AUG. 4
1928

FIFTEEN CENTS

RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

332d Consecutive Issue—Seventh Year

FADING CAUSES FOUND!

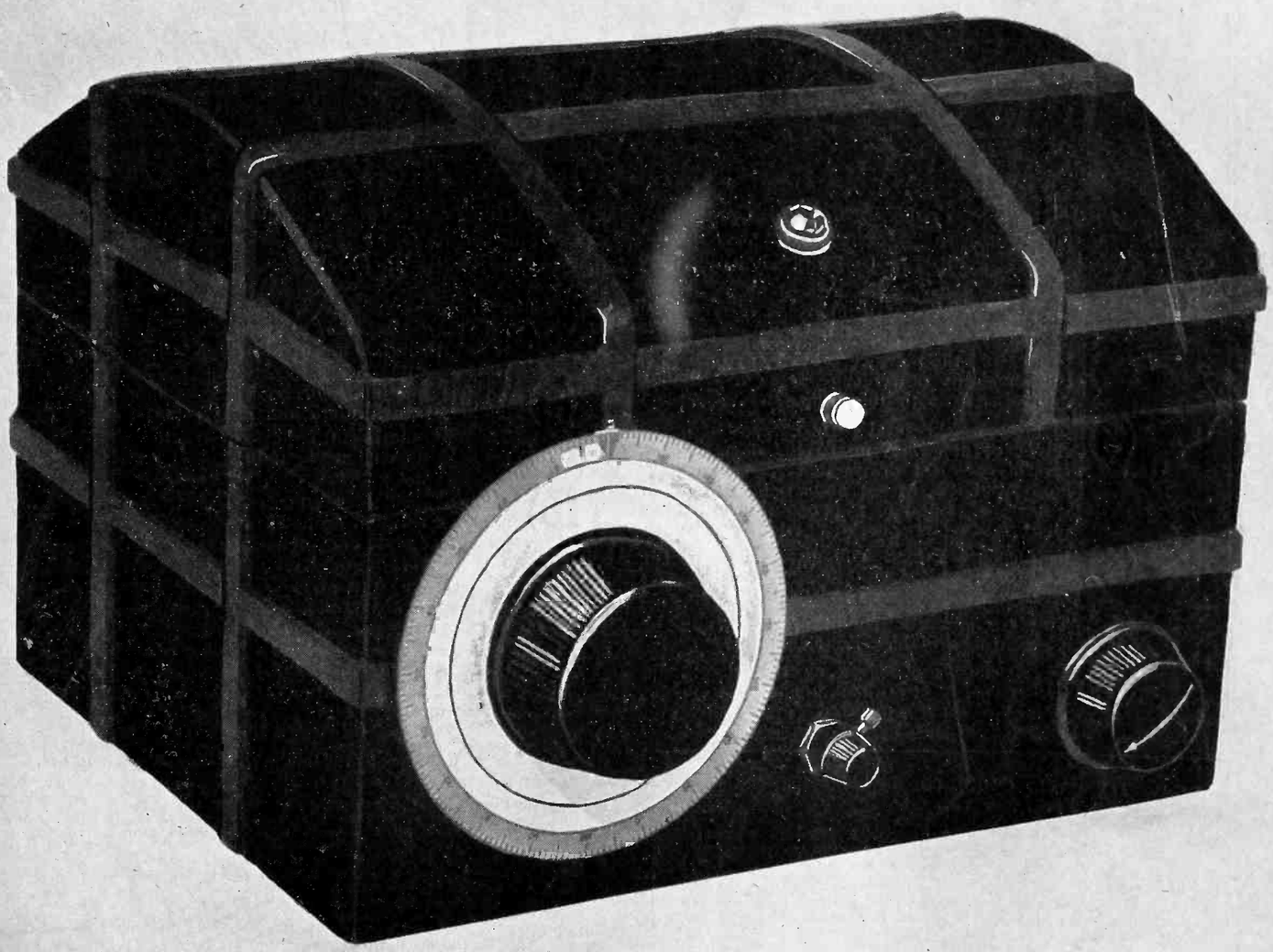
DISC FOR TELEVISION!

1-TUBE SHORT WAVER!

SCREEN GRID DETECTORS!

CURSE OF ZERO BEAT!

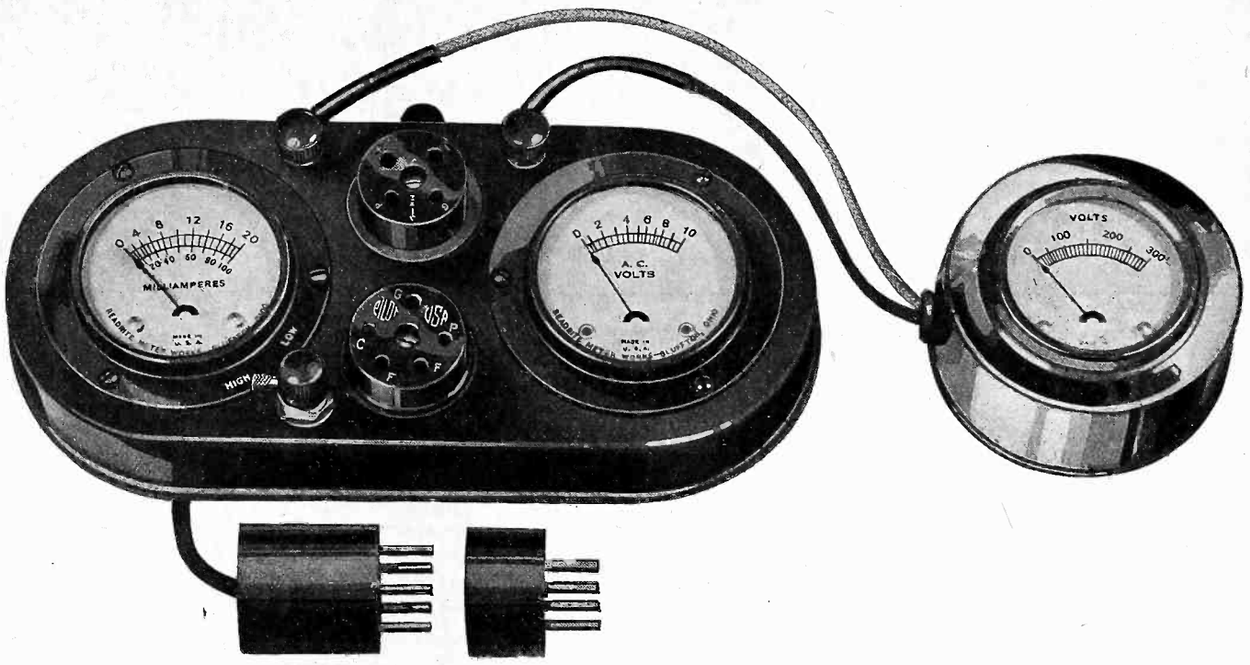
CHINATOWN YIELDS IDEA FOR A CHEST!



(Hayden)

A Complete Receiver was built in this Chinese Chest, as described on pages 4 and 5.

12 VITAL TESTS
In Only 4½ Minutes!



The Handsome Outfit, Shown One-Half Scale

With this Scientific Trouble Shooting Combination AC and DC Tester (at left) and the high resistance voltmeter (at right) twelve vital tests were made of tubes and receivers, in 4½ minutes, because the combination can be used quickly for the following purposes:

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

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

(3) to measure the total plate current of a receiver or amplifier, up to 100 milliamperes. (Hardly any set draws more). Open common A and B of set and connect to P of tester socket and to P prong under adapter plug;

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

(5) To determine the condition of a tube, by use of the grid bias switch.

(6) To measure any tube's electronic emission (tester cuts in at no load, hence plate current equals filament emission).

(7) To regulate AC line, with the aid of a power rheostat, using a 27 tube as guide, turning rheostat until filament voltage is 2.5 or 2.25 volts.

(8) To test continuity of resistors, windings of chokes, transformers and circuits generally.

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

(10) To read grid bias voltages, including those obtained through drops in resistors (bias read by noting plate current and voltage and consulting chart).

(11) to determine the presence of distortion and overloading, by noting if milliammeter needle fluctuates.

(12) to determine starting and stopping of oscillation, as milliammeter needle reads higher current for oscillation and lower for no oscillation.

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

Please send me at once, on a five-day money-back guaranty, one complete Two-in-One (AC and DC) scientific trouble-shooting test set, consisting of one No. 215 and one No 346, for which I will pay the postman $13.50, plus a few cents extra for postage.

☐ If 0-500 v. high resistance voltmeter No. 347 is preferred, put cross in square and pay $14.50, plus postage, instead of $13.50, plus postage.
☐ One No. 215 alone, $10.00.
☐ One No. 346 alone, $4.50.
☐ One No. 347 alone, $5.50.
☐ Two adapters for UV-199 tubes, $1.00.

NAME .....

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

Service Men, Custom Set Builders, Home Constructors, Experimenters, Teachers, Students, Laboratories

Order one of these combination 215 AC-DC testers and 346 meter 0-300 volts. Send no money. Just fill out coupon. If after five-day test you're not delighted, return and purchase price will be promptly refunded! Here's what you get for only $13.50.

(1) One newly-designed Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.

(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with changeover switch. This reads plate current, which is always DC in all sets.

(3) One 0-300 volts high resistance voltmeter, No. 346, with tipped 30" cord to measure B voltages.

(4) One 5-prong plug with 30-inch cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.

(5) One grid switch to change bias.
(6) One 5-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome moire metal case.
(10) One instruction sheet.

$13.50
SEND NO MONEY

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"UNINTERRUPTED READER INTEREST"
EVERY WEEK — EVERY YEAR

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(Just East of Broadway)
Phone: BRYant 0556 and 0559

Fading Cause Found

TO BE LARGELY WAVE FRONT DISTORTION

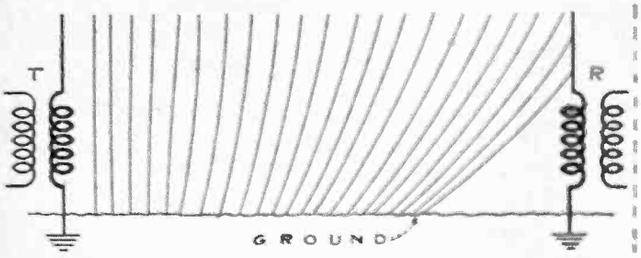


FIG. 1

THIS SHOWS HOW THE ADVANCING RADIO WAVE STARTING FROM THE TRANSMITTING ANTENNA T VERTICALLY GRADUALLY INCLINES TOWARD THE HORIZONTAL. ONLY THE VERTICAL COMPONENT OF THE WAVE IS EFFECTIVE IN THE RECEIVER ANTENNA R. IF THE INCLINATION VARIES FOR ANY REASON FADING RESULTS.

FIG. 2

WAVES NORMALLY SPREAD OUT FROM THE TRANSMITTING ANTENNA T IN CIRCLES. RECEIVER LOOP THEN POINTS DIRECTLY TO T FOR MAXIMUM SIGNAL STRENGTH. IF THE CIRCLES ARE DISTORTED (DOTTED LINES) WAVE REACHES LOOP AT AN ANGLE. IF ANGLE VARIES PERIODICALLY FADING RESULTS.

Washington.

THE radio phenomenon known as "fading" may be caused by waves not reaching the receiving antenna in the same position relative to the antenna in which they start, according to a statement by the Radio Division, Department of Commerce.

The full text of the statement explaining the results of the investigation by the Bureau of Standards into this phenomenon follows:

"For the past several months an investigation has been conducted by the Bureau of Standards to determine the factors contributing to the phenomenon known as fading.

Special Apparatus

"Special apparatus utilized in conjunction with radio receiving sets make it possible to secure graphic records of the increase and decrease of signal strength such as is commonly experienced when listening to programs from distant stations at night.

"This apparatus, sufficiently sensitive to indicate variations smaller than the ear can detect, was used with receiving systems employing different types of antennas to analyze the manner in which the waves transmitted from a broadcasting antenna arrive at the receiving antenna.

"The factors which may cause variations in the intensity of radio waves are complex, and a critical study of fading has suggested explanations of some of these factors.

"Graphic records of a single selected transmission were made, using identical receiving sets except for the antennas.

Types of Antennas

"The antenna systems used in the course of the investigation were (1) vertical antenna, (2) coil antenna directed toward the station being received, (3) coil antenna with plane at right angles to the direction of the transmission path, (4) combination of coil antenna and vertical antenna connected in such a way as to eliminate waves received directly from the station. Simultaneous records were made, using two receiving sets with different types of antennas.

"Examinations of data from simultaneous measurements made with a coil antenna in maximum position and with a vertical antenna, respectively, indicated that for stations 165 to 1,500 kilometers distance the same sort of fading occurred simultaneously in both antennas, but that for stations 13 to 53 kilometers distance similar fading characteristics did not occur simultaneously.

Results Interpreted

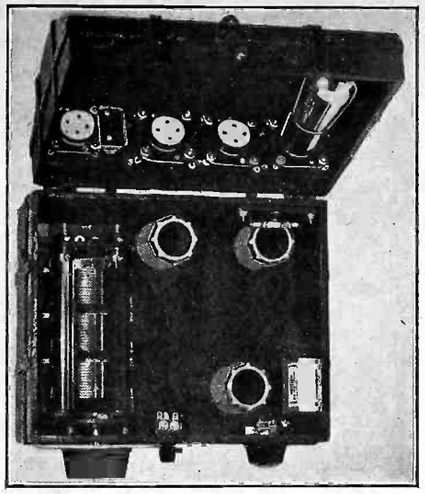
"Records made with coil antennas at maximum and minimum positions showed that for a station 300 kilometers distant, for instance, there are considerable periods in which an increase of intensity in one antenna is accompanied by a decrease in the other.

"Often a relatively rapid and periodic fluctuation of small magnitude is found superposed on the longer-period trend of the records. It was that, for one station at least. This superposed, rapid fading of periodic type occurs with considerable regularity directly after sunset and lasts for approximately a half hour.

"The results may be interpreted to mean that the waves do not reach the receiving antenna in the same position relative to antenna in which they start; that is, their plane of polarization is changed. This change only takes place when the wave has been reflected.

"Several reflections from different points may take place, resulting in there being at the receiving station two or more waves which started at the same time from the transmitting station and traveled very different paths before reaching the receiving station."

At a great distance from the transmitter the waves may reach the receiving antenna as in Fig. 1 because they have been reflected down from the Heaviside layer about 200 miles above the earth. The ground effect would cause the inclination at shorter distances. The distortion in Fig. 2 might be caused by a difference in the terrain, for example, a river at the upper side and dry ground on the lower.



THE SOCKETS ARE IN THE LID, THE TUNER IS IN THE BOX.

Yo! Ho! A Chinese

Four-Tube Speaker Set Built Into Resulted from a T rip to

By Herbert

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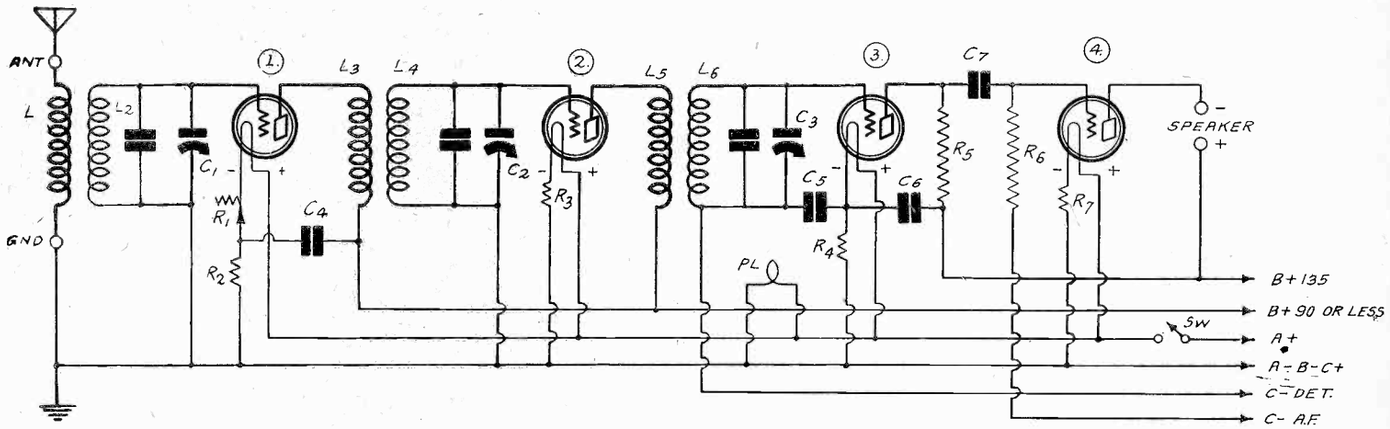
Chest Construction

The Chinese Chest idea may be developed to suit one's particular needs, since it is necessary to have only the general constructional groundwork to render this possible.

the wood, to give the curvature. This is easily disposed of by steaming the wood over a large boiler, such as a wash boiler, turning the wood from one side to the other, to get the full benefit of the steam on both sides, and then slowly exerting pressure until the wood is bent into the desired shape.

It is well to be able to identify this



A HIGH MU TUBE IS USED AS GRID BIAS DETECTOR IN THE CHINESE CHEST CIRCUIT

Photographs by the Author

AN entrancing cabinet design was fashioned after a Chinese Chest which I glimpsed during a Saturday afternoon stroll through a spacious curio shop in Chinatown. The chest was colored somewhat too boldly for my own tastes, in the original, so in the duplicate I embodied somewhat more dignity in the color scheme and built myself a chest that I believe will please many radio enthusiasts to possess.

