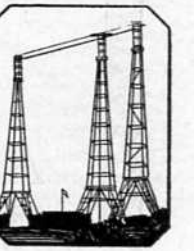
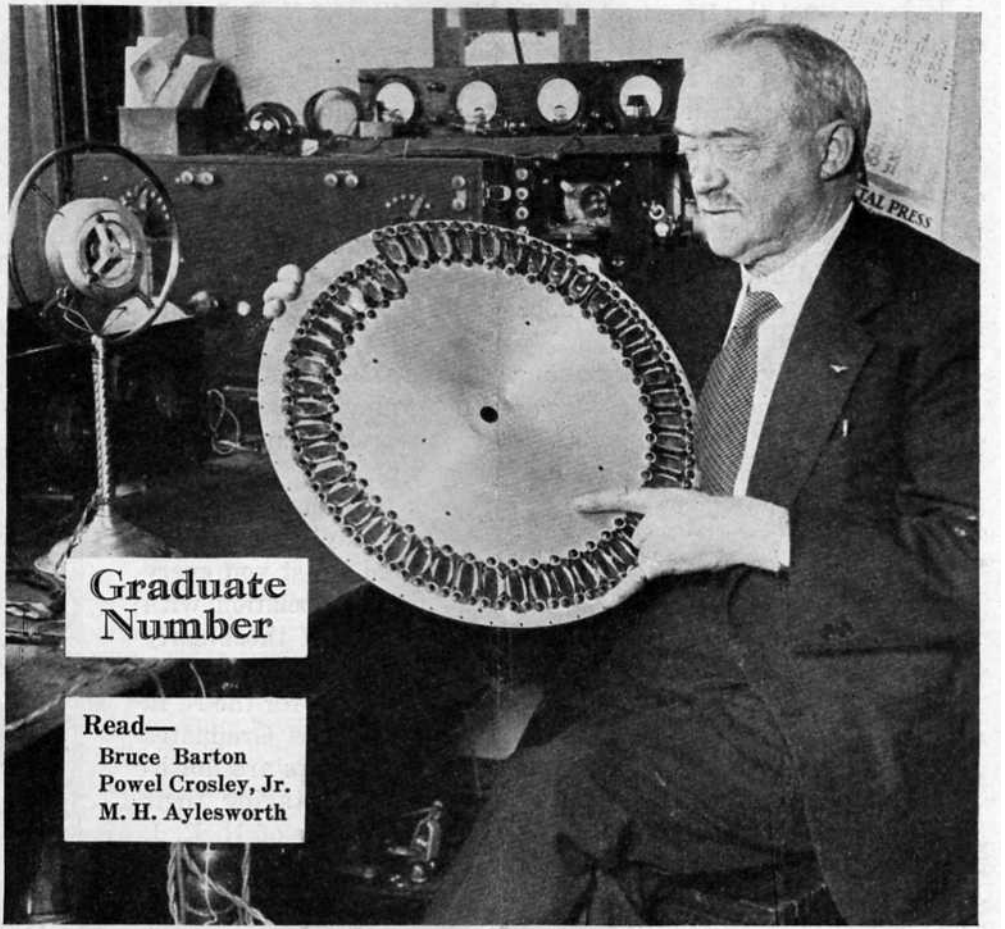
NATIONAL RADIO NEWS



FROM N.R.I. TRAINING HEADQUARTERS

Vol. 2—No. 3 WASHINGTON, D. C. OCTOBER, 1929



Graduate Number

Read—
Bruce Barton
Powel Crosley, Jr.
M. H. Aylesworth

JENKINS' FAMOUS AERIAL TELEVISION EYE SEE PAGE 5

OUR GRADUATES

By J. E. SMITH

AT A RECENT Radio Show a business friend remarked about my success and the wide fame that the N. R. I. has. I thanked him and then said, "You have heard the Chicago Symphony Orchestra haven't you? Then you heard the tumultuous applause showered upon the Director of that famous orchestra after it had finished a stirring march. Now you know, the Director knows, and the audience knows that the praise really goes to the musicians themselves —not the Director! And so it is with the N. R. I. The praise belongs to our Graduates!

They have studied and mastered Radio, finished the course, earned their diplomas and are making **good** out in the Radio field. They are making reputations for themselves and **their** success naturally reflects on the N. R. I. It is true, they have proved that my methods of training are practical and result-getting, but the real honor belongs to these men who have pushed on and on in this big opportunity field of Radio. My friend agreed.

To you, Graduates, congratulations! It has made me extremely happy to see you forging ahead. Keep advancing. Keep alert, Radio is marching swiftly and you want to keep up with its pace!

Although our contact with you may not be as frequent as it was when you were studying—just the same we are here to back you up and assist you every chance you give us. Keep up your association with the Institute—keep alive the memories of those early day associations as student and teacher.

Your loyalty and friendship have gained for the N. R. I. an enviable reputation. Naturally, new Graduates look to you for cooperation. New members are finishing their training right along and are taking their places beside you to make the great body of N. R. I. men a still bigger, more influential factor in Radio!

RADIO'S ACCOMPLISHMENT

M. H. AYLESWORTH

President of the National Broadcasting Company

EIGHT years ago the country had one broadcasting station—KDKA, in Pittsburgh. Today it has 630.

Eight years ago there were virtually no receiving sets in existence, only home-made crystal affairs that were considered playthings for the children. Today there are twelve million Radios in use, costing from five dollars to more than one thousand dollars each.

When you compare the latest rich-toned receiving set in an ornamental cabinet to the crude jumble of tubes, coils, wires and batteries of only five years ago, you again realize how rapid the Radio changes have been. The laboratories are all striving to make instruments of Radio better and better, and we may confidently look forward to continued improvement—a situation expressed most effectively by Mr. Owen D. Young, who said, "It is what the engineers do not know today that makes me have faith in the future of Radio."

Eight years ago there was no such thing as entertainment broadcasting and there was not a single Radio artist in the country. In 1928, five million dollars were paid out in salaries to Radio entertainers through our organization, the National Broadcasting Company, alone. One million microphone appearances a year are made in the 630 broadcasting stations of the country. In our own studios we have six thousand microphone appearances every month. Throughout the country, forty or fifty million people listen in simultaneously to special programs or special events virtually every week.

