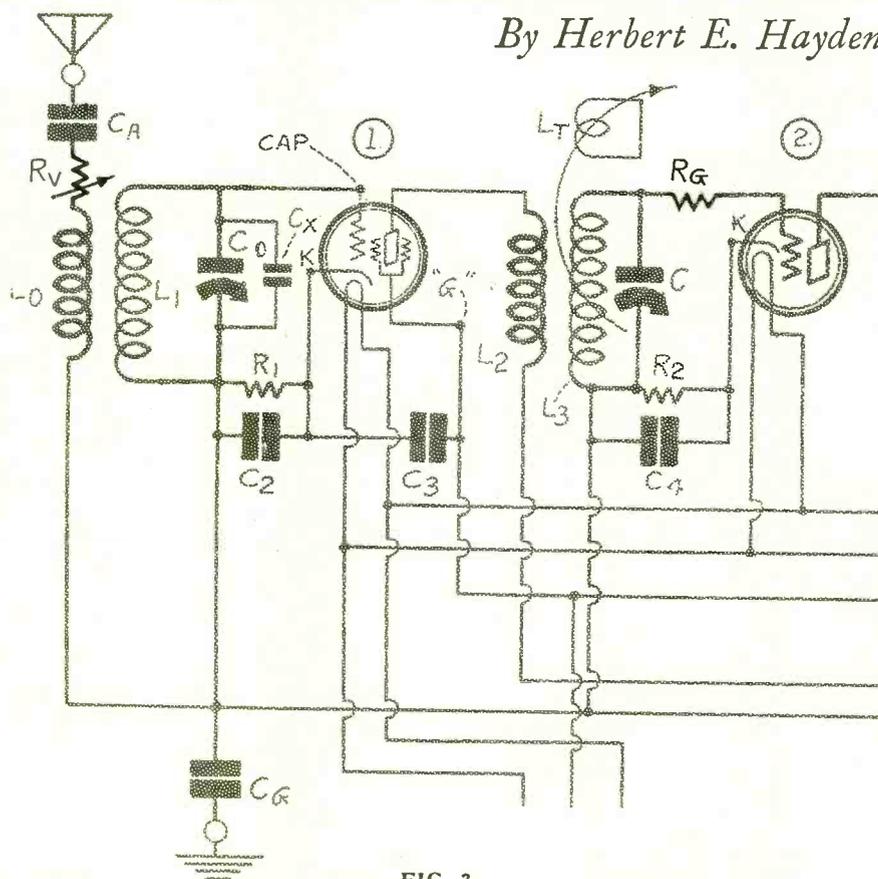


FIG. 3

AN EXTRA VOLUME CONTROL FOR CITY DWELLERS IS SUGGESTED, THIS BEING A 0-5000 OHMS VARIABLE, WITH AN 110-VOLT AC SWITCH ATTACHED, TO AVOID ADDING AN EXTRA CONTROL ON THE FRONT PANEL. THIS VOLUME CONTROL IS RV. FOR ASSURANCE OF STABILITY, IN THE EVENT ANY SELF-OSCILLATION ARISES AT RADIO FREQUENCIES, A GRID SUPPRESSOR MAY BE INCLUDED. THIS IS RG.

Part I of this article on an all-electric 6-tube receiver, using one screen grid AC tube, four 227 tubes and one 245 tube, was published in the March 16th issue, while Part II appeared in the March 23d issue. Herewith is a discussion of how to achieve best operating results.—Editor.

TWO choices are presented by conditions that will develop in individual receivers patterned after Fig. 1, the schematic diagram published in the March 16th issue. One is the inclusion of a volume control that operates independent of oscillation considerations, and the other is the inclusion of a neutralizing resistor or grid suppressor, in the event self-oscillation at the higher frequencies is present, even at maximum coupling of the short-circuiting tickler LT.

The object of the tickler is to subdue self-oscillation, so that you may use full amplification at the high wavelengths, where it is needed most, but can introduce positive resistance at the lower wavelengths, as needed. Thus the tickler is not a regeneration inducer, as most ticklers are, but is a regeneration killer. It provides negative feedback in Superdyne style. It is therefore serviceable as a volume control.

Condition in Cities

But conditions are not the same in all localities. Many report that a tickler volume control is abundant for them, since they live in the country, and the nearest station is a hundred miles away, or more. Too much volume is never one of their

troubles. Hence such folk may build the receiver with the single tuning dial in the center, although higher in position than ordinarily, i. e., 4 inches up from the bottom, the tickler knob at left, and a 110-volt AC switch of the knob type at right.

But persons living in cities will want an additional volume control, since the receiver amplifies so greatly that strong local stations will come in with altogether too much volume, even with the tickler turned parallel with the secondary. This extra volume control may well be a 0-5,000 ohms variable resistance, with an 110-volt AC switch attached, so that the switching on and off is done with the same knob that governs volume, and an extra panel control is avoided.

The volume control is RV, shown emphatically in the diagram this week, which is a section of the circuit schematic diagram sufficiently inclusive to illustrate the points now under discussion.

Oscillation at High Waves

Even when the regular volume control is included, as described, it is necessary to pay a little attention to the tickler, since you will want utmost sensitivity at the high wavelengths, obtainable only by using almost the full amount of self-feedback of which the circuit is capable.

It may be found that even at the highest receivable wavelengths—the lowest frequency in reach—the set may oscillate a little, and this is an indication that a grid suppressor is needed. Where to put this is shown emphatically in Fig. 3. The constant is designated RG.

As stated previously, the screen grid tube is not the one that will oscillate first: indeed, it is safe to say that you will not run into any self-oscillation trouble with this tube in the present circuit; but the second tube is the one that has a tendency toward self-oscillation. Hence the grid suppressor is in this tube circuit; in fact, so is the positive resistance tickler.

Value of RG Determined

The value of the resistor in the grid circuit can not be given absolutely. The way to decide the question for yourself is to use the lowest possible value of resistance consistent with absence of squealing when you tune in the lowest receivable wavelength. It is not enough to be assured that the squeals are totally eliminated, for that end is altogether too easily achieved by using too high grid resistance.

