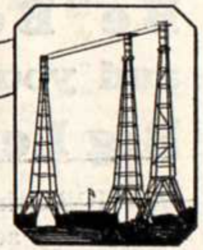
NATIONAL

RADIO



NEWS

FROM N.R.I. TRAINING HEADQUARTERS

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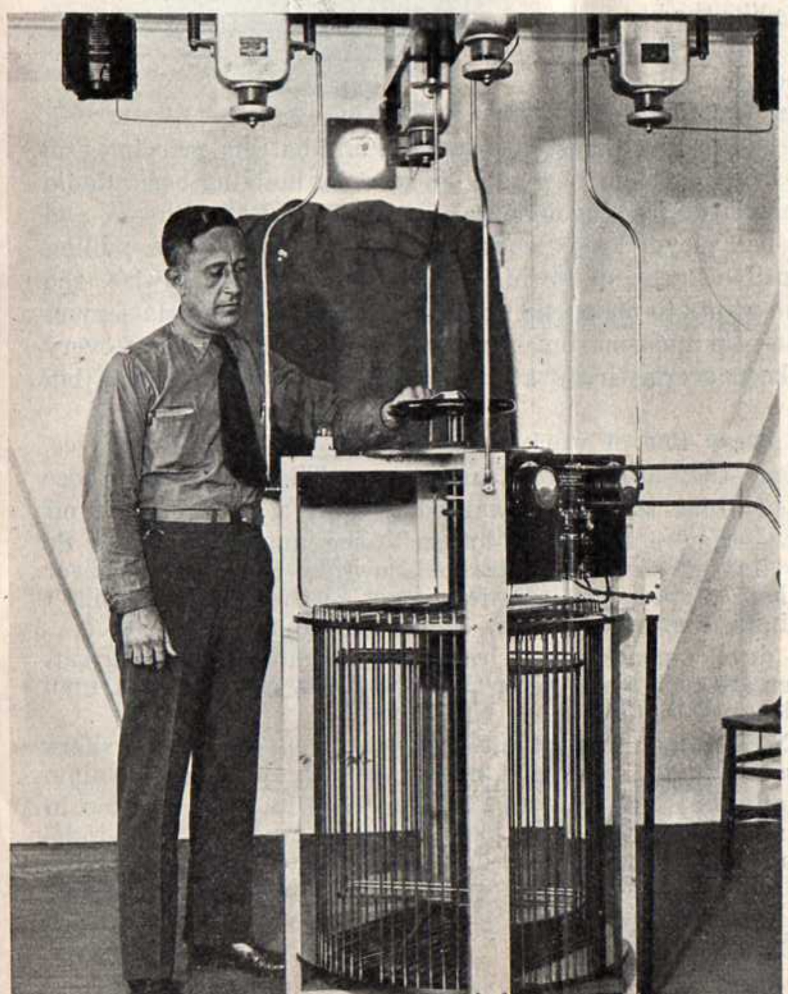


In This Issue---

For Story on Cover— See Page 15

Be Better and you'll be a Big Leaguer

President Smith and Willis Hudlin at N.R.I. entrance.

A SHORT time ago Willis Hudlin, ace pitcher of the Cleveland Indians, paid the Institute a visit. I learned a lot from him about big-league baseball men. In a way a big-league baseball man is like the big-league Radio man. Both start at the bottom. Both have to master the fundamentals. The ball player learns base-running and batting principles on the sand lot team; the Radio man gets his start by building basic Radio circuits and mastering the fundamental principles of Radio theory and practice. The ball player keeps working, keeps training, keeps pulling his way up until he gets in the big league class. And, likewise, the Radio man who wants to make the big-pay, big league Radio class must keep digging in—he must master every lesson, take advantage of every opportunity—keep everlastingly at it, always climbing up to the big jobs in Radio.

In nearly every line of work there are the well paid executives, the trained men—they are the big-league men. Then, there are those who waste their time, those who wanted to wait a while, put it off until tomorrow—they're the "sand-lotters"—the untrained men. So the world has its full share of untrained, low-pay men. They never realized they had to specialize in order to get to the top—they didn't know that training was necessary, or they just didn't care.

In Radio, developments are so rapid, opportunities are so great, and N. R. I. men are such a big factor that practically every N. R. I. man can be a "big-league" Radio man—a big success!

We back N. R. I. men to the limit. We want you to get your share of the big jobs in Radio. And that means careful, thorough training.

Willis Hudlin would tell you that if you want to reach the top in Radio—or in anything—you must have practical training, stick-to-it-iveness, and an honest-to-goodness desire to get there—to be somebody. And Hudlin knows—he is a sure enough "big-league" man in every sense of the term, and—here's a surprise for you—he's an N. R. I. student himself!

J. E. SMITH.

New Jersey Plane Talks With London

By Member N. R. I. Technical Staff.

On a number of occasions in the past, new possibilities in communication by inter-connection of wire and radio circuits have been demonstrated.

Recently, another demonstration of this character was made when a group of press representatives flying over northern New Jersey in the radio equipped airplane of Bell Telephone Laboratories were connected with the British representatives of their organization in London by a combination of wire and radio circuits.

Passing between the airplane and the Bell Laboratories' ground station at Whippany, New Jersey, by radio, the conversations were then carried to and from New York by a telephone circuit of the usual kind. In the long distance office of the American Telephone & Telegraph Company in New York, the circuit was split, the east-bound channel passing by wire to one of the trans-Atlantic radio transmitting stations, thence by radio to a receiving station in England, and to the long distance office of the British Post Office in London.

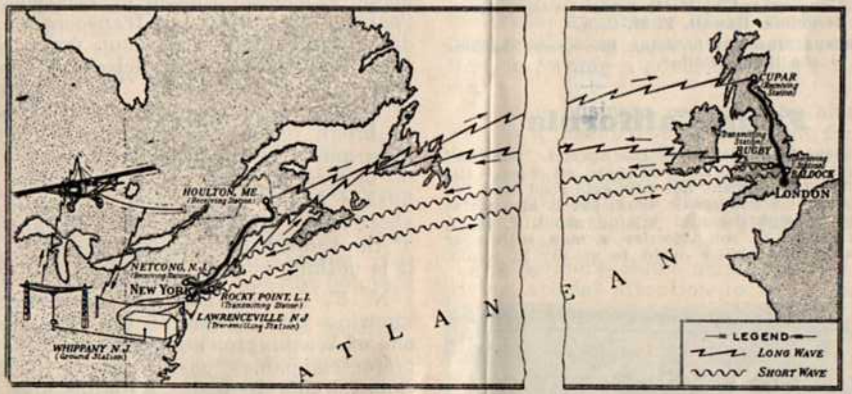
From the office in London, where the British representatives were assembled, the conversation passed over an ordinary telephone wire to and from the long distance office in that city, where the west-bound channel was separated and carried over a wire circuit to the English radio transmitting station. After being received in the United States, this channel passed over a wire circuit to the long distance office in New York where it entered the two-way wire channel to Whippany.