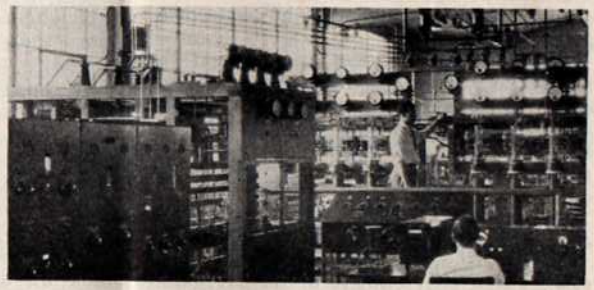
Eight years ago there was no such thing as a broadcast network. Today the country is blanketed by upwards of one hundred thousand miles of leased wires used every day to carry programs to every corner of the land.

Eight years ago not a penny was spent by anybody for wire charges for broadcasting. In 1928 the National Broadcasting Company alone paid to the American Telephone and Telegraph Company two million dollars for this purpose.

Eight years ago not a single Radio receiving set had ever been manufactured for sale. In 1928 the volume of business of the Radio manufacturers of the country was nearly seven hundred million dollars.

Nothing in history has ever caught the fancy of the American people as did Radio. Nothing has ever moved with the same speed in reaching popular acceptance. Years of time and years of promotion effort, together with expenditure of vast sums for development and advertising marked the progress of the telephone, the electric light, the automobile and the airplane. But Radio came into its own almost over night.

If the future of Radio is to be measured by its past, the next eight years are destined to give the world a series of fantastic events almost beyond the power of human visualization.



This picture shows the transmitter of a 100-KW developmental transmitter. It utilizes the recently developed water-cooled Pliotrons. Radio Engineers are constantly at work improving the design of transmitting apparatus, and are keeping the United States well in the lead in this field. Several N. B. C. stations have 50,000 watts power which is far ahead of any stations abroad.

(Reprinted by courtesy of Century Magazine.)

Have You Ceased To Study? If So, Good Night!

By BRUCE BARTON

A MAN named Brown and a man named Black graduated from high school and entered business in New York at the same time.

Both made rapid progress. At twenty-five each of them was drawing $2,500 a year.

"Coming men," said their friends. "If they are so far along at twenty-five, where will they be at fifty?"

Black went on. At fifty he is president of his company, with an income of $25,000 a year.

Bruce Barton's writings have shown thousands how to live a happier, more successful life.

But something happened to Brown. He never fulfilled the large promise of his youth: at fifty he had hardly advanced beyond his thirty mark.

What was it happened to these two men, of equal education and—so far as the world could judge—equal ability?

I will tell you.

Brown became satisfied. He ceased to study, which means that he ceased to grow.

Black has told me that when he reached $5,000 a year he said to himself: "I have made a good start. Nothing can stop me if I keep my health and keep growing. I must study, study, study! I must be the best informed man on our business in the United States."

There is the difference. One stayed in school; one did not.

The position you attain before you are twenty-five years old is of no particular credit to you. You gained that simply on the education your parents gave you—education that cost you no sacrifice.

But the progress you make in the world after twenty-five—that is progress that you must make by educating yourself. It will be in proportion to the amount of study you give to your work in excess of the amount the other man gives.

Analyze any successful man and you will find these three great facts:

He had an aim!

Lord Campbell wrote to his father, as an excuse for not coming home over the holidays:

"To have any chance of success, I must be more steady than other men. I must be in chambers when they are at the theater: I must study when they are asleep: I must remain in town when they are in the country."

He worked!

"I have worked," said Daniel Webster, "for more than twelve hours a day for fifty years."

He studied!

Vice-President Henry Wilson was born in the direst poverty.

"Want sat by my cradle," he says. "I know what it is to ask my mother for bread when she had none to give. I left home when ten years of age, and served an apprenticeship of eleven years, receiving one month's schooling each year, and at the end of eleven years of hard work a yoke of oxen and six sheep, which brought me $84."

Yet in those eleven years of grueling labor he found time to read and study more than one hundred books.

Really big men check themselves up each autumn, at the beginning of a new business year.

"This year," they say, "I am going to master one new subject. I am going to pursue studies which will increase my ability and earning power."

The bigger they are, the longer they keep themselves in school. Gladstone took up a new language after he had passed seventy.

Have you left school?

As a matter of fact, did you grow mentally last year at all? What definite subject are you planning to devote your evenings to this year?

"As a rule," said Disraeli, "the most successful man in life is the man who has the most information."

How much will you increase your stock of useful information in the next business year?

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. October, 1929

Get Your Share

IN the past eight years Radio has grown in leaps and bounds. Last year this baby-giant industry startled business leaders by doing a volume of over $650,000,000 business in the United States alone. And from all indications, this year will see a bigger volume of business done with correspondingly greater profits to Radio men.

Here's another point—the Department of Commerce, in a recent survey, found that 40% of the whole year's Radio business is done in only three months of the year—October, November and December! Over 1,200,000 new Radio sets will be sold in the next three months. Tubes, loud speakers, batteries and accessories will bring in something like $100,000,000.00. Then there are around 12,000,000 sets to keep serviced, repaired and in good operating condition to receive the bigger, more expensive programs on the air, the big football games and other events. That spells OPPORTUNITY—and more of it—right ahead of you!

Get in on this increased demand for Radio service and apparatus of all kinds. Line up your prospects for new sets and service. Put some extra cash in your pockets. Harvest your share of golden Radio profits!

E. R. HAAS.

Finally, education alone can conduct us to that enjoyment which is, at once, best in quality and infinite in quantity.—Mann.

Big jobs generally go to the men who prove their ability to outgrow smaller ones.

News From Some Grads

R. I. Sawtell is with R. C. A., New Brunswick, N. J.

Kotera is with WOW, Omaha.

R. H. Frey is with John Wanamaker, New York.

Earl Merryman is with WRC, Washington.

Wm. Schmidt, Lasalle, Hayden, Parsons and a number of N. R. I. men are with Atwater Kent, Philadelphia.

L. E. Payne and W. O. Kinsman are with Westinghouse Electric Company, E. Springfield, Mass.

Ed. Stanko is with WGR, Buffalo.

