March 9th, 1929

WGY'S VICTORY OVER COMMISSION!

15 Cents

RADIO WORLD

REG. U.S. PAT. OFF.

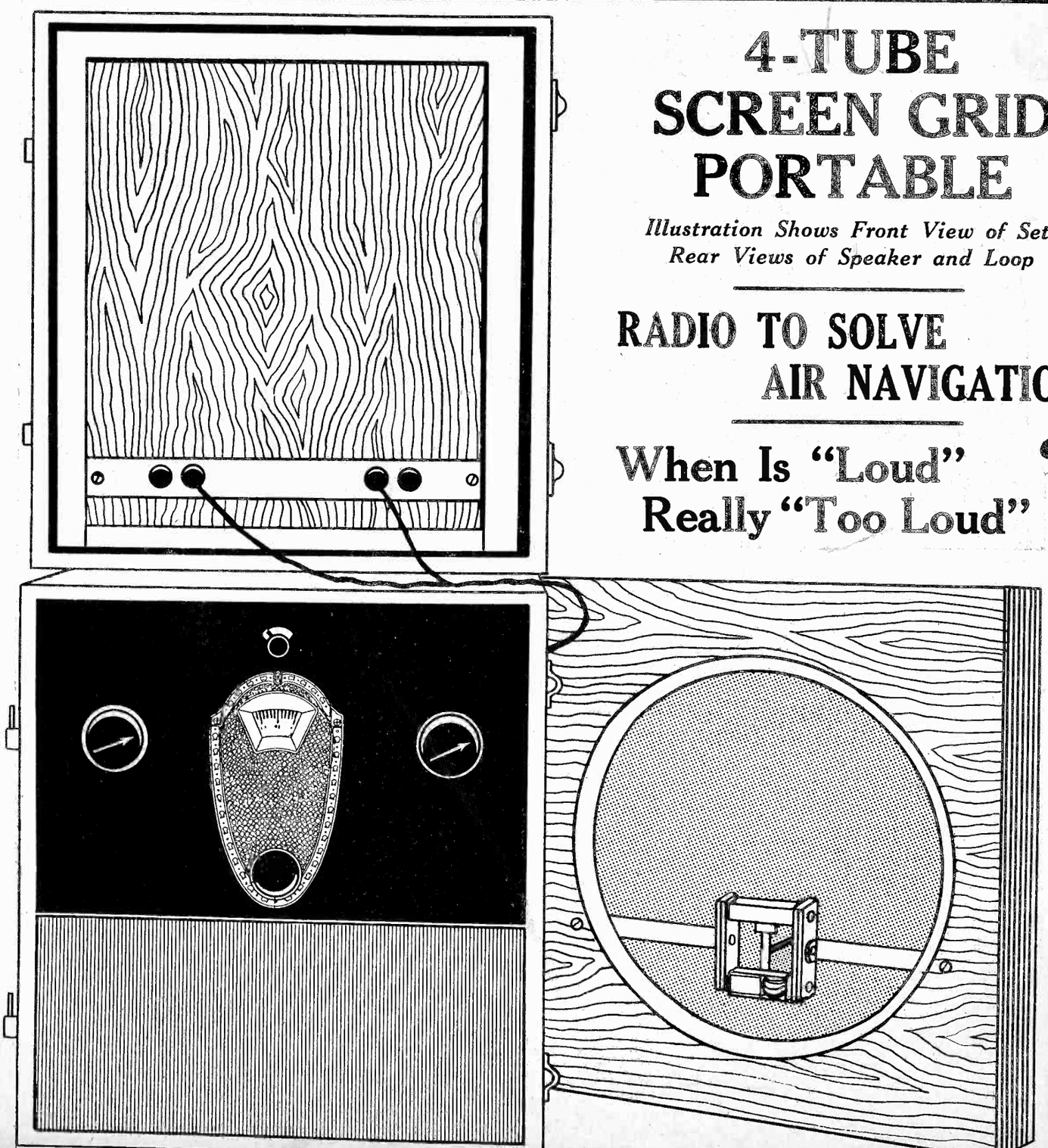
The First and Only National Radio Weekly

363d Consecutive Issue—Seventh Year

AMERICA'S FIRST CONDENSER SPEAKER!

DAMROSCH'S BLUNDER ON PERPETUAL MOTION

REGULATION BY THE STATES EXCEEDS THEIR AUTHORITY



4-TUBE SCREEN GRID PORTABLE

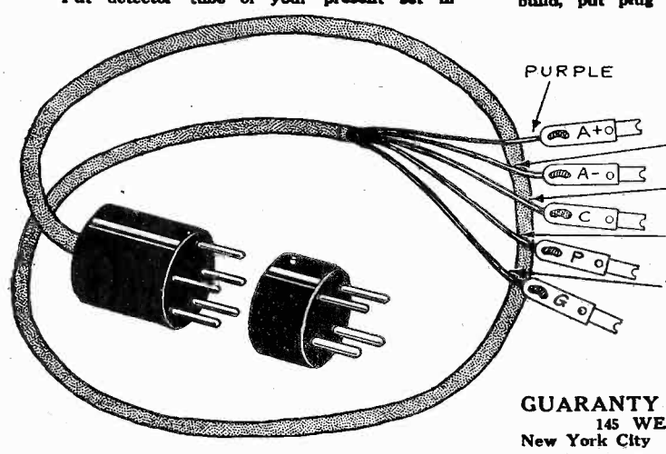
Illustration Shows Front View of Set, Rear Views of Speaker and Loop

RADIO TO SOLVE AIR NAVIGATION

When Is "Loud" Really "Too Loud"?

PLUG AND CABLE for any SHORT WAVE ADAPTER

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



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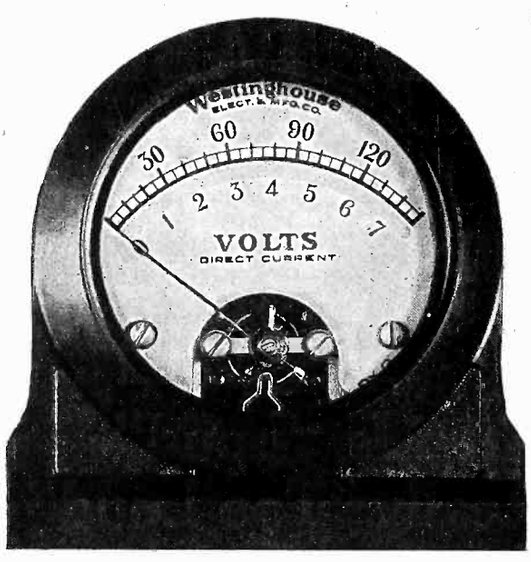
Westinghouse 0—7½ 0—150 volts

Double Range Table Model Voltmeter

FREE!



Double range table model voltmeter; scales, 0-7½ volts and 0-150 volts; made by the Westinghouse Electric & Manufacturing Company.. Accurate to 1% plus or minus. Equipped with built-in zero corrector. 34" connecting cable with tip jacks furnished with each meter. Illustration is actual size.

THE Westinghouse double-range (0-7½, 0-150 volts) table model voltmeter, illustrated at left in full size, is a precise and sturdy instrument, a product of the famous Westinghouse laboratories. Each meter bears the imprint "Westinghouse Electric & Mfg. Co.," as illustrated, and is packed in a red box bearing the Westinghouse registered trade mark as well as the Westinghouse Company's name and address, while the box contains an instruction sheet published by Westinghouse.

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

The scale is read through a sturdy crystal.

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

Meter Employs Dynamic Principle

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

End-stops are built in.

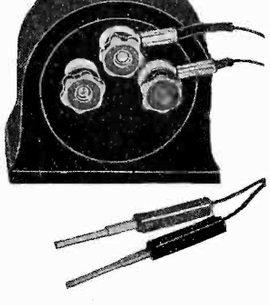
The low scale (0 to 7½ volts) reads ¼ of a volt per division, with ample room for closer reading, while the high scale (0 to 150 volts) reads 5 volts per division, with closer definition equally easy.

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

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

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

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



Rear view of meter, with connecting cable attached. The center post is always minus. The post at right is for 0-150 volts reading, the one at left for 0-7½ volts. Each post is plainly marked on the casing.

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

Enclosed find $6.00 for one year's subscription for RADIO WORLD, (52 numbers, one a week) and send as a premium one Westinghouse double scale table model voltmeter (0-7½ and 0-150 volts direct current).

☐ Present subscribers may take advantage of this offer by putting a cross in the square above, remitting $6 and signing coupon. Subscription will be extended one year.

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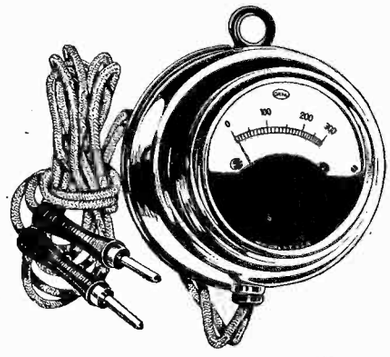
METERS

For Portable or Panel Use



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

No. 347F, same as above, but 0-500 volts, $6.00

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No. 8—For testing A batteries, dry or storage, 0-8 volts DC scale.....$1.00

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No. 40—For testing A and B batteries, dry or storage, but not for B eliminators; double reading, 0-8 volts and 0-100 volts DC scale.. 1.75

No. 42—For testing B batteries, dry or storage, but not for B eliminators; 0-150 volts DC scale 1.50

No. 348—For testing AC current supply line, portable, 0-150 volts..... 4.00

PANEL AC VOLTMETERS

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

No. 351—For reading 0-15 volts AC.....$2.25

No. 352—For reading 0-10 volts AC..... 2.25

No. 353—For reading 0-6 volts AC..... 2.25

(See No. 348 under "Pocket and Portable Voltmeters.")

PANEL VOLTMETERS

No. 335—For reading DC voltages, 0-8 volts, $1.00

No. 310—For reading DC voltages, 0-10 volts, 1.00

No. 316—For reading DC voltages, 0-16 volts, 1.00

No. 326—For reading DC voltages, 0-6 volts, 1.00

No. 337—For reading DC voltages, 0-50 volts, 1.00

No. 339—For reading DC voltages, 0-100 volts, 2.25

No. 342—For reading DC voltages, 0-150 volts, 2.25

No. 340—For reading DC voltages, double reading, 1-8 volts, 0-100 volts..... 1.50

VOLTAMMETERS

No. 18—For testing amperage of dry cell A batteries and voltage of dry or storage A batteries, double reading, 0-8 volts, and 0-40 amperes DC.....$1.25

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

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No. 311—For reading 0-10 milliamperes DC..$1.75

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

POCKET AMMETER

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

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

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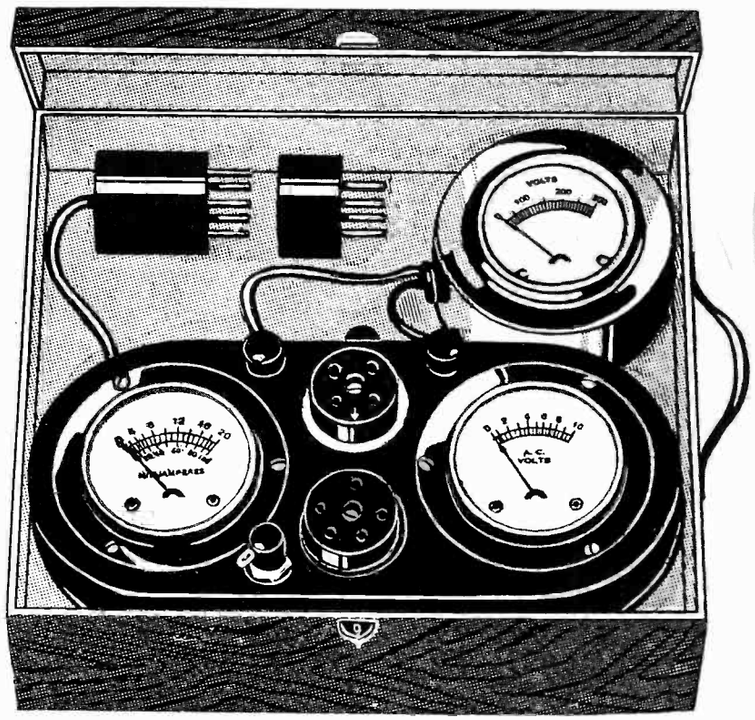
De Luxe Carrying Case FREE

With Each Jiffy Tester Combination!

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

INSTRUCTION SHEET GIVES FULL DETAILS OF THESE THIRTEEN TESTS

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



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

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

Jiffy Tester a Scientific Trouble Shooter

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

$13.50

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

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Here Are the Thirteen Vital Tests!

(1) to measure the filament voltage, up to 10 volts, of AC and DC tubes;

(2) to measure the plate current of any one tube, including any power tube, from less than 1 milliampere up to 100 milliamperes;

(3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more);

(4) to measure the B voltage applied to the plate of tube; the voltage across B batteries or B eliminators, up to 300 volts;

(5) to determine the condition of a tube, by use of the grid bias switch;

(6) to measure any tube's electronic emission;

(7) to regulate AC line, with the aid of a power rheostat, using a 27 tube as guide;

(8) to test continuity of resistors, windings of chokes, transformers and circuits generally;

(9) to find shorts in bypass and other condensers, as well as in inductances, resistors and circuits generally;

(10) to read grid bias voltages including those obtained through drops in resistors;

(11) to determine the presence of distortion and overloading;

(12) to test for correct bias;

(13) to determine starting and stopping of oscillation.

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

Note All That You Get!

For $13.50 you receive:
(1) One Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.
(3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.
(4) One 5-prong plug with 30" cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
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(8) Two binding posts.
(9) One handsome moire metal case.
(10) One instruction sheet.
(11) One de luxe carrying case

If 0-500 volt 5% accuracy high resistance meter is preferred to 0-300 volts, add $1.00, and order Combination C at $14.50.
If 0-500 volt 1% accuracy high resistance meter is preferred to 5% accuracy 0-500 voltmeter, add $2.00, and order Combination D at $15.50.
[Note—A pair of adapters for UV199 tubes, Cat. No. 999, at $1.00 extra. These are not sold except with Jiffy Tester Combination.]

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

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- ☐ 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.....

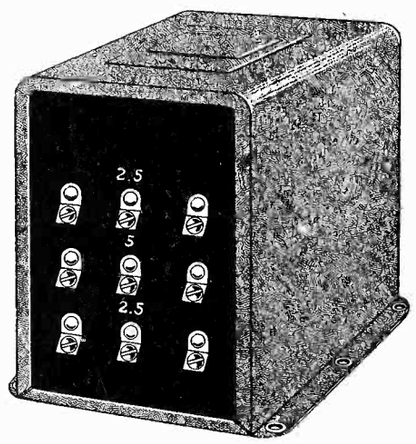
CITY..... STATE.....

5-DAY MONEY-BACK GUARANTY

RADIO WORLD, a weekly paper, published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y. Phone: BRYant 0558 and 0559. 15c per copy, $6 per year. This issue is dated March 9th, 1929, and is Vol. XIV, No. 25. Whole No. 363. Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March, 1879

New Heavy-Duty Filament Transformer

for AC Heater Type Tubes and One Power Tube, including new AC Screen Grid and 245



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

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

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

The 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 7½-volt power tube by series-aiding connection of the 5-volt and the bottom 2½-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 7½, 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 7½ 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 7½-volt series connection for 281 tube or tubes, in which case the top 2½-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 52-inch AC cable with plug. Six riveted mounting holes for baseboard or subpanel. Size, 3¾ in. high, 2⅝ in. wide, 3 in. deep. Shipping weight, 6 lbs.

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

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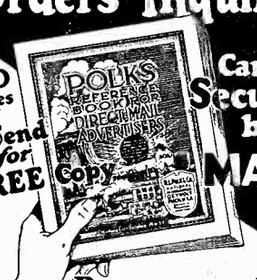

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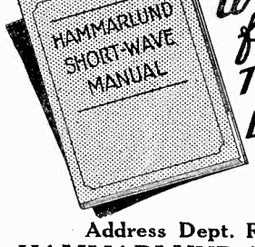

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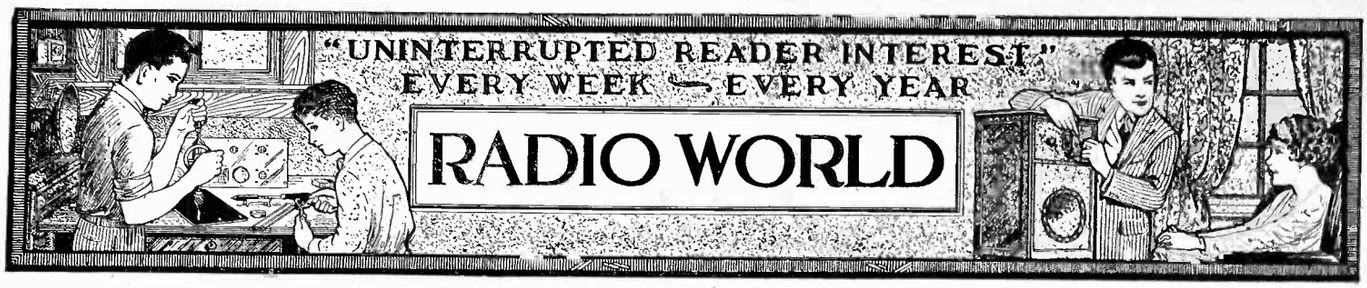

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March 9th, 1929
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[Entered as second-class matter, March 1922, at the Post Office at New York, N. Y., under Act of March, 1879]

Latest News and Circuits
Technical Accuracy Second to None

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

WGY Wins in Court!

BAD RECEPTION IS PROPHESIED BY THE LOSER

Washington.

Louis G. Caldwell, formerly chief counsel of the Federal Radio Commission, and now its special counsel, commenting on the court decision whereby WGY was granted full time, declared that the decision destroys the equalization between the First and Fifth Zones. He said:

"The opinion holds that WGY is entitled to full-time operation with 50,000 watts power on the frequency of 790 kc. This frequency or channel was assigned by General Order 40 to the Fifth Zone to be used by the General Electric Company station at Oakland, California.

Order Held Invalid

"Although the court does not say so, this decision necessarily holds that General Order 40 is invalid to the extent that it assigns this channel to the Fifth Zone; and if both KGO and WGY are to continue to operate on it, the channel ceases to be a cleared channel, with the result that all the listening public outside of a comparatively small area around either station will have reception spoiled for them by a heterodyne whistle.