When the speaker in the airplane desired to talk, he held a microphone to his lips, and pressed a button which enabled him to talk to the ground station. This action disconnected his receiving circuit. When his voice reached the ground by radio, it operated a relay which disconnected the radio transmitter. As soon as he was silent and released his transmitter button, the upward circuit was ready for conversation to come to him from the land wire. A somewhat similar arrangement is a part of the trans-Atlantic radio circuit except that there all the operations are performed by voice-actuated relays. The voice of a person talking over the trans-Atlantic radio circuit clears a path in front of itself and closes the path in the reverse direction.

Technical details of the new apparatus are as follows: The receiving set in the airplane consists essentially of four tubes, three of which are of the screen grid type, while the fourth is of the three-element heater type. It has two stages of radio frequency amplification, a detector and 1 stage of audio frequency amplification. Due to the employment of the space charge grid detector circuit, the set is extremely sensitive.

The set operates from a generator which is driven by the action of the wind on a small propeller and has a total weight of less than 7 lbs. This generator supplies both 9 volts and 220 volts to the receiver.

The transmitter has a carrier power of 50 watts. The output and full modulation is 200 watts. A frequency range of from 1500 to 6000 kilocycles is provided and the operating frequency is maintained under all conditions. To accomplish this, a crystal oscillator is used.



Power for the transmitter is obtained from a separate direct current generator driven by the wind. Special control is provided to maintain constant speed of this generator with varying air speeds.

When the airplane radio receiver is disconnected from the headphones by operating the transmitter push button, the headphones are connected to the talking circuit so that the speaker can hear his own voice. This is of great importance to the noisy surroundings of an airplane because it gives the talker a rough check of the loudness of his own voice.

In Our Mail Bag

"Since enrolling I have, by my spare time Radio earnings, paid all of my college expenses, bought a second-hand coupe in very good condition, purchased three new suits, hats, overcoats and had nearly everything that a boy in college could desire. I think that is a wonderful record for one in college to make. As a rough estimate I should say that besides attending college the past nine months, I have earned around \$850." Mr. Lynn K. Chapman, 418 Oak Avenue, Waterloo, Iowa.

"The first week I took in \$60.00 for repair and service work without any paid advertising. N.R.I. training puts me in a position to do work that others will not tackle." Mr. Leroy Brownson, 2004 Walnut Ave., Venice, Calif.

"You are giving me as good training as a private teacher would give. You take such interest in me that it puts PEP in me." J. C. McDowell, 721 Pope St., Newberry, S. C.

"I've 'cashed in' on plenty of side jobs and now I have a part-time shop. My best week was \$101.00." Mr. H. E. Trautmann, 2406 Arlington Ave., Pittsburgh, Penna.

"I now have my license. The N.R.I. course sure made that exam easy. I made 93 on the theory. I have seen many text books and talked to students from other schools, but I have not heard of a course that really teaches every angle of Radio as the N.R.I. course does." Mr. M. Sanderford, 1527 So. 4th St., Waco, Texas.

"In Warsaw I knew your student, Mr. Musnicki, well. His father was a famous General in the Polish Army at the time of the Boxer uprising. Mr. Musnicki is intensely interested in Radio Engineering—is tremendously ambitious and 100% wrapped up in the possibilities of Radio. He'll go far if encouraged." Merle Scott, General Secretary, Honolulu, Hawaii, Y. M. C. A.

Student Musnicki is doing fine—we're backing him to the limit.—Editor.

From California

Student L. N. Morriss of Los Angeles, "peps up" things for N. R. I. everywhere he goes. His unique advertisement not only gets good leads for Radio service and repair work, but it also starts others to thinking and talking about N. R. I. More power to you, Morriss—a man with your initiative and ability ought to go far in Radio.

J. E. S.

The Future of Radio

By AUSTIN C. LESCARBOURA
Editor, Radio Manufacturer's Monthly.
Associate Editor of Radio Engineering.

"To one who has been privileged to see his inventions develop from crude experiments to world-wide institutions and industries far beyond the wildest dreams of fancy," states Dr. Lee DeForest, inventor of the audion or three-element vacuum tube now in universal use, and also the Father of Radio, "the role of prophet presents problems in unrestrained imagination rather than in conservative deduction. So, in attempting to look ahead in Radio developments, I am moved to be as rash as possible in my predictions, fully confident that in so doing I shall make a better guess than the more timid prophets of today."

Even present-day radio achievements are hardly realized by the so-called Man in the Street. Few of us realize the extent of the broadcasting institution created less than a decade ago. We cannot grasp the significance of over seven hundred broadcasters catering to an audience of well over 35,000,000. We overlook the 13,000 miles of wire employed by one network alone in grouping together far-flung stations for simultaneous broadcasting of programs. We never give thought to an industry that has grown from an annual income of about \$2,000,000 to one of \$600,000,000 yearly. We forget the transoceanic radio circuits that reach out from New York City and San Francisco to almost every part of the world. We only think of marine radio when some ship happens to break in on our favorite broadcast programs with its dot-dash tongue. Few of us realize that radio programs are flashed across oceans and continents by short-wave transmitters. The present of the radio art is indeed wonderful, but it is nothing compared with its future.

N. R. I. men may be interested in knowing that busses of the Gray Line, one of Washington's biggest sight-seeing motor companies, pass right by the National Radio Institute Building and the Institute is pointed out by the guides to all passengers as the oldest and largest Radio home study school in the world. N. R. I. men visiting Washington will also find this a convenience for it will afford you the opportunity of locating the Institute easily in order to stop off and pay us a visit.

"A home without a Radio is like a house without a window."—Arthur Brisbane.

National Radio News

Published monthly in the interest of
N. R. I. students and graduates, by the
NATIONAL RADIO INSTITUTE
16th and U Streets, N. W.
Washington, D. C.
J. E. SMITH, Publisher. E. R. HAAS, Editor.

Washington, D. C. September, 1929

Every Month Now!

TWO years ago the National Radio News was put out three or four times a year. Last year it was published every two months. But from now on you will get the News **every month!**

This magazine is yours. It is published in your interest. In its pages we want to bring to you every month the latest news on receiving sets, television, talking-movies—the new developments in all fields of Radio. Each copy will have a service manual on some new Radio set giving the schematic diagram and other helpful, technical information.

It costs the Institute quite a bit of money to get this magazine out. The postage alone each month is over \$250. But we believe we can make the News worth even more than that to you and other N. R. I. men. We want the News to be a sort of free "service station" for N. R. I. men to give you tips and pointers and profit-making ideas.

This growth of the News has been made possible by the loyal cooperation of our students and graduates. But it cannot keep on growing unless it continues to get the support of N. R. I. men. Tell us what you like about it and what you don't like about it. Contribute articles yourself from time to time. Many students have ideas about servicing and selling Radio sets that would help other N. R. I. men in other parts of the country. Whenever you have some good ideas on selling or servicing sets—shoot them in and we shall publish the best ones. Send in stories of any special Radio job or installation you have made. Cooperate with the editor of the News and he will try to give you in return the kind of information and practical tips you want. Let's all work together—make the News the most helpful, result-getting student magazine in the old U. S. A.!

