

Jan. 8  
15c

# RADIO WORLD

REG. U.S. PAT. OFF.

Vol-10 #16 250



*The National-Lynch Power Amplifier  
and B Supply*



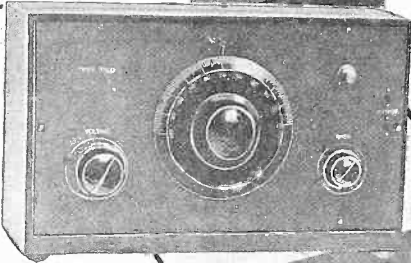
# I Will Train You At Home To Fill a Big Pay Radio Job



**"I give you all this apparatus so you can learn quickly at home the Practical Way"**

J.E.S.

FREE OF EXTRA COST



## You Get All of This

All instruments shown here and others sent to all my students free of extra cost under short time special offer. Clip coupon now—find out all about this big unequalled offer while you still have time to take advantage of it. This training is intensely practical—these instruments help you do the practical work. You learn workmanship and get added confidence in your ability.



**\$70 In One Day For T. M. Wilcox**

"I am in business for myself and RECENTLY MADE \$70 in ONE DAY. I was an electrician of rich experience, occupying a splendid position as telephone superintendent when I enrolled with you believing it would open up greater opportunities—have not been disappointed. Estimate Radio will be worth tens of thousands of dollars to me in next few years." T. M. Wilcox, Belle Island, Newfoundland.

### World Famous Training That "Pays for Itself"

My Radio course World-Famous as the training that "pays for itself." Make more money QUICK when you take up this practical course. Work on millions of antennae, receiving sets, offers you big chance to make spare time cash while you re-learn the "how" of the latest "dope." I'll show you how—teach you the latest "how" to get the business and make it pay. My students don't wait a year to increase their income—they report QUICK INCREASES as a result of this course—often two or three weeks after starting.

Howard Luce, Friedens, Pa. made \$320 in 7 weeks during spare time. D. H. Swift, Newport, Ark., writes "While taking the course I earned in spare time work about \$900." Earl Wright, Omaha, reports making \$400 in a short time while taking course—working at Radio in spare time! Sylvester Senoo, Kaukauna, Wis., made \$500. These records not unusual—these men a few of hundreds.

### Your Satisfaction Guaranteed

We who know the results this practical tested training gets—the increased earnings it has brought to men everywhere—stand behind it all the way with a signed guarantee bond that we give you when you enroll. On completion if you're not entirely satisfied in every way, you get back every cent you've paid us. No strings to this offer—you yourself are the only judge. Get started today! It's your big chance for one of the bigger Radio jobs—mail coupon NOW for my Big FREE BOOK and proof! No obligation.

If you're earning a penny less than \$50 a week, clip coupon now. Send for AMAZING FREE BOOK, "Rich Rewards in Radio." Why go along at \$25 or \$35 or \$45 a week, when you could earn \$50 to \$250 in the same six days, as a Radio Expert? Hundreds of N. R. I. trained men are doing it—why can't you?

## Earn \$50 to \$250 a Week—RADIO EXPERTS IN BIG DEMAND

Radio needs trained men. Get into this new live-wire profession of quick success. It's the trained man, the Radio Expert, who gets the big jobs of this profession—paying \$75, \$100, \$200 a week and up. Every day N. R. I. trained men are taking good places in the Radio field—men just like you—their only advantage is TRAINING. You can prepare just as they did, by new practical methods. Our tested clear training makes it easy for you. Big Free Book contains all the proof.

## You Learn Quickly In Spare Time

So sure am I that I can train you successfully for a better future in this new Big-Pay profession, that I guarantee your training with a money-back bond. Lack of experience or education won't hold you back—common schooling all you need to start. You can stay home, hold your job, and learn quickly and pleasantly in your spare time. My practical, helpful methods enable you to start RIGHT AWAY toward one of the bigger Radio jobs paying \$50 to \$250 a week. No delay, no losing time from work—no scripping or scraping to get your training.



**Operates WMAQ**  
"Accepted a position with the Chicago Daily News Station WMAQ. MY INCOME PRACTICALLY DOUBLED, thanks to you. I handle all consultation, also do operating. Your course taught me not only the theoretical but also the practical knowledge that makes my work easy for me." Keith Kimball, Station WMAQ, Chicago, Ill.

## Get This FREE BOOK

Most amazing book on Radio ever written—full of facts and pictures—tells all about the great new Radio field, how we prepare you and help you start. You can do what others have done—GET THIS BOOK. Send coupon today—no obligation.

J. E. SMITH, President  
NATIONAL RADIO INSTITUTE  
Dept. AC-7, Washington, D. C.



J. E. SMITH, President  
NATIONAL RADIO INSTITUTE  
Dept. AC-7, Washington, D. C.

Dear Mr. Smith—Without obligating me in any way, send me your free book, "Rich Rewards in Radio" and all information about your practical, home-study Radio Course.

MAIL THE COUPON TODAY

Name..... Age.....  
Street Address.....  
Town..... State.....

EMPLOYMENT SERVICE TO ALL GRADUATES

Originators of Radio Home-Study Training

## Good Back Numbers of RADIO WORLD

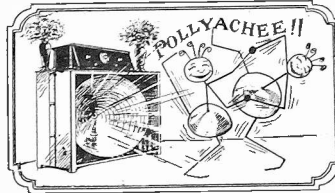
The following illustrated articles have appeared in recent issues of RADIO WORLD:

- 1926:
- April 3—How to Get DX. by Capt. P. V. O'Rourke, A Compact B Supply, by Lewis Winner.
  - April 17—The New 1-Dial Power-tone, by Capt. P. V. O'Rourke, The Action of Transformers, by Lewis Winner.
  - May 8—To Wind a Loop on a Cardboard Frame. How to Reflex Resistance AE, by Theo. Korr.
  - May 15—Super-Heterodyne Results Brought Up to Maximum, by Herman Bernard. The Truth About Coil Fields, by J. E. Anderson.
  - May 22—A Built-In Speaker Set, by Herbert E. Hayden. The Power-tone in Operation, by Capt. P. V. O'Rourke.
  - June 5—Five-Tube Compact Receiver, by J. E. Anderson. A Tester for Tube Circuits, by Spencer Hood. Problems of Portables, by Hugo Gerstback.
  - June 19—Selectivity's Amazing Toll, by J. E. Anderson. The Light 5-Tube Portable Set, by Herman Bernard.
  - July 3—Set with a 1-Turn Primary, by Herman Bernard. Part 2 of the Victoreen Portable, by H. Bernard. Trouble Shooting Article for The Light 5-Tube Portable.
  - July 10—A Rub in Single Control, by Herman Bernard. A DX Double Regenerator, by Capt. P. V. O'Rourke. A 2-Tube Dry Cell Receiver, by Samuel Schmalz.
  - July 17—A Double Duty Loop Aerial, by J. E. Anderson. How to Measure Coupling, by John Rider. A 1-Control Crystal Set, by Smedley Lyons.
  - July 24—Why the Super-Heterodyne Is the Best Set, by Herman Bernard. A 1-Tube Reflex Receiver, by H. A. Reed.
  - July 31—What's Best in an AF Amplifier, by Herman Bernard. A 6-Tube Reversed Feedback Set, by K. B. Humphrey.
  - Aug. 7—The 5-Tube Tabloid, by A. Irving Wits. The Wiring of Double Jack, by Samuel Lazer.
  - Aug. 14—The Improved Browning-Drake, by Herman Bernard (Part 1). Storage Batteries, by John A. White.
  - Aug. 21—A New Stabilized Circuit, by E. H. Loftin and S. Y. White (Part 1). The Browning-Drake, by Herman Bernard (Part 2).
  - Aug. 28—The Constant Coupling, by E. H. Loftin and S. Y. White (Part 2). The Browning-Drake, by Herman Bernard (Part 3).
  - Sept. 4—The Four Rectifier Types, by K. B. Humphrey. A Simple Battery Charger, by J. E. Anderson.
  - Sept. 11—The Beacon (3-tubes), by James H. Carroll. The 1927 Model Victoreen, by Herman Bernard.
  - Sept. 18—The 1927 Victoreen, by Arthur H. Lynch. Eliminator in a Cash Box, by Paul R. Fernald.
  - Sept. 25—The Lynch Lamp Socket Amplifier, by Arthur H. Lynch. Wiring up the Victoreen, by Herman Bernard.
  - Oct. 2—The Victoreen (Continued), by Herman Bernard. New Equamatic System, by Capt. P. V. O'Rourke.
  - Oct. 9—A Practical "A" Eliminator, by Arthur H. Lynch. Building the Equamatic, by Capt. P. V. O'Rourke.
  - Oct. 16—The Bernard, by Herman Bernard. How to Box an "A" Supply, by Herbert E. Hayden.
  - Oct. 23—The 5-tube P. O. Samson, by Capt. P. V. O'Rourke. Getting DX on the Bernard, by Lewis Winner.
  - Oct. 30—The Singletrot Receiver, by Herbert E. Hayden. How to Get Rid of Squawks, by Herman Bernard.
  - Nov. 6—Reduction of Interference, by A. N. Goldsmith. Variations of Impedances, by J. E. Anderson.
  - Nov. 13—The 4-tube HI-Power Set, by Herbert E. Hayden. A Study of Eliminators, by Herman Bernard.
  - Nov. 20—Vital Pointers About Tubes, by Capt. P. V. O'Rourke. The 4-tube Diamond of the Air, by Herman Bernard.
  - Nov. 27—The Antennulee Receiver, by Dr. Louis B. Han (Part 1). Short Waves Yield Secrets, by M. L. Prescott.
  - Dec. 4—The Regenerative 6-Tube Set, by Capt. P. V. O'Rourke. The 8-tube Lincoln Super, by Sidney Stack. The Antennulee Receiver, by Dr. Louis B. Han (Part 2). Winner's 1st Eliminator, by Lewis Winner.
  - Dec. 11—The Universal Victoreen, by Ralph G. Hurd. Some Common Fallacies, by J. E. Anderson.

Any copy, 15c. Any 7 copies, \$1.00. All three 32 copies for \$4.00 or start subscription with any issue. RADIO WORLD, 145 West 45th Street, New York City.

# WORLD'S FINEST LOUD SPEAKER ~ GENUINE ~ "ENSCO" 3 FT CONE KIT

ONLY \$10  
Can be Assembled in Less Than an HOUR



ONLY \$10  
The Original Three Foot Cone Speaker KIT

**NO THE SOLUTION OF THE PERFECT  
DISTORTION LOUD-SPEAKER PROBLEM FIDELITY**  
*The Choice of Leading Engineers*

COMPLETE parts furnished in kit form. We guarantee this speaker the equal of any manufactured cone speaker at any price. With this THREE-FOOT CONE SPEAKER you hear all the tones. It brings out the true depth and beauty of orchestral and instrumental music. Can be operated softly for living room music or full volume for dancing, and without trace of distortion. Kit includes famous "ENSCO" cone unit, the only direct-

drive, distortionless unit for large cones; Alhambra Fonotek for big cone, with brass apex, two soplá prints showing cabinet or stand construction for cone speaker, also wall and roll types. All necessary instructions.

Buy this wonderful speaker under our absolute guarantee. Your money back if you are not convinced that it is the finest reproducing medium obtainable at any price. It works on any set, with ordinary Tubes or with Power Output.

When in New York City visit Studio and listen to Demonstration of the WORLD'S FINEST LOUD SPEAKER

ENGINEERS' SERVICE CO., 25 Church Street, New York City

SEND NO MONEY!

Write your name plainly as indicated below, then mail and complete kit will be forwarded to you. Just pay postman \$10.00 upon delivery.

Name .....  
Address .....  
City and State .....  
ENGINEERS' SERVICE CO., 25 Church Street (Desk W), New York City

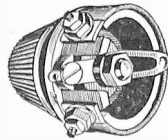
### WATCH EXPIRATION OF YOUR SUBSCRIPTION!

Subscribers will note that the end of their subscriptions is indicated on the labels on wrappers. If your wrapper shows a date earlier than the current issue, please send payment for renewal. Changes in expiration dates on wrappers appear two weeks after receipt of renewal.

RADIO WORLD, 145 West 45th St., New York City. (Phones: Bryant 0558-0559.)

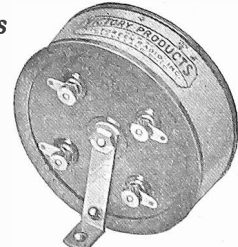
# VICTOREEN

in Super Sets means  
Volume Selectivity  
and Satisfaction.

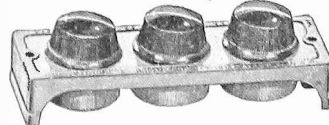


**VICTOREEN RHOESTAT**  
Zero temperature coefficient. Increased number of turns of wire. Third terminal to simplify wiring. Five resistances—2, 6, 10, 20, 30 ohms—\$1.20 each.  
Victoreen Potentiometers — 200, 400, ohms—\$1.50 each.

A Victoreen Super is the last word in radio. If you have never built a set using the Victoreen Universal Circuit, you have missed one of the greatest pleasures in radio. Ask your dealer or send to us for folder giving complete information.



**VICTOREEN R-F TRANSFORMERS**  
Tuned to a precision within one-third of one per cent—made by a pioneer radio manufacturer. Two types—No. 170 for use with regular tubes; No. 171 for dry cell tubes. Price \$7.00.



**AUDIO CONTROL UNIT**  
Permits minimum number of panel controls and consists of 3 rheostats of proper ohmage mounted on the bakelite base. Controls the second detector and audio tubes.  
Use Type 3-R for 201 A tubes. Use Type 3-R-L for power tube.  
Price—\$4.50 each.



**MASTER CONTROL UNIT**  
This one dial unit has been so constructed that by means of compensator controlling the antenna condenser, adjustment is permitted up to a 20 degree variation in capacity, with a 360 degree vernier motion. Used in circuits employing two or more condensers of the same capacity. Easy mount—no change in wiring necessary.  
Two condenser type—Price \$19.50.  
Each additional condenser—Price \$4.50.

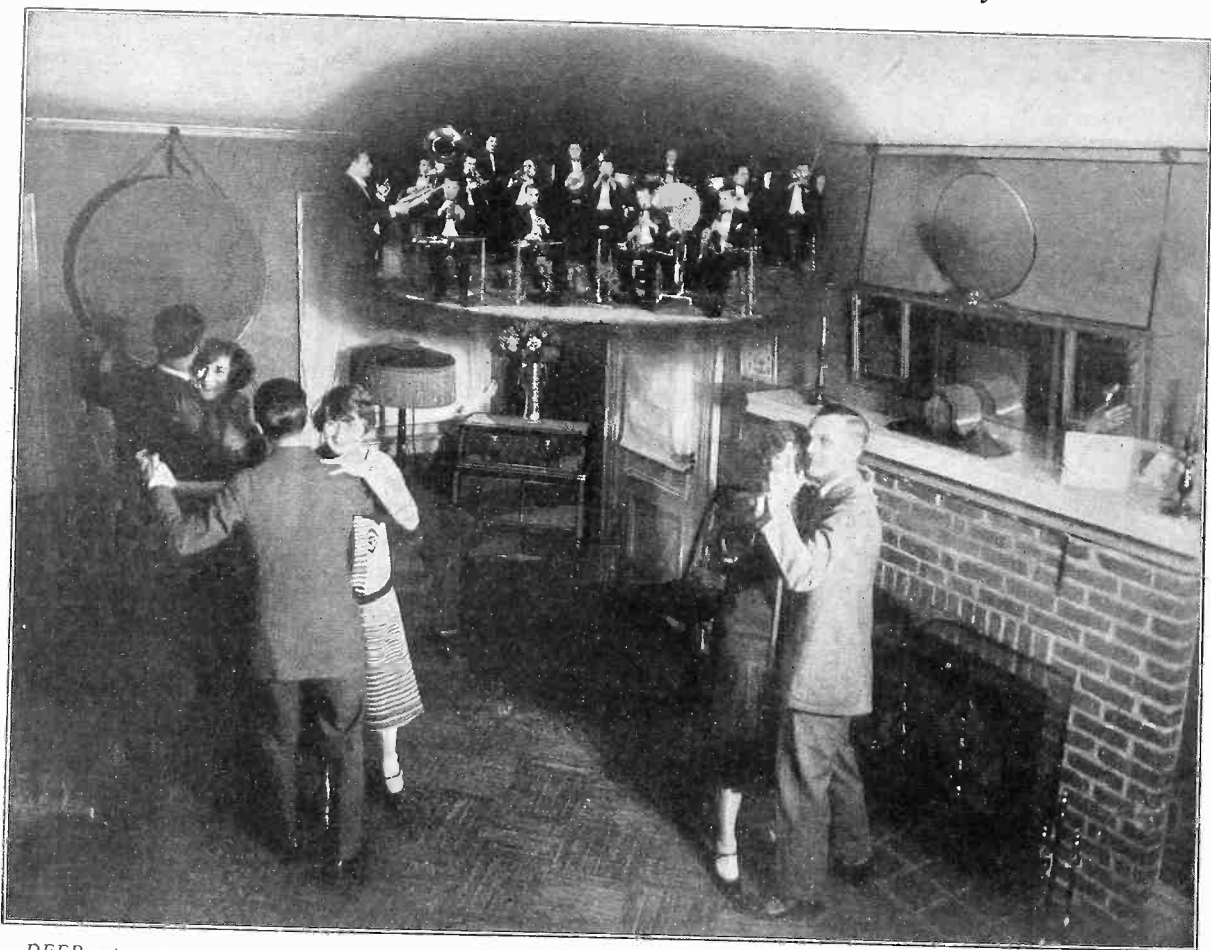
**The George W. Walker Co.**  
6528 Carnegie Ave. Cleveland, O.

Merchandisers of Victoreen Products

[Entered as second-class matter, March, 1922, at the post office at New York, N. Y., under Act of March 3, 1897]

## The National-Lynch Power Amplifier and B Supply

*A Raytheon Circuit for Use With the De Luxe Receiver or Any Other Set*



DEEP entrancement attends dancing to the full-powered strains of music emanating from the De Luxe Lamp Socket Receiver, through the 3-foot cone of the Engineer Service Company (in background). The receiver's tone is so pure, true and full that one imagines the orchestra is right there. The photograph was taken at the author's country house and the apparition devised with the photograph on page 7.

**T**HIS is the second of a series of four articles on the De Luxe Lamp Socket Receiver. These articles appear each week in Radio World. Our technical staff attended several demonstrations of this receiver and does not hesitate in saying that for all-around performance it has never heard one better.

In the following article Mr. Lynch describes the theory as well as the construction of the National-Lynch Power Amplifier and B Supply. This unit, though described by the author in connection with his Two-Tube De Luxe Receiver, may be used to advantage with any receiver now on the market.

Even though you may not desire to build any of the equipment in this series you will find that the articles are extremely interesting and describe in non-technical language many fundamentals of receiver design never before published and little understood heretofore.

*By Arthur H. Lynch*

**T**HE audio channel of the new De Luxe receiver is perhaps the outstanding development in the field of radio receiver engineering during the

past year. Although essentially a unit of the complete De Luxe receiver, the new amplifier is also particularly well suited for modernizing any other set. In

fact the improvement in tone quality and general operating characteristics, when the new amplifier is used with such popular factory-made sets as the Atwater-





HERE you see Vincent Lopez himself, in person, and nobody else but, leading his own famous orchestra, which broadcasts regularly from WEAf and an imposing chain of stations. To the tunes played by this orchestra the author's week-end guests were dancing when the photograph on opposite page was taken. (Apeda)

Kent, Freed-Eisemann, and Fada, is almost beyond belief. Certainly the person who now has such a receiver will never be able to imagine the tremendous difference that the new amplifier-power unit can make in its performance until he hears it. The amplifier-power unit was developed after many months of experimental and research work by the author in conjunction with James Millen, a well-known consulting engineer in the radio field.

For purpose of discussion, the amplifier and power unit, although so tied together electrically and mechanically as to be only one unit, will be treated separately.

#### The Amplifier

Fundamentally the audio channel consists of a stage of impedance coupled and two stages of resistance coupled amplification.

The input impedance is a National impedanceformer which contains in one compact unit, in addition to a high inductive impedance, a Tobe coupling condenser, Lynch metallized filament grid resistor and an input radio-frequency choke coil. The RF choke is extremely important to stabilize the operation of the detector circuit and to prevent distortion due to audio tube overloading as a result of the presence of RF currents in the audio amplifier.

#### Why An Impedance Input

Although theoretically better quality would be obtained as a result of the use of resistance rather than impedance coupling in the first stage, the difference in tone quality, when an impedance of the high quality of the National unit is employed, cannot be detected by the human ear as differing from that when using a resistance input. The advantage of an impedance over a resistance input concerns mainly the new special detector tubes, about which considerable was said, by the writer in the January 1 issue of RADIO WORLD. The plate current drawn by such tubes is in the neighborhood of 6 milliamperes at the higher values of plate voltage recommended for them. Such a current is considerably in excess of the amount that even the new metallized filament resistors will carry, so it is necessary to use an input device that will safely and continuously carry at least 6 milliamperes. As the National impedanceformer will carry considerably more than this current without difficulty it was selected as the input unit.

The resistors used in the resistance coupling units are of the metallized filament type. They were used because of their high current carrying capacity, silence in operation and permanence of ohmic value. The impregnated paper resistors formerly so much used in resistance coupled amplifiers did not possess any of these characteristics and as a result did much to give resistance-coupled

amplification a poor name. Resistance coupled amplification, employing high grade resistors and coupling condensers is one of the most certain methods of obtaining the very best of quality in a most inexpensive way.

#### The Reasons For Each Unit

The coupling condensers are of large capacity, 0.1 mfd., so as to reproduce the very low notes, and at the same time are not large enough to introduce distortion due to the hysteresis loop of the condenser.

CeCo high mu tubes are used in the first two amplifier stages because of the high amplification obtainable from these tubes and because, unlike some other high mu tubes, the filaments require only five volts, hence function properly even after the voltage of the storage battery, if such is used for A power, drops below six volts.

The last or final stage is a power stage. Real energy is required properly to reproduce the lower notes and the only way to obtain real energy is from a power tube capable of passing a sizeable quantity of energy. There are on the market at present at least two power tubes which can supply sufficient energy properly to reproduce signals at normal or natural volume without distortion. One is the CX371 or CeCo J-71 and the other is the 210. To use the 210, however, is much like using a five gallon pail to carry a quart of milk. A half gallon pail is much more practical. As the J-71 will supply more than the necessary amount of energy for use with the home radio set without the necessity of the dangerously high plate voltage required for the 210, it is quite foolish to even consider the 210 under the circumstances.

Furthermore, due to its lower plate impedance, the use of the J-71 power tube will result in a little more nearly perfect quality.

When receiving a very weak or distant station, the overall amplification obtainable may be increased by using the CX112 or CeCo type F semi-power tube in place of the CX371 or J-71 power tube in the last stage. The grid bias control will have to be readjusted to a different value when using the CX112 or CeCo type F, as these require a very much lower grid voltage for a given plate voltage than the J-71.

For normal use, however, the CX112 or CeCo type F should not be employed as they are too easily overloaded by loud signals, resulting in distortion.

#### Using a Tone Filter

The final unit in the audio amplifier proper is the output device. Output devices are of two general types, the impedance capacity units, known as tone filters, and the transformers. The tone filter arrangement is employed in this amplifier for at least two good reasons: First, the tone filter unit is so designed

as to eliminate audio frequency current coupling between the plate circuit of the power tube and the plate circuits of the other tubes. Although the phase of the AC in the plate circuit of the last tube with respect to the AC in the other plate circuits is generally of such an angle as not to cause trouble, it is well worth while to eliminate this possible cause of "motor-boating." The second and more important reason for using an inductance-capacity tone filter unit in preference to an output transformer is the fact that it is quite impossible to manufacture for anything like a reasonable price an output transformer with sufficient primary inductance to give good quality, which will have a core that will not saturate when used with the J-71 power tube with 200 volts on the plate.