"It also means that the equalization which the Commission so carefully worked out between the five Zones has been destroyed as between the First and Fifth Zones with respect to cleared channels. Just what effect, if any, the decision will have on the other portions of General Order 40 it is too early to say."

Court Called Discourteous

He added that the decision was handed down while a brief prepared by him was being printed, and that according to rules of the court he still had several days left to file the brief. He said a rehearing would be asked, and the case taken to the United States Supreme Court, if possible.

Senator Dill (Dem.), of the State of Washington, said in the Senate:

"Throughout the case, the court's treatment of counsel of the Commission has been discourteous to say the least. I do not know of any case of a legal nature where counsel has been treated with so little courtesy or where his rights have been so overridden as in this case."

Court Decision Satisfies Public

The court decision in favor of WGY in its suit against the Federal Radio Commission meets public favor, because the public likes to see WGY receive substantial justice.

Never has the Commission made its case perfectly clear. It gave the impression there were not enough full-time wavelengths to go around, although the numerical fixation was its own, and said that any alteration would disturb the entire reallocation. The Commission, moreover, adhered so stubbornly to its own narrow code, rather than to the broad spirit of the Radio law, that the contentions of WGY that it deserved full time as a station rendering important service became a blazing torch by contrast.

WGY's contentions were (1) that it had a vested property right to enjoy 790 kc full time and (2) that the Board's order limiting the station to part time was against public interest.

The property-right plea always did sound fantastic, even when Charles Evans Hughes uttered it as the station's counsel, and it was reassuring to have the court rule against this.

On the ground of public welfare, however, WGY won. WGY, therefore, is entitled to broadcast full-time, on the same frequency as its sister station, KGO, so both may be on the air at night, but meanwhile neither station has a cleared channel.

It would behoove the Commission to inquire more deeply into the public value of its acts, because some stations which the Commission has judged by too narrow standards may not be able to remedy the injustice in the way WGY did, not having the $50,000, hence might have no practical redress.—Herman Bernard.

WNYC to Broadcast Oratorical Contest

WNYC, the New York municipal broadcaster, again will broadcast the regional finals of the National Oratorical Contest on the Constitution, which "The Times" (New York), as one of forty American newspapers sponsoring the contest, is conducting in that city. The finals for the New York region will be held at the Town Hall on Friday evening, May 17. The winner of this contest will qualify for the national finals at Washington, D. C., to be held the following week, the winner of which will receive a trip to South America, a cash prize of $1,000 and a gold medal.

This is the fourth year WNYC has broadcast this event.

STATION GIVEN FULL TIME AND 50,000 WATTS

Washington.

On the ground that the order of the Federal Radio Commission, granting only part time to WGY, Schenectady, N. Y., was unreasonable and contrary to public convenience, interest and necessity, the Court of Appeals of the District of Columbia ordered the Commission to issue a full-time license to the station.

The other contention presented by WGY, that by virtue of its long possession of the 790 kc frequency it had a vested property right therein, akin to the possession of a trade mark in commercial affairs, and that the part-time order was an invasion of such constitutional property right, was denied.

Reasons for Decision

The court was persuaded in favor of WGY because of the station's scientific importance, due to its developmental and experimental work; because of the $1,500,000 capital investment, and because of the 2,000,000 listeners in New York, Massachusetts, Vermont and New Hampshire who depend largely on WGY for regular reception of programs.

The court compared the operation of WGY on part time, whereby it was ordered by the Commission to stop broadcasting at sunset Pacific time because KGO, Oakland, Calif., was scheduled to have exclusive use of the channel from then on, and the simultaneous operation of WGY and KGO after sunset Pacific time.

Both WGY and KGO are owned and operated by the General Electric Company. WGY had been authorized to use 50,000 watts by court order, while KGO has 10,000 watts.

The Two Compared

"It must be assumed," the opinion contends, "that WGY, operating in the evening at 50,000 watts, would at certain distances interfere with the broadcasting of KGO, with its smaller power."

The court held that such interference would be secondary to public inconvenience caused by WGY being silenced at night.

Full Text of Court's Decision In Favor of WGY

THE GENERAL ELECTRIC COMPANY, APPELLANT, V. FEDERAL RADIO COMMISSION, NO. 4870; THE PEOPLE OF THE STATE OF NEW YORK, APPELLANT, V. SAME, NO. 4871; THE GENERAL ELECTRIC COMPANY, APPELLANT, V. SAME, NO. 4880. COURT OF APPEALS FOR THE DISTRICT OF COLUMBIA.

The Court of Appeals of the Distrcit of Columbia, in the opinion herein, held that the Federal Radio Commission had improperly restricted the time of operation of radio broadcasting station WGY, at Schenectady, N. Y., owned by the General Electric Company, in granting a renewal of the license to operate the station on November 11, 1928.

Th Commission was ordered by the court to grant a reference to the controlling statutes, and also a statement the station may be operated on a full time schedule. The court held that th time restriction was not reasonable, in view of the circumstances, and that the public interest would be enhanced by granting full time to station WGY.

Appeal from the Federal Radio Commission. Before Martin, Chief Justice, and Robb and Van Orsdel, Associate Justices.

The full text of the court's opinion, delivered by Chief Justice Martin, follows:

These appeals are brought under Section 16 of the Radio Act of 1927 (44 Stat. 1169), for a review of a decision of the Federal Radio Commission whereby the Commission refused the application of apellant for a renewal of its broadcasting license dated November 1, 1927, for the operation of station WGY located at Schenectady, N. Y., with permission to use 50 kilowatts power, at a frequency of 790 kilocycles, and without limitation as to time of operation.

The novelty of this subject justifies a preliminary reference to the controlling statutes, and also a sattement of certain elementary facts drawn in part from the record and in part from common knowledge and public history.

The electric impulses which carry sounds when broadcast proceed through the "ether" in waves which move at a distance of 300,000,000 meters per second. The length of the waves may be measured by scientific instruments, likewise the number of waves produced each second; the latter measurement is called the "frequency" of a station, the former its "wavelength." A vast demand is made for the use of the ether for various purposes, of which broadcasting is only one. In the present state of the art the broadcasting band is limited to frequencies extending from 550 to 1,500 kilocycles per second, or if stated in wavelengths, from 545 to 200 meters.

It is conceded that in order to avoid interference between stations when broadcasting at the same time, there should be a difference of 10 kilocycles between the frequencies respectively employed by them, otherwise they will interfere with one another and cannot be clearly distinguished by the receiver. It follows that there are but 96 practicable frequencies, or so-called wave channels, employed in broadcasting as at oresent carried on. Six of these channels have been set aside for the exclusive use of stations in Canada, with the result that only 90 remain for use in the United States.

It is agreed that certain broadcasting stations, employing high power, should be recognized as national, and be given the exclusive use of appropriate frequency bands in order to avoid interference with one another and with smaller stations; while certain other stations, recognized as regional or local, operate with less power, and for this reason, and because of relative geographical locations, may operate with the same frequency without serious interference with one another.

It is well known that the time of day or night which may be allotted to a broadcasting station is a factor of importance in its operation. Owing to the fact that the sun's rays absorb the broadcasting waves, there is less interference among stations in the day time than at night. The greater audiences, however, listen in to radio programs between sundown and midnight, and from September until March, and accordingly that period is the most advantageous for operation.

On August 13, 1912, Congress passed "An Act to Regulate Radio Communication" (37 Stat. 320), which was the first general law upon the subject, and was in force from its date until the passage of the Act of 1927. The art of broadcasting, however, as now understood had not then been developed, as appears from the follwoing extract from the report of the Senate Committee upon the bill:

"The term 'radio communication' instead of 'radio telegraphy' is used throughout the bill so that its provisions will cover the possibility of the commercial development of radio telephony (Sec. 6, p. 14). Experiments have been made here and abroad for some years in carrying the human voice on hertzian waves, but with only limited and occasional results. Radio telephony involves the application of the same principles as are involved in inventions to enable apparatus to select and record accurately one message on a given wavelength out of a mass of messages on various lengths. When this latter result has been attained—an unfulfilled promise of some years' standing—radio telephony will quickly follow. The bill is framed to be adjusted to that improvement when it comes, but in the meantime it deals with the art as it exists today. (Senate Report 698, Sixty-second Congress, second session, pp. 5, 7.)"

The "unfulfilled promise" thus referred to was finally fulfilled, and the first broadcasting station in the United States was constructed in the year 1920. Other similar stations rapidly followed, and owing to the lack of effective regulation under the Act of 1912, a chaotic condition known as the "breakdown of the law" ensued, and the usefulness of the art for the time being seriously impaired.

In order to correct this condition Congress enacted the Act of February 23, 1927, entitled "An Act for the regulation of radio communication, and for other purposes" (44 Stat. 1162). This act, which is yet in force, forbids all radio broadcasting in this country except under and in accordance with a license granted under the provisions of the act. For the purposes of the act the United States is divided into five zones, the first zone including the State of New York and certain other northeastern States, while the fifth zone includes the State of California and certain other western States.

The act establishes the Federal Radio Commission with power to classify radio stations, to prescribe the nautre of the service or class of stations, to assign bands of frequencies or wavelengths to the various stations or classes of stations, and determine the power which each station shall use and the time during which it shall operate, to determine the location of classes of stations or individual stations, and to make such regulations not inconsistent with law as it may deem necessary to prevent interference between stations and to carry out the purposes of the act, provided, however, that changes in the wavelengths, authorized power, in he character of emitted signals, or in the times of operation of any station, shall not be made without the consent of the station licensee unless, in the judgment of the Commission, such changes will promote public convenience or interest or will serve public necessity or more fully comply with the provisions of the act.

The act provides that the licensing authority, if public convenience, interest, or necessity will be served thereby, subject to the limitations of the act, shall grant to any applicant therefor a station license provided for by the act; and that in considering applications for licenses, when and in so far as there is a demand for the same the licensing authority shall make such a distribution of licenses, bands of frequency or wavelengths, periods of time for operation, and of power among the different states and comunities as to give fair, efficient, and equitable radio service to each of the same.

The act provides that no license for the operation of a broadcasting station shall be for a longer term than three years, and upon the expiration of any license, upon application therefor, a renewal of such license may be granted from time to time for a term of not to exceed three years; and no renewal of an existing station license shall be granted more than 30 days prior to the expiration of the original license.

The act also provides that if upon examination of any application for a station license or for the renewal or modification of such a license the licensing authority shall determine that public interest, convenience, or necessity would be served by the granting thereof, it shall authorize the issuance, renewal, or modification thereof in accordance with its finding, but if the licensing authority upon examination of any such application does not reach such decision with respect thereto, it shall notify the applicant thereof, and shall fix and give notice of a time and place for hearing thereon, and shall afford such applicant an opportunity to be heard under such rules and regulations as it may prescribe.

The act also provides that any applicant for the renewal of an existing station license whose application is refused by the licensing authority (in this case the Federal Radio Commission) shall have the right to appeal from such decision to this court, by filing with the court within 20 days after the decision complained of it effective, notice in writing of the appeal and of the reasons therefor; that the licensing authority shall be notified of the appeal by service upon it, prior to the filing thereof, of a certified copy of the appeal and of the reasons therefor; and within 20 days after the filing of the appeal the licensing authority shall file with the court the papers and evidence presented to it upon the original applications for a permit or license, and a copy of its decision thereon and a full statement in writing of hte facts and the grounds for the decision as found and given by it; that the court may order the taking of additional evidence in such manner as it may deem proper; that the court shall hear, review, and determine the appeal upon the record and evidence, "and may alter or revise the decision appealed from and enter such judgment as to it may seem just."

By force of an amending act, known as the Davis act; passed March 28, 1928 (45 Stat. 373), it is provided that the people of all the zones established by the Act of 1927 "are entitled to equality of radio broadcasting service, both of transmission and of reception, and in order to provide said equality the licensing authority shall as nearly as possible make and maintain an equal allocation of broadcasting licenses, of bands of frequency or wavelengths, of periods of time for operation, and of station power, to each of said zones when and in so far as there are applications therefr; and shall make a fair and equitable allocation of licenses, wavelegths, time for operation, and station power to each of the States, the Distsict of Columbia, the Territories and possessions of the United States within each zone, according to population." And that "the licensing authority shall carry into effect the equality of broadcasting service hereinbefore directed, whenever necessary or proper, by granting or rfusing licenses or renewals of licenses, by changing periods of time for operation, and by increasing or decreasing station power, when applications are made for licenses or renewals of licenses."

The General Electric Company was first licensed to operate station WGY on February 4, 1922, under the Act of 1912. The license was for three months; the power 1,500 watts, the frequency 832.8 kilocycles, corresponding to a wavelength of 360 meters. Thereafter during successive periods of three months each the company applied for and was granted renewals of its licenses, each for the period of three months. By the renewal of May 21, 1923, it was assigned a frequency of 790 kilocycles, which it has had ever since, although at times the same frequency has been concurrently used by other licensed stations. The station power was gradually advanced by successive renewals from 1,500 watts to 50,000 watts, with greater power allowed for experimental purposes.

On June 1, 1927, the first license issued to the company under the Act of 1927 was received by it. This license was for the period ending July 31, 1927, and granted a frequency of 790 kilocycles, the time to be shared with station WHAZ. On September 15, 1927, a renewal license was issued to the company for the term ending October 14, 1927, frequency 790 kilocycles, power 50,000 watts, time of operation to be shared with station WHAZ. On November 1, 1927, a similar renewal license was granted the company for the term ending December 31, 1927, with the same frequency and power, but with unlimited time of operation.

The licenses issued under the Act of 1927 contained the following term: "This license is issued under and in accordance with the Radio Act of 1927, and all of the terms and conditions thereof are made a part hereof as though specifically set out in full herein." By certain General Orders of the Commission the license dated November 1, 1927, was extended until November 11, 1928, being a period slightly in excess of one year. On January 14, 1928, the company filed an application for a renewal of this license. On October 12, 1928, the Commission authorized a revision of the allocation of all broadcasting stations, to take effect on November 11, 1928.

By the terms of this revision WGY was granted a frequency of 790 kilocycles and power of 50,000 watts as before, subject to the limitation that the station was to share this frequency with station KGO, Oakland, California, and was not to operate after sunset at the latter station. This would require WGY to cease operating at the following average times throughout the year, to wit: During the month of January, at 8:17 o'clock; February, 8:48; March, 9:18; April, 9:47; May, 10:17; June, 10:32; July, 10:28; August, 10; September, 9:16; October, 8:32; November, 8:01; December, 7:56. Station KGO, Oakland, California, also belongs to the General Electric Company, and operates with a power of 10,000 watts.

The Commission's order accordingly granted a cleared or exclusive channel of 790 kilocycles for the use of the two stations, granting KGO full time of operation, and WGY limited time at night as aforesaid. Appeals 4870 and 4871 herein were filed on November 9, 1928. Appeal 4880 was filed on November 30, 1928. They present the same issue, and while the earlier appeals may have been premature the last appeal conforms to the rules and is regular.

The appellant rightly contends that the refusal of the Commission to renew its license except as modified with respect to the time of operation amounted to a refusal of a renewal within the sense of the Act of 1927; and appellant contests the Commission's action upon a claim (1) that it wrongfully deprives appellant of its property rights by preventing the full-time operation of station WGY; and (2) that in fact the public convenience, interest and necessity will be served by renewing appellant's former license with unrestricted time of operation, and will not be served by the modification aforesaid.

In respect to appellant's first contention we may say that under the commerce clause of the constitution Congress has the power to provide for the reasonable regulation of the use and operation of radio stations in this country, and to establish agencies such as the Federal Radio Commission to give effect to that authority. Without such national regulation of radio a condition of chaos in the air would follow, and this peculiar public utility which possesses such incalculable value for the social, economical and political welfare of the people, and for the service of the Government, would become practically useless. Davis, Law of Radio, p. 71; Zollman, Law of the Air, pp. 102, 193.

Reference is made in appellee's brief to a decision by Judge Wilkerson in White v. Johnson, United States Attorney, U. S. District Court, Chicago, not yet reported, (III U. S. Daily 2050) wherein it is said, "The construction of plaintiff's plant and its operation under the license obtained prior to the Act of February 23, 1927, did not create property rights which may be asserted against the regulatory power of the United States if that power is. properly restricted."

The terms and conditions of the various licenses received and enjoyed by appellant as herein recited also tend to confirm the view that if the time limitation imposed by the Commission upon WGY be reasonable and such as to serve the public convenience, interest, or necessity, the order should be sustained; otherwise it should be overruled.

Upon this point, however, we feel that the contention of the appellant should be sustained. It appears that station WGY represents a large investment of capital said to be $1,500,000, adventured in part during the pioneer stages of broadcasting, and that the station has been one of the most important development stations in the country; that through its enterprise important and valuable apparatus has been developed which has greatly advanced the art of broadcasting; that it has been one of three stations recognized in this country as Development Broadcasting Stations; and that at present it carries on great experimental work of this character in the public interest.

It appears that within a hundred miles of the station there is a very large population both urban and rural, estimated to number more than 2,000,000 persons residing in the states of New York, Massachusetts, Vermont and New Hampshire, who in large part are dependent upon this station for reliable and regular broadcasting service; and that if the station should be silenced during the early hours of the evening, as determined by the Commission, the general public within this territory would be seriously prejudiced. In view of the service to the art hitherto rendered by WGY and still continued by it, with the resulting advantage to the public, and in view of the "public convenience, interest and necessity" of so great a constituency for full-time operation of the station, it appears that the restriction complained of is not reasonable and should not be enforced.

The considerations inducing the action of the Commission are fully set out in the record. When the Commission commenced its official services under the act of 1927, and undertook to bring order out of the chaos then prevailing in broadcasting, it decided that the public convenience, interest, and necessity, required not more than 40 of the 90 available broadcasting frequency channels should be maintained as cleared channels for the exclusive use of the high-powered national broadcasting stations, and that the remaining 50 channels should be reserved for regional and local broadcasting.

Accordingly under the Davis amendment of March 28, 1928, the Commission divided the 40 cleared channels equally among the five broadcasting zones, allocating eight to each zone. In making this allocation the Commission assigned the frequency of 790 kilocycles to station KGO, Oakland, Calif., as a cleared channel for use by it without time limitation, and assigned the same frequency to station WGY, but forbidding its use by the latter in the evening hours after sunset at station KGO.