The chest I made measured 9½ inches long by 5¼ inches deep by 6½ inches high. Into it could be placed conveniently a four-tube assembly, and after some thought I decided on a two-stage radio frequency amplifier, feeding a grid biased high mu detector, which proved to be enough indeed to operate a loudspeaker with only one stage of resistance-coupled audio.

Catches the Eye

Single tuning control, due to the use of a three-gang condenser; volume control by means of a rheostat; a switch for turning the set on and off, made the front of the chest simple ad presentable in appearance. On the top of the lid, near the front, was placed a colored window behind which reposed the pilot light, so that the green or red sparkle gave an added touch of fetching color—a fine contrast to the deep-hued grey of the chest itself, and the buff leather straps glued on in imitation of the steel bands on the original chest that caught my eye that happy Saturday afternoon.

No doubt everyone who reads these lines has built several radio receivers and expects to build many more, and it is equally certain that fetching effects are always sought by the builder, therefore I commend to all the Chinese Chest for its utter novelty, attractiveness, compact-

The chest is made in two sections. The lower one is a straight box. The curved lid is the other part. A springy piece of wire or other resilient medium is used for measuring the flat dimension of the curved portion, by straightening out to see what the total depth of the wooden lid should be before bending.

Next comes the problem of warping

LIST OF PARTS

L1L2L3—Three radio frequency transformers for .00035 mfd. tuning (Benjamin).

C1C2C3—One three-section .00035 mfd. condenser, with insulated sections, and built-in trimmers (Remler).

R1—One 20-ohm rheostat.

R2, R3, R4, R7—Four 1A Amperites.

R5—One Lynch .5 meg. metallized resistor.

R6—One Lynch 5.0 meg. Metallized resistor.

C4, C5—Two .006 mfd. fixed condensers (Aerovox).

C6—One .5 mfd. bypass condenser (Tobe).

C7—One .01 mfd. fixed condensers (Aerovox).

PL—One pilot light with switch Sw (Yaxley).

(1), (2), (3), (4),—Four sockets (Benjamin).

One ciricular dial, 340 degrees (Remler).

One Yaxley 6-lead cable connector.

Four binding posts (Ant. Gnd., Speaker +, Speaker —).

Two CeCo type A tubes, one CeCo type G, one CeCo type F12A.

One six-volt storage battery with .5 ampere trickler charger B supply, 135 or 180 volts.

Two 4½-volt C batteries (for 135 plate volts) or three for 180 volts.

shape instantly, and to that end a piece of cardboard may have been cut, as

Detector Tube

The volume one gets from a magnetic pick-up used for playing records through the audio amplifier of the radio set depends a good deal upon the design of the amplifier itself and upon what tubes and battery voltages are employed. There is another consideration, however, which has a highly important part in determining the maximum volume available. This is the method of connecting the phonograph pick-up to the radio receiver.

The old method of employing the pick-up called for an adapter which fitted in the detector socket of the radio receiver, with the output of the pick-up feeding into the first audio stage. The detector tube of the set had to be removed and, consequently, the amplification gain of this tube was lost. Today there is a new method of utilizing an efficient magnetic pick-up, such as the Pacent Phonovox, which method gives greater volume, when desired, and is at the same time much simpler.

Leave Detector In

The secret of obtaining the added volume lies in leaving the detector tube in its socket. The value of feeding the pick-up into the detector tube rather than into the first audio stage is apparent when one compares the overall amplification of the two systems. Assume that we have for detector an —01A type, or an AC—27; for firststage audio a tube of the —01A type; and for the output stage a —71 type power tube. Now terming the old method with the detector tube removed and replaced by the socket adapter Method 1, and the new system using detector tube

Chest!

Bizarre Cabinet that Chinatown

E. Hayden

shown in the illustration. The spring may be bent to conform to the curve on the cardboard, then straightened to give the actual width of the wood to be cut. The length of the wood, that is, the distance from side to side on the completed chest, when you are looking at the chest from the front, is not affected sufficiently to require any precautions for compensation.

Straps Decorative

The straps are not necessary for physical reasons, but they add a decorative touch and lend verisimilitude. Buff leather was used, this being a popular hue, and it made a good combination with the deep gray that the chest was painted.

At the rear two hinges are placed, as shown in one photograph, and also an opening is drilled for the cable connector. The plug part of the cable is not shown, but this has the flexible external leads connected to it, while to the jack end the wire leads in the set are carefully soldered.

The Circuit Itself

The tuning condensers, coils, switch, rheostat, fixed condensers and amperites are placed in the box part of the chest, while into the lid are built the four sockets and the single audio stage. A photograph shows this.

Flexible wire leads connect the parts in the box to those in the lid, so that when the lid is opening there is enough free room to prevent any lead from being strained.

As for the circuit diagram, this is a conventional two-stage radio frequency amplifier, using standard tubes, such as —01A, feeding a tuned detector input, where the detector, however, is a mu 30 tube known as high mu, and represented by the -40 type and CeCo type G. Unless a high mu tube is used as detector, with grid biased detection, the results are poor, but if the tubes are used as suggested, then there will be ample volume to operate a reproducer distortionlessly, a fact some who have not done much experimenting with this type of detector and audio cricuit may be inclined to doubt. But their own impending experience will rout their doubts for a certainty.

Value of Constants

If the voltage source applied to the detector plate resistor is 135, then the negative grid bias, with a .5 meg. resistor, should be about 3 volts, while for 180 applied volts the bias should be about 4½ negative. However, experiment yourself until you ascertain exactly the correct voltage.

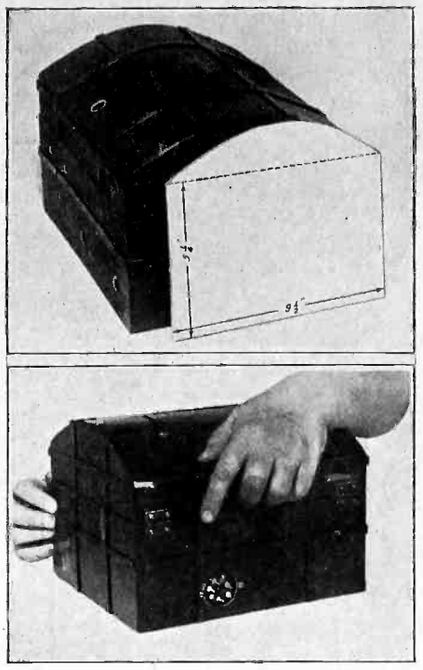
The circuit as shown is intended for a 112A output tube, and 135 volts total will be plenty, although if you have a 180-volt source you may use that maximum on the detector and even on the 112A, as well, by increasing the bias on the audio tube to around 15 volts negative and using an output device like the National Tone Filter.

Good Situation

As the 112A has a working mu of a little more than 8, a 3½-volt negative bias on the detector will cause the last tube to overload before the detector, a good point

The value of the plate resistor R5 is important from a frequency response consideration, since the high values of plate load have a high capacity effect. When .5 meg. is used the capacity resulting from the mu the tube and the plate resistance is enough to constitute an RF shorting condenser, hence one would not be needed, although if a smaller value of plate resistor is used, such as .1 meg., it is usually advisable to include a fixed condenser from detector plate to A minus or C minus, of about .0005 or .0001 mfd. capacity.

The volume control is a rheostat, and it works very satisfactorily at a value of 20 ohms maximum. It is impossible to overheat the first tube, as the 1-A Amperite R2 is constantly in circuit, and this prevents a filament voltage of more than five volts when the source of supply is six volts.



THE SIDE PATTERN AND THE REAR VIEW.

Handy Condenser

The gang condenser has built-in trimmers, shown in the diagram, and it is suggested that the circuit be balanced for tuning somewhere near the middle of the broadcast band.

This is done by tuning in some station, not particularly a strong one, and adjusting the trimmers with a wooden dowel until volume is maximum. Be careful to have no resistance of the rheostat in circuit when this balancing is being done.

The trimmers are of the set-screw type, hence the dowel is a sort of wooden screwdriver. Do not use a metal screwdriver, as the work is made difficult, while with a wooden dowel it is easy.

The circuit may oscillate a little at radio frequencies. If so, reduce the RF plate voltage. Satisfactory operation at 45 volts is obtainable, but greater voltage gives more volume, usually. The limiting factor regarding high voltage is the tendency toward oscillation. This may be checked additionally by putting grid suppressors of about 800 ohms or more between the stator of each tuning condenser and the grid of the RF socket to which it goes—but none in the detector stage.

However, the rheostat R1 will take care of oscillation control very nicely, if you want to operate the circuit under conditions that render regeneration possible. That method, of course, gives some extra "kick," which many prefer. Others, who desire a set that will not self-oscillate, may gain their end by following the suggestions already given.

Boosts Phonograph Volume

amplification Method 2, let us compare the overall voltage amplification:

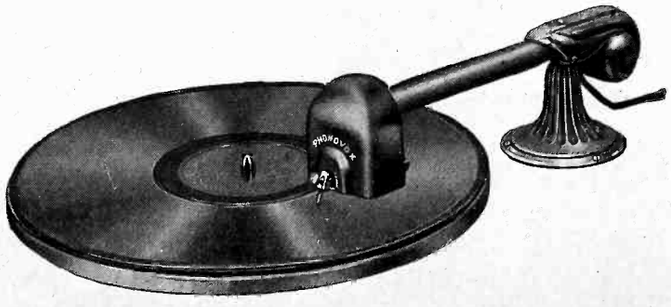
	Detector Amp.	1st Audio Trans.	1st Audio Tube	2nd Audio Trans.	2nd Audio Tube
Method 1	0	3	8	3	3
Method 2	8	3	8	3	3

Total Amplification: Method 1: 216
Method 2: 1728

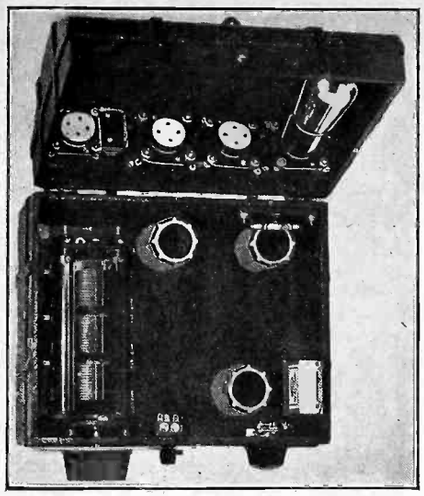
These two results show that the new method of hooking in the magnetic pick-up results in considerably greater amplification, and naturally greater volume, when desired, from the speaker.

Simple Method

The method of getting the extra amplification is extremely simple, and calls for no wiring changes or adjustments of the radio receiver or amplifier. As a matter of fact, the new method with its better results is easier to handle than the old, which called for removing and replacing the detector tube in the set as the operator changed from radio to recorded entertainment. New style Pacent adapters for both battery-operated and AC sets are available which fit over the prongs of the detector tube. Once the adapter is in place, the tube is put back in its socket and need not be removed when records are played with the Phonovox. This new method gives full advantage of detector tube amplification at zero bias, with the resultant increase in volume, which, of course, can be controlled readily from a whisper to the full maximum which is called for when there is dancing and a shuffle of many feet.



The phonograph pick-up gives much greater volume results when the detector tube, used as an amplifier, is included in the circuit.



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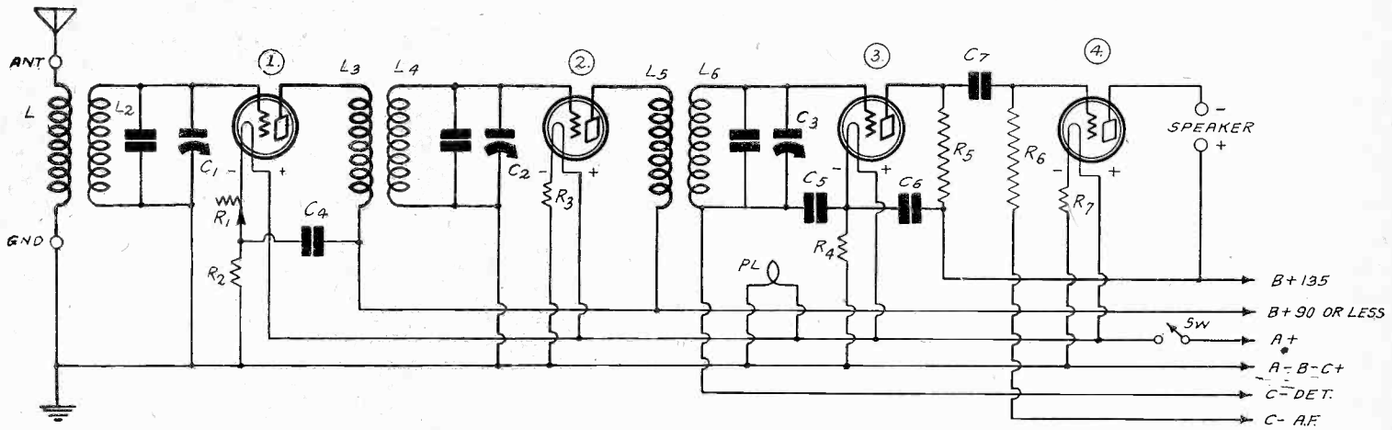

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As for the circuit diagram, this is a conventional two-stage radio frequency amplifier, using standard tubes, such as —01A, feeding a tuned detector input, where the detector, however, is a mu 30 tube known as high mu, and represented by the -40 type and CeCo type G. Unless a high mu tube is used as detector, with grid biased detection, the results are poor, but if the tubes are used as suggested, then there will be ample volume to operate a reproducer distortionlessly, a fact some who have not done much experimenting with this type of detector and audio cricuit may be inclined to doubt. But their own impending experience will rout their doubts for a certainty.

Value of Constants

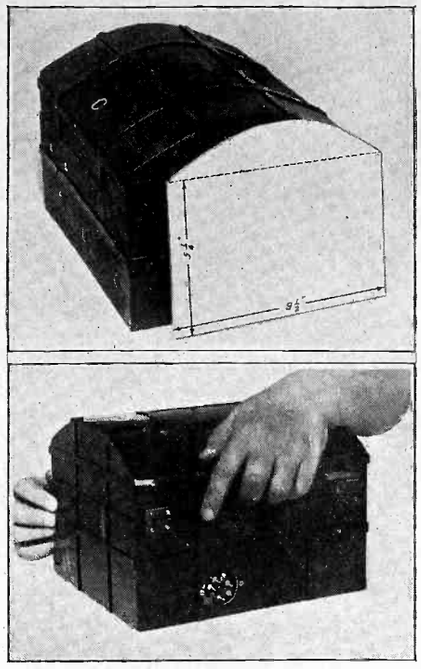
If the voltage source applied to the detector plate resistor is 135, then the negative grid bias, with a .5 meg. resistor, should be about 3 volts, while for 180 applied volts the bias should be about 4½ negative. However, experiment yourself until you ascertain exactly the correct voltage.

The circuit as shown is intended for a 112A output tube, and 135 volts total will be plenty, although if you have a 180-volt source you may use that maximum on the detector and even on the 112A, as well, by increasing the bias on the audio tube to around 15 volts negative and using an output device like the National Tone Filter.

Good Situation

As the 112A has a working mu of a little more than 8, a 3½-volt negative bias on the detector will cause the last tube to overload before the detector, a good point

The value of the plate resistor R5 is important from a frequency response



THE SIDE PATTERN AND THE REAR VIEW.

consideration, since the high values of plate load have a high capacity effect. When .5 meg. is used the capacity resulting from the mu the tube and the plate resistance is enough to constitute an RF shorting condenser, hence one would not be needed, although if a smaller value of plate resistor is used, such as .1 meg., it is usually advisable to include a fixed condenser from detector plate to A minus or C minus, of about .0005 or .0001 mfd. capacity.

The volume control is a rheostat, and it works very satisfactorily at a value of 20 ohms maximum. It is impossible to overheat the first tube, as the 1-A Amperite R2 is constantly in circuit, and this prevents a filament voltage of more than five volts when the source of supply is six volts.

Handy Condenser

The gang condenser has built-in trimmers, shown in the diagram, and it is suggested that the circuit be balanced for tuning somewhere near the middle of the broadcast band.

This is done by tuning in some station, not particularly a strong one, and adjusting the trimmers with a wooden dowel until volume is maximum. Be careful to have no resistance of the rheostat in circuit when this balancing is being done.

The trimmers are of the set-screw type, hence the dowel is a sort of wooden screwdriver. Do not use a metal screwdriver, as the work is made difficult, while with a wooden dowel it is easy.

The circuit may oscillate a little at radio frequencies. If so, reduce the RF plate voltage. Satisfactory operation at 45 volts is obtainable, but greater voltage gives more volume, usually. The limiting factor regarding high voltage is the tendency toward oscillation. This may be checked additionally by putting grid suppressors of about 800 ohms or more between the stator of each tuning condenser and the grid of the RF socket to which it goes—but none in the detector stage.

However, the rheostat R1 will take care of oscillation control very nicely, if you want to operate the circuit under conditions that render regeneration possible. That method, of course, gives some extra "kick," which many prefer. Others, who desire a set that will not self-oscillate, may gain their end by following the suggestions already given.

Boosts Phonograph Volume

amplification Method 2, let us compare the overall voltage amplification:

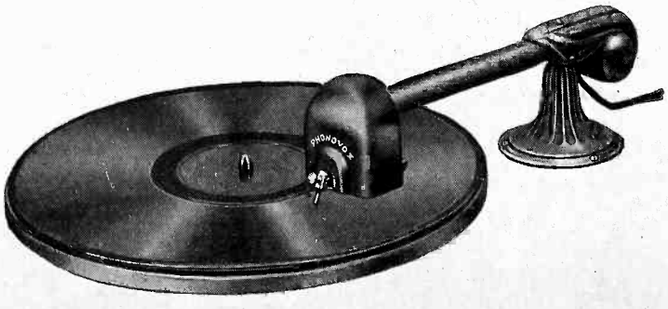
	Detector Amp.	1st Audio Trans.	1st Audio Tube	2nd Audio Trans.	2nd Audio Tube
Method 1	0	3	8	3	3
Method 2	8	3	8	3	3

Total Amplification: Method 1: 216
Method 2: 1728

These two results show that the new method of hooking in the magnetic pick-up results in considerably greater amplification, and naturally greater volume, when desired, from the speaker.