E. R. HAAS.

An Open Letter to N. R. I. Men

I wonder how many of you men are reading the special informative articles on various Radio topics that Mr. Smith is writing for newspapers and magazines? They appear from time to time in various papers and magazines—usually on the Radio pages. They are planned to give N. R. I. men valuable publicity and advertising, and it will pay you to keep on the look-out for them and bring them to the attention of your friends. They will go a long way toward acquainting your friends with N. R. I. methods and the N. R. I. influence and ought to help some in building up your own Radio business. You can help us check up on these by sending any articles you find to us after you are through with them.

N.R.I. Publicity Director.

The Farmer Goes in for Radio

Cash in on the growing farm market for Radio apparatus of all kinds. The farmer is being interested, as never before, in owning a good, up-to-date Radio set.

It is a business necessity to him as well as a means of entertainment for his family. Crop reports, weather reports, market information and much other data that's invaluable to the farmer today is being put on the air. Every farmer **must** have a set.

Furthermore, Radio manufacturers are giving special attention to the farmers Radio needs and are getting out improved types of battery operated sets equipped with screen grid tubes and other new features. There's a big market being opened up. N. R. I. men in the rural sections should get in on the sales and service profits!

"There is only one recipe for success and that is to keep at it—to keep everlastingly, tirelessly, doggedly striving for the thing you want."—Judge E. H. Gary.

"The human will can overcome any obstacle or any handicap, if a man has backbone enough to use it."—Thomas A. Edison.

Vacuum Tubes Used in Elevator Control System

A new system of elevator control, by means of which elevator cars are automatically brought to the correct floor level, and which involves the use of a 3-element vacuum tube similar to those used in radio sets has been adopted by a leading maker of elevators.

The vacuum tubes used in this system are known as Pliotrons. These tubes have been used for a number of years on railroad locomotives for transmitting block signals into the engineer's cab in visible form so that the engineer does not have to depend on watching the semaphore and light on the side of the track. While it is similar to the common radio vacuum tube, it differs in the value of operating voltages which are used.

The use of the Pliotrons in the automatic levelling of the elevator cars is based on the characteristic of the increase of plate current when the tube changes from an oscillating to a non-oscillating condition. A suitable number of these tubes are mounted on each elevator car and they are normally in oscillation. By a special arrangement of coils and vanes, the motion of the car as it approaches the floor level is made to stop the oscillation of the tube, thus actuating relays. The relays govern control circuits which slow up the car and stop it at the correct position. This method controls the car when running in either direction.

In operation, the elevator operator throws his car switch to the "off" position as he approaches the floor at which it is desired to stop. On nearing the floor, the relays are actuated by a combination of coils and vanes, thus slowing the car up and bringing it to a stop at the floor level without any attention or work on the part of the operator. After discharging or receiving passengers, the car is started in the usual manner and operation is continued as before.

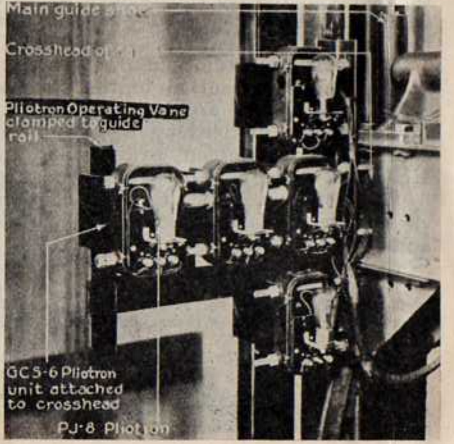
Another application of the Pliotron tube to elevator operation makes it unnecessary for the operator to watch his position in the hatchway. Devices similar to those used in automatic levelling are employed, and in addition, signalling equipment consisting of suitable push-buttons, lights and a bell is used.

When each passenger enters the car, he calls out the number of the floor at which he wishes to get off, and the operator immediately presses a push-button corresponding to this floor. When all passengers are in the car, the operator starts by the usual method. As he approaches the first floor at which a stop is to be made, a signal light flashes and a bell rings, notifying the operator that a stop is to be made. He then throws the car switch to the "off" position, and the car continues at full speed to a predetermined point in the hatchway where it is slowed up automatically and brought to level with the next floor by the automatic levelling device. The operation is continued in a similar manner until the trip is completed.

In addition to this arrangement, push-buttons are installed on each floor. A passenger waiting for a car presses a button which lights a signal and rings a bell in the first car approaching in the direction in which the passenger desires to travel. A corridor lantern also lights to show the passenger which car will be the first to reach his floor travelling in the desired direction.

An operator receiving a signal from a floor push-button throws his car switch to the "off" position and the car is stopped in the same manner as described.

With this system, the operator does not have to know where he is in the hatchway, and as long as he pushes the button for each floor called and shuts off his car switch each time the light flashes, or the bell rings he knows that he will make every stop required.



Pliotron installation on top of elevator car. This is only one of the thousands of ways in which Radio apparatus and Radio principles are being used. New fields of opportunity for the Radio trained man are opening up right along!

Radio-Trician's Service Manual

on the Philco Screen Grid Model 65 Receiver

The Philco A. C. screen grid receiver Model 65 employs three tuned stages, the detector stage and a stage of push-pull amplification. The Screen Grid Tubes are used in the two R. F. stages. The —45 type power tubes designed for A. C. set operation are used in the stage of push-pull audio amplification.

The ground terminal shown on the schematic diagram, Fig. 1, is electrically connected to the chassis which is used as a return lead. All the ground connections shown in the schematic diagram are connected to the chassis. The antenna terminal is connected directly to the first R. F. transformer, with a 10,000 ohm resistor, bridged across the primary. This transformer has been designed for use with the Screen Grid Tube and is tuned by the first section of the tuning condenser. There is a fixed compensating condenser connected across the first section of the tuning condenser. This compensates for capacities introduced in the wiring by the other R. F. transformers which are somewhat different in construction from the first. Another compensating condenser, not shown on the diagram, is bridged across the first section. This is the compensator that is built into the condenser unit.

The connections to the first screen grid tube are made in the regular manner to the base of the tube and with a flexible lead from the first tuning condenser to the control grid of the tube. (The control grid of the screen grid tube corresponds to the regular grid of other tubes. The grid shown in the schematic diagram, between the control grid and the plate of the tube, is the screen grid.) The plate of the first tube is connected to the second R. F. transformer. This transformer is tuned by the second section of the tuning condenser which also has a compensating condenser built in with it, though not shown in the schematic diagram. The same procedure is followed, the third R. F. transformer being tuned by the third section of the tuning condenser. There is, however, no compensating condenser built into the third section.

Neither grid leak nor condenser is required in the detector stage as a biased detector is used. An R. F. choke coil is inserted in the plate lead of the detector to keep the R. F. current from the audio circuit. Two audio transformers are used, first the input transformer designed for push-pull operation, and the output transformer, a special push-pull transformer for coupling the receiver to the electro-dynamic speaker.

It is extremely important that all parts of the receiver be well shielded. The use of the Screen Grid Tubes allows the use of the full amplification of the tubes without setting up any oscillation or regeneration. It is not necessary to neutralize in any way the Screen Grid receiver. This has been taken care of by the design of the tubes and the receiver. The shields are not shown on the schematic diagram although each R. F. stage is effectively shielded from other stages.

