FEB. 6
1932

CLASS "A," "B" and "C" AMPLIFIERS

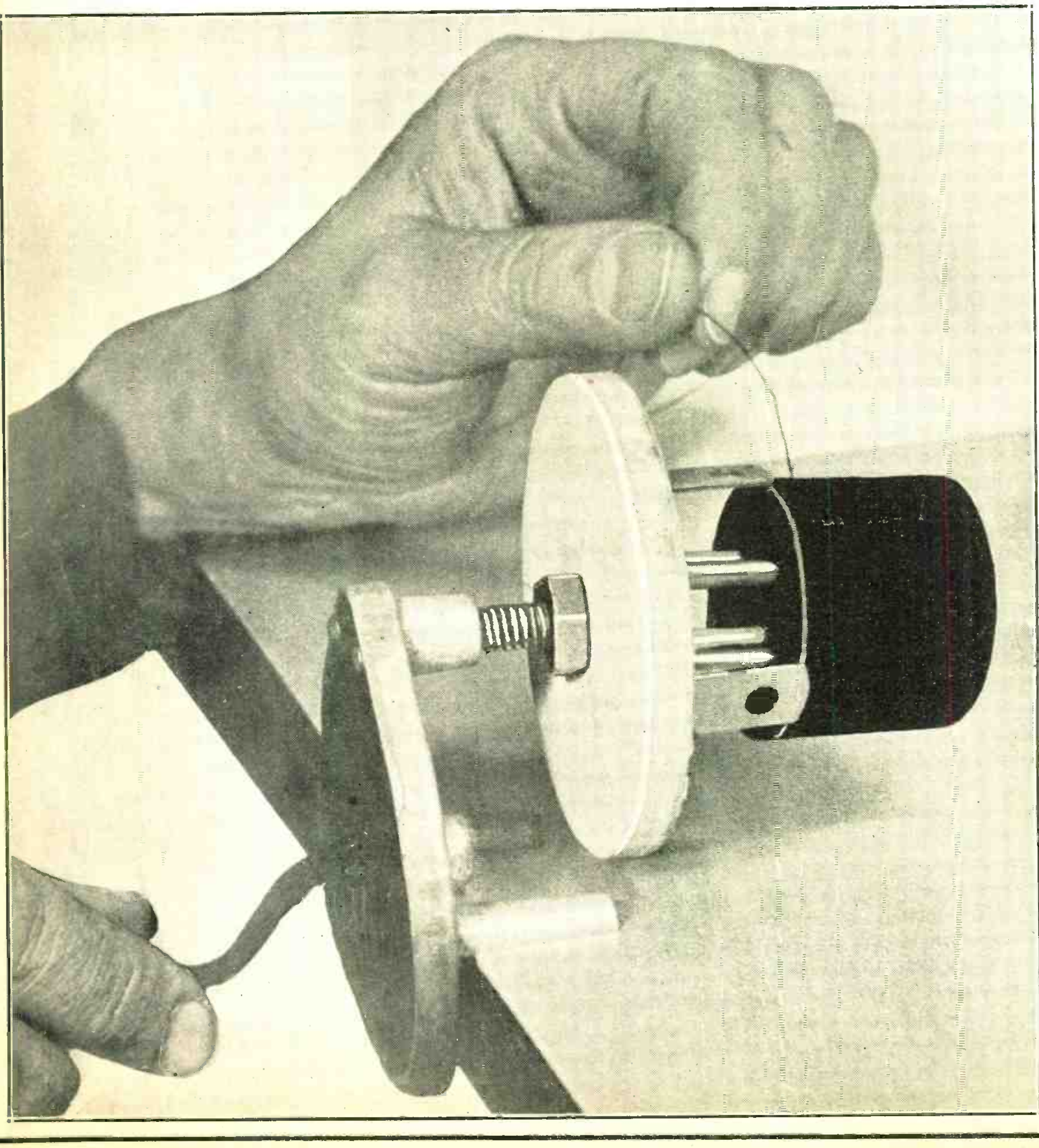
Price
15 Cents
Per Copy

RADIO WORLD
REG. U.S. PAT. OFF.
The First and Only National Radio Weekly
515th Consecutive Issue
TENTH YEAR

Test Oscillator, 1700-550 kc, also 300-150 kc, That Costs Only $5 to Build

Service Sheets on Resistance Measurements

What Best Minds Are Doing on the Ultra Frequencies



EASY WAY TO MAKE A COIL WINDER

An inexpensive knife sharpener may be converted into a coil winder by some simple changes. Page 3.

HEARING DEVICE PARTS

Send for Our Price List Covering

DeForest Parts

To Make the Wonderful

VACUUM TUBE AMPLIFYING EAR AID

•

HEARING DEVICES COMPANY, Inc.
2453 Times Bldg., Times Square, New York

•

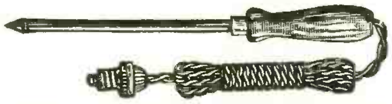
On Request We Will Be Pleased to Send Circulars Describing the New De Forest Audiphone for the Deaf
Simple—Compact—Efficient—Moderate Price

1,000 PAGES! 2,000 DIAGRAMS! IN RIDER'S NEW 7-POUND MANUAL

JOHN F. RIDER'S PERPETUAL TROUBLE SHOOTER'S MANUAL is the book you need if you want to do profitable servicing. This loose leaf volume contains every bit of radio service information of all popular commercial broadcast receivers manufactured since 1920 and includes the latest diagrams. In addition to the wiring diagrams of the receivers the Manual contains chassis layouts, color coding, electrical values, chassis wiring diagrams, and the wiring of units sealed in cans. It also contains a course in Trouble Shooting, the use of set analyzers, data upon Superheterodynes, automatic volume control, etc. Page size is 8½x11, bound, 1,000 pages, index and advertisements on additional pages. Order CAT. RM-31 and remit $4.50. We will then pay postage. Shipping weight 8 pounds. Ten day money back guarantee.

RADIO WORLD
145 WEST 45th ST. NEW YORK CITY

SOLDERING IRON FREE!



Works on 110-120 volts, AC or DC; power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

RADIO WORLD
145 West 45th St. N. Y. City

EBY antenna-ground binding post assembly for all circuits. Ground post automatically grounded on sets using metal chasses. Assemblies, 30c. each. Guaranty Radio Goods Co., 143 West 45th St., New York, N. Y.

SERVICEMEN! Resistor Replacement Manual FREE

with purchase of 10 LYNCH Metallized Resistors, or $1 cash
More Than 200 Circuits

Metallized

LYNCH Resistors 1, 2, 3 WATTS

Write for Manual, new Reduced Price Catalog and RMA Color Code Card.
LYNCH MFG. CO., INC., 1775 WR B'WAY, New York

BLUEPRINTS

627. Five-tube tuned radio frequency, A-C operated; covers 200 to 550 meters (broadcast band), with optional additional coverage from 80 to 204 meters, for police calls, television, airplane, amateurs, etc. Variable mu and pentode tubes. Order BP-627 @ ....25¢

628-B. Six-tube short-wave set, A-C operated; 15 to 200 meters; no plug-in coils. Intermediate frequency, 1,600 kc. Variable mu and pentode tubes. Order BP-628-B @ ....25¢

629. Six-tube auto set, using automotive tubes, with pentode push-pull output. Order BP-629 @................25¢

RADIO WORLD
145 WEST 45TH ST., NEW YORK, N. Y.

—SPECIALS—

Five-lead cable, 2 ft. long, with plug to fit a five-prong (UY) socket. The cable is connected at the factory so that following wires represent the respective prongs of the socket: Blue with white marker—G post of socket; Red—plate of socket; Green—cathode of socket; Yellow—heater adjoining cathode; Black with yellow marker—heater adjoining plate. ....Net 65c

MARCO black bakelite vernier dials. Read 0-100 with a supplementary scale reading 0-10 between figures on large scale. Takes a ¼" shaft...Net 50c

Parts for "A" battery eliminator: Dry rectifier, $2.10; 0-10 ammeter, 75c; 20-volt filament transformer, $2.50. Will handle up to 2 amperes filament current.

GUARANTY RADIO GOODS CO.
143 West 45th St. New York, N. Y.

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR **$7.00** Canadian and Foreign $8.50

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total, 64 issues for $7.00.
RADIO WORLD, 145 West 45th Street, New York, N. Y.

BRACH RELAY—List price $4.50; our price 99c. Guaranty Radio Goods Co., 143 W. 45th St., N. Y. C.

Dynamic Speakers

Rola dynamic speakers, selection of three sizes of cones—output transformer built in matches pentode impedance. 7 inch diameter virtually standard for midget sets. Larger diameters fit cutouts in standard consoles. Extreme sensitivity and faithful tonal response. 7 inch cone, $4.50—10.5 inch cone, $5.85—12 inch cone, $7.25. These are new series F speakers, latest models, brand new.
Rola automobile dynamic, 7 inch cone, field coil fed by 6 volt storage battery; output transformer for 238 pentode, $4.95.

Filament Transformers

20 volt filament transformer, for heating heaters of three of the automotive series tubes for a-c operation, when heaters are in series. 89c—2.5 v. center-tapped secondary transformer, up to five heater tubes. $1.69.

Highest Grade Tubes

Heaters of the 7 Second Type. These tubes are of the finest quality and are guaranteed to be received in perfect condition.

227 @$0.60	245 @$0.66	240 @$1.80	236@$1.65
224 @ .60	250 @ 3.60	112A@ .90	237@ 1.05
235 @ .96	U-99 @ 1.50	222 @ 2.70	238@ 1.65
247 @ .93	V-99 @ 1.68	230 @ .96	239@ 2.05
226 @ .48	120 @ 1.80	231 @ .96	280@ .60
171A@ .54	201A@ .45	232 @ 1.30	281@ 3.00
210 @ 4.20	200A@ 2.40	233 @ 1.65	

Converter Parts

Parts for a short wave converter, a-c operated, supplies all its own power, to work on any set, 15-200 meters, two tuning controls. Costs 1/10c per hour to run. Uses three 237 tubes, one of them as rectifier. Husky transformer. Clear diagram. Can be built in 1½ hours. 16 mfd. filter capacity, 15 henry choke. All parts, less tubes, $7.60.—Three 237 tubes, $3.15 total extra.

Blueprints

627, five tube tuned radio frequency set, a-c operated; vari mu and pentode; can be used also to 80 meters with tapped coils and switch. Blueprint, 25c.

628-B, six tube 15-570 meter receiver. A-c operation, multi mu, pentode output. Blueprint, 25c.

630, a three tube a-c short-wave converter that can be built for $7.60. Rectifier circuit included. Blueprint, 25c.

Other Parts

Three circuit tuner for 0.0005 mfd., tuning condenser, 69c; antenna coils for any capacities, 36c; a-c synchronous motor and phonograph turntable, 80 rev. per min., $4.45.—Set of three shielded standard coils for screen grid sets, using 0.0005 mfd., $2.45; for 0.00035 mfd., $2.45.

Guaranty Radio Goods Co.
143 West 45th Street
New York, N. Y.

Two for the price of One

Get a FREE one-year subscription for any ONE of these magazines:

- ☐ RADIO CALL BOOK MAGAZINE AND TECHNICAL REVIEW (monthly, 12 issues)
- ☐ Q.S.T. (monthly, 12 issues; official amateur organ).
- ☐ POPULAR MECHANICS AND SCIENCE AND INVENTION (combined) (monthly, 12 issues).
- ☐ POPULAR SCIENCE MONTHLY
- ☐ RADIO INDEX (monthly, 12 issues), stations, programs, etc.
- ☐ RADIO (monthly, 12 issues; exclusively trade magazine).
- ☐ MODERN RADIO (monthly).
- ☐ EVERYDAY SCIENCE AND MECHANICS (monthly).
- ☐ RADIO LOG AND LORE. Monthly. Full station lists, cross indexed, etc.
- ☐ AMERICAN BOY—YOUTH'S COMPANION (monthly, 12 issues; popular magazine).
- ☐ BOYS' LIFE (monthly, 12 issues; popular magazine).

Select any one of these magazines and get it FREE for an entire year by sending in a year's subscription for RADIO WORLD at the regular price, $6.00. Cash in now on this opportunity to get RADIO WORLD WEEKLY, 52 weeks at the standard price for such subscription, plus a full year's subscription for any ONE of the other enumerated magazines FREE! Put a cross in the square next to the magazine of your choice, in the above list, fill out the coupon below, and mail $6 check, money order or stamps to RADIO WORLD, 145 West 45th Street, New York, N. Y. (Add $2.00, making $8.00 in all, for extra foreign or Canadian postage for both publications).

Your Name..

Your Street Address ....

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

DOUBLE VALUE!

☐ If renewing an existing or expiring subscription for RADIO WORLD, please put a cross in square at beginning of this sentence.
☐ If renewing an existing or expiring subscription for other magazine, please put a cross in square at the beginning of this sentence.

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

NEW DRAKE'S ENCYCLOPEDIA
1,680 Alphabetical Headings from A-battery to Zero Beat; 1,025 Illustrations, 920 Pages, 240 Combinations for Receiver Layouts. Price, $6.00. Radio World, 145 W. 45th St., N Y C

SUBSCRIBE NOW!

RADIO WORLD, 145 West 45th St., New York City. Enclosed please find my remittance for subscription for RADIO WORLD, one copy each week for specified period.

- ☐ $10.00 for two years, 104 issues.
- ☐ $6 for one year, 52 issues.
- ☐ $3 for six months, 26 issues.
- ☐ $1.50 for three months, 13 issues.

$1.00 extra per year for foreign postage.

☐ This is a renewal of an existing mail subscription (Check off if true)

Your name ....

Address ....

City ....

UNINTERRUPTED READER INTEREST
EVERY WEEK — EVERY YEAR
RADIO WORLD

Vol. XX No. 21 Whole No. 515
February 6th, 1932
[Entered as second-class matter, March, 1922, at the Post Office at New York, N. Y., under act of March, 1879]
15c per Copy. $6 per Year

TENTH YEAR
Technical Accuracy Second to None
Latest Circuits and News

A weekly Paper Published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Telephone, BRyant 9-0558 and 9-0559

RADIO WORLD, owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.; Roland Burke Hennessy, editor; Herman Bernard, managing editor; J. E. Anderson, technical editor; J. Murray Barron, Advertising Manager.

A Simple Coil Winder

New Use for a Cheap Knife Sharpener

By Herbert Erwin

A COIL-WINDING machine is easily made from a rotary knife sharpener. Such a sharpener can be purchased in many chain stores and costs only a few cents. On a circular piece of wood, about 2⅞ inch diameter, put three right-angle brackets. These brackets are standard and may be obtained in almost any radio store, with a mounting hole on each angle. However, if one of the holes is made U-shaped, by using cutters to extend the circular opening, and if machine screws and nuts are used for fastening the brackets at this point to the circular wheel, then the brackets may be shifted in position. For winding on tube bases the brackets would be pushed toward the center of the wheel, for winding on larger diameters the brackets would be moved in the opposite direction. Of course you may use the particular form used as your guide.

The brackets should be long enough to reach the form even if the form has socket pins, as it would have if plug-in coils are to be wound. Socket pins usually extend almost 9/16 inch from the bottom of the base, so if the brackets are ¾ inch each angle side they will be just about right, as larger bracket extension on the form would cause loss of winding space.

The front cover illustration shows how the winter is attached to a table by means of a clamp which is an integral part of the sharpener.

Gear Is Inside Device

The illustration herewith, Fig. 1, shows the two main pieces, the frame at left and the wheel at right. The two feet on the frame go on top of the table, the screw underneath is tightened and the frame is thus clamped to the table. At the other end of the frame is shown a threaded socket, with screw and two nuts which are used for tightening the wheel to the revolving mechanism.

The coil-winder has a handle for driving, and inside the frame a larger gear operates a smaller one, so that the rotary motion is thus communicated, at an increased ratio, to the driven wheel. Greater speed can easily be accomplished than ever will be needed in coil-winding.

The diameters that can be accommodated are depended on the length of the slot cut in the brackets, but normally a difference of about ¾ inch may be enjoyed. However, for greater difference all you need do is get larger brackets, cut down to size the angles that extend upward, so they won't extend too far on the coil form, and use the cutters to provide the larger U-shaped openings for the horizontal portion. The form always will be held tight enough in the winder by the friction contact of the brackets.

In winding coils either the intended inductance is usually known, and the number of turns computed, or the actual number of turns is known. However, for the benefit of those unfamiliar with the number of turns for specific uses, some general coil data will be given.

Turns for Some Diameters

If the diameter is 1 inch, then for 0.00035 mfd. tuning, to cover the broadcast band, assuming a copper or aluminum shield will be used, wind 127 turns of No. 32 wire, or any size wire thereabouts. To begin tuning at the high frequency end of the broadcast band, to bring in the first short wave band, put on 42 turns. It can be seen that the ratio of turns is approximately 3-to-1 for 0.00035 mfd. This also suggests

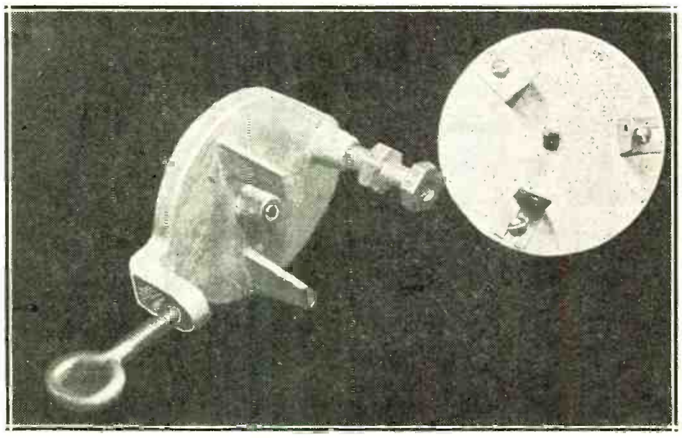


FIG. 1
The frame of the sharpener is shown at left, while at right is the disc with three brackets on it for holding the coil form in place.

that the number of turns is approximately proportional to the frequency.

For 1⅛ inch diameter, No. 32 enamel wire or thereabouts, wind 120 turns for the broadcast band, 40 turns to begin at the end of the broadcast band, these data also for 0.00035 mfd.

To cover succeeding bands with 0.00035 mfd. any diameter, divide the number of turns for the first short-wave band by 2.5 each time. Thus the turns would be, for 1 inch diameter, 17 for the next coil and 7 for the last coil, and the total frequency span would be, with three coils, 545 to 200 meters, 200 to 80 meters, 80 to almost 30 meters. To go to lower waves use 3 turns for the last coil, reaching 15 meters.

In the same way the data may be worked out for the 1⅛ inch diameter, while for larger diameters fewer turns would be necessary.

If for short waves smaller capacity is to be used, the ratio would be smaller. For instance, for 0.002 mfd., on 1 inch diameter, start with 50 turns for 1,500 kc, and use the factor 2.3 throughout, for 0.0001 mfd. start with 62 turns and use the factor 2.1 throughout. There will be some overlap according to all of these directions, but overlap is necessary. In fact, even the coil to reach 1,500 kc to begin tuning in short waves will go to lower frequencies actually.

The primary data have not been given, but the primaries may consist of one quarter the number of turns on the secondaries, wound beside the secondaries, and separated therefrom by 1.8 inch.