The theory of the grid suppressor is that it introduces a positive resistance to overcome the negative resistance present when the circuit is oscillating. This negative resistance is greatest, usually, at the lowest receivable wavelength. Since negative resistance is "minus," therefore the resistance is "more minus," the lower the wavelength.

A happy condition indeed exists when the grid resistor is of just enough resistance to kill off all squeals (with the aid of the tickler in the present circuit), but not so high as to cut down materially the volume on any station.

How to Adjust for Stability

Set the tickler at zero coupling, which is usually at about right angles to the secondary, and determine if the receiver squeals. If so, turn the tickler to the extreme, one way, then the other, to see whether you can get rid of the squeal in this way. If not, then leave the tickler at the angle, parallel or almost parallel with the secondary, that affords the greatest suppression, and with the tickler kept in this position, try various values of resistance for the grid suppressor.

As a clue, it was found that with the voltages obtainable from the prescribed parts, 5,000 ohms was altogether too much resistance and on some low wavelengths killed off signals that came in weakly before, and that 2,000 ohms was good. Many, however, will find a little more than 2,000 ohms necessary, say, 2,500 ohms, while most will ascertain, no doubt, that 1,800 ohms is just about right. It is preferable, therefore, to use a resistor with an adjustable slider, so that if you buy a 2,500 ohm value you will be able to reduce the resistance to 1,800 ohms, or so, if necessary, simply by moving the slider. The Electrad wire-wound resistor has this slider feature. The catalogue number of the 2,500 ohms value is B25.

Synchronized Tuning

The circuit must be made resonant at a low wavelength, preferably at the lowest wavelength within easy reach, that ordinarily produces low volume from a particular station. The object of selecting a low-volume station is that the adjustment of the trimming condensers can be made more readily at low volume, since if they are off register there will be no reception of this station whatever, in all likelihood, whereas accurate setting will provide utmost volume. Another reason is that the extra but small capacity is a greater percentage of the total capacity used at a low wavelength.

The Moore-Daniels

Constructional Data on Great DX Receiver Are Presented

By E. Bunting Moore

[The Moore-Daniels, a 5-tube battery-operated receiver of remarkable distance-getting ability, was outlined last week, issue of March 23rd. This week the construction is discussed. In a subsequent issue the AC model will be discussed. The designers of both circuits are Alfred J. Daniels and Mr. Moore.—Editor.]

SOME departure from what has been considered standard practice marks the Moore-Daniels 5-tube receiver, and this departure has been deliberately undertaken because of the proved superiority of results.

As shown, we have three inductors with unconfined fields. To remove the danger of trouble due to coupling between these coils it is of course necessary to mount them in line, and at right angles, as well as reasonably well separated.

This, then, was the controlling factor in physical layout. Since the selectivity is dependent, except for losses in the coils and condensers themselves, upon the resistance of the leads connecting the coils and condensers, it necessitated the placement of the condenser directly opposite to the coils. Convenient space is thus left for the two dials in the center of the panel.

Dials Adjusted

So that the dials will clear the baseboard, it is necessary to mount the condensers about a half inch above the base panel on by means of the spacers supplied. This may be done most readily by taking another small piece of wood a half inch thick and cutting out three pieces which can be screwed fast to the baseboard underneath each of the three tuning condensers.

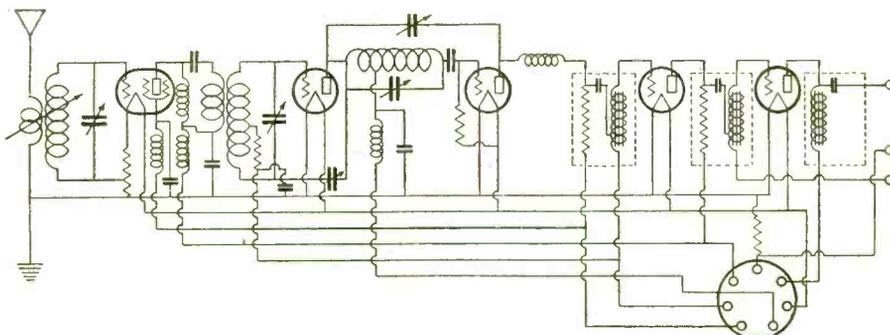
Be very careful to mount the condensers exactly the right distance back of the panel, and exactly in line, for any deviation will make them turn hard and destroy the chance for fine tuning.

Now assemble the dials, attach them to the front panel, and mount the whole panel assembly, and if the condenser mounting is correct, the dials will line right up with the shafts of the condensers. If they don't, then remove the condensers and enlarge the mounting holes with a rattail file until they fit properly. Don't finally tighten the mounting screws until the shafts are all hooked together.

Stick to Layout

Now mount the coils as shown in the front cover illustration. The shaft of the antenna variocoupler comes out just beyond the left-hand single condenser, about 3 1/2" from panel edge. The midget is mounted as shown, just back of the space between the two right-hand condensers, to balance antenna knob and a piece of quarter-inch round stick is used to connect the midget to the knob. This prevents any body capacity effect, since both sides of this condenser are "hot," or at high R. F. potential, and if the condenser were right on the panel the operator's hand would affect the tuning. As the set is built up, there isn't room for the condenser on the panel anyway.

The other apparatus, such as by-pass condensers, chokes, sockets, etc., are now mounted. While it is highly recommended that they be placed exactly as in our layout, the position may be altered somewhat provided that all R. F. leads



CIRCUIT DIAGRAM OF THE MOORE-DANIELS

be kept very short, and well separated.

The neutralizing condenser is mounted right on the plate of the second R. F. amplifier tube socket, so that this condenser will duplicate as closely as possible conditions within the tube. The R. F. choke in the detector plate circuit will be found to connect exactly from the plate post of the detector socket to the proper solder connector on the first audio unit.

It will be noticed that the audio amplifier is situated entirely to the rear of the cable running the length of the set, while the R. F. amplifier is entirely in front of it. This serves a dual purpose. The audio is kept well away from the R. F., assuring against feedback with its accompanying hiss, and besides if it is desired to use another type of audio system, such as push-pull, it is easy to change that part of the set without disturbing the tuner. The space left as a separation between the two sections works out very well as a channel in which the cable containing the battery wires may be laid, or cabled.

