RADIO BROADCAST

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How Michael Pupin Succeeded

A Story Which Reads Almost Like a Chapter From Horatio Alger, Jr.—The History of "Immigrant to Inventor," Whose Electrical Inventions Have Greatly Aided Radio, the Cables, and Telephony

BY MYRA MAY

A STURDY, dark-haired boy, clad in a summer suit of clothes and wearing a red Turkish fez, crept close to a stack on an ocean liner during a particularly cold March crossing to America in 1874. He was a queer figure, this youngster of fifteen, minus the traditional mattress and blanket of the immigrant, with no friends or family aboard and only the warm smoke stack for company.

Yet he kept his courage, although he had only five cents in his pocket, when he landed at Castle Garden, at the Battery, New York. The genial sunshine, the activity in the harbor, the swarms of people, all thawed out his loneliness and augured that he had reached the land of opportunity. When he left the ship, he bought a prune pie from a vendor. The pie, however, proved a snare and a delusion. It was filled with prune pits instead of the actual prunes. Having spent his entire capital, he nonchalantly strolled up Broadway.

So Michael Pupin, now professor of electro-mechanics at Columbia University, and widely known as the inventor of the Pupin coil, entered America.

He had run away from home. Back in Hungary, he had been known as a bright boy who had too easily absorbed the nationalistic theories of the radicals and so had been transferred from his own local school to Prague. There, disgusted with the military spirit of the academy, he decided to run away to America. It was a sudden decision. There was no time to write home and discuss the plan, but time only to hurry to Hamburg where an immigrant ship bound for America sailed. To supplement his scanty funds, he sold his warm clothing,

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>
> —PROFESSOR PUPIN.

his books and even then, lacking sufficient money, he had to sell his heavy sheep's wool overcoat and cap to eke out his steerage fare. Then clad in the light summer suit—his sole remaining garment—plus the red fez, he came aboard.

Immigrants had to supply their own bedding. But young Michael Pupin, too poor to buy even a mattress and blanket for the hard bare floor of a third-class ship, hugged close to the smoke stack and fought off intruders. He had national traditions and five cents to bring to the new country.

Discharged from Castle Garden, Pupin looked with bewildered eyes at the clanging horse cars, at the thick network of telegraph wires overhanging the buildings, at the handsome new custom house, at the New York of 1874. Prague and Budapest had seemed bustling cities compared to his native village but the vastness of New York overshadowed even those cities.

Once in a Lifetime

The story of the success of Michael Pupin, who progressed from a poor immigrant, who landed in New York with five cents in his pocket, to a famous scientist known and respected by the entire world is one which can't be read very often. But a success such as his happens just frequently enough to assure the world that such things can happen, after all. It was not altogether by what the enthusiastic fiction writers call "sheer pluck and indomitable energy" that Pupin arrived at the position he now holds. There is a great deal of what we call ability involved. Professor Pupin, in addition to being a scientist of unquestioned standing and prominence, is personally, a tremendously good fellow, as any of his acquaintances will tell you. Miss May's story is published through arrangement with Charles Scribner's Sons, New York, who publish his autobiography, *From Immigrant to Inventor*. Many of the photographs used in this article are reproduced through the courtesy of Scribner's.

—The Editor.

TWO-FISTED AMERICANS

HE WAS soon accosted by a group of newsboys attracted by the novel fez. Pupin could speak no English, and the bully of the crowd, finding that he could not fight him with words, substituted fists. These Pupin understood much better. In his native Hungary, he had tended cattle and out in the open had learned wrestling from the sportive herdsmen. He was lithe and strong. It was not long before he had his adversary down on the ground yelling "enough."

"I then had my first introduction to America," Professor Pupin relates. "In Europe a crowd stuck together, putting up a united front against the stranger. Over here, on my first morning, the newsboys initiated me into the fraternity of fair play. When the boys saw that I had won the fight honorably, they cheered me and when a large official in blue suddenly appeared, they apparently interceded in my behalf, for the large official dropped his gruff tones, released my arm and even handed me my battered fez, torn and dusty from the scuffle. My adversary shook hands with me and as I swaggered back to Castle Garden the whole crowd cheered. I already liked America.

Even in far-off Hungary the fame of Franklin and Lincoln had penetrated. Now, while working on a Delaware farm—almost his first job—the immigrant boy learned the legends of Pocahontas, of the Jamestown settlement, the gallant Captain Smith, and many of the other blood-quickening tales of pioneer America.

IN PHILADELPHIA LIKE FRANKLIN

THE lessons which I learned from my farm teacher seemed to prove that America was a great country with equal opportunities for all if we could only take advantage of them," Professor Pupin says. "I made up my mind to find new opportunities for myself, to leave the Delaware farm and to journey to Philadelphia."

"I had compared myself to Benjamin Franklin, whose story I loved because he had been my incentive in coming to America and because he had first awakened an interest in electricity. I made my entrance into the town in the most approved Franklin manner, walking along the street eating a roll. Although I wandered five days I could find no work. I was ready for opportunity but it seemed to have passed me by. My heavy farm boots were almost worn out from hard use I had given them while I searched for a job. My ten dollars—wages I had brought from the farm—was nearly gone. As I sat in Fairmount Park and ate a big Philadelphia bun, I reflected that even Franklin with all his hardships, had been an American and had known the printing trade and all I knew was

how to drive mules. While I moodily speculated on my difficulties, a farmer approached me and offered me a job driving mules. I accepted and once more left for the country."

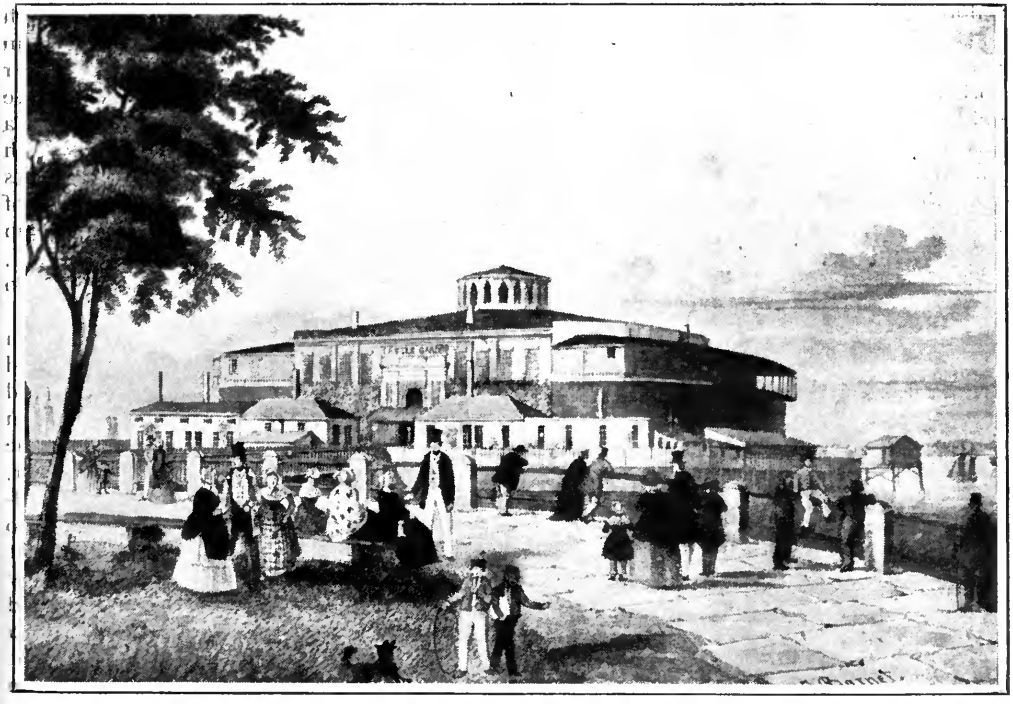
But the farm was hot, the opportunities to learn English or a new trade negligible, so once more Pupin took up his wanderings. From the farm in southern Maryland, he journeyed to Baltimore and thence to New York. In those days before the Pennsylvania tunnel, trains deposited their passengers at Jersey City and a ferry took them over from there to New York. Along with the rest of the crowd, Pupin was landed in lower New York in the heart of the shipping district.

As he walked uncertainly through the unfamiliar neighborhood, he saw a small hotel with a German name. It was an oasis in a region of strange sights and sounds. The proprietor had a son about Pupin's own age and the two became friends immediately.

Pupin's funds were so limited that the two boys decided their first consideration must be to get him a job. This, however, was no easy matter. During the previous year the entire country had suffered from the great panic of 1873. This was the summer of 1874, but the country was not yet settled again. There was widespread unemployment. No matter how early the two boys went in response to advertisements for labor, they were sure to find long lines ahead of them. In those gloomy days men were so desperate they waited all night at the newspaper offices so that they could read the "help wanted" inserts in the first editions and stand all night in line to apply for work the next morning.

Pupin and Christian, the son of the hotel keeper, soon discovered that the erstwhile farmhand would never get a job in this way. More drastic methods were necessary in a neighborhood so close to the shipping center. The opportunity finally presented itself. During a strike of longshoremen, Christian, who acted as Pupin's business manager, signed up his client as a scab.

"My job was to help the sailors paint the ship," Professor Pupin remembers. "Partly as a means of protecting us from the strikers and partly as a means of getting the work done quickly, we substitute workers were out in the bay. Of course, I knew nothing about painting but bitter need for employment will give us ability to do almost anything. At the end



CASTLE GARDEN, NEW YORK

Where Pupin landed from the German immigrant ship in 1874. Castle Garden has since been converted into the Aquarium and immigrants no longer land there, but down the Bay at Ellis Island.

of three weeks, when I returned to the little German hotel and my friend, I was a full fledged painter with thirty dollars, which was more money than I had ever earned before.

My new found work was short-lived. Christian left town for a Western city and I, with my best friend gone, was no longer interested in the German hotel. I rented a small room near Cooper Union, in an entirely different part of New York.

WHERE HIS STUDY REALLY BEGAN

THEN I started hunting work as a painter. Conditions were hopeless; more than a year had passed since the great panic, and labor was still a drug on the market. I tramped the streets from early morning until the last shop closed, but I could not find employment. My little hall bed room was so unfriendly that I formed the habit of spending my evenings at Cooper Union. Here I first read of the mysteries of science and tried to reason out the phenomena of sound and light.

"After I had hunted work in vain for several weeks I finally created a job for myself. I followed coal wagons and when the coal was dumped in front of its destination, I would offer to put the coal in the cellar for fifty cents a ton. It was back-breaking work. I frequently toiled two days to make a half a dollar. But when it was over, I could buy a bowl of filling bean soup and a chunk of brown bread for five cents at the Bowery Mission, so I never starved.

"When the coal was in the cellar I would suggest that I paint the walls and ceiling of the basement. My story of being a journeyman painter out of work and forced to carry coal for fifty cents a ton was so heartrending that owners were often glad to help me by giving me painting jobs. Carrying coal and refurbishing damp, dismal cellars were not cheerful occupations for the winter, you will admit."

In the spring, Pupin paid a return visit to the German hotel keeper. He was full of sympathy for the unfortunate immigrant and promised to get him a steady job. Within a few days he had made good his word. Pupin had a position in a cracker factory, working with a squad of boys punching the name of

PUPIN'S BIRTHPLACE

In Idvor, in Banat, Hungary. The house is the first on the left. Pupin left his native Hungary in 1874 to come to this country where he landed with scarcely a cent in his pocket

the company on sweet biscuits. It was not the mechanical act of pressing the name on the crackers that interested him, for that merely required a certain manual dexterity. It was the boiler room in the factory that fascinated seventeen-year-old Pupin.

Early in the morning, before the factory whistle blew, he was shoveling coal, watching the fires, and learning engineering from the fireman. There, in the boiler room, he had his first lessons in engineering. He was puzzling over the phenomena of light and sound, but the boiler-room professor could not shed much light on his difficulties.

A BOILER SHOP SCHOOL

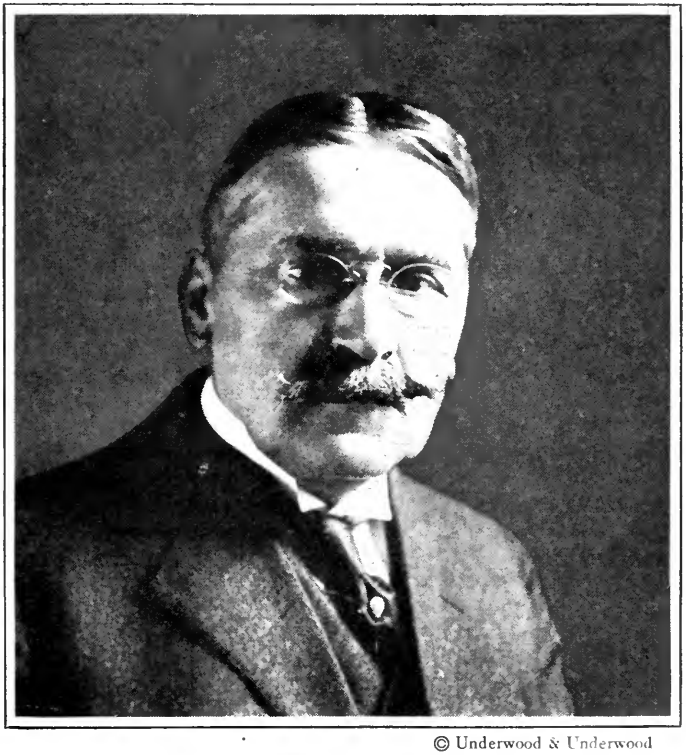
THIS improvised school, with its science department in the basement, had a classical course which was given on the top floor. In a philanthropic attempt to utilize some waste space to the advantage of the workers, the company had made sleeping accommodations in the attic of the factory. Pupin, a homeless waif, lived in this make-shift dormitory. One of his roommates was a crippled German student with a remarkable knowledge of Greek and Latin, a veneration for ancient civilization, and a contempt for modern industrialism. He instilled in Pupin a love for the classics. At the close of the factory day the two machine workers forgot their manual labor during the long mill hours, and recited Latin prose and reveled in the sound of Greek verse.

Naturally under these circumstances, Pupin longed for more education. He had no money to pay for college tuition. But a boy who had taught himself the ways of a new land could find the means to get further education. He did. The factory was his high school. For a science laboratory, he used the boiler room and for his classical subjects, he had an expert tutor in the German scholar. In his Columbia College entrance examinations he did so brilliantly that he was given a scholarship for the entire four years.

College over, Pupin was offered his choice of a fellowship in either literature or science. His record in both departments had been equally high, but he chose the science.

"When I was a little sheep herder in the old country," Professor Pupin confides, "we used to warn each other about straying cattle by means of signals which we sent by tapping on a knife stuck deep in the hard ground. I had observed that the sound was carried for greater distance through the hard ground than through the air. I could not understand why. It was a problem that fascinated me so that when I had the chance to continue my studies, I selected science in the hope that it might answer my question."

In Europe, Professor Pupin worked at Cambridge and then studied for a doctor's degree at Berlin. Meantime Columbia University, his alma mater, had organized a department of electrical engineering in the school of mines. When Pupin heard of it, he applied for the position. Needless to say a student who had made his brilliant college record, who had won scholarships in Europe, was promptly given the post at Columbia.



A RECENT PHOTOGRAPH

Of Professor Pupin, who now holds the chair of mathematical physics at Columbia University

A PROFESSOR AT COLUMBIA

THE physical equipment of the new department was primitive. There was only a temporary shed, a "cowshed" the students called it, with a laboratory equipment of a dynamo, a motor, and an alternator. It seemed a hopeless prospect to the young teacher fresh from the marvels of European science but his enthusiasm was such as to conquer all difficulties.

"From my studies of the experiments of the European physicists, I concluded that sound, like light, traveled by the vibrations being carried from one wave to the other, reinforced by each wavelength. I believed that by shortening the length of the wave, the sound could be carried further and on this basis I perfected my induction coil. By using three or four coils to the mile on a long-distance telephone wire, the size of the wire could be considerably reduced. Not long ago, a friend of mine, a telephone executive, figured that my invention had saved the telephone company about a hundred million dollars and went on to say that without it long-distance communication could never have been greater than about twelve miles."

PROF. M. I. PUPIN
In 1883 when he graduated from Columbia University

Professor Pupin has not only cradled the art of long-distance telephonic communication but he is responsible for six out of the nine basic radio inventions. In 1895–6, while he was an assistant professor at Columbia and working in the derided "cowshed" laboratory, he evolved an apparatus for electrical tuning and rectification, and in 1902 he sold his patents to the Marconi Company. This fact is not generally remembered.

Professor Pupin, fresh from his European studies, had become much interested in the theories of Hertz, the father of radio, and had begun experimenting with them. At that time, the rectification electrical transmission of sound was not known, the waves brought an indistinguishable buzz which Professor Pupin hoped to make audible. After a year's experimenting, he succeeded.

Sounds which the waves brought could now be understood. But the growth of radio had only just begun. Professor Pupin, who nurtured radio in its infancy, brought it still another step forward. He suggested modifications which transformed these explosive electrical motions into more or less damped oscillations.

All of us know to-day that when our receiver is not in resonance with some particular transmitter, we simply turn a knob to get the desired wavelength. But in the 1890's tuning wasn't so simple. In fact, troublesome wavelengths were one of the biggest drawbacks to the science. Professor Pupin undertook to correct this deficiency. Through exhaustive experiments, he devised an apparatus which superimposed these waves and got them in phase.

"The electrical tuning at the receiving end, as we know it, came into use when Marconi took over my invention of electrical tuning," Professor Pupin explains. "Selectivity was thus introduced into wireless reception and it eliminated some of the objections to the new form of electrical communication. Rectification of the received electrical oscillations by crystals of asymmetrical conductivity, or by my balanced electrolytic rectifier was the next advance."

A TEACHER OF FAMOUS MEN

AS A teacher, Professor Pupin has started many of our most famous radio figures on their triumphant way. At one time three boys were working under him for their doctor's degrees. They were E. H. Armstrong, J. H. Morecroft, now of Columbia University, and Alfred N. Goldsmith of the College of the City of New York. It was in Professor Pupin's laboratory at Columbia that Armstrong successfully developed his feed back circuits. It was in Professor Pupin's laboratory

that Robert Andrew Millikan began his scientific career.

Pupin, this famous teacher of famous men, exhorts boys everywhere to "monkey with their sets."

"The more boys work with their apparatus, the more knowledge of the science of electricity they will obtain, and the more will their interest in the marvels of radio be aroused," he says. "Radio is the coming science, and if its disciples attain as much practical experience and grounding in electrical principles as is possible to crowd into their lives, they can be sure of making progress."

During the war, Professor Pupin did research work for the United States Government in radio communication. His results became government secrets and outside of the fact that his war activities necessitated many trips to Key West, the world knows nothing of his work. As a product of his activity at this time, he helped organize the third arm of our national defence—the National Research Council, an organization of scientific men with headquarters in Washington.

The story of America contains many epics of boys who, beginning at the bottom, struggled to the top, but none illustrates more clearly than this one the chances for a penniless, working boy to achieve a technical education and to become a power in the scientific world.

THE CHURCH
Where Pupin worshipped as a young boy in Idvor

The Way of the Transgressor

A Word About Common Deceptions in the Sale of Tubes, Batteries, Antennas, and Complete Sets—Some Guides for the Tyro Wandering in the Radio Forest

By WILLIAM P. GREEN

Associate Director of the National Vigilance Committee, Associated Advertising Clubs of the World.

PROBABLY the most outstanding instance of outright fraud in radio today, is found in the manufacture and sale of counterfeit tubes, both in tube construction and in fake labels and cartons. The counterfeiting at times would almost baffle an expert.

In some instances former employees of large electrical manufacturing concerns which hold tube patents are ferreted out as members of these counterfeiting rings. They hold forth in secluded spots, sometimes in the rear of a garage or perhaps in a private residence. No signs are in evidence to indicate what is being done on the premises. Frequently the blinds are drawn. In many cases investigators have found it difficult to secure entrance at all, visitors being required to state their business in a front hallway or even out on the sidewalk. As many as eight hundred tubes a day have been manufactured in one of these places alone.

Recently a complaint was made to the National Vigilance Committee that a concern in a middle western city was selling tubes represented to be genuine Radio Corporation of America products, under circumstances that appeared suspicious. Tubes were purchased at the store and forwarded east for examination. This examination showed that the grid, plate, and the glass bulbs were not genuine R. C. A. products. The bases were the genuine article. The use of the base in this way made it possible for the tubes to be sold with every appearance of being a genuine Radio Corporation product.

Occasionally the practice of buying up worn out tubes of standard make, in order to secure the bases, is discovered. Add to the base a counterfeit filament and other essential parts and the finished product has all the appearance of the genuine article. Even the identification mark, such as the well known General Electric circle frequently is counterfeited. The counterfeiting of the cartons and the directions accompanying standard make tubes usually is accomplished by means of the ordinary photographic plate process.

One manufacturer of counterfeit tubes may sell to many distributors. As a general rule the distributor knows what he is buying and when questioned about the tubes he is marketing, he refuses to disclose the source of supply.

The manufacture of counterfeit tubes is, of course, outright fraud. It is not to be classed with many other forms of deception and trickery that put in an appearance.

REPAIRED TUBES

THIS counterfeiting of tubes is one of the handicaps in radio to the removal of which manufacturers and retailers are devoting much attention.

Some concerns advertise that they will repair radio tubes and this raises the interesting point of whether the tube actually is repaired

Truth in Advertising

Is the splendid slogan of the Associated Advertising Clubs of the World, and this forms the second of a series of excellent articles by Mr. Green, an official of that organization, on common deceptions in radio merchandising and advertising, all of which are violations of faith, whether the deceptions are committed intentionally or otherwise. The first of Mr. Green's articles appeared in RADIO BROADCAST for August, 1924, and discussed fraudulent practises in selling complete radio receivers. The Better Business Commission, which is now organized in 36 cities in the United States, has also in some cities taken steps to insure that radio dealers abide strictly by the highest code of professional ethics in their advertising and merchandising. Neither this magazine nor Mr. Green wish to give the impression that the radio business is full of irresponsible and conniving dealers. That there are not more dealers whose methods are not above reproach is remarkable, considering their now large numbers. Every one who buys radio apparatus should be interested in what Mr. Green has to say.—THE EDITOR.

or a new tube constructed on the old base. This question is closely concerned with the patent rights of the leading manufacturers of tubes.

There is one Federal decision which holds in effect, that the replacement of a vital part is a violation of patent rights.

Most certainly the filament of a vacuum tube is the vital element of the product (said an official of the Radio Corporation of America in discussing this question). It is the part that emits the electrons, producing the actual phenomenon of detection or amplification. There is no substitute that can be used for this filament. If it is omitted, no results whatever will be obtained. In most so called repair work, the replacing of the filament is not the only thing that is done. A new vacuum must be obtained to permit the electrons to pass from the filament to the plate. The tube, therefore, must be evacuated anew and, as a matter of fact, it costs almost as much to repair certain tubes on a commercial scale as it does to make a brand new product.

L. E. HOLLAND

Who is serving his third term as president of the Associated Advertising Clubs of the World Himself an ardent radio enthusiast, Mr. Holland has been keenly interested from the beginning in the protection of the radio industry and the public from deceptive merchandising and advertising practices

This question of tube manufacture and repair still is fraught with some uncertainty. The chief interest of the consumer is in the question of whether tubes are genuine or counterfeit, actually repaired or completely rebuilt, and, in any case, whether the result, as determined by actual use, is in accord with the representations made by the advertiser. The average consumer is not much interested in patent rights or infringements. What he wants to know is whether the merchandise he buys is what it is represented to be, in name, quality, and utility.

Still other conditions which vitally affect the public are coming in for consideration. Perhaps the most interesting of these is the cut price situation. Some retailers, as a steady policy, offer sets at prices on which the manufacturers claim the retailer cannot possibly make a profit. These manufacturers do not claim that the merchandise is not always genuine or that it is defective, although many purchases have been traced where such was the case. Their chief contention is that in some instances cut price merchandise is offered as a leader in order to bring the customer into the store as prey for the sale of other inferior goods. Undoubtedly it is true that radio offers a fertile field for certain types of "bait advertising" because of the number of accessories needed with a set. In many cases the total cost of such accessories equals or exceeds the cost of the set itself.

The source of supply of cut price merchandise is a constant problem with the radio manufacturer. Much of this cut price merchandise is secured through indirect channels. The retailer asks some friend in a distant city, who happens to be in good standing with the distributor, to order certain goods which, when received, are relayed to the retailer desiring them. Another source of supply is the overstocked retailer who, when a representative of a cut price store appears on the scene, is glad to unload at a price approximating the manufacturer's.

One retailer, whose chain of radio stores features cut price merchandise, maintains that the radio manufacturer's profits are in proportion to his sales and that the retail price is not a factor in his profits at all.

MORE THAN A SHADOW OF DOUBT

Extravagant claims, which in many instances, actual trial shows to be unjustified, breed certain dissatisfaction and tend to impair the enthusiasm of radio purchasers. The radio public itself should cooperate to require advertisers to tell the truth about their products

"If the manufacturer maintains a sentimental attitude as to how his goods shall be priced by the retailer," he argues, "let him total his cash book at the end of the year and he will find that the radio chain store quite probably has moved one hundred times as much merchandise as the collection of small jobbers."

Careful reading of magazines and newspapers continues to disclose practices which bear out the statement that radio is passing through a period in which the buying public must exercise great caution and discrimination. Take as an illustration a recent advertisement of a well known battery by a retail store. It read——

We are the only dealer in the city in a position to supply the public with unlimited quantities of this

NEW

108 volt B battery

The fact was that this battery, instead of being a new model, was being discontinued. The agency handling the advertising copy explained that the word "new" was intended to mean that the batteries were fresh from the factory and that "unlimited" meant that enough were available to supply the store's trade. Certainly the word "new" in the copy was objectionable because the average reader might well take the advertisement to mean that the manufacturer was bringing out a new model.

THE OVER-ENTHUSIASTIC ADVERTISER

NOW and then advertisers inadvertently get off on the wrong foot. Around the time of the national political conventions, an eastern manufacturer of radio sets advertised in newspapers on the Pacific Coast, urging the public to buy his product in time to listen in. Investigation developed that Kansas City was the nearest point from which the conventions were being broadcast and the feat of reaching that far east from the west coast during the day time, when range of reception is very limited, was anything but a certainty. Again we have the manufacturer of a well known loud speaker, whose advertising in the middle west emphasized the pleasure to be derived from listening in on New York grand opera. It is well known that the Metropolitan company is not heard over the air.

Another case in point is the loose statements made about "noisy batteries." One radio expert to whom the writer talked recently stated that such noise practically never occurs in batteries used for filament supply but that it sometimes is found in plate batteries. The cause is either a defective cell in the battery, or a loose connection between the cells. Almost any dry cell, he pointed out, even those of the most reliable makes, may develop noise when they are nearly used up.

Other extravagant claims are made concerning the life of batteries. This is a difficult factor to determine, and it is here that batteries of different manufacture may be expected to vary materially if at all. Only usage can determine the real utility and life of any particular battery with consideration, of course, for proper care. This is all the more reason why purchasers of radio equipment should give real consideration to the makes and types of batteries they purchase for their sets in order that they may have the maximum protection on the money expended.

Claims for new and startling discoveries in the battery field likewise should be carefully examined. Years of study have brought them to their present point of efficiency and most of the possible improvements could hardly be called revolutionary.

Within the last year one concern has advertised that its batteries will enable the operator of a radio set in the middle west to hear England or South America as clearly as Detroit or Chicago. The advertising copy was so worded as to make it appear that whatever troubles are encountered with a set may be removed by substituting the batteries ad-

vertised for those in use. This is obviously absurd.

Another type of advertising into which the public should inquire carefully before purchasing the goods advertised is that offering various indoor aerials either of the loop or single wire type. Representations that such aerials will equal or outdo the results obtained with an outdoor aerial, regardless of the type of set used, are not always justified, as shown by actual experience in certain locations and under varying conditions. Results obtained at close range may not be possible at all over long distances and it would be well for purchasers to have a very definite understanding that the merchandise may be returned if it does not live up to the claims made for it.

Then again, we often hear mathematics spoken of as an exact science. One might reasonably conclude from this that statements in radio advertising that are based on mathematical calculation could be taken without the proverbial grain of salt. That such is not always the case, however, was demonstrated recently when a well known radio store advertised a standard make receiver at half price, with the added attractive offer that with each purchase an extra piece of apparatus, designed to increase signal strength, selectivity and to improve tone quality, would be given *free*.

Price figures were set out in detail, as illustrated in the following:

List price of receiver	$150.00
List price of extra unit	25.00

Now if the receiver were being sold at half price, and the extra unit given free with each purchase, the customer would have to put on the counter only $75. to be entitled to the complete outfit. On the contrary, however, the price quoted was $87.50. Either the receiver was not being sold at half price or the extra piece of apparatus was not being given free to each purchaser of a set. The advertising agency explained the discrepancy by saying that a mistake had been made in the figures.

BUY CAREFULLY

RADIO BROADCAST, through its columns, is endeavoring to inform the public concerning practices by reason of which purchasers of sets and accessories should shop carefully. The National Vigilance Committee of the Associated Advertising Clubs of the World recently prepared a resumé of practices which may be useful to the radio public in reading radio advertising and in making purchases on the strength of it. This resumé is as follows:

1.—Appropriation of radio tube type numbers, or any substantial or material part thereof, such numbers having been originated by and become identified with the products of certain well-known manufacturers is a form of unfair competition. Illustrations of such original type numbers are "WD-12", "UV-199" and "201-A" as applied to the tubes of the Radio Corporation of America, and "DV-2" as applied to the tubes manufactured by the De Forest Radio Telephone and Telegraph Company. Tubes manufactured by any other companies should be advertised and sold under their own original and distinctive identification marks.

2.—Sets built by retail stores and containing certain licensed parts bearing the names of well-known manufacturers of sets using the same circuits, should be advertised and sold in such a way as to make it perfectly clear to the public that they are store built rather than factory built. Neutrodyne sets are a case in point.

3.—When a concern seeks to advertise any type of radio product concerning which there is reason to believe that the patent or license rights do not permit the manufacture or sale of the product, the concern should be required to make a reasonable showing that it is within its legal rights and entitled to market the merchandise.

4.—Claims for radio apparatus, such as distance reception, should in most cases be based on average performance rather than some rare, exceptional feat. If the exceptional instance is featured, the advertis-

SPECIAL OFFER
FOR TODAY ONLY

THE SENSATIONAL COLUMBIA REFLEX

At the Unheard-of Price of

$79.50

DOES THIS MEAN WHAT IT SAYS?