Any tickler windings should be similarly tightly coupled, and should consist of one-quarter the number of grid turns for the broadcast band, one-half the number of grid turns for the first short-wave band, two-thirds the number of grid turns for the second short-wave band, and as many plate turns as grid turns for the rest of the short-wave coverage.

[Other Illustration on Front Cover]

Class A, B and C Amplifiers Determine

By Franklin

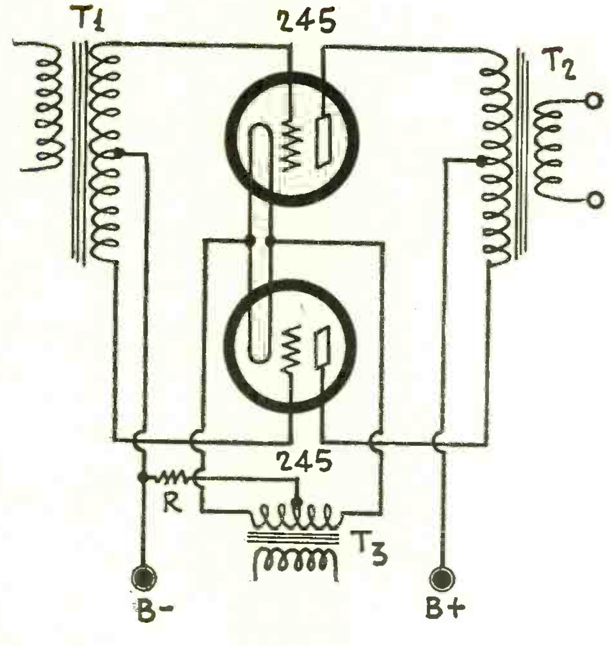


FIG. 1
A push-pull amplifier utilizing two 245 tubes. This is a typical Class A amplifier which is characterized by high quality and low efficiency.

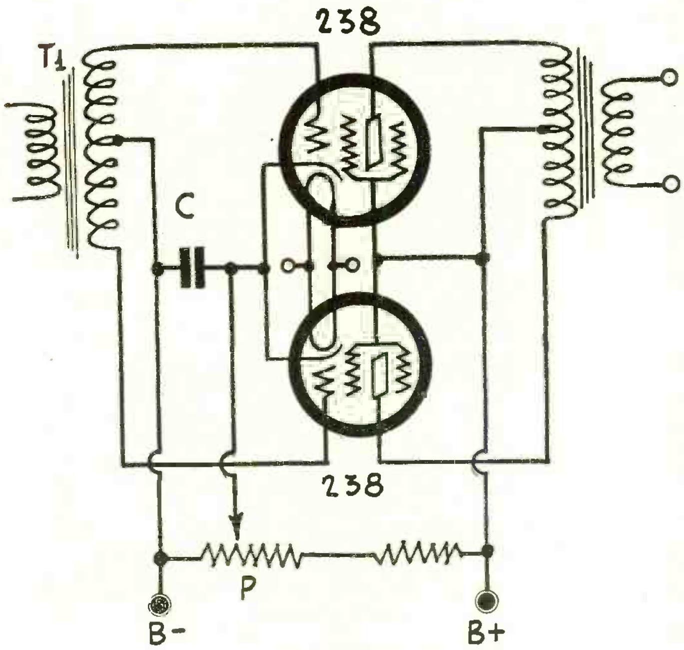


FIG. 3
In this Class B amplifier two 238 tubes are used to obtain a higher sensitivity coupled with the advantages of high efficiency and high output capability.

THREE different classes of service in the application of amplifier tubes are recognized, and amplifiers based on these types are referred to as Classes A, B, and C amplifiers. The feature which distinguishes one class from another is the operating bias on the grid or grids. If we deal strictly with amplifiers, the circuit arrangements of the three classes are the same since the value of a bias voltage cannot be shown diagrammatically.

A Class A amplifier is one of a type with which we are most familiar in radio receivers. The tube is operated so that the relation between input and output is virtually linear, that is, so that there is a negligible amount of wave form distortion. Where high quality is paramount this is the type of amplifier that is employed. However, a Class A amplifier is relatively inefficient, the high quality being gained at a sacrifice of power.

An amplifier, of course, may be either push-pull or single sided. In Fig. 1 is shown a push-pull Class A amplifier utilizing two 245 type power tubes. The bias is provided by means of resistance R in the common lead to the cathode or filament. When the tubes are operated in a Class A amplifier there is always plate current in both tubes when no signal voltage is impressed, and as long as the tubes are not overloaded there is plate current in both tubes all the time, although the current is constant in neither tube.

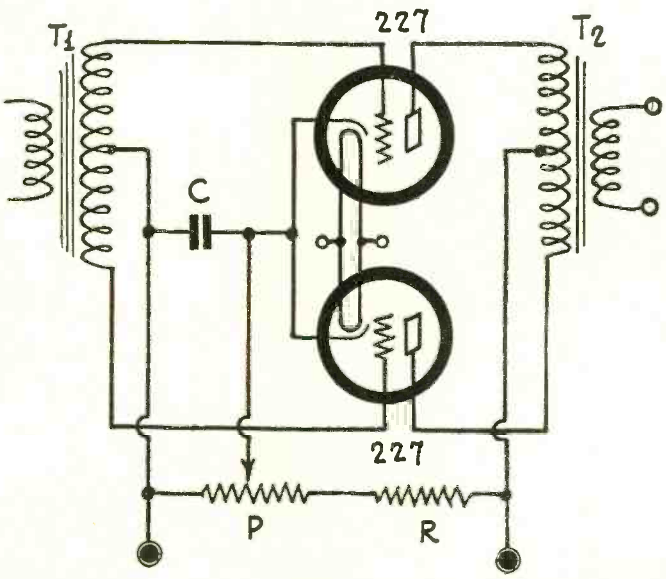


FIG. 2
In this circuit two 227 tubes are used in a Class B amplifier, which is characterized by high bias, high output capability, high efficiency, but low sensitivity.

How Bias Is Obtained

Since there is a considerable current flowing at the operating bias it is practical to obtain the bias by means of a resistance connected in the manner shown in Fig. 1. For this particular tube, the current in each tube, with a total applied voltage of 300 volts between B minus and B plus, is 34 milliamperes. The two tubes, therefore, will draw 68 milliamperes. The drop in the resistance R, or the bias, should be 50 volts. Hence the value of the bias resistance should be 50/0.068, 735 ohms. However, this value is not very critical, so that if some other value is specified it should not be assumed that there is an error. Any value between 600 and 1,000 ohms may be specified for a push-pull stage of two 245 tubes. In case of doubt it is usually better to select the higher of two values provided this does not exceed 1,000 ohms. The reason why the higher value is recommended will be evident when we discuss Class B amplifiers.

The by-pass resistance across R in Fig. 1 is not essential because the signal voltage drop across R is negligible for a balanced circuit. However, no harm will result if a condenser is put across R in this circuit.

Class B Amplifier

The circuit in Fig. 1 can be converted into a Class B amplifier by increasing the bias to about twice the value in the Class A amplifier. The main object of a Class B amplifier is to get more undistorted power out of the tubes. Since the 245 tube push-pull amplifier gives more sound power than is necessary for home use, there is no good reason why this amplifier should be converted. It would be better to use smaller tubes in conjunction with the Class B amplifier. In Fig. 2 is shown

Explained; Bias on Power Tubes
s Grouping

Ellis

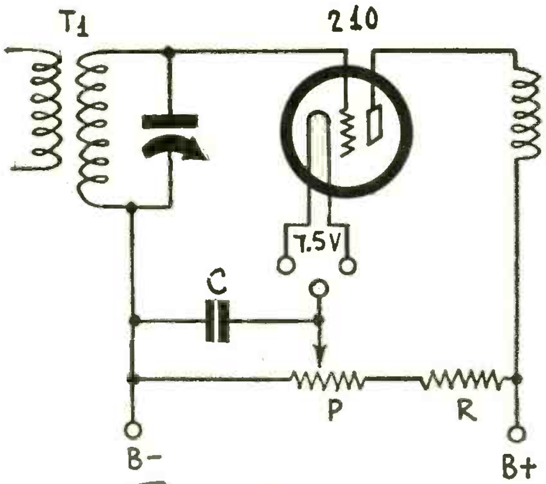


FIG. 4
In this circuit a 210 power amplifier is used in a Class C circuit. This type of circuit is characterized by extremely high operating bias and corresponding high efficiency.

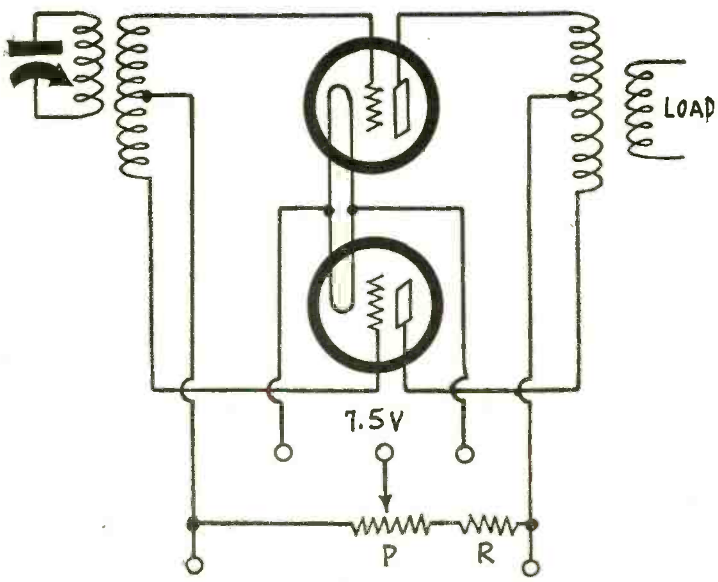


FIG. 5
In this circuit two 210 power tubes are used in a Class C amplifier. It is not a push-pull circuit. High wave form distortion is a feature, a fact taken advantage of in making frequency doublers.

a Class B amplifier with two 227 tubes, which will give nearly as much sound output as the 245 Class A amplifier.

The Class B amplifier is not push-pull, although the circuit appears to be. It is two equal amplifiers side by side and so connected to the signal voltage source that the tubes take turns handling the load. One tube handles the positive side of the signal wave and the other the negative side.

When this amplifier is properly adjusted the plate current in both tubes is very low at the operating bias. It is not practical to use a bias resistance to obtain the high bias, for if one were used, it would have to have a very high value. Suppose the supply voltage is 275 volts, which is recommended when the tube is used as a power detector. The bias should be 30 volts and the plate current in each tube will be about 0.2 milliampere, or the total current will be 0.4 milliampere. Therefore the required bias resistance would be 75,000 ohms. This is a very high value for an amplifier and a better arrangement is that shown in Fig. 2. Here the plate current of the tubes is not depended on only to establish the bias voltage drop, but the greater part of the current is obtained from R and P.

We might adjust the sum of the resistances of R and P so that the current is approximately 10 milliamperes. Since the voltage drop across these two resistances is supposed to be 275 volts, the sum of the resistances should be 27,500 ohms. The current through the bias portion of P will be about 10.4 milliamperes. Since we want a drop of 30 volts, we need a resistance of about 3,000 ohms to the left of the slider. Therefore we might make R equal to 20,000 ohms and P 7,500 ohms. But it is all right to make P equal to 5,000 ohms for this will allow us to make the proper adjustment.

Wattages Required

A word should be said about wattages of these resistors. For the sake of safety let us assume that the current through R is 15 milliamperes. On this basis the wattage of R should be 4.5 watts. Hence if we select a 5 watt resistance we are safe in so far as heating is concerned. We may assume the same current to be flowing through P. Since the resistance is 5,000 ohms, the wattage should be 1.125 watts. If we select one that will handle two watts we are safe.

When the bias on the two 227 tubes is adjusted so that either tube alone is virtually a rectifier or biased detector, only one tube at a time is delivering power to the load and only one half the circuit is active at a time. Suppose we consider that half cycle of the signal which makes the upper grid more negative. The plate current in that tube is then completely shut off and no power is delivered to the secondary of the output transformer by way of the upper half of the primary. But as grid of the upper tube goes more negative, that of the lower tube goes less negative, and current flows in the plate circuit of that tube. Hence power is delivered to the secondary of the output transformer by way of the lower half of the output transformer primary. In as much as the tube is essentially a linear power detector there is comparatively little distortion in the half wave that is amplified. When the signal voltage reverses, the situation is reversed, and the upper tube delivers power to the output transformer, and this, too, without any appreciable distortion. Therefore both halves of the signal wave are amplified.

More Input Required

It may be assumed that the Class B arrangement is a means of getting greater sensitivity out of a receiver. This is not the case. In fact, it is a way of getting less sensitivity. The only thing that is increased is the power handling capacity of the tubes without an increase in distortion. The Class B connection should not be used unless there is so much amplification ahead of the stage that we can sacrifice one half of it in the interest of double volume handling capacity. If the bias on the tubes is doubled, as compared with the bias on a Class A amplifier, it is necessary to double the signal voltage on each tube in order to load the circuit to the practical limit. The permissible signal swing is equal to the bias on either tube.

Since the Class B amplifier is not push-pull in the strict sense, there is always a signal voltage across the bias resistance. This would cause a reduction in the amplification if we did not connect a large by-pass condenser across it. For this reason, in Fig. 2 a condenser C is used. The larger the capacity of this condenser the better. Certainly, it should not be less than one microfarad.

Using the Pentode

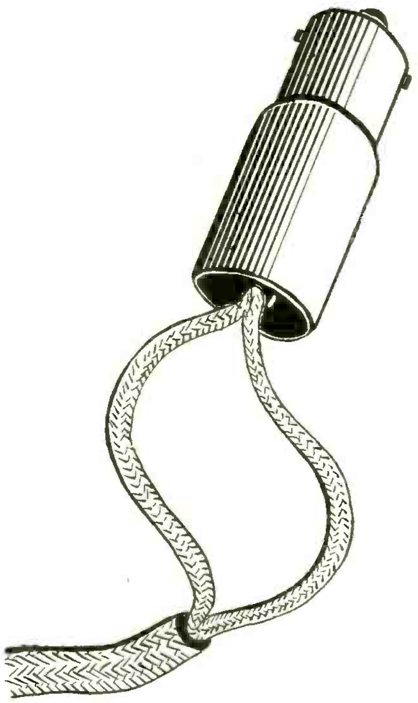
The 238 pentode is a power tube that cannot handle a great deal of power in the ordinary connection, but it has a high voltage gain. Hence this tube offers a good opportunity for Class B service. In Fig. 3 is an output stage utilizing these tubes in a Class B amplifier. The circuit is essentially the same as that in Fig. 2 except that the screen connections have been made. In a Class A amplifier of this type the bias should be 13.5 volts, when the plate voltage is 135 volts. If we make the bias 25 volts we shall have approximately the correct adjustment for Class B service. The total voltage between B minus and B plus should be 160 volts. Again we may assume that the total current through R and P is 10 milliamperes, which is so

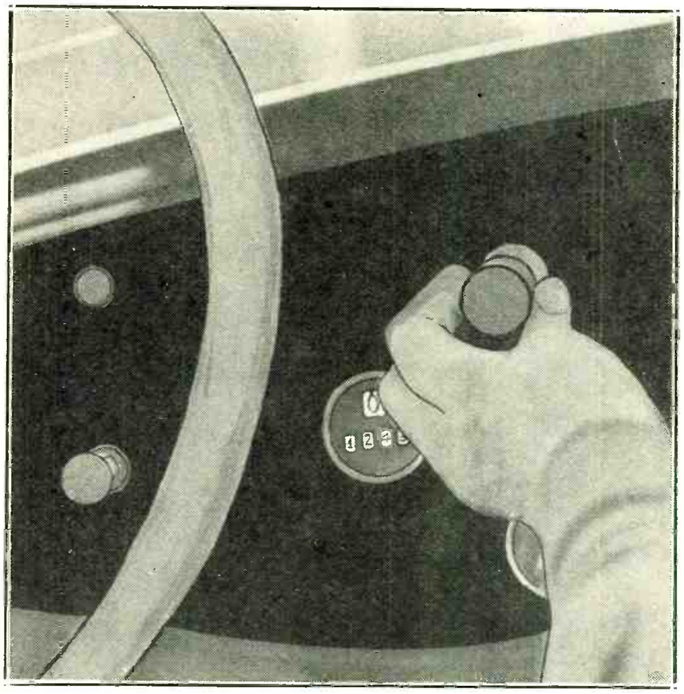
(*Continued on page* 12)

Ideas for Auto Sets

"A" Battery Voltage Plug—Set Location

By K. T. Vera





The plug and cable are shown at left, while at right is a view suggesting use in a car.

IN testing auto sets it is sometimes desirable to have the A battery voltage accessible. This can be accomplished by using a bayonet plug, that fits into the lamp socket on the instrument board, so that instead of the lamp the plug is inserted. Then the leads from the plug will render the battery voltage accessible. In a pinch the base of an old lamp can be used, and collar glued to it, as illustrated. The idea is furnished by one who has used it for several months with satisfaction.

Study of the auto set problem has revealed several interesting facts. One of them is that the aerial should not be loop-shaped, either by accident or design, for then the directional effect is pronounced, and the volume changes considerably as one changes the direction of driving.

Another is that the A battery voltage access through a cable, as in remote control installations, requires that the cable be of very low resistance. An auto set that worked well in the laboratory turned out to be a flop in the car and the reason was not apparent. Study revealed that in the laboratory the cable was not used, in the car it was. The difference in voltage on the heaters was 1 volt, enough of course to make a great difference in performance.

Use Low Resistance Cable

Another point is that the volume control had better govern the cathode of the tubes and not intermingle with the aerial connection, for a grounded shield is on the cable leading from the remote control, and there is too much loss to ground under these conditions.

Where to put the set in a car is always discussed. Some favor removing the rear-observation mirror, thus to make room for the set up front, directly before the driver, but not interfering with his vision. Then the observation mirror is put on the set instead. Also no remote control is necessary. This location limits the size of the set considerably, and then there is the speaker to consider. The B batteries can be put under the floorboard somewhere.

Some consider the bulkhead or fireboard of the car as a suitable place for the speaker, stating that a hole could be cut out, and there would be a decent sized baffle. It strikes me that there would be too much heat, as the speaker would be in the engine compartment. Also, putting the set in the engine compartment is another idea, but again there is the heat problem, especially when there are wax-impregnated condensers in a set.

Short Waves Favored

Aside from molestation of the instrument board, which all seek to avoid, it seems to me as good a place as any, under the circumstances, is just behind the bulkhead, under the instrument board, in the foreground of the seat next to the driver's. The set and speaker may be placed there.

There is a growing demand for sets in cars, and persons are beginning to ask about short waves as well as broadcast band coverage in car sets. There is an excellent opportunity for enterprising manufacturers to turn out auto sets that tune in the broadcast band and some short waves as well, at least the police band, and the market for auto sets is bound to increase greatly as soon as some one takes the initiative in this direction, he will find many following him.

How to Make Band Pass Filter

Those desiring to constitute an intermediate amplifier as a band pass filter, with a reduction in sensitivity but improvement in quality, may do so along lines previously explained in this magazine. This method consists of disconnecting the grid connection of the condensers across the secondaries of the intermediate coils and peaking the amplifier on the basis of the plate tuning only. Then when greatest response is obtained the plate connections of the primary condensers are removed, the secondary condensers re-established and the amplifier peaked on the new basis.

Now when the condenser grid connections are resoldered the amplification will be lower but there will be a band passage with fairly sharp cutoff outside the band.