Ground the Cases

When all the apparatus has been mounted and screwed down to the baseboard, dismount the front panel, dials and variable condensers. This is done to provide greater accessibility while wiring the rest of the set.

Now put in the wire from the plus 45 post on the first audio unit to the cable plug. This is the base for the cable. Now proceed with the filament wiring, winding the leads around the wire already in and departing at right angles only to get to the sockets, switch, other instrument and to a soldering lug under the mounting screw of each of the audio units. Connect these parts by a wire wound into the cable, direct to the ground binding post. Neglect of this "grounding" of the cases may result in unpleasant audio oscillations. **Be sure to wind all these leads into the cable.**

Wherever you have two wires close together away from the main cable, twist them. Continue with all the audio, "B plus" and "C minus" leads, as well as the by-pass condensers and the leads from them to the R. F. chokes.

Then put in the grid and plate leads of the first and second R. F. tubes and the detector. The tuning condensers should be remounted and wired at this time. Be as careful to keep these leads as well separated from each other and all other leads as you were careful to get the low potential leads into the cable.

Continue with all other R. F. po-

tential leads, such as those to the neutralizing and regeneration condensers, keeping them well apart from other wires.

These should be kept short, too, for each of them will act as a miniature antenna, both transmitting and receiving, and if they are allowed to get long they will transmit and receive from each other. The cable, of course, has lots of capacity between it is component wires, and saves the need of additional by-pass condenser.

Instead of a single long shaft being used to connect the condensers and right-hand dial together, three short shafts are used with flexible insulating couplings. These keep the condensers rotating smoothly and are necessary insulators, because two condensers are not at ground potential on either side.

Attach the Panel

Now attach the panel again. Connect the switch and dial lights. Attach the batteries or power supply carefully. If any of the wires shows a spark while being attached, it is evident that there is a short circuit, and the connection to the power source should be removed and the wiring checked until it is eliminated.

Everything's right? Good, try One tube. Turn on the switch. If it lights, the filament part of that circuit must be O. K. Fine! Add the remaining tubes, one at a time, and the shield grid tube last, for it should always be taken out first and put in last when the tubes are removed from the receiver.

With the batteries, power supply, and antenna and speaker connected, a click should be heard in the speaker when the current is turned off and on. Touching the grid of the detector tube should produce a loud growling squeal. Touching the cap of the shield grid tube brings out a loud "click."

Set the dials at 82. Turn the antenna variocoupler to an angle of about 45°. Now vary the regeneration condenser. The receiver should click into oscillation at about half the condenser's capacity. If it either will not oscillate, or won't stop, then adjust the neutralizing condenser until the oscillation pops in and out at the right place. This won't be difficult.

Then set the dials at 20 and try again. After a few minutes you'll find a position for the setting of 20 where the receiver can always be thrown in and out of oscillation by varying the regeneration control. Then leave the neutralizing adjustment fixed, unless a tube of widely varying characteristics be substituted in the second R. F. socket.

Now leave the regeneration control just

(Continued on next page)

The AC Diamond

Using the New Screen Grid Tube as RF Amplifier

By Herman Bernard

[First presentation of the new, highly selective AC Diamond was made last week, issue of March 23d.]

IN building the 4-tube AC screen grid Diamond of the Air you want the switch on the front panel to turn on the B eliminator and filament transformer. This is accomplished as follows:

A porcelain screw type (Edison base) socket is screwed down at the right-hand rear corner of the subpanel. An AC cable is then provided of suitable length to reach the convenience outlet (AC 110-volt outlet). To one end of this cable is attached a male plug, the familiar two-prong type. The other end of this cable is split up, one lead going to the AC switch, the other lead going to the other post on the porcelain socket and to CG. The remaining post of the porcelain socket goes to the remaining side of the switch.

Thus when you turn the switch on you open the circuit across the porcelain socket. But there is nothing between the two sides of this socket but air.

Use Standard "Lamp Cord"

So insert a screw type female plug and into this plug you can put a two-way or three-way connector, two-way if only B supply and filament transformer are to be used, three-way if an AC dynamic speaker is to be used, too. Then the switch controls the dynamic as well.

The cable lead you supply should be the standard lamp cord. The filament transformer and B supply have cables on them. There is no need to cut these, since there is plenty of room to accommodate the slack.

The illustration visualizes the connections. The designations + and - are arbitrary, since the AC line reverses its polarity 60 times a second. The markings are for distinction only.

The foregoing disposes of the only kinks.

How Volume Control Works

It will be recalled that the AC 110-volt switch and the volume control are manufactured as one unit. It is well to have this work with maximum volume as soon as the set gets going, rather than start with minimum volume, as nobody will then ask, "Why doesn't the set work," when the volume control is at disconnection. Hence turn to the right to reduce volume.

If you turn to extreme right you dis-

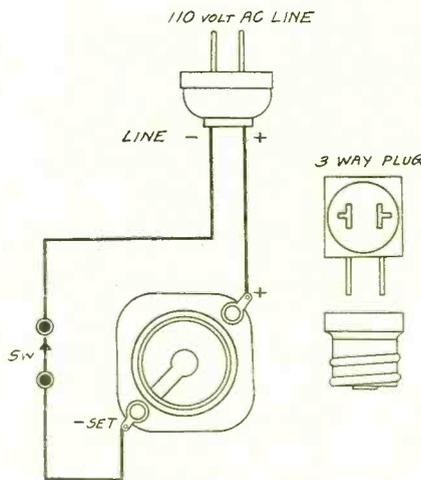


FIG. 3

THE SWITCH ON THE SET CONTROLS BOTH A AND B POWER SOURCES, SINCE THE B ELIMINATOR AND FILAMENT TRANSFORMER CABLES ARE PLUGGED INTO THE SET SIDE OF THE LINE. A SCREW TYPE AC SOCKET, A SCREW PLUG AND A 3-WAY PLUG AFFORD ACCESS.

connect the antenna and get a little hum, but you never will want to operate at that position.