A. R. Abbott is with American Bosch Magneto Corp.

E. M. Zandonini is in the Radio laboratory at the Bureau of Standards, Washington.

G. C. Gielow is with Intercity Radio Tel. Co., Cleveland.

K. W. Griffith is with KGJF, Little Rock.

G. W. Krogman is with All-American Mohawk, Chicago.

L. A. Canning is operating with Canadian National Railways.

E. A. Beasley and A. C. Preuss and others are with Crosley, Cincinnati.

N. R. I. Graduates are known to be employed in at least 61 major broadcast stations.

The most fascinating game, today, is Radio Engineering. It has all the mysteries one could possibly hope for, and a trail of adventures that leaps from earth to the unseen highways of the air. The Radio Engineer is dealing with forces as yet almost unknown, but with a skill that has startled the world.

—The Day-Fan Dial.

Aerial Television Eye

The so-called Aerial Television Eye is the latest invention to come from C. Francis Jenkins. The picture on the cover shows the inventor in his Radio laboratory with the lens scanning disc. The device consists of the disc, lens and a light sensitive cell, transmitting the light waves in electric vibrations and the usual broadcasting equipment. Further details of this remarkable invention have not been revealed.

The device is to be placed in an airplane and is expected to broadcast or "televise" views of the landscape as seen from a flying plane. In event of war it could pry into enemy secrets hundreds of miles behind the lines. It's commercial possibilities are even greater.

Radio's Big Years Are Ahead!

By POWEL CROSLEY, JR., Pres. Crosley Manufacturing Co.

POWEL CROSLEY
A Radio Pioneer

RADIO is sweeping onward toward the greatest season in its history. Broadcasters promise better and more novel programs; receiving sets are in wider use, and the public is wide awake to the remarkable possibilities of the screen grid tube.

Radio came into its own during National Radio Week, which began September 22, with a seven-day musical festival. Numerous broadcasting stations staged special programs during the week in celebrating the occasion. The giant strides made in the progress and service of radio was also demonstrated during that week at the Radio World's Fair in New York City. A similar public exhibition will follow in October at the Chicago Coliseum.

The volume of Radio business this summer was far ahead of that last summer. My own faith in the future of the industry was reflected in the addition of two new factory units to our Cincinnati plant. We are doubling our forces of employees and there is every indication that buyers' demands will result in a similar increase in production.

The seventh and eighth floors of the new eight-story factory unit will house the executive offices, the engineering department and the studios of the two Crosley broadcasting stations, WLW and WSAI. The building gives the company 222,000 additional square feet of floor space.

Our enlarged plant will then be equipped to handle a peak production output of 8,000 receiving sets per day. The completion of the new eight-story factory unit, increased switching facilities, and the installation of chain conveyors and other mechanical devices will make this maximum production possible. While we do not expect to turn out more than 6,000 sets a day in the near future, we will be able to increase the output to 8,000 sets daily if the demand for the new screen grid models continues to increase. In building two additional factory units, we have allowed for ample room for expansion for some time to come.

From this long assembly room Crosley sets can be loaded on waiting freight cars at the rate of 580 per hour.

The speed of our new production facilities is illustrated by the fact that little more than two hours after the raw chassis starts on its journey through the factory, the complete set has been packed and loaded on a freight car or truck for delivery to distributors. During those two hours, each complete set undergoes ten thorough inspections. In addition, hundreds of tests are performed upon the various parts in the sub-assemblies.

The trip of the chassis along the network of conveyors starts in the chassis assembly department, which extends through the fourth and fifth floors. The chassis comes from the stock room ready for all parts to be attached. By-pass condensers, transformers, tuning condensers, tube sockets and other parts are installed as fourteen double lines of conveyor belts carry the chassis down an assembly line.

Sub-assemblies of the condensers, coils, speakers and other parts are carried on simultaneously in the various factory units, helping to speed up production.

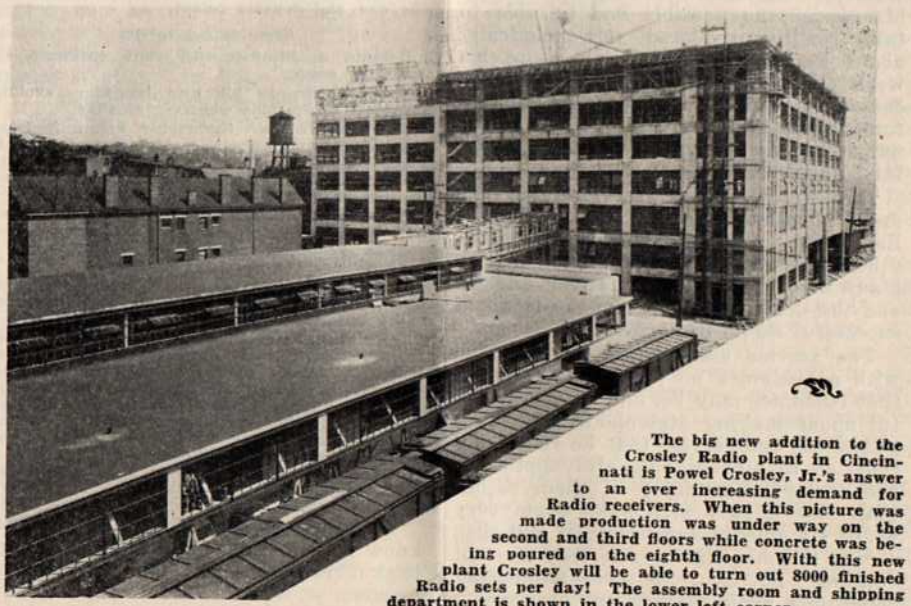
One hundred minutes after it first reaches the chassis assembly department it is placed on a chain conveyor and lowered to the third floor, where it undergoes several rigid tests.

The next chapter in the "romance of a Crosley radio set" is a trip on a chain conveyor across a bridge over Arlington Street to the new assembly building, a long, one-story structure. Meanwhile the speakers also are conveyed to this building. Each set is completely assembled, placed in either a wood or a metal cabinet and given its final tests in one of the thirty-two inspection booths.

After being pronounced ready to do its bit in interpreting what the air waves are saying, the set is packed and placed on a carousel conveyor which carries it to a truck or to a freight car on a siding adjoining the assembly building. If necessary the cabinets can be loaded at the rate of 580 sets per hour.

Space is also provided for the construction of special long-wave sets for European customers, 25-cycle 110-volt sets, 220-volt sets, D. C. 110-volt sets, D. C. 220-volt sets and D. C. battery operated sets. The maximum capacity of this department will be 1,600 receiving sets per day.