In going to a store in response to an advertisement like this, it is important to observe whether or not the retailer has on hand a sufficient number of these sets to fill a reasonably popular demand. Often only one set, advertised as the sample ad above shows, are being offered as bait to get the public into the store. The customer should be careful to see that the accessories he buys with the set are genuine and recognized by the trade as efficient products

WHICH IS GENUINE?

The only distinguishing mark between the two tube cartons cannot be detected in the photograph. The carton on the right is genuine and the one on the left is counterfeit. The tube which came in the counterfeit container was counterfeit. The color of ink on the genuine container was a deeper red than the false one

ing copy should make clear the fact that the same result is not to be expected in average day to day performance. Much disappointment and dissatisfaction may be avoided if radio novices are given some information in advance that atmospheric disturbances, seasons, and other conditions affect radio reception.

5.—Merchandise advertised as being reduced from a certain list price and represented as possessing the list price value, should carry all of the advantages, such as factory guarantees and repair privileges, to which any purchaser who buys at the regular list price is entitled. Otherwise the customer is not getting the complete service or value that is included in the regular list price quoted in the advertisement.

6.—Advertising of radio sets should state what accessories, if any, are included at the price quoted, and if accessories are not included, this should be apparent from the wording and arrangement of the advertising copy.

7.—Claims as to batteries and other accessories should accord with such limitations of performance as recognized scientific opinion in the industry has determined that the purchaser may reasonably expect from a particular type of product. Guarantees, refunds and other sales appeals should be free from the ambiguity or tricks that sometimes make them the source of current dissatisfaction and a future distrust of advertising.

8.—When a set is advertised at a reduced price after the model has been discontinued by the factory, it should not be represented as still possessing its regular list price in a way that leads the public to believe that it is securing a much better current value than actually is the case.

9.—When any particular piece of radio merchandise is featured through advertising as a leader, the concern should be required to have a sufficient supply on hand to fill a reasonable public demand.

10.—Claims for the efficiency of indoor aerials, as compared with outdoor ones should be made with due consideration of the types of radio sets to be operated, distances from broadcasting stations, location of the aerial or loop in the buildings where used, etc.

11.—Advertising of radio devices to reduce station interference should not infer that any number of broadcasters may be eliminated at one time, when such is not the case. Claims of the perfect operation of such devices should be made with due regard for usage under exacting conditions, in that such merchandise usually is purchased by reason of unfavorable location, or out of date receiving apparatus, etc.

12.—In advertising radio accessories, such as dry batteries, which show certain shelf depreciation over a period of time, use of the word "new" should carry with it a clear indication of whether reference is being made to a new model of the article involved, or merely to the receipt of new stock, fresh from the factory.

What Reflex Means

How One Tube is Made to Do the Work of Two—Problems of Reflexing and How They Are Solved—Various Uses of Reflexing—Another Family Tree Diagram

By JULIAN KAY

THIS article in this series of informative articles about some of the technical phases of radio written in a decidedly non-technical fashion deals this month with the use of reflexing. The patent on the reflex system dates back to February, 1913, when Schloemilch and Van Bronck had their application approved. There are few who have heard something about radio who haven't also heard the word "reflex." Many radio listeners want a good review of reflexing and that is just what Mr. Kay has done. Other articles in Mr. Kay's "What's In a Name?" series have discussed the various classes of receivers in use, radio-frequency amplification, audio-frequency amplification, and the super-heterodyne.—THE EDITOR.

THE old song that "every little bit added to what you've got makes just a little bit more" applies nowhere in radio quite so well as in this reflex business. Given a small pocket book and a long way to go via radio, what is one to do? The answer is to add just the little bit more—and that is what reflexing effectually does.

In the preceeding articles of this series, the various forms of detectors and amplifiers have been analyzed as separate units. Some mention has been made of complete receiving equipment such as the neutrodyne and the heterodyne, both of which are really efficient combinations both of detectors and amplifiers. It is in the latter class of complete receivers that the reflex lies.

The Family Tree diagram on page 672 shows the place of the reflex among radio circuits. It is a combination, a sort of trick combination if you will, of a detector and two amplifiers. The reflex idea may be extended to other complete receiving systems, such as to the neutrodyne, for example in the Fada 160, or to the super-heterodyne as in the Radiola.

The main idea of reflexing is to do away with one vacuum tube, to make one do the work of two. And while it is fairly simple to build a detector and an amplifier as separate units, it is a more difficult problem to build a reflex that works as well as the more complicated apparatus it replaces. Unless the reflex is correctly constructed from tried and true methods it will lose as much or more than it gains—a state of affairs that is not true economy.

Fig. 1 shows the general scheme. Energy from the output of the circuit is fed back into the input so that the apparatus involved does double duty. The necessity for the frequency changer lies in the fact that one cannot perform this feeding back stunt without having something happen—a something usually made evident by howls and groans. In other words, the amplifier oscillates.

A SIMPLE FORM OF REFLEX

A SIMPLE form of reflex with which everyone is familiar is the well known "tickler" feed back affair. In this case, shown in Fig. 2, some of the radio frequency energy is placed in the input again by means of a coil inserted in the output or plate circuit. If the tickler is brought near enough to the secondary coil, the system oscillates. The remarkable amplification that results just before oscillation takes place is well known.

If the same scheme could be applied to audio-frequency amplifiers, much more amplification

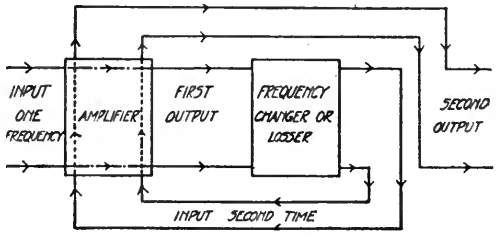
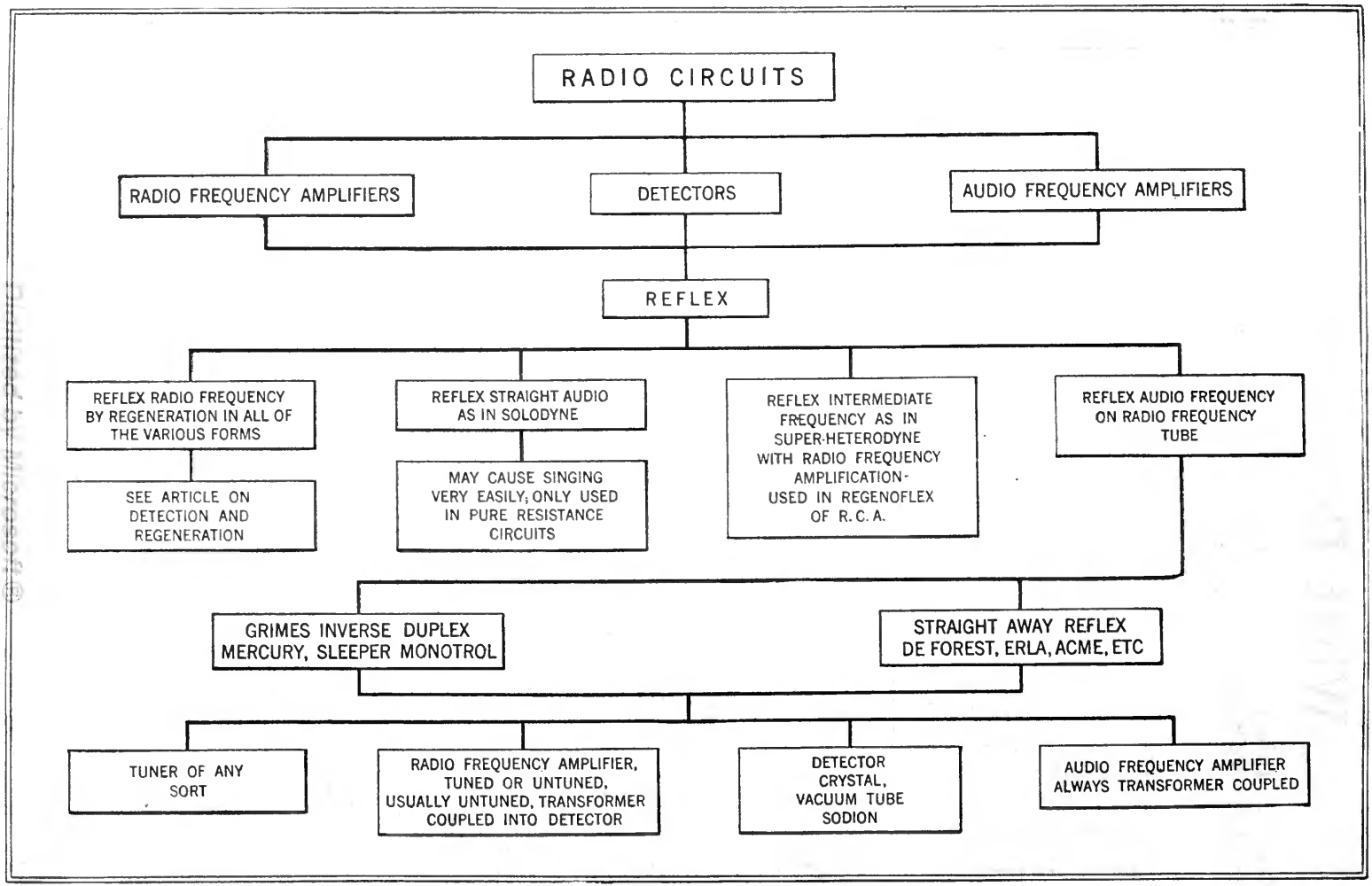


FIG. 1

The reflex idea. The main idea in all reflex circuits is to make one tube do the work of two



THE FAMILY TREE FOR REFLEX CIRCUITS

might be expected. Here, however, we are dealing with a different problem. In the tickler case we are interested in a very small percentage of the total frequency, that of the incoming signals, say one million cycles. The tuning is so adjusted and the position of the

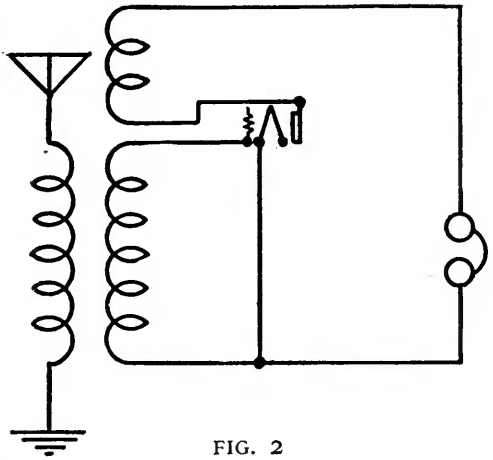


FIG. 2

One of the simplest forms of reflex and one of the best known. The coil in the plate circuit is known to all users of regenerative sets. Some of the radio frequency energy is fed back again through the tickler coil to the primary circuit

tickler so arranged that oscillations over this comparatively narrow band can be controlled.

In audio-frequency amplifiers, however, we are interested in the uniform amplification of the whole band of frequencies from fifty to several thousand cycles. If the tickler were adjusted for one particular frequency, oscillations would probably occur at another. For code reception where all signals can be brought to a single audible note, say 1000 cycles, the audio amplifier may be made to regenerate in this fashion with remarkable results.

In the case of the resistance-coupled amplifier, as illustrated in Fig. 3, part of the output energy of one tube is sent around the circuit again. There are certain precautions that

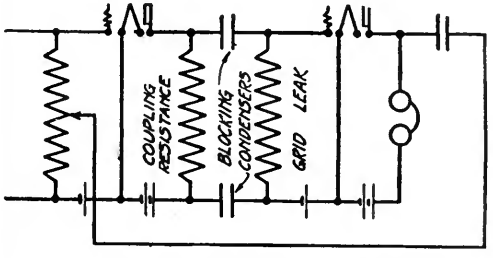


FIG. 3

Reflexing in a resistance-coupled audio-frequency amplifier

must be taken before such a scheme works, precautions with what the engineer would call the "phase relations." In general such feed back is undesirable because of the difficulty in controlling the system.

WHEN AMPLIFIERS OSCILLATE

AUDIO-FREQUENCY amplifiers very frequently do oscillate, a result of some undesirable coupling between the output and the input. A high pitched squeal may betray this state of affairs, but often the oscillations take place at a frequency above audibility. Lack of amplification and some distortion is the result. It is for this reason that all grid and plate leads in multi-stage amplifiers should be as short and as far apart as possible.

In practice, then, a frequency changer follows the amplifier that is to be reflexed and it is the greatly changed frequencies that are returned to a preceeding part of the circuit to go the rounds again. Fig. 4 shows the general principle. Incoming signals are sent through a radio-frequency amplifier where they are boosted in amplitude. They are then changed

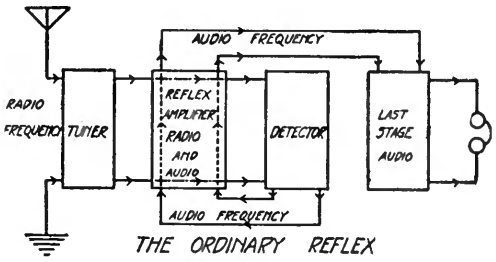


FIG. 4

A schematic diagram of the application of the reflex principle to a common type of circuit. The paths of the various frequencies are made quite clear by the arrows

in frequency by the detector and are sent back to the first amplifier. This first tube, as in the Roberts Knockout circuit, has currents of two widely different frequencies flowing through it—so widely different that no interaction occurs. For instance at 300 meters the incoming signals have a frequency of around one million cycles, at least one hundred times greater than any audio-frequency tone that will be amplified.

The detector may be any one of the various forms. Quite often a crystal is used, although louder signals will result from using a tube detector. The crystal is somewhat tricky in adjustment, a fact that has some bearing on the tuning and upon the quality of signals, as will be explained later.

The advantage of the reflex trick is obvious. With two tubes, one used as a detector and the other functioning as both radio- and audio-frequency amplifier, we get results equal to that when three tubes are used. This reduces the first cost of the set by one third and at the same time decreases the space required as well as materially lessening the battery upkeep.

REFLEXED SUPER-HETERODYNE

ONE of the best examples of reflexing is that performed on the super-heterodyne. Fig. 5 shows how the idea is applied. Following the first amplifiers, the frequencies are materially reduced by means of a detector and are then fed back into the amplifier whence they go to other intermediate-frequency amplifiers. Another stage of reflex might be applied as the dotted lines show, but the trouble from oscillations and from overloading probably would not warrant this decrease in tubes.

THE INVERSE DUPLEX

THE Inverse Duplex credited to Grimes is a good example of a complicated reflex, as shown in Fig. 6. In this case radio signals are amplified twice. Then the detector output of low frequency is fed back into the second radio amplifier, thence into the first radio amplifier and finally into an audio stage all its

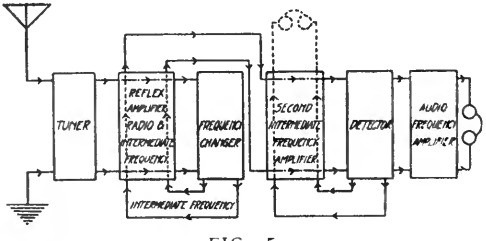


FIG. 5

A schematic diagram of the Radio Corporation reflexed super-heterodyne. Some very delicate and rather difficult technical problems are involved in making a circuit of this sort commercially practicable, but it was done by Messrs. Armstrong and Houck of the Radio Corporation

own. The "inverse" idea comes from the fact that the second stage of radio is the first stage of audio, and the first stage of radio is the second of audio—just try and figure that out!

Other reflexes are shown on the Family Tree diagram and do not differ materially from those described.

REFLEX TROUBLES

THE only advantages in the use of reflexing lie in the economy of apparatus and space effected. Electrically there is no advantage in performing three operations in two tubes in place of three. In fact, unless considerable care is taken, there are several disadvantages. For the fan, however, who is cramped for funds, who wants to get "just a little bit more" out of his apparatus, the reflex is the thing. RADIO BROADCAST has taken considerable pains to perfect the Roberts circuit which works and works remarkably well. By following the detailed directions that have been given for its construction, any one can have

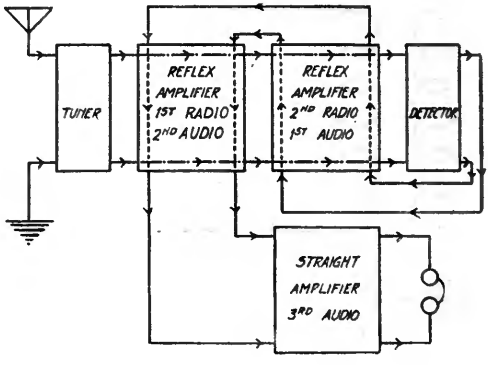


FIG. 6

The inverse reflex system usually known by the trade name as the "inverse duplex"

an unqualified success with the circuit. The other fellow has done the experimenting on it, it is now on a *pro bono publico* basis.

There are several inherent disadvantages in the reflex scheme. In the first place there are currents of widely different frequencies in the amplifier tubes. It is not the fact that these frequencies are far apart that matters, for therein lies its success, but the fact that the tubes are doing double duty. Their plate circuits are traversed by two currents, either of which may be enough to overload the tube.

Receiving from a local station may cause the entire straight portion of the tube "characteristic" to be used. Addition of more voltage from any source may cause the curved portion of the characteristic to be used—and this means modulation or distortion.

Overloading is particularly liable to take place if high ratio transformers are used. This effect was described in the article on audio-frequency amplifiers in RADIO BROADCAST for November, 1924. The remedy, of course, is the proper C battery and a lower turn ratio. As far as the writer knows there is no very high ratio transformer on the market to-day with a proper characteristic, so that one is safe only by avoiding the "10 to 1" coils.

Another defect is the introduction of high

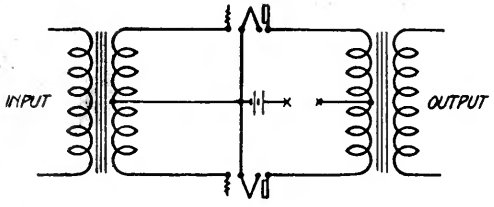


FIG. 7

The usual push-pull audio-frequency amplifier circuit. A special case of the push-pull circuit is discussed in the accompanying article

resistance into the various circuits, either through the transformer winding or by the crystal detector. This makes tuning broad, and in the crystal case it makes the tendency toward oscillation somewhat greater. For this reason, potentiometers are used to make the amplifier grids positive—a bad practice at best. Every adjustment of the crystal changes the resistance in the circuit, and necessitates readjustment of other parts of the set. Under certain conditions better signals may be obtained by removing the crystal contact, a sure sign that something is wrong. Often a point may be found that gives loud signals which if used in an ordinary crystal circuit would not be sensitive at all. This is due to the semi-regeneration which occurs in the circuit and is caused by the crystal resistance.

THE PROPER TRANSFORMERS

PROVIDED the ratio is not too high and the resistance not too great, any good audio transformer may be used in reflex circuits. Here as in any other audio amplifier circuit, only the best transformers should be used—if one is interested in quality as well as quantity. Much depends upon the proper value of by-pass condensers, and the poor quality emanating from some reflexes may be traced to these small components.

For example, a small condenser placed across the secondary winding of an amplifying transformer has the same effect as a large condenser shunted across the primary. The result is that high frequencies find a ready path through this effective primary capacity, and they naturally refuse to bother going through the transformer. The average transformer is a poor device anyway beyond 3000 cycles and when shunted by a condenser of too large a capacity it misses most of the high notes.

The coming year promises much in the way of good transformers. The writer has seen one new coil that will probably be on the market by the time this is being read and doubtless others are being perfected. The overall amplification of this transformer and a UV-201-A tube is far beyond that attained at the present time in the point of equality of amplification over the audio band. The future of radio seems to point toward better and better reproduction, a future that will be present as soon as more nearly perfect transformers are for sale.

PUSH-PULL REFLEX HOKUM

DURING the past year, the writer has seen several articles on how to reflex a push-pull amplifier. Enormous amplification is claimed, as one might suppose from getting two tubes to act as four. Who couldn't get signals loud enough to stop the clock with a four stage amplifier, one of which is push-pull?

What is wrong with this scheme?

Fig. 7 is the conventional push-pull amplifier. Between the B batteries and the output winding are two "X's" which should normally be connected together. Now the great advantage of the push-pull amplifier connected as shown, lies in the fact that all of the distortion due to overloading is balanced out, appearing only at X and not in the output. If one placed his receivers at X he would get all of the distorting harmonics and none of the fundamentals.

Fig. 8 is one of the reflex schemes. The normal output is fed back into the input as

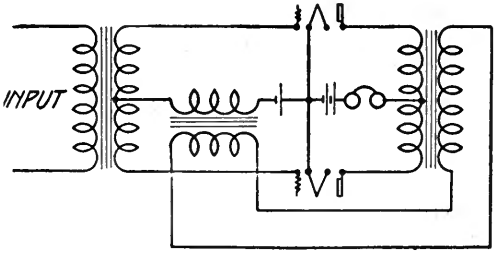
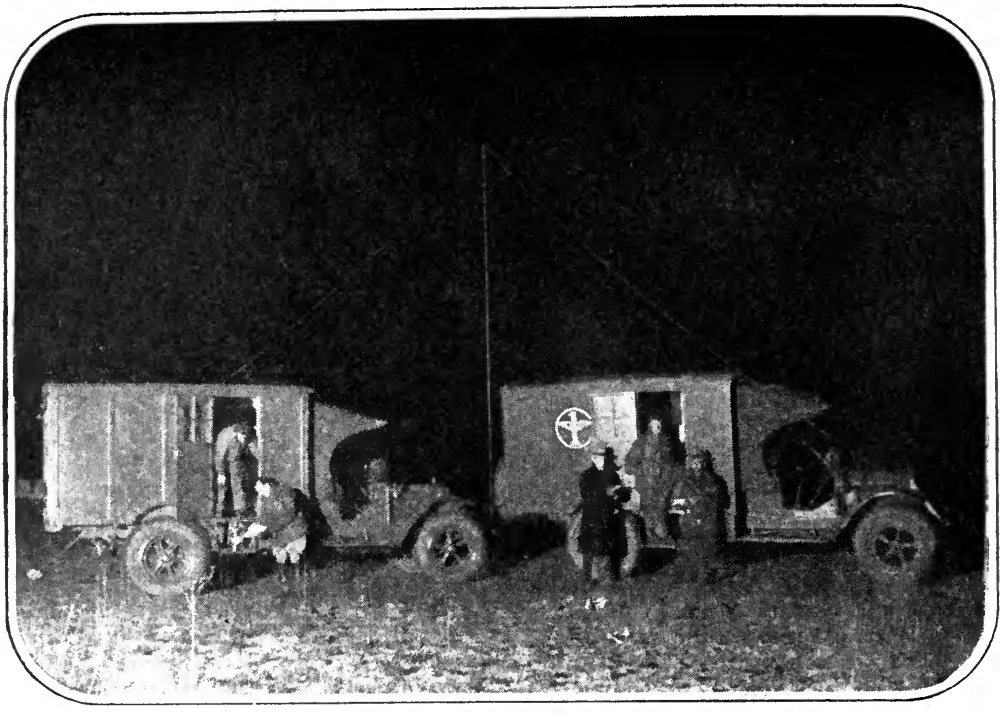


FIG. 8

A reflex scheme which has been exploited to some extent which contains a serious technical flaw explained in the article

shown and the receivers are placed where the distortion is greatest. Another scheme is to interchange the output coil and the receivers, thereby sending the distortion around again. In either case the amplifier will probably howl, and should if it does not, for here is a straight case of feeding the output back into the input without the usual ceremony of changing frequencies! Other ideas, fully as unnecessary, have appeared for reflexing the push-pull, transformer arrangement as if it were not valuable enough by itself.



JUST BEFORE ELEVEN O'CLOCK

On the first night of the International Radio Broadcast Test at Mitchel Field, Long Island. Under command of Capt. H. M. McClellan, men of the 5th Observation Squadron, U. S. Air Service, set up special radio receiving and transmitting trucks shown in the photograph. Communication was maintained with the laboratory of the magazine by short wave radio telephone and code. Various stations in England, France and Radio Iberica, Madrid, were heard here

The International Radio Broadcast Test of 1924

A Review of the Second Annual Test Between Europe and America—What They Proved Socially and Technically —Sidelights on the Event Which Interested Nations

BY ARTHUR H. LYNCH AND WILLIS K. WING

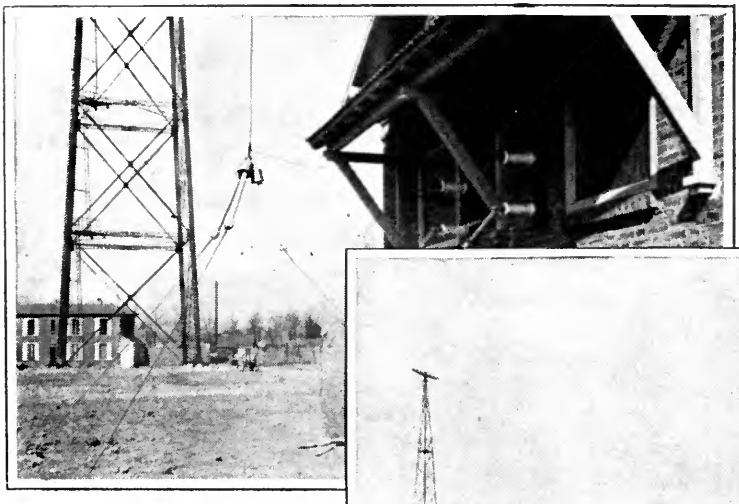
THE thousands of letters, telegrams, telephone calls, and personal messages which we received during and after the International Radio Broadcast Tests, concluded a short time ago, proved conclusively that the signals from foreign broadcasting stations were heard in every nook and cranny of the United States. Reports came with surprising accuracy and regularity from California and Oregon as well as New York State and Maine.

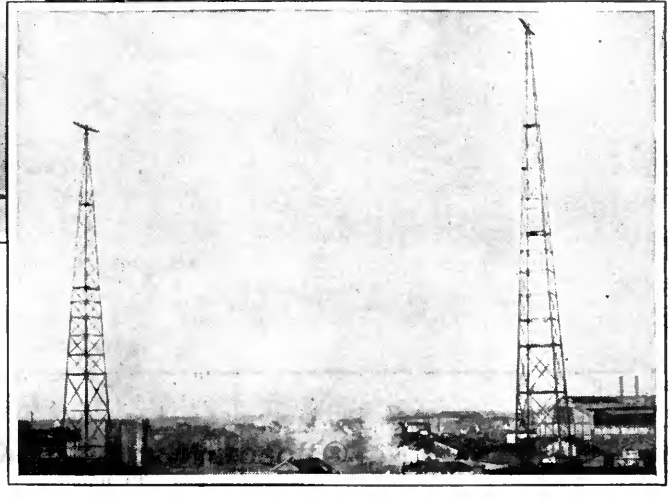
The average moderate-sized house has, perhaps, twenty-five forty-watt electric lamps to light it, which consume about one kilowatt of energy. Consider, then, that these avid and enthusiastic radio listeners who strained at their receiving sets each night of the tests were trying to pick up signals from transmitting stations using a power equivalent to that consumed by about fifteen forty-watt lamps, and then marvel, as we all do, that the foreign broadcasts were so generally and so well heard.

Marconi, when he hoisted his kite aerial near St. Johns, Nova Scotia, on December 6, 1901, used twenty-five kilowatts of power in trying to push the historic letter S across the stormy reaches of the Atlantic. The English and Continental broadcast pioneers, A. D. 1924, were using five hundred watts, less than one fiftieth of that power! It took Marconi weeks of effort to record the signal S, with no other obstacles but natural ones and the crude receiving apparatus at his command. North American listeners were trying to hear foreign programs with receiving sets of advanced design, it is true, but against great odds. Your listener, in 1924 not only had the difficulty of unusually unfavorable natural conditions, but he had to cope with man-made interference which is well-nigh impossible to overcome, in the form of squeals and howls from improperly designed and operated receivers, which were so pernicious in almost every locality you could name, that receiving with any great degree of success was nearly impossible.

It is safe to say that every one of the broadcasting stations in Europe and England was heard at one time or another during the tests while but few of the American stations were heard abroad. Those that were heard were using power considerably above the average. Inasmuch as the average European transmitter is not capable of any greater range than the transmitters used here, it seems reasonable to assume that our receivers are more sensitive than those used by the average listener in foreign countries. It will be remembered that but few of the European stations were heard in this country last year, which would seem to indicate that we have improved our receivers very materially during the past twelve months. Within the next year one can assume that additional improvements will be made in receiver design. It is also probable that high-power broadcasting stations, now being seriously considered, will result in much better reception of our programs by foreign listeners.

When a receiver is made more sensitive, it is more susceptible to interference as well as more responsive to the signal desired. It may, therefore, be desirable to use greater power for broadcasting of this nature. Then, too, there is the possibility of broadcasting on short waves for the purpose or rebroadcasting in a distant locality or foreign country. A very excellent indication of the progress being made in this direction may be seen from the success with which the programs from KDKA, the Pittsburgh station of the Westinghouse Electric and Manufacturing Company were re-broadcast by the British Broadcasting Company during the tests.





THE "RADIO PARIS" STATION AT PARIS

With the logical assumption that more powerful American signals will be available in our tests next year, it is probable that American programs will be more generally heard abroad than they were in 1924. And when we assume that perhaps more power will be available from broadcasting stations abroad and that our receivers will be improved in design and operation alike, completely satisfactory international broadcasting will without question move another step nearer.