Some data were given last week on voltages for the screen grid AC tube. These apply to "independent" tubes, as a rule, but will apply to the AC screen grid tube that RCA and Cunningham will announce, probably next month. With the RCA and Cunningham makes it will be possible to use higher plate and screen grid voltages. These tubes, by the way, will not be known as "AC 222" or "AC 322" but will have a different alphabetical and numerical designation.

Follow The Blueprint

On construction the best advice is to follow the blueprint. It is handy and easy to use an aluminum subpanel, with sockets affixed and having a self-bracketing and self-supporting feature. This subpanel then can be used as the B minus lead. Screw a lug tight to a hole in the subpanel and solder a lead to the

lug, running the wire to B minus of the external B eliminator.

The front panel is 7x21 inches, with green pilot light window above the dial. For a dial indicator simply press a needle point against the front panel and fill in the point with tooth paste. Do not "rock" the needle when pressing, or a jagged ridge will protrude.

The equalizing condenser, 70 mmfd., must be turned almost completely in, before resonance will be established. Set it at a low wavelength by testing for maximum volume. See last week's diagram, also the blueprint.

The set has squealing propensities, always a good sign, if squeals are capable of being permanently squelched. This can be done by altering the screen grid voltage (G post of socket No. 1) or by using a higher value of detector biasing resistor (R3). Try 100,000 ohms. The place to stop increasing R3 in your experiments is when the regeneration is made to fail in the detector circuit.

The battery model screen grid tube, as the sole RF tube, would not oscillate. The AC screen grid tube will oscillate. A way of surely stopping this is by inserting a grid suppressor in the circuit, between the stator plates of C2 (the first tuning condenser) and the lead to the screen grid tube's cap. Try 1,000 ohms. Increase the resistance until squealing stops on a low wavelength. But always be sure to maintain regeneration in the detector stage. Suitably low value of R3 will assure this.

Stability being vital, the foregoing points the way to its sure achievement. Once the set is gotten into condition, with the screen grid tube devoid of self-oscillation, and the detector tube readily regenerated or subdued by turning the tickler, all easy enough to accomplish, you will have a circuit that will fill you with delight.

Reconciliation

In the list of parts, published last week, R2 and R4 were described as 900 ohms each. This value is correct for R2, but R4 preferably should be 2,000 ohms. These resistance strips are of the suppressor type, manufactured by Electrad, Inc., and are wire-wound. Add to the list of parts also the following: the porcelain base socket, the AC cable lead, the male plug, the female plug-socket, and the three-way connector.

[This concludes the structural article. Other phases of the circuit will be discussed next week, issue of April 6th.]

Tuning the Moore-Daniels Five Receiver

(Continued from preceding page)

below the oscillating point and vary the dials in unison until a station is received. Then vary the tuning controls individually until reception reaches the maximum volume. Loosen the set-screw holding the dial of the antenna stage, and rotate the dial a little until it reads the same as the right hand dial, then tighten it again. Now, with the stations tuned in to maximum volume, the dials will read about alike all the way up and down the scale. A very small variation will be experienced when the position of the antenna coil is changed, and there will be trifling differences at the high frequency end, but in

the main the dials will be found to run so close together that you will appreciate the convenience.

In tuning the set, the regeneration control should not be used as a volume control but should always be kept just below the oscillating point, while the knob controlling the antenna variometer is a volume control, for, only by working in this manner will the high degree of selectivity be attained. The closer the set is to oscillation, which the consequent effective proximity of the negative resistance values to the true resistance, the sharper the tuning will be, and, further, the greater sensitivity will allow looser

antenna coupling, which also sharpens the tuning.

After manipulating the controls for a short time, the user will begin to get the hang of tuning the set, and then the DX will begin to roll in.

[The all-electric model will be described subsequently. In this set, which uses the safe parts, with the addition of the power equipment, no external connections are necessary other than to the antenna and the 110-volt line. The set requires no more space than the battery operated model, being assembled on an identical baseboard. The new AC screen grid and UX 245 tubes are used.]

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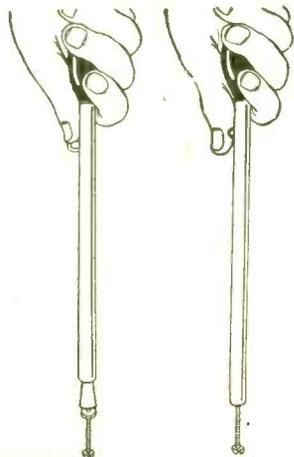
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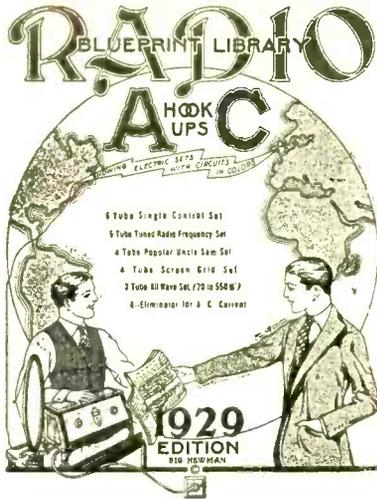
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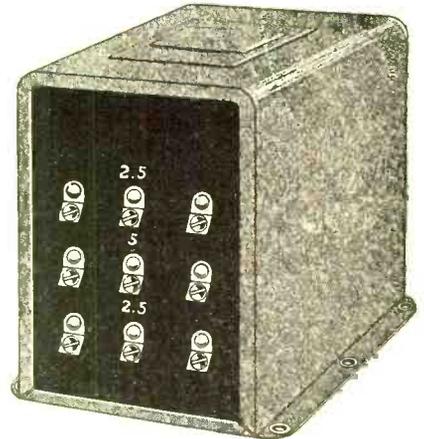
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All three windings are tapped at the exact electrical center. This precision location, made with the aid of an impedance bridge, accounts for absence of hum otherwise caused by the last tube when heated directly with AC. The heater type tubes are *indirectly*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

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

The new power tube, 245, that at only 250 volts on the plate has the undistorted maximum power output of a 210 with 350 volts, uses 2.5 volts on the filament, at 1.5 ampere. Therefore the lower 2.5 volt winding of this filament transformer may be used for the new power tube. The 245 is not a heater type tube.