Simple Method

The method of getting the extra amplification is extremely simple, and calls for no wiring changes or adjustments of the radio receiver or amplifier. As a matter of fact, the new method with its better results is easier to handle than the old, which called for removing and replacing the detector tube in the set as the operator changed from radio to recorded entertainment. New style Pacent adapters for both battery-operated and AC sets are available which fit over the prongs of the detector tube. Once the adapter is in place, the tube is put back in its socket and need not be removed when records are played with the Phonovox. This new method gives full advantage of detector tube amplification at zero bias, with the resultant increase in volume, which, of course, can be controlled readily from a whisper to the full maximum which is called for when there is dancing and a shuffle of many feet.



The phonograph pick-up gives much greater volume results when the detector tube, used as an amplifier, is included in the circuit.

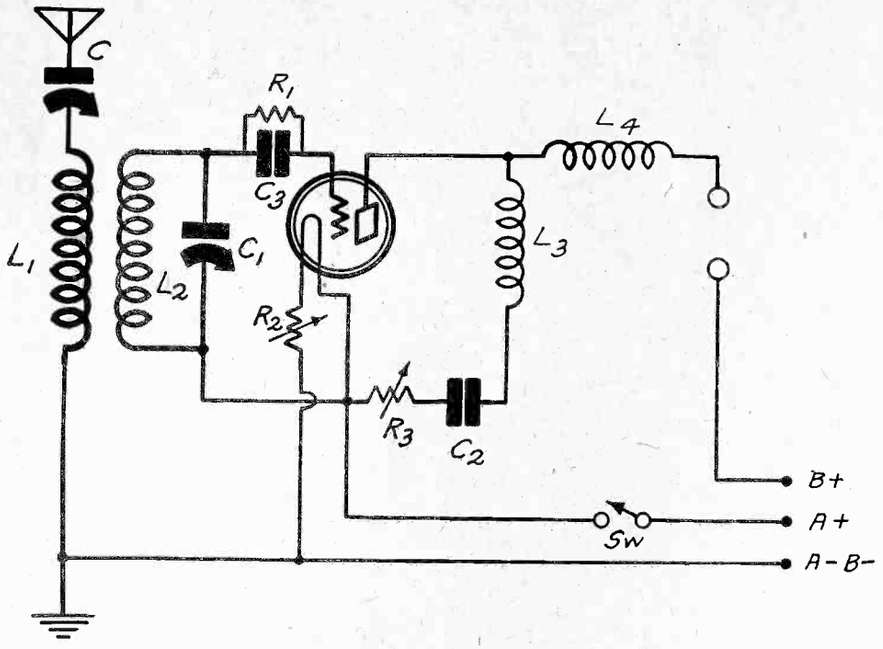
A Short-Wave

With Resistance-Controlled

By Adam

SMALL sized, low inductance coils that plug into ordinary tube sockets are now available for building short wave adapters. These coils enable the set builder to make convenient and effective adapters which cover a wide range of short wavelengths.

Each of these short wave coils usually contains three windings, an antenna circuit winding L1, a tuning coil L2 and a tickler L3. The antenna coil contains a relatively small number of turns and it is mounted on the coil form so that the coupling between the antenna circuit and the secondary is loose enough to insure oscillation at all settings of the tuning condenser.



GIF. 1

THE DIAGRAM OF A ONE-TUBE, SHORT-WAVE ADAPTER IN WHICH THE REGENERATION IS CONTROLLED WITH A VARIABLE RESISTANCE.

LIST OF PARTS

C—One 5 plate midget condenser.
C1—One .00014 mfd. tuning condenser.
C2—One .0005 mfd. fixed condenser.
C3—One .00015 mfd. grid condenser with clips for resistor.
L1, L2, L3—One set of plug-in three circuit coils with fixed ticklers and primaries.
L4—One 85 millihenry RF choke.
R1—One 2 or 5 megohm grid leak.
R2—One 25 ohm rheostat (optional).
R3—One volume control clarostat.
One three wire cord with standard four prong plug.
Four binding posts.
Two standard sockets.
One Vernier dial.
One aluminum can of suitable dimensions.
One baseboard.

The tickler coil has a number of turns such that the ratio of turns between L2 and L3 insures optimum regeneration in the middle of the tuning range for which any one coil is intended.

Several sizes of coils are available so that all the active short wave range may be tuned in, with ample overlapping of adjacent ranges to prevent gaps.

The antenna may contain a small condenser C, Fig. 1, by means of which the volume as well as the selectivity may be varied. This condenser is a 5 plate midget, which may be seen in the left front corner of Fig. 2.

Control of Regeneration

The tuning condenser C1 is a .00014 mfd. variable which may be seen at right just back of the front panel in Fig. 2. The rotor of this condenser and its frame are connected to the positive end of the filament. This insures a positive return of the grid of the detector, since the winding L2 is connected to the rotor.

Although L3 is not shown in the diagram as in inductive relation with L3 it is wound on the same form and it feeds back energy to that coil. A fixed condenser C2 of .0005 mfd. is connected in series with the coil to prevent the direct current in the plate circuit as well as the audio frequency signal from shunting around the output.

The regeneration is controlled with a 10,000 ohm variable resistance R3. This is mounted on the right of the front panel, Fig. 3, and it may be seen under the tuning condenser in Fig. 2.

The adjustment of the regeneration depends on the size of C2. Under average conditions a value of .0005 mfd. is right, but in some cases another value may be required. Suppose the condenser has this value. If the circuit oscillates at all settings of condenser C1 when R2 is set at zero and at no setting when R2 is set at maximum the value is all right. If the circuit does not oscillate at all settings when R2 is set at zero the size of the condenser must be increased. If the circuit oscillates at some setting when the resistance is set at maximum the capacity of the condenser must be decreased.

L4 is an RF choke coil of 85 millihenries used for preventing the radio frequency currents from escaping through the distributed capacity of the headset or the audio coupling transformer.

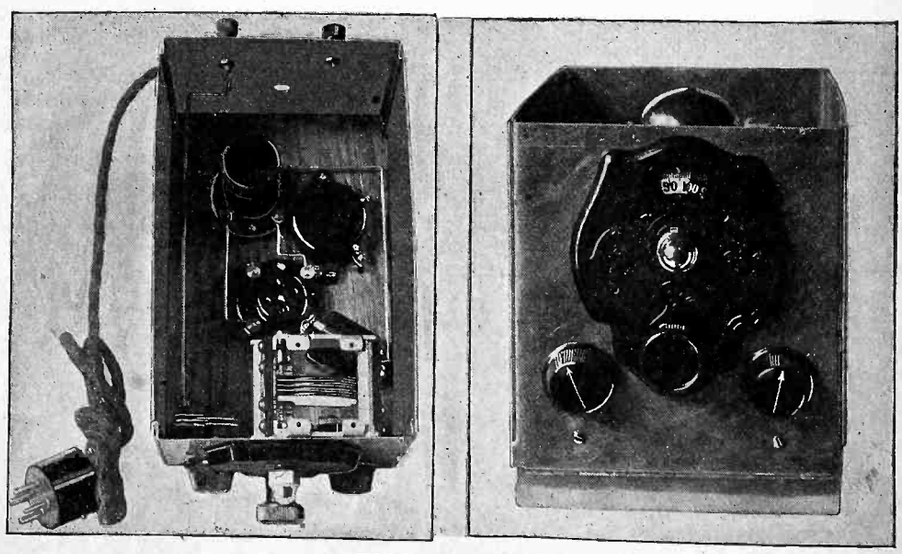
The choke coil must be so wound that it is a choke for the highest radio frequencies which will be tuned in with the plug-in coils. Special winding is necessary to insure that the distributed capacity of the choke is not so great that the coil will act as a condenser to the higher radio frequencies.

Leaky Condenser Detection

The leaky condenser method of detection is used in the circuit. R1 has a value of 2 megohms or more. C3 should have a capacity of about .00015 mfd.

A rheostat R2 is shown in Fig. 1. When the circuit is designed for plugging into an existant receiver this rheostat is not necessary because there is a filament current limiting device in the receiver already. But if the circuit is built as a separate short wave receiver R2 should be used and its value of a —01A tube should be 25 ohms.

An open circuit antenna should be used. It may be erected indoors or outdoors but its length should not exceed 75 feet. If it is too high and long the set will not be selective on the highest frequencies,



FIGS. 2 AND 3

RIGHT (FIG. 3)—SHOWS THE PANEL LAYOUT OF THE SHORT WAVE ADAPTER. LEFT (FIG. 2)—THE BASEBOARD LAYOUT OF THE SHORT WAVE ADAPTER, AS SEEN FROM THE TOP OF THE ALUMINUM CONTAINER.

Adapter

Regeneration

uggle

and it may be impossible to make the circuit oscillate properly. One of the objects of C is to shorten the effective length of the antenna. A good ground should be provided.

Two binding posts for a headset are provided in the plate circuit of the tube. If the set is built for operation in conjunction with the audio amplifier and loudspeaker these two binding posts should be connected with a wire. The proper connection with the primary of the first audio transformer is made automatically when plugging in.

The lines marked B plus, A plus and A-B-should be run to a three wire cable terminating in a plug that fits a standard socket.

Fig. 2 shows the baseboard assembly of the adapter. The terminal plug is at the left outside of the aluminum container. At the rear left is a standard tube socket with one of the three circuit coils plugged in. Between the tuning condenser and the coil is the tube socket. The choke coil L4 is seen between and to the right of the two sockets.

Fig. 3 shows the panel layout of the adapter. It contains the knobs of the midget condenser, at left, and the 10,000 ohm resistance, at right. A large vernier dial controlling the tuning condenser is in the middle.

In Fig. 3 is tube in the socket showing that there is just enough clearance in the aluminum container.

Short Wave Uses, Classified by Channels

The frequency assignments to various services from 1,500 k.c. up, as adopted by the International Radio Convention held in Washington, D. C., in December, 1927, are:

kc.	*Meters*	*Class*
1500-1715	200-175	Mobile
1715-2000	175-150	*Amateur Phone and CW*
2000-2250	150-133	Mobile and Fixed
2250-2750	133-109	Mobile
2750-2850	109-105	Fixed
2850-3500	105-85	Mobile and Fixed
3500-4000	85-75	*Amateur CW*
4000-5500	75-54	Mobile and Fixed
5500-5700	54-52	Mobile
5700-6000	52-50	Fixed
6000-6150	50-48.8	Broadcasting
6150-6675	48.8-45	Mobile
6675-7000	45-42.8	Fixed
7000-7300	42.8-41	*Amateur CW*
7300-8200	41-36.6	Fixed
8200-5500	36.6-35.1	Mobile
8550-8900	35.1-33.7	Mobile and Fixed
8900-9500	33.7-31.6	Fixed
9500-9600	31.6-31.2	Broadcasting
9600-11,000	31.2-27.3	Fixed
11,000-11,400	27.3-26.3	Mobile
11,400-11,700	26.3-25.6	Fixed
11,700-11,900	25.6-25.2	Broadcasting
11,900-12,300	25.2-24.4	Fixed
12,300-12,852	24.4-23.4	Mobile
12,852-12,350	23.4-22.4	Mobile and Fixed
12,350-14,000	22.4-21.3	Fixed
14,000-14,400	21.41-20.8	*Amateur CW*
14,400-15,100	20.8-19.85	Fixed
15,100-15,350	19.85-19.55	Broadcasting
15,350-16,400	19.55-18.3	Fixed
16,400-17,100	18.3-17.5	Mobile
17,100-17,750	17.5-16.9	Mobile and Fixed
17,750-17,800	16.9-16.85	Broadcasting
17,800-21,450	16.85-14	Fixed
12,450-21,550	14-13.9	Broadcasting
21,550-22,300	13.9-13.45	Mobile
22,300-23,000	13.45-13.1	Mobile and Fixed
23,000-28,000	13.1-10.7	Unassigned
28,000-30,000	10.7-10	*Amateurs and Experiments*
30,000-56,000	10-5.35	Unassigned
56,000-60,000	5.35-5	*Amateurs and Experiments*
60,000 and higher	5 and lower	Unassigned

Latest List of Short Wave Calls

Call Signal	Wavelength (meters)	Frequency (Kilocycles)	Power (Watts)	Controlled by and Location
8XK	Variable	Variable	40,000	Westinghouse El. & Mfg. Co., East Pittsburgh, Pa.
4XE	Variable to 200	Variable to 1,499	250	Wm. Justice Lee, USNR
8XP	10-150	29,982 to 1,999	500	General Electric Co., Schenectady, N. Y.
2XAD	21.96	13,650	Var.	Westinghouse El. & Mfg. Co., East Pittsburgh, Pa.
2XAL	30.91	9,700	500	Experimentor Pub. Co., Coteysvile, N. J.
2XAF	31.4	9,550	Var.	General Electric Co., Schenectady, N. Y.
8XAO	32	9,370	75	WJR (Inc.)
6XBR	40 and 105	7,496 and 2,855	500	Warner Bros., Los Angeles, Calif.
8XAL	52.05	5,760	500	Crosley Radio Corp., Harrison, Ohio
7XAO	53.54	5,600	100	Wilbur Jerman Inc., Portland, Ore.
2XBH	54.02	5,550	150	Charles G. Unger, Coney Island, N. Y.
8XJ	54.02	5,550	50-250	Ohio State University, Columbus, Ohio
3XL	59.96	5,000	30,000 max	R. C. A., Bound Brook, N. J.
9XU	61.06	4,910	510	Mona Motor Oil Co., Council Bluffs, Iowa
2XBA	65.18	4,600	50	WAAM (Inc.) Newark, N. J.
2XAQ	65.4	4,610	50	L. Bamberger & Co., Newark, N. J.
6XAI	66.04	4,540	50	Los Angeles Radio Club, Los Angeles, Calif.
8XF	66.04	4,540	500	Radio Air Service Corp., Cleveland, O.
6XUA	104.1	2,880	50	Times Mirror Co., Los Angeles, Calif.
6XBX	105	2,885	50	McWhinnie Electric Co., Venice, Calif.
9XAB	105	2,885	50	R. J. Rockwell, Omaha, Neb.
1XY	105, 109	2,855 and 2,751	50-250	Booth Radio Laboratories, Tilton, N. H.
7XC	105.2	2,850	5-250	Northwest Radio Service Co., Seattle, Wash.
6XAN	105.9	2,830	250	Freeman Lang, Los Angeles, Calif.
6XA	107.1	2,800	100	Los Angeles Evening Express, Los Angeles, Calif.
6XAK	108.2	2,770	50	F. Wellington Morse, Eureka, Calif.
6XBA	108.2	2,770	250	Echofone Mfg. Co., Los Angeles, Calif.
6XAL	108.2	2,770	50	L. E. Taft, Los Angeles, Calif.
6XAF	108.2	2,770	100	Clarence B. Juneau, Los Angeles, Calif.
1XAA	200	1,499	7.5	Stanley N. Read, Providence, R. I.
2XE	236.1 and 106	1,270 and 2,828	50	Atlantic Broadcast-Company, Richmond Hill, N. Y.

Merge Australian Stations

Washington—A merger of broadcasting stations in Australia has been proposed, states Counsel General E. M. Lawton, Sydney, in a report made public by the Department of Commerce. The full text of the report follows:

"A company already has been formed in Sydney to take over the control of the two stations in that city as a first step.

"Proposal of the merger is said to be the result of complaint of duplication of radio programs and lack of variety and interests in the programs generally. Definite suggestion to link up the Class A stations in all Australian States with the exception of Queensland, which is State controlled, was advanced by the Australian Minister."

Satisfactory service is expected.

The Superiority of S

THE SIXTEEN POINTS OF COMPARISON IN THE

By Herman

FOR twenty years the three-element tube, as invented by Dr. Lee De Forest, stood supreme, until the screen grid tube, with its four elements, came along, last October, to receive at first a quizzical reception, to be followed, however, by a frenzied greeting by experimenters.

Even the greatest tube manufacturers have revised somewhat their recommendations regarding the screen grid tube, simply because they have become more familiar with its uses, characteristics and performance.

Its use as a detector was either mildly suggested with leaky condenser rectification, but grid bias detection was inhibited because of "insensitivity," or nothing at all was said about it as a detector.

More recent investigations into the fascinating subject of screen grid tubes used as detectors has established in the most expert minds the conviction that as a detector, using negative grid bias, with proper plate load, the tube is in a class by itself.

Volume or Selectivity

You may use the tube as a space charge detector or in orthodox screen grid fashion, in both instances with grid bias, and have your choice of extremely high volume, or extremely high selectivity, either without distortion.

The space charge method affords the volume while the screen grid gives you the selectivity.

This option is indeed a happy one, since it confers upon this tube a versatility as a rectifier that makes it possible to conform best to the radio frequency amplification ahead of the detector.

Combination of Effects

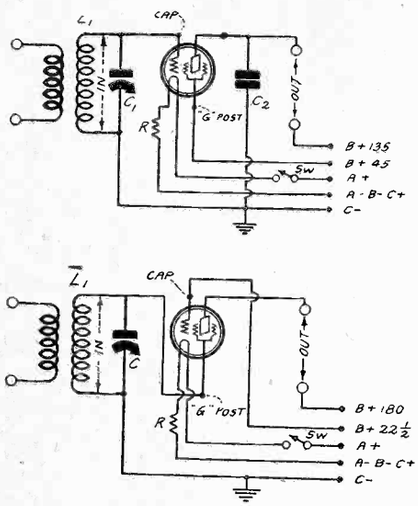
As a space charge detector, with grid bias, the tube gets its exclusive volume from a combination of effects, one of which is the increased mutual conductance, another the better proportionment of the plate load to the plate resistance. The mutual conductance is the number of microamperes of AC or signal current in the plate circuit per volt of input on the grid. The plate resistance, when speaking of tube characteristics, refers to the resistance to AC or signal current.