RECEPTION IN THE UNITED STATES IN 1923 AND IN 1924

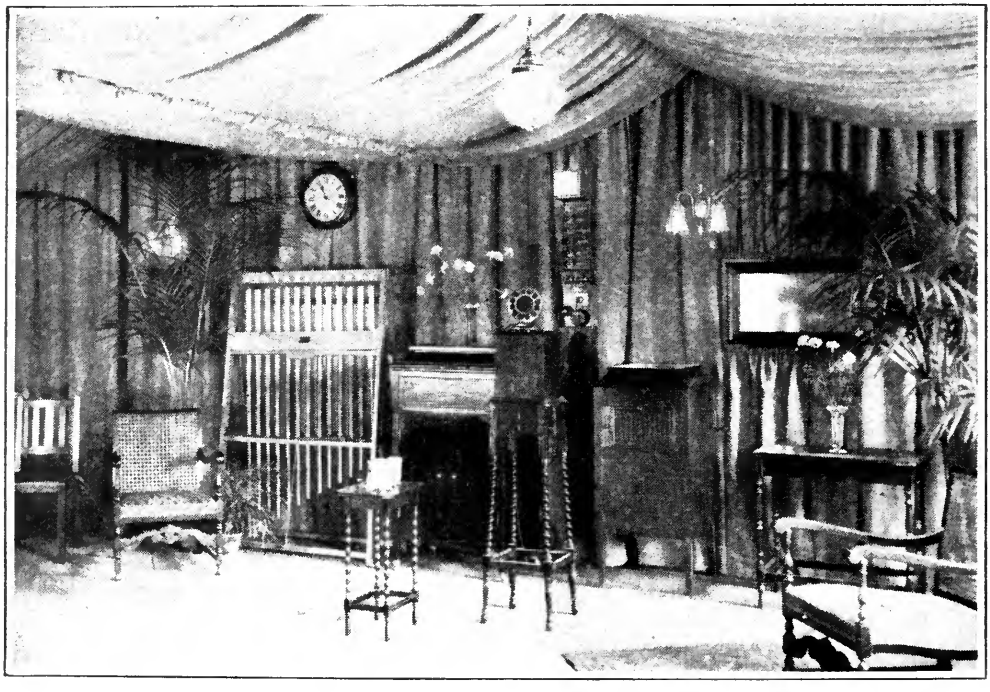
WE HAVE been asked how reception in North America during the tests this year compared with that of last year. In 1923, the English stations were reported in every section of the United States and in many parts of Canada by relatively few listeners. This year, the English and Continental stations were reported by literally thousands and thousands of listeners in every part of the nation. Many more cities and towns were represented. The difference may be laid, first to the hearty coöperation of American, Canadian, Mexican, Porto Rican, and Cuban broadcasters in keeping off the air during the foreign transmission times. Secondly, receiver design has improved, and thirdly, the owners of those receivers have grown more expert in their operation.

As a striking example of what can be done in the future, the reception of Mr. F. R. Hoyt, of Stamford, Connecticut, is of considerable importance. Each evening of the test, he brought in the foreign programs with such volume that he was able to make phonograph records of them.

A listener on a small island off Beverly, Massachusetts, where there were no radiating receivers about, carried foreign programs almost without interruption until the distant announcer stepped away from his microphone and closed the program.

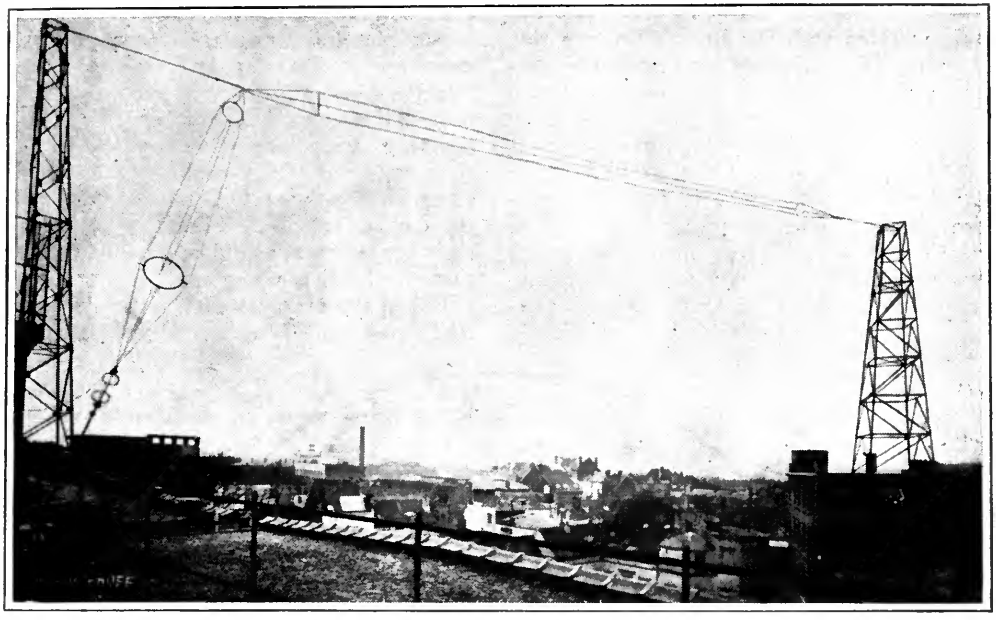
Several listeners of Maumee, Ohio, a suburb of Toledo, on several occasions received the foreign stations with clarity that they were able to put the loud speaker near the telephone which was connected by long-distance lines to our office in Garden City, nearly seven hundred miles distant. We heard a part of the program picked up from Madrid and Paris.

One of our readers who used a Knockout



THE STUDIO AT BOURNEMOUTH, STATION 6 BM

The signals from this station, operating on a wavelength of 385 meters were generally heard all over this country. The installation here looks more like that of the average American studio because the apparatus is that of the Western Electric Company



STATION SBR BRUSSELS

Signals from this station, on 265 meters were reported as far west as Denver, Colorado

four-tube receiver at his home on Long Island received Madrid every night they broadcast with intensity enough to permit a group of his friends plainly to hear their programs through the loud speaker.

Verified similar instances of just this sort occurred times without number all over the country as any reader may discover by inquiry in almost any radio group.

THE COMMUNICATIONS AT HEADQUARTERS

HAD the announcements from foreign stations been more frequent, the total number of verified North American listeners to those stations would without question be enormously increased. Many heard fragments of programs and even one or two complete musical numbers but the station faded out before the announcement was made. This made the work of verification at our office much more difficult, because the foreign stations were transmitting between four and five o'clock in the morning their time, and it was obviously very difficult to get many artists at their studios at that time. Their programs depended much on the ingenuity of the studio manager. Most of the selections broadcast from the English stations were phonograph records of well-known operas, although organ music was sent from several of the English stations during the early nights of the tests.

Very general good sportsmanship was shown by listeners on this side who heard programs on wavelengths on which no American stations were sending. These listeners wrote us, wired, and telephoned about the signals they had heard, but made no effort to claim reception when they had not intercepted a definite announcement.

But there were other sides to the communications. "Last night, at 11:20, I heard a woman singing a soprano solo. What foreign station did I hear?" was a question asked more than once, probably in all seriousness. A radio enthusiast in Costa Rica wrote in that he had heard nothing about the tests until on the second night, he heard announcements from several American stations. Accordingly, he tuned-in on the foreign wavelengths and heard the test programs in succession from both continents. Another listener in Denver, Colorado, wrote in to ask what American amateur station was using the call letters 5 NO, saying that he heard a radiotelephone program whose operator used that call. It should be remembered that American amateurs use call letters beginning with numerals.

THE ARRANGEMENTS IN ENGLAND

THE burden of making the extensive and difficult arrangements for the tests on the Continent and in England fell on the capable shoulders of Hugh S. Pocock, editor of the

Wireless World and Radio Review. Mr. Pocock, working with the British Broadcasting Company in the tests of 1923 made the complete arrangements then, and coöperated with them in verifying reports and in answering correspondence with the great number of interested British listeners. This year, his problem was a vastly more difficult one. Arrangements with scattered broadcasting stations on the Continent had to be made. Programs were finally arranged with stations in Spain, France, Belgium, Italy, Denmark, and Germany, and difficult problems were excellently solved. Working in close coöperation with him was Captain A. G. D. West, assistant chief engineer of the British Broadcasting Company, and when Captain P. P. Eckersley, chief engineer of that company, returned from his trip to this country to attend the Hoover Radio Conference in Washington, he, too, lent his valuable aid.

CAPTAIN H. M. MC CLELLAN

—United States Army Air Service, at a special super-heterodyne loaned him by RADIO BROADCAST. This is the same "super" which was successful in reaching out to London and other English stations in the transatlantic tests of last year. This receiver brought in Madrid, Bournemouth, Newcastle, Cardiff and Paris this year

North American listeners owe a great debt to the broadcasters abroad who sacrificed their rest for seven nights and sent programs from four to five A. M. It was no small task to maintain their regular schedules and to make the necessary arrangements for the special late test programs as well.

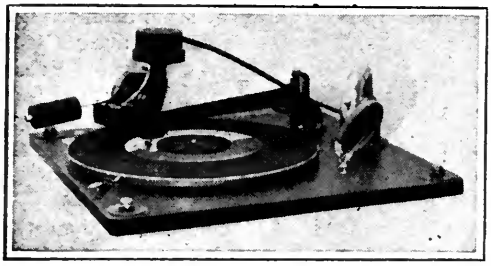
The operators at the high-powered transatlantic stations of the Radio Corporation of America at Carnarvon, Wales, and at Christiania, Norway, listened for American broadcasting, and were successful in hearing many complete programs.

ARRANGEMENTS IN THE UNITED STATES

THE first task on this side was to secure the coöperation of the five hundred and fifty American broadcasters. This meant the sacrifice of probably their most valued program hour to allow listeners here a clear ether for the foreign signals. Without notable exception they agreed to make every necessary arrangement. In Canada, Mr. Jacques Cartier, director of station CKAC, *La Presse*, at Montreal undertook to make arrangements with the fifty-odd stations north of the border. Cooperating with him were the independent stations and the large chain operated by the Canadian National Railways. In addition, the Cuban Telephone Company aided, with their station PWX, as did other Cuban broadcasters. Station WKAQ, at Porto Rico, also joined in the arrangements. The stations of *El Excelsior* and *El Universal* in Mexico City helped as well.

Among the organizations who lent their best efforts toward the success on this side were the United States Army Air Service, who extended their facilities at Mitchel Field, Long Island, the General Electric Company, who gave complete information about the tests through their various stations. In transmitting periods from this side station WGY made all their announcements in five languages to make identification of their signals easy for foreign listeners. The Radio Corporation of America had the operators of their high-power stations listen for foreign broadcasting, and the staff at their Chatham station turned in several complete logs of reception. The broadcasting stations of the Corporation took a very active part in the tests as well. In addition, the Westinghouse Electric and Manufacturing Company gave the full support of their stations and on at least one night, programs from KDKA were re-broadcast in England for listeners there. The Radio Trade Association, the American Radio Association, the National Association of Broadcasters, the Esperanto Association, and the Ilo Association were most effective in their respective fields.

Newspapers throughout the country were most active in covering the tests as a piece



THIS DEVICE RECORDED FOREIGN BROADCASTING ON A DISC RECORD

A series of thirty records was made by Mr. F. R. Hoyt, of Stamford, Connecticut, using this method of recording the signals. These discs show very plainly how considerable was the interference effected by the users of oscillating receivers. Some of the foreign signals recorded came through with great volume

of important international news. Practically every paper listed local test listeners who heard the foreign stations. Radio editors of many of the dailies were in touch with our offices by telegraph and telephone exchanging information. Some very complete and careful logs and reports came to us from a number of radio editors who took great personal interest in the tests.

Almost a thousand manufacturers of radio receivers were assigned official numbers and acted as official receiving stations and were most helpful in submitting reports of their reception. And other manufacturers sent receiving equipment and in some instances sent engineers to install and operate it, at our headquarters, at Garden City. These receivers were successful in many instances in picking up the foreign stations and, by means of liaison maintained between them by special buzzer circuits put up for the purpose, it was possible for several receivers here to keep an accurate log of several foreign stations at the same time. These logs were very valuable in checking the reports from listeners throughout the country, which began coming in by telephone before the hour for receiving was completed.

AT GARDEN CITY

THEN, too, it was possible for us to keep in touch with the three receiving sets operated at Mitchel Field by means of the short wave transmitter, which was loaned us by the Radio Corporation of America for that purpose.

Many of the manufacturers, who had accepted assignments to act as official listeners, went to no end of trouble to see that their work was effective. In several instances they had receivers installed in four or five different locations and arranged for telephone communication between them, in order that each would have a check on the others and so that the reports of reception could be wired to Garden City as soon as practicable.

The Western Union Telegraph Company and the Postal Telegraph Company made great effort to see that listeners knew where to wire their requests for verification of foreign broadcasts before the tests actually took place. The former organization went to the trouble of distributing more than two million circulars, telling people how to route their telegrams to us, in order to expedite their delivery.

Several manufacturers offered prizes for the best reports of reception of the European stations with receivers of their manufacture and in one instance they called upon us to pick the winner.

Many of those who took part in the tests last year will remember that the listening periods were only half an hour in duration, while this year the much more satisfactory period of one hour was put into effect. Next year we hope to have the test so well organized that no hitch whatever will arise and it is probable that a representative of RADIO BROADCAST will visit Europe in order to arrange the programs, so that a check of the broadcasting carried on during any test period will be found in the papers throughout this country and Canada the next morning. We

©Underwood & Underwood

A SILVER CUP

Was presented by J. D. R. Freed, president of the Freed-Eisemann Company to Mrs. Edna M. Smith of Springfield Gardens, Long Island, the first listener using one of the receivers manufactured by that company who heard verified foreign signals

hope to arrange a program which will be adhered to very closely, on which there will be a very close time check and it is very likely that the European broadcasters will make much more frequent announcement of their call letters and location, since the shortcomings of this year's effort have been brought to their attention.

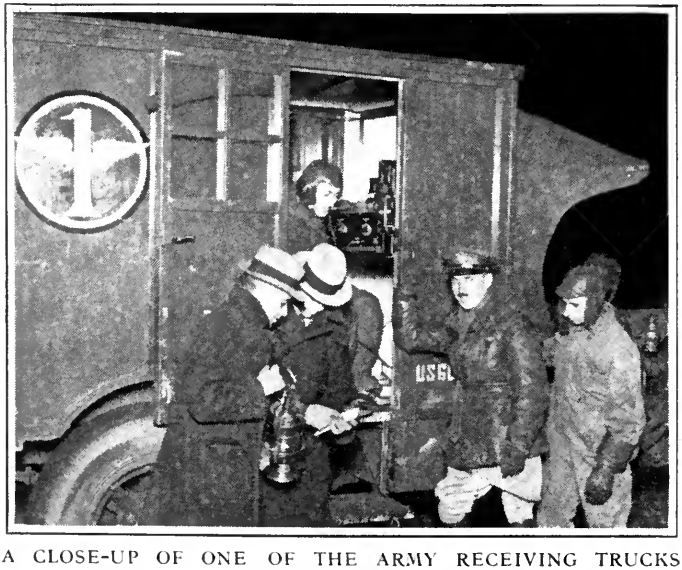
It is very likely that with a year in which to make our preparations and inspired by the great success we have had this year, it will be much simpler for us to enlist the aid of those who have, up to now, been somewhat lukewarm concerning the interest they believed listeners would take in tests of this nature. What more conclusive proof could there be of this interest than the fact that hundreds of thousands of us, everywhere in the North American Continent, Europe, and Australia, spent approximately two hours each night for a solid week listening to (or in some cases just listening for) stations in other lands?

THE RESULTS

THE International Radio Broadcast Tests interested great numbers of people who had yet to be convinced of the possibilities and benefits of radio. They showed to practically every listener that the menace of the radiating receiver is so serious that some definite, militant, and constructive measures have got to be taken in the very near future to protect radio receivers and to give listeners an air clear from artificial, unnecessary, and absurd man-made interference. And, too, they brought listeners on this continent a little closer to their brothers across the sea.

We have long talked in beautifully figurative language about "hands across the sea," but now in a very real sense we have voices across the sea. No matter now if the voices could not deliver any very complete message. It is enough that one entire continent was listening for another, that radio folk grew to think even for a short time of those on the other side. The start has been made, and in the years of progressive technical experiment, trial and error to follow, we shall get nearer and nearer to nations which before had been but names on a complicated map, or dull words in a newspaper story.

The important thing is that the effort has been made, that the electrical ice has been broken. The task is the engineer's now, and in his capable hands we can well leave it. It requires no glib gift of prophecy to think of close radio unity in future years with every nation of the globe.



A CLOSE-UP OF ONE OF THE ARMY RECEIVING TRUCKS

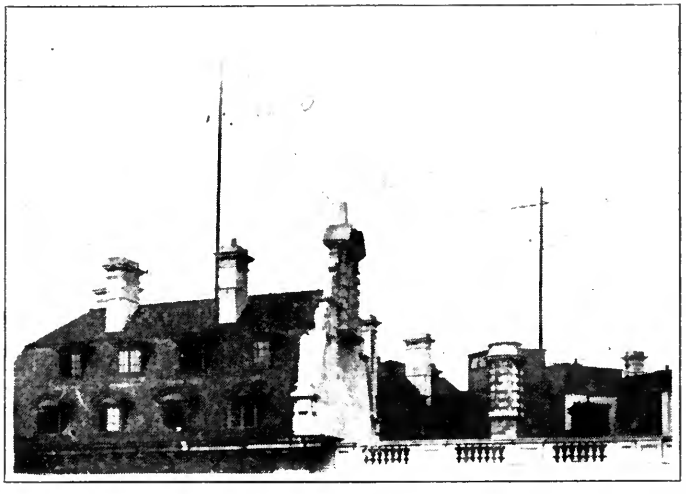
At Mitchel Field, showing the receiver and transmitter installed and a group of officers and men. Capt. McClellan is holding to the iron strap on the truck. The night this photograph was taken it was extremely cold, and there was no illumination except that furnished by lanterns and flashlights. The officers took the radio truck out to the center of the landing field, away from all obstructions and listened for the foreign broadcasts, which they heard, at times badly interrupted by blooping receivers

Hon. Alejandro Berea, the Consul General for Spain at New York, in an address recently made at a luncheon attended by a number who participated actively in the direction of the International Tests phrased very well his conclusions about the tests:

> I most heartily congratulate the organizers of this communication across the Atlantic, and I am sure that the spiritual compenetration between Europe and America will be thoroughly perfected within a short time by the use of scientific transmitters and receivers; and Spain, on account of its geographical position and because it is one of the nations of continental Europe nearer to this country, will be one of the first to avail itself of the benefits of broadcasting and be in contact with America, which is bound to it by the ties of ethnography and history.

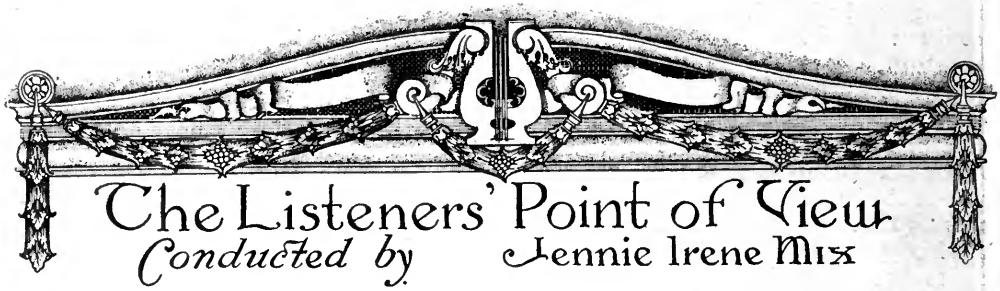
IN CHARGE OF CANADIAN COÖPERATION

For the International Radio Broadcast Tests was the staff of station CKAC, *La Presse* Montreal. J. N. Cartier, the fourth from the left in the last row, director of the station, completed his arrangements with brother Canadian broadcasters for participation in the International Tests. In the back row from left to right are Arthur Dupont, assistant announcer; Adrien Arcand, radio editor of the paper; Leonard Spencer, technician; J. N. Cartier; A. Lebeau, master of ceremonies; Front Row, J. P. Calligan, "Father Radio"; Mary Brotman and Nora O'Donnel, stenographers



THE NEW ANTENNA AT 2LO

The London station of the British Broadcasting Company. A good part of the English programs during the tests were simultaneously broadcast from this studio through the various other Island stations, linked to London by wire



What is Going to Happen to Radio Advertising

PERHAPS this much discussed question of advertising by radio will ultimately be settled by the advertisers themselves. They may find that the returns in sales in no way measure up to the amount expended in getting the name, and in some instances a description of their product, to the radio public. And, again, even under these circumstances, they may keep right on engaging broadcasting privileges at so many dollars per minute, just as they keep on sending out sales letters although not more than a half dozen out of a hundred letters usually bring returns.

One feature of this question, however, seems bound to be settled but one way. This is, giving the listener-in the privilege of knowing that advertising is about to be broadcast. Of course, when a musical organization or a monologuist bearing the name of a well-known commercial product is announced, that is easy. Twist the dial if you do not want to listen. But when a man is announced as a speaker on "The products of the Province of Paragon in Paradisio," with but a murmured postscript, "Mr. Blank is pleased to take advantage of the facilities of this station to talk to you," then, beware! You may listen quite a time before you catch on to the fact that Mr. Blank is telling you about these products because he wants you to buy them.

The radio audience will eventually take care of this unjust manner of radio advertising. They will tune Mr. Blank out, and they will do this to such an extent that even the low average of returns from sales letters will seem to him, in comparison, an almost alluring margin of profit.

It is these veiled advertising talks, and not the performances of orchestras, singers, and monologuists, that arouse the ire of the listener. When "The Gold Dust Twins" are announced, or "The Eveready Quartet," and other organizations or individuals broadcasting wholly for advertising purposes, that is a straight-from-the-shoulder game. It is offered you with no subterfuge back of its promotion. You may take it or leave it, as you please. And, in all fairness, it must be acknowledged that very often these performances put on by commercial houses to advertise their goods are superior in quality to similar attractions not paid for by advertisers but put on the broadcast program by the director who must choose his talent from the hodgepodge group of people he may be able to persuade to work for him for nothing.

The plea of the broadcasters that they cannot afford to entertain the public for nothing, and therefore they must accept advertising numbers for which they are paid, does not make any impression on the intelligent portion of the radio public. No one asked these broadcasters to erect and operate their station. A goodly number of them could go out of existence overnight and no one would complain. Many, indeed, would rejoice! This because, with some few and notable exceptions, all the stations put on the same character of programs, cheap enough, at best, and ones that are given with the same uniform mediocrity of performance. These broadcasting stations are maintained for the purpose of reaching the largest number of people possible, rather than with the desire ever to make an appeal to a discriminating public.

CARYL MARSHALL, SOPRANO

Who recently was heard through station WGY. Miss Marshall was one of the winners in the Juilliard Scholarship test held in New York not long ago, and in which were entered competitors from all over the country

The attitude of the directors of such stations is, to a degree, similar to that of the merchant who sells to all classes of people because this is the sensible way in which to conduct business. But the wise merchant keeps a quality of goods that will appeal to customers of refined taste, the while he also has a "bargain basement." Yet the same merchant will go to the enormous expense of installing and maintaining a broadcasting station to advertise his store, and then permit the director of that station to put on programs that appeal only to "bargain basement" customers. Poor advertising, this!

The owner of a broadcasting station that permits paid advertising has a strong argument in his favor when he wishes to defend himself. He can justly say that, only as long as no one is paid for broadcasting, every number on every program is in the nature of advertising. He will tell you that the persuasion brought to bear in order to get contributors to programs is that their names going out over the air to countless listeners is a rich source of advertising. And so it is, provided they prove worth the hearing.

During the last two months an increase has been noticed in the number of good musicians of fairly wide reputation who have broadcast. To be sure, their number is so small compared with the mediocre talent presented that they are all but lost in the mass. But they have been heard and greatly enjoyed. Perhaps some, or all, of them are paid. We have a very strong suspicion, pretty well justified in one or two cases, that certain stations are growing tired of giving programs by "microphone pluggers," as they are designated in the studios, and are engaging the best talent available in their vicinity and paying for it.

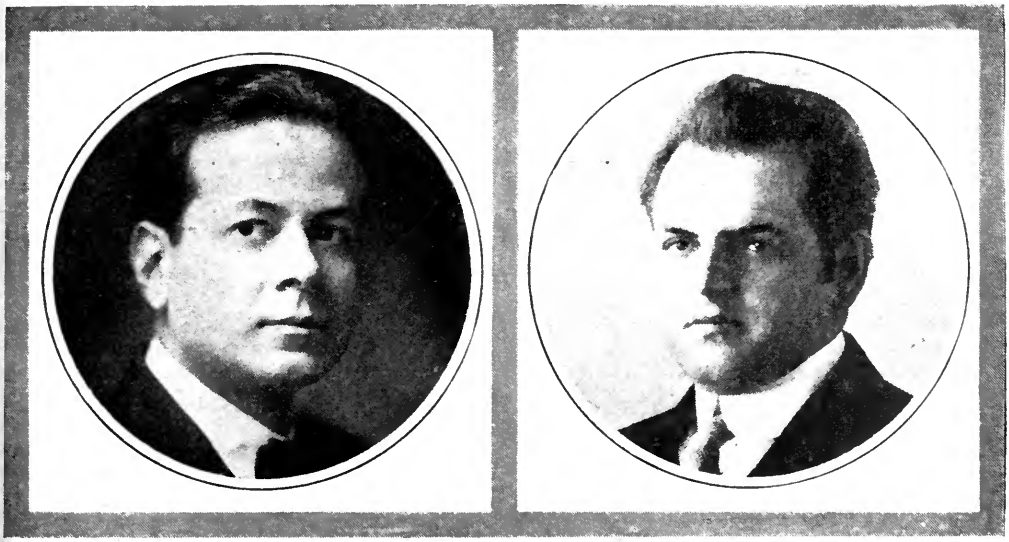
To a director who desires to put on fine programs and cannot do so because the company for which he works will not give him any money for this purpose, it must be a godsend to find promoters of public concerts who are willing to have their attractions broadcast. The best stations, so far as the present writer's knowledge goes, never miss such a chance. This shows what sort of music they would give the public if they had money to engage good artists.

Among the features of this character that have recently lifted radio music above its accustomed dullness, are the concerts of the St. Louis Symphony Orchestra broadcast by station KSD, and commented on in this department last month. Others of notable quality are the Wednesday night programs of the New York Philharmonic Orchestra, broadcast through WEAF. Also, through WEAF, the series of New York programs being given by George Barrère and his Little Symphony Orchestra. Mr. Barrère, it is scarcely necessary to explain, has been for more than twenty years first flutist in the New York Symphony Orchestra, coming to this country from Europe to join that organization. He is not only the most famous flutist in America but also has no superior in Europe. For some years he has been at the head of the Little Symphony, which he organized and which confines itself mainly to playing works not suitable for a large orchestra. The broadcasting of his series of New York concerts this season is doing much to lift radio music from its deadly monotony.

Then there are the programs of the American Orchestral Society heard through WJZ and WJY. This

LEON ROTHIER

One of the greatest operatic bassos ever heard in this country, and who has for many years been with the New York Metropolitan Opera Company. He is here seen broadcasting from station CKAC, Montreal, prior to a concert given in that city



SIGNOR GUERRERO AND FERDINAND FILLION

Recently heard in joint recital from station WGY. Signor Guerrero is a South American pianist, now of the staff of the Toronto Conservatory of Music. Ferdinand Fillion, concert violinist, is also on the staff of the Toronto school

orchestra, of more than one hundred members, is maintained chiefly for the purpose of giving young American musicians of recognized ability opportunity to keep in orchestral training so as to be ready for positions in the permanent symphony orchestras of the country when vacancies occur. Although American compositions are featured in the programs, an extended variety of the standard orchestral masterpieces are also played. In all, eighteen concerts will be broadcast, thirteen for adults, under the direction of Chalmers Clifton, and five for children, under the direction of Ernest Schelling. The remaining dates for the programs for adults are January 18 and 22, February 15, 19 and 28, March 22, 26, 30, and April 19 and 23. The dates for the children's concerts have not, at this writing, been announced, but they will be given at Aeolian Hall, New York, Saturday mornings during February and March, probably in alternate weeks. Thanks to the farseeing judgment of Franklin Robinson, executive secretary of the American Orchestral Society, the broadcasting of these programs has been made possible.

Also, there is the Eastman School of Music at Rochester, New York, that is making possible, through station WHAM, the hearing of much good music by owners of radio sets. The concerts of the Rochester Symphony Orchestra, operated in connection with the Eastman school, are being broadcast through station WHAM. The schedule of dates for the remainder of these programs is: January 22, February 19 and March 19, in the evening at 8:30, eastern standard time; and the afternoons of February 26, March 5, and March 9.

This Eastman School of Music is likewise presenting chamber music concerts which are also being broadcast by WHAM. There still remain in this series the evening programs of January 20 and 30, February 27, March 9, and March 27.

The directors of WHAM have stated that these two series of concerts are broadcast this winter because last season when the experiment was tried of putting a few of the programs from each series on the air they proved by far the most popular feature the station had ever broadcast. Which is but another proof that the public, given a chance to hear or see the best in art, will quickly appreciate it.

Some Suggestions on Studio Etiquette and Management

SOME time ago we took pleasure in quoting in this department some comments on broadcasting received from Mr. Richard K. Morton, of South Boston, Massachusetts, who has himself been heard from various radio stations in the East. Now comes to hand another letter which so well

covers some of the questions that are continually being asked the conductor of this department, by people near and far, that Mr. Morton is again quoted.

Many listeners-in wonder why so little consideration is given to balancing radio programs. If there is an important psychology in the arrangement of concert recitals, articles in magazines, etc., there is a psychology in radio programs. . . . What can a radio lecturer do, if he follows the broadcast of a prize fight? Why, moreover, is there so little regard either for the psychology of the radio artist or the listener-in? . . . Take, for example, the tired listener-in who is furnished late at night with a lecture immediately following jazz!

While broadcasting from one studio, this was the situation which confronted me: the announcer had, at the last moment, scribbled data relative to my name, the title of my talk, etc. He was vigorously puffing a cigarette in the well-padded and almost hermetically sealed studio. The air was hot, stagnant, stale. I had to stand and talk into a microphone which was only as high as my waist; the alternative was to sit in a cramped position at a small table. Fully twenty-five artists and visitors were in the studio. They made distinctly audible and belittling remarks relative to me and to my contribution.

Am I a hypocritical grouch when I ask if listeners-in want this type of situation to be endured by radio artists?

Numerous inquiries have come to the editor of this department, all couched in about the same form. "Do broadcast directors allow people in the studio while any one is broadcasting? I'm sure I can often hear other voices from the studio in addition to the one that is giving the number."

And many artists have said with emphasis after a first broadcasting experience, "Never again! There was a mob in the studio, and another mob running in and out. Imagine trying to give a decent performance on a concert stage under such circumstances."

Note what Mr. Morton has to say:

It is beyond me to understand why so many stations still persist in allowing a full studio while a number is being broadcast. It is also beyond me to understand why they allow going into and leaving the studio during a number. Personally, I feel that it is wrong for an artist to bring to the studio, for obvious reasons, a host of his admirers.