It is contended in support of this allocation that it is an essential part of a general system for the regulation of broadcasting throughout the country; that the system was adopted after thorough investigation of the situation with the aid of competent radio engineers; and that the granting of a frequency of 790 kilocycles to WGY without time limitation would destroy the system as a whole, thereby producing great confusion. It is argued also that such an order would have the result of giving the first zone nine cleared full-time channels instead of eight, which is the number allocated to each of the other zones.

We have but little information concerning Station KGO except that it operates on a power of 10,000 watts, and that it also is owned by the General Electric Company. It must be assumed that WGY, operating in the evening with a power of 50,000 watts, would at certain distances interfere with the broadcasting of KGO, with its smaller power. It does not appear, however, that this interference would compare in point of public inconvenience with that resulting from the silencing of WGY after sunset at Oakland, nor that full-time operation in the evening by WGY with 790 kilocycles would seriously impair the general scheme of allocations otherwise adopted by the Commission. We are convinced that the public interest would be enhanced by granting full time to the latter station.

It is the judgment of this Court, therefore, that the appellant, the General Electric Company, was on November 11, 1928, and is now, entitled to receive from the Federal Radio Commission a renewal of its license to operate Station WGY upon the same terms as those contained in the license dated November 1, 1927, to wit, upon 790 kilocycles with power of 50 kilowatts, and without time limit for operation; and this cause is remanded to the Federal Radio Commission to carry this judgment into effect. Costs assessed against appellee.

YOUR HANDS IN WGY CASE TIED, COURT IS TOLD

Washington.

The legal clash between WGY, Schenectady, N. Y., then seeking a cleared channel and exclusive wavelengths, and the Federal Radio Commission, which had refused both demands, took a strange turn when the Commission renewed its motion to have WGY's suit dismissed in Court of Appeals of the District of Columbia. Louis G. Caldwell, chief counsel of the Commission, stated that WGY, which is owned by the General Electric Company, was operating full time without any license to operate at all. He said that the question before the court had become moot, hence the appeal should be dismissed.

The station's license expired January 31st, 1929, he said, and was not renewed, because WGY had not filed formal application for renewal, and because of pending litigation.

Caldwell said that the conditions of the license effective from November 11th, 1928, to January 31st, 1929, were the sole subject before the court, and that the power to renew a license was vested solely in the Commission, hence the suit must be dismissed. This was prior to the decision.

Wanted Full Time

WGY wanted 50,000 watts allotted to it for full-channel, 790 kc. Only limited time on that channel was authorized.

The Commission's motion set forth:

"The period which would have been covered by such license having expired on January 31st, 1929, the question as to whether or not the Commission should have issued such a license and the question as to whether the Commission acted rightly and within its lawful powers in issuing the license which was actually issued, have become moot questions and no actual rights or interests of any part to this appeal are now involved."

Referring to WGY's application for a license for full time for the November 11th —January 31st period, the motion set forth:

"That period having expired, there can not lawfully be issued a renewal license unless and until the Commission has, upon a proper application for renewal, determined anew that public interest, convenience or necessity would be served by the granting thereof.

Faced With Dilemma

"The court may not make this determination for the Commission, but, being confined to a review of the decision from which the appeal was taken, is faced with the dilemma of either reviewing a decision the alteration or revision of which will have no effect on the present rights of the parties or of dismissing the appeal because the case presents a moot question."

The court had issued a stay or temporary injunction under which WGY was operating full time on 790 kc. pending determination of the suit.

Dials Track Nicely in the New Diamond

Editor Radio World:

In my wonderful new 4-tube Screen Grid Diamond, described in the February 9th, 16th, 23d and March 2d issues, the dial readings of the stations I picked up are as follows:

Station	L.	R.	Station	L.	R.
WLBX	6½	7	WHN	29½	29½
WWRL	7½	8	KDKA	31	31
WKDW	8½	9	CFRV	33	32½
WKBO	8½	9	WENR	40½	40
WJSV	8½	9½	WABC	41½	40½
WBBC	11½	11½	WPCH	45	44
WLTH	12	12	WJZ	50	50
WAAM	16½	16½	WGN	55½	55
WGCP	16½	16	WOR	57	56½
WBBR	16	15½	WLW	59	58
WLWL	**24**	24	WMAQ	63	62½
WAAT	**25**	25	WEAF	65	64
WOV	22½	22½	WNYC	84	83

These stations have all been received with clearness. The selectivity is wonderful. I never have to turn my screen grid tube up all the way to 3.3 volts—never more than three-quarters turn on the rheostat.

DR. VAL. H. HINSE,
943 St. Johns Place,
Brooklyn, N. Y.

Fans Appreciate Si-Len-Ser's Effect

A visit to the office of Julien J. Proskauer, I. R. E., director-in-chief of the Trutone Radio Sales Co., 114 Worth Street, New York City, would be well worth while for anyone who likes to see fan appreciation cheerfully poured forth. Since Mr. Proskauer designed the Si-len-ser and had it placed on the market his desk is literally deluged with letters of thanks and appreciation, coming in every mail from fans and dealers all over the country.

One fan wrote that he would not take a thousand dollars for his Si-len-ser if he knew he could not get another one, and actually thanked the Trutone Company for placing such relief at his disposal.

A dealer actually took the time to write a long letter telling of the sales he made and also sales he protected by the use of the device, and also of a list of successful experiments he made with it.

Another fan wrote a four-page letter going into detail over the misery and heartache suffered with his long-anticipated AC set, which, because of a bad location, picked up every possible kind of raucous line noise. The Si-len-ser cured his troubles.

Exact Grid Bias for the Power Tube

With the increasing popularity of the —50 type and kindred power tubes, many fans are building amplifiers using these. However, most of them find the proper grid biasing of the "big fellows" a real job, and guesswork makes a big difference in the tone quality produced as well as in the life of the tube. It has been found that the Power Clarostat solves the problem with its precise range of from 200 to 100,000 ohms.

BOARD ASSIGNS TELEVISION TO SHORT WAVES

By a decision of the Federal Radio Commission, visual broadcasting, including television and picture transmission, no longer will be permitted in the broadcast band, except for experimental use between 1 a. m. and 6 a. m. But certain high frequencies were set aside for experimental use for a period of six months. These frequencies are 2,000 to 2,200 kc. and 2,750 to 2,950 kc.

Licenses Issued

Licenses were issued to the following stations and corporations for experimental work in visual broadcasting for six months:

W2XBW, of the Radio Corporation of America, to be located in New York.

W2XBV, of the Radio Corporation of America, to be located in New Jersey.

A construction permit to the Radio Corporation of America for a third station.

W3XK, of Jenkins Laboratory, Inc., to be located in Washington, D. C.

A construction permit for another station for Jenkins, to be located in Jersey City, N. J.

Four licenses to the Westinghouse Electric and Manufacturing Company for stations to be located in East Pittsburgh, Pa., and Springfield, Mass.

Two to the General Electric Company, to be located in Schenectady, N. Y., and Oakland, Calif.

One to WAAM, Inc., Newark, N. J.

One to Lexington Air Station, Lexington, Mass.

One to Pilot Electric Manufacturing Company, Brooklyn, N. Y.

One to Chicago Federation of Labor, Chicago, Ill.

One to William Justice Lee, Winter Park, Fla.

One to Aero Products, Inc., Chicago, Ill.

These Denied

The applications of the following were denied:

Shepard-Norwell Company, Boston, Mass.
Frank L. Carter, Long Island City, N. Y.
Boyd Phelps, Jamaica, Long Island, N. Y.

Twenty-seven frequencies between 6,020 and 21,540 kilocycles were made available for relay broadcasting. Applicants for licenses under this class must qualify for long distance relay broadcasting, transoceanic, transcontinental, or experimental relay broadcasting.

Licenses Granted

The Commission authorized the issuance of the following experimental licenses and construction permits: The Westinghouse Electric & Mfg Co., E. Pittsburgh, Pa., six licenses for experimental long distance relay broadcasting; Great Lakes Broadcasting Company, Chicago, Ill.; Mona Motor Oil Company, Councils Bluffs, Ia.; Atlantic Broadcasting Corporation, New York City; L. Bamberger & Company, Kearney, N. J.; Crosley Radio Corporation, Cincinnati, Ohio.

A THOUGHT FOR THE WEEK

OPPORTUNITY

MANY a voice was born to sing unheard, and many a song would die on quivering tongue,
Had radio's universal aid not stirred Olympian height with music nobly sung.

Cities and States Warned By U. S. Against Illegal Regulation of Radio

WAY IS SOUGHT TO AVOID RIFTS ON AUTHORITY

Some Ordinances and Laws "Clearly Unconstitutional," Says Federal Commission's Counsel, and Offers Co-operation to Legislative Bodies — Survey Made of Enactments — Clash of Authority Presents Knotty Legal Problem

Washington.

To what extent States and their subdivisions—such as counties, cities and villages—have the right to regulate radio transmission and reproduction presents an outstanding legal problem, said Louis G. Caldwell, general counsel of the Federal Radio Commission.

The Legal Division of the Commission has just completed a nation-wide survey of laws and ordinances enacted to prohibit interference, including principally that caused by electrical household and professional devices.

Mr. Caldwell's comment on the legal tangle was made in a summary of the report. He said some of the regulatory laws are clearly unconstitutional.

Text of Summary

The summary follows:

"One of the most interesting and difficult problems of radio jurisprudence is the extent to which States and cities within States have the right to legislate on the subject.

"The digest we have made of State laws and ordinances which have already come to our attention reveals that the extent and variety of the methods already employed to suppress interferences, restrict the location of broadcasting stations, do away with the nuisance of loudspeakers in public places and at late hours, and so on, is very great. Some States have already gone so far as to class broadcasting stations as public utilities and attempt to regulate them as such.

"So far as I am aware, only one case has been decided by a court on any statute or ordinance falling within this class. This is the case of Whitehurst vs. Grimes (21 Fed. 2, 787), a decision by the District Court of the Eastern District of Kentucky in 1927, in which an ordinance attempting to license radio stations was held unconstitutional on the ground that 'radio communications are all interstate.'

Offers Co-operation

"The inevitable conflict between the power of Congress to regulate interstate commerce and the police power of the State to promote the welfare of its citiens is present in such statutes and ordinances. Where the line is to be drawn is impossible to foresee.

"As a result of my examination of the material already collected, I am convinced that some of the statutes and ordinances are clearly unconstitutional while others are legitimate exercises of the States' police power.

"I earnestly recommend that before any State legislature or city council passes an enactment concerning radio it give the matter careful study, both so that any unnecessary conflict between State and Federal Government may be avoided, and so also that the results of the experience and study of others be at hand before any hasty steps are taken.

"For the purpose of being of assistance to such States and cities as may desire it, our legal division has made a summary of material so far gathered which will be sent to any State or municipal corporation desiring it. In turn, so that we may be in the best position to be of such assistance, we request that we be advised of any statute or ordinance which has already been passed, or which is proposed, or which may be enacted in the future. We shall be glad to offer suggestions to those that submit ordinances to us.

"The following States have enacted laws to regulate and prevent interferences with radio reception, viz.:

"Maine, see Chapter 215, Public Laws of 1927.

"Michigan, see Act No. 131 of the Public Acts of 1927.

"Nevada, see Chapter 28, Statutes of Nevada, 1928.

"The Michigan and Nevada statutes provide for regulation by the public service commissions through orders, rules and regulations promulgated by them.

"In addition, Illinois has a statute with particular reference to slander by radio.

"So far as we have any information, the following municipalities have adopted ordinances to prevent interference with radio reception:

"Spokane, Wash., Ordinance No. C4237.

"Portland, Ore., Ordinance No. 51269.

"Minneapolis, Minn., Sec. VII (a) and (b), Radio Ordinance, adopted Feb 11, 1927.

13 Cities, 3 States Enforce Regulation

Washington.

According to a report by the Legal Division of the Federal Radio Commission, the status of state and municipal regulation of radio is as follows:

Three states have enacted laws to prevent interference with radio reception: Maine, Michigan and Nevada. A fourth state—Illinois—has a statute affecting slander by radio.

Thirteen municipalities have adopted ordinances to prevent interference with reception: Spokane, Wash.; Portland, Ore.; Minneapolis, Minn.; Antigo, Wis.; Ashland, Wis. Marshfield, Wis. Stevens Point, Wis.; Waupaca, Wis.; Wausau, Wis.; Iron River, Mich.; Atchison, Kan. Lincoln, Neb., and Boonville, N. Y.

MINNEAPOLIS LIMITS POWER AND AIR TIME

"Antigo, Ashland, Marshfield, Stevens Point, Waupaca and Wausau, all in Wisconsin.

"Iron River, Mich.

"Atchison, Kan.

"Lincoln, Neb.

"Boonville, N. Y.

"The operation of certain instruments, devices and machines, the operation of which would cause electrical interference with radio reception between certain hours, is prohibited by these ordinances. Some of the ordinances are general and certain of them specifically mention X-ray and violet-ray machines, vibratory chargers, machines using the Tesla coil or principles, and open and quenched spark machines.

"Minneapolis, Minn., has an ordinance forbidding the operation of broadcasting stations of more than 500 watts power within the city limits and prescribing the distance outside the city limits within which station of higher power may operate. This ordinance also provides for licensing stations and fixing time schedule of operations.

"So far as we have any information, Detroit, Mich., and Oakland, Calif., have ordinances to regulate the operation of loudspeakers so as to prevent annoyance and disturbances of those who live within the neighborhood.

Bulletin Available

"So far as we have any information, the following municipalities have adopted ordinances to regulate the installation of receiving and transmitting apparatus and antenna systems:

"Washington, D. C. St. Louis, Mo.
"Berkeley, Calif. Flint, Mich.

"The Nevada Public Service Commission Act (Chapter 28, Statutes of Nevada, 1928), above referred to, authorizes the Commission to make rules and regulations generally with respect to the installation of transmitting and receiving instruments and antenna systems.

"The University of Wisconsin, University Extension Division, Municipal Information Bureau, Madison, Wis., has published a bulletin on 'Municipal Radio Interference Ordinances' by Ford H. MacGregor. This bulletin is information report No. 69, and the price is 25 cents.

"Two reports are now available on the regulation of radio installation, and ordinances are now being collected with respect to interference with radio reception to be compiled in a future report by W. P. Capes, Executive Secretary, Conference of Mayors, City Hall, Albany, N. Y.

"We have no information that any county authorities have attempted to in any way regulate radio transmission or reception."

RADIO TO SOLVE AIR NAVIGATION, SAYS O'ROURKE

Radio will be the sole means of air navigation, while all controls for a plane will contain automatic mechanisms for observation and operation, Capt. Peter V. O'Rourke said at the recent Aviation show in New York City.

Capt. O'Rourke, whose articles are familiar to readers of RADIO WORLD, of which he is a contributing editor, is a skilled navigator. He began his life on the sea as a wireless operator aboard the S.S. "New York," in 1910. During the World War he was a Lieutenant in the merchant marine, acting as navigating officer, as by that time he held a master's license, "any tonnage, any ocean."

He has been prominent in yachting circles for eighteen years, and for ten of those years has been a yachtmaster. He has participated in many yacht races.

Takes Up Flying

For the last few years he has been deeply interested in aviation, and at the age of 37—a year ago—he took up flying. He is now regularly in flight, all the while making observations looking toward the solution of air navigation problems.

Capt. O'Rourke's statement on navigation of the air by radio follows:

"The master mariner who looked contemptuously upon the radio navigator may find in that same 'Sparks' the navigator of the air whose skill will supplant the time-honored astronomical observations of the Saga of the Seas.

Return of Operators

"Ships' wireless operators, many of whom have quit the key to become navigating officers, will return to their original calling and control the destiny of the ships of the air.

"The methods of determining position and direction as used at sea, requiring charts, mathematical tables, sextants, azimuth instruments, peloruses, compasses, protractors, chronometers and a radio set with which to check some of the instruments, are not practical in ordinary use for piloting an airplane. Weight and space do not permit the use of this equipment, without considering the necessity of carrying along a skilled navigator

No Skill Will Be Required

"Radio receivers are now being developed together with transmitting apparatus which will enable the aircraft pilot to determine at a glance the direction in which to head his ship, its altitude, position and speed. Signals and weather reports will be available both visually and orally so as to obviate the hazards of flight during inclement weather.

"Finding one's position by means of radio bearings is at present common practice at sea and in the air. This process is simple and most accurate.

"The airplane instrument board of the near future will contain lightweight simplified radio appurtenances automatically operated and requiring no skill on the part of the pilot.

What It Will Show

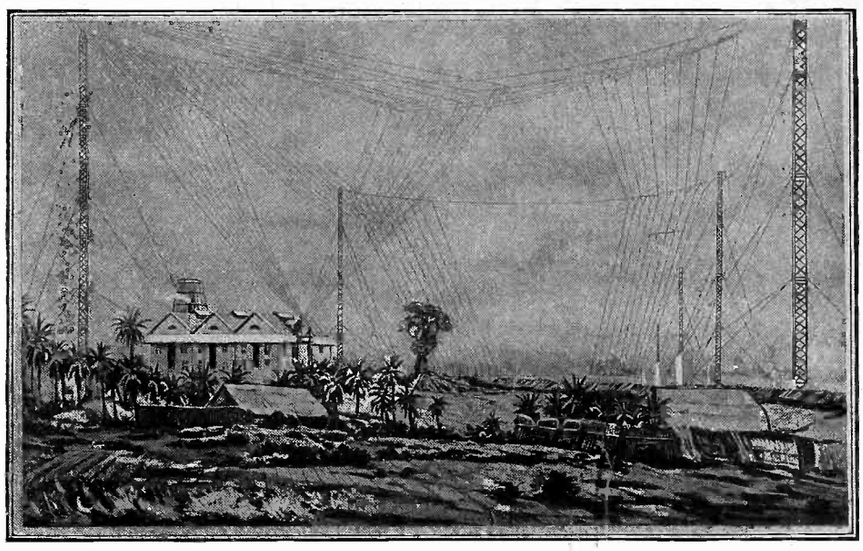
"It will portray for him the complete log of the flight and will include television devices showing close-ups of the terrain beneath the plane regardless of atmospheric conditions.

"It is not beyond the bounds of reason to expect radio to furnish the motive power to propel the plane, thereby reducing mechanical weight and completely eliminating the problem of fuelling.

"To radio we must look for the future of aviation.

"On the crest of a Hertzian wave will the ship of the air ply its way."