The volume is controlled by regulating the voltage of the Screen Grid of the R. F. tubes. The B and C voltages for the tubes are supplied by a full wave rectifier. The resistor network is so arranged that the proper plate voltages are provided for the various tubes without coupling between the various circuits.

On the furniture models pure gum washers ¼ inch thick are placed around the hold-down bolts between the chassis and the mounting shelf. To hold the chassis solid in shipment 3/16 inch wood strips are placed between the chassis and the shelf, and the bolts are tightened so as to compress the gum washers and hold the chassis down against the wood strips.

To prevent any possibility of microphonic trouble when putting the receiver in service, the four hold-down bolts should be loosened just enough so that the wood strips can be pulled out from under the chassis. After removing the strips, tighten the bolts again, so that the chassis is resting on the rubber washers and spaced exactly 3/16 of an inch above the mounting shelf. The control knobs on the front of the panel will be lined up correctly with the chassis mounted this way.

If it is ever necessary to repack a receiver for shipment, put the 3/16 inch strips between the chassis and the mounting shelf and tighten the bolts to hold it securely in place.

Testing and Servicing

Figure 1 is a schematic diagram of the receiver and speaker circuit. The numbers enclosed in the circles in the sche-

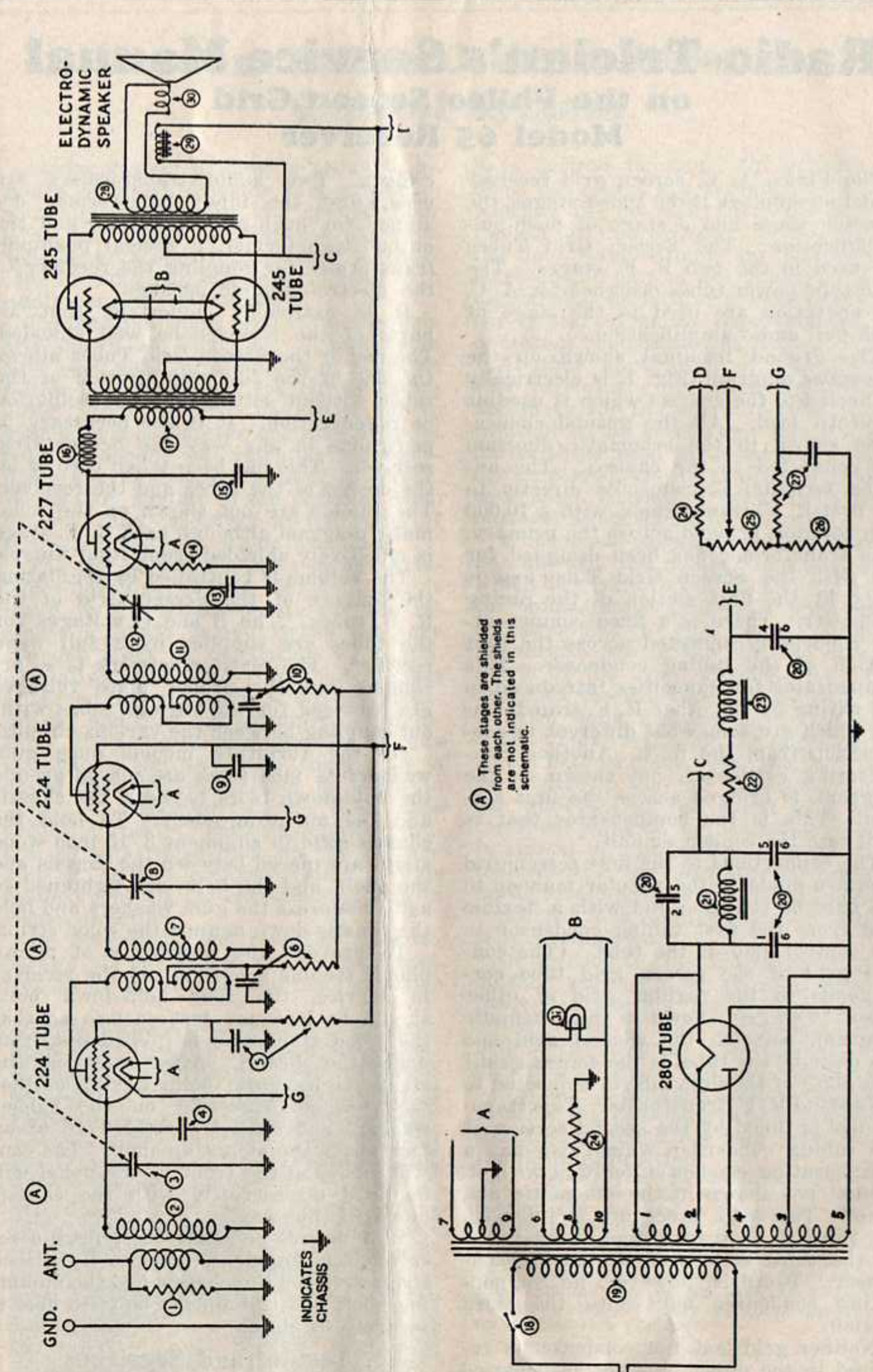


Fig. 1—Schematic Diagram of Philco Screen Grid Receiver, Model 65.

matic diagram refer to the different parts used. Table 1 lists these numbers and the apparatus which they indicate.

IMPORTANT NOTICE. The power transformers in a few of the first receivers manufactured had different terminal numbers than those shown in Figure 1. In such receivers the figures in the Figure 1 should be changed as follows: Change No. 1 to No. 4, No. 2 to No. 5, No. 4 to No. 1 and No. 5 to No. 2.

lead from an oscillator is connected to first, the stator of the third tuning condenser; second, the stator of the second tuning condenser; third, the stator of the first tuning condenser. With the receiver tuned to the oscillator frequency the signals should be heard and should increase in strength in each succeeding position. If the signal is heard when testing at one point but does not increase at the following points the trouble lies between the two test points.

TABLE NO. 1.

1. Antenna Resistor.	10. By-Pass Condenser and Plate Resistor.	21. First Filter Choke.
2. R. F. Transformer (Antenna Coil).	11. R. F. Transformer.	22. Detector Plate Resistor.
3. Tuning Condenser.	12. Tuning Condenser.	23. Second Filter Choke.
4. Fixed Compensator.	13. Cathode By-Pass Condenser.	24. B. C. Resistor.
5. By-Pass Condenser and Screen Grid Resistor.	14. Cathode Resistor.	25. Volume Control.
6. By-Pass Condenser and Plate Resistor.	15. By-Pass Condenser (Detector Plate).	26. Resistor.
7. R. F. Transformer.	16. R. F. Choke.	27. By-Pass Condenser and Cathode Resistor.
8. Tuning Condenser.	17. Push-Pull Input Transformer.	28. Push-Pull Output Transformer.
9. By-Pass Condenser.	18. Set Power Switch.	29. Field Winding.
	19. Power Transformer.	30. Voice Coil and Cone.
	20. B Filter Condenser.	31. Pilot Lamp.