As for the question of requesting cards from the radio audience, I think it is very poor taste for a speaker to request cards relative to his own speech. Even announcers should make such requests with moderation. . . . And why do listeners-in, when sending in cards relative to broadcasts, confine themselves to flattering but meaningless generalities? Why not give the artist genuine criticism, showing an intelligent interest in his contribution? Why not be specific, discussing the item in a concrete, analytical style, which will stimulate the artist, give him suggestions, and call his attention to points of value to him?

Kossuth, Wheeling

GEORGE BARRÈRE

Flutist of international renown and conductor of the Barrère Little Symphony Orchestra whose New York concerts this season are being broadcast by station WEAF

The cards that are sent to radio stations are a good deal like the telegrams and telephone calls sent in during a program, than which nothing could be more tiresome or stupid. Fortunately, broadcast directors do not attempt to read to their listeners-in the communications they receive by mail. If they did—but perish the tho't!

Radio Vision Both Ways

SCARCELY a week passes without a story being published regarding the future of radio vision, if it may be called that. We are constantly being told that, ere long, we shall all be able to see as well as hear the radio speaker or musicians. We shall even be able to follow the games that, point by

point, are now broadcast, or to see the opera to which we listen at the receiving set, or the orchestra.

Will this predicted marvel work both ways? Will the broadcast directors be able to watch their listeners-in? It is to be hoped so. For the quickest and surest way to bring about the much needed reform in radio programs is for the broadcast directors to see how their programs are being received. Some of them would experience a tremendous shock.

Why They Say "Please Stand By"

HAVE you ever wondered why the broadcast announcer, when there is a wait between numbers, always tells you to "Please stand by"?

Why, "stand by"? That ancient bos'on's warning?

Mr. Rhodehamel, of station KGO, at Oakland, California, explains that this term and various others used by broadcast announcers, came into use in radio stations because nearly all broadcasting operators have been to sea as ship operators. He states that, at KGO, the operators alway refer to the floor as the "deck." Walls are spoken of as "bulkheads." Windows are called "ports." Operators do not work so many hours, they "stand watch." The book recording transmission and changes of apparatus is called "the log." The clock isn't a clock, but a chronometer, all rigged up in gimbals to take care of the swaying of the ship, in the regular little brown mahogany case.

Not all broadcasting stations are as nautical as this, but from every one of them you will hear the old call of the sea, "Stand by!"

There is a Demand for Education by Radio

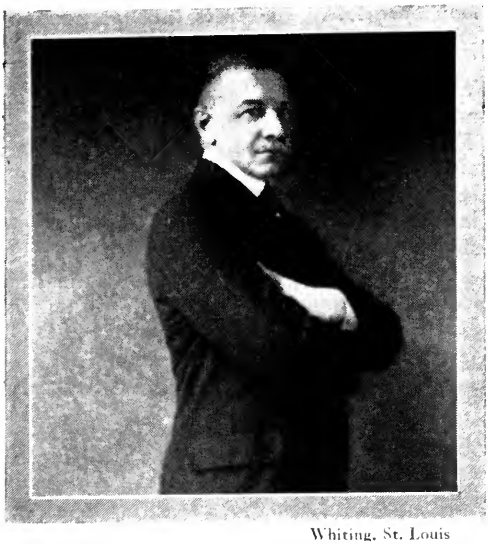
THE lectures on music appreciation given Friday evenings at 7:30, through station WBZ, by Professor Stuart Mason of the New England Conservatory of Music, have been a pleasing diversion to some listeners-in and, no doubt, a source of much desired instruction to many more.

But, as these lectures, which are illustrated at

Thomas Coke Knight, New York

BERNHARD LEVITOW

And his Hotel Commodore Orchestra scheduled for 200 radio concerts from WJZ and WJY this season. They play much beautiful music and play it remarkably well



Whiting, St. Louis

RUDOLPH GANZ

Conductor of the St. Louis Symphony Orchestra whose Saturday evening concerts are being broadcast from station KSD. Mr. Ganz, in addition to his orchestral work, has long been among the world's noted concert pianists

the piano by Professor Mason, occupy but one half hour, he must feel, as do some of us who have studied the subject matter of the lectures during our years of musical training, that the time allotted him is so short he can scarcely touch his subject before it is time for him to stop. That he can get over as much ground each week as he has so far succeeded in doing shows well that he is thorough master of his subject. But, even so, such courses in music appreciation confined to one half hour a week cannot be other than superficial.

When radio has settled down to a constructive basis, instead of being, as now, chiefly a medium for light entertainment, these educational courses will take on a more important aspect. No doubt, broadcast directors would hesitate to put on a musical lecture that lasted an hour. They would see, in their imagination, thousands of impatient listeners tuning out to a more congenial attraction. Yet, they might also use their imaginations to realize that those who interest themselves in these educational courses would be more numerous if they thought that the paying of the fee of one dollar, for literature and examination papers, would include an hour's instruction weekly.

Perhaps, in time, we shall have certain broadcasting stations given over wholly to educational programs. If this day comes—and is not such a thing plausible?—a course in musical appreciation, in literature, or any of the other educational subjects now put on the air, will be more thorough than is at present possible.

A Good Entertainer of Children

THE oh, so sweet, dearie-dovey children's entertainer is the most aggravating thing that comes over the radio. But when such an entertainer is good, that is to say, when he or she talks to children as if they knew something, then this program feature is a delight.

Such an entertainer is "Uncle Walt," of the Chicago *Tribune* station, WGN. He is an unfailing joy. He talks to the children as if they were his equals, and so they are. Who was it said that the only people for whom you have to write in words of one syllable are grown-ups? For children, never! Uncle Walt understands this. Have you ever heard him reading *Alice in Wonderland* to the children? And have you ever heard him sending up stars for them? If you haven't heard him sending up the stars you have missed one of the most beautiful features ever broadcast.

It really seems as if it is up to us listeners-in to devise some way of sending up a big star for Uncle Walt. Yet, upon second thought, that would be much like carrying coals to Newcastle. For Uncle Walt is himself a bright and shining star in the broadcasting world.

Musical Laughter

HERE is a semi-musical joke that came from station WEAF. If memory serves rightly it was told by one of the "Happiness Boys," excellent fellows that they are.

"Did you hear about George going home just a little lit-up the other night? No? Well I'll tell you about it.

"His wife, she was awful mad when she saw him, and she says:

"'What's the matter with you?'

"'Syn—syn—co—pa—shun,' says George.

"'What?'

"'Syn—syn—co—pa—shun.

"'And what's that?'

"'It's syn—syn—co—pa—shun.'

"Well, his wife didn't say anything more that night. But when George came home the next night she says:

"'Huh! I knew I was right last night about what was the matter with you. I looked that

syncopation up, and it said it means, uneven rhythm from bar to bar!"

That's a relief from jazz, anyway.

NEVER, even though the whole world adopt it, will this department ever refer to broadcasting as "radiocasting." Of all the unimaginative, hard-sounding, machine-like words invented, "radiocasting" is the most disagreeable. When it comes over the air, "This is radiocasting station XYZ"—*à bas!*

IF DELILAH had jazzed "My Heart at Thy Sweet Voice," when she was putting over the treachery "stunt" on Samson, he never would have been shorn of his strength by losing his locks. For he never would have fallen for jazzful love-making.

SOME women's voices of beautiful quality have been heard over the radio lately, but almost without exception the slow tempo at which the songs were sung completely ruined them. There was the contralto who sang not long ago from WBZ's Boston station "When the Roses Bloom Again" and "Drink to Me Only With Thine Eyes." We heard a lovely voice, but it was quite impossible to listen to it because of the dragging interpretation.

FROM a WGY program:

Waltz, "Take a Look at Molly". Franklin

Research Talk, "The Metallography of Paint" (Courtesy Engineering Foundation)

Fox Trot "Jealous" . . . . . Malie-Finch

Does any one except the compiler of this program know why a talk is put in such a place? Does even the program compiler himself know?

IF THOSE responsible for the mid-week services under the auspices of the Greater New York Federation of Churches, broadcast from WEAF, expect to further the cause of religion through radio, they will have to "pep up" some of the performances. We tuned in on such a whining performance of "Abide with Me" the other night, that we abided only long enough to tune-out. For consolation we listened for quite some time to the Night Hawks.

CHICAGO is one of the greatest music centers in the world, and in this country is ranked by all as equal to New York (and by some as that city's superior), as a place where the best music may be heard under the best advantages.

How, then, does it happen, that the music programs broadcast from Chicago are, with rare exception, not equal in quality to programs heard from some other cities of but slight musical reputation? Certainly, one of the Chicago stations can bring us something good.

Thomas Coke Knight, New York

MRS. CLARA E. BREAKEY

Lecturer on home economics at New York University, who gave a course on coöperative economics from station WJZ with such success that she seems to have nullified the contention that women are never as effective speakers over the radio as are men

Some Experiences With the Blind and Radio

By CHARLES T. WHITEFIELD

WE FANS have got the impression, no doubt, that everybody in the United States knows about radio—at least, knows a little—but I have recently had some experiences which have caused me much surprise.

I live in a county which contains about 125,000 people, and in a moment of bravado I offered to provide all the blind people in the county with a suitable radio receiver, so that they might listen in to the concerts in New York and get the benefit of all the good things that were going on within a few hundred miles of the metropolis.

In such a large county I expected that there would be a hundred blind persons. Much to my surprise, after making every effort to find every blind or near blind individual, I discovered that there were only about twenty. Each one of these people I visited, and had some tragic experiences.

For instance, approaching a broken-down old house, with debris of all kinds spread in every direction from the front door, the old man who opened the door kept his foot carefully in possession of the opening so that I could not break in. When I told him that I wanted to give his son—a grown man of thirty or forty who has been blind for twenty years—a radio, he was very wroth. After some conversation he said that if I brought the radio machine, he would take it out in the backyard and chop it to pieces.

Here the conversation would naturally seem to end; but I asked him if I could not see his son, who still at eleven o'clock in the morning was lying in bed with nothing to do except to think of his own misery. The son took a more cheerful point of view, and said that he had been told about the radio, but had never actually listened to one. After some persuasion I got the old man to agree that if I would send a machine, with a Boy Scout to put it up, he would allow it to be introduced; but he reiterated a dozen times that he wouldn't pay a cent, and I had the greatest difficulty in convincing him that I was not looking for money.

Some of the other cases were not quite so successful as this. For instance, I visited an old man who had caned chairs and done other things, but in his weakness had had to give up even this occupation. He was taken care of by two or three sisters who lived in the house with him, and I thought it was an ideal place for a receiver. After broaching the matter with as much delicacy as I knew how, he made a violent speech to the effect that he had already heard the radio once, and he never wanted to hear it again. I still urged that perhaps this radio was better than the one he had heard and that his sisters might enjoy it with him; but he ended up by stamping his feet and saying that he was prejudiced against the radio and would not have one. I hope to live long enough to go back with a portable set and make a convert of him, but the incident is closed for the present.

Is It Not True

That most of our happiness comes from making others happy? Here's a chance for you to do a great deal of real good for the blind in your neighborhood. The accompanying article describes how the blind in a certain county were made more happy by the gift of a radio set. The gift was made complete, with batteries, head phones, and loud speaker, and the local Boy Scouts agreed to install and inspect the sets monthly. There is much that radio can do for those unable to get out in the work-a-day world, and it is good to know that concerted effort is being made to see that the wounded veterans have receivers. This latter is being handled by the *Sun*-Roxy Fund in New York. Another fund now being raised nationally by the American Radio Association, 50 Union Square, New York, is to buy radio sets for every blind person. The Association will undoubtedly welcome independent aid of the sort outlined here.—THE EDITOR.

Some of my visits were quite inspiring. For instance, one man who had been blind for about seven years was extraordinarily cheerful, and he told me that until he adjusted himself to his new life he was very, very unhappy. Finally he convinced himself that a man could live and take an active part in life though blind; and when he had done this he became happy, and has been happy ever since. He had accomplished the extraordinary feat of building himself a house, mostly with his own hands and the help of his wife. He was an enthusiastic radio fan, but had to go a mile and a quarter to the house of a friend when he wanted to listen in, and this was difficult because he had to have some one take him. Naturally, the idea of having a machine for himself was a source of great joy to him.

Three or four blind people I found had a radio, and all of them were receiving the greatest benefit and enjoying it hugely.

HOW THE SETS WERE INSTALLED

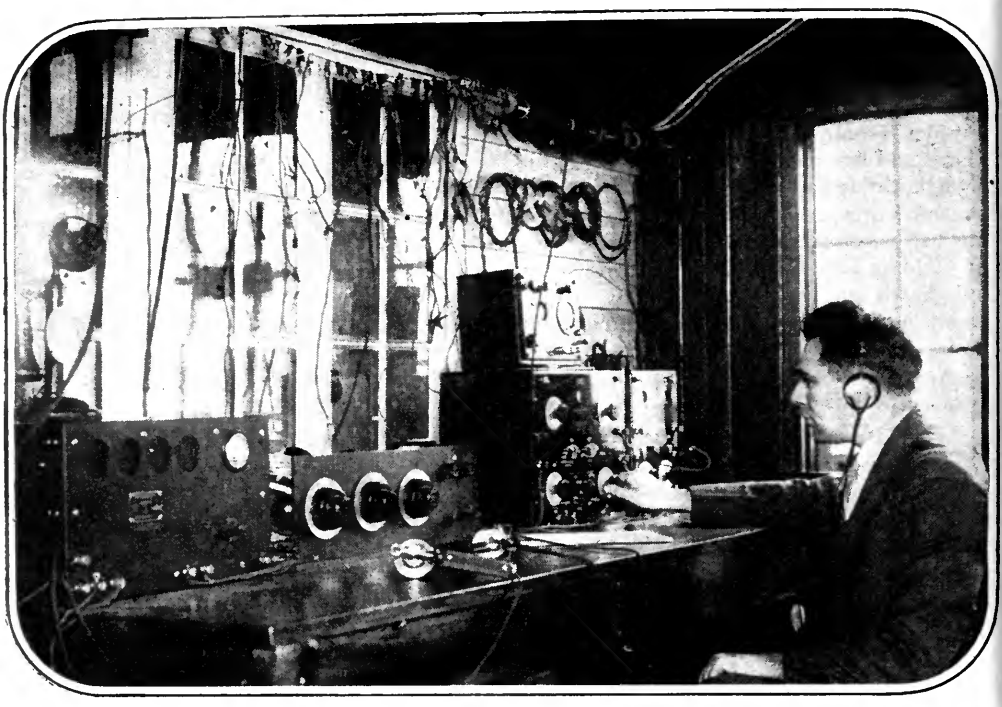
AFTER rounding up all the people whom I could find, I enlisted the help of the Boy Scouts to put up the machines and take care of them. We selected a very simple type of machine, some with a pair of head phones, and some with loud speakers. The cost of the machine, batteries, and tubes was about forty dollars apiece. The Boy Scouts put them up, of course without charge, and are expected to make a monthly inspection of each blind person's radio and report the conditions.

Although there were some blind people who were unwilling to have anything to do with this new-fangled machine, in almost every case I persuaded them that they would get pleasure. The humorous side has been their fear that it would cost them money. Without exception, they showed the greatest apprehension lest they would be led into something which would bring them financial responsibility. When I told them that I was doing this for pleasure, they did not accept it with any degree of cordiality, feeling that there was something behind which they did not understand; in fact, that something was being put over on them.

The experience of visiting these people, which I apprehended would be an unpleasant job, was quite the reverse. Enough people were very grateful to make the whole enterprise worth while, and I feel sure that the success of the thing is beyond peradventure.

Among the readers of RADIO BROADCAST there must be thousands who could do this in their local town or county. My own experience has proved that it has to be done personally and cannot well be done by somebody hired for the job. I cordially recommend the idea to anybody who wants to add comforts and pleasure to the lives of blind people. If a sufficient number of people could be got together to cover the country, the load of pain and suffering would be tremendously decreased.

For the practical reader I may say that the machine we have found best adapted to the purpose is of the reflex type.



CHECKING RECEIVERS FOR THE INTERNATIONAL BROADCAST TEST

A corner in the RADIO BROADCAST Laboratory which shows some of the apparatus employed in the tests. At the left is a low powered radio telephone transmitter, presented by the Radio Corporation, next to it is a Roberts short wave receiver, and beyond that, a Kennedy long wave set is being operated by John B. Brennan, editor of the Grid. Signals from all the European countries participating in the tests were logged at the laboratory through which the broadcast activities of two continents filtered during the test week

THE MARCH OF RADIO

By J. H. Morecroft
Past President, Institute of Radio Engineers

The Great Success of the International Tests

WE CAN record a well-merited success for those who conceived and executed the international radio broadcast tests of 1924. It is only a short time ago that Mr. Paul F. Godley, one of the most skilled radio operators in America, first attempted to hear a low-powered, short-wave set span the Atlantic. It was really a wild idea at that time, and one for which a successful outcome had been predicted by practically no one.

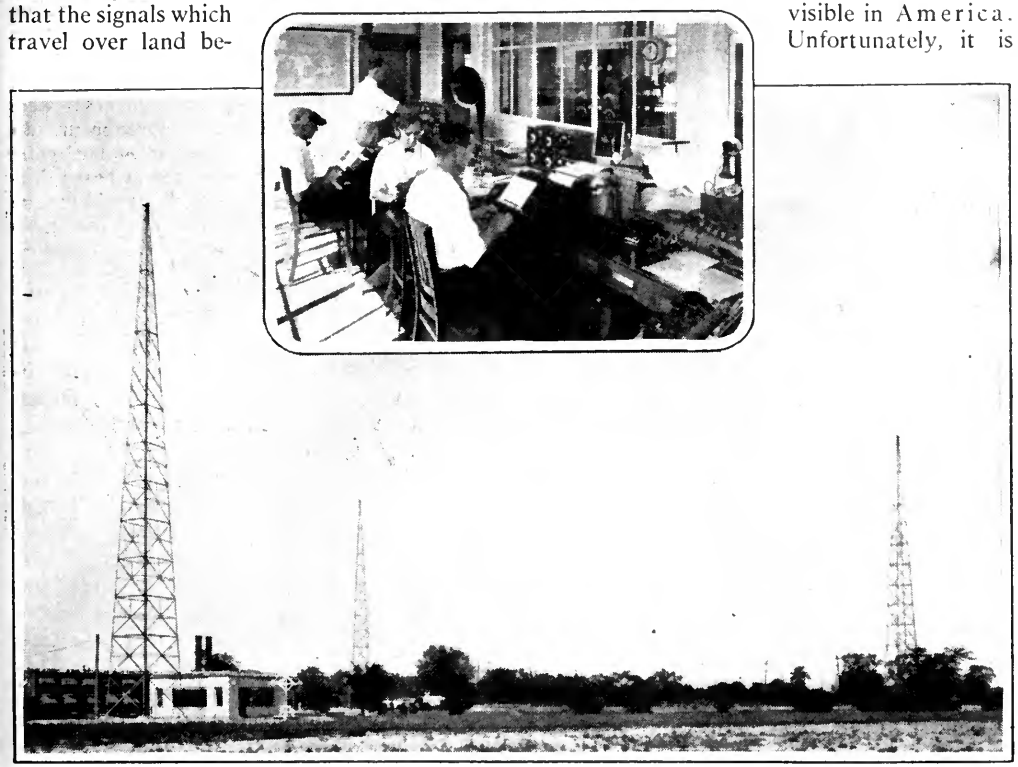
He used a many-tubed super-heterodyne working on a specially constructed antenna, and was finally successful in picking up code signals from several American amateurs. Mr. Godley's receiving apparatus was set up in Scotland.

During the test just come to a close, thousands of American radio fans heard many of the low-powered, short-wave European stations. When one compares Godley's test with those of 1924 one cannot but believe that radio

communication is striding forward rapidly. The successful listeners during the test were not skilled amateurs. They had sets using a half or a third as many tubes as did Godley's, they had ordinary short antennas, and in some cases loops only, and they received radiophone signals, whereas Godley received dot and dash telegraph signals. This latter fact is of much more importance than one might think; the same amount of power used for telegraphing as used for telephoning is good for possibly twice the distance of communication.

It is not easy to conceive of just what these long-distance tests mean from the standpoint of power. A station rated as 500 watts probably radiates about 100 watts of power, and the energy thus thrown off spreads out in all directions. Much of it is radiated up 50 or 100 miles and there is partly dissipated in the semi-conducting atmosphere and partly reflected down again to the earth. Part of the energy is absorbed by buildings, and even by vegetation on the earth's surface, which is evidenced by the fact that the signals which travel over land between two stations are by actual measurement only about one third as strong in summer as in winter.

In spite of this dispersion, absorption, and reflection, there is still left sufficient power after a voyage of 4,000 miles to give an intelligible signal to the radio listener. Imagine a 500 watt incandescent lamp burning in France, Italy, or England, being visible to thousands of observers in our country! Imagine communication being carried on between those countries and ours by a blinker code worked on the lamp. In trying to imagine such a feat remember that our best lighthouses, having lamps of 100,000 candle power or greater, are visible at most over perhaps 50 miles. One feat which has been accomplished in radio is still aiting to be solved in the realm of optics, that is, the magnification of the received signal. If we had some apparatus through which to look, which would do the same thing to the light waves as our amplifiers do to the radio signal, then possibly the 500 watt lamp in Europe would be visible in America. Unfortunately, it is



HENRY FORD'S RADIO PLANT

At Dearborn, Michigan. The three towers of the 1000 watt station WAV which operates on 1713 meters with Ford stations at Springfield and Jackson, Ohio. The four lake carriers of the new Ford Fleet are in constant communication by radio with the home office, wherever they may be on the Great Lakes, which can be a maximum of five hundred miles distant. More than 400 messages a day are handled by the operators, shown in the insert

not possible to amplify light as yet. Radio has been able to march right away from the older branches of science in this respect.

Besides giving a thrill to the broadcast listeners who heard the transatlantic stations, these tests, planned and executed by RADIO BROADCAST, have a real educational value. Few listeners to-day really appreciate the true status of radio transmission. If a signal will go 1,000 miles, why not 2,000? No reason at all, and it actually does go 2,000 miles, or 10,000 miles for that matter. Every day the signals from all the European stations are racing past our receiving sets. Just because we don't hear them is no evidence that they are not there. The signals are there, but so are all the other electrical noises set up by electrical disturbances of all kinds, artificial as well as natural. Every time a trolley wheel jumps off the wire in Chicago a radio signal is sent to New York and beyond, and every elevator which starts or stops in New York reciprocates for the benefit of Chicago listeners. Every electrical storm in the Gulf of Mexico splashes radio signals of all conceivable frequencies over the whole world, and the little regenerative receivers in Baraboo and Chappaqua add their share to the Babylonian chatter resulting in what we call interference, static, or plain "noise."

And here we add the telephone engineers' motto on transmission, a motto which is of as much significance to the listeners as to the engineer. "Don't let your signal get lower than the noise or you'll never find it again." Now the reason we do get European stations during these tests and not at other times is because ordinarily the noise level is higher than the signal and there is no set yet made which can reach down into this mess of noise and extract the signal we are looking for. So we know now that the way to hear Europe is to lower the noise level (at least insofar as it is due to artificial causes) and hope the natural noise is not too loud. Another way is at once evident to us, that is, to raise the signal strength by putting more power into the sending station—this is probably the real answer to transoceanic radio phone transmission. Raise the signal level a hundredfold, then the amount of noise we ordinarily have to-day will not be able to submerge it.

Government Monopoly of Radio Is Wrong

IN A recent talk before a meeting of representative business men, Professor Pupin, known to scientists because of his contributions to alternating current theory and practice, and to the general public because of his autobiography *From Immigrant to Inventor*, expressed his views on governmental control of technical developments and industries. In view of a recent cable dispatch from France indicating a tendency in that country to control radio by strict governmental supervision, Professor Pupin's views seem especially timely. Besides being a scientist of a high order, he is known by his friends to be of sound business sense, having reasonable and well-founded views on the important questions daily confronting our country.

> The weakest point in democracy has always been the lack of appreciation of expert knowledge. Railroads, telegraphy, telephony and radiobroadcasting, electrical lighting and the electrical transmission of power are certainly public utilities, but the intelligent people of the United States will never consent that these things, requiring an enormous amount of expert knowledge, be placed under government ownership. The machinery of our government or of any other form of government known to man to-day is utterly incapable of handling technical problems, which require the highest type of training applied to the highest type of intelligence.
>
> All of these public utilities are full of complex technical problems which cannot, and never were intended to be, handled by any government. In Europe we see that where there is governmental ownership, the utilities are being run at heavy deficits. And only recently Mussolini has said that he wants to get away from government ownership and adopt the American system.

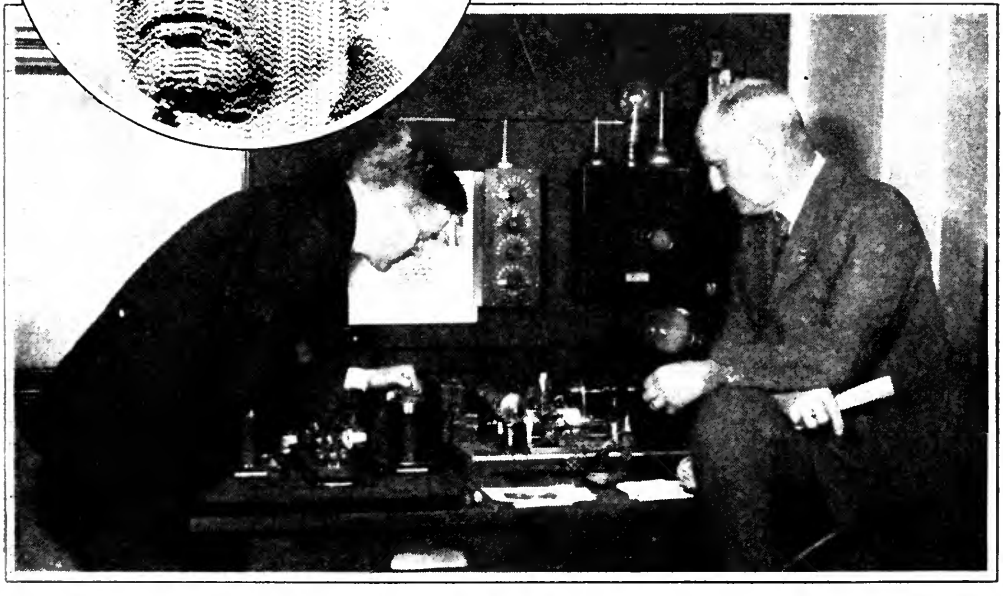
In the light of this opinion, it is apparently an unwise step which is being fathered by Pierre Robert, Under Secretary of State for Posts, Telegraph, and Telephone. He recently announced in the Chamber of Deputies that he believes that radio broadcasting should be organized as a government monopoly. He proposes to submit a bill to the Chamber at its present session and will urge its adoption. It seems strange that Professor Pupin, who knows his Europe much better than most of us, used it as a striking example of the futility of expecting public utilities to be operated successfully under governmental control.

We learn also that the Minister of the Interior has organized a special "listening-in" service to be operated by police headquarters to insure that radio broadcasting shall not disseminate information detrimental to what he considers the "country's good." Propaganda of all kinds will be taboo, and we learn that the police will try to prevent the "transmission throughout the provinces of information on daily market conditions and prices, as essen-

tial products would thus be held up by the producers for the most favorable terms, thus increasing the cost of living." Here in the United States the farmer is continually urged to utilize the radio dispatches of the Department of Agriculture and other government bodies which send out market conditions specifically to enable him to market his products most profitably. It is difficult to understand the French attitude. Isn't the farmer entitled to whatever help radio can give him? Certainly no government official in the United States would boldly declare, as did the French minister, that he didn't mean to help the farmer market his wares as profitably as possible. It seems that there must be no "farmer vote" to worry about in France as there is in America, as most of our politicians seem to think.

Photographs Across the Sea

ONLY a short time ago we commented on the excellent transmission of pictures from Chicago to New York over the wires of the American Telephone and Telegraph Company and also on the successful attempt to send them from Washington to Baltimore by a radio channel. About the same time that occurred here, in France M.



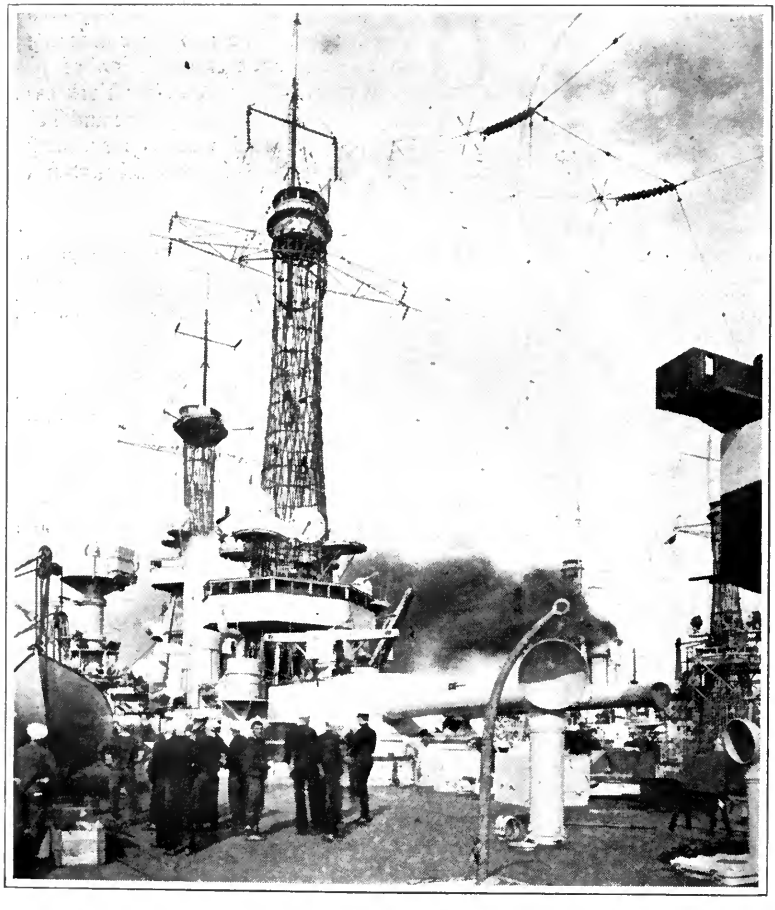
FACES ACROSS THE SEA

Became a reality when engineers of the Radio Corporation of America and the British Marconi Company succeeded in transmitting photographs by radio from London to New York. The system was developed by Capt. R. H. Ranger of the Radio Corporation. The top photograph shows Capt. Ranger, the round insert is a photograph of Ambassador Kellogg, one of the first to be transmitted across the Atlantic. The bottom view shows General Harbord, president of the Radio Corporation (right) and Capt. Ranger

Bélin announced the successful conclusion of his efforts to transmit pictures by radio. Now we have pictures across the Atlantic. The Radio Corporation of America has succeeded in sending some quite recognizable portraits from Carnarvon, Wales, to Riverhead, Long Island. High power is used so that the signal received in America is reasonably large compared with static disturbances, and in this way the blotchy appearance which is sometimes caused by atmospheric disturbances has been practically eliminated.