To some of us pioneers in the industry, the miracle of radio is an ever-recurring one. As I recall the time when a daily output of ten receiving sets was "a great day's work," and as I reflect that more than 350,000 persons are employed in radio today, not to mention the millions for whom it has furnished entertainment, education and culture, I hesitate to try to predict the bright future of this amazing industry which emerged from its swaddling clothes only a few short years ago.



The big new addition to the Crosley Radio plant in Cincinnati is Powel Crosley, Jr.'s answer to an ever increasing demand for Radio receivers. When this picture was made production was under way on the second and third floors while concrete was being poured on the eighth floor. With this new plant Crosley will be able to turn out 8000 finished Radio sets per day! The assembly room and shipping department is shown in the lower left corner.

Service—The Keynote to Successful Selling

By H. A. WILMOTH

The picture shows H. A. Wilmoth, an N. R. I. graduate, instructing a number of Sparton dealers in servicing sets. Graduate Wilmoth is assistant service manager of Sparks-Withington Co., makers of the famous Sparton Equasone. He gives some practical tips in this article. Read it.
—Editor.

MOST any Radio-Trician can sell a radio set nowdays that enjoys a national reputation through advertising and service, but allow service to be neglected and the sales returns will tell their own story. The old adage, "He who serves best serves most," could well be used by Radio men slightly changed as "He who serves best sells most."

The service man should be of the type that can "sell himself" and then sell his services. He should be as familiar with his product as possible and be able to talk intelligently and non-technically about Radio. He should go about his work cheerfully and efficiently and endeavor to gain the confidence of the customer and thus pave the way to the names of friends that are in the market for a receiver.

Too many dealers' service men are mere boys with very little training in Radio and none in meeting the public in a business way in their homes, and they many times talk too much or not enough and the dealer wonders why he is not a successful Radio dealer.

The service man should never argue with a customer no matter how wrong that customer may be, and be very careful about making statements regarding guarantee and service that he is not authorized to make. This also applies to the dealer as so many of them rather than lose a sale will make some very wierd statements and promises and then censor the manufacturer if they are not fulfilled. So, to avoid these unpleasant conditions, avoid making any statements regarding service and guarantee other than what is authorized by the manufacturer.

Some DONT'S

Do not lead your customer to expect too much and he will demand less. The less you have to say about guarantees and service the less you will have to give.

Do not claim you have more than the other fellow in a belittling manner as you may have to prove it and loose out, and the humiliation added to defeat is bad for your business.

Do not make too direct camparisons as they often lead to arguments, and arguments do not make friends or sales.

Above all, do not knock. A knock is a boost any day and denotes defeat.

Some things to DO

Become acquainted with your customer and learn his needs.

Talk to him in his own language, avoiding technical expressions wherever possible.

Test the receiver thoroughly before it leaves your shop, and make a careful workmanlike installation, also making any adjustments to the receiver specified by the manufacturer to be made in the customer's home.

A few hours spent in a careful installation will mean many hours saved later in service.

Show your customer all he should know to properly operate the receiver.

Do not be afraid to tell him about static and other interfering noises, and you will be saved many needless service calls.

Do not be afraid to talk to him about the tubes in the set. If properly explained he will listen to reason and you can very favorably compare the tubes in his set to the tires on his car; and that their life depends on the number of miles they are driven, and not a definite period of a year or six months. In fact, you need not state any period on anything if the receiver performs as you told him it would and show him how to operate it as smoothly as you do it.

To sum up, promise little, give much, know your product and the manufacturer back of it and sell receivers on their own merits.

Radio-Trician's Service Manual

on the

Atwater Kent Screen Grid Receiver, Model 55

General Description

The Model 55 receiver is a seven-tube A. C. outfit representing a distinct departure in design from previous models. It incorporates two stages of R. F. amplification, using screen grid A. C. tubes, detector, one stage of resistance coupled audio amplification, and a double-audio stage for the out-put. A heater type tube is used in the first audio stage and new power tubes, type 245, are used in the double audio stage. The usual 280 type rectifier is employed.

Among the distinct advantages of this type receiver may be mentioned the following:

The various units of the power pack are mounted in separate metal containers, simplifying replacement.

The volume control operates by regulating the voltage on the "screen grid" in the R. F. tubes, this voltage being continuously variable from zero to the maximum of about 75 volts. This gives quieter and smoother operation than previous designs which had the control in the antenna circuit.

The Model F-4 electro-dynamic speaker which can be used with Model 55 receiver uses for its field supply the entire B current supply, same as furnished to plates of all tubes. (See Fig. 2.)

Special Notes on Installation

Antenna: The Model 55 is very sensitive and does not require a large antenna. Two antenna posts are provided on the set, marked "Long Antenna" and "Short Antenna." The long-antenna post will give greater selectivity and should be used if the aerial is 30 feet or more in length. The short-antenna post should be used if a very short (inside) antenna is employed. If extreme selectivity is desired use a short antenna connected to the long-antenna post. Indoor aerials for Model 55 should be erected as far as possible away from grounded metal, such as pipes, electric wiring, etc.

Ground: Ground connections must be used with Model 55. This set will also not operate (as some A. C. sets do) with either antenna post connected to the ground.

Output Tubes: The two A. F. output tubes used in the audio stage should be matched on a tube tester, otherwise the set may hum.

Speaker: Do not use any other model of Atwater Kent speaker with Model 55, than the type F-4 or F-4C. Do not remove speaker plug from socket when set is in operation.

Local-Distance Switch: The set should be operated with the "local-distance" switch in the local position when receiving nearby stations. Failure to do this may result in overloading of the detector tube, which will be evidenced by a decrease of output volume at the resonant point on the tuning dial, as well as a slight ragged type of distortion on extremely strong stations.

SERVICE NOTES

Replacing R. F. Transformers and Variable Condensers

As in the other Atwater Kent single dial receivers, if one R. F. transformer is defective, the entire group must be replaced. Likewise, if one variable condenser is defective, all three condensers must be replaced. It is necessary to remove the R. F. transformer shields when replacing the transformers. Care must be taken to avoid scratching or otherwise injuring the coils when replacing the shields. Also note that a lead from the secondary of each R. F. transformer to the bottom stator-terminal on each variable condenser should pass under a slot at the base of the shield, and must not be caught between the shield and the metal base plate.