In other days a sharp distinction was attempted between alternating current and pulsating direct current, but since both of them alternate, the term AC has come to be applied to both.

As a screen grid detector, with grid bias, the high selectivity is obtained almost exclusively from the absence of flow of direct current in the grid. As is well-known, a positively biased grid draws current, whereas a sufficiently negatively biased grid draws none.

Location Becomes a Factor

Therefore, given a great option, one may accommodate his grid biased screen grid detector to either condition of radio amplification—one where the selectivity is high and the amplification low, and one where the selectivity is low but the amplification is high. Incidentally, the method to be employed is also affected by location conditions, since folk living in the rural sections will want the volume, not needing the extra selectivity, where urbanites will prefer the increased selectivity, their favorite stations coming in with volume aplenty, but with some cross-talk and other interference arising from insufficient selectivity. Then again,



TWO USES OF SCREEN GRID TUBE AS A DETECTOR

(Top)—A grid biased screen grid detector, used in screen grid fashion, whereby the cap is the control grid and the G post of socket is the screen grid. A condenser, C2, of .001 mfd., aids detection by providing a low impedance to radio frequencies and a high impedance to audio frequencies. Note that the plate voltage is 135 and the screen grid voltage (G post) is 45. "In" designates input, "Out", output.

(Lower)—The other way of using the screen grid tube is by the space charge method, whereby the cap goes to B plus 22½ and the G post to the grid coil. This gives eight times as much volume but 40 per cent less selectivity. Note the plate voltage is 180, not 135, and that the screen grid voltage is 22½, not 45. No condenser is used in the plate circuit to bypass radio frequencies, because the plate-to-filament capacity is high enough to give this aid to detection.

the two fine uses may be combined in the Super-Heterodyne, where the modulator (first detector) may be a grid biased screen grid detector, while the second detector is a space charge type. It is always important to have good selectivity in the first detector, since any interference arising from low selectivity at this point, will be amplified in the intermediate channel, and the greater the amplification at the intermediate frequency, the worse the interference becomes.

Permits Single AF Stage

The second detector, however, well may be a space charge variety, since then the volume gain may be used quite readily to operate a loudspeaker with only one stage of audio amplification, and that resistance coupled!

Hence there would be only one audio tube, and that the power tube.

Lest there be suspicion that no power tube could be operated efficiently in this fashion, due to small input for the low mu of some of the power tubes, let it be known that a —71A may be taxed to its utmost by a space charge detector output, the second detector, on many stations, developing 7 volts on the grid, 49 on its output, operating on the square law, hence 8.5 volts in excess of the standard bias of 40.5 negative grid volts for 180 plate volts of the —71A. (The root mean square of the AC signal voltage, which is about seven-tenths of that voltage, need not be distinguished from the DC voltage for the purposes of this illustration.)

Screen vs. Control Grid

The screen grid tube has the usual elements of control grid, plate and filament, plus the fourth element or screen grid, which surrounds the plate and is the outermost element inside the glass envelope. Next, travelling inwardly, comes the plate, then the screen grid again, then the control grid, and then the filament, the innermost element.

In terms of the socket binding posts, the plate and filament are standard, while the G post is the outer or usual screen grid. The control grid connection is made to a cap on the top of the tube. This terminology of control grid distinguished from screen grid presupposes the use of the tube as a screen grid amplifier or detector. When the space charge adaptation is used, the functions of the two grids are reversed, since the cap, instead of being the control or old familiar grid, becomes the screen grid, while the G post or outer grid is the control grid. Whichever grid takes the input is the control grid.

The Sixteen Points

The two different uses of the screen grid tube cause very definite changes in the operating characteristics and in the requirements of load impedances:

(1) The AC plate resistance of the screen grid type of hookup is 850,000 ohms, which is enormous.

(2) The AC plate resistance of the space charge circuit is 150,000 ohms.

(3) The positive voltage on the plate of the screen grid hookup should be 135 volts.

(4) The positive voltage on the plate in the other method should be 180 volts.

(5) The positive voltage on the outer grid—G post of socket—in the screen grid hookup should be 45 or thereabouts for 135 plate volts.

(6) The positive voltage on the space charger—this time the cap of the tube—should be 22½ volts or thereabouts for 180 volts in the plate.

(7) The selectivity of the screen grid detector is about 40 per cent. greater than that of the space charge detector.

(8) The volume of the space charge detector is about eight times as great as that of the screen grid detector, grid bias rectification being used in both instances.

(9) The plate current usually is larger in the space charge connection while the screen grid current (from the B supply) is usually less, since for a given bias the sum of the two currents remains roughly a constant.

(10) The tube's mutual conductance, which may be regarded as the figure of merit of the tube, is 350 for the screen grid circuit.

(11) In the space charge circuit the mutual conductance becomes 400.

(12) The voltage amplification factor of the screen grid amplifier is 300, too high to be of practical maximum use in cascaded

(13) The voltage amplification factor of circuits.

the space charge amplifier is 60, although the seemingly sharp difference between (12) and (13) does not apply to detection, because the voltage amplification is no better than the square law permits.

(14) The screen grid method requires a

creen Grid Detection

AMAZING RECTIFYING POSSIBILITIES OF THIS TUBE

Bernard

very high plate resistor, perhaps too high to permit sufficient flow of plate current, which is low indeed in the detector circuit under any conditions, often being no more than .1 or .2 milliamperes, or otherwise requiring a compensatingly high plate voltage not obtainable from B supplies in general use and not safe for the tube.

(15) The space charge detector functions best with plate resistors of general utility and distribution, hence the load resistance is better proportioned to the plate resistance, and the rule that the resistance of the plate load should be at least twice the resistance of the vehicle (plate of tube) is readily applied.

(15) The screen grid hookup provides extremely low plate-to-filament capacity (.00000002 mfd.) and needs a plate RF bypass condenser.

(16) The space charge detector develops a capacity of .0013 mfd. at 10,000 cycles under given conditions and no external bypass condenser should be used.

Why a Resistor?

In actual practice 250,000 ohms (.25 meg.) may be taken as the nearest convenient approach to double the plate resistance, since the next highest resistor value readily obtainable commercially is .5 meg. However, higher values should be preferred as against lower values, because the voltage drop in the plate resistor constitutes the sole input to the succeeding resistor, and the grid resistor should be at least twice as high as the plate resistor.

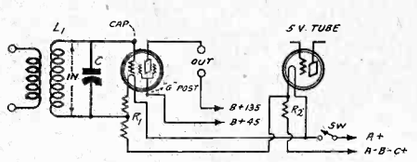
It is assumed that a resistor will be used as the load on the plate circuit, because of good frequency characteristics, readiness of change of load resistance for experimental purposes, economy and absence of inductive field. An audio choke coil may be used, but it is doubtful if its impedance ever can be high enough to approach the ideal, unless some special form of winding is used for keeping the distributed capacity low enough to prevent over-bypassing higher audio frequencies.

Whether such avoidance can be accomplished when the space charge circuit is used is extremely doubtful, for the tube elements themselves build up a capacity between plate and filament of .0013 at 10,000 cycles, with 2 meg. external plate load, caused largely by the mu of the tube and the external or load resistance, this capacity being measurable from grid to filament, because of the common leads of the batteries or plate and grid returns. Hence the capacity becomes the input capacity of the tube.

What Bias?

From these considerations the reason for requiring no external bypass condenser with a space charge detector becomes obvious—the capacity exists in the tube. However, with the screen grid detector (as distinguished from space charge) it has been found advisable to include the bypass condenser, to contribute the extra capacity needed for affording low radio frequency impedance (a virtual RF short circuit) while retaining high audio impedance.

What the negative grid bias should be for detection is a confusing subject, judging from available reading matter, but with 180 plate volts best rectification was obtained from a 12-volt battery. As a resistor dropped the 6 volts of the storage battery to 3.3 volts at the filament, this drop of 2.7 volts, lying between minus A and negative filament, made the grid actually 14.7 volts negative. As bias is reckoned always from



HOW BIAS IS OBTAINED FOR SCREEN GRID RF AMPLIFIER

If the voltage source is 6 then 2.7 volts would have to be dropped at a current flow of .132 ampere, to provide the 3.3 filament voltage for the screen grid tube. This calls for 20 ohms. However, some commercial devices are 15 ohms, tapped at 5 ohms. These are intended for connection to filament minus of a 5-volt tube. The resistor in the 5-volt tube filament has to be readjusted then.

negative filament, the grid return, if connected to minus A, would be 2.7 volts negative, and by the interposition of the C battery this voltage adds to that automatically dropped in the filament resistor.

At 135 plate volts, 7½ volts negative bias worked well.

Adjust Plate Voltage

With screen grid detection by the grid bias method the bias should be in the regions suggested, although it is easy for the experimenter to determine the question for himself. The space charge detector usually requires less negative bias than the other. In conducting experiments, however, bear in mind that the characteristic curve is steep, hence the region of detection is limited, and 1½ volts difference may give you splendid detection as compared with no detection at all. You might build a set and get no signals, therefore, only because the negative grid bias was a few volts out of the way. It is therefore suggested that the plate voltage be adjusted, since finer gradations are possible, as compared with the 1½-volt minimum jumps required by C batteries.

Change in plate voltage may require change in screen grid voltage, therefore make all adjustments with grid bias, plate voltage and screen grid voltage in mind. The adjustments, once made, need not be changed, unless B batteries are used until they are at or past the point of cutoff voltage which marks the normal end of their useful life.

For a Super-Heterodyne first detector use 22½ volts negative for 180 volts in the plate.

Best There Is

The screen grid tube, therefore, used either way as a grid bias detector, will stand a bigger grid swing than any other tube used as detector in broadcast receivers, is the only tube that distortionlessly permits the driving of the most popular power tubes, 112A and —71A, to maximum of their undistorted power output without any other audio tube, constitutes as a screen grid detector the most selective detector so far known, and as a space charge detector the loudest undistorting detector so far known, gives you the option of eight times as much volume or, instead, 40 per cent. greater selectivity, and by the screen grid method is almost as sensitive as any other detector, and by the space charge method is more sensitive than any other.

By grid bias it is the most versatile detector tube and the best deetctor tube there is.

Table Tells What Size of Drill to Use

When building radio sets the question often arises as to what size of drill is to be used for a given size machine screw. One size of hole is necessary when it is to be tapped for a given size screw and another size of hole when the screw is to pass clearing the hole.

While there are many standard sizes of screws and number of threads per inch there are only a few which are commonly used in radio and it is easy to remember what drill is required for each.

Common Sizes

The most common sizes met in radio work are 2-56, 4-36, 4-32, 6-32, 8-32 and 10-24. The first part of each of these refers to the number or size of the screw and the second refers to the number of threads per inch.

The size of hole required for clearance depends on the number of the screw. The size of hole for tapping also depends on the number of threads per inch. The following table gives the number of drill required for tapping and clearance for the six common screws named above.

Screw number	Drill number tapping	Drill number clearance
2-56	49	42
4-36	42	31
4-32	43	31
6-32	35	26
8-32	29	17
10-24	25	8

These drill numbers refer to metal work. For some other types of material it is required to drill a slightly larger hole for clearance, or rather to use a slightly larger drill in order that the hole may be large enough. This is particularly true of laminated materials used for panels as well as of hard rubber.

Rubber Different

In the case of rubber the hole drilled with the regular drill is large enough at first but the substance has a tendency to flow when hot, thus decreasing the size of the hole.

Polymet Head Weds

Nat Greene, vice-president of the Polymet Manufacturing Company, recently became the husband of Dr. Esther Tuttle, of Boston, at the Hotel Biltmore, New York. After the ceremony the couple left for a honeymoon at Lake Placid, in the Adirondack Mountains. On their return they will live in New York City.

NEW YORK OFFICE OPENED

A. Irving Witz, of Gray Sales Co., 611 Widener Bldg., Philadelphia, announced that the Company has opened a New York office and showroom at 222 Fulton Street, Telephone, Cortlandt 6209. Max Witz, Irving's brother, will be in charge.

The Curse of

By Capt. Peter

Contributing

MANY of the early eperimenters in radio will remember the zero beat method of reception, the most sensitive method known. It was that method which was used by the Western Electric Company in 1915 for receiving voice signals in Washington, D. C., from Honolulu, as well as signals in Paris from Washington.

The zero beat method employs a local oscillator tuned to exactly the same frequency as the transmitter frequency so

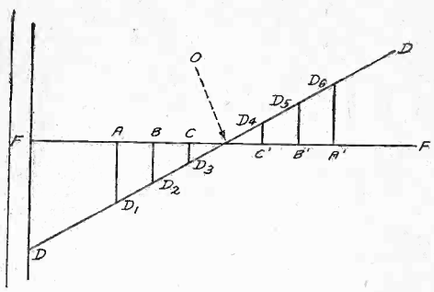


FIG. 1

A DIAGRAM ILLUSTRATING HOW THE ZERO BEAT REGION BETWEEN TWO OSCILLATORS DEPENDS ON THE COUPLING. THE VERTICAL LINES BETWEEN DD AND FF ARE THE VALUES OF THE BEAT FREQUENCIES WHEN THE BEAT DISAPPEARS AND REAPPEARS FOR VARIOUS DEGREES OF COUPLING.

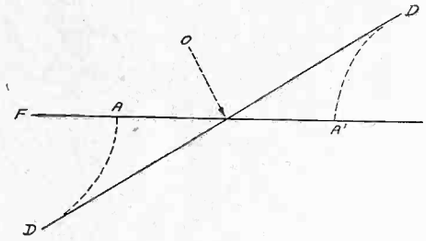


FIG. 2

THE DOTTED LINES CONNECTING FF AND DD REPRESENT REGIONS OF INSTABILITY OF OSCILLATION AND SHOW HOW THE FREQUENCY OF ONE OSCILLATOR IS PULLED OVER TO THAT OF THE OTHER AS THE NORMAL FREQUENCIES OF THE TWO WILL APPROACH EACH OTHER.

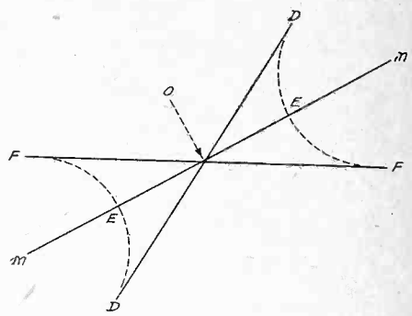


FIG. 3

WHEN TWO IDENTICAL OSCILLATORS ARE COUPLED TOGETHER THEY MUTUALLY AFFECT EACH OTHERS' FREQUENCIES. THE BEAT TAKES THE ROUTE OF THE DOTTED CURVES. IN THE REGION EE THE TWO OSCILLATORS ACT AS ONE WITH A FREQUENCY WHICH IS THE MEAN BETWEEN THE TWO.

that the beat frequency between the two oscillators is zero. The intensity of the received signal in this case is proportional to the product of the amplitudes of the local oscillation and of the radio frequency picked up from the distant station. The strength may be built up to almost any desired extent by merely increasing the strength of the local oscillation.

Many operators of regenerative receivers have employed the same system in receiving distant broadcast stations. They have advanced the regeneration until the circuit oscillated vigorously and then adusted the frequency of the local oscillation until it was the same as that of the distant oscillation. Stations have been picked up in this manner when the signals from them were entirely too weak to be picked up by ordinary regeneration.

Boominess of Signals

But the operators of these zero beat receivers noticed that the signals were boomy and of a decidedly hollow and unpleasant quality. Only the low frequencies were present. The high frequencies which give crispness and naturalness to the signals were entirely absent so far as the ear could tell.

The wonder is that any signals at all could be received. When the local frequency is adjusted to exactly the same value as the frequency of the distant oscillator the side frequencies very close to the carrier frequencies are built up to enormously higher values than the side frequencies nearer the modulation crest. Thus the sub-audible frequencies were intensified and the audible side frequencies were relatively suppressed. The effect is the same as the side band suppression caused by ultra-selective circuits.

One reason for the intelligibility of the received signals by this method is that the signals received from the distant station control the frequency of the local oscillator within a certain band. This produces a narrow band of zero beat rather than a point. For example, the zero beat does not occur at the frequency point F, but in the frequency band limited by F—f and F+f. Thus all frequencies within the band 2f cycles wide could be received. If 2f has a width of 10,000 cycles side frequencies as high as 5,000 cycles would be included in the reception and the signals would be perfectly intelligible.

Narrower Band Received

But in most instances the zero beat region was much narrower than that. In many instances it contracted down to 100 cycles, when the intelligibility would be very poor.

The width of the zero beat band depends on the degree of coupling between the two oscillators and the relative intensity of the oscillations at the receiver. Thus if the received signal is strong and the local weak, the zero beat band is wide, and if the received signal is weak and the local strong the band is narrow. Hence the greater the distance to the station received the more boomy and less intelligible would the signals be.

The behavior of two beating oscillators can be studied by measuring the value of the beat frequency between two calibrated oscillators, the frequency of one of which remains constant and the other is varied. Referring to Fig. 1, let the horizontal line FF be the frequency of the constant oscillator. Let the inclined line DD be the frequency of the variable oscillator. The abscissas are laid out to an arbitrary scale which will make DD straight.

Variation of Beat Frequency

At first set the frequency of the variable oscillator at a value much lower than that of the fixed. The beat frequency is measured by the line FD. The difference between the two frequencies is so great that the two are entirely independent of each other. Increase the variable frequency until the beat is AD1.