This method may be resorted to by those who desire to use a television feature, or even for general utility. Since there is little trouble concerned, the builder may institute the band pass filter, and if he prefers the other method can establish it, simply by resetting the condensers, without any wiring disconnections or connections.

Design of a Super

All-Wave Coverage and T-R-F Included

MANY experiments with superheterodynes have confirmed the desirability of having some tuning ahead of the modulator. Even if the intermediate frequency is 400 kc there is great danger of squealing, heard throughout the dial, so if the intermediate frequency is lower the same trouble arises, only on a larger scale.

One tuned stage ahead of the modulator introduces a very satisfactory remedy, and since the purpose is mostly increased selectivity, the coupling between the t-r-f tube and the modulator need not be tight.

An untuned stage ahead of the modulator does little good, thus confirming previous results, or lack of results, with such systems.

So a three-gang condenser is used, the oscillator section padded for the broadcast band. If short waves are to be received, also, then the secondaries of the three coils may be tapped for this purpose, and a padding condenser introduced in the modulator and t-r-f stages so that the capacities of the three sections will be the same.

Manual Trimmer's Assistance

The intermediate frequency here is 175 kc. When short waves are being received, the frequencies involved are high, and the intermediate frequency is a smaller percentage of the original carrier and the oscillator frequencies. That is, the absolute difference is always the same between these two, for reception, but the percentage decreases as the frequency increases.

The t-r-f stage that was important for selectivity improvement on the broadcast band is not of so much practical aid in this direction for short waves, since now we are not dealing with stations that are 10 kc apart, and the practical selectivity of the first stage is less, which may be so without impairment of reception, provided that a small manual trimmer is put across the modulator.

Since the capacities otherwise would be equal, the trimmer is used for establishing the frequency difference between the modulator and the oscillator. Since the modulator frequency should be lower than the oscillator frequency, by the amount of the intermediate frequency, a small trimmer will take up this difference nicely. Then, also, the taps may be the same for the three coils, that is, the number of turns from the grounded end.

Coil Switching Method

The receiver is intended primarily for finest performance on the broadcast band, with short waves as an additional service. While it was intended to use plug-in coils, as was explained in an article published last week, issue of January 30th, many have written in asking for a switching arrangement. Thus one is shown. But the set can be built either way, following substantially the same diagram.

The antenna coupler requires five different connections, and so does the interstage coupler, while the oscillator requires six. However, the sixth may be the control grid, and if the oscillator plug-in coils are of the shielded type, with control grid lead and clip attached to each of four different coils used, then five base connections serve the other purposes. Hence UY plug-in forms can be used, if shield is attached.

The coil switching method consists of moving the tuning condensed from extreme of coil, which goes to grid, to points farther removed from grid. The part of the secondary outside the tuned circuit thus acts as a booster. This is better than the shorting out unused turns or leaving them dead-ended, for the entire coil secondary remains in circuit, the turning being moved from the total secondary to various percentages of the total, but the rest of the winding remaining as a continuation to grid for step-up ratio.

Effect of Series Condensers

The switch if the three tier type, with shaft insulated, and besides has two shorting contacts, to short out the "padding" condensers of modulator and r-f stage for short waves. Really, the so-called "padding" condensers are not used for padding at all in these two stages, but for depadding, that is, for equalizing the capacities used for tuning. It would be practical, of course, and simpler, just to short out the padding condenser of the oscillator, but then all the capacities would go to full maximum for short waves, and moreover the maximum oscillator condenser capacity would be higher for short waves than for broadcasts, but all capacities would be too high for convenient tuning. Suppose the condensers used are 0.0005 mfd. Then, as the padding condenser is 0.00076 mfd., the resultant capacity is 0.000327 mfd., while if the capacities are 0.00035 mfd., the reduction is to 0.00024 mfd.

The manual trimmer displaces an intended tone control. A phonograph jack is used for accomplishing all switching in connection with the pickup, including cut-off of the r-f input. A second detector plate bypass condenser is added, and the television-speaker switch is so arranged that a load of 0.01 meg. is on the screen only when the neon lamp is in circuit, otherwise the full applied voltage is on the screen. The neon lamp connection is included so that television signals, which the set will bring in, may be scanned by those who so desire, although the selectivity will be higher than that obtaining in strictly television receivers.

Last week's article on the step-by-step design of a super dealt with troubles encountered and intended solutions. The receiver is being rebuilt according to Fig. 1 of this week's issue, and a report will be rendered on results obtained.—HERMAN BERNARD.

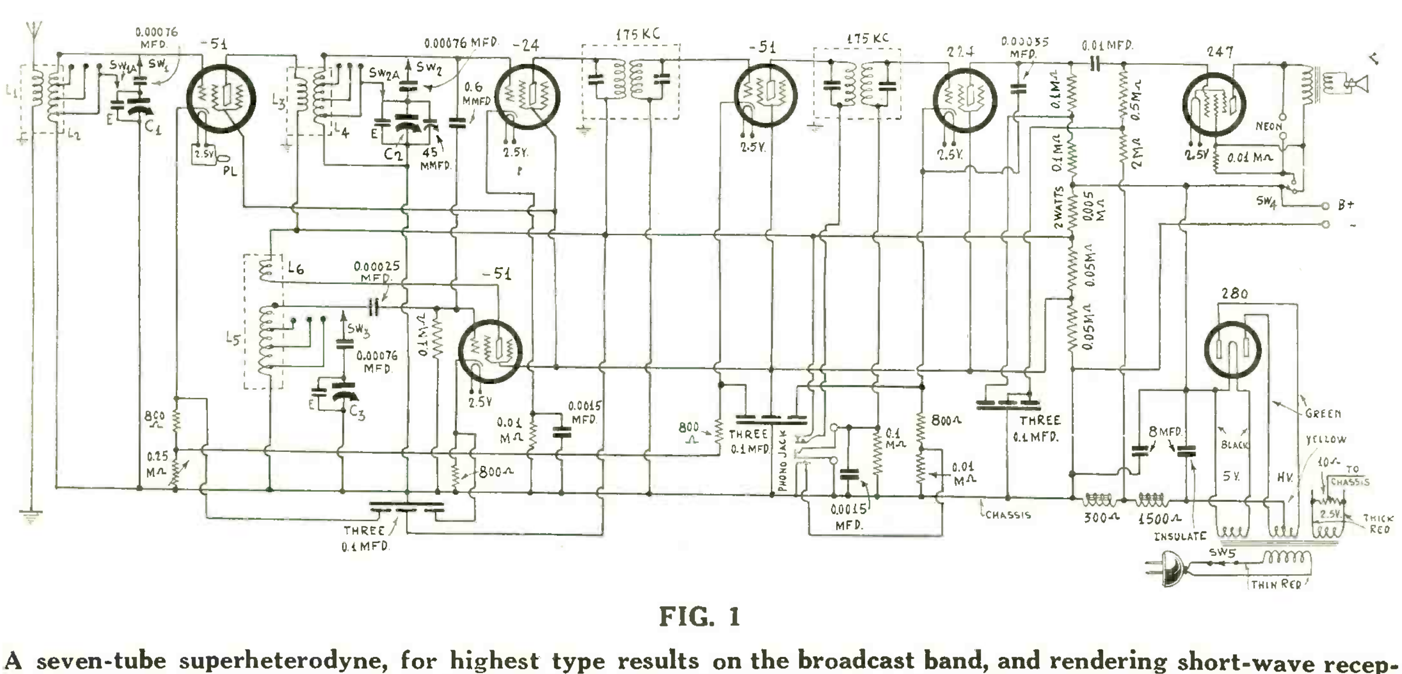


FIG. 1

A seven-tube superheterodyne, for highest type results on the broadcast band, and rendering short-wave reception also. The B plus connection at right is for voltaging any external apparatus to be tested, such as a short-wave converter. Television terminals are included.

A $5 Test Oscillator Used for R-F Lining Up

By Herman

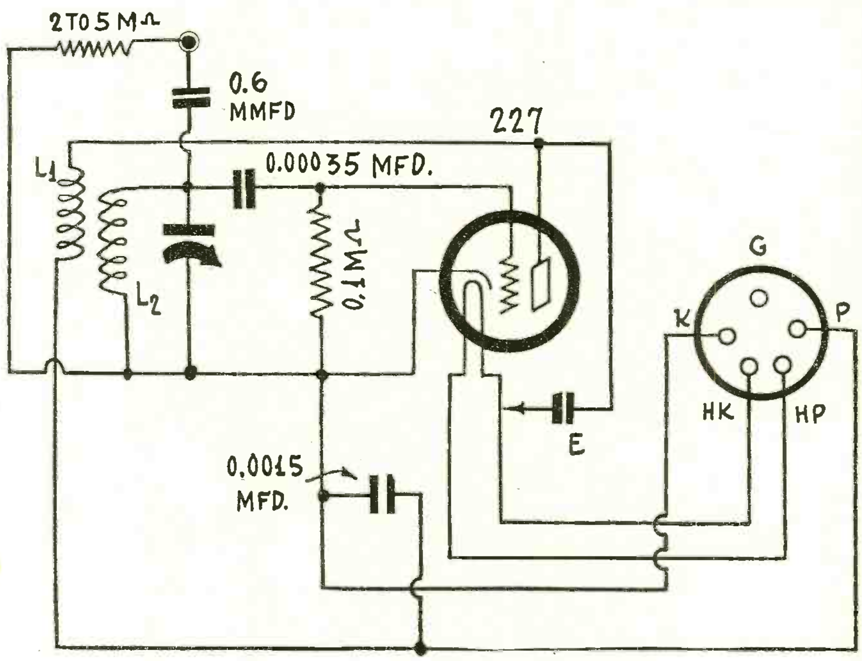


FIG. 1

A test oscillator of the plug-in adapter type may be built acocrding to this diagram, and the cost would not exceed $5. Yet the tester will prove exceedingly valuable, since it permits lining up t-r-f sets and supers, including intermediate channel and padding of oscillator.

TWO types of oscillators are illustrated herewith, Fig. 1, a simple one that gets its power from the socket of a set, and the other, Fig. 2, self-powered and covering a greater frequency range. The simpler one uses two plug-in coils, so that superheterodynes may be tested for service work and home construction, ranges about 150 to 300 kc with one coil and 1,700 to 550 kc for the other. The larger test oscillator covers these frequencies as well as short waves to about 15 meters. Both types are for modulated-unmodulated service. The 60-cycle a-c is used for modulation.

In the smaller model this modulation is introduced in a moderately satisfactory manner by switching one side of the heater to a condenser (E) of 0.0001 mfd. that connects to plate. In Fig. 2 the heater and cathode are switched.

Very Inexpensive Outfit

Let us analyze first Fig. 1, since it serves a most important purpose and will cost not more than $5, including everything, even cabinet (not the 227 tube).

The voltage derivation from the set applies to any type of tube, no matter how operated. The device under discussion has a UY (five-prong) socket and a UY plug, and, as it stands, requires that a UY tube be used (227, 237). If the set into which the cabled plug is connected has 2.5 volt heater type tubes, the 227 is used as the oscillator in the tester, but in any other case the tube in the tester has to be other than a 227, i. e., one of the series of the tube removed from the set. Since the plug is UY this would require a UX adapter for the set socket, as well as a UX adapter for the tester socket, although one tube, the 237, needs no adapters, but only that the 237 be used as an oscillator. The point is that the heater or filament voltage, whatever or whichever it is, is picked up, and as generally the set has 2.5 volt heaters, the tester may be built on that basis. For extension of service, indeed universality, the two socket adapters and tubes to meet the filament or heater voltages where they differ from 2.5 volts a-c are required. The tube normally can be obtained from the set.

Bias and Plate Voltages

It is clear, therefore, that the heater or filament voltage is picked up directly. Bear in mind that a tube must be removed from a set socket to enable insertion of the plug, and that that socket is dead for any other purpose. The point will come up again later.

Now, besides filament or heater voltage, we need a grid voltage and a plate voltage. The grid voltage for the oscillator may be zero, or, if the leak-condenser hookup is used, there will be a slight negative bias, due to the flow of grid current. Hence connect grid return to cathode. When a socket adapter is used, since the "killed" connection is that of cathode, which the adapter joins to negative filament, the return for battery tubes would be to negative filament, which is a satisfactory solution.

Now, for the plate voltage. This is present in the set socket, but there would be an r-f load in the plate circuit of the oscillator, usually a coil, the primary of the r-f transformer in the set. A capacity, if large enough, connected from plate to cathode, will constitute the coil-condenser combination, a sort of r-f filter, so that in effect the r-f load is removed from the oscillator, and the plate voltage as thus derived is applicable without menace to oscillation. Since a B voltage high enough to insure oscillation is desired, it can be obtained every time by plugging into an r-f socket of a t-r-f set or superheterodyne, or in some instances, as will be explained, the oscillator or an intermediate socket of the super is itself used.

Now we have all three requisite voltages: plate, bias and filament or cathode.

The question may arise, what about plugging into a socket that had a screen grid tube in? Will the oscillator work then? What about the screen, which on the 227 would be instead the control grid connection? The answer will be found in the diagram, Fig. 1. The G post of the set socket *is not picked up*, nor in the case of a screen grid tube in the set socket is the control grid or clip connection picked up.

Oscillation and Coils

The 227 is the oscillator tube in the tester in every instance of plugging into an a-c set using 2.5 volt heaters, and only the cathode, heater and plate voltages are picked up. What kind of a 2.5 volt a-c heater tube was in the set socket into which the plug goes does not matter.

Now, as for oscillation. We know that we can tune the grid circuit. We also know that we can put another winding close to the grid winding and connect it in the plate circuit in the proper direction and obtain oscillation all over the frequency span of any condenser we shall use. Therefore as we desire to cover two bands that have diverse requirements we shall wind two coils. One will be for the broadcast band and a little more, the other will be for the intermediate frequency band. A coil will easily cover the broadcast band if 115 turns of No. 28 wire are put on a tube base diameter, which is about 1 5/16 inches in most instances. The problem is to cover some more. The tuning condenser is 0.00035 mfd.

Since the popular intermediate frequency of the day is 175 kc, the oscillator in superheterodynes being padded to tune 175 kc higher than the modulator, we desire to tune the oscillator in the tester from (1,500 kc + 175 kc) to (550 kc + 175 kc), or from 1,675 kc to 725 kc.

We could do that with fewer turns, but we also desire to tune the test oscillator to the lowest broadcast frequency, 550 kc, hence desire to cover from 550 to 1,675 kc. With a 0.00035 mfd. of low minimum this can be done, since the frequency ratio is 3.05-to-1, and 0.00035 mfd. will yield that in the broadcast

for Superheterodynes; and for Oscillator Padding

Bernard

band. What we have to guard against, however, is a large minimum capacity in the oscillator circuit itself.

Leak-Condenser Corrective

This large minimum is frequently present and is due to the flow of grid current. The grid to cathode resistance of the tube may be low enough to constitute a path for tens of microamperes, and the resistance becomes a ratable factor in determining the frequency of the tuned circuit. Since the frequency is lowered, the effect of grid current flow under such circumstances is that of a deterringly high minimum capacity, and not only a high minimum but a changing one, this adversely affecting the efforts to establish frequency stability in the oscillator.

For that reason a corrective is applied, in the form of the leak and condenser, not only for rectification, which of course is present and will be needed, but so that the inverse effect of the voltage drop across the resistor will tend to stabilize the bias voltage, maintaining it slightly negative, and get rid of the high minimum. In some measured instances the minimum was as high as 0.0001 mfd. But with the leak and condenser the minimum was reduced to working limits, and permitted the wide frequency coverage desired.

The plate winding may be put on top of the grid winding, as there may be hardly any room for any other method on the usual tube base forms, because No. 28 enamel winds 74.1 turns per inch. The turns then may consist of 20 of any fine wire. Preferably put insulating fabric between the two windings. If the winding is to be beside the other, leave 1/8 inch and put on 30 turns of any fine wire.

The coil system for the intermediate frequencies consists of an 800-turn honeycomb for the grid circuit, and a 300-turn honeycomb for the plate circuit. These are commercial type coils, wound on 3/8 inch dowel, and can be fitted inside a tube base. The coupling should be close. The two coils may be held together by fastening a nut to a screw put through the dowel core, the short extensions of the dowels facing each other. The distance apart should not exceed 3/4 inch.

Uses Listed

If oscillation fails on either coil system, reverse the tickler connections.

Now as for the uses to which the circuit in Fig. 1 may be put. These may be listed as follows:

(1)—By plugging into one set, to obtain power, and thus calibrate the broadcast and oscillator coverage of another set.

(2)—By plugging into the first r-f stage of a tuned r-f receiver to calibrate the broadcast coverage of that same receiver on the basis of its succeeding tuned stages, the first t-r-f stage later to be peaked with the rest after the adapter is removed.

(3)—By plugging into the first (usually only) r-f stage of a superheterodyne, if it has t-r-f pre-selection, for calibrating the broadcast coverage of the modulator, by feeding the present oscillator's output to the grid circuit of the modulator.

(4)—By plugging into an intermediate frequency socket, for calibrating the oscillator of the superheterodyne itself, as to oscillation frequencies.

(5)—By plugging into oscillator socket, using the low frequency coil, for calibrating the frequency of the intermediate amplifier.

Those are the five principal uses. It should be noted again that the adapter has to be plugged into a socket to derive power, and that kills one stage of the set, and the selected stage always will be one not otherwise needed, with the exception that the complete receiver, whether t-r-f or superheterodyne, can never be tested by introducing the test oscillator's frequencies at the antenna post, on account of the killed stage. But as each of the individual tests can be made on the respective circuits, and as the overall is the total of these performances, the frequency testing is complete.

Padding a Super

The object of the device is frequency coverage checking and line-up or peaking. Frequency coverage is important because it is imperative to cover the entire broadcast band, and whether this coverage is attained can be determined, and corrections applied. Also, the oscillator and modulator frequencies of tuning, in a superheterodyne, can be calibrated, and this, too, is a form of lining-up. The test of course includes padding the oscillator. This consists of making the oscillator function at the proper frequencies, higher than the frequencies of the modulator by the amount of the intermediate frequencies, at the same dial settings as prevail for the modulator. This is a task because of the diversity of frequencies. Without some sort of oscillator it is almost impossible to make satisfactory tests or pad correctly.

Tuned radio frequency peaking has been explained, the stage or stages after the first being lined up, then, with adapter disconnected and tube restored to the set socket, the antenna stage is peaked with the others, say, at some medium or high frequency (800 or 1,300 kc, for example).

The superheterodyne lining up concerns at least three circuits: modulator, oscillator and intermediate. There may be t-r-f in the super, whereupon line-up at this level may be accomplished by plugging into the oscillator. With supers it is necessary to go through some extra motions, and these will be explained.

Test of Oscillator

To test the oscillator tuning characteristic of a superhetrodyne, disconnect the control grid from the second detector, connect a wire to this control grid, and run the wire to the control grid of the modulator. The object is to gain audio response. Connect the output of the adapter, a post representing the upper side of the 0.6 mmfd. condenser in Fig. 1, to the control grid of the modulator. With screen grid tubes this is simple, as cap removal makes access to the control grid of the second detector very easy, and a clip can be used for connection here. There might be blocking of the grid circuit unless a leak were used, and that is the reason for the 2 to 5 meg. leak across the 0.6 mfd. condenser. No modulation is used in the adapter-oscillator for this test. The adapter dial is turned until the beat between the two is heard. In some instances more than one squeal will be heard, that is, more than one setting of the oscillator-adapter will yield a squeal. However, you know approximately the frequency being tested, and besides, the strongest squeal is the one you want. Therefore tune in the right squeal and then turn the test oscillator dial until the squeal disappears and returns again on the other side. Then retune to get in between the squeals for zero beat. Consult your calibration and you know the oscillator frequency in the superheterodyne. You should test the super's oscillator at several points, including a few near the low frequency end of the dial.