Replacing Eyeletted Parts: The tube sockets, identifying plates and tube-shield bases are fastened with eyelets to the base-plate, and several parts are eyeletted to the main panel, but if any of these parts require replacement, it may be removed by cutting out the eyelets, and the replacement part may then be mounted in position with short 6/32 or 8/32 screws and nuts.

Replacing Filter-Condenser Assembly: The filter condenser assembly in Model 55 is a completely air-sealed type which prevents entry of moisture, thus greatly prolonging the life of this unit. The condenser assembly is mounted in an outside

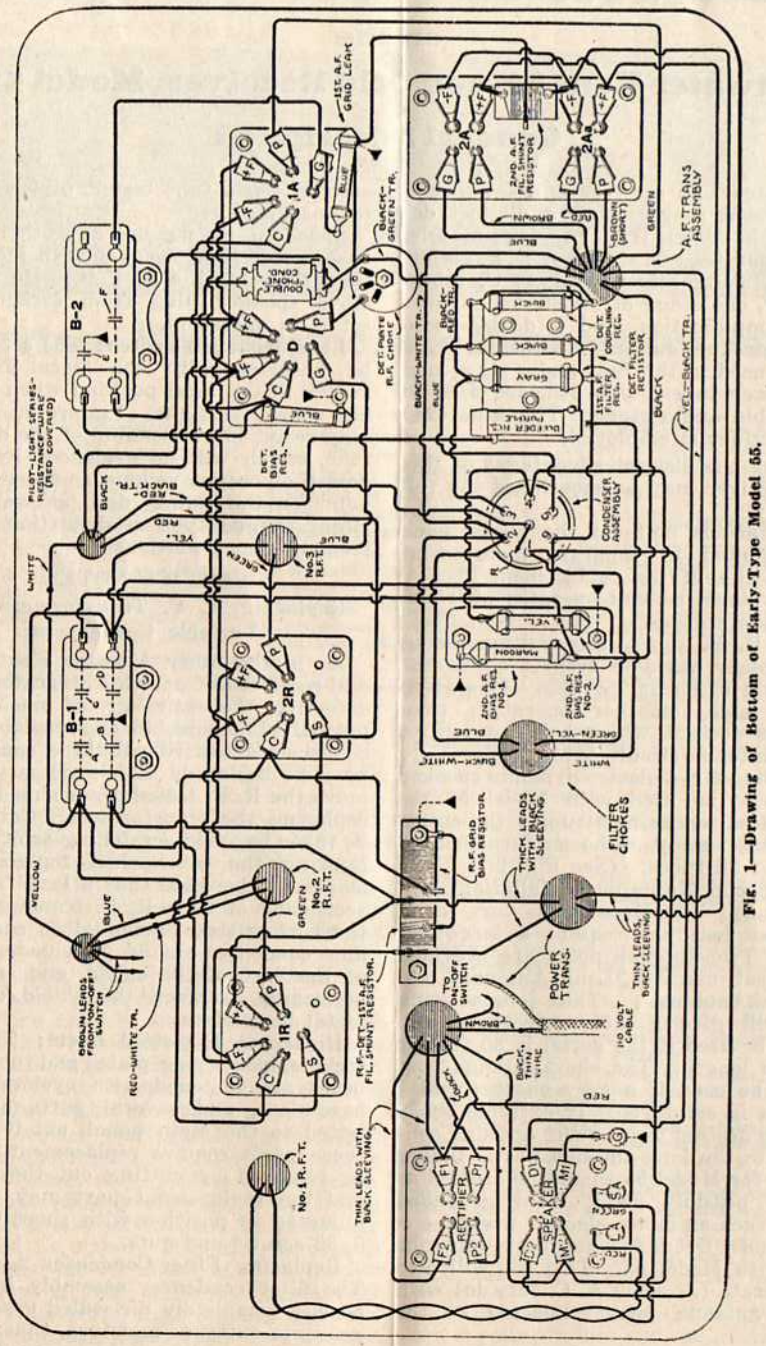


Fig. 1—Drawing of Bottom of Early-Type Model 55.

TABLE 1

VOLTAGE READINGS ON ATWATER KENT MODEL 55 RECEIVER

Tests Made With Set In Operation, All Tubes and Speaker-Plug in Sockets

Use High Resistance D. C. Voltmeter (about 0-50-250) to Measure Plate and Grid Voltages. Use A. C. Voltmeter to Measure Filament Voltages.

MAKE TESTS IN ORDER LISTED

	MEASURE ACROSS	APPROX. VOLTAGE	NO READING INDICATES‡	REMEDY
FILAMENT VOLTAGES	—F to +F Contacts on the detector, 1st A. F. and each R. F. Socket.	2.4	Open filament winding or connection.	Make all voltage tests first to get a general idea of the trouble, then disconnect the set and test the suspected parts with a continuity testing circuit for opens, shorts & grounds.
	—F to +F on each 2nd A. F. Socket.	2.4		
	F1 to F2 on Rectifier Tube Socket.	4.9		
PLATE VOLTAGES	C1R to P1R.*	175	Open high voltage winding, open speaker magnet coil, open filter choke, open primary No. 2 R.F.T., or open R.F. bias resistor.	
	C2R to P2R.*	175	Open primary No. 3 R.F.T.	
	CD to PD.	105	Open detector filter resistor, coupling resistor, R.F. choke, or det. bias resistor.†	
	C1A to P1A.	70	Open 1st A.F. filter resistor, primary of A.F. input transformer, or 1st A.F. bias resistor.	
	—F2A to P2A.	235	Open primary of output transformer.	
	—F2Aa to P2Aa.	235		
GRID VOLTAGES	C1R to G1R.*	3	Open secondary No. 1 R.F.T.	
	C2R to G2R.*	3	Open secondary No. 2 R.F.T.	
	CD to GD.	12	Open secondary No. 3 R.F.T.	
	C1A to G1A.	2	Open 1st A.F. grid leak.	
	—F2A to G2A.	42	Open No. 2 2nd A.F. bias resistor or secondary of input A.F. transformer.**	
	—F2Aa to G2Aa.	42		
SCREEN VOLTAGES	C1R to S1R.*	85	Open connection to slider of volume control, open volume control resistor, or open bleeder resistor.	
	C2R to S2R.*	85		

* Volume control knob set at maximum.

** If No. 1 2nd A. F. bias resistor is open, the grid voltage will be approximately 85.

† The detector plate voltage will be low, and the detector grid voltage high, if the "phone" condenser is shorted.