Aerial Spans Sky in African Veldt



THIS STATION ON THE AFRICAN VELDT IS ONE OF THE LINKS IN THE WORLD-WIDE COMMERCIAL RADIO SYSTEM THE GERMANS ARE CREATING RAPIDLY. THIS STATION, LOCATED IN TOGO, GERMAN EAST AFRICA, IS DESIGNED FOR LONG RANGE COMMUNICATION AND NOT FOR BROADCASTING. NOTABLE FEATURES ARE THE COMPLICATED ANTENNA SYSTEM AND THE SUBSTANTIAL BUILDING HOUSING THE APPARATUS AND THE PERSONNEL

Televox Lights Field for 'Plane

The Televox, an electrical device invented by R. J. Wensley of Westinghouse Electric & Manufacturing Co., was used recently to turn on the lights of the municipal landing field at the Port of Newark. Peter Branson, a pilot, with two Westinghouse engineers as passengers in the 'plane, approached the field at an altitude of 2,000 feet. Faint lights could be seen below but the outlines of the landing field could not be made out.

The pilot reached for a switch in the cockpit, starting a siren. The noise was heard on the ground. The pitch of the siren gradually changed until a certain value was reached, when the lights on the field below flashed on, flooding the field and clearly outlining its limits.

The pilot did not land but flew off into the darkness and rose to 3,000 feet. The lights were turned out for another test. The second time the pilot approached the field from another direction. Again he sounded the siren and again the lights flashed on. The electrical sentinel was never asleep.

Pilots and aeronautical engineers who witnessed the demonstration were greatly impressed by the possibilities of the device as an aid to aviation

The Televox on the ground has a microphone which picks up the signal. When the sound is of a certain frequency an audio frequency resonance circuit amplifies it and the output actuates a relay that throws on the lights.

TEMPLE TO GO ON AIR

A new series of broadcasts to be known as The Temple of the Air will start early in April, featuring an orchestra. This series will be heard over the twenty-two key stations of the Columbia Broadcasting System and will cover the east and middle west. These programs will be sponsored by Temple Corporation of Chicago, radio receiver makers.

CANADA PACT ROILS WATSON

Washington.

Senator Watson (Rep.), of Indiana, chairman of the Senate Comittee on Interstate Commerce is "violently opposed" to any agreement with Canada on continental wavelengths that would give the United States only 1½ waves to 1 for Canada.

He questioned W. D. Terrell, chief of the Radio Division of the Department of Commerce, who was a delegate to the short-wave conference with Canadians, recently held in Canada. The questioning took place at a hearing held by the Interstate Commerce Committee. Terrell said he was informed such an agreement was contemplated.

Senator Watson then declared:

"I am violently opposed to that allocation. It's based on our population as it existed a century ago and on the estimated population of Canada a century hence."

Mr. Terrell said no agreement had been made yet, but that an effort was being made to reach an agreement.

International Zest to Programs Soon

"The day of international broadcasts has arrived." M. H. Aylesworth, president of the NBC, said the other day. "Recently a speech by the President of the United States was followed with a program from London, rebroadcast by the NBC's coast-to-coast system. Radio programs from the United States are heard regularly in Europe, Asia, Africa, Australia and New Zealand. We have arrived at the point where radio communication to the masses of other nations is an accomplished fact.

"We visualize in the near future an interchange of radio programs with other nations, chiefly English-speaking nations, which will be available to American listeners."

Damrosch's Blunder A

Great Musical Conductor Tak

Realm of

By J. E.

DURING the first General Electric hour Walter Damrosch played a number entitled "Perpetual Motion." He not only played the music but he gave a preliminary explanation of perpetual motion to aid his hearers in understanding the music. During this explanation this distinguished musician said that the greatest physicists had been working ceaselessly for many years to bring about perpetual motion. And he added that "we may have to wait a hundred years for it, or we may get it tomorrow."

What a surprise listening physicists got, and what a shock! No doubt it was great news to them that physicists have been working to bring about perpetual motion, particularly that the greatest of them have been engaged in this endeavor.

There is no doubt that Mr. Damrosch is one of the great musicians. But that he knows anything about what the great physicists have been doing since the days of Isaac Newton, there is much doubt. He certainly does not know what they have done about perpetual motion during the last 300 years.

In effect Mr. Damrosch called all physicists a bunch of ignoramuses and idle dreamers who do not know the first principles of physics. He owes them all an apology. As his faux pas occurred during the General Electric hour there must have been many physicists listening in, since so many of the personnel of the General Electric Co. are good physicists. And he must have offended them all.

Perpetual Motion Impossible

Nearly the entire subject of physics is based on the impossibility of perpetual motion, as the term is generally understood. Every student of physics is taught early the principle of conservation of energy. It is necessary that the student understand it before he can understand the subject of physics, its laws and its problems. And the principle of conservation of energy contradicts the possibility of perpetual motion. Once the student has grasped the meaning of this conservation principle he ceases to be interested in perpetual motion schemes as practical possibilities, but he takes great delight in exposing the fallacies on which proposed schemes are based. And it does not take much knowledge of physics to expose the schemes, although some of them are very clever.

So well established is the principle of conservation of energy that every physicist, and every elementary student of physics who has grasped this principle, dismisses every perpetual motion scheme instantly because it violates the principle. So well established is the principle that patent examiners in every country, all of whom are physicists, refuse to consider any patent application on perpetual motion schemes. Ever since the principle of conservation of energy has been fully understood, and that has been a long time, no great physicist, no near-great physicist, nor any serious student of physics has ever wasted any time trying to bring about perpetual motion. But many of them have enjoyed at least a few moments exposing some of the schemes.

Most physical measurements are based on the inviolability of the principle of conservation of energy, and hence the impossibility of perpetual motion, at least most indirect measurements.

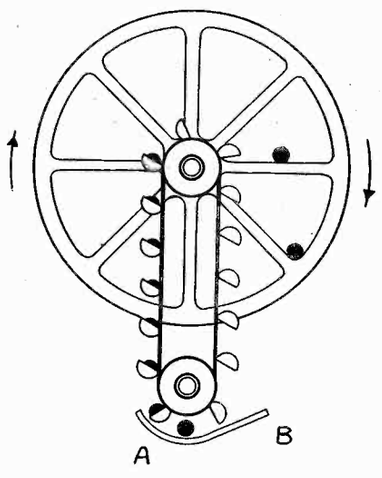


FIG. 1
ONE OF THE MANY PERPETUAL MOTION SCHEMES PROPOSED FOR KEEPING A MACHINE RUNNING WITHOUT ANY MOTIVE FORCE.

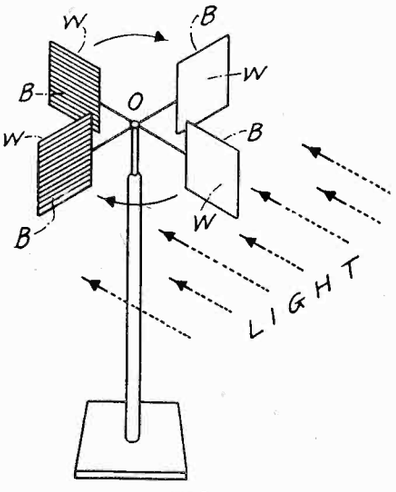


FIG. 2
THE RADIOMETER ILLUSTRATED HERE IS NOT A PERPETUAL MOTION DEVICE BUT A GENUINE HEAT ENGINE.

What Principle Is

The principle of conservation of energy is that the available energy is constant. The energy available may be changed from one form into another, or from one form into several other forms. If a certain amount of energy disappears in one form an exactly equal amount appears in one or more other forms. Another way of stating the principle is that energy can neither be created nor destroyed.

Hydro-electricity is an example in which energy goes through many changes of form. Energy comes from the sun in the form of light. It produces evaporation of water and lifts the water in vapor form into the sky. The energy is now partly potential and partly molecular. Ultimately the water falls in the form of rain, hail or snow. In this process the molecular energy turns into heat energy. The potential energy first turns into kinetic and then into heat. But not all the potential energy has been given up, because the water is not yet back in the ocean.

When Principle Is Applicable

The water possessing some of the original energy is used to drive a turbine. The water goes through various forms of kinetic energy, such as its own motion and turning wheels. Some of the energy is frittered away in heat. But part of it is converted into electric energy and travels over wires to various electrical appliances. Some goes into luminous energy, some goes into useful heat, some into sound, some into moving machinery. Ultimately all of the energy is converted into heat. And when the water that was lifted by the heat of the sun is back in the ocean, the earth as a whole is heated by the same amount as if the water had never been lifted to go through all the changes. And this heat is finally radiated into space. If it were not, the energy that comes from the sun soon would melt the earth.

The principle of conservation of energy is particularly applicable to each stage of conversion in a "closed" system. For example, a weight is lifted a certain height. It took a certain amount of energy to lift it to that point. Its potential energy is exactly equal to the energy put into it. Then the weight falls to the ground. The instant before it hits the ground all the energy put into the weight is kinetic, or energy of motion. The kinetic energy is equal to the potential. When the weight has hit the ground and come to rest, all the energy is molecular or heat energy.

A certain amount of electrical energy is put into a broadcasting transmitter. This energy leaves the transmitter as a whole in two forms, heat waves and radio waves. The sum of the energy that leaves as heat and that which leaves as radio waves is equal to the energy which was put into the system as electrical energy. The greater part leaves as heat. Hence the radio is very inefficient.

Motion Perpetual

The principle of conservation of energy does not deny the possibility of perpetual motion in the correct sense of that term. In fact, perpetual motion is asserted by the principle. Motion is one form of energy,—kinetic. And any amount of energy may remain in that form forever. The popular meaning of perpetual motion is that a machine can be constructed which will run itself and in the process create energy to perform some useful work. The possibility of this the principle of conservation of energy denies.

Since heat is always frittered away in every transformation of energy, and as heat is energy, more energy must be supplied to any machine than the energy which that machine delivers in useful form. Some machines, like electric transformers, are very efficient. They deliver up to 98 per cent of the energy delivered

bout Perpetual Motion

es a Fallacious Dip into the Physics

Anderson

to them. A steam engine, such as that in a locomotive, is very inefficient, for only 8 percent of the energy in the coal that is burned is converted into useful energy.

Perpetual Motion Machine

An example of a perpetual motion machine is shown in Fig. 1. A wheel having many spokes, each grooved so that heavy steel balls may roll from the hub to the periphery, is the main member. The wheel drives an endless chain provided with buckets. The steel balls are lifted up by the belt and delivered to the spokes. The balls roll out along the spokes and so cause the wheel to turn. When a ball leaves a spoke at the periphery of the wheel it falls into an inclined trough to roll to the bottom of the endless chain only to be lifted up again.

That is the operation according to the inventor of this perpetual motion machine. Of course, the machine will not run at all because it takes much more energy to lift the balls from the bottom of the trough at A than is produced by the balls while they roll down the spokes. So even if the machine were frictionless it would not run. At least, it would not do any work, for that would be friction.

As proposed, the length of the endless chain was such that the balls had to be lifted only the height of a spoke, but that alteration does not remove the fallacy.

The radiometer is sometimes pointed to as a perpetual motion machine. This device is shown in principle in Fig. 2. Four vanes are mounted on a spindle O so as to have very little friction. These vanes are covered with lampblack on one side, indicated by the letters B, and are polished on the opposite side, indicated by the letters W. When light falls on this device as indicated it will turn the axis O in the direction indicated by the arrows.

But this is no more a perpetual motion device than is a steam engine. In this case the radiant energy of light supplies the motive force. In the steam engine it is the burning coal, or oil or whatever fuel is used. The light exerts a greater force on the blackened surface than on the white, because the light is absorbed by the lampblack and not by the polished metal surface. The effect is a thermal one rather than one of light pressure, because the light pressure is greater on the white surface. This machine will stop as soon as the light is excluded.

All Similar to These

All perpetual motion machines proposed may be shown to be similar to some of the following:

Driving a locomotive without fuel, but using the exhaust steam to produce more steam.

Operating a vacuum tube oscillator without any plate and filament power.

Running a water turbine or water wheel by leading the spent water up again to be used continuously.

Running an electric generator by a motor driven by the same generator.

Driving an electric generator by a steam engine the boiler of which is heated by the electricity which is produced by the generator.

In each case the motion resulting is about the same as results from an effort to lift oneself by the bootstraps.

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. Either this blank 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 .....

Eugene W. Throop, 1163 3rd St., N. E., Washington, D. C.
Oren Hays, 11503 Superior Ave., Cleveland, Ohio.
Geo. M. Caven, 931 Hawthorne Ave., Cincinnati, Ohio.
Everett Penrod, 503 West Exchange St., Sycamore, Ill.
R. W. Deck, 406 Center St., Sandusky, Ohio.
N. W. Minesinger, Pughtown, W. Va.
H. H. Crimnel, c. o. Sneath Glass Co., Hartford City, Ind.
Mark S. Bassett, 700 Plymouth Bldg., Minneapolis, Minn.
A. L. Miller, 821 Austin Ave., Waco, Texas.
C. B. Trevathan, 324 Adams St., Paducah, Ky.
A. E. Gosselin, Service Rep., P. O. Box 1016, Springfield, Mass.
Roy M. Holden, 43 Homer Rd., Pittsfield, Mass.
H. J. Shaw, 463 School St., Lowell, Mass.
H. G. Groves, 499 Chestnut St., Gardner, Mass.
John P. Powers, 105-15 169th St., Jamaica, N. Y.
W. E. Gawthorne, 1031 Leavenworth St., San Francisco, Calif.
Daugherty Bros., 5th & Main Sts., Paris, Ky.
Vernal J. Sies, 203 N. 4th St., Allentown, Pa.
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John Fagan, 2767 Bryant St., San Francisco, Cal.
Tod A. Kelty, Burghill, Ohio.
Edgar Reist, R. R. No. 2, Waterloo, Ont., Can.
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R. C. Lanning, 2819 W. Mallon Ave., Spokane, Wash.
Louis A. Baxter, 211 N. 6th St., Cambridge, Ohio.
H. G. Greenfield, Box 283, Essington, Pa.
R. Finnick, 27 Edinburgh Ave., Hamilton, Ont., Can.
Stanley Solek, 328 Barbour St., Hartford, Conn.
H. Bissett, 19 Poplar St., Malden, Mass.
W. W. Wilkerson, 320 So. Wilmer, Anniston, Ala.
R. L. Bonskill, 48 Pearson Ave., Toronto, Ont., Can.
H. C. Brobst, Clarkston, Wash.
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R. D. Ward, 1016 N. Carson St., W. Hollywood, Calif.
C. H. Waltner, 120 So. Monument Ave., Hamilton, Ohio.
Alan Ferguson, Bloomington, Calif.
David E. Miller, 1643 S. Marston St., Philadelphia, Pa.
R. J. McCutcheon, c. o. The Colo. Fuel & Iron Co., Pueblo, Colo.
Bert Kress, Box 618, R. 8, Detroit, Mich.
R. M. MacLeod, 820 Mass. Ave., Cambridge, Mass.
Henry Priebe, Box 115, Kent, Ohio.
Frank Behringer, 553 Bushwick Ave., Brooklyn, N. Y.
G. W. Anglin, P. O. Box 13, Duncan, B. C., Can.
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J. L. Outen, Box 338, Kannapolis, N. C.
H. C. Gillian, Box 488, White Plains, N. Y.
L. C. Harris, 258 E. Market St., Wilkes-Barre, Pa.
C. W. Curtis, 433 Central St., Lowell, Mass.
Robert Houghton, P. O. Box 267, Cooperstown, N. Dakota.
C. D. Banghart, Belvidere, N. J.
L. Haake & Sons, Warrenton, Mo.
Helmer Romness, R. F. D. No. 4, Zumbrata, Minn.
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Arnold Sutter, 2 Anson St., Derby, Conn.
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Homer H. Ordung, 723 Cleveland Ave., South Bend, Ind.
Geo. Woolf, 5500 W. Grace St., Chicago, Ill.
Z. H. Polachek, 1234 Broadway, New York City
H. M. Clark, Eckman, N. D.
L. A. Atkins, 1704 Center St.
Clarence Hoaglund, Arthur, Iowa.
E. W. Almquist, Box 31, Sax, Minn.
Earl W. Stein, 1204 Belknap, Superior, Wis.
Leo Carr, Box 70, Myers, N. Y.
Thomas J. Sherin, 50 Hill St., Greenwich, N. Y.
A. C. Turner, 686 Liberty St., Painesville, Ohio.
W. B. Davenport, Littlefield, Tex.
Chas. H. Bradshaw, Box 893, Trail, B. C., Can.
C. E. Forney, 329 S. Handley, Wichita, Kans.
Fred H. Seitz, R. No. 1, Box 46, Sutton, Nebr.
Ross H. Seasly, P. O. Box 287, Fayetteville, Ark.
H. S. Rosser Radio Co., 418 Rhem Ave., New Bern, N. C.
Karl Williams, 164 S. Pardee St., Wadsworth, O.
Donald S. May, 823 Leason Ave., Van Wert, Ohio.
Arthur B. Cooney, 1331 Acacia St., San Bernadino, Calif.
G. E. Harris, 13th Floor Cosden Bldg., Tulsa, Okla.
H. M. Bostic, 4111 Southern Parkway, Louisville, Ky.
Ralph Badenell, Pleasant City, Ohio
M. Botto, 102 Bowdoin St., Clifton, N. J.
C. F. Martin, R. F. D. No. 1, Crowley, Ala.
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Ross P. Wilson, 611 41st St., Rock Island, Ill.
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Roy F. Smith, 612 E. 2nd St., Oil City, Pa.
Rondol Cartwright, Glasgow, Ky.
Paul Badress, 1080 Griswold Way, Sharon, Pa.
Bliss R. Bowman, Union Stock Yards, Cincinnati, Ohio.
W. M. Stephenson, 130 Washington St., Lakewood, R. I.
Charles E. Owen, Lanham, Md.
Willard Battery Service, 270 King St. E., Kitchener, Ont., Can.
H. E. Gagnon, 12 Wadsworth St., Hartford, Conn.
Floyd Albertson, Benton, Pa.
J. C. Rothrock, Box 58, Weatherly, Pa.
C. W. Howell, Boomer, N. C.
D. L. Schaub, 13310 Ferris Ave., Cleveland, O.
B. A. Adams, Bristol, S. Dak.
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Catherine Eastman, 372 Kingswood Rd., Toronto, Ont., Canada.
H. J. Tilden, care of L'Ecluse, Washburn & Co., Fisher Bldg., Montauk, L. I.
G. K. Smiley, R. D. No. 2, Carlisle, Pa.
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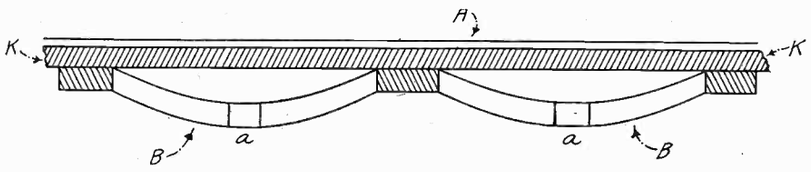
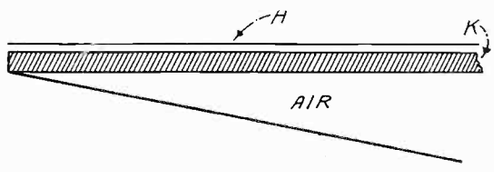
K. J. Peters, 724 Bergen Blvd., Grantwood, N. J.
Patsy Di Rubio, 24 West Dane St., Beverly, Mass.