If the coupling between the two oscillators has a certain value the beat frequency cannot be decreased beyond the point A, but the two oscillators break into oscillation at a single frequency and the beat suddenly disappears. Now if the frequency control of the variable oscillator be changed so as to increase the frequency the beat remains zero until the point A^1 is reached, when the beat suddenly appears with the same frequency it had when it disappeared at A. Thus AA^1 is the zero beat region between the oscillator for the given degree of coupling.

If the coupling between the two oscillators be decreased the beat can be lowered until it has the value BD2. As the virtual frequency of variable oscillator is increased the beat remains zero until the point B^1 is reached, when it suddenly reappears with the same value it had at B. That is, BD2 equals A^1D5. Between B and B^1 no beat is audible.

Reducing the coupling still further the beat may be reduced to the value of CD3. At C it disappears and reappears at C^1 again. Thus the zero beat region has been reduced to CC^1 by reducing the coupling between the two oscillators.

If the coupling is reduced to zero the beat can be reduced to zero at the point 0, when the two oscillators have the same frequency and the region of zero beat has been reduced to a point.

Of course it is not possible to observe the case when the two oscillators have the same frequency, for when there is no coupling there can be no beat. But by visual means it is possible to approach the point 0 as closely as is desired. For example it is possible to reduce the coupling and observe the beat on a galvanometer until there is one beat in a minute, or until the frequency is 1/60 cycle per second. The line DOD is the limiting case when there is no coupling at all between the two oscillators.

An Ideal Case

Fig. 1 represents an ideal case in which the coupling between the oscillators once set remains constant as the frequency of the variable oscillator changes. In practice the coupling does not remain the same, for it is a function of the frequency. Hence AD1, that is, the beat at disappearance, is not the same as A^1D6, the beat at reappearance. Usually the beat at disappearance is greater. But that again depends on the direction of approach to the 0 point. It also depends on the nature of the coupling, whether it is predominantly capacitive or inductive.

Neither does the frequency of the variable oscillator follow the straight line

the Zero Beat

. O' Rourke

Editor

DOD as the zero beat region is approached. Fig. 2 gives more nearly the change in frequency of the variable oscillator as the frequency control is changed. The approach of the actual frequency of the variable oscillator follows a curved line like the dotted line DA. At the other side of the 0 point the frequency follows the line A1D. The variable oscillator in the dotted region is very unstable and it is difficult to get the same beat frequency twice for the same setting of the variable oscillator.

The curve shown in Fig. 2 was obtained by the use of three oscillators. The third oscillator was auxiliary and was used to insure that the frequency of FF was kept constant. Hence the variation shown was of the frequency of DD as compared to FF. The frequency of the auxiliary oscillator had no appreciable influence on the frequency of DD.

Had not the frequency of FF been held constant the effects of FF and DD would have been mutual. That is, as the frequency setting of DD was changed the frequency of FF would have changed also, so that the actual frequency of the two at zero beat would have been a compromise frequency between the two.

For two identical oscillators the frequency of one would have increased by the same amount as that of the other was decreased. This effect is illustrated by Fig. 3, in which the dotted lines show the variation of the beat frequency as the frequencies of the two oscillators approach each other, becoming identical at EE. Thus the distance between EE is the zero beat region in which the two oscillators act as one oscillating system with a frequency which is the mean between the two frequencies the oscillators would have if they were not coupled.

Application to Super-Heterodyne

This pulling together of two oscillating or tuned circuits plays an important part in the functioning of super-heterodynes. Suppose the intermediate frequency of the Super-Heterodyne has a value f, which is small compared with the frequency of the oscillator or of the signal.

The pick-up coil constitutes a coupler between the oscillator and the circuit tuned to the incoming signal. Thus the RF tuned circuit will tend to make the oscillator oscillate at the frequency of the RF circuit. It may happen that the beat frequency, that is, the intermediate frequency, will fall in that region where the oscillation frequency is unstable, or in the dotted region of Figs. 2 and 3. Very unstable and uncertain functioning of the Super-Heterodyne will result. In fact if the value of f is low as compared with the signal frequency there will be no beat at all and the Super-Heterodyne will not function at all. This often happens for the higher broadcast frequencies when the intermediate frequency is of the order of 30 kc.

It is this pulling together of the RF tuner and the oscillator in the homodyne circuit which makes this practically useless and which forced the use of the second harmonic method of reception.

In order to stay well outside not only of the zero beat region but also outside the unstable border region the intermediate frequency in the Super-Heterodyne must be made large or else the pick-up coil must be coupled very loosely to the oscillator coil.

Amplification in Super-Heterodyne

The effectiveness of an intermediate amplifier is better the lower the intermediate frequency. Also the closer the coupling between the pick-up coil and the oscillator the greater is the output, provided there is a beat produced, although loose coupling is required for practical reasons of reception.

When the intermediate frequency is low the coupling must be loose to avoid zero beat, and if the intermediate frequency is high the coupling may be close to offset the loss in amplification. Thus from the point of view of output there is little choice between a high and a low intermediate frequency. Other considerations must decide which should be used.

It has been shown that in order to prevent overlapping of side bands produced in the intermediate amplifier by the beating of the first harmonics of the signal and oscillator frequencies and by the beating of the second harmonics of these frequencies (See RADIO WORLD March 10, 1928) the intermediate frequency must be at least 45 kc. A higher intermediate frequency is preferred for other reasons, for example, a frequency of 70 kc.

The higher the intermediate frequency the less will the effects of zero beat be for a given coupling. Also the less will be the distortion arising from the mingling of the harmonics with the fundamentals, as discussed in the article cited. Further, the less troublesome image interference will be, for the radio frequency giving rise to image interference will be tuned out effectively in the RF tuner.

If the intermediate frequency is high other difficulties will enter. The best compromise, all things considered, is an intermediate frequency which is one order of magnitude less than the mean radio frequency which is to be received with a given tuner. For example, the mean frequency in the broadcast band is the square root of the product of 550 and 1,500 kc., or 910 kc. Thus 91 kc is a suitable value for the intermediate frequency. But any frequency from 50 to 120 kc will work equally well.

Voltage Adjustments for Series Filaments

On pages 6 and 7 of last week's issue of RADIO WORLD, July 21st, was given a discussion of a completely electrified receiver using two —50 tubes in push-pull, and three screen grid tubes with filaments connected in series, heated by the plate current from the two power tubes. Certain additional statements will be necessary to make that discussion complete. They relate to the plate voltage adjustments and the rectifier and power supply circuit.

Plate Voltage Adjustment

The plate returns of the three screen grid tubes are connected to a tap on the voltage divider which is at 145 volts with respect to the lowest potential point. Thus the applied voltage on the first RF tube is 145 volts, that on the second about 140 and that on the detector about 135 volts. A 4 mfd. condenser C15 should be connected from the 145 volt tap to the negative side of the filter.

The voltage required on the plate of the first audio tube is 135 volts. To get this voltage, in view of the 22½ volt drop in the filaments and bias resistors, it is necessary to connect the plate return to a point which is about 158 volts above the negative side of the filter circuit.

The plate voltage applied to the power stage should be 450 volts. This voltage should be measured from the mid tap of the secondary winding of T3 and not from the negative side of the filter. Since the bias should be 84 volts the voltage across the entire voltage divider should be 534 volts. This is obtainable by the choice of the proper power transformer and rectifier tubes.

Full Wave Rectifier

To secure good regulation of adequate rectified current and thorough filtering a full wave rectifier composed of two type 281 tubes is used. The output of this rectifier is filtered by two heavy duty choke coils Ch6 and Ch7 and three condensers, C11, C12 and C13. Each of these chokes should have an inductance of 30 henrys or more when 140 milliamperes flow through them. C11 may have a capacity of 2 mfd., C12 of 4 mfd. and C13 of 8 mfd. All three of these condensers must stand a voltage of 1,000 volts in continuous service. The condensers across portions of the voltage divider need not be rated at higher voltages than 300 volts on continuous service.

The total resistance of the voltage divider should be such that no more than about 5 milliamperes flow through it. That is the value through the lower portion of it. Thus R8 should be 10,000 ohms. R9 should be about 9,000 ohms. R9 may be about 1,200 ohms and R10 may be about 19,000 ohms. The total resistance therefore is 39,200 ohms. The best way to get this resistance is to use wire wound resistor provided with sliders, connecting the separate units in series and then placing the sliders where the desired voltage is obtained.

The adjustment of the voltages is best carried out with the aid of a high resistance voltmeter, or better still, with a vacuum tube voltmeter which does not change the voltage distribution at all when connected to the circuit.

May Use Tube Voltmeter

A vacuum tube voltmeter may be constructed with a power tube like the —71A or —50, preferably the larger tube when high voltages are to be measured. The method of using a —50 tube as voltmeter will be discussed in next week's issue in connection with the taking of characteristic curves on screen grid tubes.

When the voltage to be measured exceeds the range of a voltmeter of any type it is often possible to measure it part at a time and adding up the total. This is obvious when batteries are used and it holds when the voltage output of a B battery eliminator is to be measured provided that taps are available on voltage divider, as is the case in nearly all circuits.

SHIP INTERFERENCE SEVERE IN NEW YORK

VIEW OF LOWER BAY, NEW YORK HARBOR, TAKEN FROM THE TOP FLOOR OF AN APARTMENT HOUSE NEAR FORT HAMILTON, BROOKLYN, SHOWING SHIPS ARRIVING AND LEAVING. CODE INTERFERENCE FROM THESE SHIPS HAS BEEN SEVERE LATELY, AFFECTING THE ENTIRE METROPOLITAN AREA. BROAD SPARK ON 600 METERS, STRONG ENOUGH TO AFFECT WEAF AND WJZ, IS THE MAIN COMPLAINT

Six Commandments for Summer Listener

By Dr. A. N. Goldsmith

Chief Broadcast Engineer, Radio Corporation of America

Some of us can recall the Summertime broadcasting of a few years ago. One vivid recollection is that of an important ring battle amid the din and roar of static, which, after its completion, left us wondering as to the actual outcome.

We can remember looking with dread upon the approaching outdoor broadcasts, realizing that the barrage of static would soon be mowing down the broadcast programs long before they could reach anxious ears. We can recall turning away from radio at the first signs of warm weather, realizing the futility, at that time, of competing with Nature's own broadcasting efforts.

Yet in the few intervening years, many things have happened to change the summertime broadcast picture. Broadcasters have increased their transmitting power many-fold, in order to meet adverse atmospheric conditions. Network broadcasting has brought the national programs to within local reach of listeners throughout the country, thereby shifting the burden of spanning the gap, from the receiver to the transmitter and its associated wire line. Studio technique has made vast strides, particularly in the direction of selecting program features of sufficient "body" to cover up whatever static background may persist at the loudspeaker end.

Great Strides Forward

Radio reception has undergone marked improvements, especially in the way of sharper tuning, better audio frequency amplification, and a more natural pitch for the radio rendition, which feature serves to accentuate the program feature itself while minimizing the static interference.

The sponsored program, which has reached its zenith in network broadcasting, assures the highest type of entertainment throughout the year. Sponsors, realizing fully the importance of continuity in good will broadcasting, cannot afford to skip the few months of Summer in their well planned campaign. Hence the sponsored programs continue during the warm months.

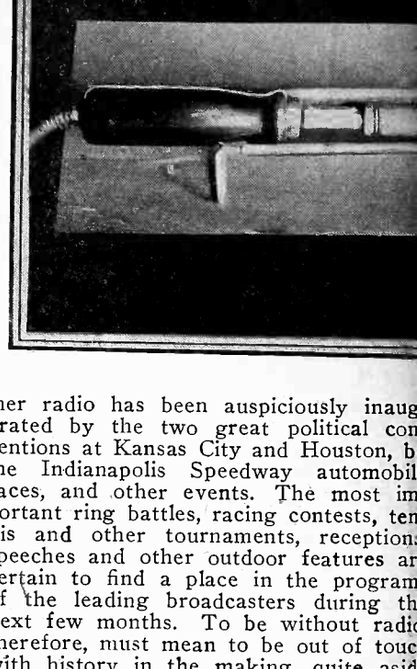
In addition to these features which we have come to consider as part of our everyday life and which may well be called the backbone of broadcasting, we have numerous special broadcast features which come as a pleasant surprise. The summer season presents a greater stage for the program. Outdoor features, more or less absent during the remainder of the year, are now available for that variety which is the spice of the radio program.

Outdoors Beckons "Mike"

While it is true that the present trend in broadcasting is to bring the feature to the microphone in the studio, still, there are some events which, like the proverbial mountain, cannot be brought to this Mohamet.

The microphone must be and is carried to the outstanding events during the outdoor season, so that our summertime programs are certain to be punctuated by many outstanding sporting events, national ceremonies, and the like. This Summer radio has been auspiciously inaug urated by the two great political con ventions at Kansas City and Houston, b the Indianapolis Speedway automobil races, and other events. The most im portant ring battles, racing contests, ten nis and other tournaments, reception speeches and other outdoor features ar certain to find a place in the program of the leading broadcasters during th next few months. To be without radi therefore, must mean to be out of touc with history in the making, quite asid from the consideration of entertainmen

HEAT CONSERV



The Two Main Aids

Two principal factors, then, are con tributing towards insuring better recep tion of programs so far as the broadcast ers are concerned: first, the vast net work of wire lines which serve to lin up many scattered radio broadcasting sta tions, so that given programs may b placed on a "local" basis in many sec tions of the country; secondly, increase transmission power for greater signa strength to override the summertim static level.

Prior to the advent of network broad casting, a radio listener, during the sum mer months, was virtually doomed t confine his radio entertainment to hi local station. Programs from the bi centers were not to be counted upon save for rare periods for good atmos pheric conditions when long-distance re ception was feasible.

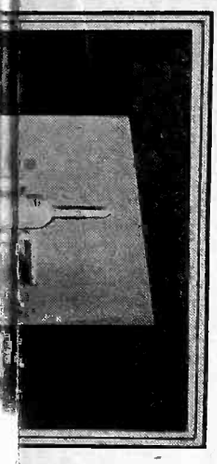
Today, contrariwise, the national pro grams are brought over hundreds an even thousands of miles of wire line t the local station of the network, and the disseminated, so that the listener in Kan sas is as near the Broadway program as the listener in New Jersey.

Networks Aid Listening-in

More than any other factor, network broadcasting has placed Summertime pro grams on a sound and lasting basis. I has been estimated that the average dis tance to be spanned between transmitte and receiver for more listeners, for pro grams of national importance, has been reduced from 1,250 miles to 130 miles with the advent of present-day network broad casting.

A certain amount of improvement has taken place at the receiving end with static amelioration in mind. Among the measures taken at this end are great selectivity, tending to reduce the overall static pickup while accentuating the de sired signal. Amplifiers and loudspeakers have been developed with a deeper, more mellow tone, tending to accentuate the program while reducing the otherwise sharp, scratchy static interference. The burden of amplification has been placed on the audio end, rather than on the criti-

TION FOR IRON



A soldering iron may be left on the cradle when the iron is cold, but if the iron is in use it is better to turn the cradle upside down, for then less heat is lost in the metal of the support.

cal radio frequency end, so as to bring n less parasitic disturbances.

In the final analysis, however, the enjoyment of Summertime radio resolves itself into the usual human equation—he radio listener himself.

Six Sound Rules

For those who want to enjoy the good hings on the air during the next few months, here are just a few suggestions:

1. Select programs from the most powerful stations within your range. Be content with "local" signal, for DX is really a winter sport, although this Summer promises to be light on static.

2. Select programs which have plenty of "body", such as bands, orchestras, organ recitals and other features which maintain good volume so as to cover up the background noises when static is unusually bad.

3. Try listening to your radio at some distance, which tends to drop out the background noises. Thus listening to the radio from out on the porch or lawn usually brings new enchantment to radio entertainment. The loudspeaker itself may be brought outdoors, if an extention cord is available.

4. Do not use a long antenna. The practice is to have a short antenna, even one placed indoors, for Summertime reception, while leaving the long antenna for the more favorable conditions of winter.

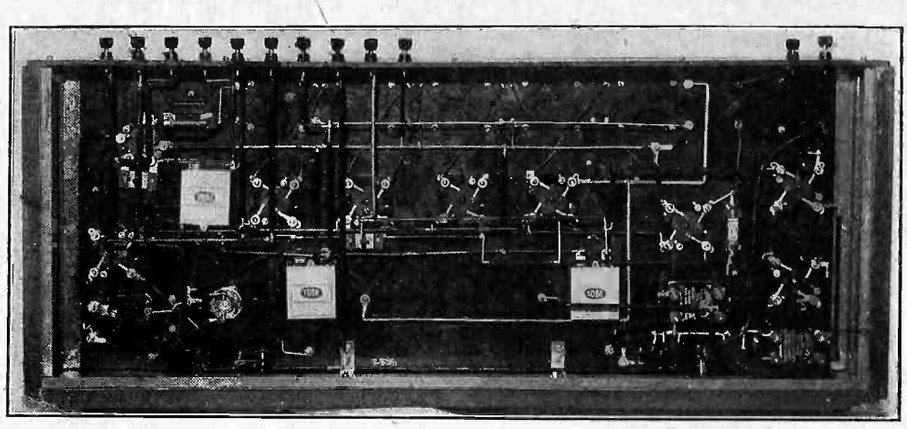
5. Do not hesitate to take your radio set along with you. Present-day radios, whether of the battery-operated or socket-power type, are virtually portable so far as installation on the farm, in the camp, in the summer boarding house, on the houseboat or elsewhere, is concerned. The radio receiver may readily be transplanted to a summer location.

6. The radio set should be placed in the best possible operating condition, by checking the batteries and tubes, cleaning the exposed parts, inspecting and tightening connections, and by going over the antenna and ground.