‡ Low plate or grid voltages may indicate a partially shorted by-pass or filter condenser.

case and cover, with a flat spring-plate inside to hold the assembly in place.

Replacing Tubular Resistors: In later Model 55 receivers, the tubular resistors are made with cast metal caps or contacts, which have a comparatively low melting temperature. Accordingly it is necessary in replacing these units to exercise considerable care when soldering in order not to melt the entire cap. The soldering iron should be held in place only long enough to insure a good electrical connection between the cap and the lug to which it is to be fastened. A few experiences in soldering these new tubular resistors will quickly show the correct method required for good results.

Whenever a tubular resistor of this type is replaced, the soldered connections should be tested for mechanical strength by endeavoring to push the resistor away from the contact lugs.

Testing: One of the quickest methods of testing Model 55 is by measuring the voltage at each tube socket as indicated in the accompanying table. These measurements must be made while the set is in operation, using either a commercial set-analyzer, with adapters which fit into the tube sockets, or using separate A. C. and D. C. voltmeters, making connection to the tube socket contacts under the base-plate. All of the socket contacts may be exposed by inverting the set and removing the flat bottom plate. The indentification of all contacts and parts under the base plate is given in Figure 1.

Separate parts may be tested for continuity with a voltmeter and battery in the usual way. If there is any doubt as to whether a part is shorted, grounded, or open, it is advisable to remove all connecting leads to that part and test it separately.

Synchronizing Condensers

When synchronizing the condensers, connect a modulated oscillator pick-up

lead to the short-antenna binding post, and place the local-distance switch in the "distance" position. Adjust the volume control to give about half scale reading on the output meter, and then leave the control in this position.

Owing to the design of the R. F. amplifying circuit in Model 55, it is necessary to use a top shielding plate when synchronizing the variable condenser, and in order to make the rotor of No. 1 condenser accessible for adjustment it is necessary to cut or file a hole in the top-shield over the rotor of No. 1 condenser. This hole should be about 1½ inches in diameter, with its center 2¼ inches from the left edge of the shield and about 1⅜ inches from the front edge. The rotor of No. 1 condenser may then be adjusted with one finger through this hole. No. 2 condenser rotor may be adjusted by turning the control knob, and No. 3 rotor may be reached from the right-hand side of the chassis.

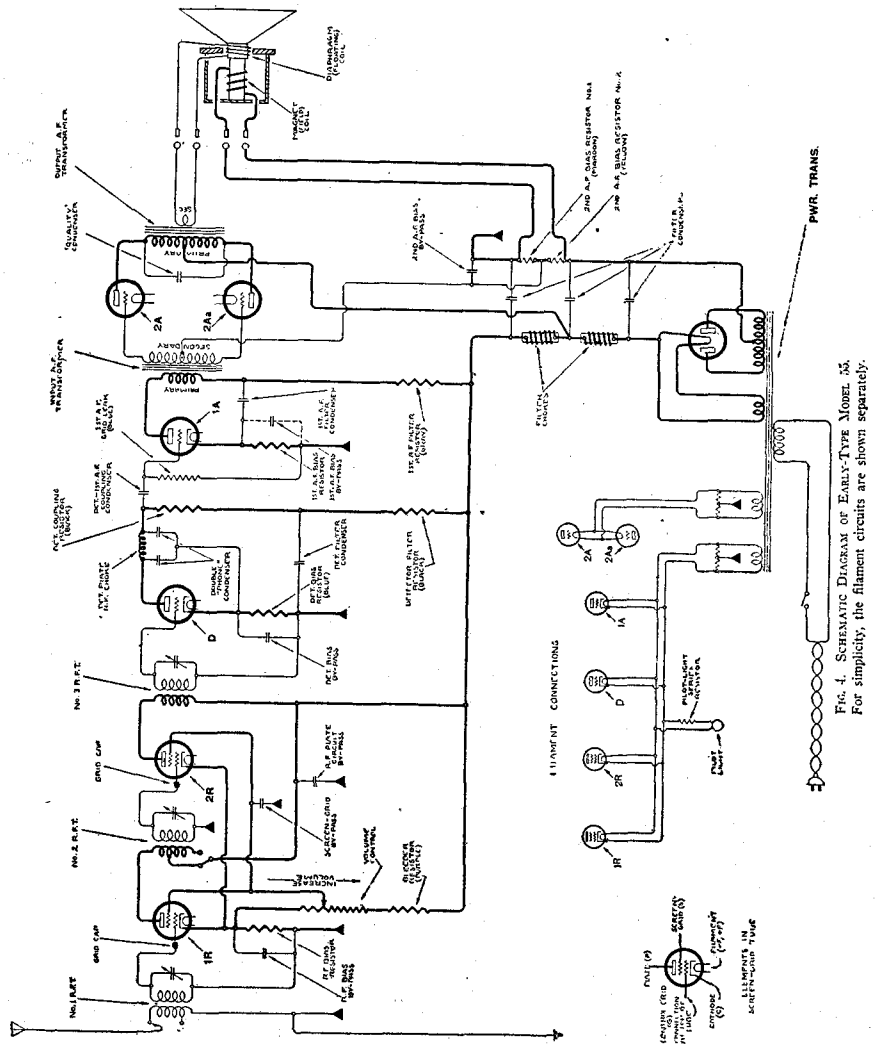


Fig. 4. Schematic Diagram of Early-Type Model 55. For simplicity, the filament circuits are shown separately.

Fig. 2—Schematic Diagram of Early-Type Model 55 Atwater Kent Receiver.

This Month's Tips

Students and graduates in small towns and rural sections—don't think for a minute that there's more Radio opportunity in the big cities. Everything is shaping up for one of the biggest Radio years ever on the farm and in the small town.

For the past year Radio engineers of a number of big factories have been trying to develop even better equipment for the farm market. Many refinements have been made on late model battery operated sets. The screen grid tube is a big factor in this development. Radio is fast becoming an indispensable unit on every farm. Practically every farmer is a prospect for his first set or a new modern one to replace out-of-date apparatus!

Lay your plans now for a big year. Line up your prospects. Sell your share of farm sets and get your share of the installation and service fees! And when you sell a set let the buyer know that he can depend on you to service and repair it—keep it working for him the year round. Some farmers hesitate to buy because they're afraid they won't be able to get anyone to repair it if something goes wrong.