The general scheme used is the same as before: light from (or through) the portrait to be transmitted falls on a sensitive photoelectric cell. The action of this cell controls the intensity of the signal sent from the transmitting antenna. The light beam used is very small (only about one hundredth of an inch square) so that it covers only a very small part of the portrait at one time. By moving the picture past the light beam back and forth and having quite similar receiving apparatus actuated from the received signal, a picture is formed by packing together a series of shaded lines. It takes about three seconds to draw one line completeiy across the picture, and as there are about 100 lines per inch it may be figured out that to transmit a picture about three inches square requires twent minutes.

Fixing the charge for picture service by the amount a station could earn in a similar time by transmitting telegraph signals, each picture would cost about $50. Most of us will evidently send our pictures by mail for quite some time to come, but newspapers may well use this picture service. The same apparatus can be used for sending the written or printed word, and it may turn out that, with the improvements which are sure to come, one can send a message faster by this photographic scheme than it is by the present dot and dash code.



THE U.S.S. "TEXAS"

Showing the elaborate radio antenna system, which is used to dispatch the very considerable radio traffic necessary on practically every naval vessel

It is not quite clear from the announcement made by the Company just what its engineers have contributed to this photograph transmission development. Practically the same process as that outlined has been used before for picture transmission, but it is quite possible that valuable additions to the progress of the art have been made in synchronizing the sending and receiving apparatus, and in eliminating the blotches caused by atmospheric disturbances. After the transmission has once started, it is essential in any

PROMINENT FIGURES IN THE RADIO WORLD

In the group, from left to right are, Prof. Alfred N. Goldsmith, past president, Institute of Radio Engineers, and chief broadcast engineer, Radio Corporation of America, John V. L. Hogan, consulting radio engineer, Prof. J. H. Morecroft of Columbia University, another past president of the Institute of Radio Engineers, Philip Torchio, L. W. Chubb, and Prof. L. A. Hazeltine, Stevens Institute of Technology to whom the patent on the neutrodyne receiver was granted

of these schemes that the sending and receiving drums run in exact synchronism, and to do this when 3,000 miles of ocean separate the two, is quite evidently a real task. Undoubtedly we shall later get a better explanation of the new features of the Radio Corporation's scheme, which shall show how the requisite synchronism of sender and receiver is maintained in the radio channel.

The Radio Compass Can Guide Aëroplanes

A REPORT from Washington, evidently emanating from the Army Air Service, tells of "the first practical test" of the radio compass as an aëroplane guide. We were under the impression that the radio compass was quite successfully used during the War to guide aëroplanes, but now it appears that some new developments make the Signal Corps rise and assert that a real advance has been made. Two special radio compass stations have been established, one at Dayton, Ohio, and the other at Moundsville, West Virginia. By means of the signal sent out from these stations, Lieutenant G. W. Goddard was able to "keep in a bee-line," as he says, between the two fields even though the day was so foggy that he could not get his bearings from well-known landmarks.

The transmission system was such that when he was on a straight course he heard only dashes in signalling, but when he got off the course the signal was changed. If his plane was veering to the left he heard a dash and dot repeated at ten-second intervals, but if he was going to the right of the proper course he heard a dot and a dash repeated at the same interval. By thus correcting the direction of his flight until he heard dashes only he knew that he was directly in line with the station toward which he was trying to fly.

One who has not been up in an aëroplane cannot appreciate the difficulty of getting radio signals in the cockpit. Many times we

ask some one in the house to keep quiet when we are trying to pick up a distant station. Even a low-pitched voice in the same room gives quite appreciable interference. How is it when the air is rushing by the listener at the rate of 100 miles an hour and the guy wires all singing notes of their own and the 150 horsepower motor exhausting right at his side with no muffler at all? The combination of noises is as bad as that in a boiler shop, if not worse.

To overcome this excessive disturbance, the radio listener must wear a padded helmet, in the sides of which are fitted the ear-phones. It is remarkable how much noise half an inch thickness of leather and felt can shut out. The rushing air becomes quiet and even the roar of the engine exhaust becomes a low hum. Of course even with the best helmet obtainable one needs a pretty strong signal for reasonable audibility, considerably stronger than is required by the ordinary listener. To assist the helmet in eliminating engine noises, long exhaust pipes were fitted to the engine of the test plane, so that the exhaust actually took place behind the cockpit, whereas generally it is right beside the pilot.

The antenna used was a long trailing wire hanging through the bottom of the cockpit and held reasonably vertical by a heavy lead weight. The general scheme used during the War was to have a loop antenna on the plane and get compass bearings as a ship does today.

After landing at the end of his successful flight Lieutenant Goddard said that it "had not been necessary to keep an eye open for landmarks at all." The radio signals enabled him to find his way directly to the station which was his destination.

In the same line of radio's progress we read with interest the report of George R. Putnam, Commissioner of Lighthouses of the United States. His department, we learn, now has twelve radio fog signal stations scattered along the coast and is establishing new stations as fast as funds permit. Commissioner Putnam says that this country leads the world in this form of relief. We were the first to give fog signals successfully and now have more of such stations than all of Europe put together.

Too Many Went to Fights by Radio

IN GENERAL, radio is praised for the success with which it disseminates news and entertainment, weather reports for the navigator, market conditions for the farmer, music for the dance party, and football narratives for the college alumni or sports devotees. Football games, especially, have been well broadcast. An announcer like Graham McNamee performs his task so well that we can quite clearly visualize the mud-covered combatants as they slosh around through the mire of their battlefields. Judging by the newspaper reports of the attendance at these games, which at times have been as many as 100,000 for a single contest, one may safely come to the conclusion that football broadcasting has not seriously interfered with the gate receipts.

Another line of sport has apparently not fared so well as a result of radio's publicity. Tex Rickard, who makes a very good living by matching prize-fighters, has just put radio on his own Index. For the past three years bouts have been fought before the microphone so that the cheers and jeers, the gong, and even the thud of blows could be heard by the radio listener. And so vividly has radio portrayed the fight that many have preferred to stay at home, where there was no admission to pay, and no crowd of a hundred thousand through which to mill. So Mr. Rickard has decided that hereafter radio and he shall part company; the fight fan who wants to see two human beings who consent to batter each other for about $1000 a punch will have to go to the scene and contribute his share of the gate receipts.

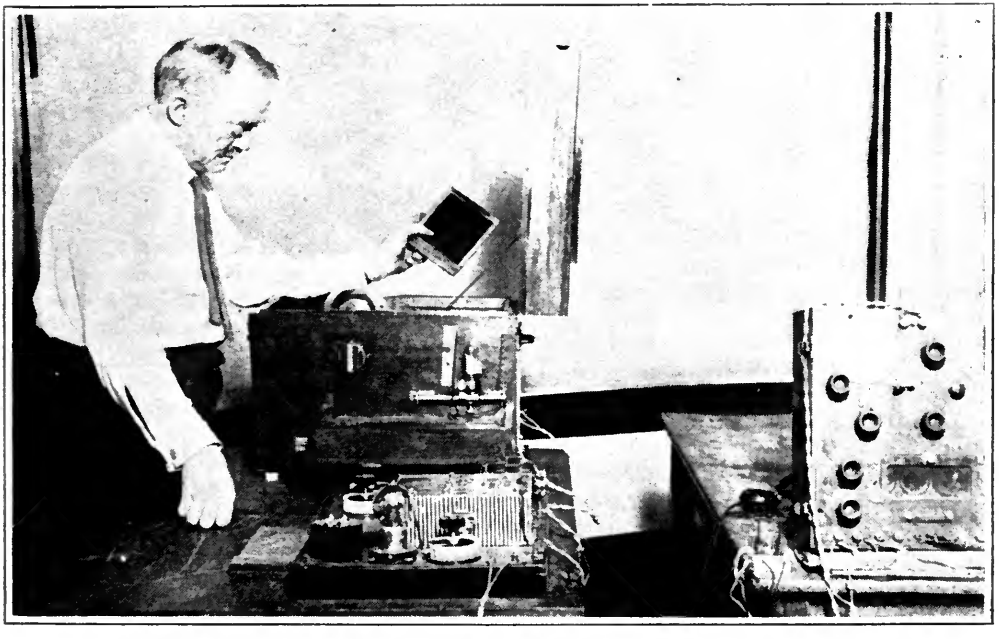
How Electrons Are Heard

IT IS only a few years ago that scientists dared to venture the idea of the electron, for before that the idea of the molecule and then its small comrade, the atom, had certainly stretched imagination to its apparent limit. For example, in a piece of cubical copper about one half inch on an edge, there are one million million million million atoms. To make a row of copper atoms one inch long, about two hundred million of them would be required. Imagine then the intrepidity of the scientific worker who dared to announce the existence of particles much smaller than the atom, so small that it takes one hundred thousand of them to make a mass equal to that of one copper atom. Gifted with a powerful imagination must be the worker who deals with electron phenomena, and especially is this true of the research worker who is going to find out new facts about the behavior of these infinitesimal particles of electricity.

It might be thought that particles as small as the electron could be dealt with only in the imagination, that measurements as to their size, velocity, quantity of electricity, etc., could not possibly be made. Yet this is far from the truth. The mass of the electron, and its size and electric charge, are known as accurately as is the length of a yard stick. Measurements of the electron carried out by independent methods agree with each other to better than 1 per cent.

Professor Millikan, when at the University of Chicago, carried out some remarkable experiments on electron measurements. So important were his results regarded in the scientific world that he was given the Nobel Prize. Millikan sprayed oil into very small drops, so small that they were nearly stationary in the air, even though free to fall. Some of the drops he used fell only one quarter of an inch in ten seconds, so little did the force of gravity attract them. A very powerful microscope was required to see them; in fact, the drops were never seen as such but appeared like the dancing circles which appear if one presses his eye-ball too severely. By having these drops of oil between electrically charged plates it was possible to make them stop falling or even move upwards if the droplet happened to be charged electrically. Now if electrons were produced in the space where the oil drops were being observed, one would occasionally attract itself to an oil drop, which would then immediately change its motion. By observing the change in motion and knowing the size of the drop (by other experiments) the charge of a single electron could be computed. Occasionally an oil drop suddenly changed its motion twice as much as did the others. This meant to the observer that two electrons had simultaneously attached themselves to the oil drop.

So by these remarkable experiments of Millikan's the electron was almost observed in motion. Now the electron is being heard! Dr. Albert W. Hull, one of the best-known research workers of the General Electric Company, announces that by apparatus which he has perfected it is possible actually to hear the electrons which fly across a vacuum tube. When they strike the plate of the tube they set up oscillations which, if sufficiently amplified, can be heard. Of course the amplification required is enormous, so great that if it were tried with the ordinary unshielded amplifier outfit, the noise due to atmospheric electricity would swamp the noise due to electron bombardment. By working inside a metal cage,



C. FRANCIS JENKINS

A radio investigator of Washington who recently was successful in transmitting photographs by radio from Anacostia, Maryland to Medford Hillside, Massachusetts on a wavelength of 746 meters. The photograph shows a laboratory set up of some of the inventor's apparatus at Washington

however, the listener is reasonably well shielded from extraneous electrical disturbances, and it is with such an arrangement that Doctor Hull and his co-worker, Prof. W. H. Williams, announced that they now hear the bombardment of the plate which is set up by the billions of electrons which every second pass from the filament to the plate of the ordinary radio triode.

Broadcasting Invades the Philippines

IN THE last session of the Filipino legislature a bill was passed granting a franchise to the Radio Corporation of America and two other concerns for the operation of radio broadcast service in that province. Governor Leonard Wood has just signed the bill, so that probably within the

OLD SOW RADIATOR

I know an old pest who be-clutters the air,
She has many children—she has 'em for fair;
She gives squealing lessons to all her young brats—
(For sharp oscillations, they have it on cats.)
A selfish old hag—with the sharpest of voices,
In spoiling our concerts she gayly rejoices;
Sing ho!—for a law to put her on the "skids—"
And listen, dear fan—don't raise one of her kids!

—Drawing and verse by W. R. Bradford.

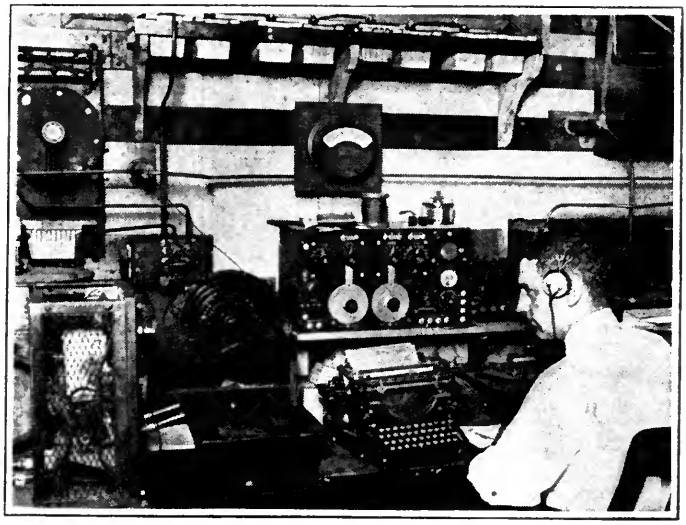
year the Philippines will have their local broadcast channels and occasionally the listeners on these islands will undoubtedly pick up messages from other lands.

Locating the Broadcast Station

IT IS now about two years since the first systematic measurement of radio signals was attempted and carried out. Where evidence about audibility and interference is obtained from untrained, observers as was first done, but little progress in radio transmission development is possible. Real knowledge of radio conditions can be obtained only by making measurements with instruments which can actually be read. It cannot be obtained by comparing the observations of two listeners having no other evidence than that given by their ears.

The next step in radio transmission investigations, after portable receiving apparatus had measured the signal strength in all directions from a fixed transmitting station, was to move the transmitting station itself to compare its performance under different conditions. It is probably true that to serve a large city and its suburbs, a transmitting station should not be in the city itself. If the transmitting station is in the middle of a group of steel buildings, practically all of its energy is absorbed in the immediate vicinity of the station and thus wasted. Much better service would probably be furnished to the city dwellers if the station was located in the country, possibly twenty miles or more away, in the open country where the absorption is comparatively small. Such a location must have good grounding facilities, and therefore actual trials of the location are always advisable before a station site is determined.

Station WJAZ of Chicago and vicinity has been doing just this thing lately. Their 100 watt transmitter, mounted on a truck, has been operated in various locations around Chicago and now a compilation of the data obtained by variously placed receiving stations around Chicago will permit the logical selection of the most suitable location for a new broadcast station.



RADIO IN RETAIL MERCHANDISING

The radio telegraph station WHI at the New York store of John Wanamaker. The Philadelphia and New York Stores carry on a great deal of traffic which was formerly handled by telegraph, letter, and long distance telephone. A five kilowatt arc is used, transmitting on a wavelength of 1700 meters. The operator in the photograph is Douglas Smith manager of the radio department at New York

A German Broadcast Station on a Mountain

THERE are indications from Germany that radio is progressing there, even if not at the rapid pace it has assumed in our country. At Lake Kochelsee in Bavaria a station is being erected which, it is claimed, will be the most powerful in Europe. The antenna will extend along the side of a mountain from the summit to its base, where the station is being erected on the shore of the lake. This will give an antenna two miles long and of rather indefinite height as far as radiation efficiency is concerned.

Following our lead in educational radio, a broadcast station in Berlin has started to radiate some university courses two evenings a week. While intended primarily as a help to those who attend the university, probably some data will be obtained as to the general appreciation of this type of broadcasting.

Is Education by Radio Wanted?

IN AMERICA, it seems likely that the demand for solid educational material is one which has to be cultivated. By far the vast majority of radio listeners regard the radio

MAJOR WILLIAM N. HENSLEY, JR.
Commanding Officer, Mitchel Field, New York

"The adaptation of radio to the airplane has completely changed the aspect of war. Under present conditions, an enemy would have no secrets. To mass troops at any one point would simply serve to inform the opposing forces that an offensive was contemplated. Artillery fire could be directed with such deadly accuracy as to annihilate any stronghold. The gun pointer would have first hand and almost instantaneous information as to the necessary corrections with the result that big guns can be fired with the precision of a rifle"

channel as one through which material for entertainment rather than education should be sent. It is not at all impossible that the educational possibilities of radio have been overestimated. Possibly the contact with the instructor, the opportunity to ask questions, to get his criticism and occasional praise, have a much higher value in the field of education than is generally supposed. The progress of educational radio must depend upon its reception by the public, and the public's demand for it may show conclusively, as has often been stated, that the teacher, and not the method or material taught, is the factor which advances the world's knowledge.

Yap Gets a Radio Station

THE small island of Yap in the western Pacific has several times loomed up in international affairs with a valuation much greater than its physical dimensions and natural riches warrant. It occupies a strategic position in cable and radio communication between the eastern and western shores of the Pacific and assumes unexpected importance, especially for Japan and the United States.

At the Disarmament Conference in Washington, Japan was granted mandatory powers in Yap, with the provision that other interested nations should have equal rights with Japan in the use of its communication facilities. Japan now announces her intention to erect next year a powerful radio station in Yap, presumably to increase the certainty of her transpacific communication channels. Undoubtedly the new station will be used for relaying. In that rôle it would be useful also to the United States when static interferes with the long spans over which our present circuit to Japan extends.

Coöperation in Solving Interference

IN A recent issue we had occasion to commend the activities of Mr. Alfred Caddell of the American Radio Association and used as an illustration of the work he was attacking with success the question of interference in the broadcast channels caused by the steamers of the New England Steamship Company, which carried on a heavy commercial traffic with spark transmitters.

The interference was there without any doubt, and we quite naturally commended Mr. Caddell for the lively measures he was taking to eliminate it. We have received a very courteous letter from the president of the Steamship Company asking us to assure the broadcast listeners that his company was anxious to help in clearing up interference as much as possible. In accordance with the recommendations made at the last radio conference the ship traffic is now being carried on on a wavelength much farther removed from the broadcast channels than the originally interfering wave of 600 meters, and he hopes the interference nuisance has been done away with.

His letter, however, contains one naïve statement which we think worth while passing along. "I get no interference from these steamers," says Mr. Parnell, "although I use a simple set consisting of three stages of radio frequency, a detector, and three of audio frequency, seven tubes in all." Well, naturally, he gets no interference. Three stages of tuned radio frequency will eliminate a whole lot of interference, but surely this is a rather expensive equipment to expect the average broadcast listener within a few miles of New York to use. If all the listeners who have

been bothered by the ship traffic would put in three stages of tuned radio frequency, the interference problem would unquestionably be solved, but the expense involved for the listeners might in the aggregate be sufficient to buy out the Steamship Company. An easier and more equitable solution, which we feel sure will more likely meet with commendation from the broadcast listeners, is for Mr. Parnell to order his ships to use their spark sets no more than absolutely necessary during broadcasting hours, and we are sure from the tone of his letter that suggestions of this kind will be complied with as much as possible.

Interesting Things Interestingly Said

MAJOR GENERAL GEORGE O. SQUIER (United States Army, retired; former Chief Signal Officer): "A world-wide net of electrical intercommunication linking together radio, land lines, and submarine cables in a new-born spirit of closest coöperation must be developed to the limit of possible usefulness, both for the needs of peace and as a powerful agency in preventing war."

GEORGE J. ELTZ, JR. (New York; Treasurer, Radio Apparatus Section, Associated Manufacturers of Electrical Supplies): "A large number of people who have been indifferent to the appeal of radio have just awakened with a start to find that the art has been making great forward strides. Moreover, radio has taken on a new artistic nature. When broadcasting first began, there was the attractive novelty of drawing music and speech from the air, and just what came mattered little, but now the main interest is in the quality of the entertainment and the perfection of its reproduction. A critical interest is being taken in programs, which is brought forcibly to the attention of broadcasters by the thousands of letters they receive each day."

HARRY L. FOSTER (travel writer, in *A Gringo in Mañana Land*) tells of hearing a radio concert in the Honduran wilderness at the house of a mine superintendent at Rosarie): It was as clear as though one listened-in from New York. Out there in the wilderness, forty miles from the nearest town, and many hundred miles from a railway, gringo energy had produced all the comforts of home.

"'That's Vincent Lopez in the Pennsylvania Grill,' the superintendent informed me. 'Wait until I get Schenectady, and we'll have a bedtime story.'"

WILLIAM M. BUTLER (United States Senator from Massachusetts): "Citizens who heretofore regarded politics as an incident in the life of the nation have now, thanks to radio, a keener insight and a fuller appreciation of political activities. I have been much impressed with the political importance of radio as illustrated during the progress of the national conventions. I think that those of us who listened-in must have had sober moments when from the convention hall, the actual voices of the delegates came to our ears as well as the disturbances and interruptions."

HERBERT H. FROST

Chicago; President, Radio Manufacturers' Association

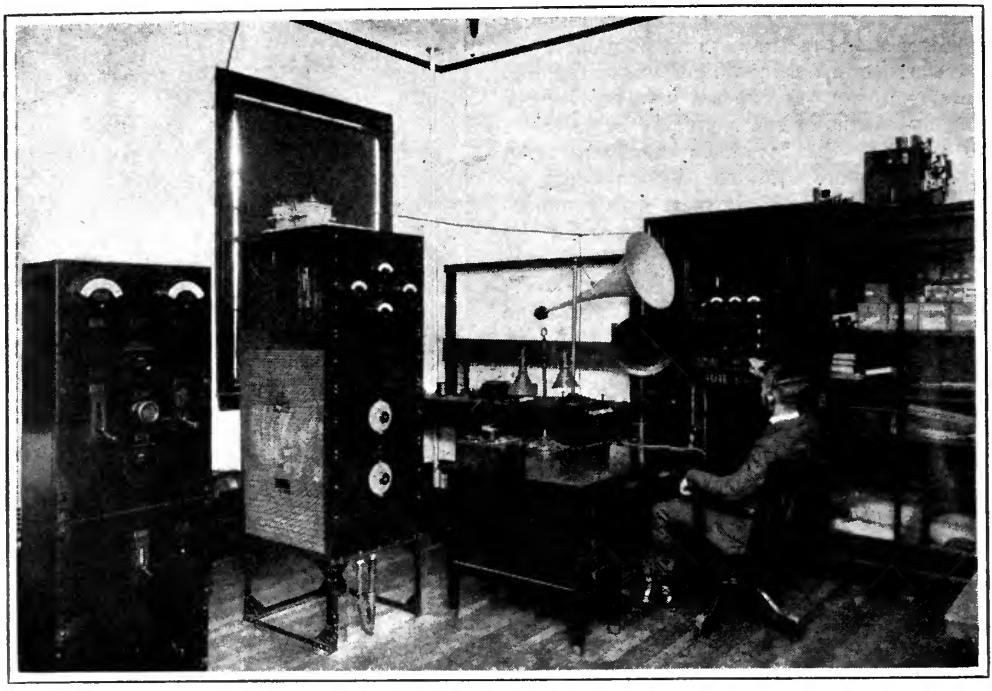
"By next summer, the new high power broadcast stations, authorized at the recent Washington radio conference will be in operation and they will make it possible for the farmer to receive his market and weather reports during daylight hours. Heretofore, such reception has been difficult, which kept the farmer from buying radio. Now, probably not more than fifteen per cent. of the American and Canadian farmers have receiving sets.

"The best engineers in the country are of the opinion that there will be no fundamental changes in radio receiving equipment in the next few years. Development in this respect is bound to be gradual and there is no danger that a person will secure a good set to-day and to-morrow find it obsolete.

"Radio has ceased to be a fad. It is the greatest source of communication since the first language was developed."

H. P. DAVIS (Pittsburgh, vice-president, Westinghouse Electric and Manufacturing Company): "International broadcasting, as I have consistently stated in the past year, must take its place as a regular feature of broadcast programs, and this may come in the very near future."

CHILDREN Sing for WBZ," says a headline in a Boston paper. Which goes Castoria one better.—*Boston Transcript.*



STATION WHAZ

At Rensselaer Polytechnic Institute, Troy, New York was one of the first college broadcasting stations to be installed. It is pointed out that a college broadcasting station is quite as good an advertising medium for such an institution as it is for a radio manufacturing concern

Who Owns Our Broadcasting Stations?

By DUDLEY SIDDALL

MR. B. C. PHANN, his wife and kids, aren't using their radio set as they used to. Six months ago it was a novelty. At first the whole Phann family came a-running at the mere cry of "Here's some DX!" But after a few weeks the thrill wore off. To-day the Phanns wouldn't sit up till midnight to hear Havana.

The Phann family has become discriminating. Nothing less than a surpassingly good radio feature will keep them away from movies, theatres, magazines, books, and other diversions. Radio no longer intrigues them with its mechanical mysteries. The loud speaker is now forced to compete for their time and attention on an equal basis with other forms of entertainment, amusement, news and education.

The movies, starting with men whose imaginations ran no farther than a single reel "chase" picture, soon produced directors like D. W. Griffith. The theatre has its creative geniuses like David Belasco. Magazines are edited by men who appear very definitely to know what the public wants, such as George Horace Lorimer and Ray Long. Books, when written by Gene Stratton Porter or Edna Ferber sell by the hundreds of thousands. In every line except radio, huge incomes await men and women who can capture public interest.

Analysis of information showing the owner-

ship of broadcasting stations proves beyond question, if there were any question, that the vast majority of broadcasting stations are operated largely for advertising purposes: in other words, as a feeder for the broadcaster's real business interest, his radio store, his garage, his jewelry shop, his clothing store, or his dance hall. So there are many who claim that the radio broadcasting station has much in common with the old time, now almost historical patent medicine vendor's show. It is, basically, they say a bally-hoo. Obviously no bally-hoo can hope to approach the proportions of grand opera, a feature film, or a Broadway theatrical production.

CASES IN POINT—WITHOUT NAMES

CONSIDER a specific station, in a Southern state. In 1922 an electrical store put in a line of radio supplies. To draw trade, the dealer installed a 500 watt transmitter and hired a local newspaper reporter on a part time salary of $20 a week as "director." This reporter is also the announcer, the publicity man, the scout for talent, and all the rest of the non-technical staff. One of the store clerks serves as the engineering department of the station. The "director" has long since made the rounds of such local talent as can be induced to sing, play, or talk. He has no fund to hire artists or even to buy them dinners and taxi rides. All things considered, he does fairly well; but he has no opportunity to give his radio audience anything better or bigger or newer or more impressive than as if he were directing a Sunday school social entertainment.

The dealer who pays the small weekly bills for this station charges the expense to advertising and is content. At heart he is an electrical retailer. Even if he were willing to spend $2000 a night on talent, which he isn't and never will be, he wouldn't know how to do it.

Another case. A chief executive in a metropolitan city plays with radio as a hobby. His real job is selling building materials. He cheerfully writes out a small weekly check to support a broadcasting station just for the fun of the thing.

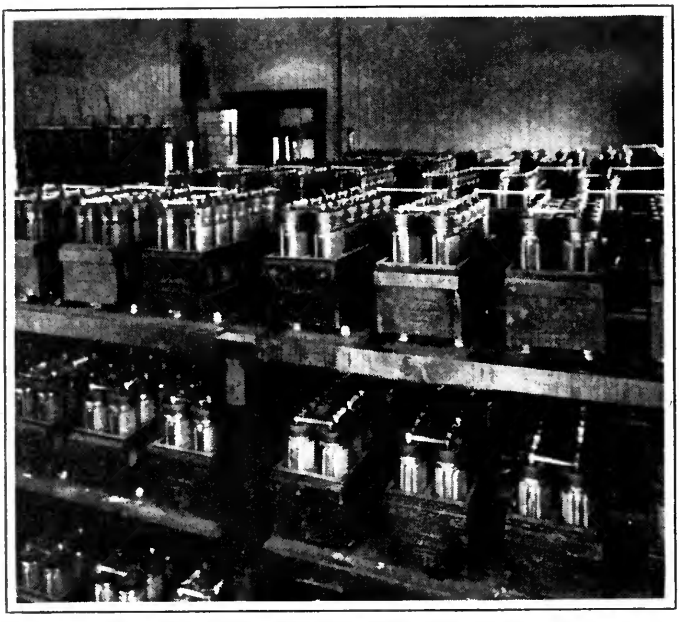
Much the same sort of a motive is back of a station operated by a large service company. A high executive in the organization is a radio enthusiast. He is so high up that nobody questions his right to use company time, men, and money to build a transmitting station; nor to pay a part-time salary to a publicity expert to "direct" it. Ostensibly the station is run so "that employees may be benefited." Thus the bills pass the auditing department under the general heading of welfare work. But those on the inside like to call this station "the chief's toy."

Newspapers, not knowing exactly what effect radio was going to have on their business, went into broadcasting on a fairly large scale to find out. Many of them did find out, and soon there was a lot of transmitting apparatus in newspaper storage rooms for sale cheap. A few papers, strategically located, have been able to make broadcasting pay by adding special radio sections to their Saturday or Sunday issues. Because the papers with broadcasting stations stand out as "radio mediums" they garner most of the radio advertising in their territories. These exceptions will stick to broadcasting as long as radio advertising volume holds up. Since the expense is usually charged to "promotion" it is certain that no radical artistic program innovations of an expensive nature will ever come from this source.

Nor can the public expect anything very highly artistic or highly important from the municipal stations, of which WNYC, New York City, is a notable example. Whether or not a municipal station is, as has been charged, a bally-hoo for the politicians is of no importance. The fact remains that tax-payers

What the Idea Is

Many radio listeners have often asked themselves, or what is more to the point, others, who owns all the vast numbers of American broadcasting stations. Those who tune-in, night after night, to the more or less varied programs from every section of the nation, should be, and usually are, interested in knowing the ownership of the stations figuratively knocking at their antenna insulators each evening. Mr. Siddall has analyzed the ownership of our 550 stations and has included some interesting remarks of his own about the general problem of who is broadcasting, how they are doing the job, and what is likely to happen to broadcasting. According to the estimate of the writer, it takes roughly 11,000 separate features to supply American broadcasting programs for one day. Is there that much talent in the country to supply material for each of the 365 days?—THE EDITOR.