Other options include the heating of 7 1/2-volt power tube by series-aiding connection of the 5-volt and the bottom 2 1/2-volt windings. Connect the right-hand posts of these two windings with No. 18 insulated wire. Connect a 50-ohm center-tapped resistor across the remaining posts of these windings. The voltage across the posts at left is then 7 1/2, while the grid return goes to the center tap of the extra resistor. In such a case disregard the center taps of the two windings themselves, as they are not centered in respect to 7 1/2 volts.

Every B supply rectifier tube, or pair of tubes, requires a separate winding, that is, you can't use a winding that also feeds a tube in the receiver proper. But the 5-volt winding of this filament transformer may be used for a 280 rectifier tube, or the 7 1/2-volt series connection for 281 tube or tubes, in which case the top 2 1/2-volt winding would be used for the 227 tubes and the 245 power tube in the set.

The transformer is beautifully finished in crackled glossy black, with bakelite front, and comes equipped with 5/2-inch AC cable with plug. Six riveted mounting holes for baseboard or subpanel. Size, 3 3/4 in. high, 2 3/8 in. wide, 3 in. deep. Shipping weight, 6 lbs.

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

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

Build the New Diamond (AC or Battery Model) The 4-Tube Circuit Supreme!

USE THE OFFICIAL PARTS
AS SPECIFIED BY
HERMAN BERNARD,
Designer and Author

The parts listed herewith are exactly the same as those used by Mr. Bernard in his laboratory model.

PARTS FOR THE AC DIAMOND

CA, CG, C7—Three Aerovox .0005 mfd. mica fixed condensers, moulded. @ .25	\$0.75
C3, C4, C8—Three Aerovox .006 mfd. mica fixed condensers, moulded. @ .50	1.50
C6, C9—Two Aerovox .02 mfd. mica fixed condensers, moulded. @ \$1.00	2.00
C10—One Aerovox 4 mfd. condenser	2.50
C11—One Hammarlund Equalizer, 70 mfd.	.40
C2, C5—One Hammarlund Midline double condenser, each section .0005 mfd. (MID23)	6.00
R1, SW—One Electrad Royalty volume control (0.5,000 ohms) with 110-volt Hart & Hegeman AC switch built in	1.50
B2—One Electrad 900-ohm resistance strip (grid suppressor type)	.20
B3—One Lynch 50,000-ohm resistor, with clips	.20
R4—One Electrad 2,000-ohm resistance stub	.20
R5—One Electrad 2,000-ohm type B resistor (B20)	
T1, T2—Two National A100 audio frequency transformers @ \$5.70	11.40
T3—One filament transformer; one winding 2.5 volts at 9 amperes or more, one winding 2.5 volts at 3.5 amperes or more, one winding 5 volts at 2 amperes or more (merchandised by Guaranty Radio Goods Co.)	6.00
PL—One Yaxley pilot light bracket with green jewel and lamp	.55
Ant. ground, speaker —, speaker +, four binding posts @ .10	.40
One roll Braidite wire	.30
One 7 x 21-inch front panel	2.35
One 19 x 20-inch official AC Diamond aluminum subpanel, self-bracketing, with three five-prong sockets and one four-prong socket built in	3.25
Front and subpanel together	5.25
Porcelain AC socket, screw plug 3-way plug, cable (lamp cord) and wall plug	.75
One dial	.90
Two knobs (one for tickler, the other for volume control) @ .20	.40
Note: The optional condenser, CX, is .006 mfd. @ .50	.50

ACCESSORIES

One National elvett-B, type 3550, with 280 tube	16.13
One 222 AC tube, two Kelly 227 tubes, and one Kelly 112A or 171A tube	11.00
One 7 x 21 x 12-inch cabinet (walnut)	12.00

PARTS FOR BATTERY MODEL DIAMOND

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

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

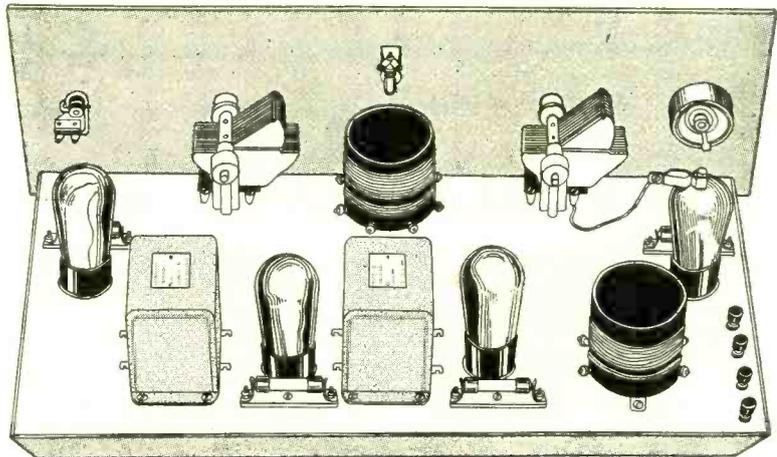
Complete List of Radio Stations

RADIO WORLD dated March 23d carried a full and thoroughly up-to-date list of broadcasting stations as they stood at the time of going to press. This list contained the stations in the order of frequency and gave the owner, location, power and time sharers.

Mailed for 15c a copy; or subscribe now and start with the March 23d issue.

Radio World, 145 W. 45th St. N. Y. City.

Most Selective DIAMOND



See what a dandy appearance this simple, efficient receiver makes! One SG tube, two 201A and one 112A (or 171A) are used. Aluminum subpanel shown.

Follow Blueprint

THIS IS THE BATTERY MODEL

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

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

Volume "to fill the house"—even on distance. Tone quality excellent.

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

RADIO WORLD
145 W. 45th St., N. Y. City
(Just E. of B'way)
 Enclosed please find \$1.00 for which please send at once the official blueprint of the new, highly selective 4-tube screen grid Diamond of the Air battery model.
 60 cents extra for the February 9th, 16th, 23rd and March 2nd (1929) issues of Radio World, containing Bernard's articles on the construction of this receiver.
 \$3.00 for 6 months (26 numbers) subscription for Radio World. Send Diamond blue print and four Diamond issues FREE, in addition to 26 current issues.