FRIEDMAN-SNYDER NAMED

The Friedman-Snyder Company, of 9 Park Place, New York City, has been appointed A-C Dayton representative in the Metropolitan District, Adolph ("Otto") Friedman announced.

ORDERLY POSTS IMPROVE NEATNESS



NEATLY ARRANGED BINDING POSTS, EQUALLY SPACED, ADD A CAREFUL TOUCH TO THE APPEARANCE OF A RECEIVER. THE PAINSTAKING WORK SHOWN ABOVE WAS DONE BY H. H. MYERS.

Independents Fight Board's Merger Plan

Charging that the Federal Radio Commission is threatening to destroy small broadcasting stations and then urging larger stations to buy them up, the Independent Broadcasters Association 134 South La Salle Street, has launched an attack on the Commission's "consolidation plan."

In a statement the Association says:

"The Federal Radio Commission has found a new way to help the trust destroy the little fellows on the air. The first step was to threaten the cancellation of the licenses of 162 independent stations. Now it is discovered that the Commission has a plan to induce the large stations to buy up helpless victims in smaller cities and make branch radio stations out of them.

"One of the Commissioners has gone so far as to write to a Congressman, offering to help him carry out such a project in his home city. The Commissioner said this plan is being carried out in other sections."

Cites Commissioner's Letter

In his letter, the Commissioner wrote: "If your city is in earnest and has enough radio enthusiasts, I see no reason why they could not purchase a number of stations that have been placed on the doubtful list. Consolidations of this nature are under way in practically all the "overquotad" states, and should you care to pass this suggestion on to your people, I assure you of my fullest co-operation.

"It is difficult to find words strong enough to condemn this attempt to destroy the radio rights of communities.

"The assumption is that the stations that are threatened with the loss of their licenses could be bought cheap. This is just what the Radio Trust wants. It is trying to destroy the little fellows or to put them under monopoly control. It is hard to believe that the Federal Radio Commission, charged by Congress to protect broadcasting against the Radio Trust, should deliberately undertake to force such consolidations and sales.

"The broadcasters of the United States and their listeners should protest at once against this plan. It would destroy the independence of every broadcaster if the Commission were allowed to condemn station—large or small—and then help other stations to buy them up.

Compared with Newspapers

"Every city, no matter how small, has a right to broadcasting facilities. What would the nation say if the Post Office department tried to force little newspapers into bankruptcy, and then induced papers in large cities to buy them up? The radio situation is an exact parallel."

The statement was broadcast.

Dates for New York and Chicago Shows

The Fifth Annual Radio World's Fair will be held in Madison Square Garden, New York City, September 17th to 22d. The Seventh Annual Chicago Radio Show will be held at the Coliseum, October 8th to 14th. These shows are for the public.

A search for the "Radio Queen" to be honored at these events is going on.

B BATTERY PRICES REDUCED

The National Carbon Company announced another price reduction in B batteries. No. 486 Layerbuilt, formerly $5.00 list, was reduced 75 cents to $4.25; No. 485 Layerbuilt, formerly $3.50, was reduced 55 cents to $2.95; No. 762, a new small 45-volt battery for portables, was announced.

SANFORD HANDLES B. B. L. UNIT

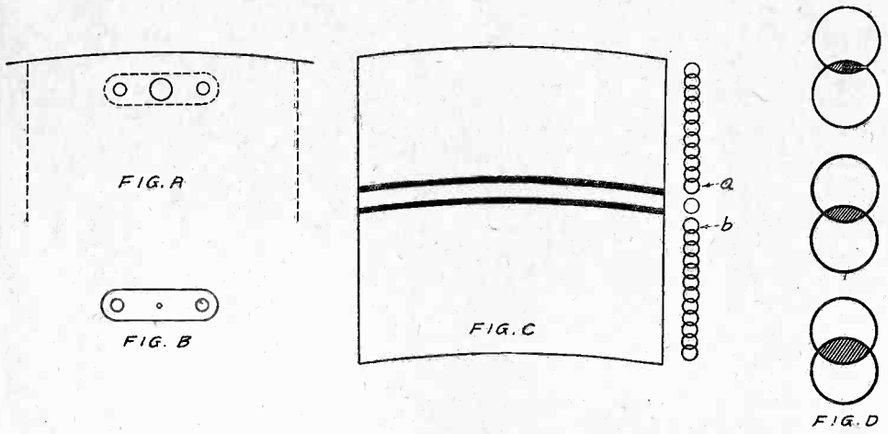
The Sanford Radio Corporation, 122 Greenwich Street, jobbers, announces it is handling the new B. B. L. Unit in the brown housing. This unit is manufactured by the Best Mfg. Co., Irvington, N. J. Sanford also handles Cunningham tubes and announces a new replacement policy which means that the purchaser is doubly protected in the purchase of Cunningham tubes of any type. This concern also represents the Newcombe-Hawley Reproducer. Charles Ollstein is the New York sales representative of Sanford. Full information on the above lines will be sent to those interested by the Sanford Radio Corporation, mention RADIO WORLD.—J. H. C.

APLIN HANDLES BOOK

Ben Aplin, Room 429 at 30 Church St., N. Y. C., distributes Drake's Radio Cyclopedia to the trade, in the Metropolitan district, the publishers announced.

The Apertures

By Neal



A. A SECTION OF A SCANNING DISC IN WHICH THREE HOLES ARE DRILLED, ONE FOR SCANNING AND TWO FOR SECURING ADJUSTABLE METAL PIECE AS OUTLINED BY DOTTED LINES.

B. THE METAL TO FIT OVER THE DOTTED PORTION IN A. THE SCANNING HOLE IS OF PROPER SIZE AND IS ADJUSTABLE RADIALLY AND ANGULARLY.

C. TWO DARK LINES IN FIELD DUE TO DISPLACEMENT OF HOLES A AND B. THE FIRST IS DISPLACED OUTWARD AND THE SECOND INWARD.

D. UPPER SHOWS TWO ADJACENT SCANNING HOLES WITH INSUFFICIENT OVERLAPPING. MIDDLE SHOWS TWO HOLES PROPERLY PLACED. BOTTOM TWO HOLES SHOW TOO MUCH OVERLAPPING.

THE uniformity of illumination of the field of a neon lamp as seen through the scanning holes in the scanning disc depends on the accuracy of the placement of the holes and on the size of each hole as related to the radial distance between the centers of adjacent holes. If the holes are not accurately placed the field of view will be streaky. There will be bright bands separated by dark bands. And these bands will not be of the same width. Similarly if the holes are too small for the radial separation there will be dark and light bands, but these will be regular provided that the holes are accurately placed.

Let us see how large the holes should be for a given radial separation to give a satisfactory distribution of the light, assuming that every hole is accurately placed.

In Fig. 1 are shown two scanning holes having a radial separation between centers of D. The radius of each hole is R. The upper hole will draw a luminous line across the field in a certain part of the lamp. The lower hole will draw another similar line across the field a moment later and a distance D nearer the center. There will be an area covered

9 Television Stations Soon; First 2 Licensed

Washington.

Two licenses for operation of experimental television stations and seven construction permits for erection of television stations were awarded by the Federal Radio Commission, representing the first awards of that nature in the television field. Previously several temporary licenses were awarded.

Licenses were awarded to the Jenkins Laboratory of Washington, D. C., and to J. Smith Dodge, of Lexington, Mass.

Jenkins Laboratory was given the call letter 3-XK, and was assigned the wavelengths from 61.22 to 60 meters (4.900 to 5,000 kilocycles), with 5,000 watts of power. Mr. Dodge was assigned the call letter 1-XAY, and given the wavelengths from 62.5 to 51.22 meters (4.800 to 4,900 kilocycles). The power assignment was 500 watts.

Seven Permits

Construction permits were awarded as follows:

Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., call letter 8XI; appromimate wave 63.83 to 62.5 and 19,868 to 19,737, of frequency of 4,700 to 4,800, and 15,100 to 15,200 kilocycles. Power 20,000 watts. Share time on a lower wave (19,868 to 19,737 kilocycles) with Radio Corporation of America's portable station 2XBW.

Robert B. Parrish, Los Angeles, Calif. Call letter 6XC, approximate wave 66.67 to 65.22 or frequency 4,500 to 4,600 kilocycles. Power 15,000 watts.

Harold E. Smith, near Beacon, N. Y. Call letter 2XBW, approximate wave 62.5 to 61.22 meters; frequency 4,800 to 4,900 kilocycles. Power 100 watts. Share time with J. Smith Dodge, Lexington, Mass., 1-XAY.

WREC, Inc., White Haven, Tenn. Call letter 4XA, approximate wave 125 to 120 meters or frequency of 2,400 to 2,500 kilocycles. Power 5,000 watts.

R. C. A. Prominent

Radio Corporation of America (portable station, Bound Brook, N. Y.). Call letter 2XBW, approximate wave 19,868 to 19,737 meters, or frequency 15,100 to 15,200 kilocycles. Power, 5,000 watts. Share time with Westinghouse Station, East Pittsburgh, Station 8XI.

Radio Corporation of America (portable station, New York City.). Call letter 2XBV, approximate wave 66.67 to 65.22 meters or frequencies 4,500 to 4,600 kilocycles. Power 5,000 watts.

Radio Corporation of America (portable station, New York City.) Call letter 2XBS. Approximate wave 65.22 to 63.83 meters, or frequencies 4,600 to 4,700 kilocycles. Power 5,000 watts.

Oil and Metal Made with

Washington.

As an aid to the study of the use of geophysical methods in prospecting for underground mineral deposits, the Bureau of Mines, Department of Commerce, made public translations of certain papers by various Russian authors on measurements of terrestrial radioactivity, which detail the results of experimental work conducted in different areas in Russia.

In connection with the publication of these translations, F. W. Lee, senior physicist, Bureau of Mines, has written a paper on radioactive substances and the methods for locating them. The full text of the Department's statement follows:

Sidelights on the possibilities of the use of radioactivity in prospecting for petroleum deposits are found in a paper, by L. N. Bogoiavlensky, which details the results of experiments in the radiometric exploration of certain oil deposits of the Maikovsky district in the Kuban Government.

How Intensity Is Governed

The intensity of penetrating radiations originating in the earth depends mainly on the degree of concentration of radioactive elements in the core of the earth, states Mr. Bogoiavlensky, in summarizing the results of these studies.

Recent experiments in the study of emanations of the earth lead to the supposition that the radium dispersed in the core of the earth yields a certain amount of emanations of much shorter waves than those previously admitted. The slightest change of radium content in ores must therefore be reflected in the intensity of penetrating radiation.

The radioactivity of an oil bed must differ from that of the strata inclosing it on the following grounds: Oil, being an organic compound, possesses an immense power of absorbing radioactive emanations.

Lower Layer Richer

The layers underlying the oil bed, having been developed from repositories of seaooze, are richer in radium because of the greater power of absorption peculiar to colloids. The oil bed must therefore be richer in radioactive elements than the embedding clay layer.

The experiments of the Radiometric Subsection of the Institute of Practical Geophysics with the oil deposits of the Maikovsky district have shown that penetrating radiations increase above oil lenses of light naphtha as well as above strata of heavy oil.

It may be considered a well-ascertained fact that the degree of concentration of

in Discs

Fitzalan

by both holes, the size depending on the ratio of R to half of D.

If the distance *ah* is equal to one-half R the total effective illumination half way between the centers of the holes will be equal to that at the centers, and there will be little variation in the illumination between the paths of the two centers. There will be two minima between centers, but they will be weak and hardly noticeable. These minima occur at D-R from either center. At these points the illumination is about .7 as great as at the maximum points under the assumptions made above.

This is the best distribution of the illumination that can be effected with round scanning holes.

Values Given

The distance *ah* will be equal to ½ R if the angle *hoa* is 30 degrees. The distance D is equal to 2Rcos30 or 1.732R. Hence R is equal to D/1.732. Now if we decide on a disc in which the radial distance between the holes is 1/16 inch the radius of each hole should be .0361 inch, or the diameter of each hole should be .0722 inch. If the distance between centers is 1/32 inch the diameter of the scanning holes should be .0361 inch.

It will be recalled that when the WGY transmission was sent on 48 holes with a radial distance between centers of 1/32 inch the diameter of the holes was .035 inch.

When 36 holes are used with a radial distance between holes of 1/24 inch the diameter of the holes should be .0445 inch.

Dimming of Periphery

Since the holes nearest the periphery of the scanning disc travel at a higher speed than the holes nearer the center they remain in front of the neon lamp a shorter time and this causes a dimming of the field of view near the outer edge of the disc. This decrease in the illumination is gradual from the inner to the outer edges of the field and it is directly proportional to the distance of any hole from the center of the disc. This unequal distribution of the illumination cannot be avoided as long as round holes of equal diameter are used throughout. If the holes were elongated in proportion to the distance from the center this dimming effect could be avoided. But it is difficult enough to make round holes of such small diameter and elongated holes are entirely unpractical.

The only way of reducing this type of unequal illumination using round holes and a scanning disc is to make the disc larger and placing all the holes relatively closer to the periphery of the disc.

Discs have been made in which the holes were cut along radial and circular lines. That is each hole was bounded by two arcs of circles and two radii. This construction not only eliminates the dimming of the peripheral field but also the unequal distribution due to the round holes as discussed. Fig. 2 shows the principle of the radial scanning holes.

If an endless belt were used as the scanning element the holes could be made square. This also would eliminate any variation in the illumination since every hole would travel across the field at the same rate and the entire field would be covered uniformly without any overlapping. It would be necessary in this case to place the scanning squares just as accurately as if a disc were used.

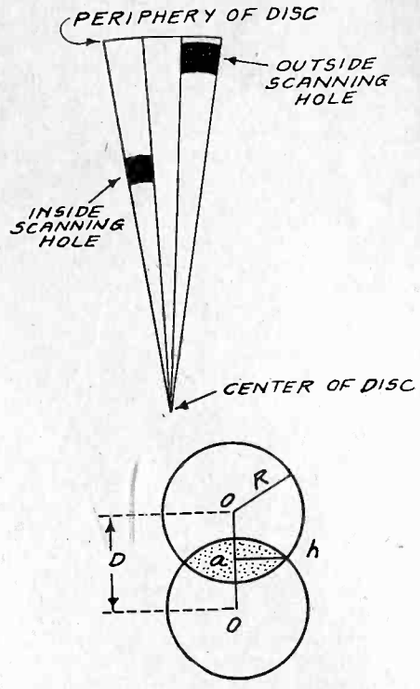


FIG. 1. (LOWER) GEOMETRICAL CONSTRUCTION AIDING THE CALCULATION OF THE PROPER SIZE OF SCANNING HOLES
FIG. 2. (UPPER) THIS ILLUSTRATES THE PRINCIPLE OF RADIAL HOLES

Prospects Radio Diviner

radioactive elements in the earth has an enormous influence on the penetrating radiations. These experiments indicate that the intensity of penetrating radiations near the surface of the earth changes sharply, in quality and quantity, even within a few meters.

Radiation Measured

Measurements of penetrating radiations from the earth made at Pyatygorsk by means of a portable electrometer covered with lead 1 cm. in thickness have shown that although the same apparatus had been used the intensity fluctuated greatly, depending upon the observation station where the measurements were made, state the authors in discussing these experiments.

The fluctuations of intensity were specially marked in places rich in radium, where divergences of no less than 100 per cent were observed between stations separated by only a few meters.

Measurements made at the same observation stations during a period of three years have shown the intensity to be constant and to be independent of meteorological conditions and fluctuations of emanations in the atmosphere, in the limits of sensitiveness of the apparatus.

Simple Method

Measurements of the radioactive elements in the upper layers of the soil have shown their constancy, which permits the supposition that the fluctuations are probably due to deeper strata only.

Radioactive indications were first used for determining the location of ores containing a high amount of radioactive substances and for determining radium emanations in springs used for medicinal purposes, states F. W. Lee, in discussing radioactive substances and methods for determining their location.

The method of detecting radioactive substances is relatively simple and has been developed in several directions. Speculation as to the geological evolution of the earth strata has, to some extent, been based on the amount of radioactivity now present in various rock formations.

Cites Methods

Mr. Lee's paper contains details in regard to the different ways of measuring radioactive substances, comprising photographic, ionization, and calorimetric methods. He also gives a short bibliography on radioactivity, measuring instruments and methods, and the application of radioactivity to geophysical prospecting.

Infra-Red Television Soon to Be Tried Here

According to Captain George Oliver Hutchinson, managing director of Baird International Television, Ltd., a public demonstration of the Baird television method will soon be given in this country. Captain Hutchinson arrived recently on the Mauretania and left for Chicago in connection with proposed television demonstration.

The plans are to include a demonstration of noctovision, a method of transmitting television by infra-red rays, which is another invention of the Scotchman, John L. Baird.

Infra-red rays are long wavelengths of light which are beyond the range of the human retina. These rays pass through dense fog and smoke and for that reason experiments testing their efficacy in lighthouses are going on. Lighthouses equipped with infra-red beam projectors can be seen by ships equipped with suitable receivers even when the fog is so thick that ordinary lights cannot be seen at all.

American rights to the inventions of Baird have been acquired by the Baird Television Development Corporation, which plans considerable development. Arrangements are being made with American broadcasters for the transmission by the Baird system over American stations.

Receivers designed to receive this television are not yet available but are promised by the end of the year. They will be attachments to ordinary radio receivers and will cost about as much as a good receiving set.

Reallocation Favors Most Popular Stations

Washington.

Four principles favored for incorporation in the forthcoming reallocation of broadcasting stations, made necessary by the 1928 law governing radio, were outlined by Commissioner O. H. Caldwell, of the Federal Radio Commission. These principles are good radio reception, equal radio facilities for each zone, provision for local stations and mimimum upsetting of popular stations.