In a choke coil-condenser output device, the condenser should be of high capacity—3 to 5 mfd.—and the choke coil of high inductance, at least 30 henrys. As the direct current cannot pass through a condenser, the direct plate current is forced to flow through the choke coil in order to complete the direct current circuit. AC, or the fluctuating current that actuates the loud speaker mechanism, on the other hand, will readily pass through a large condenser, but not so readily through an inductance. The higher the capacity of the condenser, the more readily will alternating current pass through it, or, more technically speaking, the lower will be the impedance of the condenser at any given frequency. As the frequency, or pitch, of the audio current decreases, the more impedance, or opposition, the condenser offers to the passage of alternating current.

#### How a Choke Works

Now, a choke coil has characteristics that are just the opposite to those of the condenser. AC will not readily flow through a choke. The higher the inductance of the choke coil, the less chance there is of any AC being able to pass through.

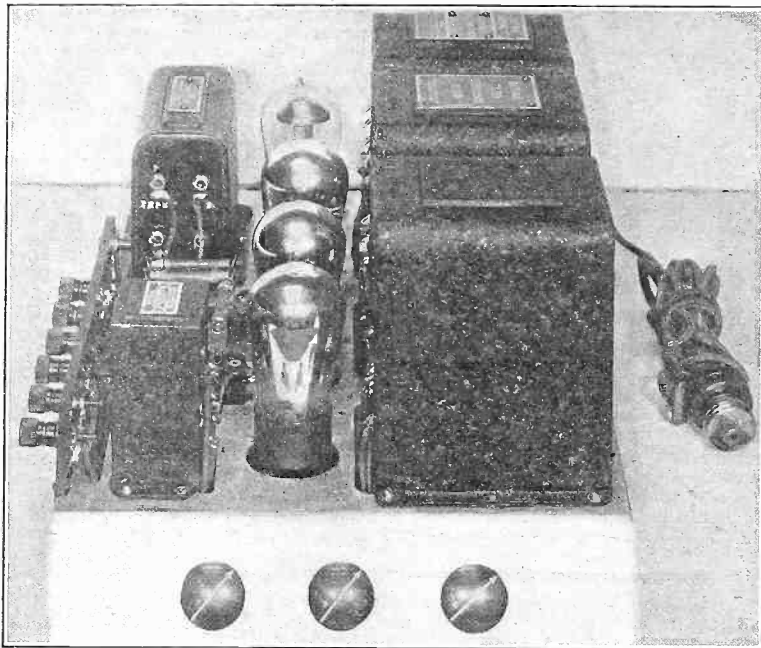
Like the condenser, the degree of opposition offered to the passage of alternating current by an inductance is a function of frequency. In the case of the inductance, or choke coil, however, the lower the frequency the less opposition there is to its flow through any inductance.

As the purpose of the capacity-inductance output device is to separate the plate current of the last or power audio amplifier into its two components, and to make each of these components go through separate circuits, it is essential for the best of quality that the separation be complete. Thus, to prevent loss of the low notes, the inductance of the choke coil must be sufficiently high to prevent any appreciable amount of low frequency audio current from passing through the choke coil rather than through the condenser and speaker.

#### James Millen Designs Power Supply

Although Mr. Millen and the writer were co-designers of the National-Lynch Amplifier as a whole, Mr. Millen, who is a consulting engineer to the National Company and one of the pioneer designers of radio power units, contributed mainly to the design of the power supply and its component parts, while the writer is responsible for the amplifier design.

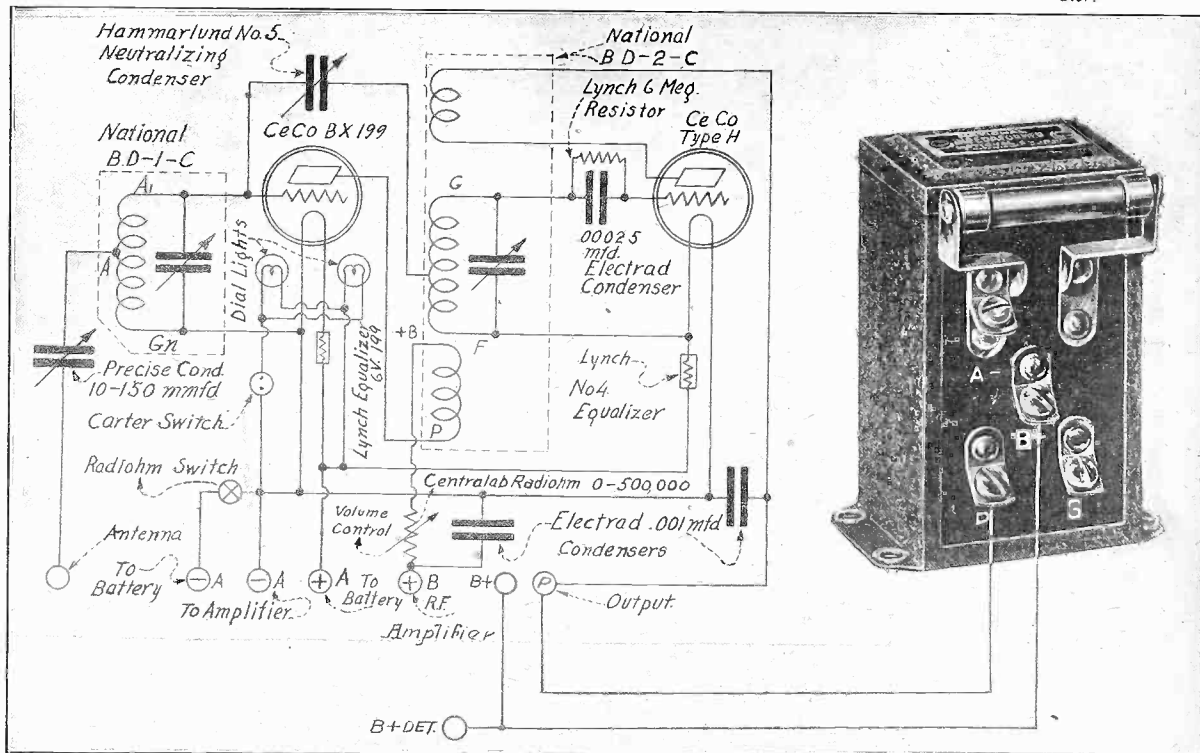
The power end of the amplifier operates directly from any 110-volt 60-cycle AC lamp socket and supplies constant and silent filament power for the J-71 power tube, B power for all of the amplifier tubes, as well as the detector and RF tubes in the tuner unit, and C voltage for the power tube. The power supply consists of a special National transformer, Raytheon rectifier tube, National filter chokes and special National-Tobe high



AN END VIEW of the National-Lynch Power Amplifier, with the tubes in squad formation, "Corporal Raytheon" farthest from you. The other tubes are two CeCo type G (high mu) and one CeCo type J-71 (heavy duty power tube).



CLOSE-UP of "Corporal Raytheon." B.H. are the initials, and faithful duty at all times is his unblemished record. He has four feet but uses only three of them. He carries his own base with him, like a provident soldier.



THE Two-Tube De Luxe Receiver (described in the January 1 issue) is connected to the audio circuit as shown. On the set are two output posts, P and Bt. Bt is connected to Bt Det. post of set and to Bt on the National Impedaformer. P on set goes to P on Impedaformer. The Lynch leak is part of the National unit.

voltage de-hydrated filter condensers, with fixed resistors and three Clarostats.

Mr. Millen was assisted in the design of the power apparatus by Phil Eyrick of Cambridge, who designed the power transformer.

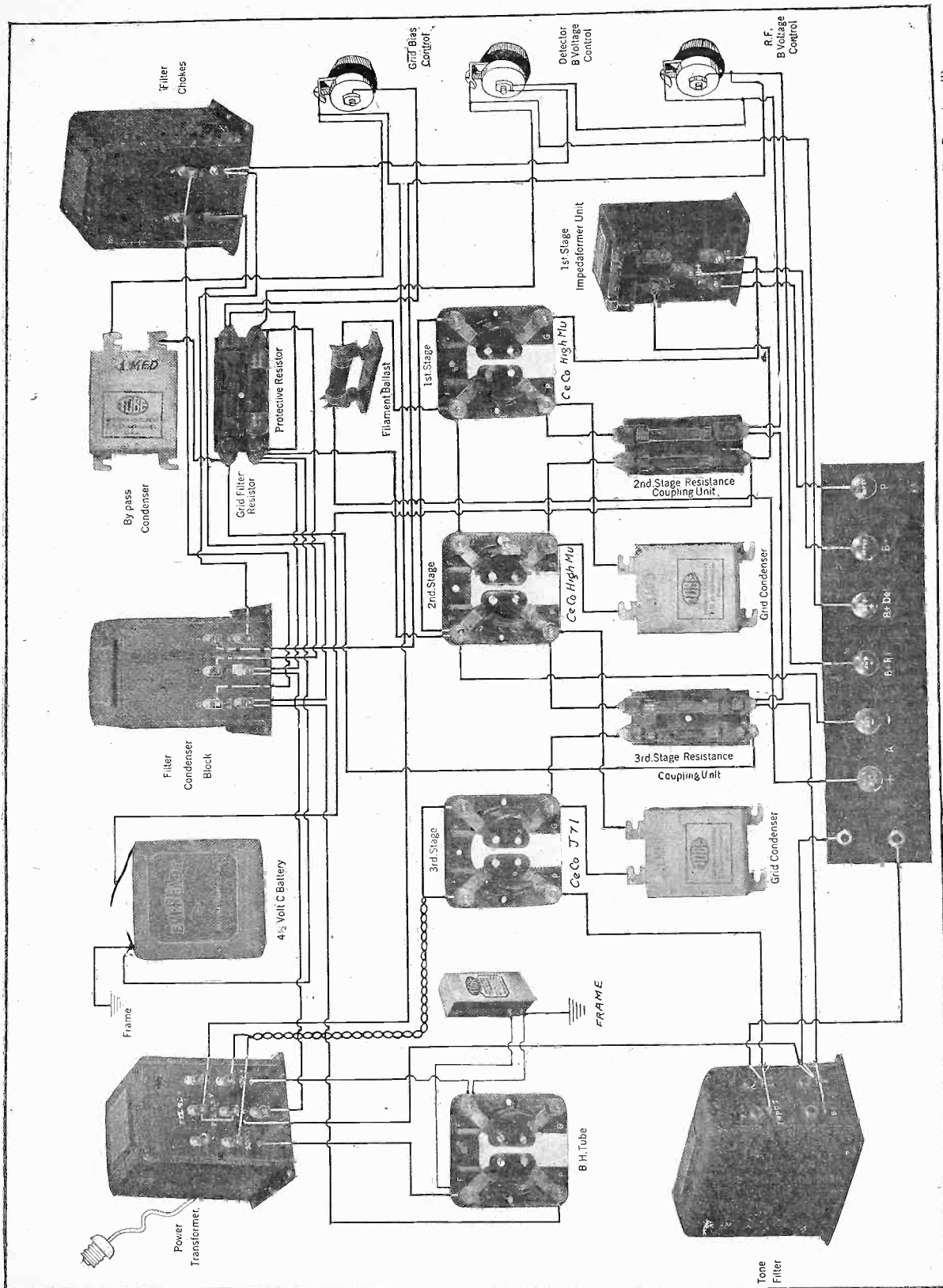
The transformer consists of a 110 volt primary, a five volt and a seven and one-half volt filament winding, with center taps, and a high voltage secondary with center tap. The secondary voltage across each half is 300 volts. In order to reduce

stray magnetic flux from the transformer to a minimum, so that it will have no ill effect upon the proper action of the choke coil, the transformer core is of the shell type and the complete instrument is mounted within a heavy gauge metal shield. A bakelite terminal board is provided with screw posts for all the lower voltage taps, while completely insulated flexible leads are furnished for the high voltage leads so as to prevent any possibility of shock from exposed high voltage metal terminals.

The 110-volt connections are made within the container and the completely insulated 110-volt lamp socket cord is brought out through a bushing in the back of the transformer case.

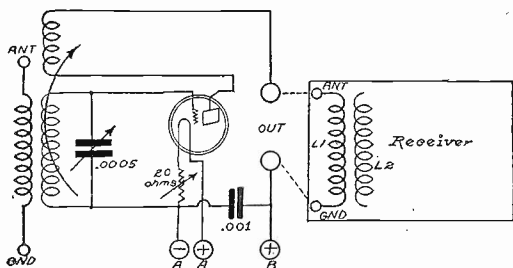
A very important feature—that of electro static line noise shielding—was made entirely automatic in the transformer by placing the filament windings, which are at all times within a very few volts of ground potential, between the 110-volt winding and the high voltage winding.

(Continued on page 23)



WIRING DIAGRAM of the De Luxe Lamp Socket Amplifier and B Supply, with connections to the actual parts clearly shown. (Courtesy "Radio Broadcast")

# Tuning Out Powerful Locals Made Practical by Addition to the Receiver



Three Circuit Tuner

By J. E. Anderson

Consulting Engineer

**E** LIMINATION of interference presents a difficult problem these days, particularly to those who live in the neighborhood of a high power broadcasting station. Countless fans have voiced complaints and asked for means whereby the trouble may be abated.

There are many things that may be done which will help. All methods are based on the two properties of a radio wave—direction and frequency. Stations transmit on different frequencies so that signals differ in this respect. This difference is primarily made use of in eliminating interference. Most stations are also located in different directions from a given receiver. This fact may also be made use of in reducing interference.

When use is made of frequency differences between stations for cutting out interference we speak of tuning. We adjust a circuit in such a way that it will not respond to more than one frequency, the one which is desired. But every tuned circuit of this kind has a limit of discrimination, and that limit depends mainly on the effective resistance in the circuit.

## Resistance Cuts Selectivity

The more resistance there is in the circuit the less discriminatory it is, that is, the less selective it is. If there is interference and the circuit is not selective enough to cut it out, one way of improving matters is to use a different coil which has less resistance.

If one tuned circuit is not enough to tune out interference, the overall selectivity may be increased by using two or more tuned circuits in tandem, as is done in the Neutrodyne and other tuned radio frequency receivers. But it may be that even three or four tuned circuits in series are not enough to tune out a certain interfering station, and it is not practicable to increase the number of tandem tuned circuits. In that event the effective selectivity may be greatly increased by means of regeneration. This may be done in any stage of a radio frequency circuit by merely putting in a tickler.

But ordinarily it is not practicable to make any extended changes in receivers to cut out interference. The question is, What can the average fan do to get relief from an interfering station? What can be added to the set which will reduce the interference without at the same time cutting out the signal or reducing its strength so greatly that it is too feeble to hear?

The only thing that can be done which will not at all cut down the volume is to install a radio frequency amplifier ahead of the main receiver. This will not only increase the selectivity of the receiver

but it will also increase the volume or sensitivity. It is very easy to install an RF amplifier.

It consists of a tube and a three circuit tuner. Wire it up just as a single tube receiver was connected in the old days with the exception that no grid leak and grid condenser are necessary, and the grid return is to negative A. Fig. 1 shows how it should be wired up.

The manner of connecting or coupling the RF to the main receiver is very simple. If there is no condenser in series with the antenna to ground circuit in the receiver, and also if the ground binding post is not connected to the filament of the set, then it is only necessary to connect the output terminals of the one-tube RF amplifier to the antenna and ground posts on the set. The antenna and ground leads should then be connected to the corresponding input terminals of the RF amplifier and the A and B battery terminals should be connected to the proper posts on the main set.

## How Connections Are Made

If there is a condenser C1 in series with the primary coil L1 of the receiver, the output terminals of the RF tubes must be connected to a point below the condenser so that the plate current may flow in the plate circuit of the RF tube. If the set proper is connected metallically to the ground post of the set as in Fig. 1 C, then the connecting wire must be cut before the RF tube is connected to the set. Point X shows where the connection should be cut.

This addition to a set helps very greatly to cut out interference, especially when regeneration is used. Naturally, it increases the difficulties of tuning, but that is a price that must be paid for high selectivity in nearly all circuits.

If it is not desired to use another tube as discussed above, then a wave trap may be resorted to. A simple and effective wavetraps is shown in Fig. 2. It consists of a small winding L1 which is connected in series with the antenna lead, a larger winding L2 which is connected in inductive relation with L1, and finally a tuning condenser C. The coupling between the two windings should be variable, preferably by means of varying the number of turns on L1. This coil may contain a total of ten turns, variable in steps of single turns. L2 should be an ordinary tuning coil, preferably of very low loss construction, and it should have an inductance which matches with the condenser which is used. For instance, when a .0005 mfd. condenser is used for C, the inductance of the coil should be about 165 microhenries, or such as would be given by 44 turns of No. 22 dcc wire on a 3" diameter. L1 is of course wound on the same diameter or form.

The method of using this wave trap is

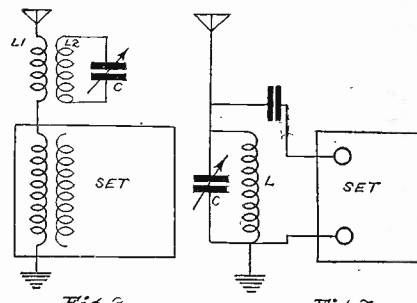


Fig. 2

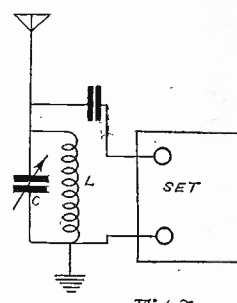


Fig. 3

as follows: First detune CL2 as far as possible. Then tune the receiver proper to the station desired. If then there is an interfering station which spoils the signal of the desired station, tune the wave trap to the interference. Any station within the tuning range of CL2 may be tuned out with this combination, or at least very greatly reduced.

The wave trap also absorbs part of the desired signal, particularly if the desired and undesired signals are very close together in the frequency scale. This absorption is reduced by making the coupling between coils L1 and L2 very loose. But by making the coupling loose the elimination efficiency of the trap is reduced. Hence the coupling should be adjusted so that the interference is reduced to the necessary extent without seriously affecting the desired signal. The wave trap is very selective and it requires very careful tuning to cut out the interference.

If there are two interfering stations, two wavetraps of the same design may be used, each being tuned to one interfering station.

Another effective wave trap, but one more difficult to handle, is shown in Fig. 3. This consists of a parallel circuit connected across the input terminals of the radio receiver. This is a shunt which cuts out all frequencies except the one to which CL is tuned.

## Infinite Impedance

For the resonant frequency of CL this circuit offers an infinite impedance and therefore forces all the signal current that comes in over the antenna into the primary of the first RF transformer of the set. For all other frequencies the parallel circuit CL offers a negligibly small impedance, and they are therefore passed by the set.

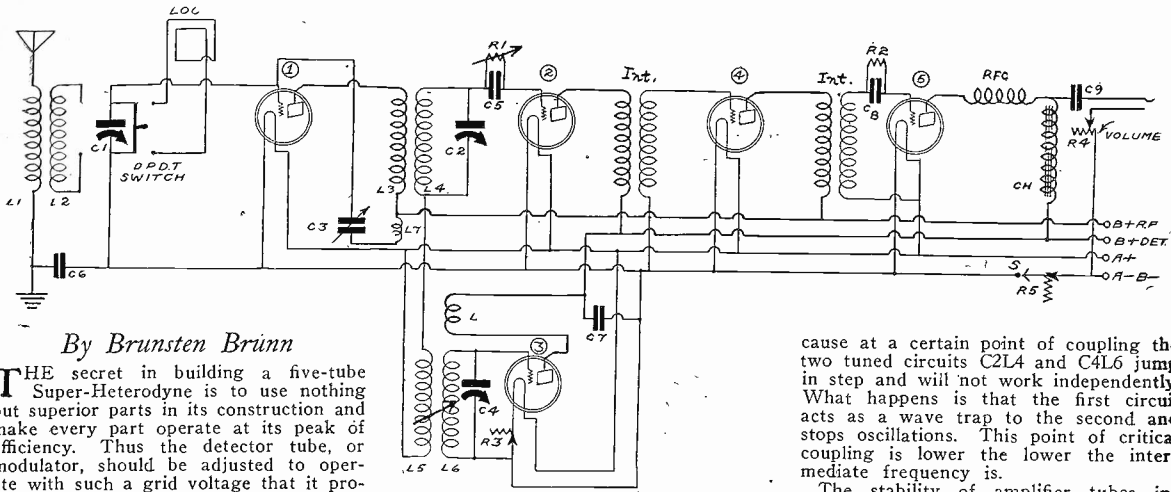
This second form of wave trap is somewhat difficult to manipulate because tuning the trap upsets the tuning of the radio receiver proper and vice versa. However, when the adjustment has once been obtained it is very effective in eliminating all interference. Despite this fact the first type of trap is much to be preferred.

Reducing the number of primary turns on the radio frequency transformers also improves the selectivity of the set and hence helps to eliminate interference. This is particularly true of the first radio frequency transformer, that is, the one that couples the antenna to the set. If the coupling is close here the antenna introduces a very high resistance into the first tuning circuit and thus broadens the set so that a great deal of interference can come through.

Hence one of the essentials of selective tuning is to have loose coupling in the RF transformers, with particular emphasis on the antenna coupler.



# A Choice Super-Heterodyne Efficiency Factors Carefully Considered



By Brunsten Brunn

THE secret in building a five-tube Super-Heterodyne is to use nothing but superior parts in its construction and make every part operate at its peak of efficiency. Thus the detector tube, or modulator, should be adjusted to operate with such a grid voltage that it produces the greatest intermediate frequency current when fed by the output of a radio frequency amplifier and an oscillator. To adjust the grid voltage the grid stopping condenser C5 should be the standard .00025 mfd. and the resistance R1 should be varied. This may be done by having a variable resistor 250,000 (or less) to 10,000,000 ohms, or by having a series of fixed resistors which may be inserted into the clips across the condenser, the one most suitable being left in the clips.

Since the output of the detector is proportional to the square of the input voltage it is obvious that to obtain sensitivity of the circuit the input should be made as great as practical before it is placed on the grid of the detector. This calls for a radio frequency amplifier ahead of the detector. Another advantage of using a radio frequency tube ahead is that it greatly increases the selectivity of the set, and it is an addition that is almost a necessity in any Super-Heterodyne. It eliminates a certain type of squealing which is usually noticeable in receivers of this type. In regards to gain in sensitivity, the RF tube will amplify the signal about four times, and since the detector output is proportional to the square of the input voltage, the effective amplification of the first tube is sixteen times.

The coupling between the RF tube and the detector should be a good low-loss tuning transformer with a fairly high turn primary. To offset any tendency to oscillate as a result of this high primary a neutralizing arrangement is employed, consisting of a coil L7 and a small variable condenser C3. The winding L3 may consist of about twenty turns of wire on a 3" diameter, and the winding L7 should contain about the same number. A 40-turn mid-tapped coil will do nicely. Size of wire is immaterial, and very fine wire is just as effective as heavier. The variable condenser C3 may be a midget vernier, preferably one having a maximum capacity around 50 mmfd. The secondary winding L4 should consist of 44 turns of No. 24 double cotton or silk covered wire on 3" tubing, provided that the tuning condenser C2 has a maximum capacity of .0005 mfd.

One of the most important things in any Super-Heterodyne is the oscillator. If the oscillator does not oscillate, the circuit is dead; if it oscillates ever so

little, the set is operative. One of the best oscillating circuits is the tuned grid and tickler combinations as exemplified in this receiver. The grid coil L6 should be wound on a 3" diameter tubing with No. 24 double cotton or silk covered wire. The plate coil L should be wound on the same form, with the same size wire, in the same direction, and it should contain about 36 turns. The two windings may be separated on the form by 1/4 inch, measured axially. To facilitate oscillation a .001 mfd. condenser C7, is placed across the B supply line as close to the oscillating coil as practical. For the same reason the rheostat, R3, is placed in the negative leg of the filament line and the grid return goes to the minus of the A battery. The slight negative bias thus obtained makes the oscillator work on the negative side and on the straight part of its characteristic, thus minimizing harmonics and at the same time increasing output.