MANY PURELY COMMERCIAL CONCERNS

Have gone into broadcasting, presumably directly to influence their sales. This photograph shows the bank of batteries used to run the station which is maintained by a battery manufacturer

would resent any lavish expenditure for talent on the part of a municipal broadcasting station. City officials are not elected for the purpose of giving nightly musical entertainments. So, while municipal stations may perform certain modest functions very capably, the people who sign "Irate Tax-payer" to their letters "to the editor" can be depended upon to sit on the municipal lid.

HOW GOOD A JOB IS BEING DONE

EDUCATIONAL institutions, churches, national guard, chambers of commerce, hotels, department stores, grain and feed establishments, monument dealers, lawyers, a chiropractic school, newspapers, music-stores—so runs the list of broadcasters. Plainly, they are using radio to advertise everything from the Gospel to "$2 Dinners With Dancing."

Day after day and night after night these stations pour forth programs. Take a pencil and figure out the staggering quantity of stuff that is annually being pushed into the air. Suppose each of the 550 broadcasting stations operates two hours a day, and suppose that the average length of each program number is six minutes, or ten items an hour. Multiply 550 by 2 by 10. The answer is 11,000; for this is the daily number of program items required to fill in the time of America's broadcasting stations. Now multiply 11,000 by 365, to get the annual number of items. The answer is 4,015,000. If you're conservative, cut this in two and you'll find that at least 2,000,000 songs, dance numbers, sermons, Republican, and Independent conventions, talks on the rubber heel industry, and bedtime stories have to be gathered and disseminated annually by the broadcasters. The wonder is, not that they do such a bad job, but that they do such a good one.

Broadcasting is still very young. It began in September of 1921. In January, 1922, the licensed broadcasting stations numbered only 28 for the whole United States. By fall, or October 1 to be exact, the number had jumped to 539. At that point the swiftly rising curve flattened out and ever since then the number of licensed broadcasters has hung around the 550 mark. On July 1, 1924, there were 549 stations; only ten more than on October 1, 1922.

The mortality is heavy; as many as 80 stations having been deleted from the list in a single month. Twenty deletions is about the average. Always, however, other new and hopeful advertisers have come along to throw their waves out into the great unknown, so that the total number of stations steadily stays between 500 and 600.

Of the 549 stations which were licensed up to July 1st, last year, 224 were pretty definitely advertising radio. That is, these 224 stations included radio manufacturers, radio jobbers, radio stores, garages handling radio equipment as a sideline, department stores featuring radio sections (of which there were 20), and music stores which were taking no chances on having their phonograph and piano business literally vanish into the air. To this classification could be added 11 stations operated by such concerns as the American Telephone & Telegraph Co., the General Electric Co., the Radio Corporation of America, and public

utilities which are in radio either for sales or experimental and patent motives. In other words, 235 or about 43 per cent. of the broadcasting is now being done by firms who have a direct interest in the radio industry.

EDUCATIONAL INSTITUTIONS NEXT TO RADIO

NEXT to the radio industry come the educational institutions with 92 stations. They are delving in broadcasting slightly, very slightly, from scientific motives; but largely, very largely, one may confidently assume, from the same advertising motives that impel them to build up strong football teams. Since October 1, 1922, the number of "educational" broadcasting stations has increased by 50 per cent.

Newspapers come third with 42 stations, just a little more than half the number operated by newspapers two years previously, before the worried business managers found they had little to fear from radio.

Fourth on the list are religious organizations with 31 stations; three times as many as on October 1, 1922. Presumably there would be many more of these "air churches" if more religious organizations had the money to build and operate them.

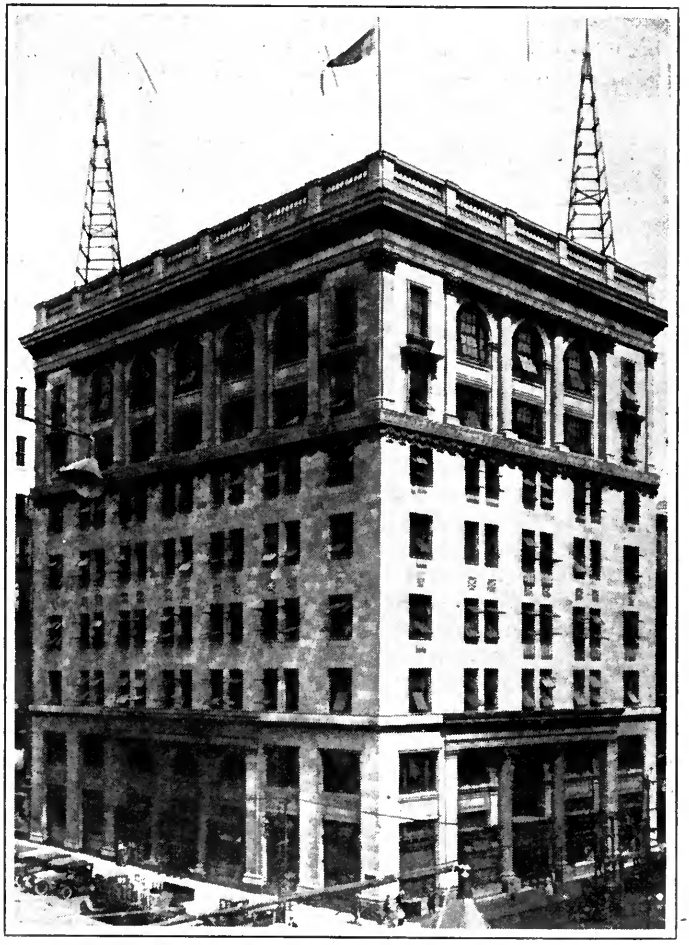
Miscellanous business establishments, ranging from a song book printer to a dance hall, account for 23 more. Municipal, national guard, chamber of commerce, and other community stations number 21, while clubs of various kinds operate 10 stations. Broadcasting is being indulged in by 7 theatres and 5 hotels. Added to all these is a group of 83 stations, chiefly of low power, in the hands of private owners and small business houses.

WHERE WE ARE NOW

IT IS not the purpose of this article to present any of the numerous schemes for bettering broadcasting, but simply to show the sources from which America's programs are now coming. And yet, on behalf of Mr. and Mrs. B. C. Phann and the Phann children, this word might be added:

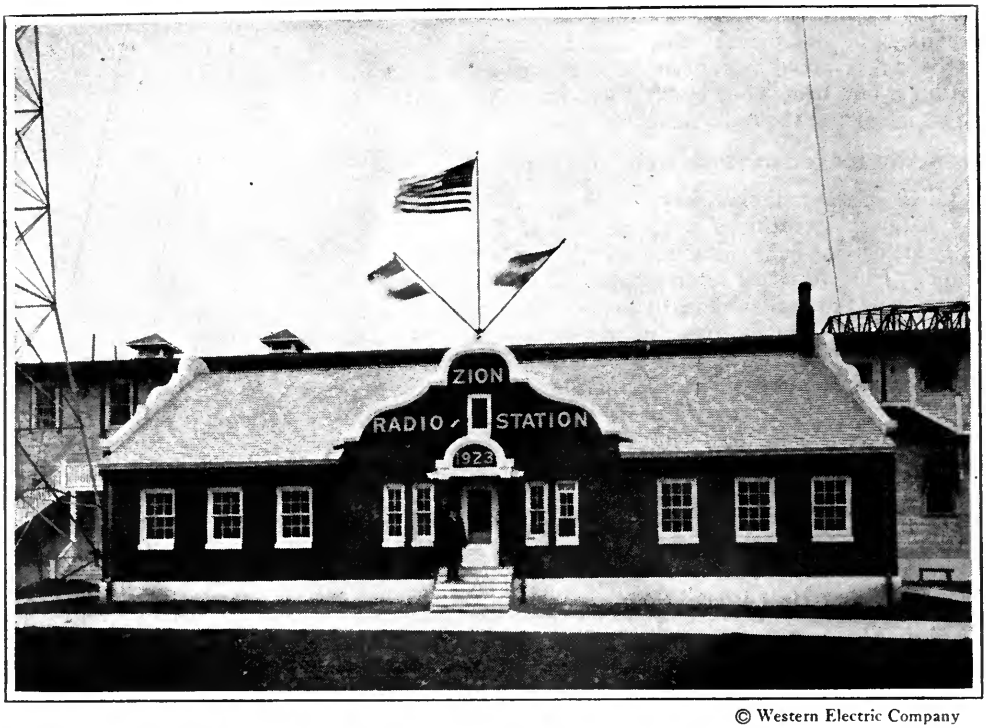
This year Mr. and Mrs. Phann are spending $350,000,000 on the mechanics of radio: that is, for parts, sets, batteries, tubes, and the rest of the paraphernalia. They are spending, practically, one million dollars a day not to count the hours and hours of time.

For this time and this money they are getting nothing, fundamentally but advertising in one form or another. They are getting the bally-hoos of political leaders, of ball clubs, of fighters, and football teams. They are getting the bally-hoos of hotels which have dance orchestras. They are getting the bally-hoos



THE ST. LOUIS "POST DISPATCH"

Has successfully operated station KSD for some time. This newspaper is one of a number of great newspapers in the country which has entered whole-heartedly into the "business" of broadcasting



STATION WCBD

Zion City, Illinois, is owned and operated by the religious community there under the direction of Wilbur Glenn Voliva. Entertainment and religious programs are regularly broadcast from this station

of actors (for the most part out of jobs) who want to "keep their names before the public." They are getting the bally-hoos of churches, of health departments, of colleges, and of popular music publishers.

The fact that a portion of these bally-hoos are good is utterly beside the point. The issue is that broadcasting of to-day is all bally-hoo—the advertising of something. The radio fans who are spending a million dollars a day are entitled to more than that. Radio, to grow into an art as the movies have grown into an art and to compete with the movies, theatres, and other arts, must find new and better food for its head phones and loud speakers. It must find inducements for directors of genius and artists of ability: men and women who can express themselves to the multitudes through the sense of hearing just as the creators of the movie art have, in twenty years, learned to translate artistic expression into terms of sight.

When that day comes, the public which is spending a million dollars a day on radio mechanics will gladly spend twice or three times as much on radio art.

"NOW, I HAVE FOUND. . ."

A Department Where Readers Can Exchange Ideas and Suggestions of Value to the Radio Constructor and Operator

FOR a long time, RADIO BROADCAST has felt the need of an outlet for the many excellent ideas dealing with various features of radio construction which reach our office. With this issue, we begin the department of good ideas from our readers, and invite the coöperation of all those who are interested.

If you have an idea about a valuable and useful new circuit, some new device, a construction or operating suggestion, we should like to have it. Payment of from two to ten dollars will be made for every idea accepted. The descriptions should be limited to three hundred words and typewritten. Accompanying sketches, drawings, and circuit diagrams should be as plain as possible.

We do not want simple, obvious suggestions. Material to be acceptable for this department must offer something of definite value to the constructor. Mere novelty is not desired. Address your manuscripts to this department, RADIO BROADCAST, Garden City, New York.—THE EDITOR.

A FORM FOR ROBERTS COILS

THE easiest way is to make a tin template to start with, from which any number of forms may be made, which will be handy when your friends hear your Roberts set and want to make one like it,

Cut a circular piece of tin $4\frac{1}{2}''$ in diameter;

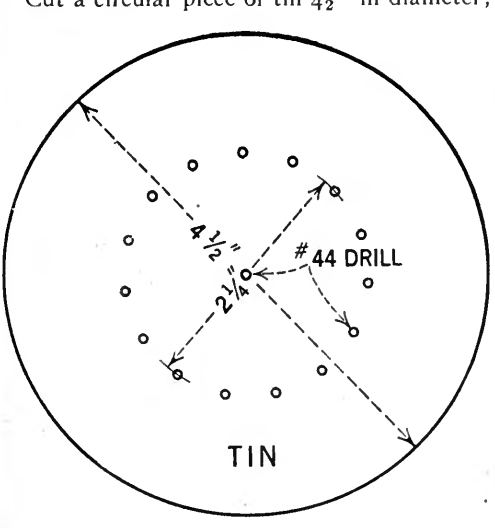


FIG. 1

then strike a circle on this piece $2\frac{1}{4}''$ in diameter. Set the dividers a little less than $\frac{1}{2}''$ and starting at a mark on the $2\frac{1}{4}''$ circle, "step" the dividers around the circle counting the steps, the object being to make 15 divisions on the circle. This will take several trials and some patience. When at last you have the dividers set right, mark the 15 divisions and center-punch them. Drill them out with a small drill, No. 44 or smaller. Drill the center hole with a No. 19 drill. See Fig. 1.

Cut out 5 pieces of $\frac{1}{16}''$ either red or black fibre $4\frac{1}{2}''$ in diameter and drill the center hole with a No. 19 drill. Bolt the template to one of the fibre pieces with an $\frac{8}{32}$ screw and run the small drill through the fibre using the holes in the template to guide the drill. Take off the

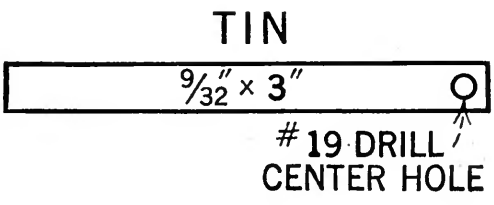


FIG. 2

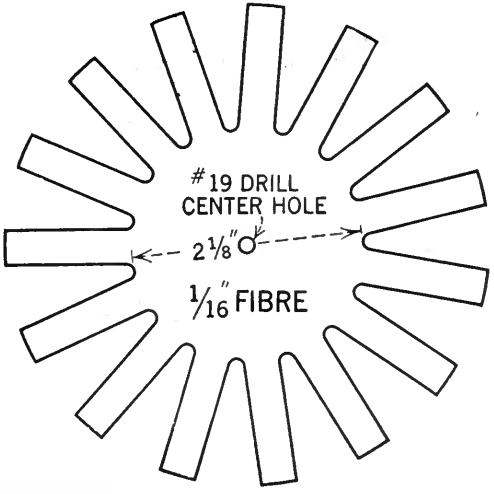


FIG. 3

template and ream out the holes in the fibre with the No. 19 drill.

Cut a strip of tin as shown in the sketch Fig. 2 and bolt it to the center of one of the fibre circles. Mark the spokes with it using a scratch awl and not a pencil, then cut on these lines with the tin snips and you will have a perfectly good form. See Fig. 3.

The forms should be boiled in paraffin for about ten minutes before winding or they will absorb moisture. After they are wound, the coils may be painted with a thin solution of celluloid dissolved in acetone.—Harding Gow, East Sound, Wash.

A FILTER FOR THE SUPER-HETERODYNE

IN PUTTING up a super-heterodyne along the lines of Mr. McMurdo Silver's set, using Acme 30 kc transformers, I found that the filter suggested, though not recommended, caused considerable distortion (due possibly to the cutting off of some of the

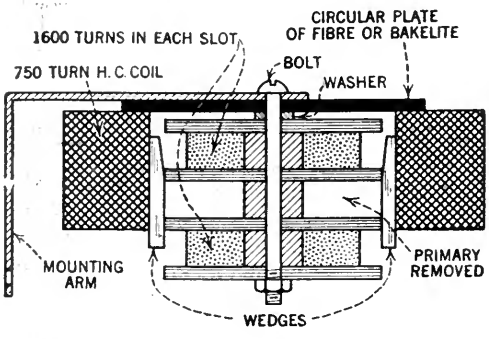


FIG. 4

side bands). I then worked out a filter which not only produced no distortion, but which also brought about sharper tuning and more volume.

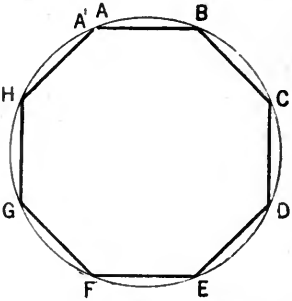
I removed the primary of 800 turns and placed the form bearing the two secondary coils, as described in Silver's filter, inside a 750 turn honeycomb coil providing the necessary mechanical support as shown in the sketch Fig. 4.

Connect the small coil as an untuned primary and shunt the honeycomb coil with a .001 mfd. variable condenser or approximately .0005 mfd. fixed condenser making this the secondary of the filter. With this substitution and using the Acmes in the two intermediate R. F. steps I could not ask for a smoother operating set than McMurdo Silver's set as described in October Radio Broadcast.—F. S. White, Syracuse, N. Y.

A PICKLE-BOTTLE COIL FORM

HERE is a stunt that you might pass on to your readers so that pickle-bottles will be not in such great demand for coil-winding purposes.

In a circle, inscribe an octagon of the size required for the coil to be wound, as in Fig. 5. Next, cut a strip of tin A-A′ long and about $2\frac{1}{2}''$ wide. See Fig. 6. Allow $\frac{1}{4}''$ at each end for a joint. Bend and form the joint first, then fold at B-C-D etc., to obtain the shape as shown in Fig. 8. Bend a piece of tin for a clamp, or slot a thin-walled brass tube so it will slip over the flaps as shown in Fig. 7.



'INSCRIBE AN OCTAGON WITHIN A CIRCLE'

FIG. 5

Small angles of tin may be soldered at one end of the completed form to guide the wire in a smooth, straight manner. Wind the turns closely together and when the proper width of coil has been wound give it a light coating of "dope" consisting of celluloid dissolved in acetone. The demountable form may be removed by withdrawing the slotted tube first.—R. B. Clapp, Cleveland, Ohio.

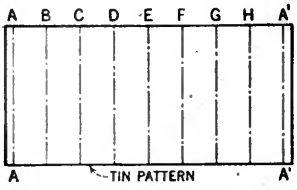


FIG. 6

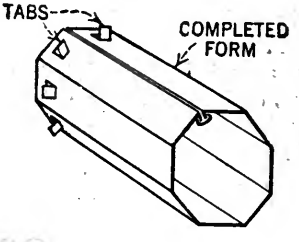


FIG. 7

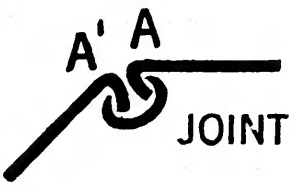


FIG. 8

ANOTHER WAY OF WINDING THE COILS FOR THE K. O. CRYSTAL REFLEX RECEIVER

IN WINDING the T1 and T2 coils used in the RADIO BROADCAST Knockout crystal reflex receiver, I am pleased to submit an idea of my own for getting clear of the trouble of supporting the leads for the primary, or smaller winding.

First, wind the primary on a tube of the proper size for the entire unit and bring out the leads as shown at A, Fig. 9. This keeps the primary winding tight. Next, place empire cloth or any other form of insulation, on each side of the primary to build up an even layer as at B. Then put on a wider piece of cloth the full width of the secondary coil as at C. Next, wind the secondary and bring out the leads as for the primary as shown at D. The result is a smooth layer of wire with no leads shown. The main point is that all the coils are tight. This system is better than when the primary coil is wound on top of the secondary.—W. A. WEST, Hopewell, N. S.

USING STANDARD COILS IN THE ROBERTS CIRCUIT

HERE is a suggestion that might be of interest to your readers. Most of the ready-made coils for the Roberts circuit are rather costly and in some instances appear to be somewhat weak mechanically as regards the adjustment of the tickler.

I have used two Crosley Varinds such as is shown in Fig. 10 and while I have not a permanent installation, they give promising results. The tapped coil on one of the Varinds may be used as a single circuit for the primary or may be used as the primary and secondary of the antenna coupler by dividing it into two sections as shown in Fig. 11.

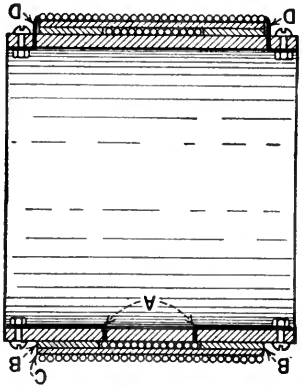
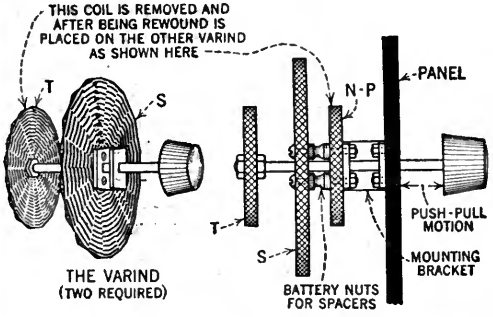


FIG. 9

On the second Varind, the tapped coil was replaced with a winding of larger-sized wire for the secondary, the sliding coil used as the tickler and the coil intended for the tickler on the first unit, constituting the N-P form. See Fig. 12. This latter coil must be rewound with a pair of wires to provide the N-P winding.

A pleasing panel appearance is produced and the units are mechanically substantial. —C. C. SHUDER, Sumner, Ill.



FIGS. 11 AND 12

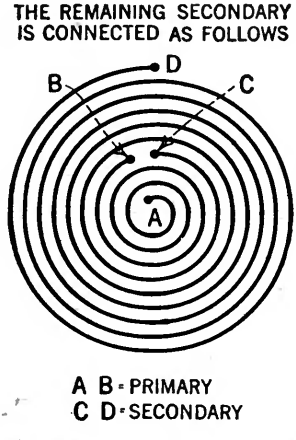
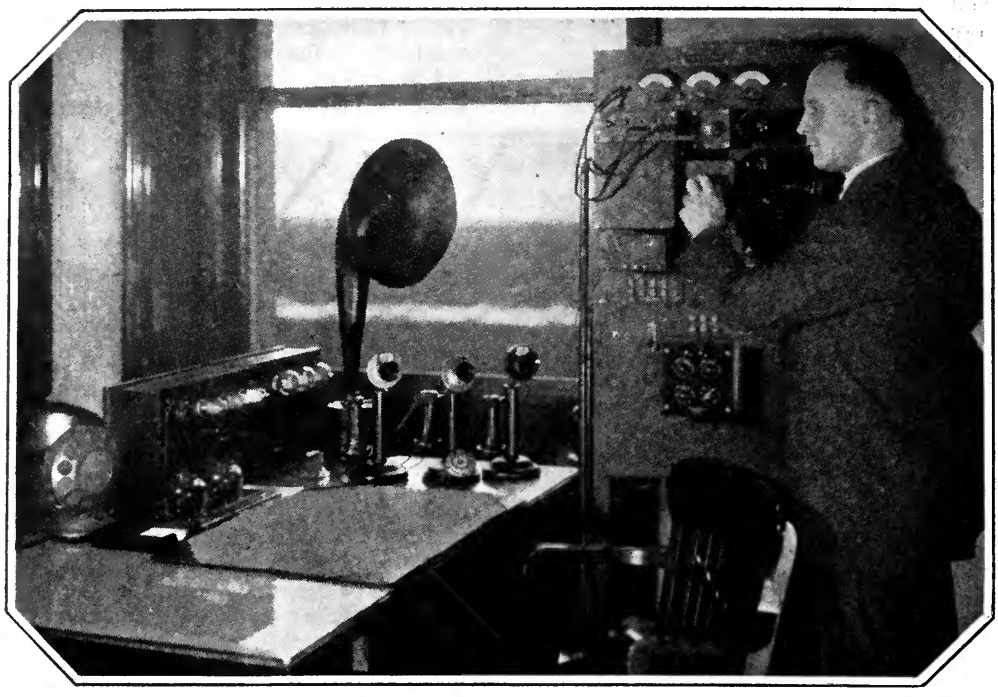


FIG. 10



THE CONTROL ROOM AT STATION WJAX, WHERE SOME OF THE RADIO DRAMA OCCURRED

Our Busiest Day

When Two Political Conventions Were Going on at the Same Time—Some Interesting Sidelights on the Life of a Broadcasting Station Engineer—What Goes on Before the Curtain is Raised

By DON S. KNOWLTON

Manager, station WJAX, Cleveland, Ohio

JULY 4, 1924, was the busiest day we ever had at station WJAX.

The excitement really started several days before, when we hooked in on the American Telephone and Telegraph Company wire tie-up and began broadcasting the National Democratic Convention from Madison Square Garden in New York. After that had been going day and night for a week the boys in the station began to get slightly weary and every time the words "twenty-four for Underwood" came through, the gang set up a cheer you could hear from one end of the twenty story Union Trust Building to the other.

To top that, along came the Filipino Orchestra from the S.S. *Leviathan* on a radio broadcasting tour. They were due to broadcast over our station on the evening of July 3rd.

We had the machinery all set up so that this *Leviathan* orchestra could do their act down in the lobby of the Hotel Cleveland and we had our remote control panel and our line installed to do the broadcasting from that location in the evening.

And then the Democrats kept right on gumming things up. Of course, we had expected that the Democrats would get through nominating and go home by that time, but they didn't. They kept right on going during the day hours of July 3rd and started in on a long evening session. Would the Democrats get through in time for us to broadcast the *Leviathan* orchestra, or wouldn't they? The *Leviathan* crowd had to make a train at twelve o'clock that night.

While we were stewing about that, in came the word that we were to broadcast the La

Follette Convention from the Public Auditorium in Cleveland the next day, July 4th!

That certainly did set the electrical kettle boiling.

Here we were all tied up with a Convention coming in from New York, sitting around waiting to work in the remote control job from the Hotel Cleveland, and along came the news that we would have to get our hook-up all set down at the big Public Auditorium in Cleveland for still another job, beginning at ten o'clock the next morning!

Well, Thorburn, our engineer, and Johnson, our announcer, work on the theory that nothing is impossible. If it had to be done, it had to be done, that was all.

THE DEMOCRATS CONTINUED BALLOTING

THE Democrats kept right on balloting. They balloted so long that the *Leviathan* orchestra didn't get a chance to broadcast at all. So at eleven o'clock that night, Johnson rushed our remote control panel from the Hotel Cleveland down to the Public Auditorium and began to get all set for our installation down there. He worked until about two in the morning and then the boys decided that sleep was more important at that time than any microphone or control panel in the world.

At six o'clock the next morning they were back again at the Public Auditorium and completed their installation. This consisted of a tie-up with the public address amplifying system already installed in the auditorium.

While the boys were working on that, we had to set up our glass broadcasting booth on the stage of the Public Auditorium just behind one of the wings, as near as possible to the speaker's platform. At four o'clock of the afternoon of July 3rd, this broadcasting booth lay knocked-down in several pieces up in the storeroom of the twentieth floor of The Union Trust Building. Between four o'clock that afternoon and eight o'clock the following morning, movers took the sections of this booth down to the Public Hall, a building company put the thing together and set it up, and then our remote control panel had to be installed inside of the broadcasting booth and the lines tested.

THE LITTLE OLD LADY IN BLACK

THE Convention was due to open at ten o'clock. At a quarter of ten the boys were almost desperate. It didn't seem possible to get the job done in time. Three minutes of ten—two minutes of ten—at last the installation was complete and they made the test.

The test was rotten!

Something was wrong. The tie-in with the general amplifying system didn't work worth a hoot.

The Chairman mounted the platform with his gavel in his hand.

"Oh! what's the use," Johnson cried, and slammed a pair of pliers on the floor.

But just then we had a life saver.

A little old lady in a black dress and a black hat—I don't know who she is, but she certainly saved our lives—came bustling up on the platform and she said to the Chairman:

"But we haven't rehearsed our songs yet. We must rehearse our songs."

"But," the Chairman objected, "we have got to start this Convention, it's due to start at ten o'clock."

"Well, the Convention will just have to wait until we rehearse our songs!"

The Chairman gave up, and the old lady gathered about her a group of women who began to rehearse the various La Follette songs which the convention was going to sing.

Suddenly Johnson had an inspiration.

"Well! we can try it," he said, "we will see if we can't put in our own installation."

If you think you know what fast work is, you ought to have seen the boys fly around during the next few minutes. They tore out entirely the hook-up with the amplifying system, got their own microphone and put in their usual remote control plan of installation, running the cord from the remote control panel through the roof of the broadcasting booth, down to the floor, under the chairs of the delegates who were seated there, and up on to the speaker's platform.

The installation was almost complete—all that was necessary was to place the microphone up on the top of the speaker's platform —and then—a terrible catastrophe.

The cord wasn't long enough! It wouldn't reach! It lacked two feet!

The ladies stopped rehearsing their songs and once more the Chairman mounted that platform with the gavel in his hand.

I wish you could have seen Johnson's face when he saw that that cord wasn't going to reach.

Life just wasn't worth living any more, that's all there was to it.

And then somebody had a bright idea.

"You doggone fool," he yelled, "if you stretch that cord from the top of the booth to the top of the platform instead of running it

down underneath the chairs, it will be plenty long enough!

So while the Chairman of the Convention stood on the platform with his gavel up-raised, ready to call the Convention to order, we were frantically stretching that cord from the booth to the platform, and one of us holding it in place while the other nailed it down.

Bang! went the last nail into place, and at almost the same instant, bang! went the Chairman's gavel and the Convention was on.

At the same instant Johnson was back into his booth,—"This is station WJAX, The Union Trust Company, Cleveland, broadcasting. . ."

The La Follette Convention was in the air!

Well, we went back to the studio and fell flat on the carpet for a few minutes' rest.

TWO CONVENTIONS AT ONCE

THEN the Democrats began to get busy. First came a lot of brass band music and then the invocation and then the reading of the Declaration of Independence address. The thing got under our skins somehow, and as hardened as we were to the radio game we sat up and took notice.

There we were with two loud speakers in the station. Through one was coming the proceedings of the National Democratic Convention in New York about to nominate a candidate for President. Through the other was coming the proceedings of the La Follette party in Cleveland, preparing to nominate La Follette for the presidency. Our radio audience was getting only the La Follette Convention, but we were getting both at the same time!