Replying to an inquiry by F. H. Doolittle of WBRC, New Haven, Conn., Mr. Caldwell stated that he was determined to see these four principles incorporated. Suggestions that general upsetting of all stations in the broadcast band was imminent were discounted by the commissioner.

The full text of Mr. Caldwell's statement contained in a letter to Mr. Doolittle follows:

"Dear Mr. Doolittle. In answer to your letter inquiring about the coming reallocation of broadcasting stations made necessary by the 1928 law, and referring to recent newspaper articles intimating that a general upsetting of all stations in the broadcast band is imminent, without corresponding improvement in radio reception, I want to make clear to you the four principles which I am determined to see incorporated in any reallocation promulgated by the Radio Commission.

These four requirements, as I see them, are:

"1. Good radio reception. This means sufficient geographical separation between stations to prevent heterodyne interference, and sufficient kilocycle separation to avoid crosstalk. It involves such time division and power reduction as are necessary to meet this paramount consideration of good radio reception for the listeners.

Locals Not to Be Sidetracked

"2. Equal radio facilities to each zone. The Davis-Dill clause, enacted by Congress in March, 1928, requires that equal facilities shall be assigned to each of the five zones. In order that such equality may be absolute and also self-evident to every inquirer, including members of Congress, it appears important that the same number of positions for stations of each class be assigned to each of the zones. This means that the number of 5,000-watt full-time assignments shall be equal as between zones, and that the same relation shall exist as between 1,000-watt assignments, 500-watt assignments, 100-watt assignments, daylight assignments, etc. Within each zone, that zone's facilities should be divided proportionally to the population of the States, as the law directs.

"3. Provision for local stations. In order that local broadcasting stations desiring to reach only a restricted area may have an opportunity to operate, it is important that provision be made for a relatively large number of such local stations with powers of from 10 to 50 watts, and perhaps up to even 100 watts in a few cases. Such a plan will extend the usefulness of every listener's receiving set by making possible local reception in communities with station programs covering purely local events and features.

Basis of Improvement

"4. Minimum upsetting of popular stations. So far as possible, stations now enjoying a large following of listeners should be disturbed or moved or modified as little as practicable, so that the least possible inconvenience will be suffered by the listening public. In connection with the coming reallocation, it seems likely that relatively little disturbance will be created among those stations which really have the ear of the listening public, so that the annoyance of changing dial markings imposed on the public will be a mimimum.

"An allocation worked out upon this basis will bring improved radio reception to the great majority of the American people, providing for both local listeners and disant farm listeners, and will, moreover, follow strictly the mandate of Congress, as required by the recent equalization law."

Hearings End as 55 Stations Go by Default

Washington.

The last of the 164 radio broadcasting stations throughout the country cited for alleged failure to serve the public interest, convenience and necessity, appeared before the Federal Radio Commission and asked for renewal of their broadcasting licenses.

The hearings then were formally closed and the Commission took under advisement the matter of whether or not any of the stations will be relicensed.

The stations named in the Commission's order (General Order No. 32), issued on May 25, were informed that unless they could show cause why their licenses should be renewed, they would be removed from the domestic broadcasting band. About 55 of the stations did not request hearing.

Representatives of the Westinghouse Electric and Manufacturing Company appeared before the Federal Radio Commission to seek continuation of a license of a station, KFKX, Hastings, Neb., declared to be one of the pioneers in broadcasting and the foremost agricultural station in the country. In an affidavit, H. P. Davis, vice-president of the Westinghouse Company, stated that any curtailment of the activities of KFKX would "seriously impede the progress of the art of many of the new developments in radio made available to the industry through these stations."

A. L. Ashby, Westinghouse attorney, declared that to deprive the station of its broadcasting license would in effect be "the same as putting to death the mother after bringing her children into the world."

Witnesses appearing for the station, representing also the Westinghouse Company, included C. W. Horn, manager of Radio Operations, and W. C. Evans,, manager of the station.

They attested to the public service value of the station. It furnishes reliable information to the agricultural industry and keeps the farmer informed by frequent market reports, Mr. Ashby said. It also has done much experimental work toward the improvement of broadcasting, he testified.

The last of the cases to be heard by the Commission was that of WTAZ, of Richmond, Va.

Signals From Abroad Increase in Strength

Washington.

Radio signals received in the United States from foreign stations last year were in general stronger than for previous years, said Dr. L. W. Austin, specialist at the Bureau of Standards, Department of Commerce.

LY, at Bordeaux, France, was the only foreign station recorded whose transmission was below that of 1926, Dr. Austin declared. The full text of the statement follows:

"Last year was a good year for long-wave long-distance transoceanic signals, radio reception measurements at the Bureau of Standards reveal. Not only were daylight transoceanic radio signals stronger last year than any year since accurate measurements have been made at the Bureau but static was also less troublesome.

"June was especially favorable for signal reception. They were stronger than for any preceding June ever recorded. October radio conditions were also much better than usual, signals that month being far above average strength. Signals from AGS at Berlin about 10 o'clock in the morning were 67 per cent higher than those the same month of 1926.

"Strongest daylight European signals ever measured in Washington were observed the 14th day of the favorable October month. They occurred two days after a magnetic storm of great intensity. Bordeaux's station was 227 per cent stronger than its average, Rugby (Great Britain) and Berlin were both 200 per cent higher and nearly all other stations both in the east-west and north-south directions were unusually clear.

"Last Summer's low static is undoubtedly due to the large number of cool days and the small number of thunderstorms. However, the present high solar activity, wherein the sunspot is attaining its maximum, may also possibly be connected with the growing favorable radio conditions.

"For instance, since the sunspot minimum in 1923, all signals with exceptions of those from Bordeaux and Buenos Aires have been increasing in intensity; at the same time, in contrast with the upward trend in signal strength, a steady drop in static disturbance, to only half last year what it was in 1924, has appeared.

Weak in Afternoon

"The exceptions to the rule, the stations at Bordeaux and Buenos Aires, may be due to other reasons. Irregular receptions from Buenos Aires may be because of changes in transmitting current or antenna arrangements.

"Although the morning signals of Bordeaux have the same observed strength in 1927 as in 1926, the afternoon signals, which have a path partly in darkness, dropped perceptibly in 1927. This behavior may be due, it is said, to the fact that the sunspot curve may have now reached its maximum which in the present cycle appears to be less sharp than the maximum in 1917. It now appears from observations thus far this year, that other long-wave stations are following the lead of Bordeaux and are also beginning to ebb in strength."

Tube Independents Infringe, Says R. C. A.

Washington.

The Radio Corporation of America, answering the Federal Trade Commission's charge of illegal monopoly and unfair practices in requiring set licensees initially to equip the recevers with R. C. A. or Cunningham tubes, stood by its guns and made the following main points:

(1) The tube clause itself does not "exclude" independent tube manufacturers because the independents "never had any lawful right whatever to supply tubes for that purpose," and because "they are excluded now, and always have been so excluded by the patent laws of the United States."

(2) The R. C. A. challenges the jurisdiction of the Commission.

The accusations of the Commission related to the licensing agreements entered into by the Radio Corporation and the General Electric Company and the Westinghouse Electric and Manufacturing Company with manufacturers of radio receiving sets whereby the manufacturers were allowed to manufacture and sell sets, the patents on which are controlled by the three companies named, a requirement (Clause 9) compelling initial equipment with R. C. A. or Cunningham tubes.

The Tube Situation

The Commission had charged that the manufacturers included in these agreements represent approximately 95 per cent of the production and sale of receiving sets in the United States and that a requirement that they use initially only the tubes made under the patents controlled by the three companies in the initial equipment of their receiving sets, has resulted in barring other manufacturers of vacuum tubes from the field.

Answering this part of the complaint the answer filed on behalf of the Radio Corporation declares that:

"The respondent (R. C. A.) admits that a vital and essential part of any radio receiving set manufactured under license agreements is a three-element vacuum tube. It alleges that prior to the cross-licensing referred to in said paragraph, no one in the United States could lawfully manufacture such a tube, because such tubes were covered by a number of patents which were owned by different companies. These patents were supplemental to each other and had to be used together in order to manufacture tubes of commercial efficiency.

Denies 95 Per Cent Allegation

"By virtue of said cross-licensing, rights to manufacture such tubes under the patents were acquired by the General Electric Company, the Westinghouse Electric and Manufacturing Company, and the American Telephone and Telegraph Company and their respective subsidiaries, whereby it became possible for the first time, lawfully to make these tubes available to the general public."

The Radio Corporation enters a denial of the statement made in the Commission's complaint that it and its associated companies together with the manufacturers with whom they have licensing contracts represent 95 per cent of the production and sale of receiving sets in the United States.

Taking up the charges made in Paragraph Six of the original complaint, dealing with the alleged effects of the licensing contracts with manufacturers, the answer filed by the Radio Corporation says in part:

"Respondent denies that the effect of Section 9 of said license agreements is to require the licensees to purchase from the respondent all vacuum tubes required for the initial operation of all receiving sets manufactured and sold by them. Respondent alleges that said Section 9 applies only to tubes required for initial installation in such sets made by the licensees as may contain the 'licensed circuits.

Attacks Independents

"Respondent denies that prior to said license agreements the other tube manufacturers had any lawful right or opportunity to compete in the sale of tubes for initial installation in such 'licensed circuits.'

"Respondent denies that its own sales, together with those of the licensees under said license agreements, constitute approximately 95 per cent of all the receiving sets produced in the United States.

"Respondent denies that it has unlawfully monopolized the sale of vacuum tubes for initial installation in receiving sets by force of Section 9 of said license agreements or otherwise. On the contrary, in so far as such tubes are supplied by it for initial installation either in its own sets or in sets sold by its licensees, respondent has a lawful and exclusive right to supply such tubes by virtue of its rights in the patents under which said sets are manufactured and assembled.

"Respondent denies that, by reason of said Section 9, other producers and sellers of vacuum tubes are excluded from competition in supplying tubes for initial installation in said licensed circuits manufactured by said licensees. They never had any lawful right whatever to supply tubes for that purpose. In so far as they are excluded from that field, they are excluded now, and always have been so excluded, by the patent laws of the United States."

In conclusion the answer filed by the Radio Corporation declares:

"Further answering said complainant, respondent alleges that said Section 9 is a bi-lateral, executory agreement, and that no order can be entered cancelling or modifying the same which will not take away or seriously affect valuable rights now enjoyed by the 25 licensees and also by the co-licensors of the respondent—namely, the General Electric Company, the Westinghouse Electric and Manufacturing Company, and the American Telephone & Telegraph Company—under said license agreements.

Jurisdiction Challenged

"The Commission is without jurisdiction to take any action which will in effect, directly or indirectly, modify said Section 9 and the rights of the various parties thereunder, without joining said licensees and said co-licensors as parties to this proceeding and giving them their day in court.

"Wherefore the respondent, Radio Corporation of America, prays that the complaint in this proceeding be dismissed."

The answer put in by the Radio Corporation is a firm adherence to the position originally taken by the corporation when it entered into the contracts with set licensees.

U. S. Farm Programs Arranged Regionally

Washington.

The Radio Service of the Department of Agriculture is commencing regional program-making for the 1928-29 season, the Chief of the Service, Morse Salisbury, announced.

The full text of the announcement by Mr. Salisbury follows:

To give stations and their listeners in each section programs which will carry only information of practical value in each section, the Radio Service program for the coming season is developed for five different regions. The farmer in the hay and pastures region—the northeastern and middle northern States—will be supplied by his radio station, in cooperation with the Department of Agriculture, with "Farm Flashers," "Farm Forum" talks and other well-known features of the Federal Radio Service which treat of topics important to the improvement of farming in his region alone. Likewise, farmers in the Corn Belt, Cotton Belt, Great Plains and Rocky Mountain Region, and on the Pacific Coast will receive from their broadcasters discussions of farm problems peculiar to their regions.

For the Housekeeper

The Housekeepers' Chat, a five-day-a-week feature for housewives, which is broadcast by more than 90 radio stations, will not, of course, be organized on the regional basis, Mr. Salisbury commented. The information needs of housewives seem to be pretty much the same all over the country. The great American home is the most genuinely nation-wide institution that we have.

The Radio Service and cooperating stations are offering two new features to be broadcast once a week during the coming season. These are "Outdoors with the Scientist" which tells of the activities of foresters, weather men, entomologists, and biologists of the Department of Agriculture's staff. It points out how their findings may be put to work in the daily lives of listeners.

Weekly Digest

"The Farm Science Snapshots" will give listeners a weekly digest of the vital announcements coming from the vast field of scientific agricultural research. "The Primer for Town Farmers" enters, with the 1928-29 season, upon its third year of service to the millions of "back-yard farmers" in the United States. "The Agricultural Situation Review," once each month, will continue to give a 15-minute summary of the farming situation throughout the nation. The service is adding a series of monthly farm playlets dramatizing solutions of the social problems of the rural community.

The most enthusiastic reception from broadcasters has been accorded the announcement of a new feature for farm boys and girls—"The 4-H Crier."

The 4-H Clubs

The weekly broadcast will tell members of the 4-H Clubs—organization of farm boys and girls who undertake specified farming or homemaking jobs and carry them to completion in approved scientific fashion—what is going on among other clubs throughout the country, and will carry directions for the conduct of project work.

The 1928-29 season opens October 1, 1928, and continues to April 27, 1929.

A THOUGHT FOR THE WEEK

NOW that the Federal Radio Commission has heard the stations protest against their proposed extermination, and has listened to engineers' plans for better reception, it still finds it necessary to make up its own mind. Advice solves no problems when it's conflicting.

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Title Reg. U. S. Pat. Off.

The First and Only National Radio Weekly

Radio World's Slogan: "A radio set for every home."

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Public Interested in Quality Programs

"To be or not to be?" is the question that has been bothering a good many station owners during the past several months—will they be able to retain their positions on the air or will they be obliged to give them up to more or less friendly rivals?

All of which is most distressing, of course, but what still really interests the public is the quality of the programs offered.

Everything else is secondary—as, indeed, it should be. Give radio enthusiasts the proper balance in popular or high-class offerings and there is no end to the liberality that fans will display in digging deep down into their pockets for everything purchasable in radio sets or parts.

The program's the crux of the whole matter!

Disgusted with Board, Two Readers Tell Why

PROTESTS AGAINST BOARD

EDITOR RADIO WORLD:

I notice that your editorials seem to be very much in sympathy with the present policy of the Radio Commission. I am rather inclined to believe that were you in Nebraska you would not feel this way. It seems to me that they have made an awful hash of the radio situation and have always favored the powerful radio monopoly.

Last year when KWKH at Shreveport, La., was fighting for 3,500 watts power, did they give it to him? Not so as you could notice it, till they were virtually forced to do so, and now they are bemoaning the fact that the South and West could have hundreds of more radio stations if not for the Davis-Dill Bill which was passed for the express purpose of forcing the Commission, because it had been unfair, to give the South, West and midwest more power stations.

The East first and second zones had about three-quarters of the total radio power of the United States and when any one else wanted some more power he didn't get it. But the favored industrial East had no trouble to get 50,000 watt stations. If somebody in Nebraska wanted 100 watts he got it—NOT.

Now the said Commission is sore because the Davis-Dill Bill was passed, which was intended to make them do the right and fair thing, and they are getting even, they think. (This thing may not be all over yet and the present Commission may have a chance to go back to their various vocations in civil life after next February.)

By discontinuing 162 stations, and practically all of them local stations, you will notice that none of the chains was affected.

If the Commission wanted to do what was right why didn't it license all of these local stations to broadcast during the daytime and have them remain silent after 7 P. M.? They couldn't do that. They had to get tough and get even with the Senators and Representatives who passed the Davis-Dill Bill, and don't think these same Senators and Representatives haven't received a deluge of mail from their constitutents telling them that they want their local broadcasting stations here in Nebraska saved and that if the present Radio Commission will not relicense them to get rid of members and give us a new Commission who will be fair and just I would prophesy that is just about what is going to happen.

The Commission is forever giving the impression that the act of 1928 says there shall be only so many stations in each zone. The fact is the law says nothing of the kind. The law says there is no restriction whatever on the number of stations to be licensed, merely requiring that channels, power and time be alloted equally to the several zones. It even goes farther than that and says that the power not used by one zone may be borrowed by another. It looks very much to us as if the Commission is peeved for the chastisement that Congress handed them for giving all the good wavelengths and high power to the chain monopoly and is squaring accounts by removing about half the stations in the States that advocated the law and were instrumental in getting it passed.

I am a traveling salesman and the above about sums up the sentiment I find all over the territory which I cover, which includes Nebraska, South Dakota, Kansas and Iowa.

I have read your magazine ever since it has been published and like it very much, all except the editorials I refer to.

ART NOBEL.
1706 28th St., Kearney, Neb'r.

* * *

THREE REASONS

EDITOR RADIO WORLD:

I have become disgusted with radio reception for the following reasons:

1st.—Detroit is too far away from New York to get the broadcasting direct with any regularity or satisfaction, so we must depend upon our local stations, which are now all on one network or another using the "canned" programs from New York, which, by the time they reach here, are so much distorted and mixed with noises picked up on the way that they are anything but perfect. Music is never clear and speech is "mushy" and almost unintelligible.

2nd.—It is very difficult to get outside stations now, even with the same equipment with which we could get Cleveland, Chicago, Cincinnati or Pittsburgh just about the same as locals, and with fair conditions could pick up Atlantic City, Jacksonville, New Orleans, Kansas City, St. Paul and many others.

The Radio Commission assigned new wavelengths to all the local stations, which are so close to the DX stations that came in best here, namely, KDKA, WTAM, WLS and several others, that it is now impossible to tune in the distant ones, as the locals are going about all the time. One local station, WGHP, heterodynes with some other station and has a continuous whistle which spoils its music.