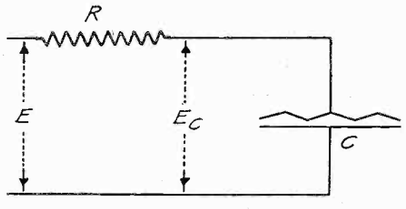
America's First Conde

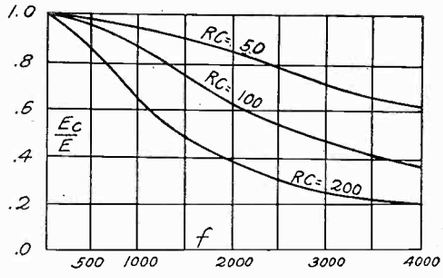
Theory Long Known, But Practical Applica

By James M









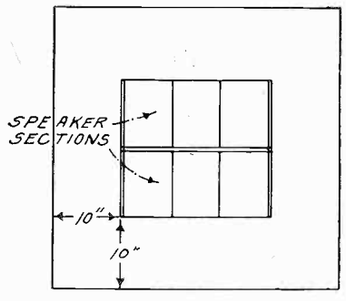


FIG. 1 (UPPER LEFT) AN ENLARGED SECTION OF THE KYLE CONDENSER SPEAKER SHOWING THE FLAT ARMATURE AND THE DIELECTRIC, THE CORRUGATED STATOR PLATE AND THE AIR VENT SLOTS.
FIG. 2 (TOP RIGHT) AN ENLARGED SECTION OF A PORTION OF THE KYLE CONDENSER SPEAKER INDICATING HOW THE DIAPHRAGM ROLLS DOWN THE SIDES OF THE TROUGHS.
FIG. 3 (LOWER LEFT) A DIAGRAM SHOWING HOW THE VOLTAGE ACROSS THE CONDENSER SPEAKER DEPENDS ON THE EXTERNAL RESISTANCE IN SERIES WITH THE SPEAKER
FIG. 4 (LOWER CENTER) CURVES SHOWING HOW THE VOLTAGE OF THE CONDENSER DEPENDS ON THE FREQUENCY AND ON THE VALUE OF THE PRODUCT RC.
FIG. 5 (LOWER RIGHT) SEVERAL CONDENSER SPEAKER SECTIONS MAY BE CONNECTED IN PARALLEL AND ASSEMBLED IN A COMPOSITE UNIT. A BAFFLE BOARD FRAME WILL HELP TO BRING OUT THE LOW NOTES.

FOR some time there has been much interest in condenser type loudspeakers. Such speakers have been made in Germany but very few of them have reached this country. Rumors have been circulated from time to time that certain manufacturers in this country have been working on the problem and that they were about to announce the perfection of such speakers.

The theory of condenser speakers has been known for a long time. It was known before speakers themselves were known and before the theory of the magnetic and the dynamic speakers was developed. But knowing the theory is not the same as knowing how to make a satisfactory speaker operating according to the theory. Before a successful condenser speaker could be built many practical problems had to be solved.

Colin Kyle, a young California school teacher, has been working on the problem for several years, and has succeeded in solving some of the difficulties. The Kyle idea has been developed further by Dr. W. D. Crozier, Dr. Fred W. Kranz, Dr. Paul E. Sabine and V. Ford Greaves, all specialists in acoustics.

Structural Features

The structural features of the Kyle reproducer are shown in Fig. 1, which gives an exaggerated cross-section of a portion of the reproducer. A is a thin metal diaphragm which constitutes the armature of the speaker, or the moving member. K is a special dielectric known as Kylite, in honor of the inventor. This material is like rubber dam and has a dielectric constant of 3.

While the diagram shows A and K separated by an air space the two are actually in contact. A may be a thin metal deposit on the surface of K or it may be a layer of metal leaf. The necessary conditions are that both A and K be thin, light and flexible.

The stator plate of the condenser is indicated by B. This member must be rigid so that it will not vibrate when a varying electric force is impressed between the plates A and B.

The stator plate B is slightly corrugated. That is, it has longitudinal troughs and ridges. In the drawing the depth of the troughs is greatly exaggerated to show more clearly the structure. The insulating layer K and the armature plate A are stretched over the stator so that the K surface is in contact with the ridges of the stator.

At the bottom of the troughs are holes, or longitudinal slots, a, the purpose of which is to allow the air to pass freely back and forth as the diaphragm moves. Without these slots the air between the two members would be trapped and the vibration of the armature would be impeded. Very low efficiency would result.

Action of Speaker

When the two plates of a condenser are charged to a difference of potential there is a force of attraction between the two charged metal surfaces. This force is directly proportional to the area of either surface, directly proportional to the square of the potential difference, directly proportional to the square of the dielectric constant of the insulating material, and inversely proportional to the square of the distance between the plates.

Hence to get a strong force between the two plates for a given potential difference, the distance between the plates should be small and the dielectric constant of the insulation should be large. The area of either plate should also be large.

Now if the dielectric is everywhere in contact with the stator plate the armature cannot move. There must be some air space between the plates to allow vibration. But air has a relatively small dielectric constant so that the air spaces reduce the force of attraction. Hence the air space must be made as small as is consistent with sufficient amplitude of the armature plate.

Fig. 2 shows a section of the condenser speaker on one side of a trough from the point of contact of the stator and the dielectric to the bottom of the trough. It will be seen that the air space in this section is wedge-shaped. This peculiar structure has much to do with the effectiveness of the reproducer.

Where Force Is Effective

As the depth of the air space increases the force between the plates decreases very rapidly. Near the bottom of the trough where, at first, the air space is much thicker than the dielectric, the force is negligible. The useful force is concentrated over a small area near the apex of the air space wedge. There the diaphragm is attracted strongly to the stator.

As the diaphragm moves down the apex is moved toward the bottom of the trough. The effect is that the armature rolls down the incline of the wedge. Of course, the same thing occurs at the other side of the trough, and in every trough of the reproducer. The armature and its associated dielectric stretch to conform to the shape of the trough.

This shows that the diaphragm does not

nser Speaker Appears

n Required Development of New Medium

on Briar

rate as a unit but in as many sections there are troughs in the stator plate. t all of the sections vibrate in phase so at the effect on the air in front of the aphragm is essentially the same as if e whole plate vibrated as a unit.

It is obvious that if the diaphragm uches the bottom of the trough through- t an increase in the force will not sult in a corresponding increase in the splacement. This limitation on the provement is akin to the limitation that e pole pieces in a magnetic speaker im- ses on the movement. But in this case verloading of the speaker does not pro- ce as disastrous results to the quality when the armature strikes the pole ces.

Performance of Speaker

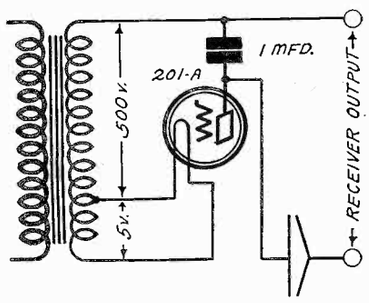
The performance of a condenser type eaker is not independent of the fre- ency of the signal voltage impressed it. Referring to Fig. 3 let E be the nal voltage effective in the output cir- it of a receiver, R a resistance in se- s with the speaker, Ec the voltage ross the speaker, C the capacity of the eaker. R may be the resistance of the e alone or it may be that and an ex- nal resistance. C is assumed to be a re capacity. The voltage Ec is then measure of the input voltage to the eaker, and the effectiveness of the eaker may be measured in terms of the io Ec/E. If this ratio depends on the equency the speaker will not respond ually to all frequencies that may be pressed.

In Fig. 4 is a set of three curves show- g the relation between frequency and e ratio Ec/E for three different values the product of R and C. It is clear at for low frequencies the condenser eaker is very effective and that as the equency is increased the effectiveness creases. The higher the product of RC e more rapid is the decrease in the ltage across the condenser. Hence it clear that if the high frequencies are be brought out strongly, the value of C must not be too large.

Capacity Not Pure

The curves in Fig. 4 were obtained on e assumption that condenser capacity is re. That is not the case, and if it ere the speaker would not radiate any und. The condenser will show motional sistance depending on the amount of und it radiates. This motional resist- ce, or radiation resistance, is higher e higher frequency. Hence if dynamic rves were plotted similar to those in g. 4 they would appear much more vorable on the higher frequencies. Such namic curves are not let available. The ape of them would not only depend the speaker itself but also on the lo- tion of the speaker, just as in the case dynamic curves for other types of eakers.

Figs. 1 and 2 might suggest the idea at the condenser reproducer is thick d that it requires a lot of room. That not so because as it has been con- ucted it is only one-eighth of an inch ck. It may be hung on a wall like picture or it may be mounted in front a radio console. It takes less room an any other speaker. Of course, if it mounted on a wall there must be plenty



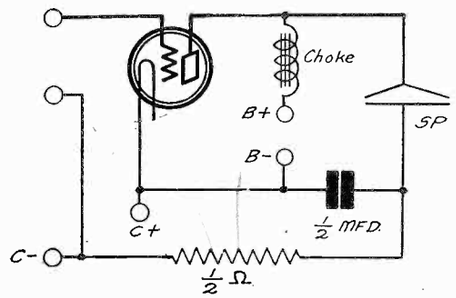


FIG. 6 (LEFT) A SIMPLE RECTIFIER LIKE THIS MAY BE USED TO SUPPLY THE NECESSARY POLARIZING VOLTAGE FOR THE CONDENSER SPEAKER.

FIG. 7 (RIGHT) THIS SHOWS HOW THE CONDENSER SPEAKER MAY BE CONNECTED TO THE OUTPUT OF A POWER TUBE SO AS TO UTILIZE THE GRID AND PLATE VOLTAGES FOR THE POLARIZING VOLTAGE.

of air space behind it so that no air will be trapped. Likewise, if it is mounted on a console the back must be open for the same reason.

The speaker may be built in many sections, as indicated in Fig. 5. This shows a speaker of six sections with a baffle board frame around it. The more sections used the better will the low notes come out, but owing to the increased capacity of the speaker, the greater will be the high note suppression. The Newcombe-Hawley is built of six sections.

Polarizing Voltage Required

The attraction between the two plates is proportional to the square of the applied voltage, as was previously stated. Under such a law of attraction every AC voltage would be doubled in frequency. This must not be. The speaker must move with the signal and reproduce the original frequencies. That is, the output must be directly proportional to the input voltage. To bring this about it is necessary to use a steady polarizing voltage which is large compared with the maximum signal voltage. This polarizing voltage has the same effect as the steady fields in magnetic and dynamic speakers.

If the steady polarizing voltage is V and the signal voltage amplitude is v, the force between the two plates at any instant will be proportional to $(V+v)^2$, or to $V^2+2Vv+v^2$, for a single signal frequency. The first term V^2 is a permanent displacement of the diaphragm toward the stator plate. It produces no effect on the output. The second term 2Vv is the useful component. It is directly proportional to the signal voltage v and also to the polarizing voltage V. This is as it should be. Since the polarizing voltage may be chosen at will the speaker can be made more sensitive by using a high polarizing voltage.

The third term v^2 results in a component of twice the frequency of the signal. That is, it produces second harmonic distortion. The speaker should be designed so that this term is as small as possible. The practical way of doing this is to use a high polarizing voltage. Hence the use of a high value of polarizing voltage produces two desirable effects. It makes the speaker more sensitive and it results in a smaller harmonic distortion.

Several methods may be used for polarizing the speaker. A high voltage storage battery may be used across the speaker in series with the signal supply leads from the power tube. But high voltage batteries are both expensive and somewhat dangerous.

A small rectifier and filter system is much more suitable. It costs much less and it is not dangerous, even if the voltage is high. For rectifier tube an ordinary receiving tube, such as a 201-A, may well be used, because practically no current is required. In fact, the circuit may be arranged so that no current at all would be drawn from the rectifier tube.

Fig. 6 shows a simple rectifier circuit for polarizing the speaker. It is a half wave rectifier using a 201A tube. The supply transformer has two secondary windings, one of 5 volts for the filament and one of 500 volts for the polarizing voltage. The 1 mfd. condenser is the filter. Although this is small it is quite effective since no current is drawn in the circuit. The polarizing voltage in this case is the peak voltage of the input wave, which amounts to about 700 volts.

The output of the receiver is impressed across the two terminals indicated in Fig. 6. It is assumed that there is also a choke coil across these terminals, unless the speaker is supplied by the secondary of a transformer.

Another method of polarizing the speaker is indicated in Fig. 7. No special rectifier is used but the circuit is arranged so that the grid and the plate voltages of the last tube serve as polarizing voltages. When the last tube is a 250 and the voltages are the maximum recommended for this tube, the polarizing voltage on the speaker will be about 550 volts.

Both in Fig. 6 and in Fig. 7 small stopping condensers are used in series with the condenser speaker. In Fig. 6 the 1 mfd. filter condenser serves as stopping condenser. In Fig. 7 a ½ mfd. condenser is used. It is customary to use much higher values. But when a condenser speaker is used high values of stopping condensers are not necessary. This is due to the fact that the speaker itself is a condenser of relatively small value. The stopping condensers recommended are large in comparison. Hence there will be practically no signal voltage drop across the condensers. Nearly all of the drop will be across the speaker, as it should be.

Radio University

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I HAVE a Super-Heterodyne which is full of repeats. What causes them and how can I get rid of them?

(2)—I use an outdoor antenna. Would it be better to use a loop?

JESSE JONES,
Covington, Ky.

(1)—Your oscillator and the various broadcast stations cause the repeats. There is no simple cure-all. Try grid bias detection for first and second detectors. Put a .0001 mfd. condenser in series with the aerial.

(2)—A loop for a Super-Heterodyne will pick-up less interference and hence reduce the number of repeats.

* * *

I HAVE a receiver which gives very good quality when I first turn it on, but gradually a low-pitched howl builds up which becomes louder than the signal. What causes this and how can it be stopped?

(2)—Would a radio frequency choke coil in the plate lead of the detector help to stop it?

(3)—Will a change in the grid bias prevent the building up of this sound?

(4)—Would you recommend bypass condensers for stopping the noise?

FRANCIS KELLY,
Boston, Mass.

(1)—The noise is either due to a feedback through the air or to feedback through the B battery eliminator. If it is air feedback the noise will be metallic in character and can be stopped by protecting the detector from the sound of the loudspeaker, or by using a non-microphonic detector tube.

(2)—A choke coil in the plate lead will not help. But an audio choke in series with the detector plate supply lead may help, provided you connect a condenser of about 2 mfd. from the B plus post on the transformer to ground.

(3)—An increase in the grid bias on the two audio tubes sometimes is effective.

(4)—If the noise is due to feedback through the B battery eliminator, bypass condensers are most effective. Connect a condenser from B plus on the last tube to ground. If this condenser is large enough it will stop the feedback and the howling. Start with a 4 mfd. unit.

* * *

DOES THE PITCH of an organ change with the temperature and if so how?

(2)—Is the pitch of any instrument or voice changed in broadcasting, that is, is the pitch of a note emitted by a loudspeaker the same as the pitch of the original note in the studio?

(3)—Is there any way of transmitting a sound so that the pitch will be changed at the receiver?

(4)—When one loudspeaker is said to be high pitched and another low pitched, is there actually a difference in the pitch of the tones?

MARTIN SVENDSEN,
Chicago, Ill.

(1)—If the organ pipes are made of material which does not contract and expand as the temperature changes, the pitch varies directly as the temperature. That is, the higher the temperature, the higher the pitch. If the length of an **organ pipe** expands at the same rate that the velocity of sound in air increases, there is no change in pitch. But there is no such material of which to make organ pipes.

(2)—It is not changed.

(3)—If the single side-band method of transmission is used the pitch of any note may be changed to any other. But that does not mean that the key may be changed at will.

(4)—The pitch of any two speakers is the same always if they are reproducing the same music at the same time. The speakers have nothing to do with the pitch.

* * *

I HAD A GOOD radio receiver. It was loud, sensitive, selective and there was no hum in it at all. I substituted high-priced audio transformers and now the set hums. What is wrong?

(2)—Do you think that I have the wrong grid bias or plate voltage? I use a B battery eliminator.

ARTHUR EVANS,
Miami, Florida.

11)—Since you changed nothing but the transformers the hum is probably due to the fact that the new transformers are more efficient on the low notes. The hum comes from the B battery eliminator.

(2)—You may have improper voltages. Try increasing the C bias. Put a 4 mfd. condenser from B+ det. to ground in the set.

* * *

PLEASE PUBLISH a diagram of a four-tube circuit having two screen grid tubes, three tuned circuits and one stage of resistance coupling following a grid bias detector. I wish to use this circuit in conjunction with a push-pull audio frequency amplifier which I have.

(2)—Can such a circuit be built without shielding between stages?

(3)—Is it practical to combine two of the tuning condensers on one shaft so as to make the circuit dual control?

HENRY DAY,
Portland, Ore.

(1)—See Fig. 733.

(2)—It can be built without shielding but it will work more satisfactorily with it, and very thorough shielding at that.

(3)—Yes, if the two tuned circuits are equal.

I AM LOCATED in a DC district and wish to electrify my four tube screen grid receiver. Will you please publish a diagram showing how this may be done.

(2) Is it necessary to use a filter for the filament current?

AARON PERLMAN,
New York, N. Y.

(1)—See Fig. 734 (next page).