Condenser C4 controls the frequency and is the chief tuning control. Its correct placement is of utmost importance. Many complaints have come in from Super-Heterodyne operators because their tuning condensers have not been connected correctly. The trouble is body capacity. The remedy is to ground the rotor side of the condenser, as has been done in this circuit. Actual metallic connection to ground is not required in all cases. It is sufficient if the rotor is connected metallically to the filament battery. A capacity connection to ground will help, provided the condenser is large enough. Thus C6, a .25 mfd. unit is a great aid in stabilizing the receiver as far as body capacity is concerned.

Coil L5 is known as the pick-up and it transfers the output of the oscillator to the first detector. The closer the coupling between L5 and L6 is the louder will be the signals, but the less the selectivity. It is therefore desirable that the coupling between these two coils should be variable, that is, placed on a shaft which may be turned from the panel. The coupling cannot be too close, either, be-

cause at a certain point of coupling the two tuned circuits C2L4 and C4L6 jump in step and will not work independently. What happens is that the first circuit acts as a wave trap to the second and stops oscillations. This point of critical coupling is lower the lower the intermediate frequency is.

The stability of amplifier tubes increases as the frequency decreases. Therefore it is desirable from this point of view to have a low intermediate frequency. A suitable one is 30,000 cycles. Transformers having a maximum transmission characteristic at this frequency may be obtained on the market. Two stages of them coupled with storage battery tubes will give a great increase in the signal strength.

The second detector is as important as the first and must be adjusted carefully for maximum efficiency. As in the case of the first, the grid leak and stopping condenser method is used for changing the frequency. The grid condenser C8 should be the standard value .00025 mfd. The grid leak again should be capable of variation within certain limits, but it is not necessary to have a continuously variable leak, but merely a supply of fixed resistors in steps of about one megohm until the right one is found.

In the output circuit of the second detector the DC component of the current is separated from the AC by means of a choke coil CH and a condenser C9. The choke coil should have a very high inductance, say 100 henrys or more. It need not have a carrying capacity of more than about 5 milliamperes. Suitable coils may be purchased. The condenser C9 in series with the output should have a very large capacity, preferably 4 mfd. or more.

A variable resistance R4 is placed in series with the speaker for controlling the volume. This method of controlling the volume may be employed in this circuit without causing any distortion because it does not affect the plate voltage as it would do if it were in series with the choke coil. The output is divided between the loud speaker and the resistance in direct proportion to the impedances of the two. That is, when the value of the resistance is equal to the impedance of the speaker the volume is just half what it would be if the resistance R4 were zero. When the resistance is very high the effective input to the speaker is very small, and consequently the volume is also small.

A radio frequency choke coil RFC is inserted in series with the plate lead to prevent the radio, or intermediate frequency current, from entering the speaker. Its value need not be large. (Concluded on page 31)

# The Commonest Trouble Cause Is Mutual Impedance in Sets and Adjuncts

By Selwyn Thursten

TO judge from the number and style of complaints received from fans, the greatest source of poor results is the common impedance in the plate circuit of amplifiers. This applies to receivers operated by both dry cell B batteries and by B eliminators, but particularly to the latter.

The trouble is variously described as clucking, dripping, put-putting, motor-boating, squealing, oscillation, howling, overloading, blasting hissing and roughness of signals. In nearly every case the trouble is the same—regeneration because of feedback through the common impedance.

If the set misbehaves in a manner that may be described by one or more of the above terms, the first thing that should be attended to is the impedance of the source of plate voltage.

## Remedies For the Trouble

If the audio amplifier is transformer coupled, some relief may be obtained by reversing leads, but this is by no means a sure remedy, as thousands of fans have discovered. There are other and more easily applied remedies.

By-passing is one of the quickest to apply. A large condenser should be connected across the battery or eliminator, particularly across the portion of it which is used for the detector. The size of the condenser to use depends on the frequency at which the trouble occurs and on the value of the impedance of the plate voltage source. If the frequency is high a small condenser will do, but if the frequency is low, a large one must be used. In fact for the same efficacy the product of the capacity and the frequency should be a constant. The larger this constant is, the better. Thus a 1.0 mfd. condenser at 1,000,000 cycles, giving a constant of unity, will give almost 100% by-passing for all reasonable values of common impedance.

The same efficacy would be obtained at one cycle per second provided that the condenser used had a capacity of 1.0 farad. But such a condenser would require a skyscraper to house. Hence for the low frequencies it is necessary to be satisfied with less complete by-passing. But in any case the condenser used should be several times larger than is actually necessary to stop the oscillation in order that any distortion of the signal may be reduced to a minimum. At the frequency where oscillation occurs, blasting and overloading are likely to occur long after the capacity has been increased to stop oscillation.

## Trouble at Low Frequencies

The trouble often occurs at a frequency considerably lower than one cycle per second, particularly in resistance coupled amplifier receivers served by B battery eliminators. The better the quality of the circuit the more likely the trouble will occur and very low frequencies. Old-time receivers and receivers built with cheap audio frequency transformers are not good enough to show up the trouble, so that the occurrence of a very low frequency oscillation is indicative of an amplifier that is capable of bringing out the low notes when it works properly. By-passing of such receivers is expensive, since it requires enormous condensers, particularly when the oscillation is so low that it takes the form of slow fading.

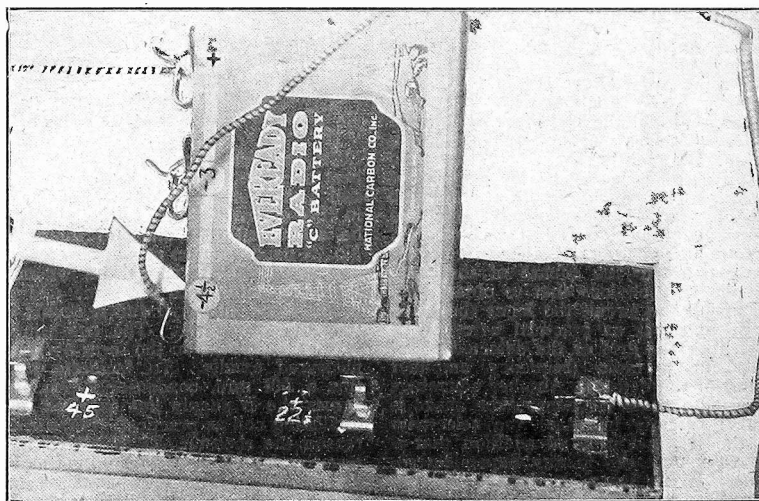
There are other ways than by-passing that may be employed. For instance, when the voltage on the various tubes is obtained from a high voltage source by drops in resistors, separate resistors should be used for every plate circuit in the amplifier. There should be no common impedance, even for two circuits. Some common impedance is of course necessary so long as the same source of voltage is used for several tubes. The source has an impedance whether it be a battery or an eliminator. This part of the impedance should be by-passed by the largest condenser that is practicable.

Another method that is usually most effective is to use a separate B battery for the detector. Even when the receiver is served by an eliminator, the detector should be placed on a battery. In most cases, even the severest, the trouble will entirely disappear. However, it largely depends on the type of coupling that is used in the amplifier and on the number of tubes employed in it. Sometimes it is better to use the battery on

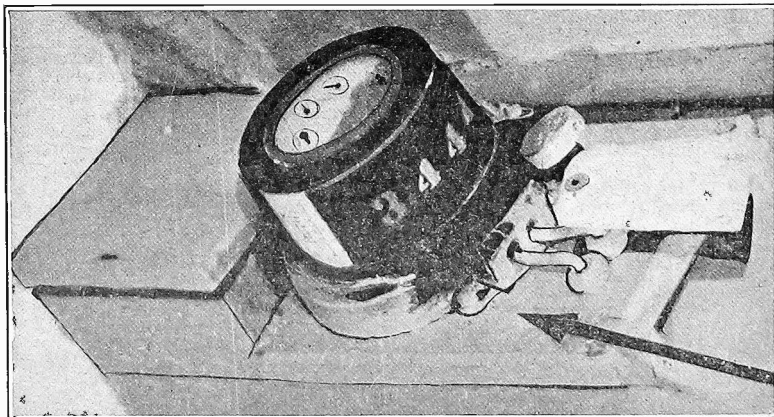
two tubes and the rest on the common connection. Another way of reducing the trouble is to use a choke coil and condenser in the output of the last tube and to connect the speaker return to the negative of the A battery. This by-passes the AC in the plate circuit in the last tube almost completely and hence it has no effect on producing oscillation. However, the impedance of the choke coil must be very large at low frequencies, or the improvement will be slight. Also the condenser used in series with the speaker must be of large capacity, or again the trouble at the lowest frequencies will not be materially reduced.

The best and simplest way is to use a separate B battery on the detector and perhaps on some one other tube.

In resistance coupled audio amplifiers, if motorboating is experienced, then try using a larger resistor in the plate circuit of the detector tube. Herman Bernard discovered this remedy and suggests a .5 meg. resistor instead of the usual .1 meg.



IF YOU have a 45-volt B and a  $4\frac{1}{2}$  volt C battery, and you wish to obtain  $40\frac{1}{2}$  volts C bias for your 71 type power tube, at 180 plate volts, connect the plus 45 of the separate battery to the A minus, the B minus to the minus of the small C battery and the C plus of the small battery to the grid circuit of the power tube. Note the small battery is used with reversed polarity to subtract  $4\frac{1}{2}$  volts from minus 45 to make  $40\frac{1}{2}$ .



THE WATTMETER in the cellar tells how much electric energy is taken from the line. The energy required to operate a B battery eliminator is so small that it makes no appreciable difference on the monthly reading of the meter.

# Radio Wave Not Alternating Says Expert, Calling It Constantly Positive

By Lewis Rand

THE question has been raised as to whether a radio wave is alternating or direct current or voltage. It is neither. It is not a current and it is not a voltage. It is a movement of energy in electromagnetic form. It is capable of inducing a varying electro-motive force in a closed circuit exposed to it. To have an electric current it is necessary that electrons move. But in free space there are no electrons to move, yet an electro-magnetic wave may pass through it. An exception may be taken to the statement that the wave is not a voltage, since the intensity of the wave may be measured in terms of volts per meter. But it may be measured equally well in terms of magnetic units, that is, in magneto-motive force.

It is true that in the case of a vertical radio wave there exists a potential difference between two points of different altitude, and this P. D. may be measured in terms of volts. But that is not all of the wave. There is a magnetic component which is horizontal and this may not be measured in volts. This component is just as much a part of the radio wave as the electric component. One cannot exist without the other.

### It Varies, Not Alternates!

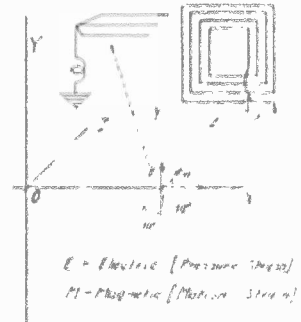
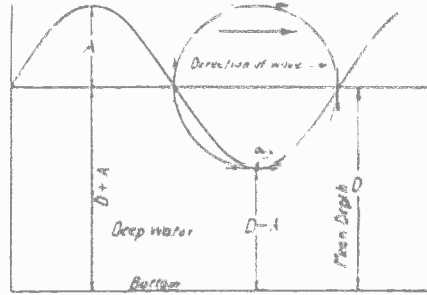
Is it alternating in nature? All that can be said is that it is varying in intensity at a certain frequency. Whether it is alternating or not depends on the point of view. Consider as an analogy a body of water. Is the motion of the water alternating? Each particle of water moves in a circle in a vertical plane and therefore the particle rises and falls, as the wave crest does. This motion might be compared to the magnetic component of the radio wave. But does the height of any particle alternate, that is, does its position alternately become positive and negative? That all depends on the level that is taken as the base. If the bottom of the ocean is taken as the base, the height does not alternate, it is always positive; but the height varies. That may be compared with the electric component of the radio wave. If the surface of the ocean when the water is still taken as the base, the level or height alternates, it becomes positive and negative alternately, as a wave passes.

Another analogy may be taken from meteorology. The air pressure varies from day to day, and it varies roughly in the same way as does a radio wave. One day it is high, the next day it is medium, and on the third day it is low, and so on. Is the meteorological wave alternating or direct?

### The Measurement Discussed

The pressure merely varies from day to day, but it is always positive. The motion of the air which results from the varying pressure may be alternating, that is, the wind may be northerly one day, zero the next, and southerly the third. The motion of the air is just as much a part of the air wave as is the pressure. One cannot exist without the other in open air.

Something may be put in the way of a water wave to measure its height, and similarly something, like a barometer, may be put in the way of an air wave to measure the air pressure. A record of these meters would show varying height and varying pressure. Likewise something may be put in the way of a radio wave to measure its intensity. An antenna suitably coupled to an indicator is such a meter. And in this case, as before, of course something may be put



To a man standing on the bottom of a large and deep body of water the height of the surface is not alternating. It is always positive and above his head. The distance to the surface is varying, however, between the values  $D+A$  and  $D-A$ , where  $D$  is the mean depth of the water and  $A$  is the amplitude of the wave. The pressure of the water on him is also varying in the same proportion. The motion of the water is circular, that is, as the wave passing every particle of water near the surface describes a complete circle. On the wave front the water moves upward, on the crest it advances, on the back of the wave the water subsides, and in the trough it recedes. Thus the particle  $P$  traces out the circle drawn in the direction indicated while the wave moves one wave length to the right. Near the bottom of the water each particle describes an ellipse, which degenerates into a line on the bottom. If the water depth is less than  $A$  the waves break. A radio wave in space progresses in somewhat the same manner as a water wave. In the so-called vertical radio wave the electric component  $E$  is vertical while the magnetic component  $M$  is horizontal. The wave advances in a direction perpendicular to both  $E$  and  $M$ , or in the direction  $X$ . An antenna responds to the vertical or electric component while a loop responds to the magnetic. But the two components of the wave are equalized and cannot be separated.

in the way of water and air waves to measure the speed of the moving materials. Likewise something may be put in the way of a radio wave to measure the speed of an "ether particle." Such a meter is a loop suitably coupled to an indicator.

When the question is raised as to whether a wave is alternating or varying it is necessary to fix a datum or base level. If the datum is so chosen that the pressure is alternately in one direction and the other, it is alternating. If it is so chosen that it is always in one direction, it is varying in one direction, or pulsating. The same holds true of current or motion.

In the case of motion it is easy to fix a datum so that the motion will be alternating. The datum is usually the position of the observer or that of his instrument. In the case of pressure it is not always as easy. Where the observer position may be taken as the datum the pressure will alternately be felt in one direction and in the other. But if the datum is taken as a position far away, the pressure will always be in one direction, but it may be of varying intensity. In the case of electrical potential the datum is at a point infinitely far away, and it must be in one direction, but it may vary in intensity from time to time. But it is possible to take the potential of the earth as the datum, and that is the same as to take the position or potential of the observer as the starting point. The pressure may be either in the direction from the earth or toward

it, that is, it may fluctuate about the potential of the earth as a mean.

In a closed electric circuit the electro-motive force induced by a radio wave that strikes it is alternating, and the resulting current is also alternating.

This means that the electric force driving the current is first in one direction and then in the other. The electrons flowing in the circuit as a result of the alternating  $E, M, F$  first move in one direction and then in the other, and it does not matter what point in the circuit is chosen as the datum point. Neither does it matter whether the wave inducing it is alternating or pulsating, or varying. The variation is the thing.

The voltage on the grid of a vacuum tube is not alternating, but varying. The current in the plate circuit is also varying, but not alternating. It is always in one direction. But the varying plate current flowing in the primary of a transformer will induce an alternating  $E, M, F$  in the secondary of the transformer, and if the secondary is a closed circuit the current flowing will be alternating. But if one side of the secondary is tied to the filament of another tube and the other side is tied to the grid, the circuit is open and the grid potential on the second tube is not alternating, but fluctuating with the filament as the datum. That is, if the filament is sufficiently positive. It might be better to regard the potential of the plate as the datum.

The point is that positive and negative demand a point of view or a datum point, and that is entirely arbitrary.

## American Stations Poach On Canada

WASHINGTON.

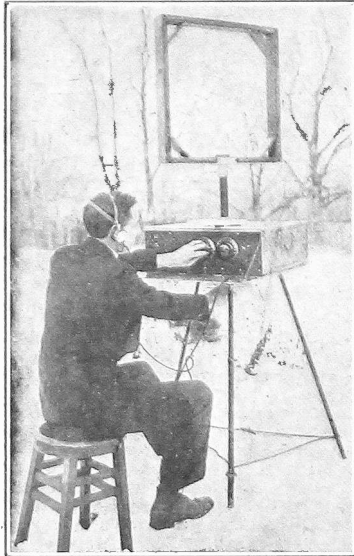
Canadian authorities have called the attention of the Department of Commerce to the fact that American broadcasters are causing considerable interference to Canadian stations.

In announcing the breakdown of regulations last July, Secretary of Commerce Hoover made a special plea to American

broadcasters to keep off the six Canadian wavelengths. Instead, a number of American broadcasters promptly jumped to the Canadian waves with the resulting interference and complaint.

Secretary Hoover has notified the American broadcasters of the complaint and that's about all he can do about it, he says.

## Direction Finder Rids Loop of Its Capacity Pickup



(Underwood & Underwood)

A RADIO direction finder of the rotating coil type suitable for use outdoors has just been developed by the U. S. Bureau of Standards in Washington. The new finder is convenient in operation, portable, and has a large range of frequencies—90 to 7,700 kilocycles (3,300 to 39 meters). C. E. Dunmore of the Bureau staff is shown operating it.

By Hari Kahn Bey

A direction finder is nothing more than a loop or coil antenna, attached to a graduated circle. There may also be a compass for orientating the loop and the graduated circle. It operates on the principle that when the loop is parallel to the wave front of the advancing wave no signal whatsoever is picked up. A slight deviation from parallelism in either direction shows a signal. If the pointer is attached to the loop in such a way that the pointer is perpendicular to the plane of the loop, the pointer points directly to the station when the signal is minimum or zero, or it points in exactly the opposite direction.

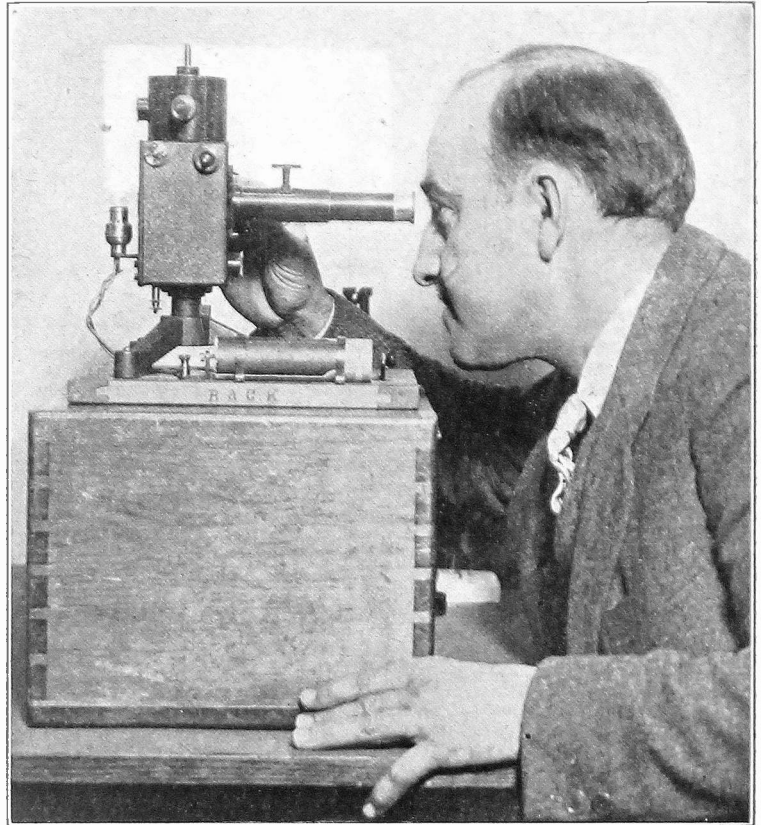
To determine whether the station lies ahead or to the rear it is necessary to co-ordinate the observations of two direction finders in different places, or else it is necessary to take two observations with the instruments located at some distance apart. If the distance between these two points is known it is also possible to determine the exact location of the station. This is used in locating ships which are unable to take observations on the stars, for reasons of fog, clouds and so on.

To get accurate directions with a direction finder it is necessary to eliminate the antenna effect of the loop. Every loop acts as a miniature open circuit antenna, and the pick-up of this antenna is not directional. The effect of this is to unbalance the loop and give a wrong direction. However, by means of balancing condensers it is possible to adjust the loop so that the antenna effect is nil. The direction given is then the true one.

### NO SUN SPOT LAW

That sun spots affect the transmission of radio waves has been established, but not enough data have been collected on the subject to formulate a definite law.

## Free Electrons Playing At Aerial Hurt Signals



(International Newsreel)

The electrometer with which Dr. G. R. Wait is shown, measures the quantity of electricity in the atmosphere. Since radio has become so extremely popular this device has been kept busy.

### They Absorb Wave Energy, Thus Robbing the Receiver—Active by Day, They Take It Easy by Night, Hence Better Reception in Darkness

An electron is a very little thing and its electric charge is extremely small. Yet when there are many electrons their combined effect may be very great. The number of free electrons in the atmosphere has a great effect on the operation of radio receivers and transmitters and the progress of the radio wave between the two. On account of the great practical importance of the free electrons in the atmosphere it is necessary to measure them, that is, to count the number of them in a given space, say in a cubic inch.

To measure the number of electrons that are flying around in the air it is necessary to have extremely delicate instruments as well as great skill in manipulating them.

In the usual radio calculations it is assumed that there are no free electrons in the space through which the wave travels. But this assumption is not rigorously correct when the wave travels through air or any material objects. There are free electrons which the atmosphere is exposed. Some of these forces are ultraviolet and visible light, the aurora borealis, X-rays and the like.

When there are free electrons in the space through which a radio wave travels its direction of motion is affected and its strength diminishes more rapidly with distance. This

accounts for the much lower efficiency of radio during the day than during the night. Again if there is a great number of free electrons in the atmosphere condensers discharge much more quickly than if there are no free electrons. This has a bearing on the operation of a receiving antenna. An antenna is nothing but a condenser, the conductor being one plate and the ground the other.

If there are many free electrons in the space in which the antenna is erected a certain impinging wave will not be able to charge the condenser to the same potential as it would if there were no free electrons, that is, signals will be very much weaker when electrons fly around the antenna in great numbers.

### "A YEAR OF TROUBLE"

WASHINGTON.

Chief Radio Supervisor W. D. Terrell thinks the chief radio development during 1926 was "trouble." He hopes the major accomplishment of 1927 will be relief from station interference.

"There are now too many stations for satisfactory operation," says he. "No doubt Congress will be able to do something about it."



# The Twin-Choke Audio Amplifier

[The complete exposition on the theory, building and installation of the Twin-Choke Amplifier was discussed in last week's issue, January 1.]

By *Kenneth Harkness*

Noted Designer of the Harkness Reflex and the Counterflex

The exact connections of the seven battery cable from the unit to the receiver, with the C battery and special Rabco radio frequency choke coil insertions are shown in Fig. 5. It will be noted that the filament switch is inserted in series with the A minus post. This, as stated last week, may be placed in the A plus lead, according to the individual wiring characteristics of the receiver you are now using.

A B eliminator can be used instead of B batteries if desired. Unless the eliminator is specifically designed for use with a -71 tube, it will be necessary to use a -01A tube in the output. To obtain good tone quality the eliminator must, however, be able to supply at least 135

volts to the last tube when under load. Some eliminators are designed for use with a -71 tube in the last stage and

supply about 180 to 200 volts to this tube. The tone quality with an eliminator of this type is exceptionally good.