Modulator Test

To test the modulator tuning characteristic, remove the control grid connection from the first and second detectors, and connect the control grid coil terminal (for screen grid tubes this is a clip) to the control grid of the second detector. Connect the output of the test oscillator to the antenna post of the receiver. Then tune in until the modulation (hum) is loudest, or, preferably use an output meter. A method of utilizing the power tube of the set as a detector, with a cheap meter, for output meter work, was described in last week's issue, dated January 30th. The t-r-f stage or stages (if any) may be lined up by this method.

Intermediate Frequency Testing

To test the intermediate frequency, or adjust it to any frequency within the range of the low frequency coil (150-300 kc), plug into the set's oscillator socket and connect output of the test oscillator to the plate of the modulator tube socket. The modulator tube may be removed if access is desired by pushing a wire into the plate prong, or if the chassis is rendered accessible clip a connector to the plate while the modulator tube is in circuit. Use the modulation in the tester. Tune the intermediate frequency transformers for greatest response at the desired frequency, as determined by the test oscillator calibration.

The intermediate frequency may be made exactly what is desired, or what it should be, if within the 150-300 kc range, and this adjustment or test is usually made first. Then with the intermediate frequency known, if the modulator frequency chart is obtained by use of the tester, the desired oscillator chart can be drawn. Add the intermediate frequency to the oscillator frequency for the modulator frequency for a dozen settings fairly evenly distributed over the dial span and then test the oscillator and, if necessary, repad it until the dial readings that prevailed for the modulator now prevail for frequencies higher than those of the modulator by the amount of the intermediate frequency.

A word about padding. It is necessary to use a series con-

(*Continued on next page*)

(Continued from preceding page)

denser in the oscillator tuning circuit, assuming equal capacities in a gang, and also to use fewer turns. As a guide, it is well to know that for 0.00035 mfd. tuning a commercial value of padding condenser of the fixed type, highly accurate, is 0.00076 mfd., 760 mmfd. However, frequently an adjustable padding condenser is used, 700 to 1,000 mmfd. With the fixed type it was found that with 127 turns of No. 32 enamel wire on 1-inch diameter, which covered the broadcast band for modulator, had to be subjected to a 10-turn reduction, to 117 turns, for the oscillator. Equally good results were obtained with 101.5 turns for the oscillator, setting an adjustable padding condenser until there was matching at a low frequency.

It is always well to watch the low frequencies carefully, as the padding condenser is most effective on these, because then it is in series with a capacity about twice as great as its own. However, at the wide open end of the condenser the series capacity has little effect, as it is a large capacity in series with a very small one. It is therefore obvious that the trimming condenser, in parallel with the modulator, should be adjusted on the basis of high frequency response after the padding condenser has been adjusted for low frequency response. Then a recheck will show in what direction the change, if any, should be. If the oscillator tunes to too low frequencies, with a fixed padder, remove turns from the oscillator grid winding, or, if with an adjustable padder, set the padding condenser at higher capacity. If the oscillator tunes too high in frequency, put on more turns in the one case (fixed padder) or use less padding capacity in the other (adjustable padder).

Calibration

So far the calibrations have been referred to, but whence are they derived? Commercial models doubtless would provide calibration charts. But one may calibrate the oscillator.

Take the broadcast band. Skip an intermediate stage or a t-r-f stage by moving the grid connection over one stage, so a socket will be available for plugging in. Connect the output of the test oscillator to the antenna post of the set. Tune in a station on the set. Note the frequency of the station and tune to the zero beat frequency of the test oscillator. Do this for a dozen stations well scattered over the dial. Then get some plotting paper and on the upright column (ordinates) at left write down the frequencies from 1600 to 500 kc, and on the horizontal (abscissas) column write down the dial numbers, 0-100 or 100-0. Then find the intersecting points for the frequencies and corresponding dial numbers and through these points draw a smooth line. You will then have the dial settings for all the frequencies. Stations of excellent frequency control should be used, if possible, and therefore a list of the crystal-controlled stations that adhere with extreme closeness to their assigned frequency is given on the next page.

Low Frequency Calibration

For the low frequency coil the same station system is used, except that instead of tuning for the fundamental one tunes for harmonics of the test oscillator frequencies. You know the approximate range (150-300 kc), therefore try to beat the fourth harmonic of the tester with a 700 kc station and adjust for zero beat. This is then the 175 kc setting of the test oscillator. It requires almost 0.0001 mfd. capacity of the tuning condenser, or somewhere near 50 dial setting on many 0.00035 mfd. tuning condensers. The sixth harmonic would be 1,060 kc, the eighth harmonic 1,400 kc. Therefore the fourth, sixth and eighth harmonics will give you three points below 50 on the dial for calibration, using only the one station. Only even order of harmonics are practical for use.

So, selecting other stations, the same method is repeated. The lower the frequency of the coil-condenser combination in the adapter-tester, the more harmonics in the broadcast band that can be used for station selection to produce beating. Finding a few points, you become sensitive to the frequency region of operation, and by tuning in loud locals on the receiver, and establishing test circuit harmonic beats, you can get enough points to run the second curve.

Modulation Difficulties

The method of introducing modulation, as shown in Fig. 1, is not infallible, since the resistance between one side of the heater and ground may be so low as there is insufficient voltage drop to make the plate condenser effective for hum-production.

This would be due to receiver conditions, of course, but is a situation that can be met by a simple means. The present method calls for the use of simply a single throw switch, to open and close a circuit, but at the expenditure of only a few cents more it is practical to utilize a different method of modulation introduction.

The grid return of the 0.1 meg. leak is connected to the pointer or index of a single pole double throw switch. The two other connecting points of the switch then are the heater and the cathode.

Hum or No Hum

When the grid return is made to cathode, by throwing the switch in one direction, there is no hum, but when the grid return is to the heater, then there are at least 1.25 volts of 60-cycle a-c, and this is enough to insure modulation.

Also, it is a method that does not detune, which the switching of the condenser does, in Fig. 1. However, the detuning is not serious for the bands covered, but would become so above 1,700 kc.

Analysis of Fig. 2

Fig. 2 is on the same general principle, but, as stated, covers a wider frequency range, and has its own power. Therefore with Fig. 2 tests on short waves may be made, also the receiver may be functioning completely, and there is no plugging into any socket. The grid leak, omitted from the position across the 0.6 mmfd. condenser, may be included as in Fig. 1.

A three deck switch is used, of the shaft-insulated type. There are six connections for each deck, besides the pointer or index connection, hence coil-changing is done by switching, not by plugging in. One deck is used for shorting out the series condenser C2, which is 0.00035 mfd., for the low frequency and broadcast bands.

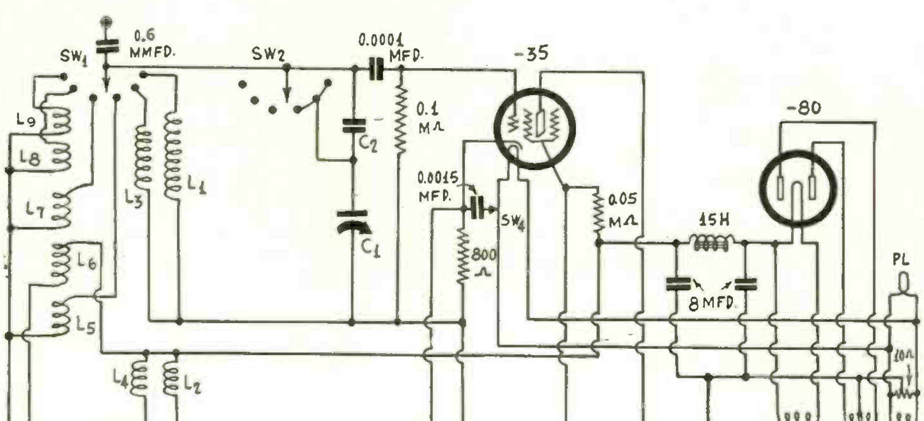


FIG. 2

This circuit constitutes a wholly self-powered test oscillator, and the frequency range is much greater than that of the tester shown in Fig 1. Besides, switch control of wave bands supplant plug-in coils. The cost of building a device like this would run around $18.

Coil Data for Fig. 2

L1 is the 800 turn honeycomb coil, L2 is a 300 turn feedback coil. L3 is 300 turns, L4 is 100 turns, both honeycombs. The separate plate windings are necessary for support of oscillation. The coverage from about 550 kc up is on the basis of a single plate winding serving various grid windings, all on one tubing. The larger coils, plate and grid combined, are separate, and spaced apart by 2 inches. If the diameter for winding the rest of the coils is 1 inch, then L5, the broadcast coil, consists of 125 turns, or, if the diameter is 1 5/16 inches (tube base size) is 115. The plate winding is 1/8 inch away, beside the grid winding, and consists of 30 turns. Then 1/4 inch space is left on the other side of L6 for the next grid winding, which has one-third the previous number of grid turns, while L8 has two-fifths of the number of turns on L7 and L9 has two-fifths of the number of turns on L8, 1/4 inch separation between windings. The wire may be No. 28 enamel.

In Fig. 2 the modulation method is good, but not of best, and the method suggested as an alternative in Fig. 1 may be applied here, or, in either figure, the grid leak may be raised to 5 meg., so that grid blocking produces modulation which has no reference to the 60 cycle hum.

Stations for Calibrating

Only recently has it become practical to use broadcasting stations for frequency calibration, due to the crystal control of frequency. The following is the most recent list of stations checked by the Department of Commerce, Radio Division, and found to be deviating from assigned frequencies by 200 cycles or less. Not all stations were monitored, in fact 383 out of 600-odd, so other stations than those enumerated may be in the close-adherence class. However, the list represents known quantities, and may be used reliably for calibration by the zero beat method. The Department supplied the following data, except the frequencies:

OFF LESS THAN 50 CYCLES

Call	Frequency	Transmitter location, studio location *in parentheses*
KELW	780	Burbank, Calif.
KFAB	770	Lincoln, Nebr.
KFAC	1300	Los Angeles, Calif.
BFBK	1310	Sacramento, Calif.
KFDM	560	Beaumont, Tex.
KFEL	920	Denver, Colo.
KFEQ	680	St. Joseph, Mo.
KFI	640	Los Angeles, Calif.
KFJI	1370	Astoria, Oregon
KYW	1020	Bloomingdale, Ill. (Chicago)
KFLV	1410	Rockford, Ill.
KFOR	1210	Lincoln, Nebr.
KFPY	1340	Spokane, Wash.
KFQU	1420	Alma-Holy City, Calif.
KFSG	1120	Los Angeles, Calif.
KFUO	550	Clayton, Mo.
KFVD	1000	Culver City, Calif.
KFWB	950	Hollywood, Calif.
KFXF	920	Denver, Colo.
KFYR	550	Bismarck, N. D.
KGB	1330	San Diego, Calif.
KGBZ	930	York, Nebr.
KGEF	1300	Los Angeles, Calif.
KGER	1360	Long Beach, Calif.
KGFJ	1200	Los Angeles, Calif.
KGIZ	1500	Grant City, Mo.
KGNO	1210	Dodge City, Iowa
KGO	790	Oakland, Calif. (San Francisco)
KGW	620	Faloma, Oregon (Portland)
KHQ	590	Spokane, Wash.
KLX	880	Oakland, Calif.
KLZ	560	Denver, Colo.
KMED	1310	Medford, Oregon
KMJ	1210	Fresno, Calif.
KMO	860	Tacoma, Wash.
KMOX	1090	St. Louis, Mo.
KMPC	710	Beverly Hills, Calif.
KMTR	570	Los Angeles, Calif.
KOAC	550	Corvallis, Oregon
KOIL	1260	Council Bluffs, Iowa
KOMO	920	Harbor Island, Wash. (Seattle)
KOY	1390	Phoenix, Ariz.
KPO	680	San Francisco, Calif.
KPPC	1210	Pasadena, Calif.
KRLD	1040	Dallas, Tex.
KRMD	1310	Shreveport, La.
KSAC	580	Manhattan, Kans.
KSD	550	St. Louis, Mo.
KSL	1130	Salt Lake City, Utah
KSO	1380	Clarinda, Iowa
KSTP	1460	Radio Center, Minn. (St. Paul)
KTAR	620	Phoenix, Ariz.
KTBR	1300	Portland, Oregon
KTBS	1450	Shreveport, La.
KTM	780	Santa Monica, Calif. (Los Angeles)
KTRH	1120	Houston, Tex.
KTSM	1310	El Paso, Tex.
KVOO	1140	Tulsa, Okla.
KVOS	1200	Bellingham, Wash.
KWKH	850	Kennonwood, La. (Shreveport)
KWLC	1270	Decorah, Iowa
KXA	570	Seattle, Wash.
WAAB	1410	Lexington, Mass.
WAAF	920	Chicago, Ill.
WAPI	1140	Birmingham, Ala.
WASH	1270	Grand Rapids, Mich.
WBAA	1400	West Lafayette, Ind.
WBAK	1430	Harrisburg, Pa.
WBBM	770	Glenview, Ill. (Chicago)
WBEN	900	Martinsville, N. Y. (Buffalo)
WBEO	1300	Marquette, Mich.
WBSO	920	Needham, Mass.
WBT	1080	Charlotte, N. C.
WBZ / WBZA	990	Millis Township, Mass. (Boston)
WCAM	1280	Camden, N. J.
WCAO	600	Baltimore, Md.
WCBM	1370	Baltimore, Md.
WCCO	810	Anoka, Minn. (Minneapolis)
WCFL	970	Chicago, Ill.
WCKY	1490	Crescent Springs, Ky. (Covington)
WCSH	940	Scarboro, Me. (Portland)
WDAE	1220	Tampa, Fla.
WDBJ	930	Roanoka, Va.
WDEL	1220	Wilmington, Del.
WDOD	1280	Brainerd, Tenn. (Chattanooga)
WDRC	1330	Bloomfield, Conn. (Hartford)
WEAI	1270	Ithaca, N. Y.
WEAN	780	Providence, R. I.
WEDC	1210	Chicago, Ill.
WEEI	590	Weymouth, Mass. (Boston)
WENR	870	Downers Grove, Ill. (Chicago)
WEVD	1300	Forest Hills, N. Y. (N. Y. City).
WFAA	800	Grapevine, Tex. (Dallas).
WFBL	1360	Collamer, N. Y. (Syracuse).
WFI	560	Philadelphia, Pa.
WGCM	1210	Mississippi City, Miss. (Gulfport).
WGES	1360	Chicago, Ill.
WGN	720	Elgin, Ill. (Chicago).
WGR	550	Amherst, N. Y. (Buffalo).
WGY	790	Schenectady, N. Y.
WHAM	1150	Rochester, N. Y.
WHAS	820	Louisville, Ky.
WHAZ	1300	Troy, N. Y.
WHB	860	Kansas City, Mo.
WHDH	830	Gloucester, Mass. (Boston).
WHN	1010	New York, N. Y.
WHO	1000	Des Moines, Iowa.
WIBO	560	Desplaines, Ill. (Chicago).
WIBW	580	Topeka, Kans.
WILL	890	Urbana, Ill.
WILM	1420	Carrcroft-Edgemoor, Del. (Wil.).
WISN	1220	Milwaukee, Wis.
WJAG	1060	Norfolk, Nebr.
WJAX	900	Jacksonville, Fla.
WJBO	1420	New Orleans, La.
WJMS	1420	Ironwood, Mich.
WJZ	760	Bound Brook, N. J. (N. Y. City).
WKBF	1400	Clermont, Ind. (Indianapolis).
WKBH	1380	La Crosse, Wis.
WKRC	550	Cincinnati, Ohio.
WKZO	590	Kalamazoo, Mich.
WLAP	1200	Louisville, Ky.
WLBZ	620	Bangor, Me.
WLOE	1500	Chelsea, Mass. (Boston).
WLS	870	Downers Grove, Ill. (Chicago).
WLW	700	Mason, Ohio (Cincinnati).
WMAL	630	Washington, D. C.
WMBC	1420	Detroit, Mich.
WMBI	1080	Addison, Ill. (Chicago).
WNBH	1420	Fair Haven, Mass. (New Bedford).
WOAI	1190	Selma, Tex. (San Antonio).
WOC	1000	Davenport, Iowa.
WODA	1250	Paterson, N. J.
WOKO	1440	Albany, N. Y.
WOL	1310	Washington, D. C.
WOW	590	Omaha, Nebr.
WPCC	560	Chicago, Ill.
WPOR / WTAR	780	Norfolk, Va.
WPTF	680	Raleigh, N. C.
WQBC	1360	Vicksburg, Miss.
WRAX	1020	Philadelphia, Pa.
WRUF	830	Gainesville, Fla.
WSAR	1450	Fall River, Mass.
WSB	740	Atlanta, Ga.
WSM	650	Nashville, Tenn.
WSMB	1320	New Orleans, La.
WSUI	880	Iowa City, Iowa.
WSVS	1370	Buffalo, N. Y.
WTAD	1440	Quincy, Ill.
WTAG	580	Worcester, Mass.
WTAM	1070	Brecksville Village, O. (Cleveland).
WTMJ	620	Brookfield, Wis. (Milwaukee).
WWJ	920	Detroit, Mich.