(2)—If C7 in this circuit is an electrolytic condenser and if Ch is a 30-henry choke no other filter is necessary in this this circuit.

* * *

I WISH to build an AC receiver with push-pull output stage and impedance coupling. If convenient please publish a diagram of such a circuit.

(1)—Such a circuit is given in Fig. 735.

* * *

IF IT IS PRACTICAL to build an AC receiver with impedance coupling and push-pull output will you please publish a circuit diagram of such a receiver?

(2)—I have two 100-henry choke coils. Are they suitable?

(3)—Would you recommend heater type tubes for the impedance stages?

(4)—What size coupling condensers and grid leaks should be used?

WILLIAM SANTELLA,
New Haven, Conn.

(2)—As far as the inductance is concerned they are all right.

(3)—They are the only kind that should be used.

(4)—The coupling condensers may be .01 mfd. and the grid leaks 1 megohm.

* * *

IF I PUT ONE ONE NEW TUBE in my eight-tube set, must I put seven more new ones in, or may tubes that have given good service still be used with the one new tube?

EMIL ANDRUSS,
Ames, Iowa.

You may put in just one new tube and keep using the seven tubes that had been rendering good service. A mistake some persons make is to put one or two new tubes in a receiver, and use these in conjunction with old tubes that have lost much of their emission and amplifying capabilities. Therefore they note little improvement. But the rule about a tube is that its use prior to that of another tube does not preclude it from being used still more. If the old tube is a good tube it may be just as good as a new one. The lay public should change its tubes completely—the entire set—once a year, to be sure it does not continue to use tubes that have done their share and ought to be retired as decrepit. At best, the advice to the lay public must be general, and all general statements are tinctured with inaccuracy. It is by technicalities of the subject-matter that absolute accuracy of exposition is attained. You have it within your own power to determine whether a tube has outlived its usefulness. Test it with a Jiffy Tube and Set Tester.

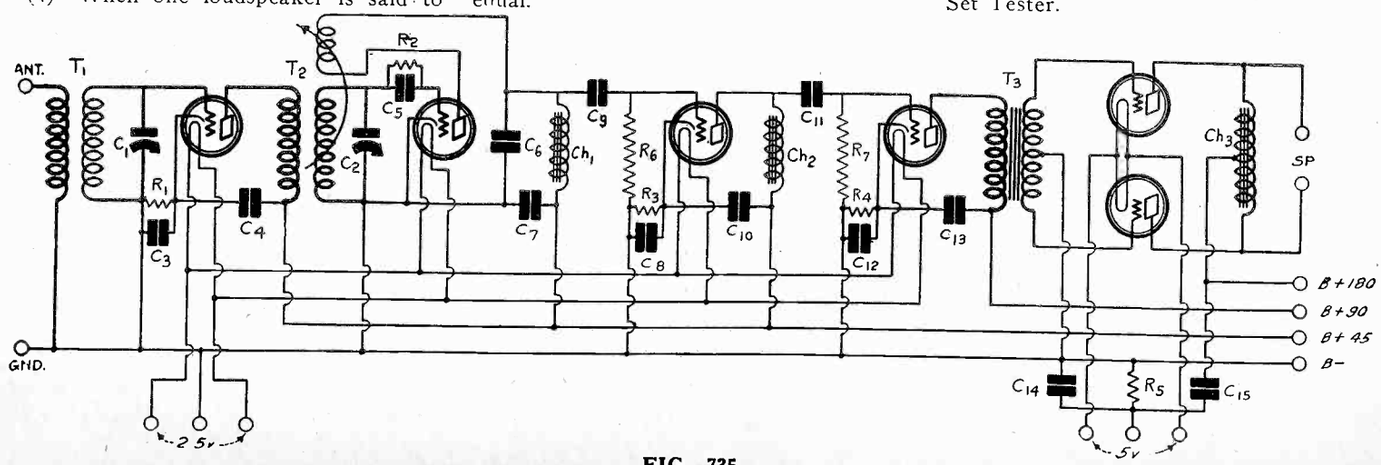

FIG. 735
THIS AC RECEIVER IS IMPEDENCE COUPLED AND CONTAINS A PUSH-PULL OUTPUT STAGE. REQUESTED BY WILLIAM SANTELLA.

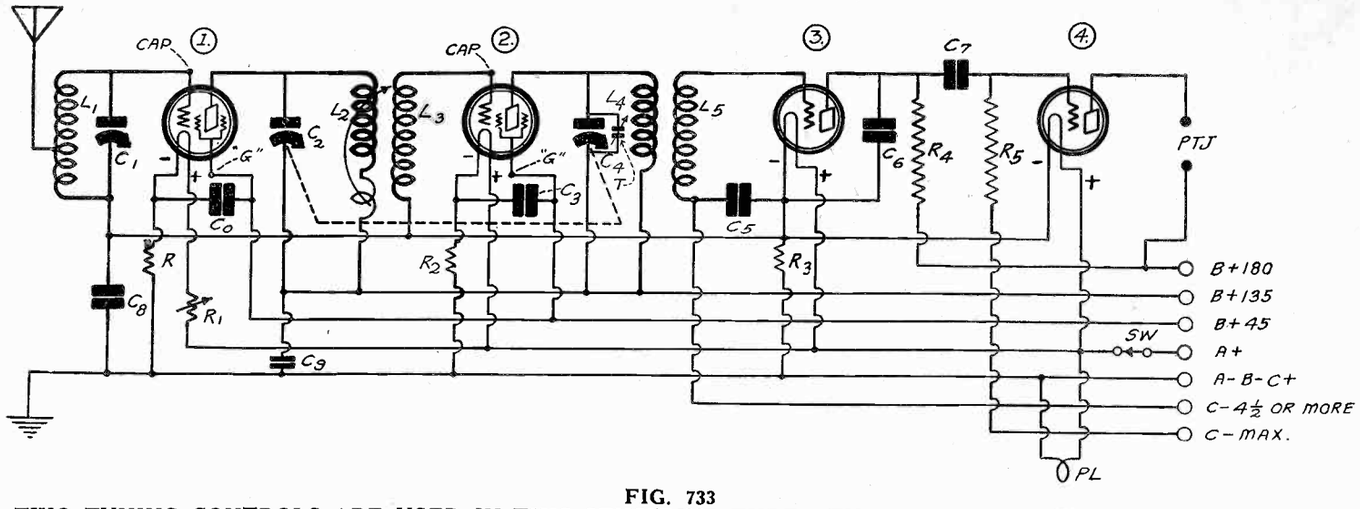

FIG. 733
TWO TUNING CONTROLS ARE USED IN THIS SENSITIVE THREE TUNER CIRCUIT, WHICH INCORPORATES TWO SCREEN GRID TUBES, A GRID BIAS DETECTOR AND ONE STAGE OF RESISTANCE COUPLED AMPLIFICATION. REQUESTED BY HENRY DAY.

WHAT KIND of waves do the broadcasting stations send out?

HARVEY DUNN,
Mobile, Ala.

They transmit modulated continuous waves.

* ó *

SHOULD I BE ABLE to get a consistent reception on a four-tube set over 1,500 miles, day or night?

CONRAD FICKER,
Spokane, Wash.

No. In actual practice you can not expect any certain, steady range, since the conditions that produce the range vary. Under good conditions, particularly at night, a well-designed four-tube receiver in a good location may pick up several stations 1,500 miles on farther away. To do this a stage of tuned radio frequency and a regenerative detector usually are necessary, and this radio channel must be followed by high-gain audio, to make the distant signals loud enough for speaker operation.

* * *

AUTHORITIES are divided as to whether television is practical now. What do you say?

ADAM PETERS,
Dubuque, Ia.

The entire discussion hinges on the definition of the word "practical." Virtually all scientists are agreed as to the facts, but there is disagreements as to the interpretation of the facts. Whether 10-kilocycle separation, as required in the broadcast band, permits adequate detail in a television transmission, is one subject of disagreement. All know how much definition is possible under present known methods. But one man will consider a certain amount of definition wholly sufficient to warrant broadcasts, while another, more particular, will insist that the transmissions for public use be delayed until further development asserts itself, and until transmissions may be regarded as a public service, something standard, rather than experimental. It seems advisable, therefore, to give television a good test at present in the broadcast band, even during regular musical program transmission hours, and then let the public decide the future course. There will be plenty of interference, and all hands will have the official answer quickly enough from the real jury—the public. Television is certainly still experimental, and can not rate as a public serviceP until further developed.

* * *

I HAVE READ that the screen grid tube is not usually worked at its maximum, also that it does not oscillate, also that various choices of coupling media present themselves, and produce different results. Are these statements true?

CONQUEST HARMES,
Bombay, India.

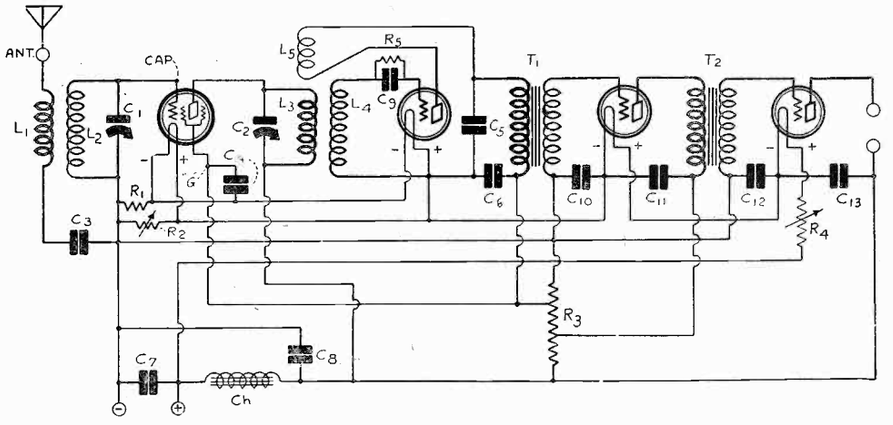

FIG. 734
A SIMPLE DIAGRAM OF A FOUR TUBE RECEIVER DESIGNED FOR OPERATION FROM A 110 VOLT DC LINE. REQUESTED BY AARON PERLMAN.

Screen grid tubes are worked at maximum only in formulas, never in receivers. There is no practical way of using the so-called maximum, principally because stability can not be maintained. There are other limitations, as in an audio channel where, if a coil is used in the plate circuit, it never can have a high enough impedance to come anywhere near maximum voltage gain, without having a self-capacity so high that the higher audio frequencies would be bypassed. The tube is usually worked far from its maximum. The tube certainly will oscillate. One of the problems, rather, is to prevent it from oscillating, hence careful shielding is necessary if more than one screen or grid tube is used. One alone will be stable at RF without special treatment, the other tube being a standard detector. The choice of coupling media, in general, is impedance, transformer and resistance. In the radio part of the circuit a well-designed transformer will give adequate gain with less selectivity, while the resistance will give fair gain at no selectivity. However, in the audio channel the resistance is a very fine load on the plate circuit of a screen grid tube. Therefore, the first and last situations in your question are true and the other one—about freedom from oscillation trouble—is false. You should experiment with the screen grid tube. It is the most interesting tube in the world today for the home experimenter.

Not Too Loud, Please!

Even 250 Push-Pull Should be Worked at Comfortable Level

By Chester Charlton

THERE is much to say in favor of a receiver that ends up with a 250 push-pull amplifier and a dynamic speaker. The quality of that combination can be expressed in superlatives without stretching either the imagination or the truth. The maximum undistorted volume of that combination speaks for itself so forcefully that no one can question its superior magnitude.

But it is not the fellow who lives next door to such a combination of superlatives who appreciates its good points. Neither is it the fellow who lives next to him who is tempted to extol the unquestioned virtues of receiver, nor the fellow who lives next to him. In fact, not a person within a block can be found who bubbles over with enthusiasm for that receiver. Each person, for some reason, prefers his own receiver, regardles of what the merits of that receiver may be. And he perfers to listen to it when the mood is upon him and not when the mood is upon someone else.

Sounds in the Night

The reproduction from that 250 push-pull receiver may be realistic but that does not lend charm to its sound when it is running in the middle of the night. The sound is not as realistic as that of crying children, and nobody appreciates that past midnight, not even the distracted parents of the howling babes. The "noise" from that receiver is not as realistic as the meowing and yowling of cats on the back fence in the early morning, and no one feels disposed to toss appreciatory bouquets at the cats. The noise from the receiver is not as realistic as the racket caused by a group of young girls and boys at a party, and nobody not a particpant of the party derives any particular enjoyment out of it at any time of the night.

But the fellow who has a 250 push-pull job believes he is giving his neighbors a special treat every time he turns on his set. He turns up the volume until his loudspeaker executes a jig, he opens his windows wide, and leaves the door ajar so that all the neighbors may receive all that their ears can stand.

And he enjoys giving his neighbors this treat. Does he not give them volume and quality the like of which they have never heard before?

He Serves Jazz

And to what does this possessor of a 250-push-pull receiver treat his suffering neighbors? Jazz in the early morning, jazz in the middle of the evening, and more jazz into the early hours of the moruing. If a symphony starts up he may quickly turn the dials to jazz. He may do likewise if operatic selections are transmitted. Even when he listens to some good music he turns the volume up so high that the effect upon his neighbors is no more favorable.

Just how many families are disturbed by one such receiver in a crowded locality? Suppose it is Summer, when all the windows are open and that the receiver is located in an apartment house of six floors. Every family on the same floor as the receiver can hear it. Every family on the floor below and on the floor above. Most of those living two floors above and below can hear it. Also the people living in the apartment house across the street, and those living in the house across the backyard.

At night when everything else is still the receiver can be heard two or three blocks away. And that is one of the boasts of the fellow with the powerful set.

"It is so loud," he says, "that every word can be heard a block away." If every word can be heard a block away, every note of a jazz band can be heard a mile away. Nobody who has lain awake for hours listening to the set doubts the claims for it.

Circuit Has Virtues

The 250 push-pull amplifier has many virtues. Some of them are fidelity of reproduction, a minimum of waveform distortion, capability of bringing out the low notes, and ample volume where volume is necessary. It can be used in the home without being a nuisance to the neighbors provided that no attempt be made to show the neighbors what a wonderful set it is. If it is operated at a volume which is pleasant to the people in the same room with the speaker, the sound will not carry far and the reproduction will be very much more faithful to the original than when the volume is turned up to the point where it inflicts pnishment on the ears of those close to it.

There is no sense in turning up the volume to the limit, because the ears of those nearby become partially paralyzed. They do not appreciate the loudness any more than if the volume were only a half, or a third or a tenth as great. Besides, if theloud sound is continued for long the ears will be permanently impaired.

Purpose of Power Tubes

The purpose of large power tubes and of push-pull circuits is to provide distortionless reproduction at moderate volume. It is not the purpose of these tubes and circuits to annoy the neighbors and to deafen those about them. Nothing is gained by the use of push-pull and large power tubes if the volume is turned up to the limit. There will be just as much distortion as if smaller tubes and single-sided circuits were used at lower volume. But for equal volume the push-pull circuit and the large power tubes are much superior to the others.

It is particularly on the low notes that the push-pull and the power tubes are advantageous. In order to get much power out of the low notes the amplitude of the signal must be large. And if the amplitude is large the tubes and circuits must be so arranged that the signal voltage on the tube may swing widely without distortion.

That a large amplitude is necessary for low notes is obvious when observing the behavior of stringed instruments such as pianos, harps, bass viols and the like. Strike, pluck or stroke one of the high pitched string and a loud noise results, but the vibration of the string is not visible. Excite one of the base strings similarly and a relatvely weak noise results. But the vibrations of the string can be seen very clearly. The string swings widely. The same thing occurs when the music is in its electrical form. And the signal voltage is proportional to the amplitude of the vibration. Hence for low tones the circuit and the tubes must be designed for wide electrical swings.

J. T. Bulger, 300 Craig St., Schenectady, N. Y.
Bruce Bassett, Bloomsbury, N. J.
E. Tapper, 1120 Center St., Chicago, Ill.
F. W. Goss, Box 1442, Westwood, Calif.
P. W. Waddell, 63 Cleveland St., Arlington, Mass.
M. S. Wilson, Irvington Hotel, Denver, Colo.
Harter Herness, 1909 W. Jackson Blvd., Chicago, Ill.
Fluhart Williams, 2124 Queen Anne Ave., Seattle, Wash.
O. B. Loud, 19 Smith Ave., Lawrenceville, Mass.
R. Gulickson, 141 Bismarck Ave., New Brighton, S. I.
A. R. Miller, 33 Circuit Drive, Riverside, R. I.
L. W. Simonds, 25 Ocean St., Santa Cruz, Calif.
C. Pokorny, 12117 Farringdon Ave., Cleveland, O.
W. S. Hile, 117 N. Franklin St., Allentown, Pa.
M. D. Clark, Western Union Cable Co., Havana, Cuba.
John DeNoce, 461 Bagley Place, Grantwood, N. J.
O. S. Harvey, 16 Avon St., Portland, Me.
Lyman Burton, Woodnorth, Man., Can.
E. S. Frost, 1159 N. Howard St., Glendale, Cal.
Franklin Howe, 5308 Third Ave., Los Angeles, Calif.
H. E. Richardson, Mesa Ae., Box 68, Ariz.
A. F. Slawski, 6039 Dubois St., Detroit, Mich.
Robert Bucken, 1615 W. 13th Ave., Spokane, Wash.
J. Olivet, 46 Sterling St., East Orange, N. J.
H. F. Scholtz, 4649 Warwick, Chicago, Ill.
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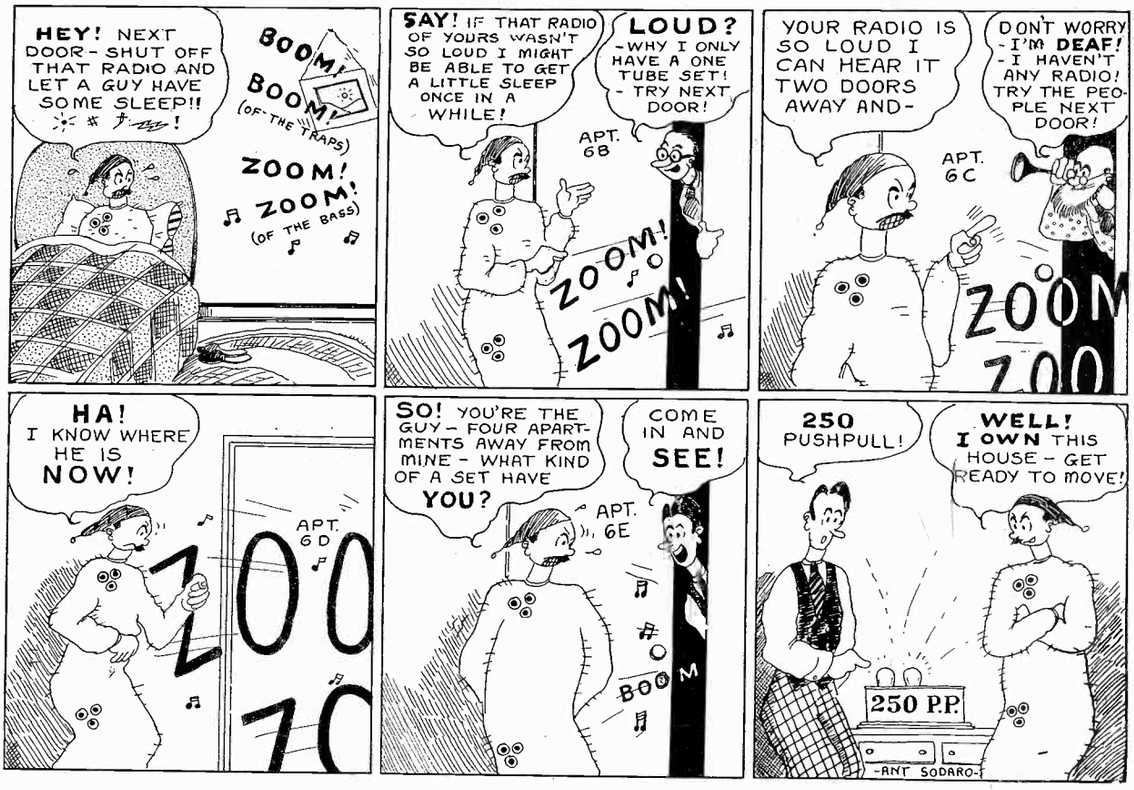
TOO DEMONSTRATIVE

By Anthony Sodaro



Operating a Short-Wave Tuner

By Lewis Winner

[*Part I of Lewis Winner's description of the Hammarlund Adapter Receiver was published last week, issue of March 2nd. Herewith is the second instalment of this two-tube model. Details about the four-tube model will be published next week.*]

THE receiver is an unusually sensitive one. It is capable of picking up distant stations really never thought possible. But, and a big but, too, the wiring must be carefully done and the layout must be followed religiously. Carelessness in either or both will impair results seriously.