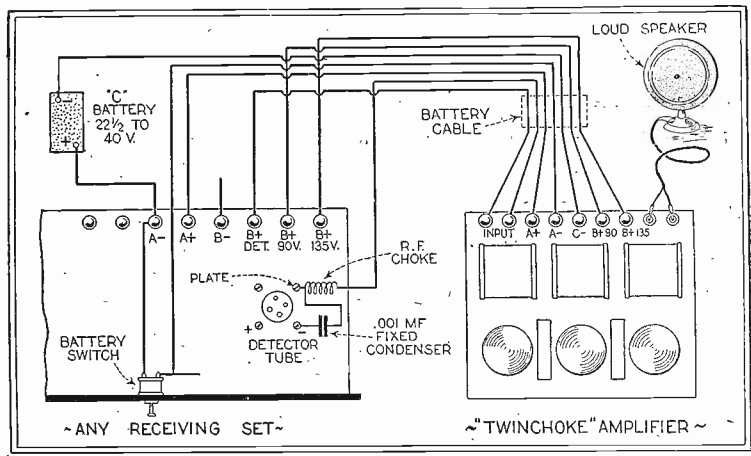


FIG. 5.

The picture diagram illustrating the connecting up of a battery cable from the unit to the set.

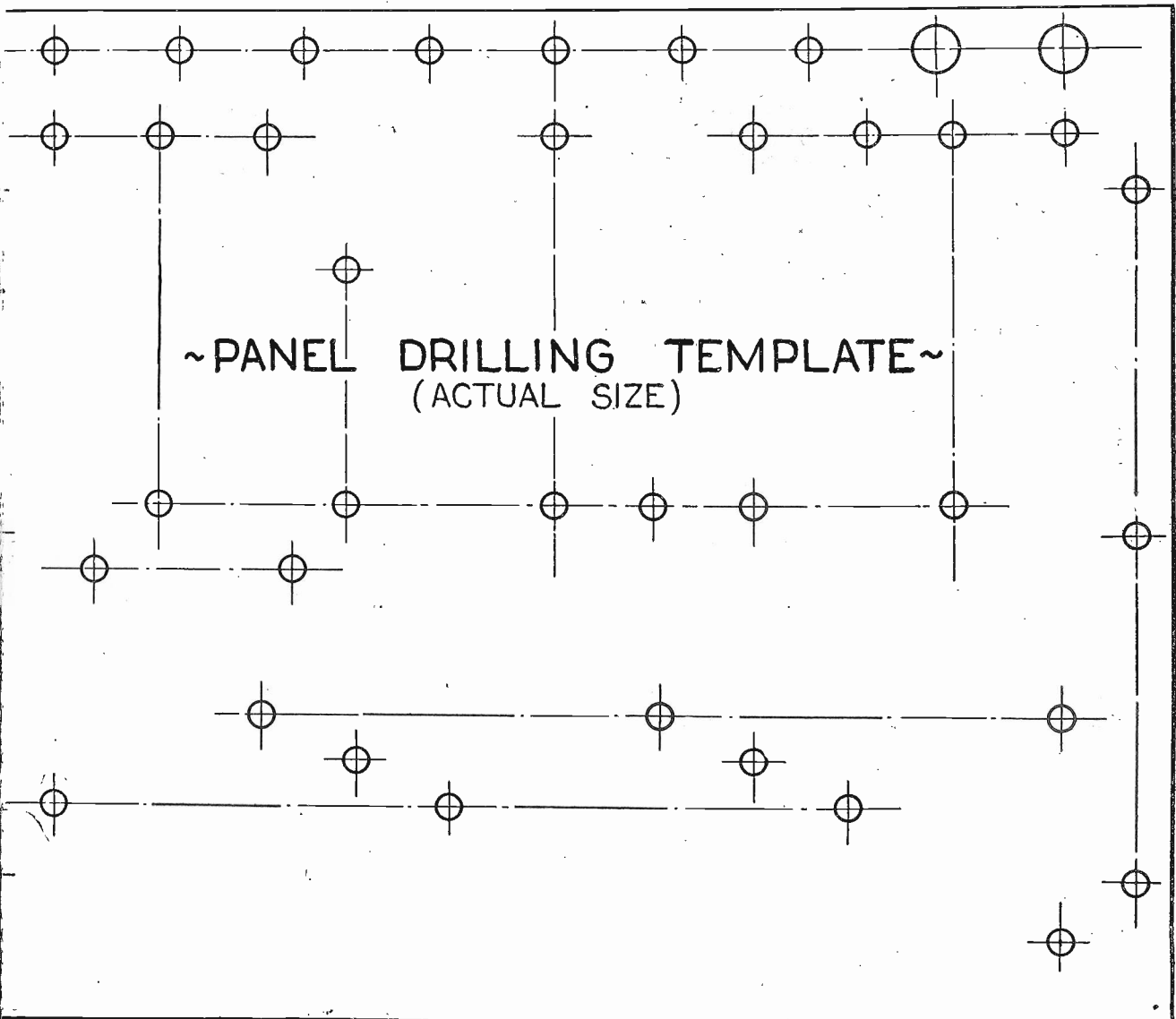


FIG. 6

# Radio University

FREE Question and Answer Department conducted by RADIO WORLD for its yearly subscribers only, by its staff of Experts. Address Radio University, RADIO WORLD, 145 West 45th St., New York City.

When writing for information give your Radio University subscription number.

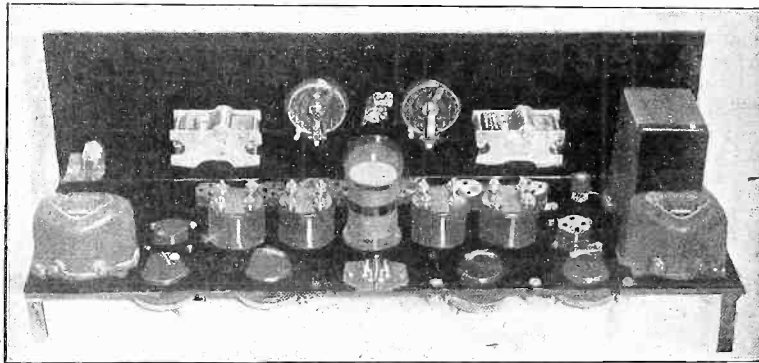


FIG. 491

The back view of the Lincoln Super-Heterodyne.

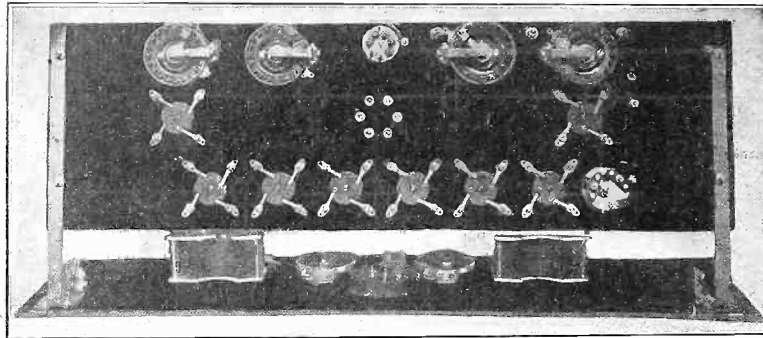


FIG. 492

The bottom view of the Lincoln Super-Heterodyne.

I HAVE two Precise audio frequency transformers. Could I have a back and bottom view of the complete Lincoln Super-Heterodyne, using these transformers and a Silver-Marshall type 221 output coil, using the rest of the parts as specified in the Dec. 4 issue of Radio World. Please state the positions of all the parts.—Monroe Schultz, Montclair, N. J.

Figs. 491 and 492 show the views of this set, as per request. In Fig. 491, the back view is shown. The two audio transformers are at each end of the subpanel in the rear. The three 20 ohm and one 5 ohm rheostats are mounted in the rear, also, with the battery plug inserted between. Directly in front of the plug is the oscillator coil, while to the left and right hand sides are the long wave transformers. On the extreme left and right hand sides of the long wave transformers are the first and second audio socket. The other sockets are mounted near the panel. The 200,000 ohm variable resistance is mounted underneath the switch in the center of the panel. To the left and right of this combination are the 20 ohm rheostats controlling the filaments of the oscillator and modulator tubes. The other 20 ohm rheostats control the filaments of the detector, first and second audio tubes. The 6 ohm rheostat controls the filaments of the three intermediate frequency tubes. The small midget condenser connected in the plate return of the modulator tube, for controlling the regeneration, is placed near the output transformer. It can be noted by the small knob protruding from the subpanel. One of the jacks can be seen in the lower left hand corner of the panel, while the other is hidden by the output transformer in the right hand corner. The bottom view is shown in Fig. 492. The three 20 ohm and 5 ohm

rheostats can be clearly seen with the battery plug between. Note the midget condenser to the right, exactly to the end of the subpanel to the front. Any type of mounting bracket can be used.

I HAVE a spool of No. 38 double silk covered wire and a 1" diameter coil form. Please state the number of turns to wind to constitute a radio frequency choke coil. (2) How should it be connected in the detector circuit to keep the RF currents out of the transformer audio amplifier. I use a non-regenerative detector.—L. Merwin Gerad, Atlantic City, N. J.

(1) Wind 220 turns. (2) Break the lead of the P post which goes to the P post on the transformer. Connect the beginning of the winding to the P post on the detector post socket. Connect the end of the winding to the P post on the transformer. A .0005 mfd. fixed condenser should also be connected from the plate of the detector tube socket to the minus A post.

WHEN NO exact value is stated for the grid leak, using a CX301A tube, what value should be used generally?—Irving Goldenberg, N. Y. City.

Use a 2 megohm leak. A leak having a higher value gives greater signal strength on weak stations. It may, however, cause blocking or distortion on strong stations.

I RECENTLY heard a new station on the air, whose call letters sounded something like WBMC. I could not find them listed in any of the station lists, I have. Could you please tell me on what wavelength they operate, by whom they are owned and where they are located?—Morris Ernerst, Atlanta, Ga.

This is a new station, owned by the

Malbrook Company and located at Woodside, N. Y. They operate on a wavelength of 293.9 meters.

IS IT advisable to add regeneration to the 5-tube receiver shown on page 8, Dec. 4 issue of Radio World, under the article by K. B. Humphrey? This set was a reflex, having the first two tubes act as RF-AF amplifiers, the third tube as a non-regenerative detector and the fourth and fifth tubes connected up in a transformer coupled audio frequency amplifier.—John Mauller, Brookings, S. D.

No, the set will be too difficult to control.

IS IT good practice to mount tubes horizontally? (2) Many times I see specific B voltages specified for the RF, detector or AF tubes in many circuits. However, when I test out these sets using these B voltages, I do not get good results. But upon increasing the B voltage, the results are brought up to that point of satisfaction, as expressed by the designer. Does this hurt the tube?—Nurway Migrat, Brooklyn, N. Y.

(1) Always mount a tube vertically. (2) No, not as long as you keep within the highest voltage specified by the manufacturer on the carton. These voltages always vary according to the different characteristics of these tubes and should always be experimented with, regardless of specified voltage by a designer.

I HAVE a fixed radio frequency transformer, which covers from 200 to 550 meters. Could I have the circuit diagram of a 5-tube receiver, using this transformer in an untuned stage of radio frequency amplification, two stages of tuned radio frequency amplification, a crystal as a detector and two stages of transformer coupled audio frequency amplification as well as a panel layout also. I have three .0005 mfd. variable condensers. Please state the values of the coils, condensers, etc. Give subpanel layout suggestions, also.—Archie Murrels, Jersey City, N. J.

Figs. 493 and 494 show the circuit diagram of the set and the panel layout. As to the circuit diagram, L1, L3 and L5, the primaries, consist of 10 turns. The secondaries, L2, L4 and L6 consist of 55 turns. Each primary and secondary is wound on a 2 3/4" diameter tubing, using No. 22 double cotton covered wire. A 1/4" space can be allowed between the two windings. The filament of the first RF tube is controlled by a 20 ohm rheostat, R1. The filaments of the other two RF tubes are controlled by a 10 ohm rheostat, R2. The filaments of the audio frequency amplifier tubes are controlled by a 1/2 ampere ballast R3, Amperite 112. C1, C2 and C3 are the .0005 mfd. variable condensers. They, you will note, shunt the secondaries of each of the tuned radio frequency transformers, and are used for tuning each circuit. C4 is a crystal detector. C5 is a .001 mfd. fixed condenser. The minus post of a C battery, which may be a 4 1/2 or 9 volt type, depending upon the B voltage used, is connected to the F minus posts of both audio transformers. J is a single circuit jack. The grid returns of the RF tubes are brought to the A minus posts. S is a filament switch, inserted in series with the A plus, B minus lead. The -01A tubes should be used throughout the set. It will be found that the rheostat controlling the filament of the first RF tube, also controls the oscillatory action of the tube. Therefore, exercise care when turning the knob of this rheostat. The same does not apply to the rheostat controlling the filament of the other RF tubes. The rotor plates of the variable condenser in the crystal circuit is grounded. The panel layout for this set is shown in Fig. 494. A 7x18" panel is used. The two rheostats are mounted below the larger dials used on the shafts for the variable condensers. The switch is inserted in the lower left hand corner, while the

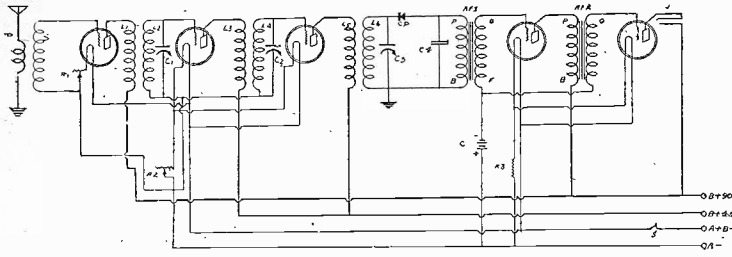


FIG. 493

The circuit diagram of the 5-tube receiver. Using a crystal detector.

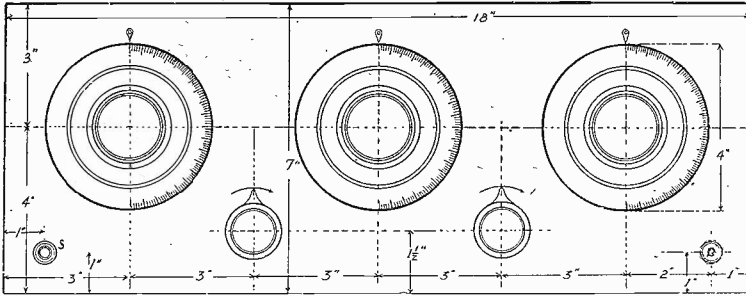


FIG. 494

The front panel layout for the 5-tube receiver, requested by Archie Murrels

jack is the opposite corner. Any size dial may be used. As to the subpanel, the coils may be placed directly on the frames of the condensers, at angles. The fixed RFT is placed underneath the subpanel. The audio transformers are placed on top of the subpanel in the rear of the sockets, holding the AF tubes. The sockets should be so mounted that the leads from the various transformers will be very short. This should be especially watched with the G and P posts. Either a battery cable or binding posts may be used.

**CAN VOLTAGE** exist across the terminals of a condenser, without any current flowing? (2)—What different ways are there of storing up electrical energy? —Charles McLowd, Canton, N. Y.

(1)—Voltage, or potential difference, can exist across the terminals of a condenser without having any current flowing, just as there can be a difference in air pressure inside and outside the tank without having any current of air. If the potential difference between the terminal of a condenser exceeds a certain value the condenser will break down. The analogy in the case of the tank is an explosion if the pressure exceeds a certain value. The violence resulting in each case is proportional to the energy stored in the container. The energy stored in a compressed automobile tire is possibly billions of times greater than that stored in the condenser discussed above. (2)—There are different ways of storing up electrical energy. In the condenser it is stored by compression. In a primary battery, as well as a secondary, it is stored in the form chemical energy. In an induction coil it is stored in the form of magnetic flux.

**HOW IS** it possible to calculate the capacity of condensers, where the parallel plates are separated by an insulation, having a known dielectric constant?—Lawrence Grader, Atlantic City, N. J.

The calculation of the capacity of home made condensers is not extremely difficult, particularly those composed of parallel plates separated by insulation of known dielectric constant. The formula is  $C$  equals  $0.0885KS$  divided by  $t$ , where  $K$  is the dielectric constant of the insulator,  $S$  is the area of one side of one plate, and  $t$  is the thickness of the insulating ma-

terial. All dimensions are in centimeters and the capacity is in micromicrofarads. If all the dimensions used are in inches, then the capacity will be obtained by multiplying by 2.54. The formula then becomes  $C$  equals  $0.225KS/t$  micromicrofarads. If there are more than two plates in the condenser it is necessary to multiply the result by  $(N-1)$  where  $N$  is the total number of plates in the condenser. All the plates must be the same size.

**IN REFERENCE** to the 4-tube receiver shown in the Radio University columns of the Nov. 6 issue of RADIO WORLD. (1)—Can resistance coupled audio frequency amplification be employed successfully, instead of the transformer stages? (2)—Can high mu tubes be used in the first two stages and a low mu or power tube in the last stage, using  $1/4$  ampere ballast resistors to control the filaments of the high mu tubes and a  $1/2$  ampere ballast resistor to control the filament of the last tube? (3)—Is it O. K. to connect up these stages without any double circuit jacks intercepting the various stages, a pair of phone tips being connected at the output?—Henry French, Miami, Fla.

(1)—Yes. Be sure to use the proper resistors in the plate circuits, e. g., .1 megohm type; also in the grid circuits,

e. g., a 1 megohm resistor in the grid circuit in the first tube, a .5 megohm resistor in the grid circuit of the second tube, and a .25 megohm resistor in the grid circuit of the last tube. The coupling condensers should be of the .25 mfd. type. (2)—Yes. (3)—Yes.

**I AM** going to construct the 2-tube reflex receiver, using a crystal detector, shown in the Radio University columns of the May 15 issue of RADIO WORLD. I have three audio transformers. One of these is a high ratio type, (6 to 1), while the other two are of lower ratio type, (3 to 1). How can they all be utilized? What changes will it be necessary to make?—Leo Forren, Newark, N. J.

The high ratio AFT can be used in the reflexed stage, while the other two can be used in straight transformer audio coupling. The original hookup has a single stage of audio coupling. However, the addition of the extra stage is done very easily. The plate output of the last audio tube in the hookup is brought to the P post on the transformer, instead of to the top terminal of the single circuit jack. The bottom terminal of this jack is brought to the B post on the AFT. It is also connected to a B plus post, (90 volts). The G post on the new AFT is brought to the G post on the new socket. The F post on this AFT is brought to a C minus post. The P post on the socket is brought to the top terminal of the single circuit jack, which formally was inserted in the first audio output. The bottom terminal of the jack is brought into the B plus post, (135 volts). The F post on the first AFT is not brought to the A minus post as per diagram. Instead it is brought to a C minus post. Using —01A tubes, use a 4.5 volt C battery for the first AF tube and a 9 volt C battery for the last tube. Use a separate ballast resistor for the last tube filament of the last tube.

**I AM** bit confused about the wiring up of the 5-tube Diamond of the Air from the picture diagram on the blueprint. I am going to use standard variable condensers, with the rotor plates going to the frame. (1)—Do the rotor plates of the variable condenser in the tuner circuit, connect to the A plus post? (2)—Do the stator plates of this same condenser connect to the one terminal of the grid leak and condenser combination? (3)—Is J2 necessary at the detector output? (4)—Can the small binding posts at this terminal also be eliminated connecting the output of this portion of the circuit directly to the input of the primary of the audio transformer?—Francis Zander, Jersey City, N. J.

(1)—Yes. (2)—No. It just enables you to listen to the detector output. (3)—Yes.

## Join RADIO WORLD'S University Club

And Get Free Question and Answer Service for the Coming 52 Weeks  
This Service for Yearly Subscribers Only

Have your name entered on our subscription and University lists by special number. Put this number on the outside if the forwarding envelope (not the enclosed return envelope) and also put at the head of your queries. If already a subscriber, send \$8 for renewal from close of present subscription and your name will be entered in Radio University. No other premium given with this offer.

[In sending in your queries to the University Department please paragraph them so that the reply can be written under or alongside of each query. Write on one side of sheet only. Always give your university number.]

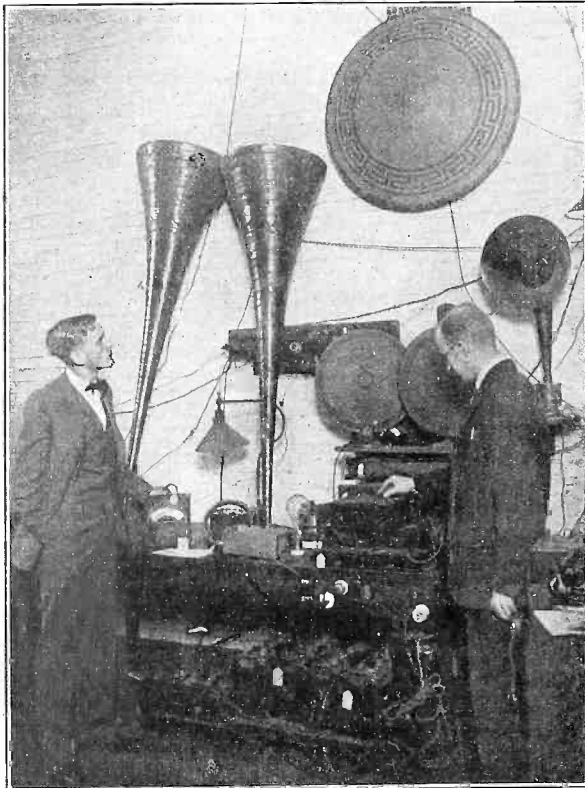
RADIO WORLD, 145 West 45th Street, New York City.  
Enclosed find \$6.00 for RADIO WORLD for one year (52 nos.) and also enter my name on the list of members of RADIO WORLD'S University Club, which gives me free information in your Radio University Department for 52 ensuing weeks, and send me my number indicating membership.

Name .....

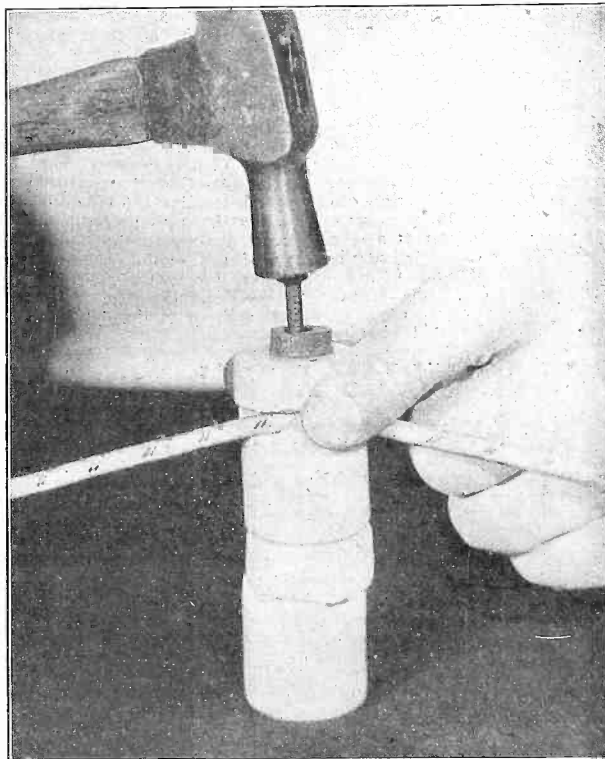
Street .....

City and State .....

LOUD SPEAKERS ARE TESTED

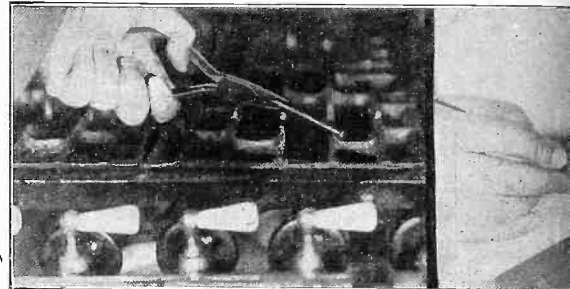


(Herbert Photos)  
**WILLIAM G. RUSSEL** (left) and **William W. Macalpin** testing loud speakers in the Hartley Research Laboratory, Columbia University.



FOR an aerial leadin standoff you may stock up two or more porcelain insulators.