This change is necessary on only a very few of the first models manufactured.

Before doing any service work on receivers make sure that the trouble is not due to some external condition such as a poor antenna and ground, poor contact in the A. C. receptacle or defective tubes. Too much emphasis cannot be placed on seeing that the trouble present is not due to some one of these causes.

On checking a receiver that will give no signals, first determine whether the trouble is in the R. F. or the A. F. side. Allow the detector tube to become thoroughly heated. Removing the detector tube from its socket will cause a loud click in the speaker if the circuit is right between the detector and speaker, and indicates trouble in the R. F. circuit. If no click is heard when the detector tube is removed the trouble lies in the A. F. circuit. The A. F. circuit can be tested by connecting a pair of headphones in front of it to act as a pick-up. The easiest method of doing this is to use a phonograph pick-up adapter in the detector socket. The two terminals of the phonograph pick-up adapter connect with the plate and cathode of the detector socket, and can be connected to the head phones. Any sounds transmitted into the head phones will be reproduced in the loud speaker if the audio circuit is right.

To test the R. F. side of the receiver an oscillator can be used to an advantage. A test should be made when a

DEFECTIVE TUBES: Replace the tubes one at a time using a good tube of the proper type noting the improvement. If the complaint has been that the set fades, is noisy or hums, it is especially important to try one or more —27 or —24 type tubes.

NO VOLTAGE ON THE RECEIVER: This indicates a poor connection or open in the A. C. receptacle or the A. C. plug, a defective switch or transformer.

INCORRECT VOLTAGE ON ONE OR MORE TUBES: Due to variations in tubes, the voltage readings obtained at the tube socket will vary slightly from those given in Table 2. If a set tester is used to test the voltages at each socket, and large variations from the values given in Table 2 are found, the cause should be determined.

GROUNDED ANTENNA: In this case no signals will be heard. Thoroughly test the entire antenna installation. If the ANT terminals on the receiver or the lead going to it are grounded to the metal base the reception will be cut out.

OPEN ANTENNA CIRCUIT: This will diminish the signal strength so that only the most powerful stations will be audible. To check the internal antenna circuit, disconnect the antenna from the ANT terminal. Attach the antenna lead tie bar on the stator of the first tuning condenser. If normal reception is obtained the trouble is an open circuit between the ANT terminal and the first tuning condenser.

OPEN GROUNDED CIRCUIT: A open ground is not usually noticeable, when listening to strong signals, but will cause a marked decrease in volume on weak signals. While listening to a weak signal the ground connection can be checked by removing the ground lead from the GND terminal which would cause a decrease in volume. If volume does not decrease look for an open ground either external or internal.

GROUNDED FILAMENT: The C bias on the —45 tubes will be affected if their secondary and filament leads are grounded. This will cause hum and distortion. Considerable hum will be noticed if the heater lead or secondary of the —27 and —24 tubes becomes grounded.

ARRANGEMENT OF WIRES: Check all wiring, both internal and external. All filament leads should be twisted, and the grid and antenna wires must be in the correct positions. Keep the speaker, aerial, ground and A. C. cord wires away from the tubes. Use separate leads for antenna and ground, rather than a two-wire cable. The inter-stage shield and base plate must be in place to prevent feed back and inter-stage coupling. Otherwise the receiver is apt to howl or cause distortion.

POOR CONTACT: A poor contact can cause noisy reception, intermittent or fading reception, or will stop reception completely. The places to look for a loose contact are at all moving contacts, such as the volume control, set switch and tube sockets. Poor contacts are much more likely to develop when the connection depends on a sliding contact than at a soldered connection.

A. C. ATTACHMENT PLUG: It is always important to try an A. C. plug both ways in the house receptacle. With the plug in one way, less hum will be obtained than with it reversed.

DEFECTIVE SPEAKER: The simplest method of checking a speaker is by substitution, connecting a known good speaker to the receiver. If the trouble is found to be in the speaker, test the speaker connection and check the voice and field coils. The correct drop across the field coils is approximately 135 volts.

COMPENSATING CONDENSER: In order to adjust a compensating condenser it will be necessary to use an oscillator similar to the kind ordinarily used for balancing receivers. The lead from the oscillator should be insulated wire and should be twisted around the antenna lead a few times thus giving the necessary coupling between the oscillator and the receiver.

Have the volume control on the receiver turned to full volume, then adjust until the signal is just barely audible. Tune the receiver to the point of strongest signal. Then adjust the compensating condenser built into the second section of the tuning condenser. This is adjusted by turning the screw which projects from the back of the condenser shell and can be done using an ordinary screwdriver. The lock-nut on the screw must be loosened slightly in order to adjust the condenser, and must be tightened again after the adjustment is completed. The compensating condenser is correctly adjusted when the maximum signal is received.

After the second section compensator is adjusted, the same procedure is followed with the first compensator, adjusting to the point of maximum signal.

Always make sure that the lock nuts are tightened securely so that the condensers will retain their adjustments.

TABLE NO. 2.

TUBE SOCKET READINGS.

Type Tube	"A" Volts	"B" Volts	"B" Volts (Screen Grid)	"C" Volts (Control Grid)	MA Plate	Cathode
224	2.5	150	*.2 to 75	1.5	1.5	+1.5
227	2.5	250	....	28	.8 to 3.5	+28
245	2.5	250	....	50	32	....
280	5.0	350-V. A.C.	....	..	55	....

*The voltage varies from 75 volts with the volume control turned for full volume to .2 volts with the control turned for minimum volume.

When there is no signal being reproduced the detector plate current will be about .8 MA. Strong signals will cause a rise in current to 3.5 MA.

The N.R.I. — 15 Years Ago and Today

By GEORGE J. ROHRICH

Head of N. R. I. Research Department.

EDITOR'S NOTE.—I felt that N. R. I. men everywhere would be interested in Mr. Rohrich's experience with the Institute and asked him to write this article for you. The picture at the left shows Mr. Rohrich doing some research work, designing new circuits and apparatus for the course. Mr. Rohrich is also a specialist in Radio mathematics and is one of the most loyal members of the N. R. I. staff. I hope you will read his article for I am sure you will like it.

LITTLE did I realize back in 1914 when I invited my science teacher, James E. Smith, to my home to inspect a crude "wireless" set that I had rigged up—little did I realize at that time what a big nation-wide Radio institution that was later to be developed by my guest.

For it was only a week after his visit that he and Mr. Haas founded the N.R.I. He foresaw Radio's big opportunities. He had that uncanny ability of looking ahead then the same as he looks ahead today and sees the giant that Radio will be in the years to come!

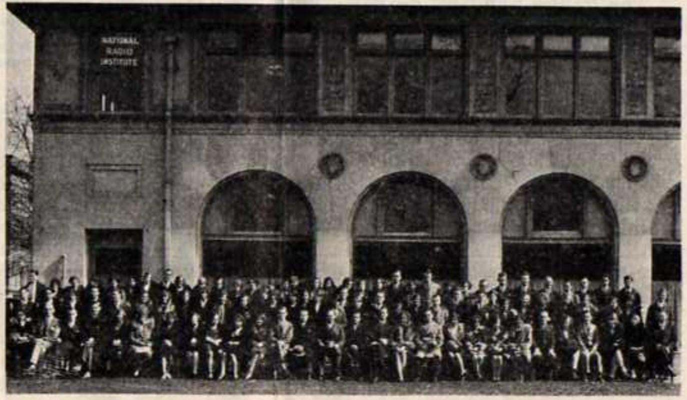
I well remember the humble beginning of the Institute for I had the pleasure of helping wire and install the equipment in its first Radio laboratory. In the first class there were only four students—three of whom are now well known figures in Radio.