It is imperative that all the leads be as short as possible, as well as direct. All wires carrying radio frequency currents should cross each other, if at all, at right angles, and clear each other as much as possible. The lead length may be increased slightly to permit this.

All connections should be soldered wherever possible. Care should be exercised here not to use too much flux, for this causes leakage.

The baseboard should be of hardwood or of some substance which does not absorb moisture.

The question of why shielding is not employed undoubtedly comes to the mind of many. It has not been used because of the mechanical difficulty in changing from one coil to another. The layout has been so arranged, however, as to minimize the capacitance between the grid and plate wires. That is why the layout should be followed so carefully.

Designed for Battery Operation

The receiver has been designed for battery operation because of its quiet and unfailing action. It is not desirable to use alternating current because of the noises introduced and also because the tuning may become erratic.

The device can be used with alternating current receivers, batteries being used for the Adapter. To do this, it is only necessary to disconnect the detector plate lead from the eliminator, B battery plus supplanting it. The minus post of this B battery is connected to the minus of the eliminator.

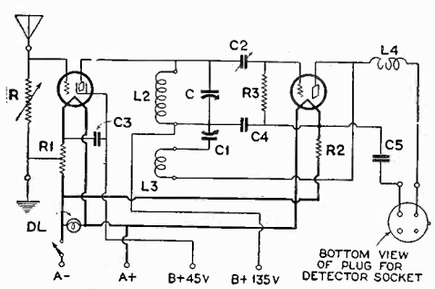


FIG. 3
THE SCHEMATIC DIAGRAM OF THE 2-TUBE MODEL SHORT WAVE ADAPTER-RECEIVER. THE BREAK IN THE PLATE CONNECTION OF THE SCREEN-GRID TUBE TO THE STATOR CONNECTION OF C AND TERMINALS OF L2 AND C2 IS UNINTENTIONAL.

Either the 112A or 201A tube may be used in the detector circuit. The 112A is more sensitive, having a lower plate impedance. It is also a more stable oscillator.

Although the 200A is more sensitive, it is noisy. A 199 tube may also be used, but the regeneration is poor at the low wavelengths.

Tuning Not Very Difficult

While the tuning of this receiver requires exactness, it is not difficult. The Hammarlund drum dial (knob control) with its 1-to-5 reduction radio permits this necessary precision adjustment.

The regeneration condenser is an important factor. This should be turned carefully until a hissing sound is heard, when the detector is just beginning to oscillate. This point should be kept throughout the tuning.

You can know when the detector tube is oscillating by touching the stator plates of the detector condenser. A sharp click will be heard if the tube is oscillating.

The grid return may be shifted from minus A to plus A for experimental purposes. Different value leaks should also be tried, although 5 meg. usually works well.

The SWC set consists of coils which enable tuning from 15 to 107 meters. Another coil known as SWT-120 may be used to tune in stations from 100 to 215 meters. This coil is a separate item.

Audio May Be Added

Any audio amplifier may be added to this Adapter-Receiver. It is necessary only to connect the plate and the B plus lead of the amplifier to the same respective posts of the detector tube circuit.

Be sure that the filaments are so connected that a switch will turn them all off at the same time, e. g., audio as well as RF and detector.

When using the Hammarlund type SWAP adapter plug, its green lead is connected to the Fahnestock clip going to the choke, while its brown or maroon lead is connected to the right hand clip, which is connected to the bypass condenser C5.

For simplicity in tuning, it is important to know just what stations are on short waves, their time on the air, etc. This is treated in great detail in the Hammarlund Short Wave Manual (10c).

[*Next week, a 4-tube short wave receiver, using a stage of tuned RF screen grid amplification, a regenerative detector and two stages of special transformer audio amplification, will be described by Lewis Winner.*]

The Band Pass Filter

How Parts Are Mounted in 5-Tube Circuit

By Capt. Peter V. O'Rourke

Contributing Editor

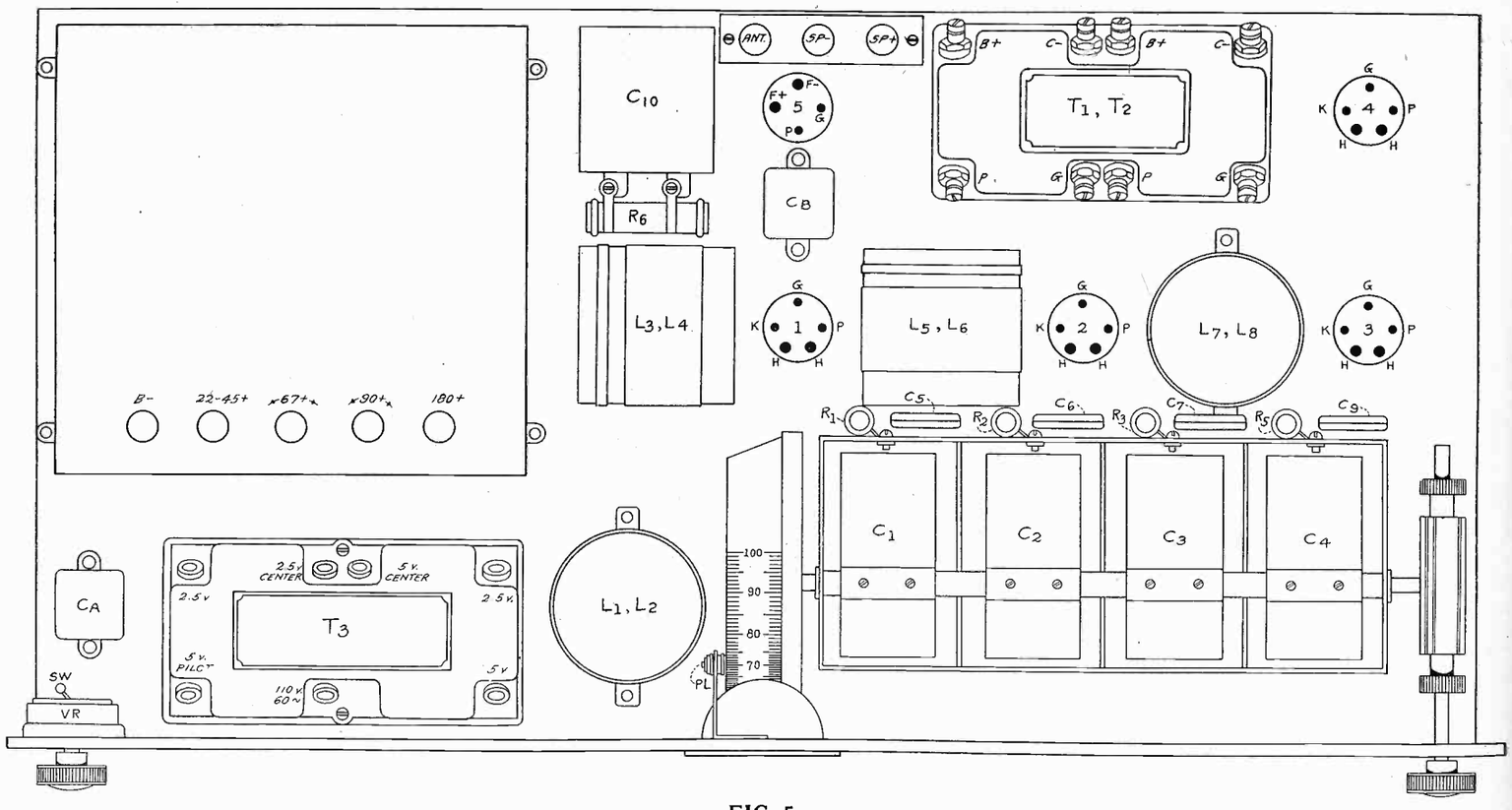


FIG. 5
LAYOUT OF PARTS USED IN THE AC ELECTRIC 5-TUBE BAND PASS FILTER CIRCUIT. FOUR 227 TUBES AND ONE 171A ARE USED.

Herewith is shown the layout of parts for the five-tube circuit, incorporating a band pass filter, as described in the February 23d and March 2d issues.

The tuning knob at right, actuating a scale at center, is quite an attractive feature, and the method of obtaining this novelty is clear from the layout.

The general disposition of parts shows a neat arrangement, and this should be followed. The scale of the drawing is one-third, therefore multiply by three to get the actual size.

The novelties of the arrangement of parts are:

The B eliminator (the National Company's Model 5280 Velvet-B) is secured to the wooden baseboard by four right-angle brackets, ½" at each angle. The four screws that hold the B supply case to the frame are removed and when restored are made to hold the four brackets. Thus, as the angles are drilled, there are four holes through which wood screws are turned, to grip the baseboard. It is not advisable to drill a hole in the baseboard for access to the socket holding the 280 rectifier, because your fingers would not be long enough to enable insertion or removal of the tube that way. For access to the 180 tube, remove the B supply from the subpanel.

The Electrad resistor R6 may be 3,500 ohms, less than 2,000 of which is used, since the sliders are moved so as to be just as far apart as the connecting lugs of the 4 mfd. condenser, C10, on which R6 is mounted.

The coils (models made by the Screen Grid Coil Company are illustrated) have uncommon stray coupling, due to L3 L4 being at electrical right angles to L1L2, and L5 L6 being at right angles to L3 L4. The two coils farthest apart are mounted on the same electrical plane, i. e., both upright (L1 L2, L7 L8).

The biasing resistors, R1, R2 and R3 affect respectively the first, second and third tubes, while R5 is for the fourth tube (first audio) and is mounted on the position shown, for convenience and symmetry. The Hammarlund "battleship" model tuning capacity (consisting of C1, C2, C3 and C4) has holes on one side of the frame, centered in respect to each tuning section, and into these holes are put 6/32" machine screws, which pass through a terminal fixture of the Electrad resistors and engage a nut on the other side of the condenser frame. These screws must not exceed 3/16" shaft length. The difficulty of attaching the nut is solved by putting the nut in position, aligned with the hole, and holding the nut in place with the flat side of a thin screwdriver. With your free hand slightly engage the screw on the nut. Then use the screwdriver on the slot in the screw, holding the nut in place with the fingers of the other hand until the greater tension of pliers becomes necssary.

The Aerovox fixed condensers C5, C6, C7 and C9 have lugs on them (not shown), and these lugs, at one end, are soldered to the Electrad resistors. File the resistor fixtures, since they are nickel-finished, and the finish resists solder a little. Another method would be to put the screw through the condenser lug as well as through the resistor lug, and avoid soldering at one end. The other lug of these condensers goes to respective cathodes of the tubes 1, 2, 3 and 4. The last tube has its own biasing resistor elsewhere (R6, previously discussed).

The volume control is a variable resistor VR in series with the antenna and is a 5,000-ohm Electrad Royalty with 110-volt AC snap switch (SW) attached (X). The same slider operates both switch and resistor contact winding.

The filament transformer T3, manufactured by the George W. Walker Co., of Cincinnati, is Victoreen Cat. No. 327. The transformer has leads emerging from the openings. These leads are not shown, but the voltages they supply are shown. Note that there is a pair of 2.5-volt leads, hence two of the 227 tubes may be fed by one pair and the other two by the other pair. The 5-volt winding heats the last tube (5) and the pilot light PL. The other Victoreen product in the list of parts is the 112 audio unit (two fine audio transformers in one casing). The plate of tube 3 goes to the P post nearest to it, while the G post at extreme right goes to grid of tube 4. This key solves the other connections to the 112 automatically.

The condenser gang must be mounted exactly as shown, so that the scale of the Hammarlund drum is not too far back from the front panel rear, nor so close that the aluminum edge touches the panel. Also the drum mechanism (at right) leaves no choice of placement. Adhere to the layout.

Screen Grid Portable

Compactness, Sensitivity and Autonomous Operation Obtained

By H. G. Cisin

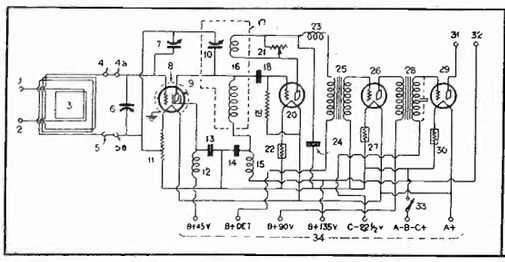


FIG. 1
CIRCUIT DIAGRAM.

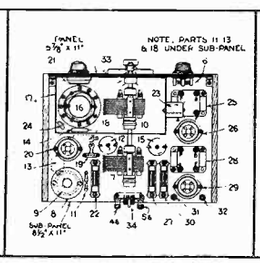


FIG. 2
TOP VIEW.

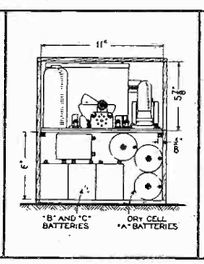


FIG. 3
REAR VIEW.

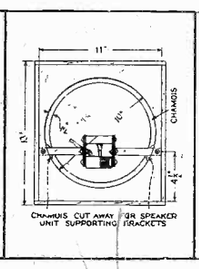


FIG. 4
CONE SPEAKER.

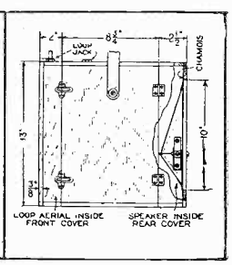


FIG. 5
SIDE VIEW.

THE seasonal interest in portable receivers already has been aroused. Radio fans are looking ahead to their vacations in the country and they are building their receivers. They are asking for sensitive and compact receivers which are self-contained.

The sensitivity requirement demands a screen grid tube as radio frequency amplifier, for no other tube will give the amplification that tube does. Sensitivity also demands regeneration, easily controlled. It also demands that type of coupling between the screen grid tube and the detector which transfers the signal most effectively. That method is tuned impedance. And for portability and compactness it is necessary to use a small loop for pick-up.

Thus we have the essentials of a good portable receiver. Other features of the circuit design are mainly to reconcile compactness with high sensitivity and stability.

Construction of Loop

The loop is built into the front cover, which is mounted on loose hinges so that it may be removed and placed on top of the set when in use. Of course, the size of the loop depends on the size of box that is selected for the receiver. No specific number of turns can be given for the loop because that depends upon the individual set. However, about 60 feet of No. 22 DCC wire will be needed. Four turns should be wound for the primary so that an antenna and ground may be used if desired where conditions permit. These turns should be inside the secondary turns. It is a simple matter to adjust the secondary turns to fit the condenser used for tuning. Wind more than enough turns. tune in a station near the 550-meter mark. and then remove turns until this station comes in at the desired point on the tuning dial.

The coupler is a three circuit tuner (16) like the Aero U-55, the secondary and tickler windings of which are used. The secondary is tuned with a Hammarlund .0005 mfd. condenser (10). The regeneration is controlled by means of a resistance (21) connected in shunt with the tickler winding.

Condensers Ganged

The two tuning condensers (7) and (10) are mounted on the same shaft so that only one main tuning dial is required. This enables greater compactness to be obtained. In order to compensate for the differences between the two tuned circuits, a midget condenser (6) is put in parallel with the loop section (7) of the gang condenser.

Special precautions must be taken to prevent oscillation in the circuit, due to the compact assembly. Two bypass condensers (13) and (14), each of .01 mfd., and two radio frequency chokes (12) and (15) are used for this purpose. Another radio frequency choke coil (23) is used to aid regeneration and also to prevent uncontrollable feedback.

The three circuit tuner and the condenser which tunes this are inclosed in a shield as a means of preventing oscillation and the screen grid tube itself is surrounded by a shield. Both of these shields should be grounded or they should be connected to the filament circuit.

Power Supply Built In

The batteries are mounted in a compartment under the circuit proper. For A battery three No. 6 dry cells are used, giving a voltage of 4.5 volts. Since this voltage is higher than required for the various tubes, ballast resistors are necessary. For the screen grid tube a 5-15-ohm tapped resistor (11) is used. The drop in the 15-ohm portion provides the bias for the tube. For the detector and first audio tubes two No. 4V-199 Amperites are used and for the power tubes, which is a 120 type, a No. 120 Amperite is employed.