# A Home-Made Wire, Spool, Nail and



A simple circuit breaker for the protection of radio apparatus. Some heavy magnet wire, an empty thread spool, a wire nail over the gas stove to remove all temper, that is, heat it to red heat. Mount the spool vertically on the upright as shown with the wire and the other to a metallic plate on the baseboard directly under the wire. When the current reaches a certain predetermined value the nail will be lifted up and the wire will be cut. The nail will fall from falling down as soon as the circuit is broken, and the wire will be cut. The wire will be cut provided the nail is pushed through.

## 319 New Stations Laid 1,000 Mark

More Than 116 Are Actually Under Construction—  
 Have Been Laid for 203 Additional—  
 by Commerce Department

WASHINGTON.

Increased understanding of the vagaries of radio waves which has made it possible to calculate definitely the service that can be obtained from a given transmitting station was one of the chief radio accomplishments during 1926, according to Dr. J. H. Dellinger, chief of the Radio Laboratory of the Bureau of Standards.

"There were noteworthy contributions to the understanding and control of the vagaries of radio wave transmission," says Dr. Dellinger. "For many years intensive work has been done in improving radio transmitting and receiving apparatus, and the results of this work have frequently been spoiled by the things that happened to the radio waves in passing from the transmitter to the receiver.

"Further advance has, therefore, depended upon better knowledge of the transmitting medium. This has led to studies of wave transmission and several important contributions to the subject were published during the year. They reveal many facts in regard to the nature and causes of fading, signal variation, atmospheric, and other vagaries of received radio signals.

"The results all tend to corroborate the hypothesis which was conceived a few years ago of the effect of an upper conducting layer in the earth's atmosphere. This upper conducting layer, called the Kennelly-Heaviside surface, has now been located. Its height is found to vary at different times of year and day all the way from 50 to 500 miles above the earth's surface. The action of this conducting or reflecting surface explains the enormous distances of transmission at night and on high frequencies. It also accounts for fading and skip distance effects.

"This knowledge makes it possible to calculate definitely the service that can be obtained from a given transmitting station. This is particularly important in connection with short waves. It has also made it possible to take up investigations of radio waves in a tremendous way.

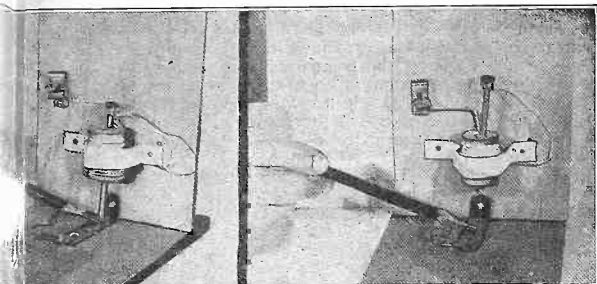
"An outstanding achievement of 1926 was the perfection of the telephone. A de-telephony between two points was conducted by the American Telephone and Telegraph Company and the Bureau of Standards. The system is now being used for commercial use, so that it is possible to have a subscriber in the United States and another in Great Britain.

"The outstanding achievement of 1926 was the perfection of the telephone. A de-telephony between two points was conducted by the American Telephone and Telegraph Company and the Bureau of Standards. The system is now being used for commercial use, so that it is possible to have a subscriber in the United States and another in Great Britain. This is particularly important in connection with short waves. It has also made it possible to take up investigations of radio waves in a tremendous way.

There are more



# Circuit Breaker Clips Constitute Device



may be made out of materials at hand in every house. Required: a couple of Fahnestock clips and a wooden board. Heat the nail. Wind the spoolfull of double cotton covered wire, say No. 20. Connect one terminal of the line to the head of the nail. If the current through the coil exceeds a certain point the nail will break the circuit. A little friction on the nail will prevent the circuit from breaking. The resistance will be supplied by the paper on the end of the spool head without removing any of the paper.

## om; n Sight

in, While Plans  
y Survey

replacing radio trans-  
engineering basis and  
calculate definitely  
be obtained from a  
ation. The advant-  
especially marked in  
high frequencies or  
frequency waves are  
ut as a result of the  
behavior it is now  
advantage of their  
power.  
radio achievement in  
ing of trans-Atlantic  
stration of two-way  
New York and Lon-  
East Spring by the  
and Telegraph Com-  
Post Office Depart-  
was developed to the  
ed for opening to com-  
any telephone sub-  
States can talk with  
Britain.  
development in  
in the shift of inter-  
from distant reception  
his change has been  
of causes, particu-  
of toll chain broad-  
removal of license re-  
priority of the listeners  
the best program fea-  
ual station connected  
and. These features are  
by advertisers, and as a  
casting stations have  
going through the sale  
the uncontrolled selec-  
ferences has led to a  
of interference and  
distant station re-  
an 600 stations now.

## 17 New Stations

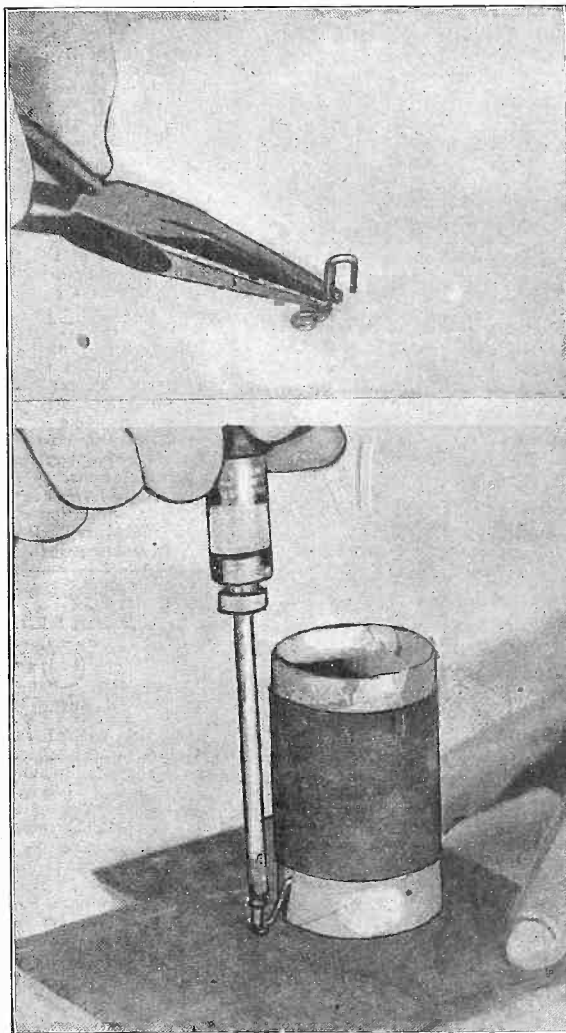
WASHINGTON.  
Seventeen new stations have been licensed by the Department of Commerce, two of which are of high power. Both of these are equipped to use 1,000 watts, one on 340 meters, where interference may be caused with Lincoln, Nebraska and Manhattan, Kansas. The other will operate on the Pacific Coast, and distance plus time difference may prevent interference.

### NEW STATIONS

|   | kc.  | m.    | w.   |
|---|------|-------|------|
| WRSC—The Radio Shop, Chelsea, Mass. ....                    | 1110 | 270.1 | 15   |
| WLBA—J. C. Van Horn, Philadelphia, Pa. ....                 | 1270 | 236.1 | 50   |
| KYA—Pacific Broadcast Corp., San Francisco, Cal. ....       | 750  | 399.8 | 1000 |
| WBET—Boston Transcript Co., Boston, Mass. ....              | 780  | 384.4 | 100  |
| KGZD—Norwegian Lutheran College, Decorah, Iowa ....         | 696  | 431   | 50   |
| WTRL—Technical Radio Laboratories, Midland Park, N. J. .... | 1070 | 280.2 | 15   |
| KGDY—J. Albert Loesch, Oldham, S. D. ....                   | 1428 | 210   | 15   |
| WLBN—W. E. Hiler, Portable ....                             | 1330 | 225.4 | 5    |
| WLBP—R. A. Fox, Ashland, Ohio ....                          | 1360 | 220.4 | 15   |
| WLBQ—E. D. Trout, Atwood, Ill. ....                         | 1300 | 230.6 | 25   |
| WLBJ—Henry Grossman, Cleveland, O. ....                     | 999  | 300   | 100  |
| WLBO—F. A. Trebbe, Jr., Galesburg, Ill. ....                | 1234 | 243   | 100  |
| WCOM—172nd Field Artillery, Manchester, N. H. ....          | 1190 | 252   | 100  |
| WLBR—Alford Radio Co., Belvidere, Ill. ....                 | 895  | 335   | 15   |
| WMPC—First Methodist Church, Lapeer, Mich. ....             | 1239 | 222   | 100  |
| WOKT—Titus-Ets Corp., Rochester, N. Y. ....                 | 882  | 340   | 1000 |
| WBSO—Babson's, Wellesley Hills, Mass. ....                  | 1239 | 242   | 100  |

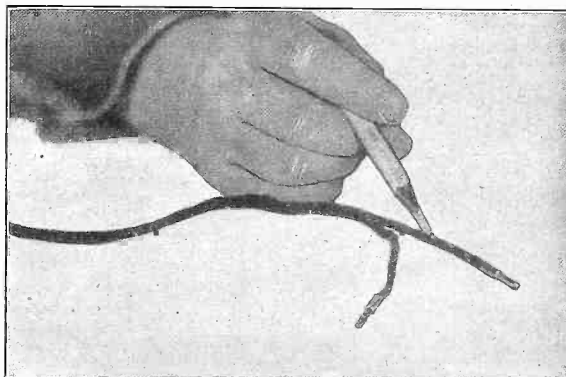
[See article on page 14 if you suffer from interference.]

## HANDY WAY TO MOUNT COIL



(Hayden)

BUS BAR can be used to a great advantage for mounting coils. The upper photo shows a portion of the wire being bent into a U shape for the coil and another portion of the same wire into a circular shape for the insertion of the screw. The insertion of the screw and the mounting of the coil is shown in the bottom photo.



(Hayden)

WHEN CONNECTING up the phone tips to the plug, be sure that you insert the cords with proper polarity. The positive cord is always indicated by the red stripes.

## A THOUGHT FOR THE WEEK

NOW that the more or less official holidays are over, radio fans can settle down to a long Winter of listening and waiting—and the success of the whole thing will be based on the percentage of each. It looks like a great 1927 for radio from where we are tuning in.

# RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

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

TELEPHONES: BRYANT 0558, 0559

PUBLISHED EVERY WEDNESDAY

(Dated Saturday of same week)

FROM PUBLICATION OFFICE

HENNESSY RADIO PUBLICATION CORPORATION

145 WEST 45th STREET, NEW YORK, N. Y.

(Just East of Broadway)

ROLAND BURKE HENNESSY, President

M. B. HENNESSY, Vice-President

FRED S. CLARK, Secretary and Manager

European Representatives: The International News Co.

Brema's Bldgs., Chancery Lane, London, Eng.

Paris, France: Brentano's, 8 Avenue de l'Opera

Chicago: William A. Diehl, 30 North Dearborn St.

Los Angeles: Lloyd B. Chappell, 611 S. Coronado St.

EDITOR, Roland Burke Hennessy

MANAGING EDITOR, Herman Bernard

TECHNICAL EDITOR, Lewis Winner

ART DIRECTOR, Gerard Sheedy

CONTRIBUTING EDITORS, James H. Carroll and

J. E. Anderson

## SUBSCRIPTION RATES

Fifteen cents a copy, \$6.00 a year, \$3.00 for six months, \$1.50 for three months. Add \$1.00 a year extra for foreign postage. Canada, 50 cents.

Receipt by new subscribers of the first copy of RADIO WORLD mailed to them after sending in their order is automatic acknowledgment of their subscription order. Changes of address should be received at this office two weeks before date of publication. Always give old address; also state whether subscription is new or a renewal.

## ADVERTISING RATES

## General Advertising

|                           |           |          |
|---------------------------|-----------|----------|
| 1 Page, 7 1/4" x 11"      | 462 lines | \$300.00 |
| 1/2 Page, 7 1/4" x 5 1/2" | 231 lines | 150.00   |
| 1/2 Page, 8 1/2" x 5 1/2" | 231 lines | 150.00   |
| 1/4 Page, 4 1/2" x 5 1/2" | 115 lines | 75.00    |
| 1 Column, 2 1/4" x 11"    | 154 lines | 100.00   |
| 1 Inch                    |           | 10.00    |
| Per Agate Line            |           | .75      |

## Time Discount

|   |     |
|---|-----|
| 52 consecutive issues                       | 20% |
| 26 lines consecutively or E. O. W. one year | 15% |
| 3 consecutive issues                        | 10% |

WEEKLY, dated each Saturday, published Wednesday. Advertising forms close Tuesday, eleven days in advance of date of issue.

## CLASSIFIED ADVERTISEMENTS

Ten cents per word. Minimum 10 words. Cash with order. Business Opportunities ten cents per word, \$1.00 minimum.

Entered as second-class matter March 23, 1922, at the Post Office at New York, N. Y., under the Act of March 3, 1879.

## INTERESTING FACTS

Light is the same thing as radio waves, the only difference being the length of the waves. The wavelength of yellow sodium light, that which is most frequently seen in flames, or when common salt is thrown in a flame, is about one billionth as long as the 600 meter wave used by ships.

\* \* \*

About 40 years ago Heinrich Hertz demonstrated experimentally the existence of electro-magnetic waves and proved the correctness of Maxwell's theory. Herzt was the first human being to send and receive radio waves. His waves were very short.

\* \* \*

About 25 years ago Guglielmo Marconi first set up radio transmitting and receiving of commercial significance. He was the first to send messages by radio waves.

\* \* \*

The term farad comes from the name of Michael Faraday, one of the most prolific of all investigators of electrical and magnetic phenomena.

\* \* \*

The ampere takes its name from Ampere, a French investigator in electrical phenomena.

## Radio Greatly Increases N. Y. Edison Co. Income

Due to the large use of radios, the annual income of the New York Edison Company has been increased by more than \$1,000,000. This, officials say, is due to the use of electric sets, charging of batteries and sitting up late of fans listening to distance, which occasions extra use of electric lights.

Arthur Williams, vice-president of the Edison Company, in charge of commercial relations, told of the company's added income because of the radio while testifying recently before the Public Service Commission on a complaint that the company's rates were too high. Part of the work of Mr. Williams is to increase the number of patrons of the company and to induce patrons to use more current.

Some of the expenditures of the company are the cost of broadcasting the speeches of some of the company's officials and the cost of "Edison Hour," consisting of entertainment broadcast by various stations, particularly WRNY. These costs have been criticized by Assistant Corporation Counsel M. M. Fertig and Joseph P. Morrissey. These costs have affected the going value of the

company, which is part of the basis on which rates are fixed.

Mr. Williams said that the company's expenditures for radio programs represented a most desirable branch of the business-getting activities of the company. He explained that investigations made by the company indicated a growing tendency among radio owners to stay at home at night. Mr. Morrissey asked the witness whether the radio had not taken the place of the saloon and Mr. Williams replied that he believed it had. Mr. Williams proceeded to explain how the increased consumption of electric current benefitted the company by saying:

"We find that many complaints about the lighting bills are more easily satisfied because, when a customer complains about his bills, we ask him if he has a radio. If he says that he has, we remind him that perhaps the radio induces him to sit up later, with the result that more light is used. In practically every case we find that this explanation satisfies the complainant."

The board was deeply interested.

## 14 Land-Grant Colleges Operate Large Stations

ST. LOUIS, Mo. Extensive use of radio for spreading information on agriculture and home economics by land-grant colleges has been reported by C. W. Warburton, director of extension work of the Department of Agriculture. The statement issued by the Extension Service on the use of radio follows:

Nearly all of the land-grant colleges of the country are now using the radio in some way or another for disseminating information on agriculture and home economics. This is shown by returns received from a questionnaire sent to all the colleges by C. W. Warburton. The returns show the following:

Thirty-four states are providing for the broadcasting of extension programs, the use of the radio varying in degree from occasional discussions of agricultural and home economics subjects from commercial stations, to elaborate courses of lectures from the stations of the institutions.

Fourteen land-grant colleges of the institutions of which they are parts, are operating broadcasting stations with power of 500 watts or more. In this list are Maine, Connecticut, Alabama, Arkansas, Texas, Michigan, Ohio, Wisconsin, Iowa, South Dakota, Kansas, New Mex-

ico, Oregon and Washington. Co-operative extension material makes up a considerable part of the programs of these institutions at present. Stations of lower power than these are operated by Vermont, Indiana, and North Dakota for broadcasting extension programs regularly or occasionally.

Commercial stations are used by 10 States for broadcasting regularly, either by direct control, remote control, or through the furnishing of manuscript material to be broadcast by the station announcers. These States are Massachusetts, New Jersey, New York, Maryland, Georgia, Oklahoma, Missouri, Minnesota, Nebraska, Colorado and Idaho.

Ten States—New Hampshire, Pennsylvania, Delaware, Rhode Island, Virginia, West Virginia, Illinois, Wyoming Montana and California—occasionally contribute material to commercial stations for broadcasting by those stations, or, if opportunity offers, representatives of the colleges do the broadcasting.

Illinois has a station of its own under construction, and plans to send out programs of agriculture and home economics from this station. New York has plans for an institutional station of its own soon to be erected.

### Klan Members In Regalia Start Fund for Own Station

PATERSON, N. J.

Plans for the construction of a radio-broadcasting station in this city are being considered by the allied organizations of the Ku Klux Klan, according to an announcement made at the close of the services in the Wanaque Reformed Church recently. Members of the allied organizations of the Klan attended the services clad in full regalia.

Towards the close of the service the announcement that the Klan intends to build a radio station was made. A special collection was taken for the broadcasting station fund after the members of the Klan had contributed to the regular church collection.

### WHAP Lecturer Is Barred From Jury for Prejudices

Charging Franklin Ford, announcer and special theological lecturer at WHAP of New York City, incompetent to render a fair and impartial verdict, Judge Otto A. Rosalsky in General Sessions, recently excused him from jury duty.

Mr. Ford's statements from the station were regarded as propaganda against Jews and Catholics. Mr. Ford said that even though he had denounced certain teachings of the Catholics and Jews, these ideas would have no effect in changing his decision toward a defendant, who in this case was a colored man.

During the examination it was disclosed that the station was sponsored by Mrs. Augusta E. Stetson.

# Each Tube Is a Tiny Niagara of Electricity Rushing From the Filament

Just As Water May Be Boiled to Give Off Invisible Vapor, So May Certain Metals Be Heated, As In the Filament, to Discharge Electrons—Tremendous Quantities of Infinitely Small Particles Are Released—Why a Tube, Like Every Cloud, Has a Silver Lining.

By Dr. A. N. Goldsmith

Chief Broadcast Engineer, Radio Corporation of America

MUCH ado about nothing" was the title given by Shakespeare to one of his famous plays. Yet the venerable Bard of Avon, had he lived today, could have found no better title with which to label the modern vacuum tube. The very nothingness of the vacuum tube is its most important feature; for without the vacuum, this device could not be; and without a high degree of vacuum, or virtually nothing, a good vacuum is, in general, quite impossible.

Now in order to get a true picture of the vacuum tube and its work let us start with an analogy. Consider, if you will, a dam, impounding millions of gallons of water. At one side there is a spillway, together with a system of flood gates. A man, through the agency of a lever, can readily control the flow of water over the spillway, from a mere trickle to a competitor of Niagara.

In the vacuum tube we have precisely the same state of affairs, although in electrical rather than mechanical form. There is a vast quantity of electricity impounded in the tube filament and ready to pour forth when the filament is heated.

## Flows from Filament to Plate

The flow of electricity is from the heated filament over to a cold surface of metal called the plate. However, this electrical spillway is controlled by a flood gate in the form of a screen or mesh of wire placed between the filament and plate and known as the grid. The slightest variation in electrical charge on the grid immediately controls the flow of electricity from filament to plate.

Just how the vacuum tube accomplishes all this is a much longer story. Everybody knows, first of all, that water can be boiled. What happens? Well, the water is converted into an invisible vapor and disappears in the air. Likewise, almost everybody knows that camphor, left about the house at ordinary temperatures, will eventually disappear. Why? Because the camphor has evaporated—tiny particles of camphor have been flung into the air to permeate it with the strong odor which drives off moths.

Few persons, however, know that electricity can be boiled out of hot metals. Yet such is the case. A metal wire, such as tungsten, when heated to incandescence, will liberate tremendous quantities of tiny electrical charges, forming a veritable fog or mist of infinitesimal projectiles, called electrons, which leave the wire in all directions.

## The Waterway Parallel

So here, then, we have an electrical reservoir, a spillway, flood-gates and the operating lever. Just as water flows over the spillway and down the valley, so electrical charges or electrons can flow out of the hot filament and over to the cold plate in the vacuum tube, provided two things occur: First, that the space between contains only almost infinitesimal quantities of gas; otherwise stated, it must be a high vacuum, or the electrical

particles or electrons will collide with the remaining particles of gas and cause a serious deterrent action. Secondly, that the plate of metal be in proper electrical condition to attract the electrical charges to itself. We keep the plate in this proper condition by shaping and placing it properly and by connecting it to one side of an electrical source in the form of a B battery or B eliminator (socket power device). The filament, on the other hand, is heated by means of current from the A battery or A eliminator.

Thus we have established a constant stream of electrical particles, quite invisible yet very real, across the vacuum, or from the heated filament to the cold plate, while from the latter the electrical particles in the form of electric current can flow out of the tube. We have, therefore, an electrical Niagara.

## The Grid Controls Electrons

But how are we to control this electrical Niagara? What is to correspond to the system of flood gates and the control lever of the dam? The solution is offered by the grid. It was discovered some years ago that an open work structure of metal could be placed between the filament and the plate, so that very trifling changes in its electrical condition would greatly change the stream of electrons passing from the filament to the plate. Here, then, we have a potent, instantly responsive electrical control mechanism. The most minute electrical charges impressed upon the grid, even at a tremendous rate of speed such as radio frequencies with millions of changes per second, cause much greater yet substantially identical changes in the electronic stream.

A vacuum tube, therefore, comprises (1) a filament; (2) a plate; (3) a grid; (4) a glass envelope or bulb; (5) a base with prongs, or contact pins for external connections. The functions of these members are obvious from what has gone before.

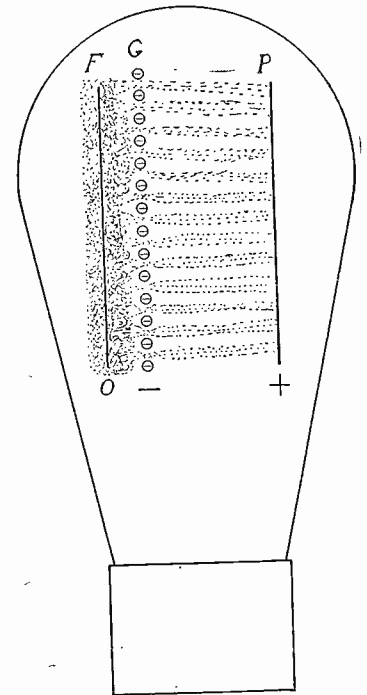
In a general way, then, what are the requirements of each of these members? Well, taking the filament first, here is a member which must be a copious emitter of electrons at reasonable temperatures to insure long and economical life.

## Precision Is Requisite

The lower the operating temperature of the filament, the less the cost of maintaining the filament lighted, because of the lowered battery drain. Originally, chemically pure tungsten was considered an ideal filament material, but a brilliant scientific inspiration led to a better substance for tube filaments.

The plate and the grid must be precise in dimensions and most carefully mounted in exact relation to each other and the filament. The necessarily delicate filament—it can hardly be seen except when lighted—must be delicately mounted so as not to vibrate or shake from powerful sound waves, of a nearby loudspeaker. Otherwise, the tube is "microphonic". The plate and the grid must be scrupulously clean, so that they cannot give off gas or impurities to interfere with the operation of the tube.

The leading-in wires passing through



THE GRID WIRES, shown in section above, are negatively charged and thus they repel the electrons coming from the filament. Fewer electrons can reach the plate when the grid is in place than when there is no grid. It is only the faster of the electrons emitted by the filament that can sneak through the openings and get by the grid. Once they are through the grid pushes them toward the plate and the plate pulls them.

the glass must be of a kind that will not expand or contract at a different rate from that of the surrounding glass. If the expansion should be too rapid, the surrounding glass will crack; if slower, a leak will be formed and the vacuum jeoparded. A cleverly conceived bi-metallic wire, known as dumet, is used for the best vacuum tubes, insuring a tight seal at all times.