Name

Address

City State

Blueprint of the AC Diamond

BUILD this 4-tube receiver, using one 222 tube, two 227 and one 112A (or 171A), and enjoy tone quality, selectivity and ease of control. The official blueprint gives the picture diagram life size, both top and bottom views; also schematic diagram and list of parts. You can use your present B eliminator externally, but the filament transformer is a part of the circuit.

Enjoy the convenience of AC operation, and still have just as selective and sensitive receiver, by building the AC Diamond. If you have 110-volt, 50 to 60 cycle AC house current, then this is the circuit for you. Fine performance. No hum.

Radio World, 145 W. 45 St., N. Y. City (Just East of Broadway)
 Inclosed please find \$1.00 for which send at once official blueprint of the 4-tube AC Diamond.
 30c for the March 23d and 30th issues (1929) describing this circuit.
 \$3.00 for 6 months subscription for Radio World. Send blueprint and two AC Diamond issues FREE.

NAME

ADDRESS

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

Aluminum Subpanel

for the New, Highly Selective

SG Diamond

Battery or AC Model (specify which)

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

Front Panels

The front panels for the battery model or the AC Diamond are of Bakelite, 7x21 inches, and are drilled with all necessary holes, each in exactly the right place. High-polish finish.

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

Enclosed please find \$3.00 for which please send one aluminum subpanel 10x20" for the new battery model 4-tube SG Diamond of the Air, with sockets built in, and with self-bracketing front and side and rear supports; also send hardware and insulating washers.
 Enclosed please find \$1.35 for which please send 7x21" drilled Bakelite front panel for the new battery model Diamond.
 Enclosed please find \$3.25 for the 10x20" aluminum subpanel, etc., for the new AC Screen Grid Diamond.
 Enclosed please find \$1.35 for the 7x21" drilled Bakelite front panel for the new AC Screen Grid Diamond.
 Enclosed please find \$5.00 for both the aluminum subpanel, etc., and the drilled Bakelite front panel of the battery model.
 Enclosed please find \$5.25 for both the aluminum subpanel, etc., and the drilled Bakelite front panel of the AC model.

Name

Address

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

Coils Built for Abundant Results!

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

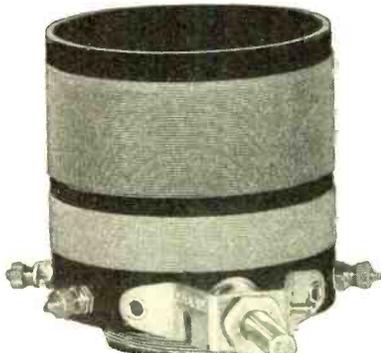
Fascinating Color Adorns the Bakelite Form as Well as the Wire Insulation

The DIAMOND Pair



AC5 \$1.50

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



SGT5 \$2.75

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



A5 \$1.75

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

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

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

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

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

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

And, remember, the dials track nicely!

Data on Coils

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

The outside diameter is 2 1/2 inches.

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

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

All tuned windings are center-tapped.

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



HT5 \$3.00

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

The UNIVERSAL Pair



RF5 \$1.50

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



TP5 \$3.00

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

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

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

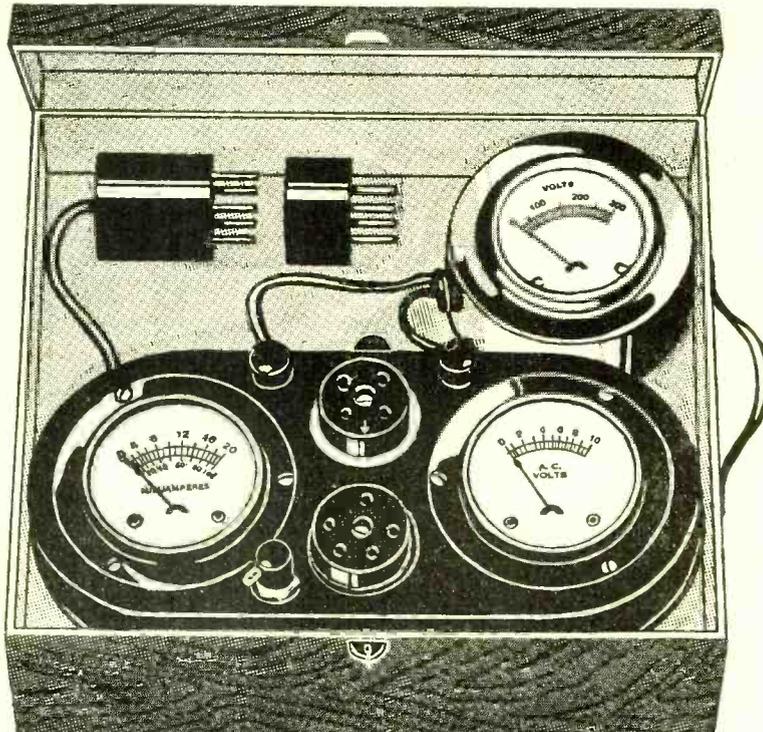
De Luxe Carrying Case **FREE**

With Each Jiffy Tester Combination!

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

INSTRUCTION SHEET GIVES FULL DETAILS OF THESE THIRTEEN TESTS

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



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

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

Jiffy Tester a Scientific Trouble Shooter

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

\$13.50

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

\$14.50

Here Are the Thirteen Vital Tests!

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

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

Note All That You Get!

For \$13.50 you receive:
 (1) One Two-In-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
 (2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.
 (3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.
 (4) One 3-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 moiré metal case.
 (10) One instruction sheet.
 (11) One de luxe carrying case.
 If 0-500 volt 5% accuracy high resistance meter is preferred to 0-300 volts, add \$1.00, and order Combination C at \$14.50.
 If 0-500 volt 1% accuracy high resistance meter is preferred to 5% accuracy 0-500 voltmeter, add \$2.00, and order Combination D at \$15.50.
 [Note—A pair of adapters for UV199 tubes, Cat. No. 999, at \$1.00 extra. These are not sold except with Jiffy Tester Combination.]