Graduates and students who have completed most of their course should pick up some extra money in installing public address systems in hotels, auditoriums, schools and many other places. The newest type of prospect for these systems is the factory. Scientists agree that music soothes the nerves, decreases fatigue and enables workers to really produce more at the same time. The Ceco Tube Mfg. Co. recently put this theory to a practical test by installing 22 loud speakers in the assembly department of their new plant. More than 1,000 employees were enabled to listen to the music while at their work. Foremen claimed it reduced fatigue and speeded up production at the same time. This shows that there really is an opportunity to install similar Radio units and speaker hook-ups in other factories. It's a new use for Radio! Scout around and see if you can't sell plant owners on this idea. It will be a big job, but it should enable you to make a nice profit besides the reputation of being the first one in your community to install a Radio system in a factory.

In Our Mail Bag

"I am in business for myself now. I have Peck Bros. & Bartle account which pays me $75.00 a month alone to service their new sold sets for 30 days. I have only been going 3 months, but I have been increasing my earnings about $20.00 a month since. Just like getting a $20.00 raise every month. I have the school to thank for this. You certainly keep after your students when they lag in their lessons." Sincerely, Mr. D. Regula, 906 E. Everett St., Portland, Oregon.

"About a month ago I was appointed Army-Amateur Net Control Station for State of Tennessee, and have had to organize my State Network comprising about fifty stations. In addition to this I now service 400 Majestic Receivers which is a real job. I am sensible enough to realize that I MUST finish the course! Believe me, the lessons will come in just as fast. I can find a few spare hours for study, and whenever I can find them. One of the finest things I have found in N. R. I. is the real interest you have in your students. The fact that even though my course has been paid for long ago, you still persistently urge me to continue my lessons shows clearly that you want to give everyone a SQUARE DEAL and give him all that's coming to him!" Mr. E. H. Leftwich, 3505 Central Ave., Nashville, Tenn.

"I wouldn't sell my present knowledge of Radio for five thousand dollars." Mr. Fred F. Bozzano, 127 N. Madison Ave., Highland Park, Pa.

"Pathfinders First"

Nor fleeting time shall dim my ardent views,
As with the hours I coax a joyous cruise
Thru melody from this and distant lands,
Into this embered room where I amuse
Or soothe my mind, which bears no reprimands.
No secret ire within, as doleful tones
Are joined with those that reach bejeweled thrones;
Linked closely with their designated zones.

Reliable these waves that span the earth
And safely guide a ship upon the sea.
Do not they reach without a costly fee
Imprisonment, and those of humble birth;
On wearied beds the sick in passive plea?

Incessantly the cycles pass beyond,
Non-ending in a ceaseless, tireless flow.
Swift as the light and sure as nature's bond—
This mighty force of which we little know.
I cannot see a greater aid to man
Thru centuries to come. The nation's eyes
Unveiled and honor bound have turned to scan
The Pioneer—the builder of this prize
Emblazoned path wherein the future lies.

GRADUATE RALPH G. ROBINSON.

Increasing the Range of Meters

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

Possession of the knowledge required to increase the range of indicating instruments, such as voltmeters and ammeters, cannot help but be of aid to every Radio-Trician who has occasion to use such devices since it permits the utilization of a device for some purpose which would otherwise necessitate a new instrument. Hence this knowledge is one conducive to economical operation of measuring instruments. Occasions frequently arise where current indicating devices at hand do not afford the operating range necessary for the test being conducted or measurement to be made.

A voltmeter can be used to measure voltages higher than its maximum scale reading by connecting a suitable resistance in series with the instrument. Such series resistances are known as multipliers. Similarly, the range of an ammeter or milliammeter may be increased

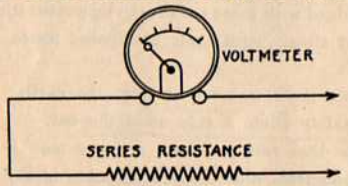


FIGURE 1

by using an appropriate resistance, which is connected in shunt or in parallel, with the instrument.

Increasing the Range of Voltmeters

To increase the range of a voltmeter, it is necessary to place a resistance of the proper ohmic value in series with the instrument. This arrangement is clearly shown in Figure 1. The series resistance will have a value depending upon the maximum scale reading required of meter and upon the internal resistance of the meter itself. The latter may be obtained from the maker of the meter on hand, who will supply data relative to their product upon request.

The application of the following formula when the internal resistance of the meter is known will make actual calculation very simple:

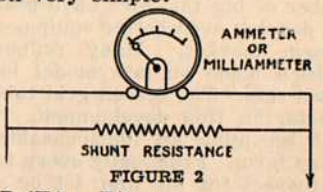


FIGURE 2

$$R1 = R\,\frac{(E1 - E)}{E}$$

R1 = Resistance connected in series with voltmeter.
R = Internal resistance of voltmeter.
E1 = Highest reading of voltmeter desired.
E = Highest present reading of voltmeter.

Thus, if we have on hand a voltmeter, the maximum scale reading of which is 100 volts with an internal meter resistance specified by its manufacturer as being equal to 100,000 ohms, and we wish to extend its range to indicate voltages up to 400 volts—

$$R1 = 100{,}000 \times \frac{(400 - 100)}{100} = 300{,}000 \text{ ohms}$$

Series Resistance = 300,000 ohms

To obtain the scale readings with this extended range voltmeter, multiply the indicated meter reading by 4 (400÷100) which gives the difference of potential across both the voltmeter and added series resistance.

Increasing the Range of Ammeters

To increase the range of an ammeter or a milliammeter, a shunt (parallel) resistance must be connected across its terminals, according to what maximum scale reading we desire of instrument. Figure 2 illustrates how the shunt resistance is connected across the meter terminals.

The value of the shunt resistance is easily determined from the following formula:

$$Rs = \frac{Ia \times Ra}{Is}$$

Rs = Shunt Resistance.
Ra = Internal Resistance of meter.
Ia = Original highest reading of meter.
Is = Current to flow through shunt.

The application of the above formula is, however, possible only if and when the internal resistance of the meter is known.

The principle underlying this formula is that the total resistance of a path consisting of two or more resistances in shunt or parallel is always less than the resistance of either one of the individual resistances. The current flow divides between the two branches; the sum of all the branches being the total circuit current. If we add in shunt to the internal resistance of the meter another resistance of equal value, the total resistance of the meter circuit consisting of the meter and the shunt resistance as shown in Fig. 2 is reduced to half the resistance.