## Fine Work is Vital

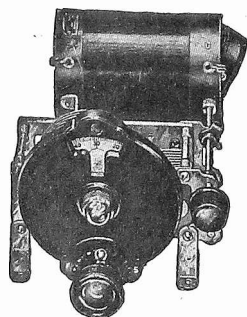
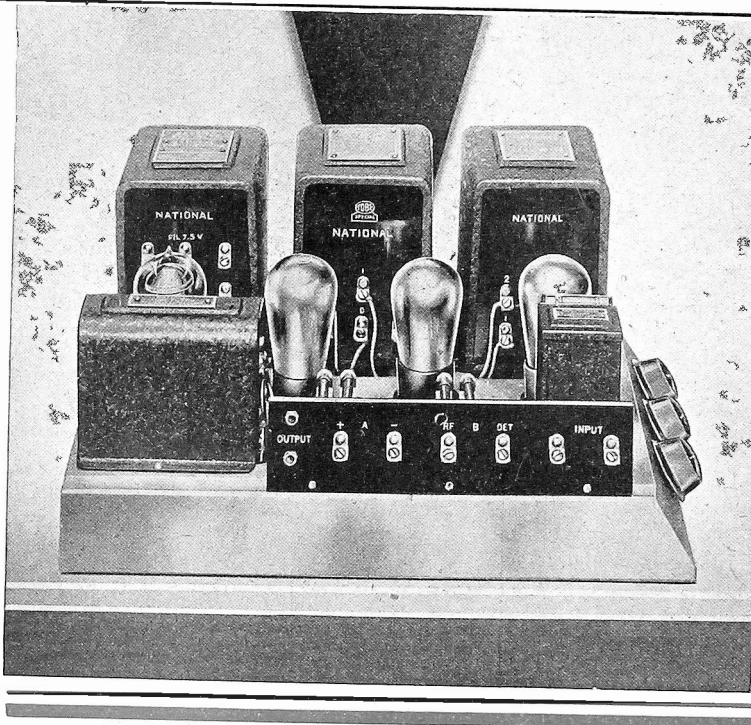
methods have had to be evolved. Pumping alone could not achieve the high vacuum in a sufficiently thorough and rapid manner to meet the demand for millions upon millions of vacuum tubes. Here again, a clever inspiration has provided what is in reality a vapor broom. Now the housewife would hesitate to sweep a room with a metallic fog. Certainly a husky broom would be preferred. Yet vacua are swept with a metallic fog. A small quantity of suitable chemical, called the "getter", is placed in the tube at the time of assembly.

## Why the Silver Lining

Following the sealing operation, when the vacuum pumps have done their best in the time allotted to them in quantity production, this "getter" is vaporized, in which form it combines with the remaining gas atoms and finally condenses on the cool glass wall. And so the bright silvery coating we see on the vacuum tube is the sign of good housekeeping on a minute scale. It signifies that the tube has been swept clean.

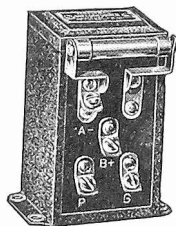
The De Luxe Lamp Socket Receiver

NATIONAL LYNCH POWER AMPLIFIER



NATIONAL TUNING UNITS

Comprise the wonderful BROWNING-DRAKE R. F. Coils and Transformers with their SLOTWOUND primary and SPACEWOUND secondaries, EQUICYCLE wide-spacing condensers and VEL-VET VERNIER Dials. They make good Radio sets.



NATIONAL IMPEDAFORMER—Type B

Includes in one case audio choke coil 0.1 Mfd. TOBE Condenser, mounted Lynch Resistor—for modern audio amplification. Price \$5.50 each

THE NATIONAL-LYNCH Power Amplifier is a new combined B-power supply and 3-stage audio amplifier, for use with either the Raytheon BH or Rectron Tubes, and with the UX-171 semi-power tube in the last audio stage. Made to be connected instantly to the detector output of any set and gives real fidelity of reproduction.

Designed in collaboration with Arthur H. Lynch and James Millen. The fine appearance of this new instrument is but a reflection of the quality packed within it.

The amplifier employs one stage of impedance and two of resistance coupling. The output is through a NATIONAL Tone Filter, for protection of loud speaker windings and further improvement of quality. The parts mount on a drilled and cored metal base in which all of the wiring is concealed and protected. When connected to a first quality loud speaker the fidelity of reproduction is limited only by that of the broadcast station being received.

Price—Completely assembled and tested without tubes (state whether BH type or Rectron UX-213 is to be used as rectifier) .....\$89.00 BH Tube extra .....\$6.00

Price—NATIONAL-LYNCH Power Amplifier, in kit form, complete for assembly in one evening, with instructions and BH Tube .....\$84.00

NATIONAL products are built to engineering standards of excellence. Anyone who has ever built a set using NATIONAL BROWNING-DRAKE Coils and Transformers knows what that means. Send for Bulletin 116-W-1.



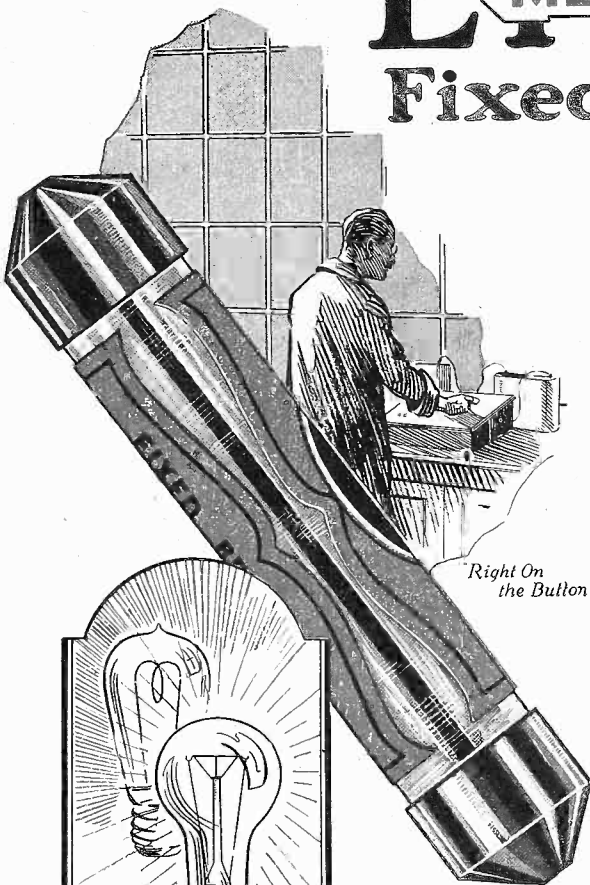
National Co., Inc., Engineers and Manufacturers.—W. A. Ready, Pres., Cambridge, Mass., Makers of NATIONAL BROWNING-DRAKE Coils and R.F. Transformers, Impedafomers, Condensers, Power Transformers, etc., for Radio.



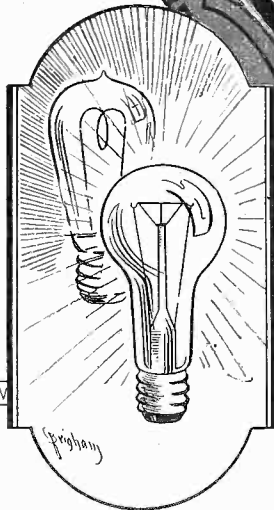
*The De Luxe Lamp Socket Receiver*

*Why the Experts Choose the*

**LYNCH**  
METALLIZED  
**Fixed Resistor**



*'Right On the Button!'*

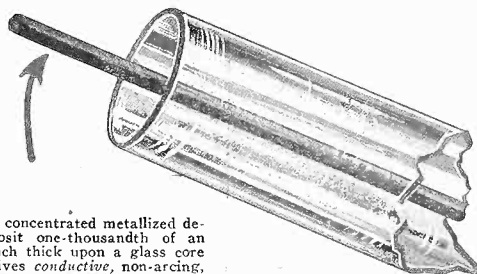


**As Great an Advance as the Tungsten Lamp**

The old carbon lamp consumed more current to give less light. Tungsten, which is metal, proved more economical, more efficient. It meant more light, longer life. Lynch Metallized Resistors are warranted absolutely noiseless, permanently accurate, dependable.

**For Better Filament Control**

The NEW LYNCH EQUALIZORS — a type for each tube, and for any combination of tubes. Complete, with Better-Built Mounting, \$1.00.



A concentrated metallized deposit one-thousandth of an inch thick upon a glass core gives *conductive*, non-arcing, silent, resistance that wins in the acid test of time.

**JAMES MILLEN** uses and endorses the Lynch Metallized Resistor.

In describing the construction of experimental receivers, amplifiers and power units, it is significant that such authorities as Laurence M. Cockaday (*Popular Radio*), Herman Bernard (*Radio World*), E. M. Sargent, G. M. Best (*Radio*), and many other eminent designers specify Lynch Metallized Resistors.

These men *know* radio. They realize the importance of resistors that will remain absolutely noiseless, permanently accurate, efficient, dependable — and they choose Lynch. There could be no greater testimony of the true worth of our product.

**PRICES**

|                          |        |
|--------------------------|--------|
| .25 to .10 Megohms       | \$ .50 |
| Above .01 to .24 "       | .75    |
| .001 to .01 "            | 1.00   |
| Single Resistor Mounting | .35    |
| Double Resistor Mounting | .50    |
| Equalizer, all sizes     | 1.00   |

**ARTHUR H. LYNCH, Inc.**

**FISK BUILDING**

Broadway and 57th Street, New York, N. Y.



**Dealers—Get Our Free Advance Information Service.**

# The De Luxe Lamp Socket Receiver

**UNIVERSAL**  
Covers every resistor requirement

current carrying capacity 20 watts

wherever a variable resistance is specified

From practically 0 to 3,000,000 ohms

one-hole mount

CLAROSTAT \$2.25

## CLAROSTAT

the greatest variable resistor!

SCORES AGAIN

Selected by

ARTHUR H. LYNCH for

### THE DE-LUXE

LAMP SOCKET RECEIVER

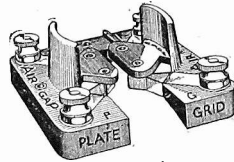
That's what 59 leading B eliminator manufacturers are doing. After exhaustive tests, they are convinced that only CLAROSTAT acts as the perfect voltage control because . . .

it has a range of from practically zero to 5,000,000 ohms . . .

it has a current carrying capacity of 20 watts—greater than that of any other variable resistor—without slightest danger of packing, arcing or crackling noises.

Have you sent for your copy of "The GATEWAY TO BETTER RADIO"? The edition is limited and you can't afford to be without it. 32 pages covering everything—reception, transmission, amplification and battery elimination. Send 25c in stamps or coin to Dept. RW.

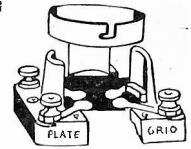
**American Mechanical Labs.**  
285 N. 6th St., Brooklyn, N. Y.



Type U.X. Universal  
Price 60c

The **AIRGAP** SOCKET  
*"It gets that last mile"*

Specially Recommended by  
Arthur H. Lynch  
for the  
**DE LUXE RECEIVER**



Type U. V. Standard  
Price 60c

**AIRGAP PRODUCTS CO.**

Send direct Post-paid if your Dealer cannot supply you.

10 CAMPBELL STREET

NEWARK, N. J.

## CARTER Parts Specified for LYNCH De Luxe Receiver

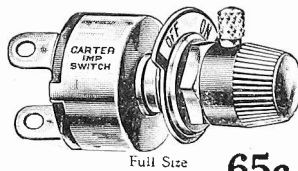
A S U S U A I

Carter parts are specified for this efficient amplifier.

Whenever you find a circuit that's popular and a success, you'll find Carter parts specified. In fact, much of the success of any circuit is due to the careful selection of parts.

If you're not now using Carter parts, try them. You'll find, like thousands and thousands of others, that Carter parts perform with a consistency and persistency unequalled.

Any dealer can supply

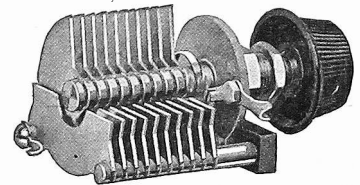


Full Size **65c**

"IMP" Battery Switch  
In Canada: Carter Radio Co., Ltd., Toronto  
**CARTER RADIO CO.**  
CHICAGO

## ELKAY EQUALIZORS

Selected personally by Arthur H. Lynch for the Two-Tube De Luxe Receiver described in this issue and made by The Langbein-Kaufman Radio Co. (Dept. W.), 62 Franklin St., New Haven, Conn. Write for prices and tables of values.



**PRECISE 940 MICRODENSER**

Series Antenna Balancing Condenser  
Especially Designed for the Browning-Drake Receiver

Selected and Specified by

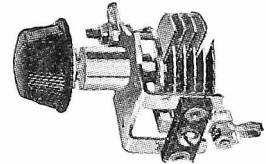
Arthur H. Lynch

for the De Luxe Lamp Socket Receiver  
100 Mmf. Capacity, \$1.75

A Precise Laboratory Quality Instrument  
Also made in 10, 20, 30, 55 and 135 Mmf. Cap.

**PRECISE MANUFACTURING CO.**  
ROCHESTER, N. Y.

New York Office: 126 Liberty Street



## "HAMMARLUND, JR."

The high-ratio shielded midget condenser, especially selected by Mr. Arthur Lynch for use in the

De Luxe  
**LAMP SOCKET  
RECEIVER**

Featured in RADIO WORLD

Made in four sizes for any circuit where a small variable capacity is advantageous.

Write for Folder

**HAMMARLUND MFG. CO.**  
424-438 West 33rd Street New York

For Better Radio  
**Hammarlund**  
PRECISION  
PRODUCTS

## The De Luxe Lamp Socket Receiver

(Continued from page 6)

The filament windings are thus made to serve as a most excellent electro static shield.

### Raytheon Tube Used as Rectifier

The rectifier tube used with the power transformer and associated apparatus yet to be described for obtaining the B and C voltage is of the Raytheon filamentless type. The Raytheon tube was selected in preference to others because of its markedly superior performance when put through exhaustive laboratory tests by both Mr. Millen and the writer. Although for some uses the 213 tube was found to be quite satisfactory, when used at the high currents and voltages to which the rectifier tube in the National-Lynch amplifier is subjected, its life was exceedingly short. Such was not the case, however, with the Raytheon tube. Several different types of "bootleg" Raytheon tubes were also tried, and without exception, all those tried were found to be quite worthless, as their useful lives were but a few hours under full load.

Two 0.1 mfd. high voltage Tobe condensers mounted in a single case located

under the base of the amplifier and known as "buffer" condensers are used to insure the most efficient operation of the Raytheon tube. Occasionally, when they are not employed in the circuit a crackling noise, much like static, is heard in the loud speaker. The buffer condensers

(Continued on page 26)

### Radio's Latest Necessity

# BRACH

The HEART of the POWER PLANT



Make your SET a POWER SET

## CONTROLIT

No radio user will be without a Controlit when he realizes how it adds to the pleasures of operation. Adding a Controlit to any set eliminates all switches from "B" Battery Substitute and Trickle Charger and places complete, automatic control of set and power supply in one switch—the set switch itself. Without added wires or alterations, the Controlit can be made a part of any set.

Price \$6  
Specified by  
**ARTHUR H. LYNCH**  
in  
The De Luxe Receiver

## Brach Radio Products

L. S. BRACH MFG. CO.  
One of Famous Brach Lightning Arrestors  
Dept. 27, Newark, N. J.

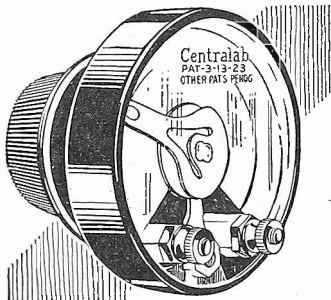
## CeCo TUBES

SPECIFIED BY  
**ARTHUR H. LYNCH**  
FOR THE TWO TUBE  
DE LUXE RECEIVER

Type H—Special Detector.....\$2.50  
Type BX—199 .....\$2.00

Ready to Mail in Special Mailing Carton  
Upon Receipt of Money Order.

**K. W. RADIO CO., Inc.**  
98 Park Place New York



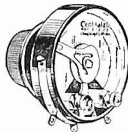
STANDARD  
**Centralab Radiohm**

**I**NSURES clearer, louder reception with most any radio circuit. It holds perfectly the sensitive regenerative position which immediately precedes the oscillation point.

Arthur Lynch has selected the Radiohm to control his new Wonder Set.

Dependable, noiseless in adjustment, and full resistance variation with a single turn of the knob. Resistance values remain exact for life of set. **\$2.00** for any resistance.

SWITCH TYPE  
**Centralab Radiohm**



With Switch  
**\$2.30**

Has an "A" battery switch, also controlled by the knob, giving a double purpose control. Is variable from zero to 500,000 ohms. Also furnished in Modulator, for tone volume control in all audio circuits.

CENTRAL RADIO LABORATORIES

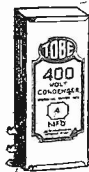
13 Keeffe Ave., Milwaukee, Wis.

Makers of a full line of variable resistances for 69 makers of leading standard sets.

# Centralab

# TOBE

## TINYTOBE CONDENSERS

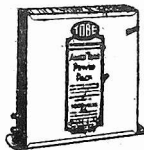


The Tobe  
400 Line

Specialty cased condensers for 400 volts D. C. operating voltage. For use with Raytheon BH and similar high-voltage rectifying tubes in B-Eliminators. Uses short-path type condensers and is equipped with unique TOBE safety terminals

at base of can.

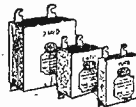
|                   |        |
|-------------------|--------|
| Prices—1 Mfd..... | \$2.00 |
| 2 Mfd.....        | 2.75   |
| 4 Mfd.....        | 4.50   |



The Tobe 600 Line

High-voltage condensers for AmerTran and similar high-voltage packs. Big, snaky 1000-volt D. C. continuous-operating voltage condensers—made to stand the gaff. Equipped with TOBE safety terminals.

|                   |        |
|-------------------|--------|
| Prices—5 Mfd..... | \$1.75 |
| 1.0 Mfd.....      | 2.50   |
| 2.0 Mfd.....      | 4.00   |
| 4.0 Mfd.....      | 7.00   |



Tobe Filter Condensers

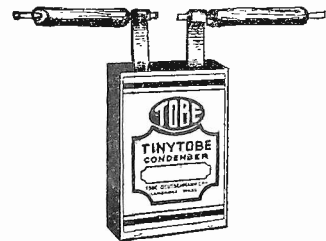
The standard for general radio use, for all operating voltages up to 300 volts D. C. Used by Philco, National Company, General Radio Company, King Radio, and many other leading manufacturers.

TOBE Condensers are specified for the Infradyne, LC-27, Bernard Lamp Socket Set, Browning-Drake, Lynch Power Amplifier, Henry-Lyford Receiver, Carborundum, Alden, Somerbridge, R. B. Lab, Dalling-Halco, Super and many other Sets, including

The De Luxe Lamp Socket Receiver

# Tobe Deutschmann Co.

Engineers and Manufacturers of Technical Apparatus  
Cambridge, Mass.



"Actual Size"

A new TOBE product making the TOBE line complete, from the smallest to the largest fixed condensers required in Radio.

TINYTOBES are made for continuous operation up to 500-volts D. C., and are for all by-pass uses in Radio sets, for coupling condensers in impedance and resistance amplifiers and for detector grid condensers.

TINYTOBES are specified in the Lincoln Superhet., Victoreen, Samson, T. C., and many other leading circuits.

It would be hard to find a more efficient, compact and generally advantageous small fixed condenser than the TINYTOBE.

PRICES:

|   |          |
|---|----------|
| .0001 Mfd., .00025 Mfd., .0005 Mfd..... | 35c each |
| .001 Mfd. and .002 Mfd.....             | 40c each |
| .005 and .008 Mfd.....                  | 45c each |
| .01 Mfd.....                            | 55c each |
| .02 Mfd.....                            | 60c each |

No condensers of this kind are genuine unless they bear the trade-mark name TINYTOBE. Accept no substitutes.

*The De Luxe Lamp Socket Receiver*

22 leading manufacturers  
and Raytheon solve the problem  
of radio light socket power

( Now you can have  
unfailing radio B power  
without batteries )

BT  
B-POWER UNIT

Coriell  
Voltage Supply

ZENITH  
B Eliminator

APCO  
Raytheon Rectodyne

ERLA  
Hum-Free B Eliminator

MODERN  
B Power

Burns  
B-Battery Eliminator

KIRKSTON  
B-Battery Eliminator

GENERAL RADIO  
Plate Supply

STORAD  
POWER UNIT

SPARTON  
RADIO

BOSCH  
NOBATTERY

Majestic  
B Current Supply

ELECTRON  
Central B Supply

Mayolian

Valley  
B-POWER UNIT

ALL-AMERICAN  
Constant B  
Battery Eliminator

Sterling  
B-POWER

WBCO  
B-POWER UNITS

ACME  
B-POWER SUPPLY

TIMMONS  
BLIM

CROSLEY  
RADIO

THESE radio  
manufacturers,  
foremost in their  
field, use the RAY-  
THEON LONG LIFE  
RECTIFYING TUBE  
in their B-power  
supply units.  
They have accepted  
Raytheon as THE  
HEART OF RELIABLE  
RADIO POWER.

THAT the manufacturers whose names appear on this page were quick to standardize on the RAYTHEON LONG LIFE RECTIFYING TUBE for use in their B-power supply units is a tribute to the Raytheon research organization.

The development of the Raytheon rectifier from a mere idea to a remarkable scientific achievement has made possible the sale of nearly \$20,000,000 worth of B-power units, Raytheon-equipped, in the comparatively short time since it was first announced to the radio world.

This means that there are already more than 500,000 satisfied users of B-power units, Raytheon-equipped.

These B-power units utilize the electric current which is furnished by the ordinary domestic lighting system. They do away entirely with B-batteries.

The manufacturers who are listed on this page have built B-power units to suit various types and styles of radio receiving sets, according to their own individual designs and the specifications of their own engineers.

All of these supply units, however, have this one thing in common—they use the RAYTHEON LONG LIFE RECTIFYING TUBE, the perfection of which was made possible by the development of the principle of gaseous conduction. The Raytheon rectifier has no filaments or liquid solutions. It has no parts to be replaced, and nothing which requires attention.

When you buy a Raytheon-equipped B-power unit you will get not only the most reliable rectifier that scientific methods can produce, but you will also have absolutely reliable, unfailing B-power, improved reception, and freedom from the annoyance of run-down B-bat-

teries. You can dispense with B-batteries entirely.

For your protection, the RAYTHEON LONG LIFE RECTIFYING TUBE is sold only to those manufacturers whose B-power units have passed the rigid laboratory tests of the Raytheon engineers. Look for the Raytheon Tube. It is used by the manufacturers whose names appear on this page in their B-power supply units. The Raytheon trade-mark is the symbol which guarantees unfailing, reliable radio power direct from your light socket.

Ask your radio dealer for a B-power unit, Raytheon-equipped. He has them—or can get one for you.

**Raytheon**  
LONG LIFE RECTIFYING TUBE

RAYTHEON IS THE HEART OF RELIABLE RADIO POWER



*The De Luxe Lamp Socket Receiver*

**For the De Luxe  
LAMP SOCKET RECEIVER**

Described in This Issue

Use CeCo Tubes, as Specified by

**ARTHUR H. LYNCH**

*For the Amplifier*

**CeCo Type J-71  
OUTPUT TUBE**

Operates largest loud speakers at full volume. Does NOT require high voltage plate supply. At 90 V will give 12 times the undistorted power of the ordinary "A" type.

Price \$4.50

**CeCo Type G**

High Mu

For Impedance or Resistance Coupled Receivers

Fil. V. .... 5.0  
Fil. Amp. .... 0.25  
Plate Volts. .... 90-180  
Gives clearer reproduction with increased volume.