And now I look back and see the strides the N.R.I. has made. I feel a close kinship in its progress. I've been as close, perhaps, as anyone to the service it's rendering its students and graduates.

When the editor of the News asked me to write about my experience with the N.R.I. the thought that was uppermost in my mind was that somehow, some way, the N.R.I. has justified its growth and progress. An institution of the size and influence of the N.R.I. could not grow as it has if it were not giving big value and service in return. First class instruction and helpful service to students and graduates, and the loyal cooperation of N.R.I. men everywhere are responsible for N.R.I.'s progress. They have helped make the N.R.I. and its methods famous the world over.

For, today, instead of one instructor and four students, the N.R.I. has a highly specialized technical staff training men the world over. Mr. Smith, Mr. Haas, "Chief" Dowie, his assistant instructors and all of the staff are wrapped up in the welfare and success of N.R.I. students and graduates.

The illustration at the right shows President Smith, "Chief" Dowie, Director Haas, assistant instructors and the administrative staff grouped in front of the new, large, well equipped building which houses the executive offices, student service and instruction department. Everyone you see in this picture is working first, last and all the time for the success of N. R. I. men.



Calculating the Sizes and Resistance of Wire Used in Radio Work

By J. A. DOWIE, Chief Instructor, Member I. R. E.

When a wire is referred to by a certain number, as, for example, "No. 16 or No. 28," this number means the "gauge" of the wire. It is a way of specifying the thickness. It would be much more convenient and scientific simply to set down the diameter of the wire in thousandths of an inch, but years ago engineers got into the habit of specifying the sizes of wires by the particular slot or hole in a "gauge plate" into which the wire would fit. The habit has persisted. These slots or holes were numbered, hence the present numbers used to designate the sizes of wire. A typical Pocket Wire Gauge that can be purchased from any wire dealer is shown in Fig. 1.

Many such systems of gauges have been in use in different countries and at different times. In the United States, for use with copper wire, only one of these systems have survived. This is the American Standard or "Brown and Sharp" gauge, often referred to as the "B and S" gauge. The numbers in it are purely arbitrary, like the width letters for shoes.

The gauge numbers do have, however, a mathematical relation to each other such that an increase of three numbers means a decrease of the cross-section of the wire by just one half; which means, in turn, a doubling of the electrical resistance of each foot of the wire.

It is not of much value, however, to bother about remembering this mathematical relation. Table No. 1 gives the numbers in the Brown and Sharp gauge, with the diameters of the wires in "mils" one mil being one thousandth of an inch. In this table, for example, No. 18 wire is seen to have a diameter of 40 mils, which means that its thickness is 40 thousandths, or one twenty-fifth of an inch.

In many electrical books you will see tables of "circular mils." This is the square of the diameter of the wire in mils. For example, No. 18 wire equals, in circular mils, the square of 40 (40x40) or 1,600. Note that this is not the area of the cross section of the wire, for the wire is circular instead of square and the area of its cross section is not the square of its diameter but must be calculated from the geometrical formula for the area of a circle.

Fortunately, the possible confusion about the circular mils has little importance in radio calculations as circular mils are not much used in radio text books. The best plan is to use always the diameter of the wire in mils. If figures are given in circular mils take the square roots of the numbers and you will have, in all cases, the diameter of the wire in mils.

Fig. I—A Pocket Wire Gauge which can be purchased from any hardware store handling copper wire.

The electrical resistance of a copper wire depends on its cross section. In Table No. 1 are given the resistances of wires of the different gauge numbers for direct current at ordinary room temperatures. In practice these resistances must be considered merely as approximate values, since the resistance of wire varies slightly with the hardness or softness of the wire, with the temperature and sometimes with other things. The figures in Table No. 1 are close enough for all ordinary purposes.

Bear in mind that these resistances are for direct current. For ordinary alternating currents, such as are used in house lighting or power work, the resistances are about the same, but for radio frequency currents the resistances are quite different because of the skin effect. (High frequency currents tends to flow principally on the surface of a wire.) It is impossible to give a general table for resistances at radio frequencies since the frequency, the nature of the winding, the character of insulation on the wire, the tube that it is wound on and even other factors, may affect the measured resistance of a radio coil.

For use in winding coils and in calculating the amount of wire needed for them, the tables of turns per inch will be found useful. This means linear inch, along the coil, one layer deep. "SCC" means "single-cotton-covered" that is, a wire wrapped with one layer of cotton insulation, similarly, "DSC" means "double-silk-covered" wire, having two layers of silk insulation. There are also "double-cotton-covered" and "single-silk-covered" wires, also enameled wire, having a thinner coating of insulation than the others, the latter generally being used in making the winding of choke coils in radio work.

Wires of unusual shape such as "buss-wire" are usually specified by the number of the round wire to which they are equivalent in electrical resistance. This means that such wires have the same cross-section. A No. 16 bus-wire has as much copper in it per foot as has a No. 16 round wire. There will be, therefore, about 1,275 feet of such wire in a pound.

In England an entirely different set of gauge numbers is sometimes used for wires. It is called the British Imperial Standard Wire Gauge, frequently abbreviated to "S.W.G." A few British publications use the B and S gauge just as we do, but if the gauge system is not specified it is safe to assume, in British work, that the S.W.G. system has been used.

This system is also used more or less in other countries, although in France, it is customary to specify, also the diameter of the wire in millimeters. A millimeter is one thousandth of a meter or about .04 inch, one millimeter equals 39.37 mils, and one mil equals .0254 millimeter. These figures permit easy conversion of either one or the other.

The B and S gauge, the S. W. G. system, the measurement in mils and similar measurement in millimeters are the only four ways commonly used to specify the size of copper wires. Other gauges are sometimes used for iron and steel wires such as Roebling, Birmingham and Stubs gauges, fortunately they have little application to radio as these gauges are not used for copper wires.

The approximate relations between the two copper wire gauges are given in Table No. 2.