OFF LESS THAN 100 CYCLES

Call	Frequency	Transmitter location, studio location *in parentheses*
KDKA	980	Saxonburg, Pa. (Pittsburgh).
KELW	780	Burbank, Calif.
KFBB	1280	Great Falls, Mont.
KFJZ	1370	Fort Worth, Tex.
KFKU	1220	Lawrence, Kans.
KFNF	890	Shenandoah, Iowa.
KFOX	1250	Long Beach, Calif.
KFSD	600	San Diego, Calif.
KGCA	1270	Decorah, Iowa.
KHJ	900	Los Angeles, Calif.
KICK	1420	Red Oak, Iowa.
KMA	930	Shenandoah, Iowa.
KMBC	950	Independence, Mo. (Kansas City).
KMBL	1200	Monroe, La.
KMMJ	740	Clay Center, Nebr.
KNX	1050	Los Angeles, Calif. (Hollywood).
KOA	830	Denver, Colo.
KOH	1380	Reno, Nev.
KOL	1270	Seattle, Wash.
KPCB	650	Seattle, Wash.
KSOO	1110	Sioux Falls, S. Dak.
KTAB	560	Oakland, Calif. (San Francisco).
KTAT	1240	Birdville, Tex. (Fort Worth).
KTFI	1320	Twin Falls, Idaho.
KTHS	1040	Hot Springs, Ark.
KUJ	1370	Walla Walla, Wash.
KUOA	1390	Fayetteville, Ark.
KWJJ	1060	Portland, Ore.
KWK	1350	Kirkwood, Mo. (St. Louis).
KXO	1500	El Centro, Calif.
KYA	1230	San Francisco, Calif.
WAAM	1250	Newark, N. J.
WADC	1320	Tallmadge, Ohio.
WAWZ	1350	Zarepath, N. J.
WBAL	1060	Glen Morris, Md. (Baltimore).
WBAP	800	Grapevine, Tex. (Fort Worth).
WBNX	1350	New York, N. Y.
WCAJ	590	Lincoln, Nebr.
WCAU	1170	Byberry, Pa. (Philadelphia).
WCDA	1440	Cliffside, N. J. (New York City).
WCHI	1490	Deerfield, Ill. (Chicago).
WCLS	1310	Joliet, Ill.
WCRW	1210	Chicago, Ill.
WDAY	940	Fargo, N. Dak.
WDBO	1120	Orlando, Fla.
WDSU	1250	Gretna, La. (New Orleans).
WEAF	660	Bellmore, N. Y. (New York City).
WEPS / WORC	1200	Auburn, Mass. (Worcester).
WFAN	790	Philadelphia, Pa.
WIP	610	Philadelphia, Pa.
WFOX	1400	Brooklyn, N. Y.
WHAP	1300	New York, N. Y.
WHK	1390	Village of Seven Hills, Ohio. (Cld).
WHP	1430	Lemoyne, Pa. (Harrisburg).
WJBW	1200	New Orleans, La.
WJJD	1130	Mooseheart, Ill.
WJKS	560	Gary, Ind.
WJR	750	Sylvan Lake Village, Mich. (Det.).
WJSV	1460	Mount Vernon Hills, Va. (Alex.).
WKBB	1310	Joliet, Ill.
WKBI	1420	Chicago, Ill.
WKBN	570	Youngstown, Ohio.
WKY	990	Oklahoma City, Okla.
WLAC	1470	Nashville, Tenn.
WMAQ	1180	Addison, Ill. (Chicago).
WMMN	890	Fairmont, W. Va.
WMPC	1500	Lapeer, Mich.
WMSG	1350	New York, N. Y.
WMT	600	Waterloo, Iowa.
WNAX	570	Yankton, S. Dak.
WOI	640	Ames, Iowa.
WOR	710	Kearny, N. J. (Newark).
WOWO	1160	Fort Wayne, Ind.
WPG	1110	Atlantic City, N. J.
WRC	950	Washington, D. C.
WREC	600	Whitehaven, Tenn. (Memphis).
WRHM	1250	Fridley, Minn. (Minneapolis).
WRNY	1010	Coytesville, N. J. (New York City).
WRR	1280	Dallas, Tex.
WSBC	1210	Chicago, Ill.
WSFA	1410	Montgomery, Ala.
WTAQ	1330	Washington, Wis. (Eau Claire).
WTAW	1120	College Station, Tex.
WTIC	1060	Mount Avon, Conn. (Hartford).
WWVA	1160	Wheeling, W. Va.
WXYZ	1240	Detroit, Mich.

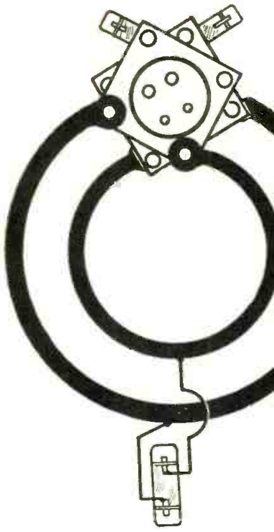
OFF LESS THAN 200 CYCLES

Call	Frequency	Transmitter location, studio location *in parentheses*
KFBS	1420	Portland, Oreg.
KDYL	1290	Salt Lake City, Utah.
KECA	1430	Los Angeles, Calif.
KEX	1180	Portland, Oreg.
KFJB	1200	Marshalltown, Iowa.
KFJF	1480	Oklahoma City, Okla.
KFJR	1300	Portland, Oreg.
KFRC	610	San Francisco, Calif.
KFRU	630	Columbia, Mo.
KFWF	1200	St. Louis, Mo.
KFWI	930	San Francisco, Calif.
KFXM	1210	San Bernardino, Calif.
KFXY	1420	Flagstaff, Ariz.
KGA	1470	Spokane, Wash.
KGGC	1420	San Francisco, Calif.
KGGF	1010	Coffeyville, Kans.
KGGM	1230	Alburquerque, N. Mex.
KGJF	890	Little Rock, Ark.
KGKO	570	Wichita Falls, Tex.
KGKY	1500	Scottsbluff, Nebr.
KGNF	1430	North Platte, Nebr.
KID	1320	Idaho Falls, Idaho.
KJR	970	Seattle, Wash.
KLS	1440	Oakland, Calif.
KRE	1370	Berkeley, Calif.
KREG	1500	Santa Ana, Calif.
KROW	930	Richmond, Calif. (Oakland).
KSCJ	1330	Sioux City, Iowa.
KSEI	900	Pocatello, Idaho.
KVI	760	Des Moines, Iowa (Tacoma).
KWG	1200	Stockton, Calif.
KWSC	1220	Pullman, Wash.
KXL	1420	Portland, Oreg.
KXYZ	1420	Houston, Tex.
WAAW	660	Omaha, Nebr.
WABC	1200	Wayne, N. J. (New York City).
WACO	1240	Waco, Tex.
WAIU	640	Columbus, Ohio.
WBBC	1400	Brooklyn, N. Y.
WBCM	1410	Bay City, Mich.
WCBA	1440	Allentown, Pa.
WCBD	1080	Zion, Ill.
WCBS	1210	Springfield, Ill.
WCMA	1400	Culver, Ind.
WCOA	1340	Pensacola, Fla.
WCOD	1200	Harrisburg, Pa.
WDAF	610	Kansas City, Mo.
WDZ	1070	Tuscola, Ill.
WELK	1370	Philadelphia, Pa.
WFBR	1270	Baltimore, Md.
WFIW	940	Hopkinsville, Ky.
WGAR	1450	Cuyahoga Heights, Ohio (Cleveland)
WGBF	630	Evansville, Ind.
WHA	940	Madison, Wis.
WHAD	1420	Wilwaukee, Wis.
WHBY	1200	West de Pere, Wis. (Green Bay).
WHFC	1420	Cicero, Ill.
WIBA	1280	Madison, Wis.
WJAR	890	Providence, R. I.
WJAS	1290	Pittsburgh, Pa.
WJTL	1370	Oglethorpe University, Ga.
WKBW	1480	Amherst, N. Y. (Buffalo).
WMC	780	Bartlett, Tenn. (Memphis).
WMCA	570	Hoboken, N. J. (New York City).
WOOD	1270	Furnwood, Mich. (Grand Rapids).
WOQ	1300	Kansas City, Mo.
WOS	630	Jefferson City, Mo.
WPAP / WQAO	1010	Cliffside, N. J. (New York City).
WPAW	1210	Pawtucket, R. I.
WPCH	810	Hoboken, N. J. (New York City).
WPRO	1210	Providence, R. I.
WREN	1220	Lawrence, Kans.
WRVA	1110	Mechanicsville, Va. (Richmond).
WSAI	1330	Mason, Ohio (Cincinnati).
WWAE	1200	Hammond, Ind.
WWL	850	New Orleans, La.

Best Minds Concentrate
Seek Efficient Method

By Kenne

FIG. 1
This shows the essential construction of Lieut. Wenstrom's balanced ultra-short-wave oscillator. The dark rings are copper tubing inductances. There are two sockets placed base-to-base.



IN "Historical Review of Ultra-Short-Wave Progress," William H. Wenstrom, U. S. Signal Corps, Fort Monmouth, N. J., in the January issue of "Proceedings of the Institute of Radio Engineers," traces the development of the transmission and reception of very short radio waves, covering the subject from the time of Hertz in 1887 to the present day. This is a valuable review to those who are entering on the study of this subject for it gives references to most of the original sources.

Following this review of the subject, the same author gives "An Experimental Study of Regenerative Ultra-Short-Wave Oscillators." This paper gives a quantitative account of the operating performance for two representative oscillator circuits. one a single tube and the other of the two-tube balanced type. A wavelength of about 3 meters was measured by two independent methods, one of which was the Lecher wire system, which is proved to be quite reliable if carefully carried out. A method for the absolute measurement of efficiency was worked out and the values obtained on the two oscillators ranged from 20 per cent. to 40 per cent. Under some conditions the single tube oscillator was more efficient, while under other conditions the balanced circuit was more efficient. However, under most conditions the efficiency of the two was about the same. In respect to frequency stability the two were about equal, the frequency variation being less than one per cent.

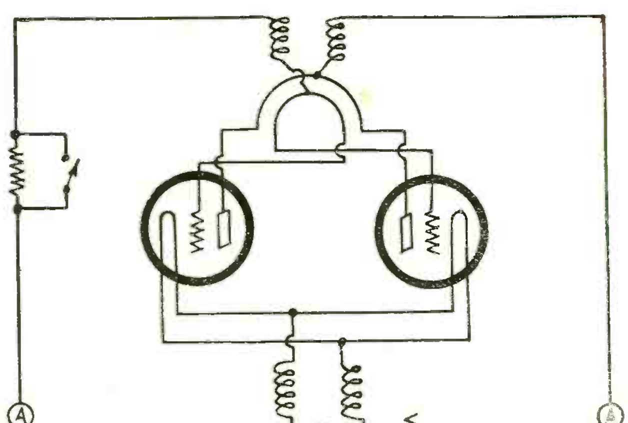


FIG. 2
This is a complete circuit diagram of the balanced oscillator shown in Fig. 1. Small r-f chokes are put in the supply leads to isolate the d-c and a-c circuits.

Two-Tube Oscillator

The diagram of the double, or balanced, oscillator is shown in Fig. 1. It consists of two rings of copper tubing connected to the sockets. These are placed back-to-back so that the two tubes are coaxial but pointing in opposite directions. The ring constituting the plate winding is connected from the plate post on one socket to the plate post of the other. The ring constituting the grid winding is similarly connected between the two grid posts.

The mid-points of the ring are connected to clips for connection to the source of power. The complete circuit diagram of the oscillator in Fig. 1 is shown in Fig. 4. On this figure it will be seen that the two clips connected to the center points of the rings pick up to choke coils, which must be small enough to be actual chokes at 3 meters. In other words, they must have so low distributed capacity that they are effective as chokes even at 3 meters.

In Fig. 1 the filament terminals are not connected, but in Fig. 4 is shown how they are connected to source of filament power. There is a radio frequency choke in each filament lead. These chokes, too, must be small enough to remain chokes at 3 meters. Independent batteries are used for filament, grid and plate voltages. There is a voltmeter for each voltage and a milliammeter for each of the grid and the plate currents. These instruments, of course, are a part of the experimental set-up and are not essential to the operation of the circuit. Likewise the two potentiometers for varying the grid and the plate voltages are unessential except for taking quantitative measurements on the effect of changes in the voltages. The four chokes, however, are essential.

In Fig. 2 is shown the single tube oscillator. Only one socket and one brass tube inductance are used. One end of the tubing is connected to the plate and the other to the grid. At the midpoint the tubing is broken and a condenser is connected across the gap. Terminal clips are connected to the two electrodes of the condenser for making external connections.

The essential circuit of the oscillator in Fig. 2 is shown in Fig 4. There it will be seen that a radio frequency choke coil is connected to each side of the condenser before the leads go

Classification

(*Continued from page* 5)

large that we can neglect the screen and plate currents in comparison. At this rate the sum of P and R should be 16,000 ohms. The bias portion of P should be 25/160 of the total resistance, or 2,500 ohms. Hence if we make P 5,000 ohms and R 10,000 ohms we shall have the means of making the correct bias adjustment. In a practical case the slider would be moved until the plate current in either tube is that which indicates good detection, that is, a current of about 0.2 milliamperes.

The 238 pentode is suggested for trying out the Class B amplifier because its output as a Class A amplifier is insufficient for many purposes and because it has a high voltage gain so that it would not be necessary to add another stage to build up the voltage to the point where the Class B amplifier could be loaded up to the limit.

The Class C amplifier is used primarily in transmitter circuits where high efficiency is of first importance and where wave form distortion is of little consequence. It differs from Class B in that the operating bias is still higher, so high, in fact, that the operating point is well beyond the point where the plate current cuts off. A very high efficiency is obtained from the tube or tubes.

As a Class C amplifier a tube may be operated singly or two tubes may be operated in the apparent push-pull connection. In Fig. 4 is shown a single tube amplifier of this class, using a 210 tube. It is biased in the same manner as the tubes in the Class B amplifiers previously discussed, namely, by means of a potentiometer in series with a resistance R, the two being connected between B minus and B plus. The position of the slider

on Ultra-High Frequencies; s of Generating Waves

th Aranow

to the sources of power. As in the balanced oscillator there is also a radio frequency choke in each filament circuit lead, next to the tube. The same arrangement for varying and measuring the various voltages and the grid and plate currents are used in this circuit as in that in Figs. 1 and 3.

The second method of measuring the frequency, or wavelength, used for checking the accuracy of the Lecher wire method, was based on heterodyning the seventh harmonic of a 20 meter crystal-controlled oscillator against the ultra-short wave oscillator. The double oscillator gave 3.21 meters with the Lecher wires and 3.18 meters with the heterodyne method. The single oscillator gave 3.15 meters with the Lecher wires and 3.12 meters with the heterodyne method. The difference was attributed to the error in the Lecher wire system.

Tetrode as Oscillator

H. A. Robinson, University of Pennsylvania, reports on "An Experimental Study of the Tetrode as a Modulated Radio-Frequency Amplifier." This is a highly interesting and important paper from the point of view of transmission, and although it deals with the UX-865 the findings are instructive in respect to receivers also for tetrodes are being used extensively as modulators in superheterodynes. The author first explains the experimental set-up of the circuit and the measuring equipment. He then gives various modifications for the different tests on the tube, and finally the characteristic curves for the different combinations.

He discusses grid modulation, screen grid modulation, plate modulation and combined screen and plate modulation. For each method of modulation he points out the limitations, the advantages and disadvantages. He reaches the conclusion that combined modulation in the screen and plate circuits, with the modulating voltage introduced in phase in these circuits, yields the best results. This method is capable of complete, or 100 per cent., modulation with negligible distortion. This result is due to the fact that when the signal is introduced simultaneously and in phase in both the plate and the screen circuits the screen current remains less than the plate current and secondary emission from the plate does not enter as a limiting factor.

Vibrating Reed Indicators

G. L. Davies, U. S. Bureau of Standards, contributes a paper on "Theory of Design and Calibration of Vibrating Reed Indicators for Radio Range Beacons," as used by aircraft. He develops the mathematical theory of small vibrations of the tuned reed and also the theory for large amplitude vibrations, where the square of the amplitude becomes comparable with the square of the gap in which the reed vibrates.

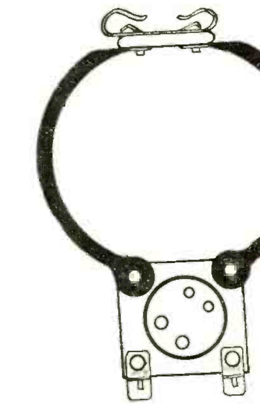


FIG. 3
This shows the essential construction of the one-tube ultra-short-wave oscillator of Lieut. Wenstrom. The heavy black lines are the plate and grid inductances.

An Untuned R-F Transformer

F. W. Schor, Chicago, Ill., discusses the theory and design of "An Untuned Radio-Frequency Amplifier" in which a specially developed iron-core transformer is used for obtaining desired amplification characteristics. Designs which strongly favor the amplification on the low frequencies and those which have uniform amplification characteristics are given. This paper is important because it shows how to construct transformers that will compensate for inequalities of amplification without using expensive filter arrangements. The iron-core transformers can be constructed cheaply and they not only have the amplification compensating feature but also a satisfactory gain throughout the broadcast band. A finely laminated iron core is the basis of the transformer. Ordinary commercial cold rolled steel was found to be the best core material, with the exception of a core made of iron dust. One transformer made with the finely laminated cold rolled steel according to specifications given gave an ampification of 28 at 550 kc, about 7 at 1,100 kc and over 8 at 1,400 kc.

Effect of Shore Station Location upon Signals

R. A. Heising, Bell Laboratories, New York, contributes a paper on this subject. Experiments are described for ascertaining the attenuation suffered by the unreflected wave in transversing relatively small amounts of land between the seashore and hypothetical island sites. The results show 8 to 12 db attenuation for one mile inland with greater attenuation thereafter for unfavorable terrain. Swampy ground produces small attenuation. The classical theory of wave transmission past a straight edge used in optics is applied to explain the reduction.

# of Amplifiers

should be determined experimentally with the aid of a milliammeter in the plate circuit. When no signal voltage is impressed on the grid the plate current indicated by the meter should be zero, but the bias should not be so great that it requires a great change to bring about a current indication.

Naturally, it requires a very strong signal to swing the grid from its high negative bias to zero potential. The strength should be such that at the peak of the signal voltage in one direction the current in the plate should be that corresponding to zero bias. The reading of the plate milliammeter will be considerably less than this. In fact, it will be somewhat less than the mean. This mean is about 32 per cent. of the maximum.

If there is ample power back of the source of the signal so that power loss in the grid circuit is of little importance, it is also possible to allow the grid to swing positive during the active half cycle.

The Class C amplifier is often used as a frequency doubler, in which case advantage is taken of the fact that there is a great deal of second order harmonics. In this application the secondary of T1 would be tuned to the fundamental and the load would be tuned to the second harmonic. If the fundamental is desired the load is tuned to that, and if all harmonic distortion is to be eliminated, the tuner must be a filter of adequate selectivity.

Fig. 5 shows a circuit using two 210 tubes in the Class C connection. This works in all essentials as the Class B amplifiers in Figs. 2 and 3, except that in Fig. 5 the grid bias is much higher. This bias is obtained by sliding the cathode connection to the potentiometer toward the plate, the positive direction.

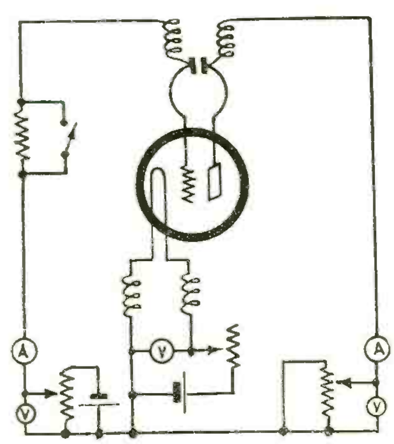


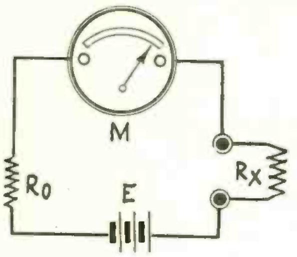
FIG. 4
This is the complete circuit diagram of the one-tube oscillator shown in Fig. 3. Small r-f chokes are placed in the supply leads to isolate the r-f and d-c circuits.

SERVICE SHEET NO. 3—*MEASURING DEVICES*

RESISTANCE MEASUREMENTS

FIG. 1
The essential circuit of an ohmmeter and the formulas on which the calibration is based.

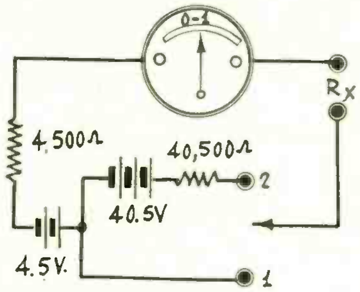
FIG. 2 (right)
A practical arrangement of an ohmmeter.



$$E=(R_0+R_x)I \ldots\ldots (1)$$

$$I=\frac{E}{R_0+R_x} \ldots\ldots (2)$$

$$R_x=\frac{E}{I}-R_0 \ldots\ldots (3)$$



AN ohmmeter can be constructed out of any current measuring instrument. For low values of resistance it is best to use a comparatively insensitive ammeter while for high resistance values it is necessary to use a sensitive milliammeter. The essential circuit of an ohmmeter is shown in Fig. 1. In this M is the indicating meter, the scale of which can be calibrated in ohms as well as in current units, I is the current in amperes, E is the voltage of the battery connected in the circuit, Rx is the resistance to be measured, and Ro is a limiting resistance inserted as a protection for the meter and also to establish a resistance zero at the point of maximum deflection.