Price \$2.50

*For the Two-Tube De Luxe Receiver*

**CeCo Type H  
Special Detector**

Fil. V. .... 5.0  
Fil. Amp. .... 0.25  
Plate Volts. .... 67-90

Improves reception especially on DX or distant stations.

Price \$2.50

**CeCo BX Type**

199 (UX base) gives Clearer Production with Increased Volume. Used in the De Luxe Receiver as a Radio Frequency Amplifier, and chosen by Mr. Lynch after Careful Tests.

RATING

Filament, volts .... 3.0  
Filament, amperes .... 0.25  
Plate, volts .... 20-80

Price \$2.00



**Radio Vacuum  
Best by Test  
TUBES**

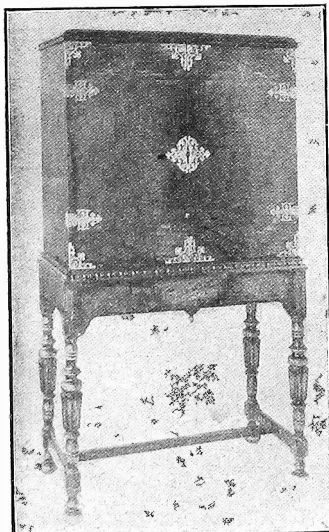
*Make a  
Good Receiver  
Better!*

The CeCo Tubes, types J-71, G, H and BX, have the "X" base for push type sockets. These tubes, properly chosen, improve reception on any set.

**C. E. Manufacturing Co., Inc.**

Write for Complete Data Sheet  
PROVIDENCE RHODE ISLAND

**PERSONALLY PICKED BY ARTHUR H. LYNCH**



**\$135** fo.b. New York  
**WESTBROKE**

A BURLED walnut cabinet that combines correctness and finest craftsmanship. Borrowing an air from another period, and yet being extremely modern in feeling, it is a distinguished example of refined taste expressed in clear cut lines. Height, 57 in.; width, 32 in.; depth, 15 in. Panel adjustable up to 10 by 20 inches.

*You Can Have Your De Luxe  
Receiver In the Same Cabinet  
In Your Own Home, Too*

THE designer of the De Luxe Receiver has been in radio many years; he knows values. Arthur H. Lynch dropped into the Cheltenham showrooms recently, and wrote out his personal check for a Westbrooke cabinet. It was for his own home—that's what I call a real endorsement!

*J. Andrew White*

CHELTHENHAM cabinets have all the authority and elegance required by the connoisseur without the exorbitant price which would be requisite were it not for large scale production in factories which for many years have specialized on the fabrication of the finest in furniture. All genuine Cheltenham radio cabinets bear the facsimile signature of J. Andrew White, dean of announcers, premier broadcaster of sporting events, who for fifteen years has been a leader as a radio dealer and manufacturer.

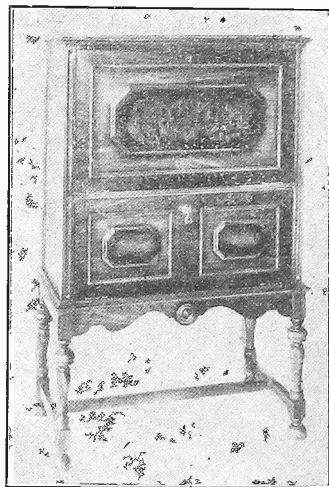
**CHELTHENHAM CABINET MAKERS, Inc.**

34 West 44th Street New York

Trade Inquiries Invited

**FAIRFAX**

WALNUT panels which are beautifully blended and grace of design set them apart from less expert attempts to attain the perfection of balance required in authoritative cabinets of the popular high-boy type. Height, 48 in.; width, 29 in.; depth, 16 in. Panel adjustable up to 8 by 26 inches.



**\$102** fo.b. New York

# How to Wire Up DeLuxe Audio And Eliminator

(Continued from page 23)

completely eliminate any such noises. Frequently some trouble is experienced in power supply circuits using the new BH type Raytheon tube due to condenser failures when the ordinary B blocks are used. For this reason the Tobe company supplies a special high voltage block, which has been thoroughly dehydrated, for use in this amplifier. Thus the constructor is insured against trouble and inconvenience from this source. Another means of accomplishing the same result is at hand in the regular Raytheon type B tube.

The choke coils designed by Mr. Millen for this amplifier-power unit are exceedingly effective. Aside from their high inductance and low DC resistance, the chokes have an unusually large air gap so that the inductance does not drop off appreciably due to core saturation even at loads up to 80 milliamperes, at which maximum current the chokes are rated. The normal current in the chokes is gen-

erally not in excess of 35 milliamperes and in many cases, such as when the amplifier is used with the De Luxe Receiver, under 30 milliamperes.

By means of variable resistors (R1, R2) properly by-passed with fixed condensers, lower voltages of variable values are obtained for the plates of the detector and RF amplifier tubes. The detector voltage is variable so as to permit of the best adjustment when the special detector tubes, such as the CeCo H, are employed, while the variable RF voltage control permits the amplifier-power unit to be used with sets possessing RF amplifiers of different types and numbers of stages.

The grid bias voltage for the last tube is obtained by a combination of a variable resistor (R3) and a resistance-capacity filter unit. (R9C4). The high grid voltage required for the power tube makes it well worth while to obtain it from the lamp socket. This is in direct contrast to the grid voltage for the first two or CeCo high mu tubes, which is obtained from a small flashlight battery. This battery is inexpensive and will last well over a year. The necessary resistors and condensers required to eliminate this battery would not only cost many times as much as the battery but would also tend considerably to complicate the amplifier-power unit circuit. The grid bias voltage on the power tube is made variable rather than fixed in order to permit the use of the CX112 or CeCo type F tube under the conditions previously described in this article.

### The Assembly

The complete unit is assembled by the manufacturer on a substantial cast metal base under which the greater part of the wiring is run and many of the small parts, such as buffer condensers, sockets, condensers, resistors, and filament equalizers, are mounted.

Aside from its sturdiness the metal base, with its neat lines and black crystal-lacquer-finish, gives the entire unit a most handsome appearance. The arrangement of the parts on the base is such, as to provide mechanical protection for the tubes and at the same time the greatest isolation of those parts which, if placed too closely together, might cause trouble due to coupling of stray magnetic fields. Thus, at one corner is the transformer, while at the opposite end are the filter chokes. The fact that the manufacturer supplies the amplifier with all parts fully mounted is of great help to the constructor as it eliminates the necessity for such items as drills, taps, files, and muscular energy. Merely a few hours of pleasant work with a pair of wire cutting pliers, screw driver and soldering iron, are required.

### Wiring the Amplifier

The wire used should be of a well insulated flexible type.

First wire the power section. The two flexible leads on the transformer are run directly to the two protected filament terminals of the Raytheon socket and soldered in place. Care must be exercised in soldering connections to the sockets to see that no soldering paste or flux gets between the contacts, or an arc will result when the amplifier is put in operation. The grid terminal of the Raytheon socket is not used. Now connect the two AC filament leads to the J-71 tube, twisting them together.

The rest of the connections of the power supply apparatus are perfectly straightforward, and, after all of the apparatus in this unit has been connected together the amplifier proper may be wired. The two leads, from each of the grid condensers (in the grid circuits of the second and last audio tubes) should be run directly to the grid and plate terminals of the proper sockets, as shown. While wiring, keep in mind the fact that the wires are finally to be grouped together and bound into cables as mentioned above. Ordinary grocer's string is quite satisfactory for this purpose and, if given a coat of shellac when finished, will be firmly held in place. The soldering lug visible on the bakelite socket strip between the second and third tube sockets, screws through the cast iron base and casings of the individual units, and is for the purpose of grounding the metal base. It is connected to the negative

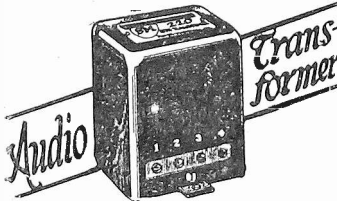
Why is the Karas Equamatic the Most Efficient Receiver Ever Designed?

Write us for Full Information

**KARAS ELECTRIC CO.**  
1148 Association Bldg., Chicago, Ill.

**SM**

220 and 221



The proof of the pudding is in eating, that's why S-M audios—sold on a satisfaction or money back guarantee, are the choice of the experts the country over—that's why they are outselling all other makes—that's why every important magazine has recommended them.

Do you know that the largest telephone manufacturing company has unofficially set up the S-M 220s as the finest they have ever tested?—that custom set manufacturers, newspaper editors, testing laboratories, manufacturers of phonograph records have endorsed the S-M as the very finest?

Can you think of any better recommendation for your audio transformers?

S-M type 220 audio transformer is designed for all stage use in ordinary or power amplifiers, with all standard tubes. S-M 221 is an output transformer, to be used between your power tube and loud speaker. It is guaranteed to improve quality and handling power unconditionally with any set or speaker. Both types are priced at \$6.00.

Ask your nearest dealer for a copy of "The Secret of Quality." It boils down in understandable language every practical phrase of quality amplification. It's free.

Prices 10% higher west of the Rockies.

**SILVER-MARSHALL, Inc.**

878 West Jackson Blvd.  
Chicago, U. S. A.

## JAYNIXON TONE BRIDGE



NO TUBES  
NO BATTERIES  
Attached instantly  
if you use a  
Power Tube you  
MUST protect  
your speaker

Your greatest Radio  
Need. Order NOW.

JAYNIXON LABORATORIES  
57 DEY STREET NEW YORK CITY  
Approved by RADIO WORLD Laboratories

## Youth Rewarded By U. S. Government For Radio Work

Made Sr. Lieut. Naval Reserves For Great Radio Advancements—Free Details Sent to All

Only a little over 21 years of age, but as a result of his work, now a Senior Lieutenant in the United States Naval Reserves—is the record of Sterling G. Sears, called one of the foremost Radio Experts in America.

His latest development—an amazing 5-tube Radio—with marvelous volume and tone quality, greatly simplifies and improves home reception, but reduces usual cost 60 to 75%. In addition to its almost unbelievable low cost, are natural reproductions of tone values (music or voice) and the quick and simple ease of home installation and operation.

For the benefit of those interested in better Radio reception and those who now own no Radio, but would like to have a really good one at very little cost—it has been arranged to supply Free information and description about "The Sterling Five" to all who write Geo. W. Naylor, Jr., Dept. 315K, 161 Chambers St., New York City. If you want to know all about it, write at once. Your inquiry will only cost you a 2c stamp and implies absolutely no obligation.

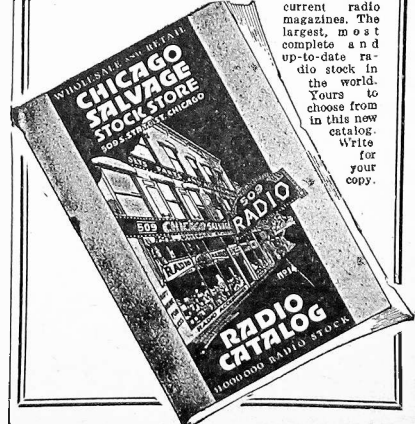
## FREE

NEW RADIO CATALOG

Write Today to

Chicago Salvage Stock Store  
509 S. State St., Dept. R.W., CHICAGO, U.S.A.

MORE THAN a score of new kits—all the latest and best—with specified parts to build them—at prices that mean big savings for you. And all the latest parts and accessories as advertised in current radio magazines. The largest, most complete and up-to-date radio stock in the world.



Choose from this new catalog. Write for your copy.

filament lead at the adjacent-tube negative filament prong.

The negative terminal of the C battery is the long strip. The short strip is the positive. The positive C terminal may either be connected to the metal clamp that holds it in place or to the ground lug previously referred to. Both of these points are grounded.

[This concludes the article on the National-Lynch Power Amplifier and B Supply. The construction of the Two-Tube De Luxe Receiver was described and generously illustrated in last week's issue, January 1. Next week, issue of January 15, Mr. Lynch will describe various alternate means now available to the public for operating directly from the lamp socket.]

## Dill Asks 1-Year Trial of New Bill

WASHINGTON.

Proposals and counter-proposals for compromise between the Dill and White radio bills in conference have been exchanged between the conferees. Hope runs high that a bill may be brought out early this month.

The latest proposal was for a Commission to decide all matters of importance in regard to broadcasting with enforcement placed in the Department of Commerce. Senator Dill proposed this plan with a request that it be given a one-year trial. The proposal is like the White bill, but does not meet the President's objection to an independent commission.

Senator Dill and Representative White are both aware of the confusion in the air and are anxious to obtain enactment of a regulatory measure as soon as possible. If it appears as though compromise will be delayed for any length of time, an emergency measure will be rushed through the House and Senate authorizing the Secretary of Commerce to refuse licenses to new stations.

### LONG KHQ PROGRAM

SPOKANE, Wash.

The 'dust to dawn' program, which was recently broadcast by KHQ, was a huge success, according to the more than 2,000 telegrams and letters received from people all over the country. Indications that people in the Pacific Ocean islands were also entertained, were given.



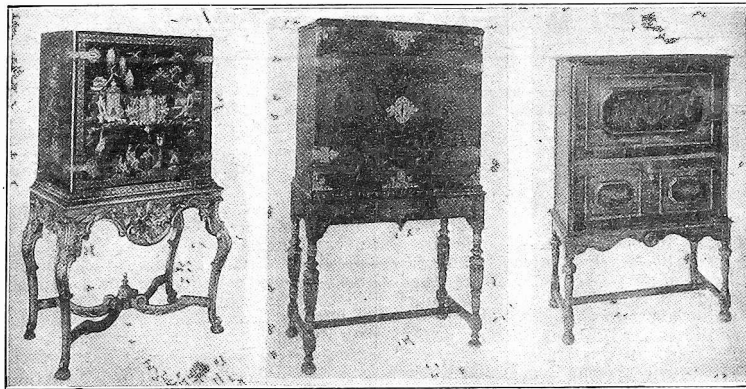
Hot off the press—latest Radio Catalog and Guide for 1927, brimful of new ideas, 164 pages of special hook-ups with information—all free. Shows savings as high as 60% on sets and supplies. Be sure to get this thrifty illustrated book before you buy. It means money in your pocket. Standard guaranteed goods.

Write letter or postal now. Also please include name of radio friend.

BARAWIK CO., 550 Monroe Street, Chicago, U. S. A.

### DIAMOND NAMEPLATES OUT

Our supply of nameplates for the Diamond of the Air has been exhausted. We can, however, continue to send a booklet and blue print for the 5-tube Diamond of the Air on receipt of 50c, and a booklet and blue print for the 4-tube Diamond of the Air on receipt of \$1.00. Radio World, 145 W. 45th St., N. Y. C.



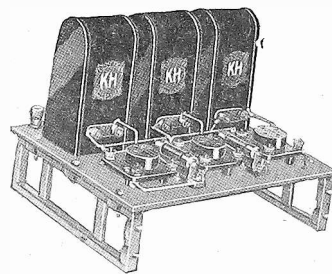
THESE consoles, designed by Major J. Andrew White, noted sports announcer, offer handsome housing for the De Luxe Lamp Socket receiver. They are Cheltenham manufacture. Mr. Lynch bought the center one for his personal use.

### Banquet Broadcast Given Up As Listeners Await Program

WRNY, the "Radio News" station in New York City, recently was scheduled to broadcast the entire proceedings of a banquet of the Young Men's Philanthropic League, in the Hotel Commodore, New York City. Many prominent actors and actresses were supposed to appear before the microphone. The crowd was so merry it was difficult to get a proper pickup. Also there was much difficulty in getting some of the stars to appear before the microphone, while others refused to appear if any mention was made of their name. Consequently the banquet was not broadcast, to the disappointment of many. It is doubted, by the officials of this station if any further attempts to do this type of work will be attempted in the future.

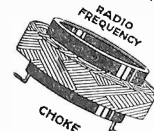
Station WCCO, the Minneapolis-St. Paul station, has completely banned broadcasts of banquets.

## Complete Parts for the HARKNESS Twin-Choke Audio Amplifier



This amazing new amplifier has the clearest and most realistic tone you have ever heard. We have all the necessary parts in stock, including completely drilled panel. All parts exactly as specified by Kenneth Harkness. Mail your order today. Send no money. Just pay the postman when he delivers parts. Satisfaction guaranteed or your money refunded. Complete parts include:

- One Drilled Panel, 7"x8 1/2" **Cat. No. H-300**
- Three KH Twinchoke Audio Couplers
- One KH Output Choke Coil
- Three Benjamin Sockets
- Two Amperites, type 112 **\$29.50**
- One 2 Mid. Condenser
- Nine Eby Engraved Posts
- Two ICA Bakelite Brackets **Complete**



## RABCO R.F. CHOKE

Cat No. R-240  
50c. each—  
Three for \$1.00  
Keeps R.F. currents out of the audio amplifier. Essential to good tone quality. Use three in every set. Instructions enclosed. Order now at this money-saving price.

**RADIO BUILDERS CO.**

124 Cypress Avenue Bronx, N. Y.

### Build a 3 ft. Cone Speaker as fine as any you can buy



**-SAVE 4/5 Retail Price**

A 3ft. Cone Speaker, which you can build in one evening at home, with PENN Cone Speaker Unit will give as fine TONE QUALITY as a factory-built speaker costing 5 times as much.

"Received material and have completed speaker. Sure is fine. Thank you," writes R. Hanson, Joliet, Ill.

"Never have heard its equal," "Have built 6 and they are simply wonderful." "Really enjoyed reception for the first time," are other comments.

Complete, detailed, easy-to-follow instructions will let you get same satisfactory results. It takes just as long to build a 3 ft. speaker using a less satisfactory unit as it does to build one using the

## Penn CONE SPEAKER UNIT

which costs very little more. A marvel of design and construction adjustable to the audio output of set with which speaker is used; so sensitive it works with any set that will operate a loud speaker. Magnet, pole pieces and armature are plated to prevent rust, preserve magnetism; shortest, strongest drive rod on any unit; full 16 oz. horse-shoe magnet; will take all volume the tubes will pass. Unit only, \$9.50. Complete parts—including 2 sheets Alhambra FONOTEX, Back Rings, Unit Mountings, Ambroid Cement and Unit—only \$14.15.

Ask your dealer for the genuine PENN Cone Speaker Unit and complete parts. If he cannot or will not supply you, we will ship on receipt of price. Pamphlet, "How to Build a 3 ft. Cone Speaker," sent for 10c. coin or stamps. Write today.

**PENN RADIO SALES COMPANY**  
104 FIFTH AVE., Suite 2193 NEW YORK CITY  
Exclusive Selling Agents for G. R. PENN MFG. CO., N. Y. C.

BLUE PRINT and Book, DIAMOND OF THE AIR sent on receipt of 50c. Guaranty Radio Goods Co., 145 West 45th Street, New York City.

# THE RADIO TRADE

## U. S. Exports to Sweden Drop Severely in a Year

While Sweden increased its imports of radio equipment in 1925, as compared with 1924, the share of the United States decreased by nearly a quarter, and this country had only 7 per cent. of the Swedish trade in 1925. The Swedish exports of radio apparatus fell off during the year, the United States having no recorded share in this trade.

Trade advices from Samuel G. Ebling, discussing the subject, have been made public by the Department of Commerce. The full text of the report follows:

Imports of radio apparatus into Sweden during 1925 increased in value by 1,464,581 crowns over that for 1924. The 1925 value of Swedish exports of this equipment decreased by 251,872 crowns, or over 39 per cent, as compared with 1924.

Purchases from Germany constituted

about 55 per cent of the total imports and the value of German goods received during 1925 was more than double that of 1924. Great Britain, which supplied over 13 per cent of the total, increased its sales by a little over 9 per cent.

Imports from The Netherlands, which furnished 9 per cent, increased in value from 90,891 crowns in 1924 to 393,504 crowns in 1925. The United States supplied 7 per cent, decreasing the value of its shipments approximately 23 per cent as compared with 1924.

France and Denmark furnished about 5 per cent each, imports from the former country declining by 22,492 crowns, while those from Denmark increased by 38,492 crowns. Norway, whose export of this equipment to Sweden in 1924 totaled 226,125 crowns, declined to only 125,029 crowns in 1925.

About 20 per cent of the Swedish export of radio equipment went to Norway, which received goods valued at 88,055 crowns, as compared with 43,072 crowns during 1924. Finland purchased 14 per cent, Denmark 11 per cent, Brazil 8 per cent, Germany 7 per cent, Italy 6 per cent, France and Spain about 4 per cent each, and Great Britain, Japan, and Po-

land about 3 per cent each of the total Swedish export value of radio apparatus during 1925. Mexico and China received equipment valued at 27,547 crowns and 53,547 crowns, respectively, in 1924 but purchased none from Sweden in 1925.

The greatest decline in Swedish radio exports in 1925 was in those to Switzerland which fell off nearly 225,000 crowns, as compared with the previous year. Shipments to Spain decreased over 50,000 crowns, and to Russia over 33,000 crowns. Sales to Germany declined almost 60 per cent, while those to Denmark almost doubled in value, and those to Brazil almost trebled in value.

### Six-Tube Factory Set Measures 8 x 10 x 7 Inches SPOKANE Wash.

Manufacture of the Spokane Six Symphony six-tube radio set, the smallest that uses this number of tubes, is forging rapidly ahead in the workrooms of the Interstate Radio Company, Spokane, Wash. The receiver, a one-dial affair, is 8 inches deep from front to rear, 10 inches wide and 7 inches high.

D. J. Ives, Spokane, formerly with a radio factory in the south, is the designer of this set, which embodies a new type of design for coil mounting.

### TRADE NOTES

GREENBERG, Pa.

Warren H. Walker, of Walker Radio recently announced the opening of a branch store at 24 West Otterman St., formerly occupied by the Harris Clothing store.

A complete line of radios and accessories as well as electrical supplies will be handled.

BELLEFONTAINE, O.

Blair Brothers recently opened up a radio store in this city, in the wall paper store of Fred Neff, east Chillicothe Avenue. They have taken the agency for the Metrodyne, a nationally known set.

### TYPOGRAPHICAL ERROR

In the January 1st issue of RADIO WORLD the type UX Universal Airgap socket was quoted at 50 cents, while the price is 60 cents, the same as the Airgap Products Co. type UV Standard.

The address of the Airgap Products Co. is 10 Campbell St., Newark, N. J.

### NAME CHANGE

D. S. Radio Corporation, Seattle, Wash., capital stock \$2,000, name changed to Robert Denny & Co., Inc.

**LOOK UP DOWN**  
INC.

**SUPERHETERODYNE SPECIALIST**  
SETS—TUBES—BATTERIES—SERVICE

**FREE** Handsome Leatherette Log and Data Book.  
Send Ten Cents to Cover Mailing Cost.

**CHAS. W. DOWN, M. E.**  
2050 Broadway, N. Y. C. Phone: Trafalgar 5879

Replaces "B" Batteries  
**\$12.50**

**FERBEND "B" ELIMINATOR**

Complete. Operates direct from socket on 110-120 volt A. C. lighting circuit. Delivers up to 100 volts. Second successful year. Amazingly low in price—high in value. Equal or superior to any "B" Eliminator, regardless of price. The FERBEND "B" Eliminator is approved and passed by the rigid laboratory tests of Radio News and Popular Radio.

Ask Your Dealer—or Send Direct  
Shipment made direct on receipt of price, or C. O. D. if preferred. Use for 10 days to convince yourself—if unsatisfactory write us within that time and purchase price will be refunded. Write for Literature.

**FERBEND ELECTRIC CO.**  
424 W. Superior St. Chicago, Ill.

**FINE RADIO CABINETS**  
WE BUILD THEM

Complete lines built of hardwood fire ply built up stock solid walnut and genuine mahogany. Size 7x18x10 to 7x30x10. Priced from \$3.25 to \$12.00. We specialize on odd sizes, send sketch or blue prints for estimates on single or in quantities, write for catalogue.