For grid and plate batteries seven 22.5 volt sections of small B batteries are used. One of these is used for bias on the power tube and the others for screen grid and plate voltages. These are connected so that the screen grid and the detector plate get 45 volts, the plate of the first audio tube 90 volts and the plates of the screen grid and power tubes get 135 volts.

The details of the wiring connections are given in the circuit diagram, Fig. 1, and the baseboard plan of the layout of the parts is given in Fig. 2.

Other Illustration on Front Cover

LIST OF PARTS

One Aero Universal three-circuit tuner, Type U-55 or U-7 (16).
Two Hammarlund .0005 mfd. Midline condensers (7, 10).
One Electrad Royalty Type F resistance (21).
One 2-megohm Lynch metallized grid leak with mounting (19).
One Polymet .0005 mfd. condenser (24).
One Polymet .00025 mfd. grid condenser (18).
Two Polymet .01 mfd. condensers (13, 14).
Two audio transformers (25, 28).
Two No. 4V-199 Amperites with mountings (22, 27).
One No. 120 Amperite with mounting (30).
One Silver-Marshall shield, Type 631-A (17).
Three Silver-Marshall RF chokes, Type 276 (12, 15, 23).
One Silver-Marshall midget condenser, Type 340 (6).
One 20-ohm ballast resistor tapped 5-15 (11).
One screen grid tube shield with shielded lead and clip (8).
One filament switch (33).
Four UX type sockets (9, 20, 26, 29).
Two tip jacks (31, 32).
Two open-circuit jacks for loop connection.
Six binding posts.
One sub-panel 8¾x10¾x3/16 inches.
One screen grid tube, two 99s and one 120 type.
One National dial (flat type not drum).
One loudspeaker unit.
One loudspeaker cone.
Three No. 6 dry cells.
Seven small 22.5 volt B battery sections.

Two New Rectifiers for Transmitters

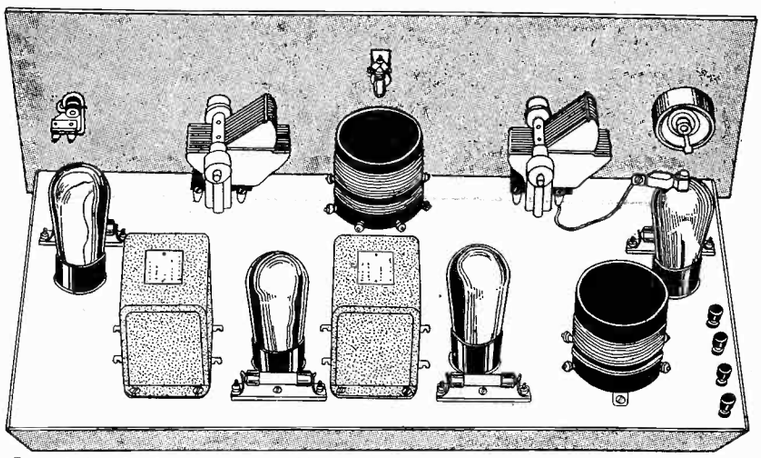
The Raytheon Manufacturing Company, Cambridge, Mass., has announced two new high-voltage rectifier tubes, the Ray SX-866 and Ray S, each rated at 250 milliamperes. The Ray SX-866 may be used with a root mean square voltage of 2,000 volts and the Ray S with 2,500 volts. The output rectified voltages at the rated current current are, respectively, 2,300 volts and 2,800 volts.

Both tubes are of the filament type and require a filament voltage of 2.5 volts and a current of 5 amperes. Both are single-wave rectifiers and intended primarily for transmitters.

NEW LINE FOR GOTHAM

The Gotham Engineering and Sales Company, located at 50 Church St., New York City, has been appointed national sales representative for the products of Transcontinental Coil, Inc., of Newark, N. J. Transcontinental coils are manufactured for both short wave and broadcast receivers.

Most Selective
is the new 4-Tube Screen Grid
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.

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L2L3L4—Screen grid tuner (SGT5).
C1—Aerovox .0005 fixed.
C2—Hammarlund .0005 mfd. Midline.
C3, C4—Two Aerovox .006 mfd.
C5—Hammarlund .0005 mfd. Midline.
C6—Aerovox .00025 mfd. with clips.
C7—Aerovox .0005 mfd. fixed.
A1—622 Amperite with mount.
A2, A3, A4—Three 1A Amperites, three mounts.
R1—50 ohm Frost rheostat.
R2—5 meg. Lynch metallized leak.
T1, T2—Two National A100 audios.
Ant., Gnd., Sp. —, Sp. + posts.
P1—Jewel window and lamp.
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HBH Unit

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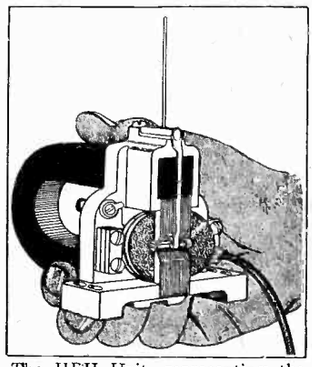
Any magnetic speaker requires a strong permanent magnet for its operation. The strength of the HBH unit is assured by the use of a long magnet of large cross-section, made of specially selected, high coercive-force steel, forged under the lowest heat possible, scientifically tempered in oil and aged.

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

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

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



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

Price **$5.95**

Moulded bracket (extra) **65c**

This Armature Stays Put

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

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

The armature is connected to the reduction lever by means of an extremely light yet rigid coupling rod. Two points of flexure are provided on this rod so that the armature and the reduction lever may move freely. The central portion of the rod is made so that it cannot vibrate at right angles to its length. **This eliminates local resonance and vibration which often give rise to false sounds in units.**

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

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

The die-cast harness which holds the entire unit together is rugged and holds the parts without any chance of parasitic vibrations. It is provided with four elongated mounting holes for attaching the speaker to the frame of any cone speaker. Two binding posts for the terminals are also mounted on the harness. These are insulated from the frame by bakelite and bushings with sufficient insulation to withstand the highest voltages which will be encountered in practice.

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

It does not give out any false tones or rattles and therefore it produces the best quality, purest tone.

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

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

☐ Please ship moulded bracket also at 65c.

Name .....

Address .....

City .....

State .....

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

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

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

10-day money back guaranty!

90 days to pay in full!

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

Quick Action Classified Ads

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

AGENTS

AGENTS averaging $17 daily showing new amazing household device that washes and dries windows, sweeps floors, cleans walls, scrubs, mops. Cleans autos. Very attractive price. Over 100 per cent profit. Harpers, 633 3rd St., Fairfield, Iowa.

AGENTS WANTED

GARAGE door holders. Large profits. Specialty Manufacturers, 524 Hall Bldg., Kansas City, Mo.

SALESMEN special new line of brushes for every store, garage, office, school. Big sales easy. Big profit. The Brush Works, 990 4th St., Fairfield, Iowa.

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

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

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

RADIO INFORMATION

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

SEEDS FOR SALE

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

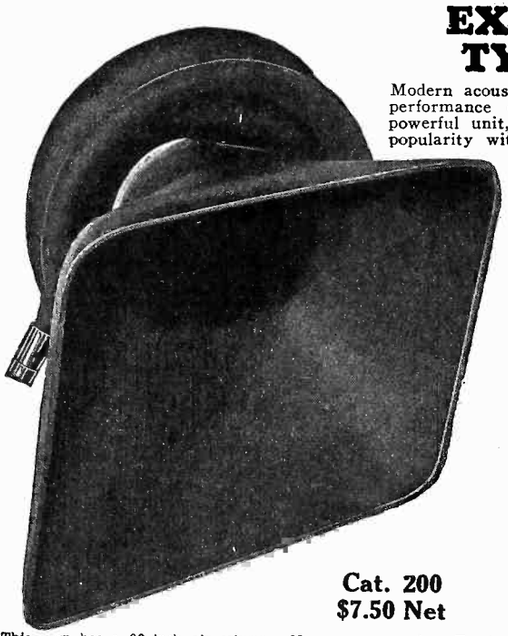
WHO HAS a 350-meter loose coupler formerly made by William Duck of Cincinnati? This coil had five taps and the primary had a sliding connection across bare wires. Address Tom W. Searle, Cascada, Mont.

MARVELOUS NEW pick up for phonograph. Only twelve left, all pippins. Money-back 10-day guarantee. Send $13.50.—P. Cohen, Room 1214, at 143 W. 45 St., N. Y. C.

Choose Your Speaker from This Complete Array!

EXPONENTIAL TYPE HORNS

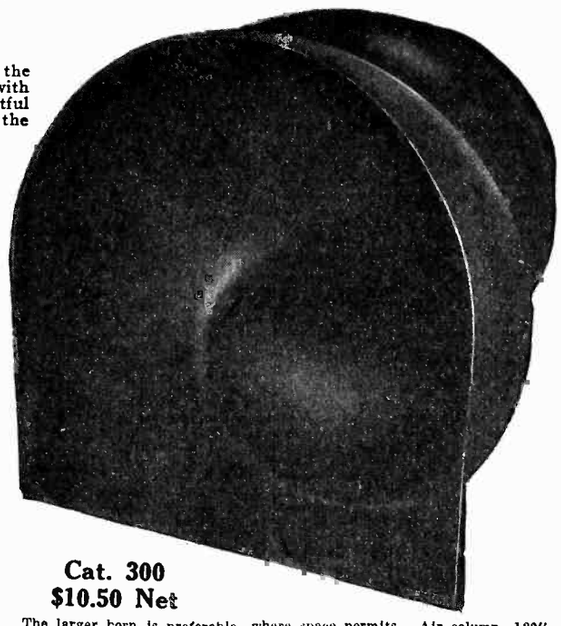
Modern acoustical science is striving to equal the performance of a large air column horn with powerful unit, while the horn enjoys its rightful popularity with trained experts. The larger the horn, the better, hence we offer two models: one with 7⅞ ft. tone travel, the other (where space permits) with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



Cat. 200
$7.50 Net

This horn has a 92-inch air column. No resonance peaks. Front, 18"x18". Depth, 13½". 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.

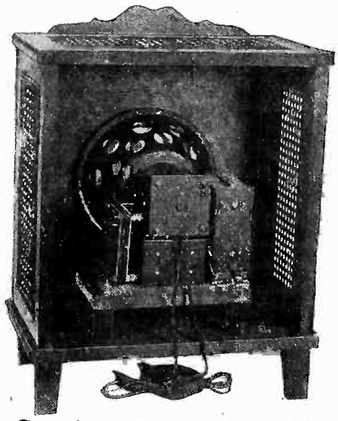
DYNAMIC CHASSES and Baffle

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

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.

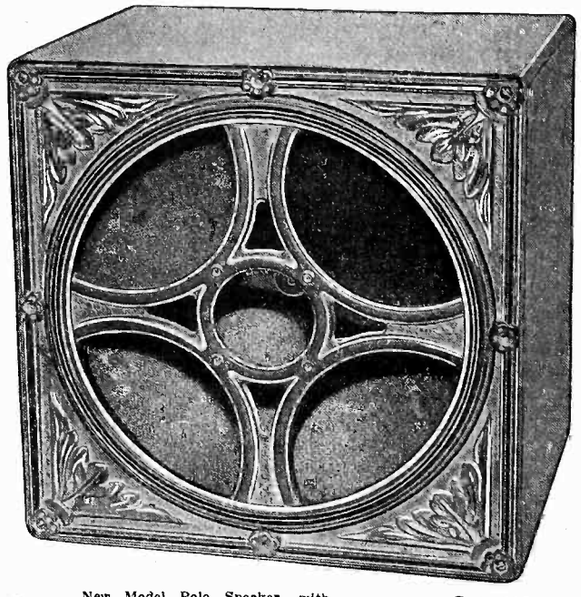
Those whose place is wired with 110-volt D.C. (direct current) should use Cat. 110 D.C. @ **$17.50 net.** Those who have no electricity should use the model that works from a 6-volt storage battery. Cat. 6 D.C. @ **$14.75 net.**

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.



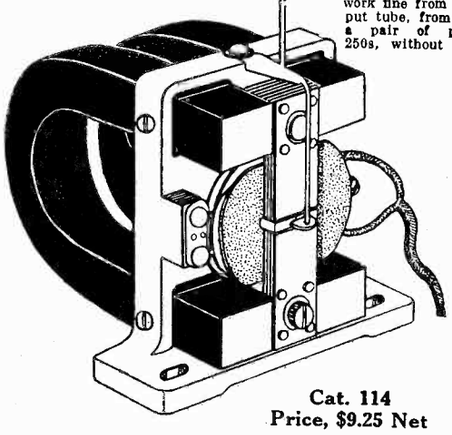
Cat. 111; Price, $11.00 Net

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



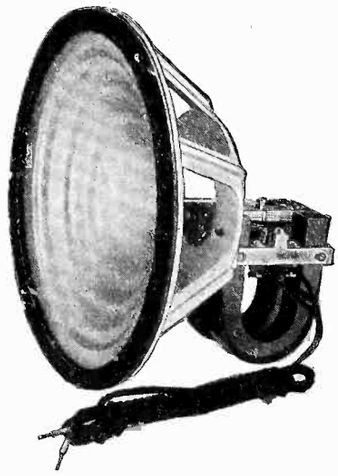
New Model Polo Speaker, with five-ply veneer walnut housing, moulded, decorated metal front piece, and containing Polo Twin Magnet Unit and Textile Cone. All ready to play. Stands 150 volts without filtering. Will work fine from **any** output tube, from 201A to a pair of push-pull 250s, without rattling.

Cat. 113
Price, $13.50 Net



Cat. 114
Price, $9.25 Net

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



Cat. 115; Price, $11.50 Net

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

FILL OUT AND MAIL COUPON

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

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

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

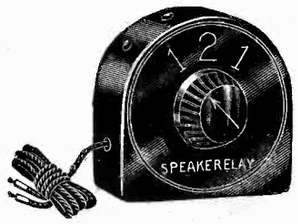
Name .....

Address .....

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

5-DAY MONEY-BACK GUARANTEE

$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 know 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 2¾" 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

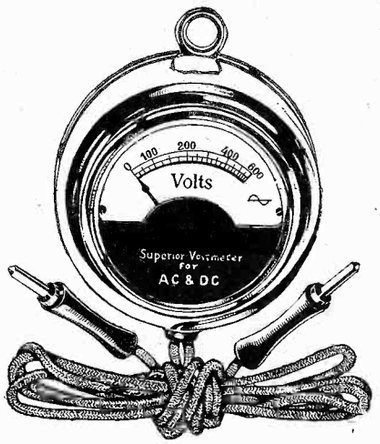
We stock the Speakerelays in quantity and sell them singly or in multiple lots, on an immediate delivery basis. We also have them on display at our office, so, if convenient, come in and see them.

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)

O-600 V. AC and DC
High Resistance Meter

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



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

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

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

Please ship at once one 0-600 volts AC and DC high resistance voltmeter, accurate to 1% plus or minus (Cat No. 600); meter equipped with 8-ft. cord, moulded tip receptacles, tips and hanger.
[Put cross in proper square below.]

☐ $7.00 enclosed

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

Name .....

Address .....

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

PARTS FOR THE AC 4

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

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

Front and Subpanel
for the
AC4

Front panel, drilled for National Drum Dial, volume control switch, and for "dummy".$2.35

Subpanel, 6x19", cut milk ladel shape, to permit room for B eliminator; 4 sockets built into subpanel; other holes drilled.....$3.65

SPECIAL: We carry National Velvet B (type 3580) in stock, also 280 tube. Get our prices on these. Blueprint for AC4.....$1.00

GUARANTY RADIO GOODS CO.
143 W. 45th St., N. Y. City

COILS FOR THE NEW AC 4

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

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

Cash in on This Offer Now!

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

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

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

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

Please use the attached coupon.

SPECIAL TWO-FOR-PRICE-OF-ONE COUPON

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

Enclosed please find $10.00, for which send me RADIO WORLD each week for two years (104 numbers), and also send me, without extra cost, each month for one year each of the following TWO magazines—total, 24 issues—grand total, 128 numbers:

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

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

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

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

Name.....

Street Address.....

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

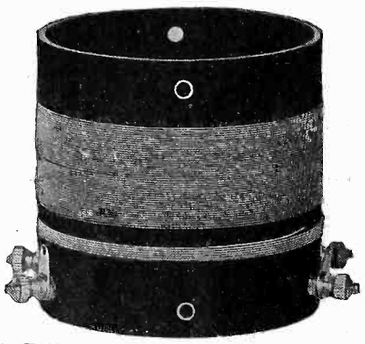
THIS OFFER EXPIRES AT NOON ON APRIL 15TH, 1929

Coils Built for Abundant Results!

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

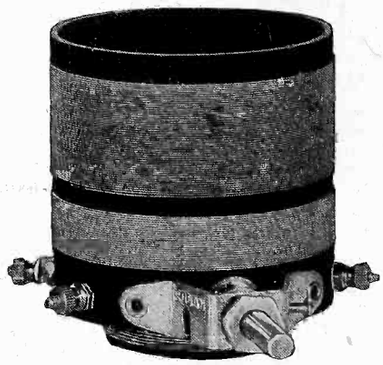
Fascinating Color Adorns the Bakelite Form as Well as the Wire Insulation

The DIAMOND Pair



AC5 . . . . $1.50

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



SGT5 . . . . $2.75

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

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

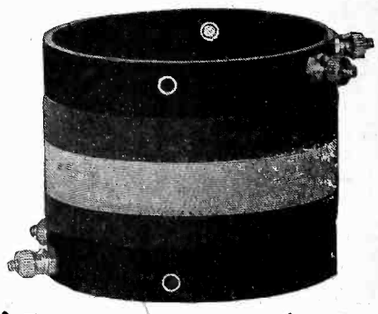
For a highly selective four-tube receiver, as great selectivity as you can command on four tubes with ample speaker volume, the two coils, AC5 and SGT5, make an unbeatable combination. Dials will track nicely. Distance will come in easily and loud. Full sensitivity is readily attained.

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

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

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

And, remember, the dials track nicely!



A5 . . . . . $1.75

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

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

Data on Coils

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

The outside diameter is 2½ inches.

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

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

All tuned windings are center-tapped.

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

HT5 . . . $3.00

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

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 .....

The UNIVERSAL Pair

RF5 . . . . $1.50

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

TP5 . . . . $3.00

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

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