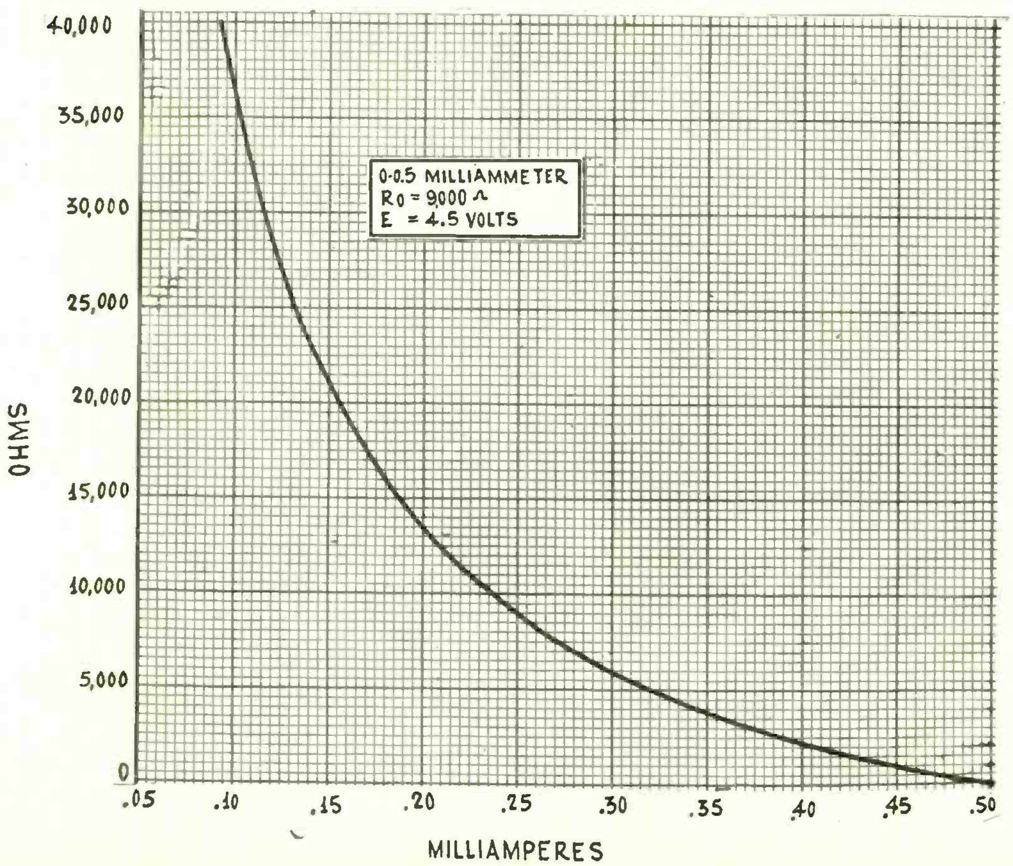
The principle of the ohmmeter is based on Ohm's law and it can be explained by means of the formulas in Fig. 1. Equation (1) is a simple statement of Ohm's law, the sum of Ro and Rx being taken as the total resistance in the circuit.

If we wish to find the correct value of the limiting resistance Ro in any case we set Rx equal to zero (1) and solve for Ro, using for E the voltage of the battery in the circuit and for I the maximum current reading on the indicating meter. For example, suppose E equals 4.5 volts and that the meter has a range of 0-1 milliampere. Then if Rx is zero in (1) we have 4.5=0.001Ro, or Ro equals 4,500 ohms.

If we wish to compute a calibration chart or table for the ohmmeter we throw equation (1) into the form given in (2) and find the value of I, the current, for various assigned values of Rx. Having done this we know that when the indicated current has a given value the value of Rx is that value indicated by the table or chart. In applying (2) we use the value of Ro determined by the method indicated in connection with equation (1). We found for the case when E=4.5 volts and the meter has a range of 0.1 milliampere that Ro should be 4,500 ohms. Let us use these values in illustrating the use of (2) in working out a calibration chart. We have I=4.5/(4,500+Rx). Now suppose we let Rx equal 3,000 ohms. Then we have I = 4.5/7,500, or I = 0.006 ampere. Therefore we know that whenever the deflection of the meter is 0.6 milliampere the value of Rx is 3,000 ohms. By assigning other values to Rx we can find the corresponding values of the current for these values in the same way and thus we can construct a calibration chart or table. Or we can write the resistance values directly on the meter scale opposite the computed values of current.

As the values of Rx increase the lines representing these resistances on the scale become crowded and it is difficult to read resistances accurately. Hence it is desirable to change the meter so as to make it more sensitive. The best way to do this is to increase the voltage in series with the circuit, that is, the value of E. However, when we increase the voltage we also have to increase the limiting resistance Ro proportionately. In general, a new scale will be required when we change the voltage and the limiting resistance, but we can easily choose such values that we can use the same scale. For example, if we multiply the battery voltage by 10, and also the limiting resistance by 10, then the same scale will apply, but we have to multiply each value of Rx by 10 also. If the useful range of the first scale is zero to 25,000 ohms, that of the other will be from zero to 250,000 ohms.

In case the resistance calibration scale, or curve, or table, is not sufficiently accurate we can read the current as



accurately as possible and then use formula (3) for computing the value of the unknown resistance. Suppose, for example, that the deflection of the meter is 0.7 milliampere. What is the value of the unknown resistance that will cause this deflection when the voltage is 4.5 volts and the maximum reading on the meter is one milliampere? We know that for this case the limiting resistance is 4,500 ohms. Hence we have Rx = 4.5/0.0007 — 4,500, or 1,925 ohms.

Fig. 2 shows a practical method of arranging resistors and voltages for making a two-range ohmmeter, one having ten times the coverage of the other. For illustration, a 0-1 milliammeter is used. For the low resistance range the series resistance should be 4,500 ohms and the voltage should be 4.5 volts. This combination is obtained when the switch is thrown to the left, or to point (1). When higher resistances are to be measured the series resistance should be 45,000 ohms and the voltage should be 45 volts. The proper combination is obtained when the switch is thrown to the right, for then 40.5 volts and 40,500 ohms are added to the circuit.

The zero error in an ohmmeter can be corrected in any case simply by subtracting the resistance reading when the Rx terminals are shorted from the reading obtained when the unknown resistance is connected across them. This correction assumes that there is a zero error because the resistance of the battery has increased. The change in the voltage of the battery is negligible, but the change in the resistance is not, for when the battery is old the resistance may be thousands of ohms.

Many commercial direct reading ohmmeters are provided with a zero adjuster to allow for the drop in the apparent voltage of the battery with use, due to the development of a high resistance inside the battery. This is done making the limiting resistance in two units, one fixed and one variable, the two about equalling the limiting resistance given. For example, in the case of the 0-1 milliampere ohmmeter the fixed resistance can be made 4,425 ohms and the variable rheostat 100 ohms. This not only would allow for increased resistance in the battery but also for excess voltage when the battery is fresh and warm.

TABLE I.

Meter range, 0-0.5 milliampere, E=4.5 volts, Ro=9,000 ohms

Rx	*I*	*Rx*	*I*
0	0.500	9,000	0.250
500	.474	9,500	.243
1,000	.450	10,000	.237
1,500	.428	11,000	.225
2,000	.409	12,000	.214
2,500	.391	13,000	.204
3,000	.375	14,000	.196
3,500	.360	15,000	.188
4,000	.346	16,000	.180
4,500	.333	17,000	.173
5,000	.321	18,000	.167
5,500	.310	19,000	.161
6,000	.300	20,000	.155
6,500	.290	25,000	.132
7,000	.281	30,000	.115
7,500	.272	35,000	.104
8,000	.264	40,000	.092
8,500	.257	50,000	.083

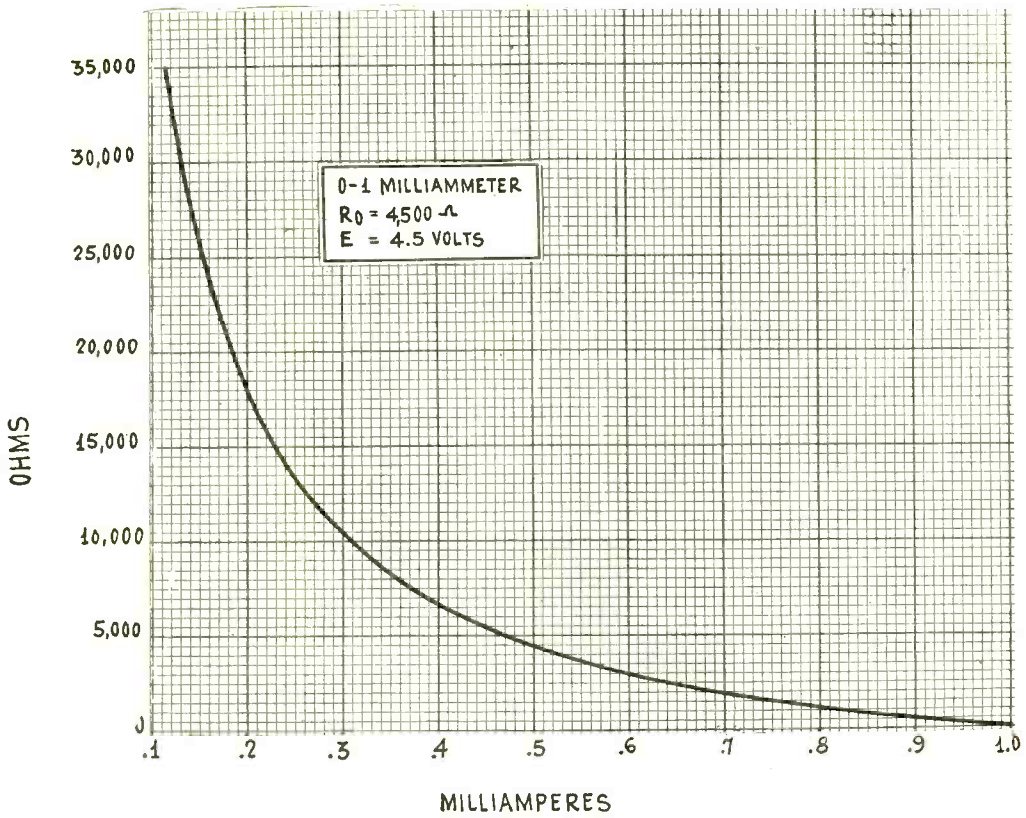
If the meter range is 0-0.5 *milliampere, E*=45 *volts, and Ro* = 18,000 *ohms, then each value of Rx is ten times the value in Table I. The corresponding value of current is the same as in Table I. Thus the last resistance would be* 500,000 *ohms and the current* 0.083 *milliampere.*

TABLE II.

Meter range, 0-1 milliampere, E=4.5 volts, Ro=4,500 ohms

Rx	*I*	*Rx*	*I*
0	1.000	8,000	0.360
500	.900	9,000	.333
1,000	.818	10,000	.310
1,500	.750	11,000	.290
2,000	.692	12,000	.273
2,500	.643	13,000	.257
3,000	.600	14,000	.243
3,500	.562	15,000	.231
4,000	.529	16,000	.219
4,500	.500	17,000	.209
5,000	.474	18,000	.200
5,500	.450	19,000	.191
6,000	.428	20,000	.184
7,000	.391	25,000	.153

If the meter range is 0-1 *milliampere, E* = 45 *volts, and Ro* = 45,000 *ohms, then each value of Rx is ten times the value in Table II. The corresponding value of the current is the same as in Table II. Thus the last resistance would be* 250,000 *ohms and the current* 0.153 *milliampere.*



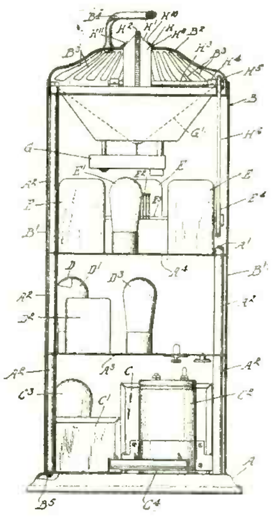
MORE Resistance Curves and Tables Next Week.

NEW PATENTS

Illustrated Reports on Radio Inventions

[Newly issued or reissued radio patents are recorded in this department. The number of the patent itself is given first. Usually only one claim is selected and the claim number also is cited. The code at the end of the title description (Cl., etc.) refers to the classification, the next number being the sub-division, which data define the nature of the patent. All inquiries regarding patents should be addressed to Ray Belmont Whitman, Patent Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.]*

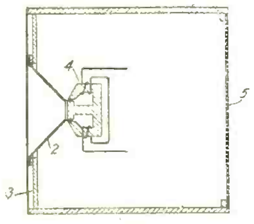
18,325. RADIO RECEIVING DEVICE. Edward F. Andrews, Chicago, Ill., assignor to Andrews - Hammond Corporation, Chicago, Ill., a Corporation of Illinois. Original No. 1,791,783, dated Feb. 10, 1931. Serial No. 263,006, filed March 20, 1928. Application for reissue filed Feb. 11, 1931. Serial No. 514,639. 17 Claims. (Cl. 250—14.)



1. In a portable radio receiver, a column-like container of substantially equal cross-section throughout its length, a hand operable indicating mechanism located on the top of the container and accessible for adjustment from all sides of the container and having a plurality of similar scales readable alike from diametrically opposite positions at the sides of the container, one or more of said scales being also readable from directly above the container.

* * *

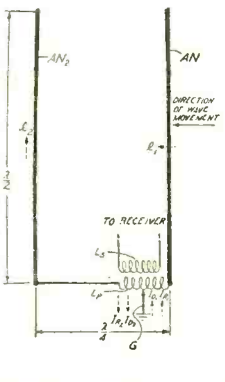
1,841,101. LOUDSPEAKER. Paul B. Flanders, East Orange, N. J., and Henry C. Harrison, Port Washington, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a Corporation of New York. Filed March 6, 1930. Serial No. 433,590. 9 Claims. (Cl. 181—31.)



1. The method of reducing cancellation effects in the air waves set up by direct radiating diaphragms which consists in confining a portion of the air displaced by one side of the diaphragm and altering the phase of the motion of that portion of the air not confined.

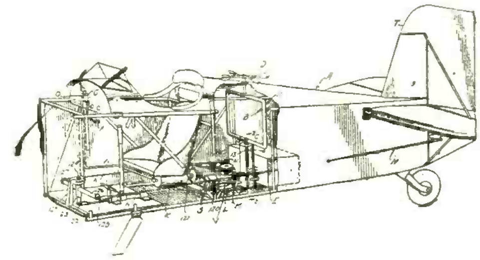
* * *

1,841,085. UNIDIRECTIONAL ANTENNA SYSTEM. Edmond Bruce, Red Bank, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a Corporation of New York. Filed June 2, 1928. Serial No. 282,382. 7 Claims. (Cl. 250—11.)



4. A uni-directional antenna system comprising two antennæ, a translating device, and an individual transmission line connecting said device with each of said antennæ, the phase shift in the path between one antenna and the device by way of its transmission line being equal to the corresponding phase shift in the path between the same antenna and the device by way of the other antenna and its transmission line.

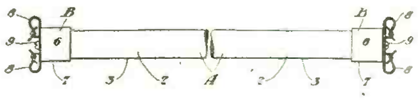
1,842,346. METHOD AND APPARATUS FOR RADIO OPERATED STEERING. Warren S. Eaton, Los Angeles, Calif., assignor to Eaton Radio Instrument Corporation, a Corporation of California. Filed Dec. 3. 1930. Serial No. 499,841. 36 Claims. (Cl. 244—29.)



2. A radio operated steering mechanism having means for selectivity receiving electro-magnetic energies, means for combining said received energies, means for utilizing said combined energy for direction indication, and means controlled by said direction indication to operate the steering mechanism.

* * *

1,841,661. GROUND RESERVOIR. John J. Mannion, Fair Oaks, Pa. Filed Sept. 26, 1928. Serial No. 308,570. 4 Claims. (Cl. 250—16.)



1. A ground resistor member for use in the ground circuit of a radio, said resistor comprising a capacity body composed of a plurality of parallel copper wires of round cross-section and having an integral surface coating of a rare metal having a materially higher conductivity than copper, means for forming an electrical contact between all of said wires at each end, means for connecting a wire from the ground side of a radio set to one end of said wires, and means for connecting a grounded wire to the other end of said wires, said capacity body having less resistance and materially greater capacity than said ground wire.

* * *

QUESTIONS ANSWERED

Readers may avail themselves of this free service for information on the subjects of patents, trademarks, designs and copyrights. If a personal answer is desired a stamp should be enclosed with the inquiry. Address all questions to Patent Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y. Write on one side of the paper only, giving full name and address. Only initials will be published.*

I HAVE obtained a patent on my invention but am now told that I may not have the right to manufacture and sell it without infringing some patent belonging to another. I thought the Government would not grant a patent unless it was free of such infringement. Please advise what is the fact.—C. W. F., New Haven, Conn.

The Government grants patents irrespective of possible infringement. The search made by the Patent Office before the granting of a patent is only directed to determining whether the invention is new and patentable. It may be only an improvement of some other person's patent, in which case that earlier patent might be infringed. Thus you would have the right to prevent others from infringing the claims of your patent without having the right yourself to use your own invention without infringing the rights of others.

* * *

IS IT POSSIBLE to sell or license a patent right on an invention before the patent has been issued and while it is still in the application stage?—I. B., Tampa, Fla.

It most certainly is. In fact many valuable license royalty contracts as well as outright sales of patents are effected before the patent has issued. After you have filed your application you can proceed to try to market your invention and patent-right-to-be.

keyhole from a listener; there was no message with it. . . . GLENN ROWELL, of Gene and Glenn, plays violin, piano, cornet and saxophone—one at a time, of course. . . . LOWELL THOMAS is raising minks on his farm outside New York City. . . . ROBERT SIMMONS has the reputation of being one of radio's handsomest and best dressed bachelors. . . . LOUIS DEAN'S greatest ambition is to hear David Ross recite "The Face on the Barroom Floor." . . . HARRY SALTER has the unique record of never having lost an account for any reason except that the account went off the air. . . . IRENE BEASLEY wrote her own theme song. . . . LARRY MURPHY at one time trained cornet players. . . . GENE CARROLL, of Gene and Glenn, will not carry an umbrella. . . . RAY PERKINS was born in Boston. . . . HARRIETT LEE, Radio's Queen of Beauty, is now featured over WOR on a beauty program. . . . JULIA NASH, who plays Mrs. Jarr on WOR, is a native cf Kalamazoo, Mich., and wife of Henry Chesterfield, Secretary of the National Vaudeville Artists.

* * *

Biographical Brevities

Introducing Ray Perkins

The new voice that you hear on the Fleischman hour is that of Ray Perkins, popular young master of ceremonies who is scheduled to appear with Rudy Vallee and Graham McNamee for several more weeks.