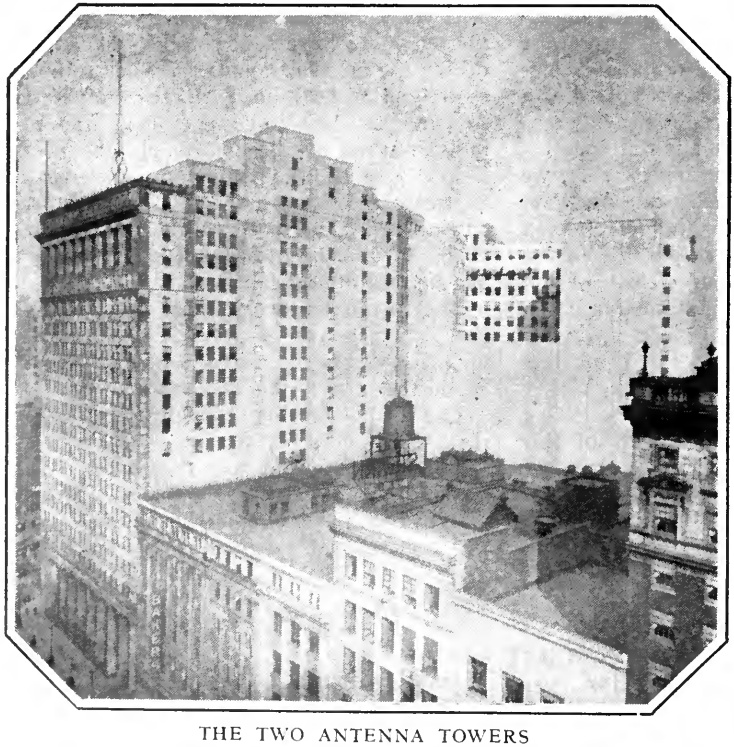
Down at the Public Hall in Cleveland a La Follette orator was denouncing what he called the "mad-house" at New York. At the same instant we heard the "mad-house" at New York going full blast.

We left the La Follette Convention in the air until the Democrats had finished their singing and the reading of the Declaration of Independence, and the Chairman's gavel sounded the call of the Convention to order. Then the writer stepped to the microphone and said, "Well, friends of the radio audience, we are now going to switch you over from the La Follette Convention at the Public Auditorium in Cleveland to the National Democratic Convention in Madison Square Garden in New York City."

Click, went the switch in the operating room and the radio audience jumped from Cleveland to New York, from La Follette to the Democrats, and once more were privileged to hear the repetition of that now world-famous phrase, "Twenty four for Underwood."

Then late in the afternoon, when the Democrats had finished their daily round and adjourned, once more we switched our listeners from Madison Square Garden back again to the Public Auditorium in Cleveland, where young Bob La Follette was making an impassioned plea on behalf of his father's candidacy.

It was a wonderful, wonderful day, but I can tell you that after it was all over, the most glorious thing of all was to go home and to bed for one good long ten hour stretch.



THE TWO ANTENNA TOWERS

Atop the Union Trust Company building in Cleveland, owners of station WJAX

LOSS STABILIZING R. F. CIRCUITS

THE greatest problem encountered in design and construction of radio-frequency amplifiers is the stabilization of the system in which they are incorporated—the dissipating or nullifying of the very strong tendency toward oscillations. This tendency is evident in each r. f. circuit, but is most emphasized *in the second stage of a two-step tuned radio-frequency amplifier*—or in the second and third stages of a three-step intensifier. In general, this tendency may be combatted in two ways—by counteraction, and by losses or absorption. Representative of the first method is the neutrodyne and the reversed feed-back systems, though in a narrow sense, these systems may also be considered as functioning through the introduction of losses. The neutrodyne and reversed feed-back method are fairly well known and have been described at length in various issues of RADIO BROADCAST. The reader is perhaps less familiar with the loss systems, the advantages of which have been strongly emphasized in recent experiments in this laboratory.

Loss methods of stabilization are just what the name suggests. Losses are introduced in the various circuits, in which there is present an oscillatory tendency, of such a magnitude that the surplus energy which would ordinarily be utilized in starting and maintaining oscillations is harmlessly dissipated. At first, the general principle of the thing may appear all wrong. The idea of deliberately introducing losses seems contrary to the fundamental precepts of radio. To-day, much effort is made to reduce all losses in circuits through scientifically designed coils and condensers. However, losses can be made very useful and are quite justified when *properly* used for stabilization. In such arrangements the losses are so adjusted that oscillations are just a little more than stopped. This permits regeneration and a practical maximum in signal strength, sensitivity, and selectivity. (We write "practical" because all of these qualities become still more intensified when the circuit is oscillating—a condition, however, in which enjoyable reception is impossible).

Unfortunately, the introduction of even losses over the entire tuning scale is an ideal condition which, at its best, can only be approximated. The tendency to oscillate increases in any tuned circuit with the frequency. The lower the wave (the higher the frequency) the greater is this tendency.

STRAIGHT ABSORPTION

LOSS stabilization systems fall into two classes that we might describe as "straight absorption" and "differential ab-

In the R. B. Lab This Month

—A good method for stabilizing radio frequency amplifiers. A comprehensive discussion of simple and effective means of subduing undesired oscillations in your tuned r. f. set. This complete article is the outcome of a series of experiments in our laboratory.

—A brief description of a six-tube de luxe Roberts Knockout receiver, employing four stages of resistance-coupled audio amplification.

—Charging Edison element B batteries at high charging rates.

—Current carrying capacities of wire sizes in small transformers.

—Other items of helpful interest.

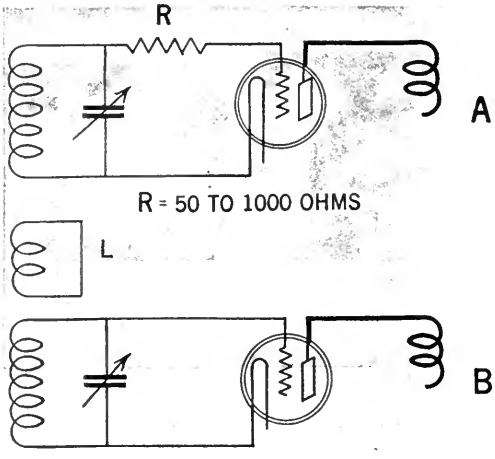


FIG. 1
Examples of straight stabilization

sorption." Straight absorption refers to systems that, without consideration of the changing tendency to oscillate, absorb over the full wave range. This arrangement is obviously very inefficient, for if the system is adjusted greatly to dampen oscillations on the higher frequencies, where a comparatively large amount of absorption is required it will dissipate much more power than is necessary on the higher waves, where almost any set is self stabilizing.

Examples of this type of absorption are numerous and are found in many amateur receivers and in a few commercial sets. The most common procedure is to place a resistance of from fifty to a thousand ohms in the grid circuit of the radio-frequency amplifier, (A, in Fig. 1). Another and widely advocated arrangement is to wind from two to eight turns of wire (L) with a diameter of about two to three inches, placing the coil close to the primary and secondary of the radio-frequency transformer (Fig. 1, B). As might be expected both of these systems work satisfactorily on the low waves where the losses are just sufficient to stabilize the receiver, regeneration with good signal strength and selectivity being permitted. However, on the upper side of the scale, the last trace of regeneration is dampened and the signal itself is absorbed. Variable controls, for obvious reasons, are only an impractical solution.

DIFFERENTIAL ABSORPTION

DIFFERENTIAL absorption refers to those systems that discriminate between the higher and lower wavelengths, and more or less adjust the amount of absorption in proportion to the tendency to over-regenerate and oscillate. Such a system will absorb considerable power on the high frequencies, and practically none at all on the low frequencies, which approaches the ideal condition outlined a few paragraphs above.

A most simple and illustrative example of differential absorption is found in a slight modification of circuit B in Fig. 1. If, instead of short circuiting the terminals of the stabilizing coil L, a fixed condenser is shunted across it, as in LC of Fig. 2 (A), an oscillatory circuit will be formed which will absorb energy only about the wave to which it is tuned. If LC is given a resonance or tuned point at about two hundred and seventy-five meters, it will absorb sufficient power to stabilize the receiver on the short waves, having little or no effect on the higher waves where external stabilization is not required. This is the system first introduced by Austin, in 1916, for the control of oscillations in long wave heterodyne reception, later used by Mr. L. M. Cockaday in a receiver designed by him. This method is at present employed in the two-stage r. f. "Starr" set.

The method just described is probably the most efficient of all absorption methods, and is very easily applied to any r. f. receiver in the course of construction or quite completed. It is only necessary to wind the absorption coils and place them in inductive relation to the secondary. The calculation of the correct number of turns is not difficult.

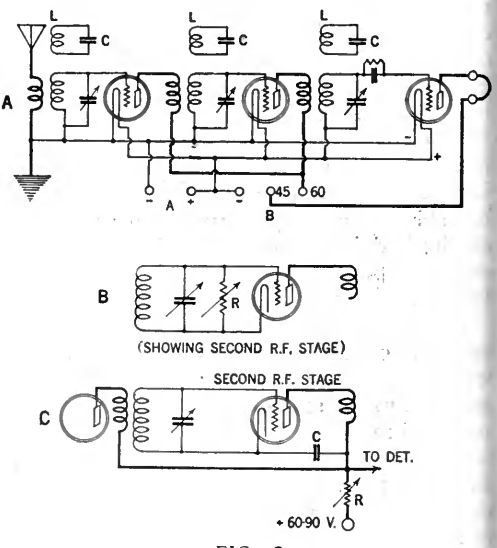


FIG. 2
Preferred and efficient methods of stabilization. The series resistance system (C) reduces the B battery consumption of the r.f. tubes, adding economy to its other desirable characteristics

It is assumed that the resonant absorption coil will be wound on a form approximating the diameter of the secondary, perhaps alongside the secondary, or on a tube that may be slipped within the grid coil. This being the case, the absorption coil should be wound with one half the number of turns on the secondary, and the condenser C should have a value of .00025 mfd. A Micadon will do nicely. This method of mounting the coil and condenser is illustrated in Fig. 3. The absorption coil has been wound alongside of the secondary.

The absorption coil should be wound with no smaller than No. 26 wire. The differential effect is curiously curtailed by the use of very small wire sizes, for the high-frequency resistance of the wire increases with the frequency, which appreciably cuts down the absorption where it is most wanted. In a few cases when the absorption coil tunes over sharply, that is when the circuit oscillates above and below the maximum absorption point, the difficulty can be remedied by winding two or three turns of the coil with resistance wire from a rheostat. This added resistance tends to increase the decrement of the absorption circuit making it tune more broadly, which allows the receiver to cover a larger wave band.

It is advisable to experiment with the coupling between the resonant absorption coil and the receiving circuit. When properly adjusted (though the adjustment is not critical and is easily effected), the set can just be made to oscillate by filament rheostat variation, thus permitting regeneration control that is very desirable and effective. When oscillations occur on such an adjustment they are almost invariably generated in the second tube, seldom, if ever, in the first bulb. Ape-

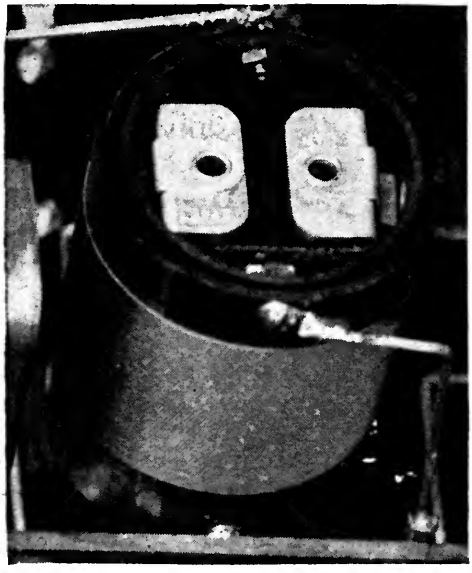


FIG. 3

A tuned radio transformer on the primary of which a stabilizing coil has been wound. The shunt condenser fits nicely within the tube

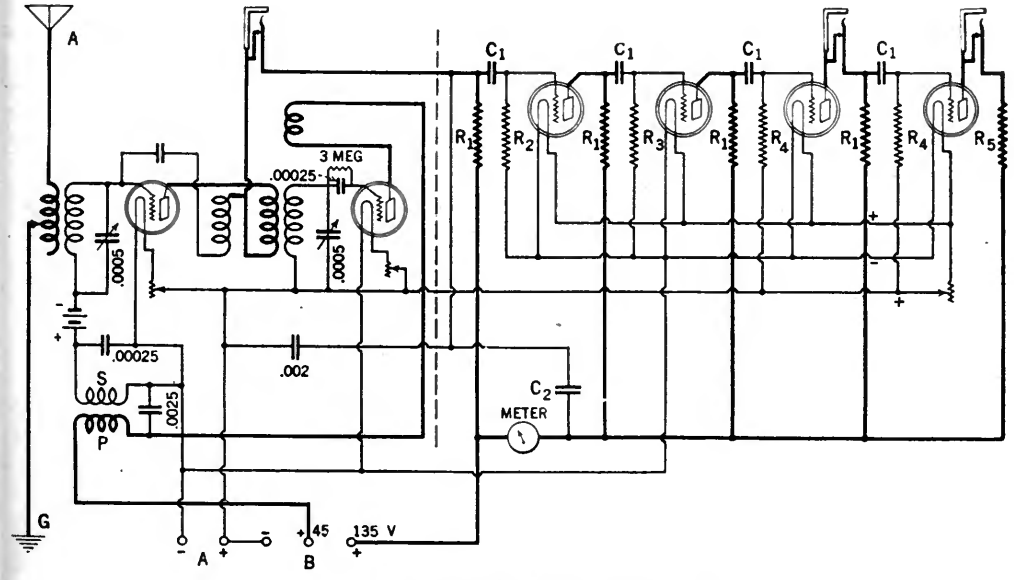


FIG. 4

The circuit of the de luxe six-tube Roberts Knockout receiver

FIG. 5
Front view of the Roberts de luxe receiver. The meter is in the plate circuit of the audio amplifier

riodic primaries are usually found on tuned radio-frequency receivers, which have an actual tuned or resonance point on the low waves which act as an additional absorption circuit at these high frequencies, choking the tendency to oscillate.

In a two-stage tuned r. f. amplifier, the resonant absorption coils should be used in the first and second stage, and in the detector circuit. In receivers already completed, it may be most convenient to wind these coils on separate forms, mounting them in the ends (grid or filament) of the r. f. transformers.

Another interesting, though slightly inferior, method of differential stabilization is the shunting of high resistances (R) across the r. f. tuning condenser (in Fig. 2, B). This has the effect of increasing the "phase difference" of the circuit. The phase angle (unfortunately a rather technical consideration) is a determinant of the power loss in any circuit which increases with the frequency. Hence, the loss will be greater on the higher frequencies or lower wavelengths.

On two stages of tuned radio-frequency amplification, the resistances across the first and third (detector) condensers may be fixed resistors, of the Daven type, having an ohmage of fifty thousand. The resistor across the middle condenser controlling, as we have demonstrated, the least stable of the three circuits, should be a Bradleyohm, having a variable resistance of from ten to one hundred thousand ohms. This, again, will provide the desired regeneration control.

Another very interesting and efficient method of stabilization, though not strictly a loss method, should be considered by the experimenter studying these possibilities. For several reasons, the tendency of a circuit to oscillate, or to become unstable, increases with the plate voltage. Hence, in any fairly stable circuit, for instance, an average r. f. circuit, a gradual reduction of the plate voltage to just below the critical point provides an adequate and efficient method of regeneration control. This principle is employed in the Deresnadyne receiver and in others of similar design. This idea is illustrated in Fig. 2, C.

The resistance R, a ten to one hundred thousand ohm Bradleyohm, adjusts the plate potential applied to the r. f. tubes and detector.

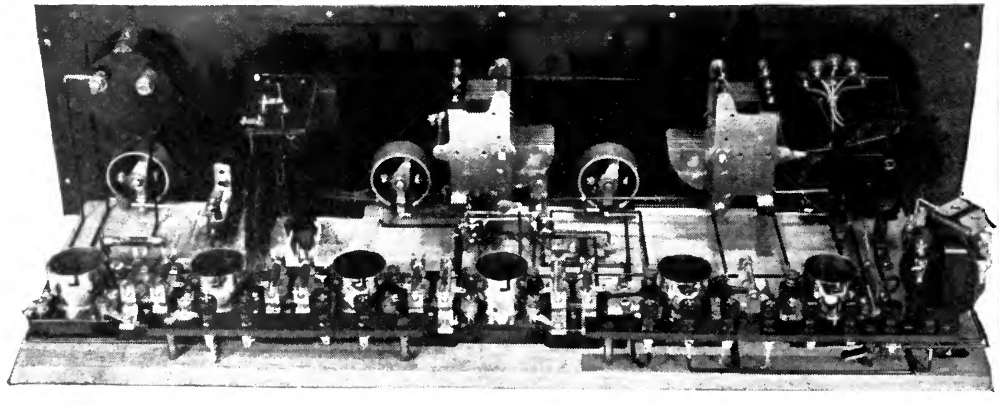


FIG. 6
Rear view showing construction

This resistance is bypassed by a 1 mfd. condenser C. The resistance probably also has a dampening effect on the radio-frequency fluctuations in the plate current, thus reducing feed-back through the capacity of the tube. Because of this, it is not necessary to reduce the plate voltage below the efficient operating potentials of the amplifying tubes in the radio frequency circuit.

A SIX-TUBE ROBERTS RECEIVER

FIGURES 4, 5, and 6 illustrate a special Roberts Knockout receiver built, from data supplied by RADIO BROADCAST, by Schneider and Horneij of New York.

The receiver employs the standard Roberts tuning arrangement followed by four stages of resistance-coupled amplification. The receiver is de luxe in every respect, only a few of the refinements being brought out in the photographs and diagram.

Referring to the diagram, Fig. 4, the apparatus to the left of the dotted line is identical with the usual Roberts equipment. C1 throughout the circuit, is a .012 mfd. fixed condenser. C2 is a 1 mfd. bypass condenser. Filament control jacks were used in the actual receiver, though for simplicity the auxiliary contacts have been omitted from Fig. 4. R1 represents the coupling resistances, having a value of 100,000 ohms. Grid leak, R2 is a 500,000 ohm resistor and R3 a 250,000 ohm resistance. Grid leaks R4 are fifty thousand ohm resistances. R5 has a resistance of five thousand ohms. A meter, reading from zero to fifty milliamperes has been included in the plate lead to the resistance-coupled amplifier.

The following is a list of the exact parts used in the receiver described. Substitution of equally efficient apparatus will not affect operation.

Bakelite Panel 7″ x 27″ x $\frac{3}{16}$″, engraved
2 Cardwell .0005 Condensers.
6 Federal Sockets
Amertran, 5:1 ratio
3 Federal Jacks (using 2 on tubes five and six)
3 Eztoon dials, 4″
Nazeley Coil
4 G. R. Rheostats
G.R. Switch and Points,
Eby Binding Posts
4 Daven Resistor Couplers, Condenser Mountings, Leaks, etc.
Dubilier Condensers, Pacent Balcon and Neutralizing Condenser
Weston 0-50 Milliampere meter in plate circuit of Resistance Amplifier tubes only.

TABLE OF CURRENT CARRYING CAPACITIES OF WIRES USED IN WINDING SMALL TRANSFORMERS

SIZE WIRE (B & S)	SAFE CURRENT WHEN WOUND ON	
	PRIMARY	SECONDARY
10	9.5	8.0
12	6.1	5.0
14	3.6	3.2
16	2.4	2.0
18	1.5	1.3
20	.96	.80
22	.60	.50
24	.37	.32
26	.23	.20
28	.14	.125
30	.095	.070
32	.059	.050
34	.037	.031
35	.023	.019

FIG. 7

These current carrying capacities are for transformer windings, and are considerably less than the safe limit for open wiring

WIRE SIZES AND CURRENT-CARRYING CAPACITY

THE publication IN THE R. B. LAB. for September and October, 1924, of data on the design and construction of small transformers, aroused considerable interest among our readers who are considering the construction of B battery eliminators and battery chargers. In the articles to which we refer, mention was made that the sizes of wires in the primary and secondaries would be governed altogether by the amount of current which they were to handle. For the benefit of our readers who have been puzzled on this point, we publish the table appearing as Fig. 7. Different sizes of wire, from No. 10 to No. 36 B & S gauge (A. W. G.) are given with their corresponding safe current carrying capacities *in transformer windings*. This data is sufficiently accurate and can be used without correction considerations in the construction of small transformers.

For example, we shall assume the experimenter desires to build a transformer operated from a 110 volt source for supplying plate potential to an amplifier. The maximum output will be forty milliamperes at three hundred volts. The secondary must there-

fore be wound with wire that will safely carry this current, and referring to Fig. 7 we find that this is No. 33.

Multiplying the volts, 300, by the amperes, .04, will give youthe number of secondary volt-amperes. In a perfect transformer this would be exactly the volts-amperes inputted to the primary. However, efficiency must be considered, and so we multiply this VA rating 12, by 1.2 the product being close to the volts times amperes in the primary circuit. Therefore, primary volts multiplied by primary amperes equals 14.4, or $\frac{14}{110}$ is the number of amperes flowing in the primary under full load. The primary current then is .122. Again referring to the table we find that the correct primary wire is about No. 28.

In all cases, of course, a larger size wire may be used for convenience or other reasons.

LABORATORY HINTS

EDISON element storage B batteries can be charged at comparatively high charging rates without harm. Most B battery chargers using electric light bulbs as a series resistance only charge at a rate of about 75 to 100 milliamperes, which is quite correct for the majority of lead plate cells. However, on Edison cells this rate may be considerably increased by the substitution of a soldering iron or an electric iron for the lamp. Fig. 8 shows a commercial type of charger—the "Unitron"—an efficient bulb rectifier for charging both A and B batteries without the purchase of additional apparatus, charging a Todd B battery through a standard 500 watt electric iron. The complete battery is charged as a forty-five volt unit at close to a one-half ampere rate. Three hours running completely charges the battery, and after six months of repeated charging no ill effects of the comparatively high rate can be observed. If anything, the battery is in better condition than when originally obtained.

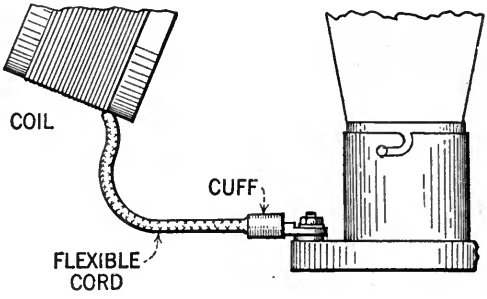


FIG. 9

A half inch of spaghetti keeps the silk from fraying

FIGURE 9 shows a wiring kink that solves in a neat and efficient manner the tendency of flexible cables to fray at the ends. Flexible wires, generally of the ordinary lamp cord type, are indispensable to the wiring of most receivers employing variable coupling, such as the Roberts. Moving coils are connected to the stationary bus-bars by means of these leads. If a small piece—a half inch or so—of spaghetti tubing is slipped over the ends of the flexible cables, forming a "cuff," a permanently neat job is assured.

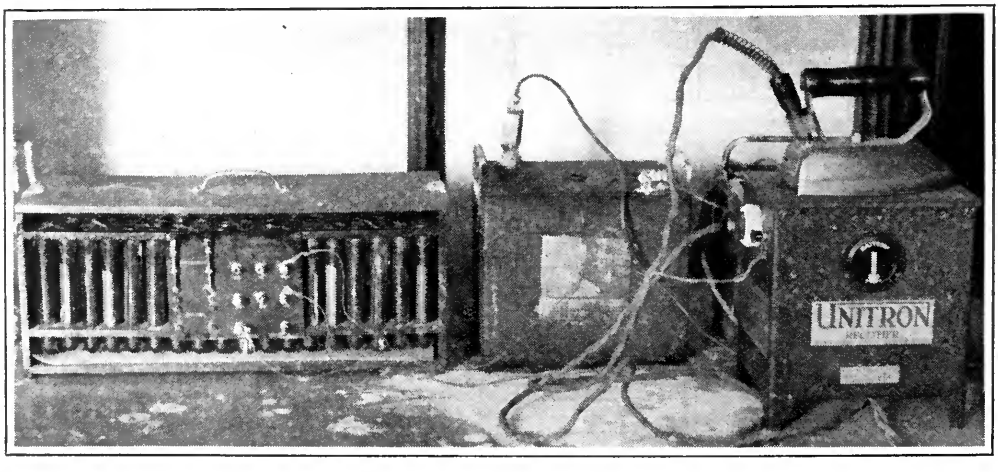


FIG. 8

A flat iron can be substituted for the usual carbon lamp when high charging rates are desired. An electric toaster will pass approximately the same current

How to Build a One-Dial Reflex Receiver

A Sensitive Non-Radiating Receiver Using Crystal Detection and Push-Pull Amplification which is Simple to Build and Operate—The Combination of Crystal and Push-Pull Produces Excellent Quality

By JOHN C. DAVIDSON

THE receiver described in this article may very well be called universal. It is, in effect a one-, two-, or four-tube layout, depending on just how much the builder cares to do at a time. One may start with the single-tube layout and add the remainder at will. The two last tubes are used in a push-pull audio amplifier arrangement and are entirely unnecessary for loud speaker operation on stations up to several hundred miles—at night, of course.

In our tests of this receiver we operated a loud speaker on stations up to 300 miles distant with a single tube, up to 700 miles distant on two tubes, and on stations 1500 miles away with all four tubes. This is not guaranteed operation, but is not highly unusual operation. The selectivity is very good, though it does not equal the two- and four-tube Knockout receivers employing the Roberts circuit. There is but a single major tuning control. The receiver is very easy to build.

We suggest building the two-tube receiver first, because it produces enough volume for most purposes. If after trying two tubes, the music is not loud enough for dancing, the push-pull amplifier may be added.—THE EDITOR.

TWO years study of reflex circuits have brought out a number of interesting points about this popular method of radio reception. It is claimed that a circuit with one tube reflexed through a crystal detector will equal on distance reception, and at the same time give far more volume and better quality than the ordinary one-tube regenerative receiver. This additional energy gain is due to the fact that one tube reflexed, gives a stage of radio-frequency amplification, a certain amount of regeneration, which seems to be inherent in the majority of reflex circuits, and a stage of audio-frequency amplification. At the same time, there is a limit to what can be expected from one tube, and this makes the reflexing of more than one tube a questionable procedure, when using an antenna-ground system.

The circuit described here is a logical development obtained from a study of the above analysis. It comprises one stage of radio-frequency amplification with a stage of audio frequency reflexed through it, a fixed crystal detector, a second stage of audio-frequency amplification and finally a stage of push-pull audio-frequency amplification. This combination gives plenty of loud speaker volume with local reception and good loud speaker volume for reception up to 1000 miles, it being understood that long range work is subject to seasonal and atmospheric conditions. At the same time, particular attention has been paid to selectivity, so that at least six or more distant stations can be brought in through the locals of the large cities. This performance is especially noteworthy in view of the fact that it is obtained with a single tuning dial and one volume control dial, which makes the operation about as simple as can be desired. Stations heard can be logged and returned to on their own dial setting.

THE CIRCUIT

THE circuit in principle can be best understood by referring to Fig. 1. Part of the radio-frequency tuning coil secondary is contained in the first grid circuit and the remainder of this coil is used in conjunction with the small balancing condenser "CB" to stabilize the circuit, and control the volume. It is the experience of the writer that the first audio

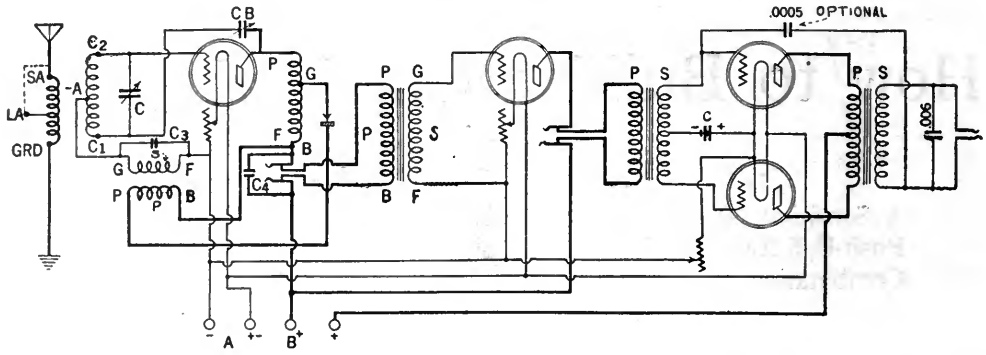


FIG. I

The schematic circuit of the reflex receiver. The peculiar connection to the grid and plate circuits are especially to be noted. The constructional details are contained in the accompanying article. The radio-frequency transformer, shown in the diagram is completely illustrated in Fig. 3

transformer should have a ratio of the order of 10:1 to work best with the crystal. A small fixed condenser, "C3" should be placed across the secondary of this transformer to bypass the radio-frequency currents. Its capacity should be .00025 or .0005 mfd. The condenser "C4" is fixed, and may be as large as .005 mfd., and is placed across the two outside terminals of the double circuit jack, as a further by-pass. The second audio transformer should be of about 4:1 ratio for good quality.

The tuning unit used here is the result of considerable experimental work. It has a low distributed capacity and at the same time the three coils have a high degree of coupling.

In designing this unit the following conditions had to be met. The circuit must be able to oscillate over the entire range of broadcast wavelengths, with a fixed winding radio-frequency transformer in the plate circuit of the tube. By means of the balancing condenser and part of the secondary coil, these oscillations must be balanced out. At the same time, a high degree of selectivity must be maintained.

The tuning coil is of the fixed coupler type with an untuned primary and a tuned secondary. The primary has one tap to be used with a long antenna. The tuned secondary has a tap so placed that one part of the coil is included in the grid circuit, while the other part acts as a balancing-out or compensating coil. When used in conjunction with the balancing condenser "CB", all regeneration can be controlled.

The coil winding data for the tuning unit is outlined below:

Size of Tubing:—2" long x 1¾" diameter.
Coil No. 1 consists of 21 turns tapped at the 16th. Inside turn connects to grid 16th to LA and 21 st to SA.

Coil No. 2, 35 turns, outside lead to C2, inside lead to —A.

Coil No. 3, 25 turns, outside to —A, inside to C1.

All the coils are wound with No. 26 d. s. c. wire on a form slightly greater in diameter than the tubing. The form has 19 spokes ⅛" in diameter producing a coil about $\frac{3}{16}$" wide. The winding style is over two and under two spokes.