If the value of Rs is equal to Ra, the meter scale is doubled.

The determination of the shunt resistance is comparatively easy. Let us assume Rs to be the required shunt resistance. Ra is the internal resistance of the meter. Ia is the meter current scale, I is the total current flow in the circuit and Is is the current which is to flow through the shunt resistance. As an example, let us assume a DC milliammeter rated at 0-30 milliamperes (.03 of an ampere) and 1.2 ohms resistance, the operating scale of which we wish to increase to 150 milliamperes (.15 of an ampere). Since the meter is capable of only passing 30 milliamperes, 120 milliamperes (.12 of an ampere) must flow through the external shunt resistance.

Applying formula No. 2.

$$Rs = \frac{Ia \times Ra}{Is}$$

I = .15 ampere
Ia = .03 ampere
Is = .12 ampere

If we consider Ra as the internal resistance of the meter and Rs as the resistance of the shunt, we determine the value of the shunt resistance by solving the following formula—

$$\frac{Ra \times Ia}{Is}$$

TABLE NO. 1.

Normal Range	2	3	4	5	6	7	8	9	10
2 volts A. C.	8 ohms	16	24	32	40	48	56	64	72
3 volts A. C.	18 ohms	36	54	72	90	108	126	144	162
5 volts A. C.	50 ohms	100	150	200	250	300	350	400	450
10 volts A. C.	140 ohms	280	420	560	700	840	980	1120	1260
15 volts A. C.	210 ohms	420	630	840	1050	1260	1470	1680	1890

Substituting our values, this formula reads Rs = 1.2 x (.03÷.12), or .3 of an ohm. In other words, a shunt resistance of .3 of an ohm will increase the range of the above mentioned instrument to 150 milliamperes.

With a known value of meter resistance and a known value of shunt resistance, the multiplying factor or the increase in current range is determined by applying the following formula—

$$\frac{Rs + Ra}{Rs}$$

Rs = Shunt Resistance
Ra = Meter Resistance

Applying this formula to our problem and substituting our values, we obtain

$$\frac{.3 + 1.2}{.3} = 5$$

In other words, the meter range is multiplied by 5.

TABLE NO. 2.

Shunt Resistance Required to Multiply Meter Scale by: 2, 3, 4, etc.

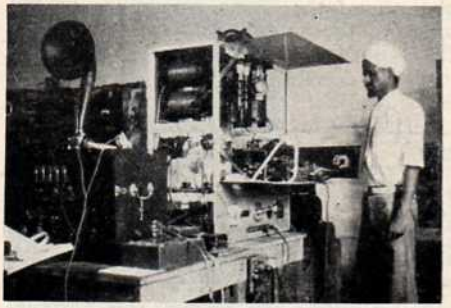
Normal Range	2	3	4	5	6	7	8	9	10
1 milliamperes	.27 ohms	13.5	9.	6.75	5.4	4.5	3.85	3.373	3.
1.5 milliamperes	.18 ohms	9.	6.	4.5	3.6	3.	2.57	2.25	2.
5 milliamperes	.12 ohms	6.	4.	3.	2.4	2.	1.715	1.5	1.333
10 milliamperes	8.5 ohms	4.25	2.835	2.125	1.7	1.416	1.213	1.062	.944
15 milliamperes	3.2 ohms	1.6	1.066	.8	.64	.533	.457	.4	.3558
20 milliamperes	1.5 ohms	.75	.5	.375	.3	.25	.214	.1875	.1666
25 milliamperes	1.2 ohms	.6	.4	.3	.24	.2	.1175	.15	.1333
30 milliamperes	1.2 ohms	.6	.4	.3	.24	.2	.1175	.15	.1333
100 milliamperes	1.0 ohms	.5	.333	.25	.2	.166	.143	.125	.111
150 milliamperes	.66 ohms	.33	.22	.165	.132	.11	.0942	.0825	.0733
200 milliamperes	.50 ohms	.25	.166	.125	.1	.0833	.0714	.0625	.0555
300 milliamperes	.33 ohms	.165	.11	.0825	.066	.055	.0472	.04125	.0366

Shunt Resistance Required to Multiply Meter Scale by: 2, 3, 4, etc.

Normal Range	2	3	4	5	6	7	8	9	10
500 milliamperes	.20 ohms	.1	.0666	.05	.04	.0333	.0285	.025	.02221
800 milliamperes	.12 ohms	.06	.04	.03	.024	.02	.01175	.015	.0133

N. R. I. Men The World Around!

In every land and under every flag N. R. I. men are studying Radio. In fact, there's not a single civilized country on the face of the globe that doesn't boast of at least one N. R. I. man. The influence of this world-wide body of ambitious men is evident. Below we want you to meet some of these men scattered in widely separated parts of the world—yet each a Radio authority in his own community:



Teja Singh, Selangor, Federated Malay States, is a coming Radio Engineer in the Malay Peninsula. Here he is shown operating station XMDI.

Roy Keith, 85 Queen St., Auckland, New Zealand, owns a nice Radio shop and writes technical Radio articles in his spare time for magazines. He is not half through the course yet.

Student George A. Johnson is with station BZL in Demerara, British Guiana.

Simeon Floro, Bulcan, Philippine Islands, finds it easy to take his Radio course along with college work. He is just one of a number of N. R. I. men in the Philippines with good prospects of a bright future in Radio.

Alfred Bauer, 134 Crown St., Glasgow, Scotland, is an N.R.I. booster. He's looking ahead to a big doings in Radio.

N. G. Motwane, Box 459, Bombay, India, is working with the local telephone and radio company while taking his course.

N. G. Matties, Atelier, Port Said, Egypt, like many other N. R. I. men in foreign countries, has found that the course not only prepares him for a career in Radio but that it also is a big help in mastering the English language.

ONE OF UNCLE SAM'S RADIO CARS

Graduate William Van Nostrand is Supervisor of Radio of the Fourth District with headquarters at Atlanta. The above picture shows the kind of laboratory cars used by supervisors and inspectors in making field experiments and checking up interference, etc.

Some very costly and elaborate Radio equipment is installed in these big cars. Graduate Van Norstrand paid us a visit this summer and gave the technical staff of the Institute an opportunity to inspect this "laboratory on wheels."

There are now 182 Government inspectors working under the supervisors, policing the ether and seeing that the broadcast stations keep on their assigned wave channels.