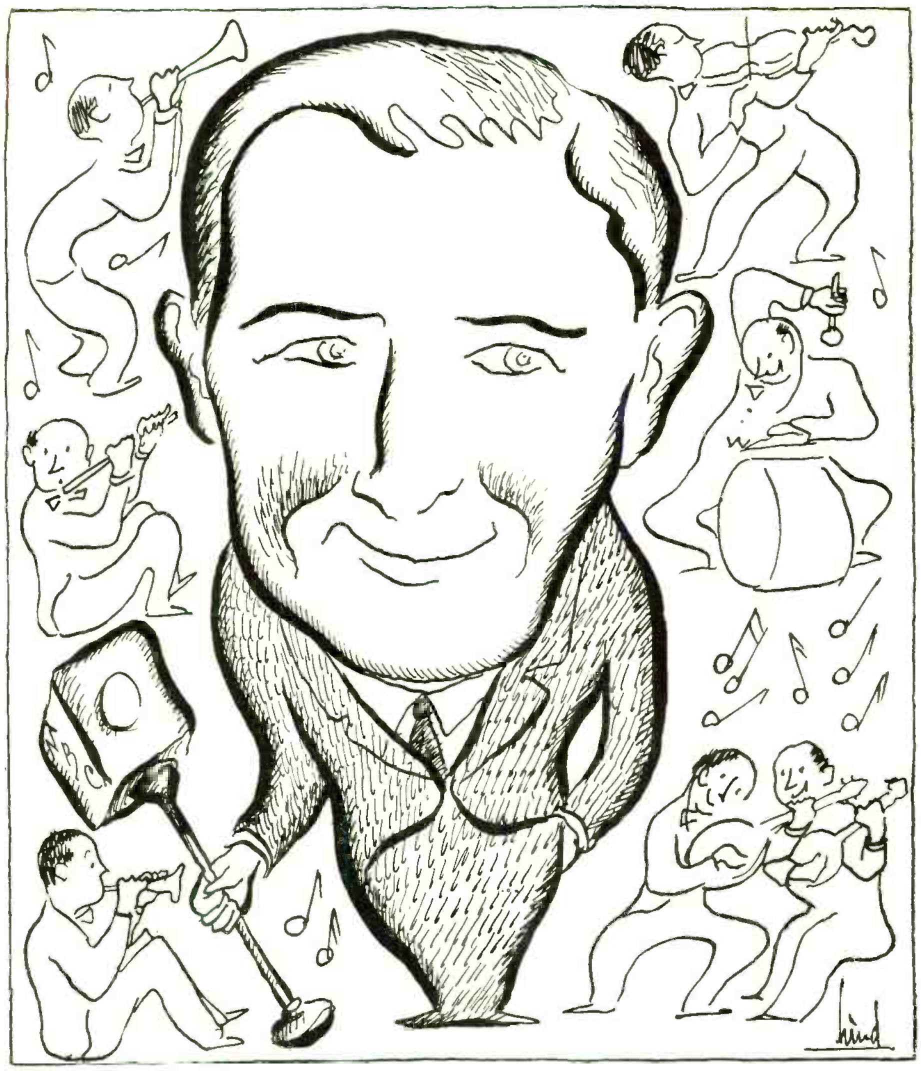
Ray has already had considerable of a radio career as monologist, pianist, singer and character impersonator. Ray was born in Boston, but grew up in Philadelphia and New York. In 1917 he was to have graduated from Columbia University—in fact, he received his diploma without benefit of final examination, as he had enlisted for the skirmish abroad.

Ray had always been an exceptional musician. At Columbia he majored in musical subjects and after the war was over he entered the popular music business as a composer. Among his better known songs are: "Down the Old Church Aisle," "Lady Luck," and "Under a Texas Moon."

In the earlier days of the radio he appeared as Judge, Jr., on the program sponsored by the "Judge" magazine. Then he dropped out of the theatrical limelight altogether, engaging in the somewhat prosaic business of building up the advertising department of "The New Yorker"; then in 1929 he went out to the Hollywood Studios for Warner's as monitor of the song-writing class and theme song composer in his own right.

On his return to New York Ray reentered the radio field, appearing variously as the Old Topper and the Prince of Pineapple. Wherever he went his piano was sure to follow, responding for the different programs as Cuthbert, Horace, or Clarence, depending upon the whim of its versatile master.

Ray Perkins has built up a radio reputation for versatility and has created a radio following without much flare of trumpets, but one that will stick to him in whatever role he appears and upon whatever program is lucky enough to sponsor this Prince of Good Entertainers.



Walter Winchell, gossip retailer and zippy announcer, heard over the WEAF chain every Tuesday, Thursday and Saturday at 10 p.m.

SUNDRY SUGGESTIONS FOR WEEK COMMENCING FEBRUARY 7TH

Sun., Feb. 7:—Eddie Cantor.....WEAF—8:00 p.m.
Sun., Feb. 7:—Footlight Echoes..WOR—10:30 p.m.
Mon., Feb. 8:—Lawrence Tibbett—Firestone......WEAF—8:30 p.m.
Mon., Feb. 8:—Alice Remsen, Evening in Paris....WABC—9:30 p.m.
Tues., Feb. 9:—Ray Perkins. Old Topper..........WJZ—6:30 p.m.
Tues., Feb. 9:—Jarr Family........WOR—7:45 p.m.
Wed., Feb. 10:—Willard Robinson and Orchestra..WOR—8:00 p.m.
Wed., Feb. 10:—Eno Crime Club. Wm. Sams......WABC—9:30 p.m.
Thurs., Feb. 11:—Golden Blossoms. Maria Cardinale......WJZ—8:30 p.m.
Thurs., Feb. 11:—Weaver of Dreams. ....Basil Ruysdael—WOR—10:15 p.m.
Fri., Feb. 12:—Alice Joy.........WEAF—7:30 p.m.
Fri., Feb. 12:—March of Time...WABC—8:30 p.m.
Sat., Feb. 13:—Danger Fighters....WJZ—8:00 p.m.
Sat., Feb. 13:—Vaughn de Leath.........WABC—8:45 p.m.

* * *

(If you would like to know something of your favorite radio artists drop a card to the conductor of this page. Address her: Alice Remsen, Care RADIO WORLD, *145 W. 45th St., New York, N. Y.)*

WMMB-WOK Case Again in Supreme Court

Washington.

A petition has been filed with the United States Supreme Court by the American Bond and Mortgage Company and Trianon, Inc., seeking to have the license of WMMB-WOK, Chicago, reinstated. The Federal Radio Commission had refused to renew the license, the station operated nevertheless, on the ground that its rights could not thus be taken away, but a court injunction stopped the operation.

The plea is now made that the Radio Act is unconstitutional because of the vagueness and the indefiniteness of the guiding principle laid down for Board action—"public interest, convenience and necessity." Moreover, it is stated that the Board, if the law were upheld, would be vested with the right to take property without due process of law. The case was before the Supreme Court once before, but the Court did not answer the questions then submitted.

FORUM

Rejuvenated

I CAN remember "way back when" your weekly became popular, and now, after having lost interest in the radio art for almost four years, your wonderfully detailed and illustrated articles have rejuvenated that interest.

HARRY M. NARLOCH.
3808 Augusta Blvd.,
Chicago, Ill.

WFOX Renews Fight For a Higher Wave

Brooklyn, N. Y.

According to Salvatore d'Angelo, president of WFOX, Brooklyn, N. Y., an appeal to set aside the decision of the Federal Radio Commission denying the application for the use of the 1,300 kc channel will be filed.

BIG INCREASE IN LICENSING OF AMATEURS

Washington.

A sharp increase in the number of amateur radio operators licensed by the Radio Division of the Commerce Department in the last six months of 1931 was shown in figures made public by Director W. D. Terrell. There were 8,676 licenses issued in this period compared with 5,633 in the same period of 1930.

Accompanying this increased interest in radio among the amateurs is a growing number of letters to Director Terrell requesting information. According to the director, most of the letters are from young men and boys who wish to build an amateur station, although there are many older men who are taking up the hobby, he said.

A recent letter to the Radio Division was written by a father who wished to know if he might hire a licensed operator to instruct his 12 year old son.

"This, of course, is possible," said Director Terrell, "but a 12 year old boy is rather young to master the things which are necessary before a license may be issued."

An Educational Force

"I like to see young men and boys taking such an active interest in radio," he said. "Many persons connected with commercial radio enterprises profess to look upon amateurs as nuisances, but these amateurs are not that.

"In the first place, the studying these boys do is distinctly educational as they must acquire a certain knowledge of radio and electricity that is likely to influence them toward a life-time profession in either the field of radio or electrical engineering."

Director Terrell also sees another distinct advantage accruing to the nation as a result of the growing interest in radio among amateurs. He points out that such a trained corps of operators would be of distinct value to the country in time of a national emergency because, with but little additional training, these young men could assume responsible positions with the army, navy or air corps.

Among the 8,676 amateur licenses issued, in the last half of 1931, 113 were in the extra first classification, according to L. A. Corridon, who is in charge of this work. This compared with 93 a year ago. There were 4,249 "firsts" issued compared with 3,432 a year ago, and 3,314 temporary licenses compared with 2,118 in the last half of 1930.

Rules to Follow

The amateurs would have less trouble obtaining licenses if they were to follow a simple routine before making application, Director Terrell advises. These are:

1. Learn the code, read text books on the theory of radio operation, and then learn the laws pertaining to operating a radio.
2. Take the examination.
3. Apply for station license from the Federal Radio Commission.

"After the amateur does these things, he obtains his call letters, and then, if he obeys the laws that are made to assure him an opportunity to operate without interference, he can have a great deal of sport." Director Terrell said.

Lost Dog Recognizes Madame's Voice on Air

Mme. Lucille Chevalier, "Golden Nightingale of the Opera," who located her pet Pekingese by singing the "Indian Love Song" over the radio. A radio fan, listening in, and who had picked up the dog in the street, noticing the dog's antics when Mme. Chevalier sang, called the radio station and reunited the singer and her pet.

Mme. Lucille Chevalier, whose golden mezzo soprano has trilled arias in the opera houses of Paris, Brussels, Berlin, Rio Janiero and Buenos Aires, never voiced such feeling as one day recently when she sang over the radio in New York with only one hoped-to-be listener as her objective.

And this radio fan was a dog—her Pierre, a pert Pekingese that strayed from the Chevalier home at 160 West 73rd Street.

In the belief that, if the finder of Pierre was to listen in, with Pierre nearby, the dog would recognize his mistress's voice, Mme. Chevalier bravely faced the mike and softly sang the "Indian Love Song" after an announcer had told the object.

Before the song was finished, the studio phone rang. A somewhat excited young woman, living in Park Avenue, exclaimed:

"I imagine I have Mme. Chevalier's Pekingese. I turned in on her song, holding the dog in my lap, and, as soon as the dog heard the voice over the radio, he jumped out of my lap and become uncontrollable."

A speedy motor trip brought Mme. Chevalier to the Park Avenue apartment and there she and Pierre were reunited.

"I've never had a desire until now," said Mme. Chevalier, "to sing over the radio, but I feel the urge to become a songbird of the air."

Mme. Chevalier, who was known in Rio as the "Golden Voiced Nightingale," intends to devote considerable of her time henceforth to radio engagements.

"I believe," she said, "there is a real field on the air for singers who will sing worth-while songs, tunes that never die."

Lowest Wave

Pittsburgh.

Westinghouse Electric Laboratories have demonstrated a new wave which is 100 times shorter than the shortest radio wave previously used. The demonstration was in charge of I. Mouromtseff, a Russian scientist and engineer now with the Westinghouse company. He stated that the new wave had the properties of both light and radio and that it could be directed accurately.

PALMER'S SON ONE OF 4 HAMS PUT OFF ETHER

Washington.

The Federal Radio Commission has revoked the licenses of four Brooklyn amateur stations and has warned one other that any further transgressions will result in revocation of the license.

One of those ordered off the air was Eric H. Palmer, Jr., operator of W2AZ, whose license was revoked for rebroadcasting WABC, WJZ, and WOR, and for helping in setting up an unlicensed station, W2ZZV, using the call W2ABC, which had been assigned to another amateur.

This boy's license was revoked for three months in the early days of the Commission at the request of the boy's father, who said that the boy spent all his time in the attic with the radio transmitter without getting proper food or sleep. The father was publicity man for the Freed-Eisemann Radio Corporation during its flourishing days, later acted in a similar capacity for the Radio World's Fair, and is now working for television interests, including Short Wave and Television Corporation of Boston and Sanabria Television Corporation, Chicago.

The others ordered off the air were Frank A. Lentino, operating W2BVY, Richard M. Simmons, operating W2CRY, and William Kessler, operating W2ZZV, which was unlicensed. The amateur given a warning was George J. Murphy, operating W2CAR, who was told that "any further transgressions would mean revocation of his license."

La Bori Signs Up With Columbia

Lucrezia Bori, Spanish prima donna of the Metropolitan Opera Company, and Goeta Ljungberg, Swedish soprano who recently made her American debut at the Metropolitan, have placed their activities outside of opera in the care of Columbia Concerts Corporation. Miss Bori's contract is with Arthur Judson, Inc. and Mme. Ljungberg's with Haensel & Jones. Both these concerns are ajliated with the Columbia and the contracts include radio broadcasting by that organization.

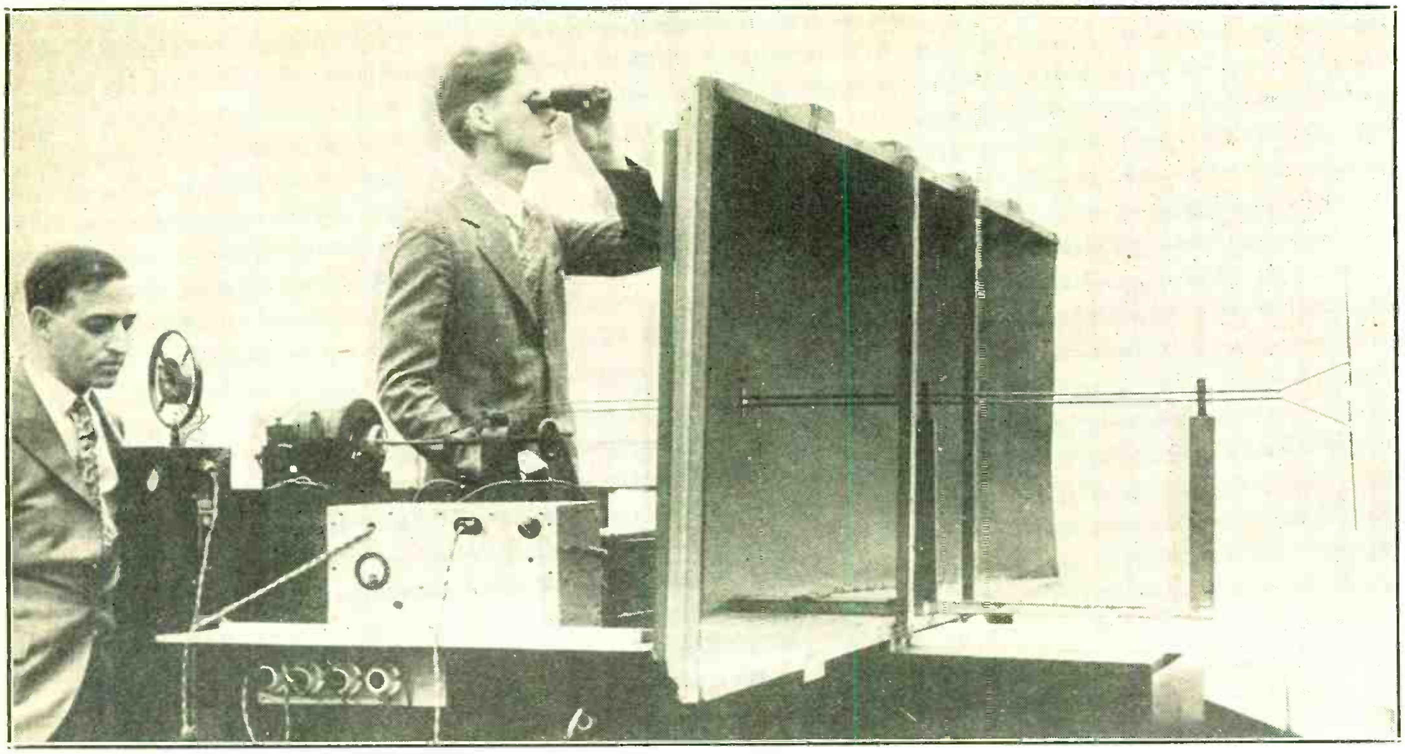
Recently the Columbia added Mary Garden and John McCormack to its staff of distinguished artists. These four artists are among 125 outstanding musical stars which will be included in next season's list of Columbia.

Two More Tube Clause Suits Settled by RCA

Washington.

Two suits against the Radio Corporation of America by independent tube manufacturers for alleged damages resulting from the RCA policy of requiring licensed set manufacturers to equip receivers with RCA tubes have been dropped, settlement of the points at issue having been effected by the Radio Corporation. Originally seventeen tube manufacturers sued for damages, but now only one remains, that of the Raytheon, Inc., the Raytheon Products Company, and the Raytheon Manufacturing Company.

HOW ULTRA WAVES ARE FOCUSED



(Acme) Westinghouse engineers have perfected equipment for producing ultra-short radio waves that may be focused like light waves. Note the tiny transmitting antenna a short distance in front of the paraboloidal reflector. L. R. Philpott, at the microphone, and G. Ross Kilgore, two of the engineers, are operating the transmitter.

CONGRESS TOLD OF PERIL IN TAX ON SETS, TUBES

Washington.

Leaders of the radio industry appeared before the Ways and Means Committee of the House of Representatives in opposition to the proposed 5% sales tax on radio and accessories, declaring that such a tax would cause increased prices to the public, reduce sales, increase unemployment and would raise negligible additional taxes for the Government. The radio spokesmen were followed immediately before the House Committee by a large delegation of automobile industry leaders in a similar plea against increased taxes on their industries.

That radio is not a luxury but a great agency of communication and human development was strongly urged by the industry spokesmen. For more than a year radio receiving sets and tubes have been generally sold to the public below cost with great losses to all but a few manufacturers, it was stated. It was emphasized that the proposed special and discriminatory tax on radio could not be absorbed and must be passed on to the public.

That the radio industry was willing to bear its share of the additional needs for Federal revenue and would recommend instead of a small general sales tax on all manufacturers was stated by the industry witnesses before the House Committee.

Those testifying before the Ways and Means Committee at the hearing arranged by the Radio Manufacturers Association, comprising virtually all the prominent manufacturers, included Frank D. Scott, legislative counsel of the Association; Arthur T. Murray, of Springfield, Mass., president of the United American Bosch Corporation; B. J. Grigsby, of Chicago, president of the Grigsby-Grunow Company; William J. Barkley, of Newark, N. J., president of the DeForest Radio Company, and A. M. Ferry, of Washington, D. C., representing radio tube manufacturers. Major I. E. Lambert, of Camden, N. J., counsel for RCA Victor Company, and several other industry representatives also were at the hearing. A death in his family prevented the presence of President J. Clarke Coit of the Radio Manufacturers Association.

Radio manufacturers have more than $500,000,000 invested in the industry and employ more than 100,000 persons, the House Committee was told by Mr. Scott. Before the depression, the employed personnel of the industry was 500,000, he explained.