**HICKORY TABLE AND NOVELTY CO.**  
Hickory, North Carolina.

**"PHASATROL"**  
Coming - Coming  
A True Balancing  
Device for All Radio  
Frequency Sets

A Revolutionary Innovation  
**ELECTRAD, Inc.**

**Choose with Confidence**



**World Radio Storage "B" Battery**  
12 Cell—24 Volt

Proved value. Thousands of users find reception almost magical. Clear, true power—instantly and unendingly. Wise economy. Sturdy construction—Solid Rubber Case protection. Recharged for almost nothing. Endorsed and listed as standard by famous Radio institutions including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab, Lofax, Inc., and other Radio authorities. What more need be said? **Extra Offer: 4 Batteries in series (96 volts) \$10.50.**

**Send No Money** Just state number wanted and we will ship C. O. D. Pay expressman after examining batteries. 5% discount for cash with order. Remember—you save 60% on "B" Batteries.

**WORLD BATTERY COMPANY**  
1219 So. Wabash Ave. Dept. 82 Chicago, Ill.  
Makers of the Famous World Radio "A" Storage Battery  
Price: 6-cell, \$10.00; 12-cell, \$18.00; 24-cell, \$35.00.  
All equipped with Solid Rubber Case.

Get your radio dial at 228.9 meters for the World Storage Battery Station WSBG. Variety—New Talent—Always Interesting.

**JERRY SHILLAVAN—Director and Announcer—CHICAGO**

**FILL OUT AND MAIL NOW**  
SUBSCRIPTION BLANK

**RADIO WORLD**

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

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

**SUBSCRIPTION RATES:**

Single Copy..... \$ .15  
Three Months..... 1.50  
Six Months..... 3.00  
One Year, 52 Issues..... 6.00  
Add \$1.00 a Year for Foreign  
Postage; 50c for Canadian Post-  
age.

City and State .....

## Trade and Stations Must Act as One, Dr. Goldsmith Says

According to Dr. Alfred N. Goldsmith, chief broadcasting engineer of the Radio Corporation of America, who recently spoke at a luncheon of the Radio Manufacturers' Association, at the Hotel Commodore, New York City, broadcasting stations and manufacturers of radio receivers must each play a part in order that the public be satisfied with radio.

"The broadcasting stations must produce programs that are diversified and interesting," he said.

"No one wants to listen to a specific type of program. Tastes differ, and what is suitable for one is unsuitable for another.

"We are on the verge of a new era in broadcasting when stations put 'chain' programs on the air. I hope that there will be many such programs in place of the features from individual stations. There is plenty of room for a few more real good broadcasting 'chains.'

"The manufacturers must keep in mind that there are certain qualifications the public wants when it comes to receiving sets. First, the designs must be simplified. Reliability is another asset the public demands.

"If the broadcasters and manufacturers keep these things in mind, there is no reason why the radio industry should not be one of the greatest industries in the United States."

### 18,000 SETS IN ERIE, PA.

ERIE, Pa.

There are 18,000 radio sets in the homes of Erie, according to Frank Gannah of the Electric Supply and Equipment company which handles Kolsters and Erlas. Mr. Gannah gets his estimates from other radio dealers and from the Radio Dealers Association which was recently organized here.

New and Improved  
**FRESHMAN MASTERPIECE**

AT AUTHORIZED  
FRESHMAN DEALERS ONLY

## Literature Wanted

THE names of readers of RADIO WORLD who desire literature from radio jobbers and dealers are published in RADIO WORLD on request of the reader. The blank below may be used, or a post card or letter will do instead.

RADIO WORLD,

145 West 45th St., N. Y. City.

I desire to receive radio literature

Name .....

Address .....

City or town .....

State .....

Lester Martin, 24 Keeney Lane, New London, Conn.

J. E. Hein, 813 Bergline Ave., Union City, N. J.

John E. Gummerson, 824 South 16th St., Lincoln, Neb.

John E. Romer, 707 North Colonial Ave., Richmond, Va.

William Richards, 10 Sherman Ave., East Port Chester, Conn.

Joseph F. Kitchen, 3310 Hibbing Ave., Minn.

L. E. Koehmstedt, Overly, N. D.

O. C. Williams, P. O. Box 86, Greer, S. C.

Theodore J. Lowery, 667 Glenwood Ave., Owosso, Mich.

Harry Stewart, 143 Fairview Ave., Jamestown, N. Y.

R. W. Deck, 406 Center St., Sandusky, O.

I. Stein, 18 Baldwin Ave., Newark, N. J.

G. W. Craig, 444 Delaware St., Gary, Ind.

E. Bauer, Box 101, Hobart, Ind.

Joseph Pagano, 28 Erie St., Clifton, N. J.

Clifford Sewr Seward, 1426 King Ave., Indianapolis, Ind.

Thomas H. Adams, 37 Pleasant St., Bristol, Conn.

C. C. Noel, Boaz, Ala.

Harry Persson, 1516 Eastford Road, Southbridge, Mass.

Gunnar Peterson, 193 Eastford Road, Southbridge, Mass.

A. G. Beech, 428 Greenwich, Belvidere, N. J.



**CARTER**  
"Midget" Rheostat with Filament Switch Say "good-bye" to trouble when you install this Carter part. Leave two instruments behind and replace them with one. It will be well worth your while. Furnished in all resistances.  
HALF \$1 SIZE  
Any dealer can supply.  
In Canada:  
Carter Radio Co., Ltd., Toronto  
**CARTER RADIO CO. CHICAGO**

## Rochester Trades Re-elects Rulers, Sharer The Head


Rochester, N. Y.

The election of officers at the annual meeting of the Rochester Radio Trades, Inc., resulted in the reelection of President Thomas B. Sharer and all other officers, including Vice-President Charles L. Horman, Treasurer William C. Ludwig and Secretary Ray M. Smith.

Leon Goldsmith, William C. Ludwig, H. C. Johnson and Robert Harmon were elected directors of the organization for a period of one year to co-operate with the other seven directors.

Rochester Radio Trades, Inc., was organized on January 25, 1926, with only six members. Today it has fifty-one. The purpose of the organization is to promote broadcasting, better merchandising and fair dealing in the radio business in and about Rochester. The spirit of the membership is said to be unsurpassed by any organization of any nature in the city, all members co-operating for the best interests of the trade in general.

Executive offices are maintained at No. 122 Cutler Building. Radio dealers wishing to become associated with the organization are invited to call.

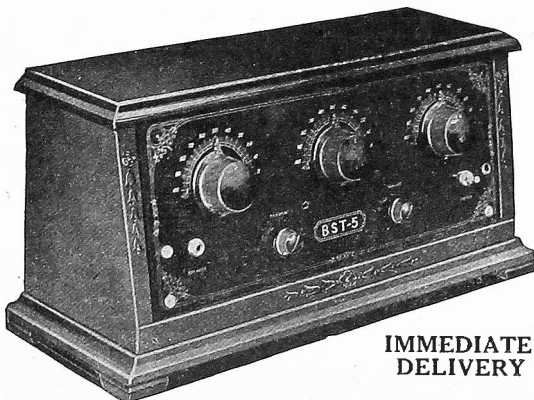


**NA-ALD**  
Sockets and Dials  
UX POWER TUBES installed in any set without rewiring by Na-Ald Adapters and Connectors. For full information write Alden Manufacturing Co., Dept. 3-22, Springfield, Mass.

# SHORE

TRANSFORMERS AND CHOKES FOR EVERY RADIO POWER NEED  
Special Transformers Made to Order  
Write for Prices—Also See Dec. 4 Issue  
**SHORE ELECTRIC CO., Inc.**  
124 Cypress Avenue, New York City

## B S T 5 \$40.00



IMMEDIATE DELIVERY

## DIRECT FROM FACTORY TO YOU SAVES HALF AND IS GUARANTEED

I take great pleasure in telling you that my B.S.T. 5-tube set is working splendid in every way, and the cabinet itself is beautiful, and admired by all my friends.

THOMAS HARTLE,  
155 Perry St., Paterson, N. J.

This highly sensitive, powerful and selective BST-5 radio receiver has all up-to-the-minute improvements. Heavy aluminum automobile type chassis, shielded against stray currents and distortion. Flexible grip, Universal type sockets, eliminating microphonic noises. Has provision for battery eliminator and any power tube. Fahnestock clips on sub-panel for adjusting C battery, has voltages for power tube. Efficient on either long or short aerial, including indoor aerial. This BST-5 sets a new standard for true tone values and selectivity. This BST-5 gives greater volume than many six-tube sets and consumes less current.

Shipment made same day we receive your cheque or P. O. Money Order for \$40.

RADIO WORLD Guarantees the Responsibility of This Advertiser

**GUARANTY RADIO GOODS CO.**

145 West 45th St., New York

New model cabinet Du Pont Duco finish; base 21" long by 8" wide, height 9 1/2", top 21" by 6". Five-ply walnut veneer



# Television Needs Physical Motion

(In last week's issue, Jan. 1, Dr. E. F. W. Alexanderson discussed the operation of the television apparatus, also how the present system was evolved. How the light beams are intercepted by a rapidly revolving drum, and interlaced so that recognizable objects can be seen, is herewith told.)

There is another advantage in the use of the multiple light beam. Each light beam needs to move only one-seventh as fast and therefore needs to give only 43,000 instead of 300,000 independent impressions per second. A modulation speed of 43,000 per second is high with our present radio practice but yet within reason, being only ten times as high as we use in broadcasting.

The significance of the use of multiple

light beams may be explained from another point of view.

It is easy enough to design a television system with something like 40,000 picture units per second, but the images so obtained are so crude that they would have very little practical value. Our work on radio photography has shown us that an operating speed of 300,000 picture units per second will be needed to give pleasing results in television. This speeding up of the process is unfortunately one of those cases when the difficulties increase by the square of the speed. At the root of this difficulty is the fact that we have to depend upon moving mechanical parts.

If we know of any way of sweeping a ray of light back and forth without the use of mechanical motion, the answer might be different. Perhaps some such way will be discovered, but we are not willing to wait for a discovery that may never come. A cathode ray can be deflected by purely electromagnetic means, and the use of the cathode ray oscillograph for television has been suggested. If, however, we confine our attention to the problem as first stated, of projecting a picture on a fair sized screen, we know of no way except by the use of mechanical motion.

If we also insist upon a good image we find that we must speed up the process 7 times and in doing so we must reduce the dimensions so that we will have only one forty-ninth as much light. Our solution to this difficulty is, not to attempt to speed up the mechanical process but to paint seven crude pictures simultaneously on the screen and interlace them optically

so that the combination effect is that of a good picture.

Tests have been made with this model television projector to demonstrate the method of scanning the screen with seven beams of light working in parallel simultaneously. A moving picture showing the apparatus and procedure during these tests will be presented. The seven spots of light may be seen on the screen as a cluster. When the drum is revolved these light spots trace seven lines on the screen simultaneously, and then pass over another adjacent track of seven lines until the whole screen is covered. A complete television system requires an independent control of the seven light spots. For this purpose seven photoelectric cells are located in a cluster at the transmitting machine and control a multiplex radio system with seven channels. A Hammond multiplex system may be used with seven intermediate carrier waves which are scrambled and sent out by a single transmitter and then unscrambled at the receiving station so that each controls one of the seven light beams.

The first part of the moving picture shows the television projector in operation moving faster and faster until the whole screen is covered with a sheet of light. The second part shows a moving picture film transmitted by telephotography at a rate of seven seconds for each picture. The same rate of speed with seven light beams would give one picture per second. Thus we see that in order to get television we must speed up the process sixteen times. However, this is not unreasonable because this film was made with a carrier frequency of only 3000 cycles.

Seven television carrier waves may thus be spaced 100 kilocycles apart and a complete television wave band should be 700 kilocycles wide. Such a radio channel might occupy the waves between 20 and 21 meters. If such use of this wave band will enable us to see across the ocean I think all will agree that this space in the ether is assigned for a good and worthy purpose.

## "Audio Amplification"

A Book—Contains Valuable Suggestions for Improving Tone Quality.

**SAMSON ELECTRIC CO.**  
CANTON, MASS.

## Radio Mailing Lists

27428—Radio Dealers, Retail, Per M. . . . \$7.50  
2660—Radio Mfrs., Per List . . . . . 20.00  
2857—Radio Jobbers, Per List . . . . . 22.50  
1847—Radio Jobbers rated \$5,000 and up, Per List . . . . . 15.00  
1060—Radio Mfrs. Complete Sets, Per List . . . . . 10.00  
and any other Radio List you want. Ask for detailed price lists all guaranteed 98% correct.

**Trade Circular Co., Inc.**

165 W. Adams Street Chicago

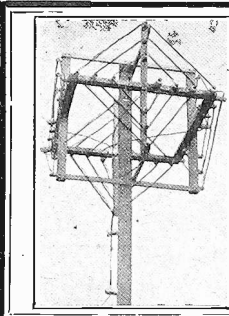
## RADIO WORLD'S QUICK - ACTION CLASSIFIED ADS.

10 CENTS A WORD  
10 WORDS MINIMUM.  
CASH WITH ORDER.

SEND FOR PAMPHLETS OF THE GOODMAN TUNER—In use for years and still good. Tested and approved by many technical laboratories. L. W. Goodman, Drexel Hill, Penna.

PATENTS—Write for free Guide Books and "Record of Invention Blank" before disclosing inventions. Send model or sketch of your invention for our Inspection and Instructions Free. Terms reasonable. Radio, Chemical, Mechanical Electrical and Trademark experts. Victor J. Evans Co., 924 Ninth, Washington, D. C.

**HARD RUBBER**  
SHEET - ROD - TUBING  
Special Hard Rubber Parts Made to Order  
**RADION and HARD RUBBER**  
PANELS, ANY SIZE  
Send for Price List  
WHOLESALE NEW YORK HARD RUBBER TURNING CO.  
212 Centre Street New York



## DX ONE POLE ANTENNA A PROVEN PRODUCT

Can be put up most anywhere. This DX ANTENNA has twice the antenna input of any other type—delivers same volume on one-half the current normally used. Saves half the battery current. Is 100% self-directional. Separates stations more easily. Simply installed, rugged construction, takes practically no room.

**DX Antenna Kit Complete, \$13.50** Post Paid

West of Rockies, \$14.00 Canada, \$14.50  
Dealers, Jobbers, Agents Write for Trade Terms

Manufactured by the  
**DX LABORATORIES**

39 Soper Ave., Oceanside, Rockville Center, N. Y.  
Tested and Approved by Radio World Laboratories

# SPECIAL PREMIUM SUBSCRIPTION OFFER For NEW RADIO WORLD Subscribers Ordering NOW

Radio World has made arrangements  
—To offer a year's subscription FREE for any one of the following publications with one year's subscription for RADIO WORLD  
—RADIO NEWS or —BOYS' LIFE or  
—POPULAR RADIO or —RADIO DEALER or  
—SCIENCE AND INVENTION or —RADIO (San Francisco) or —RADIO AGE.  
This is the way to get two publications  
—for the price of one:  
—Send \$8.00 today for RADIO WORLD  
—for one year (regular price)  
—for 52 numbers)  
—and select any one of the other  
—nine publications for twelve months.  
—Add \$1.00 a year extra for  
—Canadian or Foreign Postage.  
—Present RADIO WORLD subscribers  
—can take advantage of this offer by  
—extending subscriptions one year  
—if they send renewals NOW!

### RADIO WORLD'S SPECIAL TWO-FOR-PRICE-OF-ONE SUBSCRIPTION BLANK

RADIO WORLD, 145 West 45th Street, New York City.  
Enclosed find \$6.00 for which send me RADIO WORLD for twelve months (52 numbers, beginning . . . . . and also without additional cost, Popular Radio, or Radio News, or Science and Invention, or Radio Dealer, or Radio (San Francisco), or Radio Age, or Boys' Life (or \$10.00 for two yearly subscriptions). (No other premium with this offer.)

Indicate if renewal.  
Offer Good Until  
January 29, 1927.  
Name . . . . .  
Street Address . . . . .  
City and State . . . . .

## HOW TO WIND THE COILS FOR THE EFFICIENCY SUPER-HETERODYNE

(Concluded from page 9)

The set is arranged for either antenna or loop operation. A double pole double throw switch is provided for quickly changing from one method to the other. This switch should be of the low capacity type as indicated in the drawing, or a suitable switch jack that performs the same purpose.

The antenna coil L1 may consist of about ten turns of No. 22 double cotton covered wire on a diameter of 3" and the secondary may be wound on the same form with the same kind of wire. The secondary should contain about 45 turns provided the tuning condenser C1 has a maximum value of .0005 mfd.

There is a second rheostat R5 in the

filament circuits of all the tubes, and it is a master rheostat. Its only object is to adjust the filament current to normal, not to control volume, hence should be baseboard mounted. It should be able to carry safely without heating a current of 1½ amperes (as most rheostats do) and it may have a maximum resistance from one to six ohms.

S is a filament switch for turning on and off the receiver.

The filament battery voltage should be that furnished by a six-volt storage battery. The voltage on the detector plates should be 45 volts and that on the amplifiers and the oscillator should be from 45 to 67½ volts.

If desired an audio frequency amplifier

may be added to the circuit. This should be one capable of retaining the good quality which the circuit has up to the detector terminals. Only a leak of about 1 meg. is necessary in the first audio grid circuit to complete the first AF stage coupling. Add to that two stages of resistance coupled AF or of impedance or double impedance coupling for speaker operation. If only moderate speaker volume is desired, simply add to the first impedance stage one step of transformer coupled audio.

### VOLT NAMED FOR VOLTA

The term volt comes from the name of Volta, an early Italian investigator in galvanic electricity.

## 4, 5 OR 6 TUBE KIT FREE

**Bernard** KIT

6-Tube Wonder Circuit. Complete Kit of Parts with Blue-**\$40.** print, ready to wire.

B.C.L. RADIO SERVICE, Inc.

ANY POPULAR KIT YOU WANT

Write for Particulars

4-TUBE DIAMOND KIT, \$30.00

Bruno Regenatrol

Hammerlund-Roberts Hi-Q

New Karas Equamatic

S-M Shielded Six

Powertone 2 Control, 4-Tube

Powertone 2 Control, 5-Tube

Powertone 2 Control, 6-Tube

FULL LINE OF CE-CO TUBES

THE NEW, IMPROVED  
**DIAMOND OF THE AIR**

Mfd by the Clapp-Eastham Co. Licensed under Armstrong Patent No. 1,113,149 for Bruno Radio Corp.  
Complete Kit of Parts, with Blueprint, ready to wire, as Specified by HERMAN BERNARD.

**\$37.50**

221 Fulton St., New York City

## DEMAND **AEROVOX**

for Fixed Condensers and Resistances. Approved by M. I. T. and Yale. Used as standard equipment by over 200 manufacturers of Radio Receivers and "B" Eliminators.

AEROVOX WIRELESS CORP.  
489-491-493 Broome St. New York

ANY SET DESCRIBED IN  
**RADIO WORLD**  
BUILT TO YOUR ORDER. WRITE  
**M. LERNER**

1498 Remsen Ave. Brooklyn, N. Y.

## How to Build THE DIAMOND

FIVE TUBE MODEL

Herman Bernard, designer of this wonder circuit, has written an illustrated booklet on "How to Build Radio World's Improved Diamond of the Air." Send 50c and get this booklet, including a full-sized wiring blueprint. Send \$6 for year's subscription and get booklet, and blueprint FREE.

[Newsdealers or radio dealers, order the booklets with blueprints included, in quantity, direct from American News Co. or branches.]

**RADIO WORLD**  
145 WEST 45th ST. NEW YORK CITY

## 4 - TUBE DIAMOND BLUEPRINT

The Entire Wiring Shown in Simplified Picture Diagram Form **\$1.00**

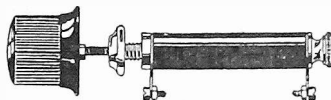
Copy of Nov. 20 issue, containing Herman Bernard's article on how to build the set, 15 cents extra.

Send money order, check or stamps.  
None sent C. O. D.  
All orders filled promptly.

**RADIO WORLD**  
145 West 45th St., New York City

HOW TO BUILD THE BERNARD, the beautiful 6-tube thumb-tuning set, fully described and illustrated in the Oct. 16 issue. Send 15c for a copy. Namepieces for affixing to front panel free to all on special request. Radio World, 145 W. 45th St., N. Y. City.

# The BRETWOOD Variable Grid Leak Is a Remedy for Distortion



Precision Range, ¼ to 10 Megohms

Much of the distortion present in radio receivers is due to an overloaded detector tube. Too much power for that lone tube to handle with fidelity. The Bretwood Variable Grid Leak permits control of the grid circuit so that the maximum efficiency **without distortion** is achieved. Put a Bretwood Variable Grid Leak in your set and marvel at the difference!

### "THE RESULTS ARE ASTONISHING"

NORTH AMERICAN BRETWOOD CO.

Dec. 26.

Dear Sirs:

I feel as it is my duty to write and tell you that I bought a Bretwood grid leak and got fine results. I placed it in the same position as a regular fixed grid leak.

THE RESULTS WERE ASTONISHING. I was quite a while adjusting it to its proper position. It means true tone, clarity, volume and many more DX receptions. I have tried many other makes of all kinds and sizes, but THIS ONE IS THE BEST YET.

Most people will write credentials praising results from instruments they have tried on sets that anything at all would improve, but my set, I thought, could not be improved on I was dumbfounded, for now I know I own a perfect set.

You may use this letter for advertising, also name and address for references of any kind.

From a well-satisfied user of a Bretwood Grid Leak.  
(Signed) GEORGE SORTWELL,  
18 Eng. House, 1915 W. Wash. St., Indianapolis, Ind.

NORTH AMERICAN BRETWOOD CO.,

143 West 45th Street, N. Y. City

Enclosed find \$1.50, for which send me one Bretwood Variable Grid Leak (or \$2.00 for leak with grid condenser attached) on five-day money-back guarantee.

NAME .....

STREET ADDRESS .....

CITY and STATE.....

(Inquiries Invited from the Trade)

APPROVED BY 18 MONTHS OF PUBLIC USE  
NO OTHER BATTERY IS LIKE IT



Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

## Practical tests have shown this to be the most economical of "B" Batteries

IN DAILY use in the home, Eveready Layerbilt "B" Battery No. 486 has fulfilled the promises made for it in laboratory tests. More than a year's study of the performance of this battery in the hands of the public has shown that it is the most satisfactory and most economical "B" battery ever developed. All loud-speaker sets require Heavy-Duty batteries—and the Layerbilt has proved itself absolutely the best of them all.

If you are now using the smaller, Light-Duty batteries, the Eveready Layerbilts will give you twice the service though they do not cost anything like twice as much. If you are already using Heavy-Duties, the Layerbilt, the longest lasting Heavy-Duty ever built, will run your set at least 25% longer, and again you will save money. Unless Eveready Layerbilts now are

connected to your set, you spend more on "B" batteries than you should, and you can have no idea how good a "B" battery can be. The Layerbilt holds a surprise in store for you.

Eveready Layerbilt's unequalled service is due to its unique construction. All other dry cell "B" batteries are made of cylindrical cells, with many soldered connections, and a great deal of space is wasted between the cells. The Layerbilt is built up of layers of flat current-producing elements, that make connection with each other automatically, and that fill all available space inside the battery case. It is every inch a battery. In it you get more active materials than in any other battery and the Layerbilt construction makes those materials much more efficient current producers.

Those are the convincing reasons why

the Eveready Layerbilt has proved itself the longest lasting, most economical and reliable "B" battery ever built.

Just remember this about "B" batteries—Heavy-Duty batteries are more economical than the smaller Light-Duty batteries on all loud-speaker sets, and the patented exclusive Eveready Layerbilt No. 486 is the most economical of all.

Manufactured and guaranteed by  
**NATIONAL CARBON CO., INC.**  
New York San Francisco  
Canadian National Carbon Co., Limited  
Toronto, Ontario

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time, through the following stations:

|                  |                |
|------------------|----------------|
| WEAF—New York    | WTAM—Cleveland |
| WJAR—Providence  | WWI—Detroit    |
| WEEI—Boston      | WGN—Chicago    |
| WTAC—Worcester   | WOC—Davenport  |
| WFI—Philadelphia | WCCO—St. Paul  |
| WGR—Buffalo      | KSD—St. Louis  |
| WCAE—Pittsburgh  | WRC—Washington |
| WSAT—Cincinnati  |                |