3rd.—When the quality of the "canned" stuff is disgustingly bad and we try for some other station, we get the same thing from every big station we tune in, and it gets proportionally worse as the distance increases. One evening I tuned in five different DX stations and heard the same program coming from each of them! Then I was so digusted I turned it off and quit. For several months our radio has been used but very little, many times not more than 30 minutes in an entire evening, because the programs were not worth listening to.

When our best local station, WWJ, is broadcasting from its own studio, both music and speech come in clear and beautiful, but when it sends the "canned stuff"—good night!

The "canned stuff" is worse than the old style phonograph, and the new improved phonograph is far superior to the best radio set when the "canned stuff" is on.

What is the use of spending money for new sets or for improving our old ones when the broadcasting is getting worse all the time? For my part I am done until conditions improve.

I have talked with a number of friends lately who, like myself, *were* enthusiastic radio fans, but *now*, like me, are disgusted and refuse to spend any more time or money on it.

I hope that RADIO WORLD will take up the viewpoint of the fans distant from New York from which this "canned stuff" emanates, and try to have conditions improved, for if it is not done the radio business will take a big drop.

A. S. McBRYDE,
1498 Calvert Ave, Detroit, Mich.

Pre-view and Review

"Radio Broadcast" for August Is Described

In the August issue of "Radio Broadcast," R. P. Clarkson in an article entitled "What Can We See By Radio?" discusses the principles and practice of television as at present developed. Mr. Clarkson is well versed in this subject and gives a very frank and satisfactory exposition of the subject.

In "All About Loudspeakers" Joseph Morgan shows the construction of several popular types of loudspeakers and gives experimental response characteristics of the types discussed. The curves given for exponential horns and electro-dynamic speakers are particularly interesting.

Robert Burnham describes "A Dual Control AC Receiver" in the same issue. This is a well-shielded and stabilized electric receiver involving six tubes besides the rectifier.

"A Screen Grid Short-Wave Receiver" is a brief but good descriptive article by Howard Barclay of the Silver-Marshall short wave receiver.

In an article "What 'Pick-up' Shall I Buy?" David Grimes does not answer the question but gives an unbiased description of several types of pick-up units which should enable any one interested to answer the question for himself.

Herbert Grove in an article "Adding Regeneration to Any Set" shows by circuit diagrams and explanatory text show regeneration may be added to existing receivers.

"What About the 5-Meter Band?" asks R. S. Kruse in an article and then proceeds to answer as no other authority on the short wave problem could do. He speaks from his experience on the frontier of radio development from the time the frontier was still at 200 meters until the present when it is at 5 meters or below.

In "Operating the National Screen-Grid Five" James Millen tells how to do it in a two-page discussion.

"Drake's Cyclopedia" In Fine, New Edition

"Drake's Radio Cyclopedia," by Harold P. Manly, published by Frederick J. Drake & Co., in a new and second edition, is a practical reference book intended to bridge the gap between the radio engineer and the radio worker by presenting useful information clearly, non-technically and with adequacy of treatment. It covers exactly 1,680 subjects in 920 pages.

The field covered is that of the action, use and construction of devices employed in radiophone reception, together with related subjects which form the foundation of radio practice.

The subjects are treated in alphabetical order, with numerous cross references, so that the student may find quickly the information available on any subject desired. The cross references enable the reader to pursue related subjects until a thorough understanding is gained of any problem in which he may be interested.

The book contains the answers to practically all questions which amateur and professional set builders and radio experimenters ask.

The book is up-to-date and it covers many topics which have been added to the art in recent months.

While the book has been prepared especially as a reference book for the non-technical it will prove a useful addition to the library of any radio engineer.

The technical staff of RADIO WORLD highly recommends this book to custom set builders, home constructors, service men and technicians generally, as the most suitable volume for those who want the facts stripped as far as possible of intricacies.

The book costs $6.

Second Edition of Lauer-Brown Book

The second edition of "Radio Engineering Principles" by Henri Lauer, B. S., and Harry L. Brown, B. E. E., published by McGraw-Hill Book Company, 370 Seventh Ave., New York, ($3.50) is a comprehensive treatment of the principles underlying radio transmission and reception, both of telegraphic and telephonic communication. The treatment of the subject is both descriptive and mathematical. The descriptive portions, which predominate, are simple and lucid so that the non-mathematical student may easily grasp the principles discussed. The mathematics used is also simple yet it is complete enough to give the definiteness to demonstrations which the analytically minded student demands.

The reader is lead by logical steps from the elementary principles of electrostatics and electro-magnetism to the practical applications of these principles to transmitters, modulators, detectors, amplifiers, oscillators and vacuum tubes, and in fact most devices used in radio. The book will introduce the reader into the technical phases of the subject and enable him to follow current technical radio literature.

It is very well written.

Army to Fly by Ear with Aid of Beacons

Washington.

Six radio beacons are soon to be installed at as many Army Air Corps fields, as aids to pilots who fly in fog or thick weather, according to the Assistant Secretary of War, F. Trubee Davison, who returned to Washington following an inspection trip which included the Army Air Corps laboratories at Dayton.

"Within the next few months we hope to have installed and in use no less than six radio-beacon stations in this country, besides one in Panama and one in Hawaii," said Mr. Davison. "These beacons will be at San Francisco, Calif.; San Antonio, Tex.; Uniontown, Penn.; Dayton, Ohio; Mitchel Field, N. Y.; and Washington, D. C. Six beacons will provide several combinations of airways that will be undisturbed by clouds and proof against fog. The beam of the radio beacon can, like a search-light be thrown in any direction and can be made visible for a distance of 100 to nearly 2,000 miles.

"The radio beacon sends three signals which run parallel to each other like fingers extended from a hand. When the pilot is on his exact course he hears the letter 'T.' If he swings to the right or left, it changes to 'N' or 'A.' In other words, if the weather is such that he cannot see, the pilot flies by ear. Any plane equipped with a radio set can hear these signals. The pilot need not even be an expert because the code, once heard, is easily remembered. On my visit to Dayton, I flew on the radio beacon and the steady "T" buzz was easily recognized from the two other signals.

"Army Air Corps engineers are doing all they can to lessen the handicaps of pilots who fly in bad weather. Two important experiments in that connection are the new landing altimeter and a system of leader cables.

"The new altimeter differs from the old-time instrument in that it gives the exact distance between plane and ground objects. The value of this new height recording device becomes apparent when one considers the fix in which pilots have often found themselves when flying or in trying to land in fog or at night.

Tells Height Over Objects

"It must be remembered that the old-time altimeter works by atmospheric pressure. Its zero is at sea-level, but a pilot who flies 1,000 feet above that level may actually have only 50 feet clearance between himself and tree tops in high and rolling country. The value of the capacity altimeter is that it tells the pilot exactly how far he is above ground objects. Lift one of these new instruments above a desk and it records exactly the height at which it is held suspended. This instrument is still highly experimental but I believe that it points in the right direction toward defeating fog—the arch enemy of aviation.

"Experiments are also being conducted with the 'leader' cable, a device designed to reduce dangers in bad weather landings. It has been used in Europe and it is now being tested by Army Air Corps engineers. The leader cable is a series of wires that radiate from the center of the airport like spokes from a wheel. Each cable or spoke sends, at various intervals, signals informing the pilot who is about to make a landing, how to govern his descent and even tells him when to put his wheels on the ground."

Well Satisfied

Mr. Davison expressed himself as thoroughly satisfied with the results of his inspection trip which covered several middle and northwestern States and included visits to a number of regular Army Air Corps stations, as well as fields used by National Guard and Army Air Corps Reserve aviators.

"The new planes used by National Guard and Reserve pilots," he continued, "in place of the antiquated and dangerous 'Jennies'—all of which were eliminated last year—are proving highly satisfactory and have done much toward increasing the morale among the members of these highly important units of our air defenses. Another feature that impressed me deeply is the progress made toward improving housing conditions for Army Air Corps pilots and enlisted personnel. Old quarters that were hardly fit to be occupied by human beings are giving way to modern and comfortable buildings, although there is still a long way to go."

IN NEXT WEEK'S ISSUE, dated Aug. 11th, will appear an article on the solution of five problems in constructing an all-wave-mixer. Also an article interesting to those hard of hearing.

Radio University

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

WHAT is the distinction between series and parallel resonance? I have seen both terms applied to the circuit formed by connecting a condenser across an inductance coil and I see no reason why there should be parallel resonance in one case and series resonance in the other.

(2) Is the resonant frequency in the two cases determined by the same formula?

(3) Why is the resistance high for parallel resonance and low for series resonance when the same coil and condenser are used in both cases?

FREDERICK MICKELSEN,
Butte, Mont.

(1) Whether there is series or parallel resonance depends on how the voltage is applied. If the voltage is applied across the condenser and the inductance coil the resonance is parallel. It the voltage is applied in series with the coil and condensen there is series resonance. Also if the voltage is induced in the coil by being coupled to another coil in which an alternating current flows, there is series resonance.

(2) Yes, the formula determining the frequency is the same in both cases.

(3) The resistances are different because the voltage encounters different combinations of impedances in the two cases.

* * *

WHEN TWO identical tubes are used in push-pull are not the internal plate resistances in series? I have seen statements in a department of a New York newspaper radio section that the resistances are in parallel, which do not seem right to me.

(2) Am I right when I say that the output impedance of two —71A tubes in push-pull is 4,000 ohms and not 1,000 ohms?

(3) Also am I right when I say that the impedance of four —71A tubes in push-pull, two on each side in parallel, is the same as the impedance of a single tube of the same type?

MERVIN MARLOW,
Chattanooga, Tenn.

(1) They are in series all right.
(2) You are right.
(3) Again you are right.

* * *

TO WHAT service have the frequencies above 60,000 kc, or wavelengths below 5 meters, been assigned?

(2) Are any wavemeters available for measuring such short waves? If not, how can they be measured?

BERTIL NORDAHL,
St. Cloud, Minn.

(1) Frequencies above 60,000 kc, or wavelengths below 5 meters, have not been assigned to any service. They remain to be developed and utilized.

(2) There are wavemeters which will go down to about 5 meters but for the measurement of shorter waves it is necessary to resort to more complex means. One way of measuring short waves is to impress the waves on two parallel wires and to locate the nodes of the standing waves by connecting a neon tube across the wires. The tube will glow at certain

(*Continued on next page*)

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EVERY FRIDAY at 5.40 P. M. (Eastern Daylight Time) Herman Bernard, managing editor of Radio World, broadcasts from WGBS, the Gimbel Bros. station in New York, discussing radio topics, mostly television.

points. The distance between two adjacent glow points is half a wavelength.

* * *

WHY is it that a loop will pick up a signal when the plane of the loop is pointed to the station desired? I understand that both sides of the loop pick up a signal voltage and that these two buck. Does not one neutralize the other?

(2) Which is better, a small compact loop of many turns or a loop of large frame and a few turns?

HERBERT E. SOULE,
Carson City, Nev.

(1) It is true that the voltages picked up by the two sides of a loop buck each other. The reason that there is a net voltage is that the voltages in the two sides of the loop are not equal at the same instant, for it takes a definite time for the wave to travel from one side of the loop to the other. The net voltage in the loop is proportional to the number of turns in the loop, to the height of the loop, and as long as the distance across the loop is small compared with half a wavelength of the wave received, it is also proportional to the distance across the loop. Thus the signal picked up by the loop is proportional to the area of the loop times the number of turns.

(2) From this it appears that it makes little difference whether a small or a large loop be used so long as the area times the number of turns is the same. If distributed capacity can be kept very low there may be a slight advantage in using a small loop.

* * *

WHAT is the meaning of resistivity?

(2) What is the meaning of dielectric strength?

(3) Please name five of the best insulating materials.

ADOLPH ECKE,
Milwaukee, Wis.

(1) The resistivity of a material is the number of ohms resistance of a cubic centimeter of the material.

(2) The dielectric strength of an insulating material is the number of volts required to break down a thickness of one centimeter of the material.

(3) The five best insulators together with their resistivities in billion billion ohms are as follows: Ceresin wax, 5 plus; quartz, fused, 5; hard rubber, 1; mica, colorless, .2; sulphur, .1. These values were obtained by measuring the substances at 22 degrees C or 71.6 degrees Fahr.

WOULD IT BE practical to build a portable screen grid Diamond of the Air using two screen grid tubes, one 99 and one 120 type power tube?

(2) What should the plate voltage be?

FRED TAYLOR,
Washington, D. C.

(1) Yes. Such a receiver will be sensitive but it would be heavy due to batteries required for the 120. The Double Shield Portable is to be preferred.

(2) The plate voltage should be 135 volts on all the tubes except the 99s, on which it should be 90 volts. Lower voltages, such as 90 and 67½ volts, may be used if light weight is of more importance than loud signals. See June 23 and 30 isues for an excellent portable, just as sensitive.

* * *

MY RECEIVER motorboats. Please tell the best method of overcoming the trouble.

OTIS OMER,
Providence, R. I.

The best cure for motorboating in any receiver is a large capacity across the output, say 20 mfd., or use a storage B battery.

Let Radio World Follow You on Your Vacation

If you are a subscriber and are going away this summer, send us your name and change of address and we will see that the paper reaches you every week.

If you are not already a subscriber, send us one dollar and your name will be placed on our subscription list from now until Labor Day and your address will be changed as often as you desire. Such change should reach subscription office two weeks in advance of date of publication.

Subscription Dept., RADIO WORLD, 145 West 45th Street, New York City

Series Filaments Delight

Editor RADIO WORLD:

The remarks of Mr. L. K. Marshall, concerning the use of series filaments, published in RADIO WORLD of June 30th, bring up a very important subject that has not been given the consideration it deserves by radio set builders and designers.

There is an attitude of inertia in the minds of radio men regarding series connections for tube filaments, simply because it has become customary practice to use parallel connections, although engineers whose experienec goes back before war times have generally regretted the adoption of parallel filaments.

Of course, in commercial equipment, the design of the radio apparatus was involved in the selection of power supply and whatever voltages were required for series filaments were provided by the power equipment.

For broadcast receivers, however, parallel filaments were adopted because of the universal use of 6-volt storage batteries.

Now we go back to the selection of supply voltages in the design of AC operated receivers.

It is no longer necessary to use parallel connection because, from AC supply devices, any voltage can be obtained.

One of the most successful all-around receivers that I have ever operated was the Pilot Electric's SP-5, a series of filament receiver with a BH Raytheon supplying A, B and C voltages or four 199s, and a 171 power tube. The latter was operated with AC on the filament.

The finest Super-Heterodyne I ever operated was built with 201-A tubes with a 171 in the last stage. This set used four rectifier tubes to supply about 150 mils for the A, B and C power.

It is my own opinion that better results can be obtained with tubes of the 201-A type, designed for approximately .125 ampere on the filament. Then the A, B and C voltages can be supplied from a single BH Raytheon.

This would make a much less expensive set than one using AC tubes, for the complete power supply would cost no more than a good B eliminator now. The power transformer would have a 5-volt winding to operate one or two 171 power tubes. Biasing voltages could be obtained simply and easily by resistances.

Filament current would be regulated by a variable high resistance connected across the series of tubes. An inexpensive type of resistor can be used, for in this type of circuit the variable resistance carries only a slight amount of current.

When receiving tubes with .125 amp. filaments are available, it is quite possible

Quick Action Classified Ads

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BLUEPRINTS of National Screen Grid Five, 4-tube Screen Grid Diamond and Karas 3-tube Short Wave Set—three blueprints—one dollar. Guaranty Radio Goods Co., 145 W. 45th St., N. Y. C.

KARAS SHORT WAVE SET, three tubes, 13 to 750 meters, described in the March 31, April 7, 14, 21 and 28 issues. Send 60 cents for these five issues and get blueprint free. RADIO WORLD, 145 W. 45th St., N. Y. City.

COMPLETE PARTS, 5 tube set $4.95. Drilled and engraved panels. Write for literature. Oman, 155 Concord, St. Paul, Minn.

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SCREEN GRID TUBES, famous standard manufacturers, no bootleg, $4.50 each. Special three circuit tuner, high primary impedance for screen grid tuned plate, $2.50. Antenna coil for screen grid circuits, adjustable primary, $2.00. Aluminum shield caps fit over entire screen grid tube, $1 each, C.O.D. only.—Philip Cohen, 236 Varet Street, Brooklyn, N. Y.

M. B. Sleeper

that they will be found more satisfactory than heater-type tubes.

M. B. SLEEPER,
Technical Editor, "Radio Design"

Mr. Marshall, adding to the remarks referred to by Mr. Sleeper, points out that the series filament method calls for an extra large B power unit, employing the Raytheon BA, i.e., milliampere tube, in the case of the quarter ampere filament tubes. Mr. Marshall added the following:

"If, however, the low-current —99 type tubes are employed, the Raytheon BH tube may be employed for supplying the increased current drain for the filaments

Some Precautions

In rewiring for series filaments, there are just two main points to observe, namely the application of the proper voltages on filaments, plates and grids; and confining the radio-frequency currents to their proper circuits.

Thirdly, there is the AC tube, which may be applied either by rewiring the receiver, or, what is far simpler and usually preferable, by substituting AC tubes for the usual battery tubes, without rewiring, by means of the harness or ready-made wiring cable together with suitable step-down transformer. The harness method provides excellent results, and there is a harness available for practically any type of battery operated receiver.

It should be noted that irrespective of the method of conversion, a B power unit is essential. Therefore, the investment made in the B power unit is a lasting one. The only change with the B eliminator or B power unit is to plug it into the same source of lighting current as the filament supply, and to provide a common switch which will turn the entire set on or off.

Needs B Power in Any Case

There is an erroneous idea among the laity that AC tubes operate entirely on alternating current, and so do away with the B power unit. The AC tube filaments do operate on raw alternating current, stepped down to the required low voltage.

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