"During the year 1931," "receiving sets and tubes were sold to the public at a price less than cost of production. In the last three years the radio receiving set and tube group has had a mortality in excess of 50%. The inevitable result of a sales tax would be to diminish sale of radio receiving sets and accessories, lessen production and further depress employment.

"In all probability the proposed sales tax would produce less than six million dollars in revenue, or two-thirds of one per cent of the Government needs."

Tariff barriers are a bar to foreign sales, the Committee was told by Mr. Scott, while the proposed sales tax would decrease even the greatly reduced domestic market.

FIRE DESTROYS LABORATORY OF DE FOREST FIRM

At 6 o'clock one morning recently fire broke out in an engineering laboratory building of the DeForest Radio Company at Passaic, N. J. Despite efforts of the night watchman, who attempted to combat the flames with a fire hose, as well as the subsequent efforts of the Passaic Fire Department, the frame building, together with its contents, was destroyed.

Little Production Delay

According to Leslie S. Gordon, president of the DeForest Radio Company, part of the engineering laboratory of the organization had been housed in a frame structure entirely detached from the main group of brick buildings housing the factory, warehouse and offices. Fortunately, the conflagration was entirely confined to this detached building, the production activities of the plant being delayed less than two hours.

Television Camera Destroyed

Although the building contained the transmitting and studio equipment of experimental radio telephone and television station W2XCD, as well as the latest Jenkins television camera and much experimental tube production equipment, the damage was entirely covered by insurance.

The destruction of the new television camera, which had just been completed, will delay television experiments.

FRENCH RULING HELD HARDSHIP

Washington.

The State Department, in a statement, declared that the French restrictions on the imports of radio sets and tubes work a "hardship" on the United States, because business along this line has been developing rapidly, while the quotas assigned to various nations were based on old import conditions.

When the new quotas were announced in the "Journal Officel," in Paris, French firms handling American sets and tubes, and also representatives of American radio concerns, declared the quotas discriminatory because limiting severely the amount of imports of American radio that otherwise would have flowed into France. When the matter first was called to the attention of the Department of Commerce here it was said there was no evidence of discrimination and no intention of lodging a protest, but the State Department finally instructed Ambassador Edge to take up the matter with the French government.

The announcement by the State Department follows in full:

"Ambassador Edge has informed the Department that quotas have been fixed covering the importation into France of radio sets, accessories and parts as well as lamps and tubes. During the year 1931 importations of radio sets, accessories and parts from the United States totaled 16,000,000 francs, while lamps and tubes totaled 4,000,000 francs.

"The monthly quotas assigned to America represent 75 per cent of the average monthly imports of the past three years on sets and 73 per cent on tubes. The American quota on sets is 166 quintals monthly out of a total of 1,541; and tubes 15 quintals out of 150 quitals. If the quota were based on the 1931 imports the quota for the United States would be 293 quintals of sets and 28½ quintals of lamps and tubes.

"Due to the fact this type of business is developing so rapidly in the United States the use of old import figures as a basis for figuring the quota works hardship on exports from the United States."

New Incorporations

Pajes Laboratories, Inc., Elizabeth, N. J., radio and television.—Atty., Aaron Kaufman, Elizabeth, N. J.
Television and Electric Corp. of America, Wilmington, Del., sound producing devices.—Attys., Colonial Charter Co.
Deltah Electric Corp., New York, N. Y., clocks.—Attys., Hays, St. John, Abrahamson and Schulman, 43 Exchange Place.
Nov-E-Line Electric Clock Corp., New York, N.Y. —Attys., Hays, St. John, Abrahamson and Schulman, 43 Exchange Place.
Radonite Co. of New Jersey, Newark, distributors of water coolers, etc.—Filed by the company.
Zerozone, Inc., Wilmington, Del., deal in all kinds of refrigerating plants, ice machines.—Attys., Corporation Trust Co.
Thor Manufacturing Co., Albany, N. Y., electrical devices.—Atty., A. J. Selkirk, Albany.
Made Rite Electric Manufacturing Corp., New York, N. Y., appliances.—Atty., A. Axelrad, 475 Fifth Ave.
Lincoln Refrigerator Corp., Brooklyn, N. Y., electric appliances.—Atty., C. Brecher, 2 Lafayette St., Manhattan.
Johnston Laboratories, Inc., Newark, N. J., deal in mechanical and electrical supplies.—Filed by the company.
Gibraltar Electric Clock Co., Inc., Jersey City, N. J., manufacturing jewelers.—Atty., Harry L. Kreeger, 551 Fifth Avenue, New York City.
Maxim Electric Corp., New York City.—Attys., B. B. Nelson, 401 Broadway, New York City.

CHANGE IN NAME

Television Products, Inc., to Globe Television and Phone Corporation, Boston, Mass.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, 145 West 45th Street, New York, N. Y.

Donald Cook, 1400 W. Short, Independence, Mo.
A. C. Evans, 123 Huton Ave., Ottawa, Ont., Canada.
Clarence Hiltz, 547 Carlton Ave., Brooklyn, N. Y.
Joseph S. Beach, Box 433, Elk City, Okla.
Theodore Ryckman, Jr., 710 North St., Howell, Mich.
Paul Tyrlick, Ayr, No. Dak.
Donald F. Cameron, 2289 Albion St., Toledo, Ohio.
Kyle J. Casto, Volga, W. Va.
Eustace H. Taylor (W3CCK), Herndon, Va.
Oliver Mitchel (on S.W. converters & Television), 22 Shelter St., Rochester, N. Y.
Norman G. Wallace, P. O. Box 743, Nelson, B. C., Canada.
Harold Peterson (on short wave sets), 423 East 2nd Ave. No., Roseburg, Ore.
H. W. Field, Corrall Falso, 245-D, Guanabacoa, Cuba.
Dr. Harold E. Brown (on short wave kits), 1026 Medical Arts Bldg., Omaha, Nebr.
G. H. Ramey, R. R. No. 5, Martinsburg, W. Va.
Elmer Druggan, 703 N. Lincoln Ave., Bridgeport, Ohio.
John Whistler, 2612 N. E. 23rd St., R. F. D. No. 9, Oklahoma City, Okla.
George J. Satter, 15 Ackerman St., Rochester, N. Y.
A. Hayden (spl. midget parts), 14475 Faircrest, Detroit, Mich.
Harold M. Stout, Post Box 75, Fairville, N. B., Canada.
Michael Pinchuk, Box 363, Syosset P. O., L. I., N. Y.
T. A. Matejowsky, Matejowsky Co., Lyons, Texas.
I. L. Dellinger, Wordensville, W. Va.
Reynold Nelson, Route No. 1, Spicer, Minn.
John F. Fox, 26 Lavaughn St., Providence, R. I.
Alfred M. Seville, Naranjos 1345 Pral, Lima, Peru, South America.
Nehemia Wilson, 5917 Race St., Philadelphia, Pa.
H. Clay Marlatt, 889 Gates St., Phillipsburg, N. J.
Leonard Johnson, 1314 Peach Ave., South Boston, Va.
Roy W. Schryer, 3084 W. 56th St., Cleveland, Ohio.
H. Buscarlet, Prop., Radio & Battery Service Station, Box 507, Souris, Manitoba, Canada.
H. B. Hughes, 1222 - 24th St., Newport News, Va.
Cosim J. Gregory, Sales Co. Mnfrs. representative, P. O. Box 157, Passaic, N. J.
H. H. Lindley, West Hillsboro, No. Car.
W. Gilbert, Jr., Buckeye Foundry Co., 2800 Beckman St., Cincinnati, Ohio.
Sam Fels, Margason Side Wing Co., 358 Vine St., San Jose, Calif.
Fred New, 20 Granger Place, Buffalo, N. Y.
Joseph Krymitzky, 84 High St., Mystic, Conn.
R. DeHart, 1814 Woolsey St., Berkeley, Calif.
Billy Smith, Erlanger, No. Car.
William F. Delaney, 542 McKean Ave., Donora, Pa.
Arthur B. Parker, 298 Hoyt St., Buffalo, N. Y.
J. R. Spencer, Fort Hamilton Station, P. O. Box 54, Brooklyn, N. Y.
R. C. Jensen (on Short Wave recept. & transm.), Guerneville, Calif.
Ernest Jahn, 4 Main St., Toms River, N. J.
R. M. Hawkins (Short Wave and Crystal), Sweetwater, Texas.
W. Harry Wheler, 86 John Ball Park Drive, Grand Rapids, Mich.
Nehemiah Wilson, 5917 Race St., Philadelphia, Pa.
Leo E. Schwam (P. A. Systems, Telev., Transmitting supplies and service men catalogs), 757 8th St., Douglas, Ariz.
Helmer Lindquist, 3525 44th Ave. So., Minneaoplis, Minn.
A. E. Redmond, 3712 So. Ainsworth St., Tacoma, Wash.
I. V. Saunders, Bayview Blvd. and Sturgis St., Ocean View, Norfolk, Va.
George F. Schumacher, 952 West Side Avenue, Jersey City, N. J.
T. Lenzner, 126 E. Hanover St., Trenton, N. J.
W. Carroll Vaden, 711 E. 12th St., Georgetown, Texas.
N. E. Goff, Excel Radio Service Co., 617 Market St., Youngstown, Ohio.
George M. Zochoichak, 219 Seneca St., Turtle Creek, Pa.
E. S. Northup, 203 W. Gregory St., Pensacola, Fla.
J. G. Eriees, Jr., 1711 N. Park Ave., Philadelphia, Pa.
R. J. DeCrocker, Route No. 1, Kalamazoo, Mich.
J. W. Newman, West Lafayette, Ohio.
Walter J. Sims, care of Railway Express Agency, 89 Luckie Street, N. W., Room No. 301, Atlanta, Ga.
W. V. Pierce, 1710 Chase Ave., Cincinnati, Ohio.
K. A. Ormond, 2227 Comer Bldg., Birmingham, Ala.
Herbert C. Thomas, 921 Connelly St., Clovis, New Mexico.
Victor J. Gard, 2641 Union St., Eureka, Calif.

BROWN NAMED BOARD MEMBER

Washington.

President Hoover announced his appointment of Thad H. Brown, of Ohio, general counsel of the Federal Radio Commission, as a Radio Commissioner, succeeding Ira E. Robinson, Commissioner, who resigned shortly before his term of office was to expire. The appointment was sent to the Senate for confirmation. The appointment is for the full term of six years.

Col. Brown was born in Lincoln Township, Ohio, Jan. 10th, 1887. He was graduated from Cardington, Ohio, High School in 1904.

He is an alumnus of Ohio Wesleyan University, 1909, and Ohio State University 1913, where he received the LL.B. degree. He was admitted to the practice of law in Columbus.

On April 3d, 1917, several days before the World War was declared, he volunteered his services in the Army and was commissioned a captain on June 12th, 1917. Following his discharge from the Army in 1919, he was commissioned a major in the Officers' Reserve Corps. He was later appointed lieutenant colonel in the Judge Advocate General's Reserve Corps.

Col. Brown serves as assistant secretary of the Fourth Ohio Constitutional Convention in 1912. In 1920 he was appointed a member of the Ohio State Civil Service Commission, where he served as member and chairman. He was elected Secretary of State of Ohio in November, 1922, and later reelected in 1924.

He was a candidate for Governor of Ohio in 1926, but was defeated.

Since July, 1929, Col. Brown has been Chief Counsel of the Commission.

TRADIOGRAMS

By J. Murray Barron

Magnavox Co., Ltd., has moved to 2131 Bueter Road, Fort Wayne, Ind. Electro-Formation, Inc., a subsidiary, maker of Mershon electrolytics, is at that address, too.

* * *

Radio-Vision Research Laboratory, Inc., Paramount Building, 1501 Broadway, N. Y. City, is sales agent for a new remote control for auto set and home use. The control is made by the Federal Telegraph Co. (Mackay).

* * *

Clarostat now has a new Ad-A-Switch line of volume controls. The control is obtainable in any taper or resistance up to 50,000 ohms. A switch may be slipped on without tools.

* * *

Radio service men may obtain a free copy of the circuit used in the Vacuum Tube Amplifying Tube Aid, by addressing Hearing Devices Co., Inc., 2453 Times Bldg., N. Y. City.

* * *

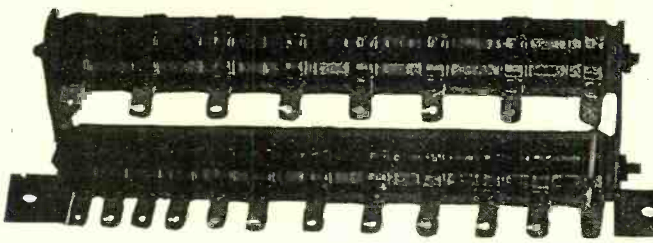
There is great activity at the factory of Television Mfg. of America, showing television is being taken up more and more, since merchandise is being shipped to all points of the United States.

McDONOUGH HEADS RCA VICTOR

J. R. McDonough was elected president of the RCA Victor Company to succeed E. E. Shumaker, who resigned. Mr. McDonough, who is thirty-seven, entered the employ of the Radio Corporation of America in 1924.

Best Quality Parts *Free!*

MULTI-TAP VOLTAGE DIVIDER



THE resistance values between the twenty taps of the fine Multi-Tap Voltage Divider are lower left to right, 0, 50, 50, 100, 200, 400, 450; 500; 550; 650; top right to left, 700, 800, 2,000, 2,000, 3,000 and 3,000 ohms. The total is 17,100 ohms and affords nineteen different voltages.

The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, in which the current rating of 100 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. Higher voltages may be used at lesser drain. Conservative rating, 40 watts.

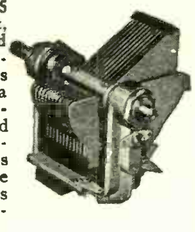
The expertness of design and construction will be appreciated by those whose knowledge teaches them to appreciate parts finely made.

When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. By making connection of grid returns to ground, the lower voltages may be used for negative bias by connecting filament center, or, in 227 and 224 tubes, cathode to a higher voltage.

If push-pull is used, the current in the biasing section is almost doubled, so the midtap of the power tubes' filament winding would go to a lug about half way down on the lower bank.

Send $4 for 35 weeks subscription and order PR-MTVD, as a premium. Shipping weight, 2 lbs.

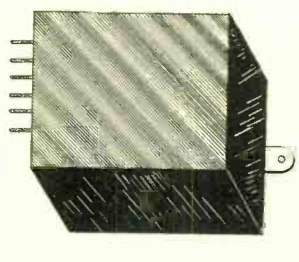
HAMMARLUND .0005 SFL



Hammarlund's precision .0005 mfd. condenser, removable shaft, protruding front and rear, and permitting reversing the condenser, as where two condensers are used on opposite sides of a drum dial. This is a most excellent condenser for calibrated radio frequency oscillators, short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction, ridigity; Hammarlund's perfection throughout.

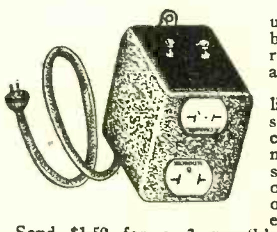
Sent free with 6 mos. subscription, 26 weeks, at $3. Order PR-HSFL. Shipping weigh, 1 lb.

FILTER BLOCKS



An excellent filter block, providing very high capacity for the B filter, a total of 14 mfd., with by-pass capacities of .1 and .5 mfd. This block is for standard 245 filtration (DC rating is 350 volts continuous). It is suggested that the 6 mfd. be placed next to the rectifier and the 8 mfd. at the other end of the B supply choke coil. No other filtration capacity is necessary. The physical dimensions are 5 inches wide x 4 inches front to back x 3 inches high. This Flechtheim block will be sent free with a $6 subscription (52 weeks). Order PR-FLB. Shipping weight, 4 lbs.

"B" ELIMINATOR – "A" BATTERY RELAY

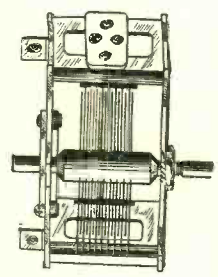


Here is a mighty handy and serviceable product for those who operate sets with storage battery and B eliminator—a genuine Brach relay, that switches charger on and set off, also set on and charger off.

Connect relay's cable plug to 105-125 volt AC line. Connect B eliminator cable plug to relay socket so marked; connect trickle or other charger's plug to relay socket so marked; connect one side of A battery to binding post, other side to A set. Then turning on your set turns on B eliminator and turns off charger, turning off set turns on charger and turns off B eliminator.

Send $1.50 for a 3 month's subscription, 13 weeks, and get this relay (PR-BRL) free. Shipping weight, 1 lb.

SCOVILL .00035 MFD



A single tuning condenser of .00035 mfd. capacity, with brass plates and mounting feet. It may be mounted on a front panel, by removing the mounting brackets and drilling a 1" diameter hole large enough to pass the locknut. This condenser, made by Scovill, increases capacity in a clockwise direction. It is useful both for broadcast and short-wave work. Send $1 for an 8-weeks trial subscription and get this condenser free. Order PR-SC-35. Shipping weight, 1 lb.

THE SUPERHETERODYNE

This is a new volume by Anderson and Bernard dealing with the principles and practice of the Superheterodyne method of receiving. It explains the function of the oscillator, the modulator, the premodulator selector, and the intermediate frequency amplifier. It explains the cause of repeat points and gives methods for avoiding them or minimizing their effect. It expounds the relative advantages and disadvantages of high and low intermediate frequencies, and shows the effect of selectivity on the quality.

It illustrates various forms of oscillators and tells of the advantages of each. Different types of modulators and pick-up systems are explained and their advantages stated. Different methods of coupling in the intermediate frequency amplifier are shown. Order PR-ABSA, free with 3 months' subscription (13 issues) @ $1.50

EXTRA-SPECIAL FREE OFFERS OF SUBSCRIPTION PREMIUMS!

RADIO WORLD, now in its tenth year, is the first and only national radio weekly, and publishes the latest, up-to-the-second news of circuits, both of kit types and of 1931 commercial receivers, as well as news of happenings in the broadcasting field. Lists of broadcast and short-wave stations are published regularly. You get your information weekly—which means quickly—and you get it accurately, so be sure to become or remain a subscriber for RADIO WORLD. We are able to offer now specially attractive premiums, and ask you to make your choice from the variety of parts offered on this page and on the opposite page. When ordering, please use coupon. We do not pay shipping charges.

The regular subscription rates are: $6 for one year, 52 issues, one each week; $3 for 6 months (26 weeks); $1.50 for three months (13 weeks); $1 for 8 weeks; 15c per single copy. All copies postpaid.

RADIO WORLD, 145 W. 45th St., New York, N. Y.

Enclosed please find $.......... for subscription for RADIO WORLD for .... weeks. Please send me the premium as indicated below:

- ☐ PR-MTVD, $4 for 35 weeks (8 mos., 1 week); shipping weight, 2 lbs.
- ☐ PR-BRL, 1.50 for 13 weeks (3 mos.); shipping weight, 1 lb.
- ☐ PR-ABSA, $1.50 for 13 weeks (three months); shipping weight, 1 lb.
- ☐ PR-30H, $3 for 26 weeks (6 mos.); shipping weight, 4 lbs.
- ☐ PR-HSFL, $3 for 26 weeks (6 mos.); shipping weight, 1 lb.
- ☐ PR-FLB, $6 for 52 weeks (1 yr.); shipping weight, 4 lbs.
- ☐ PR-SC-35, $1 for 8 weeks; shipping weight, 1 lb.

Name ....

Address ....

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

☐ If renewing an existing subscription for RADIO WORLD, please put a cross in square.