TABLE NO. I
THE SIZES AND PROPERTIES OF DIFFERENT KINDS OF COPPER WIRE

B. & S. Gauge	Diam. Mils.	Feet Per Pound	Ohms Per Foot	TURNS PER INCH Bare	S.C.C.	D.S.C.	Enameled
8	128	20	.00064	7.8	7.3	—	7.7
9	114	25	.0008	8.7	8.2	—	8.6
10	102	32	.0010	9.8	9.2	—	9.6
11	91	40	.0013	11.0	10.3	—	10.8
12	81	50	.0016	12.3	11.5	—	12.1
13	72	63	.0020	13.8	12.8	—	13.5
14	64	80	.0026	15.6	14.3	—	15.1
15	57	100	.0033	17.5	15.9	—	16.9
16	51	127	.0041	19.6	17.9	18.3	18.9
17	45	160	.0052	22.2	20.0	20.4	21.3
18	40	200	.0065	25.0	22.2	22.7	23.8
19	36	260	.0082	27.7	24.4	25.2	26.5
20	32	320	.0104	31.2	27.0	28.0	29.7
21	28.5	408	.0131	35.1	29.9	31.0	33.1
22	25.3	515	.0165	39.5	33.9	34.4	37.2
23	22.6	650	.0208	44.2	37.6	37.9	41.5
24	20.1	820	.0262	49.7	41.5	41.8	46.5
25	17.9	1.030	.0330	55.8	45.7	46.1	52.1
26	15.9	1,300	.0416	62.8	50.2	50.8	58.5
27	14.2	1,640	.0525	70	55	55	65
28	12.6	2,060	.0662	79	60	61	73
29	11.3	2,600	.0834	88	65	66	82
30	10.0	3,280	.105	100	71	72	91
31	8.9	4,140	.133	112	77	78	103
32	8.0	5,230	.167	125	83	84	115
33	7.1	6,570	.211	140	90	91	130
34	6.3	8,330	.266	158	97	99	145
35	5.6	10,480	.335	178	104	106	161
36	5.0	13,200	.423	200	111	114	180
37	4.5	16,600	.533	222	118	121	204
38	4.0	21,000	.673	250	125	128	227
39	3.5	26,500	.848	285	135	137	256
40	3.1	33,400	1.070	322	141	145	286

TABLE NO. 2.

No.	8	B and S	equals	No.	10	S.W.G.
"	12	"	"	"	14	"
"	16	"	"	"	18	"
"	21	"	"	"	22	"
"	25	"	"	"	26	"
"	28	"	"	"	30	"
"	31	"	"	"	34	"
"	38	"	"	"	42	"

The relations shown in Table No. 2 are not exact but give an idea of the relation between the American and British gauge systems. For exact diameters of wires in the two systems, as well as for other details concerning exact resistances, current carrying capacity, etc., it is necessary to consult the more comprehensive tables given in electrical engineering text books.

What's New in Radio and Television

The aerial television eye designed by C. Francis Jenkins, noted inventor, is attracting much attention in Radio circles. This apparatus is designed to broadcast views of the countryside or cities taken from an airplane. The mechanism changes the light waves of the ground objects into electric images which are broadcast over the plane's Radio transmitting apparatus and reproduced on a film screen over regular Radio receiving sets located on ground points.

A recent survey of the Radio retail field showed that dealers throughout the country employ an average of 4 service men each. Those in Radio realize that expert service and repair work is one of the biggest factors in Radio's progress. The Radio service man is coming to the front more and more. He is getting better opportunities than ever.

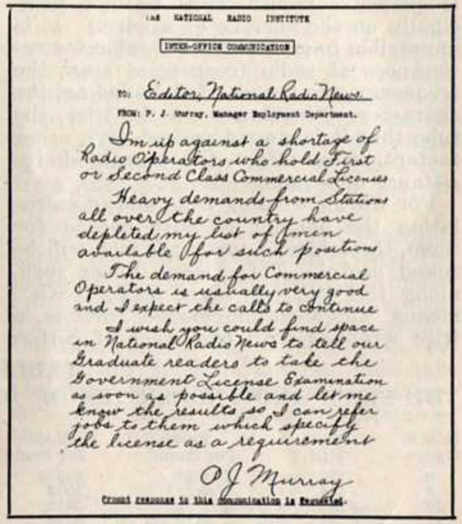
Jenkin's radio-movies are back on the air over a new 5,000 watt station just north of Washington, D. C. The first program was picked up by television receivers as far west as Chicago. These programs are "televised" regularly between 8 and 9 P. M. Eastern Standard time. Watch television! Be prepared for it when it "breaks" on a commercial scale. It spells opportunity!

The average coast to coast broadcast program, employs the services of about 200 Radio engineers. About half of these are used in studios of the various stations of the net-work, while the rest are engaged in the distributing by telephone wires.

The Boeing Air Transport Company is one of the first big airway lines to Radiofy its air lines. Contracts have been let to install Radio equipment on their planes and to equip short wave stations along the routes and at landing fields. This company has 40 planes now in operation between Chicago and Oakland.

Station WJAR, Providence, Rhode Island, has a grounding system that isn't duplicated anywhere in the United States. It is composed of 11,000 strips of copper nailed down to the floor of the transmitting room in a geometric design.

GRADUATES—Read the note I received the other day from Employment Manager Murray. Looks like he's badly in need of Radio operators. It will pay you to get in touch with him if you're qualified for Code work.—Editor.


NATIONAL RADIO INSTITUTE

INTER-OFFICE COMMUNICATION

TO: Editor, National Radio News

FROM: P. J. Murray, Manager Employment Department.

I'm up against a shortage of Radio Operators who hold First or Second Class Commercial Licenses

Heavy demands from Stations all over the country have depleted my list of men available for such positions

The demand for Commercial Operators is usually very good and I expect the calls to continue

I wish you could find space in National Radio News to tell our Graduate readers to take the Government License Examination as soon as possible and let me know the results so I can refer jobs to them which specify the license as a requirement

P J Murray

Prompt response to this communication is requested.

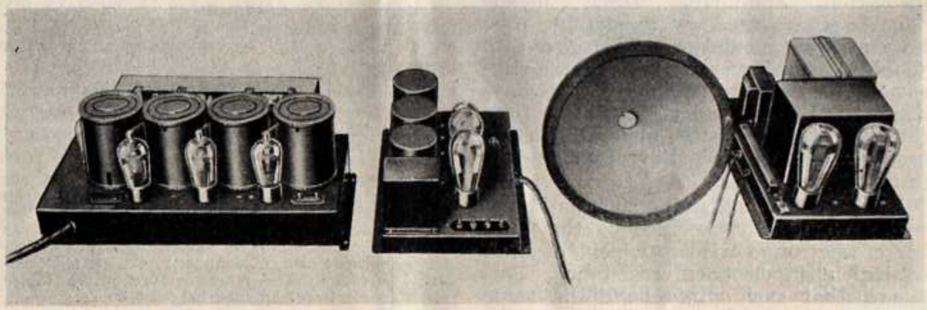
Working Parts of a 1930 Receiver

The picture below illustrates how neatly and compactly Radio sets are now being built. Left to right: Chassis, audio amplifier, cone speaker and power supply unit.

Chassis shows three screen grid tubes in front with a 327 detector tube at extreme left. The four cylinders in center of the chassis are shielded coils. Gang condenser is in the rear—four condensers operated by a single control.

Audio amplifier shows a shielded output transformer at left front. Back of it are two shielded audio frequency transformers and a shielded choke coil. Small tube in the rear is a 327 amplifier and two larger tubes are 345's in push-pull arrangement. Cone reproducer is a strongly built 11½-inch power dynamic speaker.