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

Please ship at once your Jiffy Tester Combination for which I will pay post-man advertised prices, but no shipping charges. (Check off below.)
 One Jiffy Tester Combination A (0-10 v., 0-20, 0-100 m. a., 0-300 v., carrying case, instruction booklet **FREE**) Price \$13.50
 One Jiffy Tester Combination B (same as above, but with 0-300 voltmeter accurate to 1%). Price \$14.50
 One Jiffy Tester Combination C (same as A, except 0-500 voltmeter replaces 0-300). Price \$14.50
 One Jiffy Tester Combination D (same as C, except 0-500 voltmeter is accurate to 1%). Price \$15.50
 Set of 199 adapters Price \$1.00

NAME

ADDRESS

CITY STATE

5-DAY MONEY-BACK GUARANTY

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



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

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

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

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

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

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

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

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

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

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

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

Guaranty Radio Goods Co.
145 West 45th Street
New York City
(A few doors East of Broadway)

FAMOUS NATIONAL

Velvet B Eliminator \$16.13
180 Volts (with 280 Tube)



Latest Model National Velvet-B, Type 2580, in handsome crackle finish black metal casing, for use with sets up to and including six tubes. Input 105-120 volts AC, 50 to 60 cycles. Output, 183 volts maximum at 35 milliamperes. Three variable output intermediate voltages. (Det., RF, AF). Eliminator has excellent filter system to eliminate hum, including 30 heavy chokes and 18 mfd. Mershon condenser. No motorboating! (Eliminator Licensed under patents of the Radio Corporation of America and associated companies.)

Guaranty Radio Goods Co.
145 W. 45TH STREET
(Just East of Broadway)
NEW YORK CITY

GUARANTY RADIO GOODS CO.,
145 W. 45th St., N. Y. City
 Please send C. O. D. on 5-day money-back guaranty, one National Velvet B (180 volts maximum with three variable intermediate voltages), with 280 tube, at \$16.13.
 Enclose find \$16.13. Please send above. You are to pay cartage.

Name

Address

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

5-DAY MONEY-BACK GUARANTY



A COMPLETE CATALOG with illustrations and detailed descriptions may be obtained free of charge on request.

IF YOUR SET HAS LARYNGITIS

Does it talk with a gruff, choked-up voice? Do you envy the rich, deep tone of present-day sets? If so, just place a VOLUME CONTROL CLAROSTAT across secondary of first audio transformer, adjust the knob, and see the laryngitis clear up. That's only one improvement. Many others can be made. Ask your dealer or write us for the "how."

CLAROSTAT MFG. CO., Inc.
291 North 6th Street, Brooklyn, N. Y.

CLAROSTAT

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



NEW POWERTONE UNIT
with 5-ft. cord
Designed Front Sheet
Plain Rear Sheet
Radio Cement
Mounting Bracket
Apex Chuck
Nut
Tri-Foot Pedestal
Instruction Sheet
ALL FOR ONLY \$6.00

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

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



Your name will be put on the mailing list free of charge on request.



Twice as Much for Your Money!

Send \$6.00 for one year's mail subscription for RADIO WORLD (52 numbers, one each week), and you will be given one full year's subscription for any one of the following six magazines:

- | | |
|---------------------------------|-----------------------------|
| Radio News (monthly) | Radio Engineering (monthly) |
| Science and Invention (monthly) | Youth's Companion (weekly) |
| Radio, San Francisco (monthly) | Boys' Life (monthly) |

SPECIAL TWO-FOR-PRICE-OF-ONE COUPON

RADIO WORLD, 145 West 45th Street, New York City (Just East of Broadway):
Enclosed please find \$6.00, for which send me RADIO WORLD each week for one year, 52 numbers, and also send me, without extra cost, for one year ONE of the following magazines as indicated:

- | | |
|--|--|
| <input type="checkbox"/> RADIO NEWS | <input type="checkbox"/> RADIO ENGINEERING |
| <input type="checkbox"/> SCIENCE AND INVENTION | <input type="checkbox"/> YOUTH'S COMPANION |
| <input type="checkbox"/> RADIO (San Francisco) | <input type="checkbox"/> BOYS' LIFE |

[Put a cross in the proper square above. Fill out coupon and send \$6.00. If you are a subscriber for RADIO WORLD or for the other magazine you select, or both, check off squares below, at left.]

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

Name.....

Street Address.....

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

THIS OFFER EXPIRES AT NOON ON APRIL 30TH, 1929

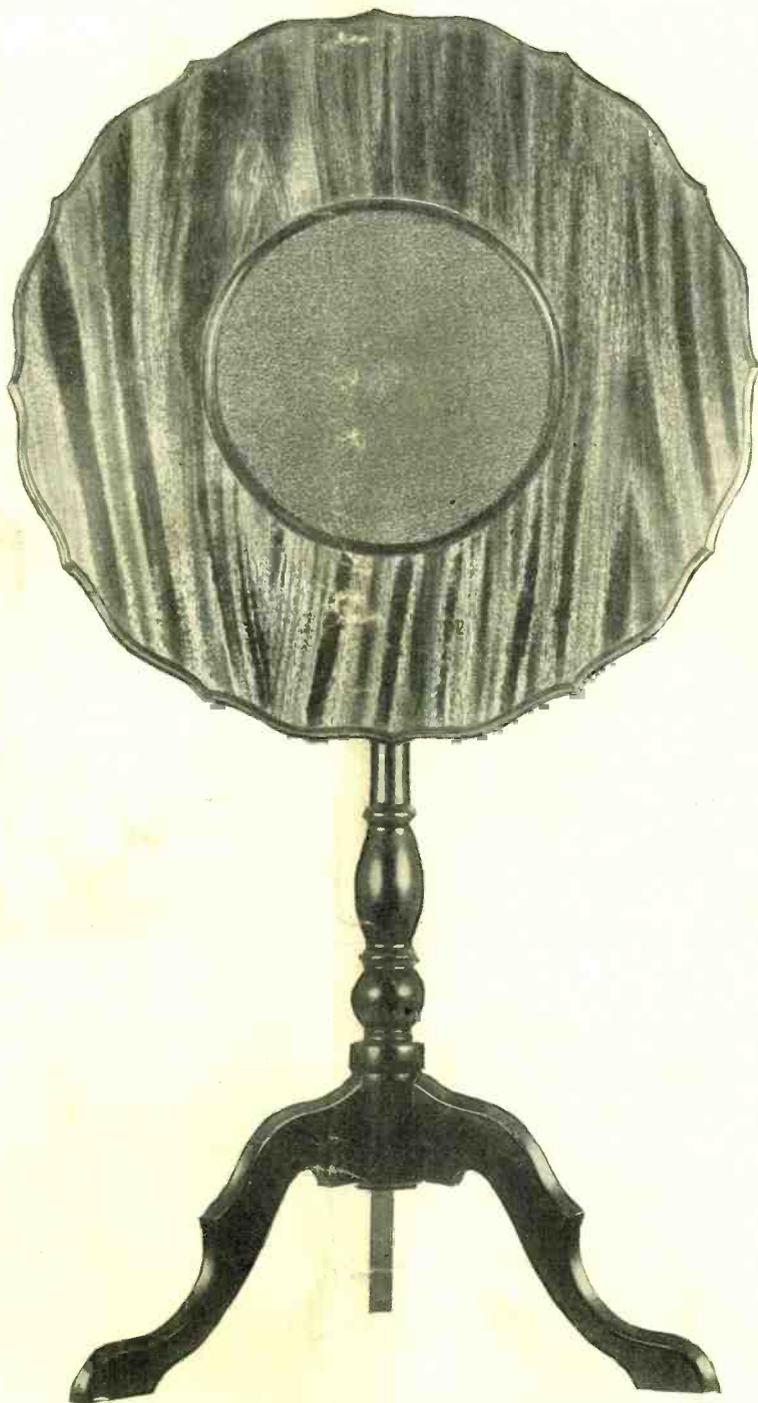
Crosley Tip-Top Musicone

Solid Mahogany Baffle!
 9½-inch (large size) Musicone!
 Tri-Foot Stand!
 9½-Foot Cord!
 Factory-Sealed Carton!

LIST PRICE, \$37.50

YOUR PRICE

\$10 ONLY



IF anybody were to tell you that you could buy a Crosley Tip-Top Musicone—list price, \$37.50—for only \$10 you'd naturally doubt his word. But we hasten to assure you we are actually selling this genuine Crosley de luxe Musicone, solid mahogany model, at \$10, on only one condition. You must act right away, and we reserve the right to refund your money in case you're too late with your order.

You can order one of these complete Musicones—with Tip-Top solid mahogany baffle, tri-foot stand and 9½-ft. cord, with perfect safety, because:

(1) We guarantee to refund your money if you are not delighted with the appearance and performance of this speaker after a five-day trial.

(2) Besides our own guarantee you will receive with your speaker the following guarantee signed by the Crosley Radio Corporation: "Purchase this Crosley Musicone. Try it in your home for five days. Test it in comparison with any loudspeaker made. If you are not satisfied, return it to the dealer from whom you purchased it. He will promptly refund your money without argument, delay or question." There will be no annoying red tape to go through."

(3) Each speaker is marked: "Mfd. by the Crosley Radio Corp., Cincinnati, Ohio, U. S. A." and bears the following notice: "Patd. U. S. A., April 22, 1924—Feb. 10, 1925—May 4, 1926. Canada, Jan. 26, 1926—July 13, 1926. Great Britain, July 1, 1926. France, Aug. 21, 1926. Other U. S. A. and foreign patents pending."

Therefore you're getting the genuine article—the speaker so popular this season and thoroughly up to the minute in design and workmanship—plus a 5-day money-back guarantee!

THERE is nothing the matter with this speaker. We assure you of that. The Crosley Radio Corp. assures you of that. You assure yourself of that, because you don't have to keep the speaker if you don't think it's all we say of it and more!

This speaker—including stand and baffle—stands 40" high. A thumb-nut easily locks the baffle in place on the stand. Without loosening the nut you may turn the baffle to another angle. You can not tilt the baffle forward and backward.

The front is a beautiful sight, the bold grain of the sturdy mahogany catching the eye with almost hypnotic appeal. The finish is extra de luxe, a high polish rubbed in by expert hands. The gold and black weave of the grille (at center) blends exquisitely with the master workmanship of the baffle. The edge of the baffle is scalloped.

At rear is the cone proper, with its apex. This Musicone should need no adjusting, as it was carefully adjusted before it left the Crosley factory. A small opening in the rear of the cone renders access to the armature by insertion of a screwdriver. Full directions for adjustment are furnished with each speaker, for those rare instances when adjustment is deemed advisable.

The 9½-ft. cord emerges gracefully at rear, from the golden fold of the turned-back flap of the grille.

Crosley Tip-Top Musicone, in a 20" solid mahogany, de luxe, grained finish baffle, with 9½-ft. tipped cord and tri-foot stand, total height 40 inches; shipping weight 9 lbs. List price, \$37.50. Special price, while they last, at more than 73 per cent. discount.

\$10.00

GUARANTY RADIO GOODS COMPANY
 145 WEST 45TH STREET
 Just E. of Broadway N. Y. CITY

THIS magnetic type speaker—the famous Tip-Top Musicone, manufactured by the Crosley Radio Corporation of Cincinnati, Powel Crosley, Jr., president—as superb in both tone and appearance. It graces any room. Well worth every cent of the list price of \$37.50 you had to pay if you bought this in a music store, it is offered now at more than 73% off list price—at only \$10. Imagine that! Perfect condition! Brand new! Every speaker in an unmolested carton, just as it left the Crosley factory!

THIS OFFER REVOCABLE WITHOUT NOTICE!

GUARANTY RADIO GOODS CO.
 145 West 45th Street, N. Y. City

Enclosed please find \$10 for which ship AT ONCE one Crosley Tip-Top Musicone, in solid mahogany baffle, with 9½ ft. cord, tri-foot stand, 5-day money-back guarantee and instruction slip. You are to pay cartage.

Please ship above C. O. D. and I will pay cartage.

Name

Address

City

State

5-DAY money-back guarantee on Tip-Top Musicone