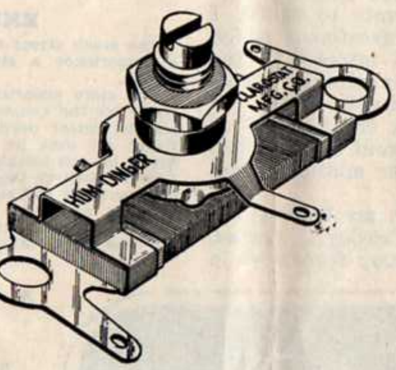
Power supply unit shows two 381 tubes used as rectifiers, backed by a power transformer and a filter condenser. In left corner is a choke used in the filter circuit which prevents audibility of power line hum.



How About Hum Voltage?

By CHARLES GOLENPAUL, Clarostat Mfg. Co.

With recent developments in audio amplifiers and loud-speakers bringing about a far greater response to the lower frequencies, the 60-cycle hum in A-C radio sets becomes a real problem. A year or two ago, when audio amplifiers and loud-speakers were relatively insensitive to frequencies below 125 cycles, A-C hum was of little or no consequence in radio set design. Hence a few words at this time about the most common source of A-C hum and how it may be eliminated, are certainly in order.



Aside from the field supply for the A-C dynamic speaker, the main source of A-C hum in the usual A-C set is filament circuit unbalance, which gives rise to what is termed hum-voltage. This hum is not only annoying in itself, but it creates an effect that actually warps the musical scale in spite of all precautions taken with regard to other components of the set. When musical notes of a frequency approaching that of the A-C hum are reproduced, the ear cannot differentiate between such notes, and the result is apparently a flat spot in the low-frequency range.

The A-C filament circuit must be balanced for a minimum of hum-voltage. That is to say, the grid return must be made to the electrical center of the filament circuit. In some circuits, a center-tapped filament transformer winding is employed, and while this method has heretofore been satisfactory, it is no longer so with improved low-frequency response. Although the utmost care may be taken to have an accurately balanced center-tap winding, the wiring of the filament circuit may result in unbalance, thereby upsetting the calculations of the transformer designer and maker. Therefore, the accepted practice today is an adjustable center-tapped resistance across the filament terminals of the vacuum tubes, so that the exact electrical center can be instantly obtained irrespective of transformer, circuit or filament unbalance.

Heretofore, a device of this kind has been in the form of a potentiometer—elaborate, large, awkward and costly. Recently, however, a new device known as the hum-dinger has been introduced, comprising a strip-wound resistor over the center portion of which slides a small contact adjusted by means of a screw-driver blade. When mounted on a panel or sub-panel, only a bushing with a recessed slotted shaft end is exposed for the screwdriver adjustment. With such a device installed, it is a simple matter to make the necessary adjustment so as to balance the filament circuit, reducing the hum to a minimum. Such an arrangement generally goes under the name of hum balancer in the broadcast receiver.

OUR COVER

This picture shows Lieut. W. B. Hough, operating one of the most modern aircraft Radiobeacons which has recently been installed at Mitchell Field, Long Island. The transmitter has 2 kilowatts power which gives it an effective range of 200 miles in daytime and 400 miles at night. With the aid of this aircraft Radiobeacon planes are enabled to fly on a definite, charted path although the earth may be totally obscured by rain, clouds, or darkness. The Radiobeacon, probably more than any other single factor, is making aviation practical and dependable. The U. S. Government is installing between 40 and 50 of these at various airports for use by air mail planes, etc. Commercial air transport companies are installing many more. All of this means opportunity for Radio trained men.

Business Opportunities

Student Alvin L. Prichard, 114-48 Sutphin Boulevard, South Jamaica, L. I., New York, is looking for a partner. If interested, get in touch with him. He writes about his proposition as follows:

"In regard to the partner proposition, I shall be glad to answer any inquiries regarding the business from anyone interested. Since my present stock and equipment, including $600 Finance Corporation Reserve, amounts to $4000, I would expect a $2000 investment which would give a full half interest in the business, including everything. This does not include a good-will charge. A salary of $50 per week for each of us and the balance of the profit to be divided at certain periods as per mutual agreement.

"This agreement with my holding the valuable Majestic, Crosley, Amrad, Eveready and Mazda Lamp franchises in a restricted territory should appeal to a real go-getter."

Writes for Q. S. T.

Graduate Alphy Blais is the author of a very interesting article in Q. S. T. for August.

Hearty Congratulations!

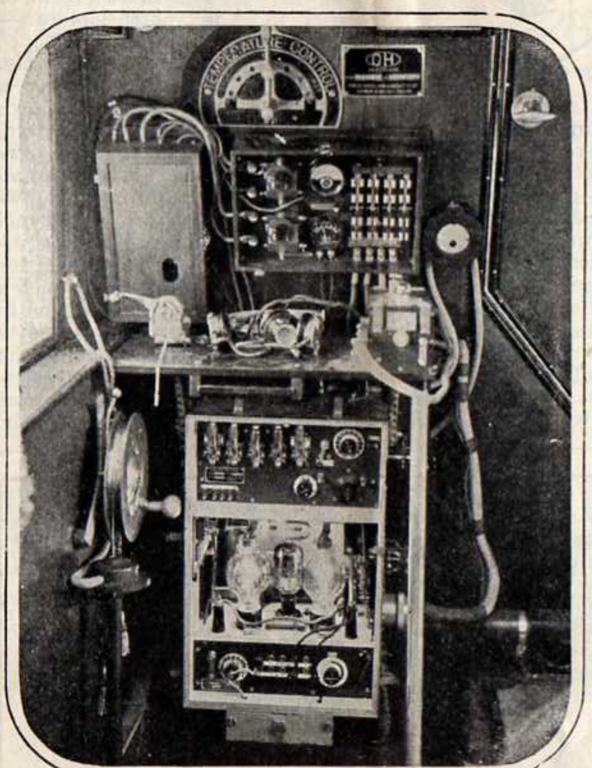
We hope to see many more articles by you and other N. R. I. men in the near future.

A number of N. R. I. men are making good names for themselves in Radio Journalism the same as in other branches of Radio.

EXPERIENCE

Too much stress cannot be laid on the amount of experience a student gets while taking his course.

The more experience he can show when he is ready for the assistance of our Employment Service the better position we are in to serve him. Every set that he can repair or install; every aerial he can install; every Radio job of any nature whatsoever that he can do adds to his stock of experience and makes him just that much more valuable and that much more in demand. So, grab on to those spare-time jobs when you have the time.—P. J. Murray, Mgr. Employment Dept.



A MODERN AIRCRAFT INSTALLATION

This radio telephone and telegraph transmitter and receiver is installed on a British commercial air liner. The transmitter is rated at 150 watts. The instrument box below the table contains at the top the receiving unit. Below it are the transmitting tubes, and at the bottom the tuning controls for the transmitter. The reel at the left unwinds the trailing antenna.

Elsewhere in this issue you'll find information about the Boeing Airline being radiofied, the new Radio beacon at Mitchell Field, the airplane over N. J. that talked with London — on every hand we see new evidence of the growing importance of Radio in aviation. You, who are now getting into Radio, are pioneering in a field that offers boundless opportunities!

Photo by courtesy of "Radio Broadcast"