BALANCING CONDENSER

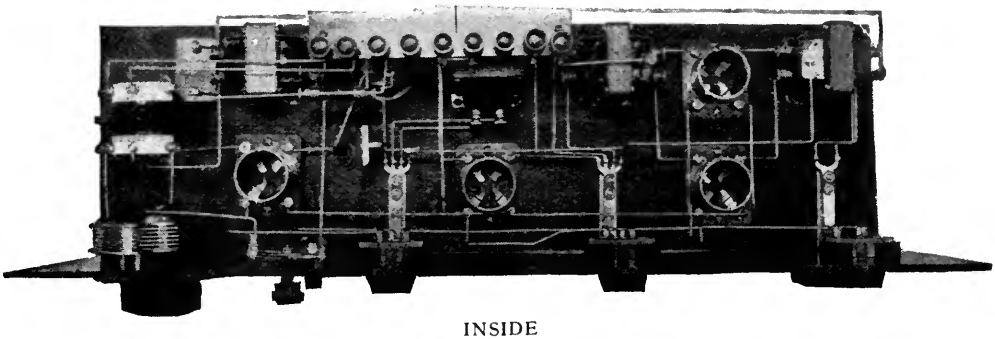
A PHOTOGRAPH of the balancing condenser is shown. It will be noted that this condenser is designed to have an extremely small minimum capacity. Unless this minimum capacity is very small, the circuit will be sensitive only over the middle portion of the broadcast wavelengths.

The small commercial condensers available were found to be unsuitable for this purpose, so that a special condenser had to be designed. Those who desire to make their own can do so with old parts on hand. The only conditions to be met are a low minimum capacity and a maximum capacity of about fifty micro-microfarads. "C" is a variable condenser whose capacity may be as low as .00029 mfd. and should be of fairly good design. This capacity is equivalent to 13 to 17 plates depending upon the make of the condenser.

THE DETECTOR

A FIXED crystal is used for the detector. Right here it may be advisable to point out a great weakness of the variable crystal detector.

A given setting of the detector introduces a certain resistance into the circuit. If the circuit is tuned and adjusted to a certain wavelength and the variable detector is then



INSIDE

The "works." As can be seen, the wiring for this receiver is not difficult and the layout parts quite easy to duplicate

reset, a different resistance will be introduced necessitating a retuning of the entire circuit. This is particularly annoying if the station that is being received is a distant one. This difficulty is entirely eliminated when a fixed type of crystal detector is used.

THE RADIO-FREQUENCY TRANSFORMER

REFERRING to Fig. 1 once more it will be noted that the radio-frequency transformer used, is of unique design and is especially built to give maximum amplification over the broadcasting wavelengths when used between a tube and a crystal detector. It has a step down ratio and will not function between two tubes as is the case with the ordinary radio-frequency transformer.

Its construction is as follows:——

On a spool $1\frac{3}{4}$" in diameter and $\frac{5}{8}$" wide, having a slot $\frac{1}{8}$" wide and $\frac{1}{2}$" deep are wound 170 turns of No. 35 wire.

First, 70 turns are wound in the slot and a tap taken off which connects to G, then 100 turns are wound over this, the end connecting to P.

The beginning of the winding connects to F and B. See Figs. 1 & 3.

WIRING THE SET

FIGURE 2 is a picture drawing of the exact layout of the interior of the set and shows each piece of apparatus in relation to the other parts. It also clearly indicates the wiring. The panel size is 7 x 24" and is drilled according to the layout in Fig. 4. There are ten terminals at the back of the cabinet. Reading from left to right they are LA, SA, GND, —A, +A, —B, +B, +B, C+, C—. These terminals should be mounted on a bakelite strip and so supported that the terminals do not come in contact with the wood.

For the sake of simplicity, the wiring will be divided into four stages, namely, the filament wiring, the antenna-grid wiring, the reflex wiring and the audio-frequency wiring.

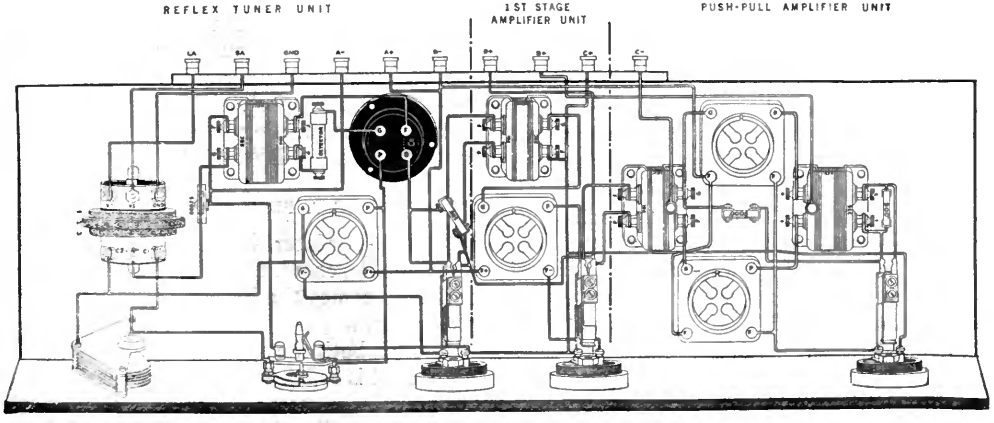


FIG. 2

A picture layout of the complete receiver

From the binding post marked "+A" run a wire to each socket terminal marked "+F". From the binding post marked "—A" run a wire to one terminal of the filament switch. From the other switch terminal run a wire to one terminal of each rheostat. The other three terminals of the rheostats are connected respectively to each socket terminal marked "—F". The filament circuit is now completed. As each wire is put in place it is well to mark it off on the circuit diagram with a red or blue pencil.

The antenna-grid circuit is wired as follows: Run a wire from the tuner terminal marked

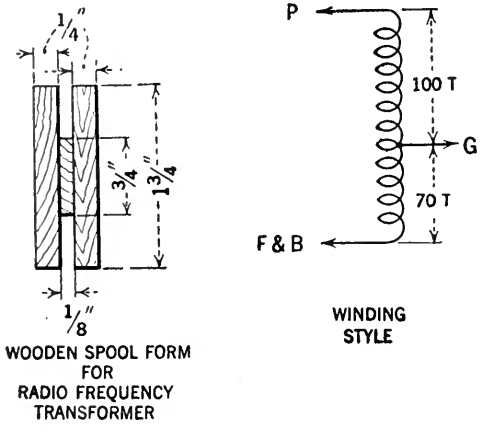


FIG. 3

Constructional and winding details o. the special radio-frequency transformer

"LA" to the left hand binding post which should also be marked "LA" (long antenna.) Run a wire from the terminal "SA" to the binding post to the right of the one marked "LA." This binding post should be marked "SA" (short antenna.) Then connect the terminal marked "GND" to the binding post to the right of the one marked "SA." This binding post should be marked "GND" (ground). This completes the antenna-ground connections. The grid circuit is wired as follows. Connect the tuner terminal "C2" to the stationary plates of your thirteen or seventeen plate condenser, and connect the terminal "C1" to the rotor plates. Then run a wire from "C2" terminal to the first socket terminal marked "G". Connect the tuner terminal marked "—A" to the secondary terminal of the high ratio audio transformer marked "G." The "F" terminal of this transformer secondary is joined to the wire from the "—A" binding post. A small fixed mica condenser (.00025 or .0005 mfd.) should be connected across the secondary terminals of this audio transformer. There remains only the compensating condenser, the rotating plate of which is connected to the first socket terminal marked "P" while the stationary plate is connected to the tuner terminal "C1". This completes the grid circuit.

All these connections are clearly shown in Fig. 2 together with the general shape of the wires, and by following the drawing the problem becomes fairly simple.

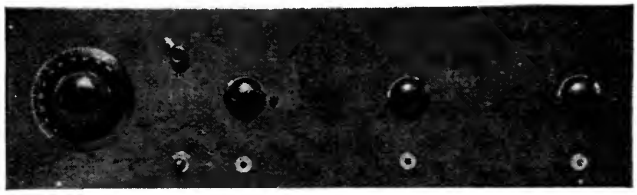
The reflex circuit is wired as follows. Connect the first socket terminal marked "P" to the "P" terminal of the radio-frequency transformer. The "B" terminal of this transformer is connected to the upper terminal of the double circuit jack. The bottom terminal of the double circuit jack goes to the binding post at the extreme right and should be marked "+B". A fixed mica condenser C4 of .005 mfd. capacity should be connected across the two outside terminals of the double circuit jack. From the "G" terminal of the radio-frequency transformer, run a wire to one end of the fixed detector. The other terminal of the fixed detector is connected to the primary terminal of the high ratio audio transformer marked "P." The "B" terminal of this audio transformer is connected to the "F" terminal of the radio-frequency transformer. The reflex circuit is now completed,

From the double circuit jack terminal next to the top, run a wire to the low ratio audio transformer terminal marked "P." The remaining double jack terminal is connected to the "B" terminal of the low ratio transformer. Join the "G" terminal of this transformer to the second socket "G" terminal and connect the "F" terminal of the transformer to the wire coming from the "—A" binding post. Connect the "P" socket terminal to the *bottom* terminal of the next double circuit jack. The top terminal of the second jack goes to the "+B" binding post. The wiring is completed by connecting together the binding posts marked "—B" and "+A."

ADDING A PUSH-PULL AMPLIFIER

SOONER or later, into the life of every real radio fan comes the desire for more volume and then comes the hunt for a means of amplification.

Though both the one-tube and the two-tube units of this reflex circuit afford good volume on all average reception, there are many who want more. But how to get this additional volume has been more of a problem than would at first glance appear.



FRONT VIEW OF THE PANEL

With the one-tube reflex unit, the problem can be solved by the addition of another tube as an audio-frequency amplifier. It has proved highly impractical to add another audio-frequency tube to the two-tube circuit. One transformer and one tube alone have been unable to handle the output of the preceding two tubes without much distortion. So push-pull amplification has been a life saver—or shall we call it a volume saver?

Push-pull amplification is a necessity when additional volume is desired.

The "how and why" behind push-pull amplification is not half as intricate as some people seem to believe. It differs from the usual straight audio, at first glance, in that two transformers and two tubes are used for each stage. The first transformer is the coupling transformer which divides the output of the preceeding tube evenly between the grids of the two push-pull tubes. The second transformer collects the outputs of the two push-pull tubes and passes the total energy on to the loud speaker.

The term "push-pull" is used because the grids of the two tubes in each stage of push-pull amplification are charged with opposite polarity at any instant. While one grid is positive, the other is negative. Any tendency to distort in one tube is counteracted by the other tube.

The first transformer performs the double duty of dividing the input current between the two tubes and of delivering it to these tubes in such a manner that the two grids will be oppositely charged. It does this by means of a split winding. While the primary winding is one continuous winding coming out to two binding posts in the usual manner, the secondary is tapped at its central point and is therefore brought to three binding posts. The binding post leading to the center tap is connected to the negative A battery through the C battery. The other two binding posts are attached to the grids of the two tubes.

Conversely, the second or output transformer of the push-pull stage of amplification has a tapped primary and a conventional secondary. In this transformer the primary winding is brought to three binding posts and the secondary winding to two. In this case the central primary tap is connected to the B battery while the other two posts are connected one to each plate. The two posts of the secondary are connected to the speaker just as the two posts of the first transformer were connected to the plate and B battery of the last audio-frequency tube.

THE LAYOUT OF THE AMPLIFIER

THE layout of the push-pull unit can be made rather flexible. If space permits, the two tubes can be placed one in front of the other. The two transformers should be put one on each side of the tubes. This makes the wiring short and direct. It also reduces the

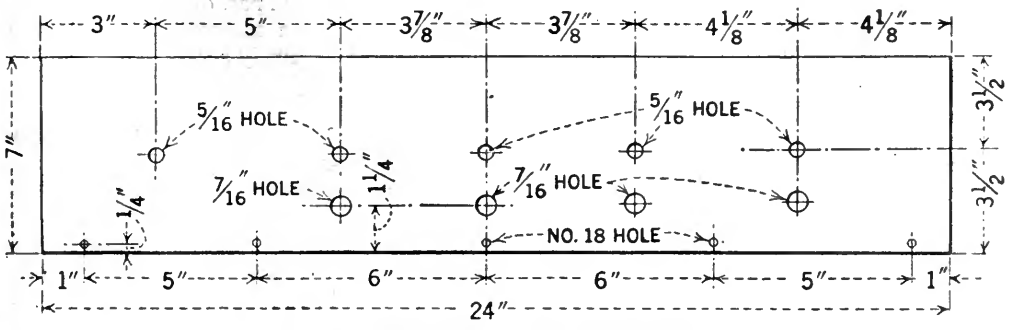


FIG. 4

The panel layout. The photograph above shows the appearance of the finished panel

chance of error, since the transformer and tubes, when in this position, almost connect themselves because of the proximity of binding posts to binding posts.

The two input or primary terminals of the first transformer are connected to the two central prongs of the center jack in the set. The outside terminals of the secondary are then connected to the grids of the two tubes, each to the nearer grid. The central terminal is run directly to the negative post of the C battery, while the positive post of the C battery is run to the negative A battery binding post.

The filament connections are made in the usual way, the two filaments being placed in parallel and being controlled by the one rheostat. The plate of one tube is connected to one of the two outside posts of the primary of the second transformer, the plate of the other tube to the other. The central binding post of the secondary is attached to the plus post of the high B battery voltage. The two secondary leads from the second or output transformer are wired to the push-pull jack. A .0005 mfd. fixed condenser C5 is connected from the upper grid side of the secondary of the input transformer to the lower side of the secondary of the output transformer as an additional stabilizing capacity. Various values of capacity may have to be substituted to obtain quiet operation.

In some cases it may be necessary to include in the push-pull amplifier circuit the .0005 mfd. fixed condenser shown connected between the G terminal of the secondary of the input transformer and the F terminal of the secondary of the output transformer. Usually its addition to the circuit will eliminate any tendency of the tubes to overload and the shunting of the .006 mfd. condenser across the secondary terminals of the output transformer will clarify the tone output of the receiver. This latter addition largely depends upon the type of loud speaker used.

PUSH-PULL AND THE LOUDSPEAKER

MOST loud speakers have an impedance out of all proportion to the impedance of the tube preceding. And yet theory has it that the best results are obtained when the impedance of the speaker or other "load" matches the tube impedance. The push-pull system corrects, or rather, overcomes this because the output transformer separates the loud speaker from the tube circuit.

The ordinary straight audio system places the loudspeaker directly in the plate circuit of the last tube and consequently subjects it continually to the full plate voltage. This means that there is a constant drag on the diaphragm of the speaker which prevents that diaphragm from responding freely to weak or complicated tones.

In the push-pull system, the full plate voltage gets no farther than the primary of the second transformer. It cannot be transferred to the secondary or loud speaker circuit because it is a direct current. Direct currents do not affect a transformer. Only when there is a current fluctuation does the loud speaker winding get an impulse, because only then is the current transferred from primary to secondary by means of induction. It will be seen at a glance that this is the ideal condition. Unless speech or music is coming through the amplifier, the loud speaker has absolutely no potential applied to it, yet when broadcasts are being amplified, the loud speaker winding gets a powerful impulse exactly in accordance with the matter being broadcast.

SELECTIVITY

THE circuit described is extremely selective in spite of the fact it has but one tuning dial. Frequently on demonstration, seven or more out of town stations have been brought in on the speaker through the powerful New York local stations.

Referring to Fig. 2, it will be noted that there are three terminals on the primary side of the tuning unit, which are marked "SA", "LA", and "GND". The terminals "SA" and "GND" include the entire winding and should be used with a short antenna of from 40 to 100 feet. The terminals "LA" and "GND" include the larger part of the coil and should be used with a long antenna. If extreme selectivity is desired the antenna may be connected to "LA" and the ground to "SA." This uses only a small part of the coil and while the volume will be somewhat reduced, the tuning will be extremely sharp.

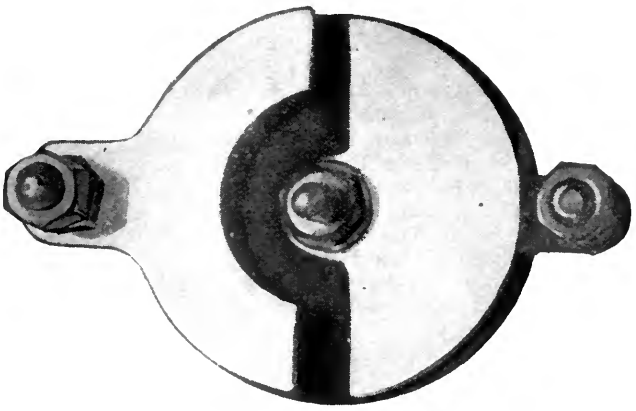
OPERATION

THIS receiver performs best with C-301-A DV-2 or UV-201-A tubes operating from a small six volt storage battery and 90 volts of B battery. At the same time good results may be obtained using a 201-A tube in the first stage and a UV-199 type tube in the second stage, running the two tubes from six volts of dry battery. If this latter method is used, the 30 ohm rheostat controlling the UV-199 type tube must be turned on only just

enough to light the filament or the tube will be burned out.

A negative C battery is used to cut down the B battery consumption and to improve the quality of signals through preventing distortion.

To operate at its best efficiency, the set should oscillate or be very near the oscillating point over the entire range of broadcasting wavelengths, when the balancing condenser is at its minimum. At this point the dial controlling this condenser should read 100 degrees. When this dial reads near zero, oscillations should not occur at any wavelength.



THE BALANCING CONDENSER

When fully opened as shown has a minimum capacity reading. The distance between the edges of the two plates is $\frac{1}{8}$ inch. The semi-circular movable plate and the narrow $\frac{1}{2}$ inch wide plates make up the full circular form $1\frac{3}{4}$ inch in diameter. The fixed plates are spaced $\frac{1}{8}$ inch apart and one semi-circular plate rotates between them. The plates are mounted on a bakelite base by means of bolts, spacers, and a shaft of the required thickness. All these parts may be secured from a radio shop with average stock

TUNING

THE method of tuning this set is very simple and can be mastered in a few minutes. It will be observed that the large dial at the left is labelled "Tuning." The next dial to the right is labelled "Volume." To the right of the dial controlling volume are three rheostat knobs, which control the current in the filaments of the first, second, third, and fourth tubes. Immediately below the volume control dial is the filament current control switch. Continuing to the right of this switch and below the first rheostat knob is a jack for use of phones with only one stage of amplification. Then there is a second jack for the speaker, using both stages of amplification and the last jack employs all four tubes.

At first it will probably be best to try to tune the set with powerful near-by stations. To do this you set the volume control dial near zero and slowly rotate the tuning dial. Then having picked up a local station, by increasing the reading of the volume control dial, the signal should come in loud and clear. The setting of the tuning dial should be recorded and thereafter that particular station should always be found at that setting.

To obtain maximum volume on distant station reception the procedure is slightly different. In this case it is best to set the tuning dial approximately at the desired wavelength and for each of these settings increase the volume control dial until you get a hissing noise. If you go beyond this point you will get an audio note and the volume dial setting should be reduced. Generally speaking, for every setting of the tuning dial get the maximum setting of the volume dial.

The rheostats should be adjusted on a moderate signal until maximum volume is obtained. At the same time, for the sake of economy the tubes should be run no brighter than is necessary to give satisfactory performance.

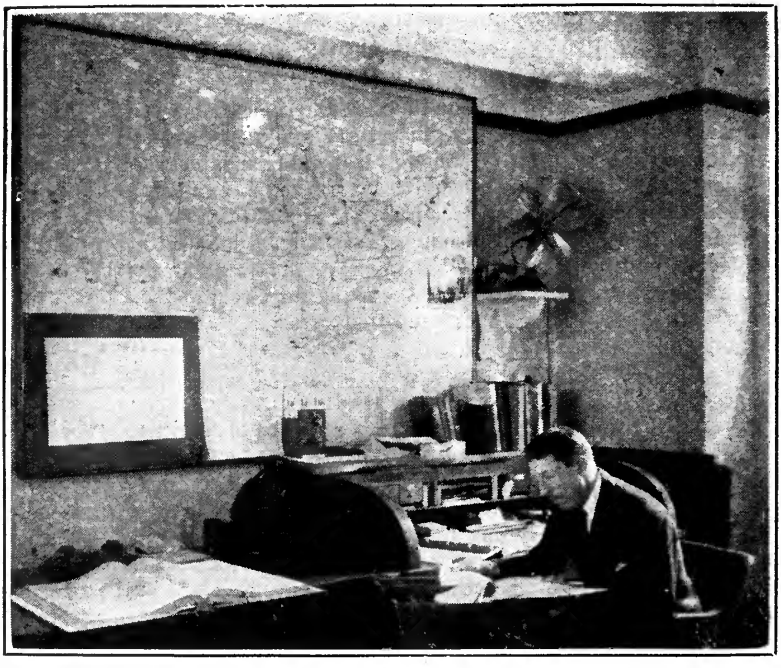
The following is the list of parts for the four-tube circuit.

It is entirely possible to use any standard type of condenser, tube socket, jack, rheostat, etc., when building this receiver, and for that reason, no especial make has been listed. However, for the tuner and radio-frequency transformer units, it is well to use the same parts as specified in the article and used in the construction of the receiver described. If the reader wants to construct his own components, he can readily do so if he follows the constructional data given.

From the data given about the radio-frequency coil, it will be observed that this is no ordinary radio-frequency transformer, such as is used for the common radio-frequency amplifier, but must be especially constructed and connected in the circuit as shown in Figs. 1 and 3.—THE EDITOR.

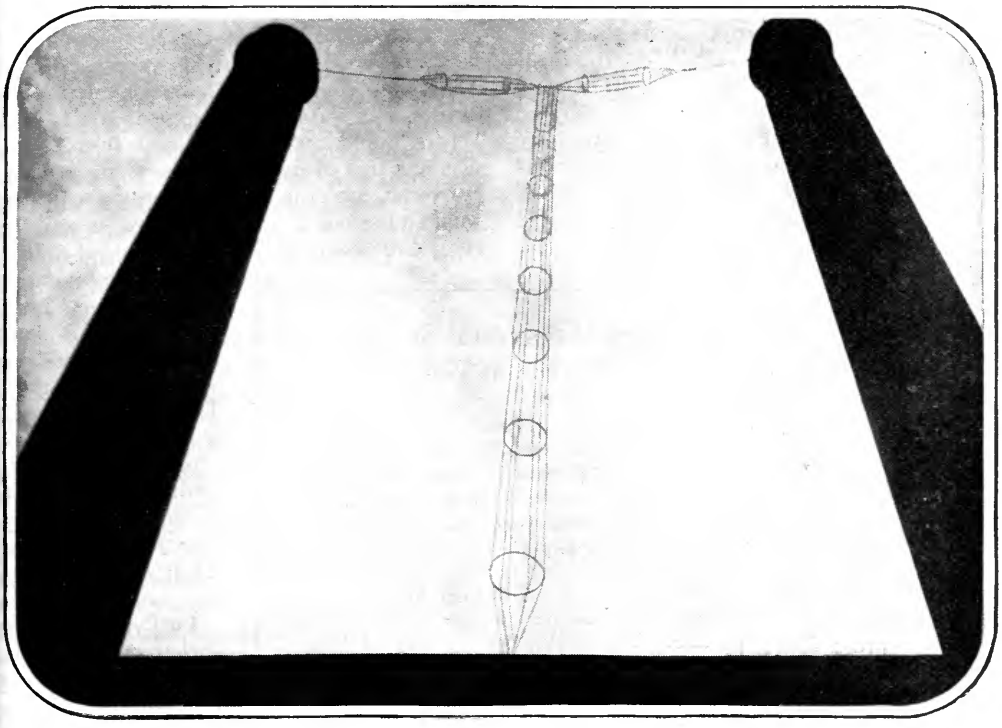
LIST OF PARTS

1 Cabinet 7" x 24"
1 Panel 7" x 24"
1 Rasla Radio-Frequency Tuner—May be purchased, or home-made as described.
1 Variable Condenser .00029 mfd. (minimum cap).
1 Rasla Radio-Frequency Transformer—May be purchased or home-made as described.
1 Fixed Crystal Detector
1 Modern 10-1 Audio Transformer
1 Modern Low Ratio Audio Transformer
1 Rasla Balancing Condenser—May be purchased or home-made as illustrated.
1 Filament Control Switch
4 Sockets
2 16-Ohm Rheostats
2 Double Circuit Jacks
1 Single Circuit Jack
1 Dial—vernier type preferable
9 Binding Posts
1 C Battery
1 Modern Push-pull transformer No. 112
1 " " " No. 113
(Other makes may be successfully employed)
1 Fixed Mica Condenser .0005 mfd. capacity
1 Fixed Mica Condenser .006 mfd. capacity.
1 Fixed Mica Condenser .005 mfd. capacity
1 Fixed Mica Condenser .00025 mfd. capacity



J. C. GILBERT

Who is in charge of the Department of Agriculture radio market news broadcasting system. The map on the wall shows the location of the broadcasting stations which the Department uses for this service



THE ANTENNA AT STATION 5IT, BIRMINGHAM

What We Are Doing With Broadcasting

The Chief Engineer of the British Broadcasting Company Compares English and American Broadcasting

BY CAPTAIN P. P. ECKERSLEY
Chief Engineer, British Broadcasting Company

I THINK we will all agree as broadcasters that it is certainly more blessed to send than to receive. But at this particular moment I do not know that I can agree with that sentiment either, because it is very difficult in a short time to give you an adequate picture of what we are doing on the other side. May I say that in trying to paint this picture I am only doing it with the idea of not vaunting it as the most wonderful thing that has ever happened, nor decrying it as the most miserable. But to show you how broadcasting has been misunderstood when comparisons between national systems have been undertaken, I may state that I have read in some of your newspapers occasionally severe criticisms of your own progress and of ours; and I have seen foolish comparisons between the two. There can be no comparison at all, where the differences of areas are something like six million square miles as compared with a few hundred, and where there is a different temperament of the people to be considered, and different conditions in every sort of way.

In the first place, we were miles behind you. You started broadcasting long before we did. But the amateurs of England petitioned the then Postmaster General two years ago that

they should have some station which should transmit to them regularly. More than forty thousand people petitioned. Well, the Postmaster General graciously permitted that such a station should be erected and operated for a quarter of an hour once a week! Strangely enough, I was put in charge of this colossal undertaking, and broadcasting in England started in that way, in the year 1922. During that year we broadcast for a quarter of an hour a week, using Victrola records, and so on; while the transmissions, which were later treated in a less serious manner, because I was in charge of them, might have raised the enthusiasm of the amateur to a fever pitch they did not quite fulfill the more cultivated tastes of the high-brows of the radio profession, and as far back as that year, 1922, people began to realize that something must be done in England to put broadcasting on a firm basis. What they did was to have a conference which lasted exactly six months; and they finally came to a decision which was really a rather wise one, considering the nature of the problem.

Where the Crystal Set Rules the Radio Waves

Britannia may rule the waves if one believe the anthem, but in English radio, it is the modest crystal set which marshals the radio wavelengths. The United States led the world in broadcasting, but England was really the second nation to follow. It is especially interesting to see along what lines British broadcasting has developed, because the two nations have a common bond of culture. Their method of payment for broadcasting is totally different from the American. And from some of the things Captain Eckersley says, in his decidedly humorous fashion, the English listener is quite different from our listener who uses "tubes" instead of "valves." This story is taken from an address made by Captain Eckersley at the Department of Commerce Radio Conference in Washington, early last October.—THE EDITOR.

EVERYONE IN ENGLAND WANTED TO BROADCAST

THEY said they all wanted to broadcast. The first idea was each one wanted to broadcast—newspapers, etc., and twenty-five applications came in to broadcast in London alone; and it was felt that would not work. So finally the scheme arrived at was that the six big manufacturers we have over there, who are called "the big six," all came together and said, "We will put ten thousand pounds into the capitalization of the company, and this company will be responsible for nothing but the broadcasting. It will not be a profit-making concern in any sense whatsoever. It is simply and solely to send out the best programs possible." They put in that money and they said, "If this thing makes a profit, we will limit our profit to seven and one-half per cent. on our original investment. Nobody can take any shares in the company unless he is a bona fide British manufacturer." Then, of course, the question was—The capital was sixty thousand pounds to start. Where would the revenue come from? The idea was that every person who made, bought, borrowed, stole, or otherwise got a receiver, would take out a license, because it was the rule of the country that he had to take out a license. And of course everyone obeyed the law. In this law-abiding nation you all know about that! This license would cost ten shillings, of which the Government would have five shillings, and the company five shillings. And so we should have our revenue.

I will not tell of our various vicissitudes, or the troubles that resulted, or of the few licenses taken out, first of all, and the total inadequacy of the service, according to the press. At any rate, at the present day the scheme has worked out very well. The first achievement was, we got 7/6 (about $1.75) from the Government, and they only took 2/6 (about $.60) The second achievement was that the original rather hide-bound regulations were done away with, and one uniform license was issued, of which we got 7/6. In 1922 there were ten thousand licenses. When I left England we were getting up a special program to commemorate the buying of the millionth license. So the progress has been extraordinary, and our income about two million dollars a year. At any rate, we are spending every penny on the service, and we hope that, being able to spend all that money on the service, the programs can be made excellent, because you can afford to buy the very best talent, and you can afford to pay people just as if they were performing on a concert platform, and you are also able with this money to put up a fine technical scheme, having regard for the English temperament.

THE TECHNICAL EQUIPMENT

WE ERECTED eight main stations of the same power as your WEAF., etc., in New York. We had one and one-half kilowatts. These stations were erected, and dotted over England, to try to get uniform distribution throughout zones, just as you are doing.

Now the Englishman is a peculiar person, and having once got this scheme going, he does not keep on living seventy or eighty miles away from the station, and getting more and more distance. He does not care to reach out—I think you call it, nor has he the ambition of the man to reach Australia on half a valve. He is far more keen to get a pure, undisturbed signal, and he only hears the one single one coming from his local station. And our ambition is that any man in England can listen in on an apparatus made up of a clothes-line or a piece of string, and really hear his program uninterruptedly. And that is the way we have worked it out. The one ambition I have had is to give everybody so good a signal that they can not complain of the engineering side of it, but always must complain of the programs. I am not an engineer! Well, that ideal was not realized by the erection of the one and one-half kilowatt stations, because outside, thirty miles from that place, the service is not what we consider perfect, because it is liable to interruption. You know, in England we are all packed together, and there is a great deal of shipping, and they have not the wavelength allocations you have.

A Frenchman fishing off our coast will signal back and forth with his nearest home station about how many fish he has caught, and every time he tells about it, the while the fish constantly growing longer, he requires a longer message to narrate the thing. And so we must create much stronger signals perhaps than you have to use here. There were large areas in densely populated places where people could not receive; so we erected a royal station, designed to serve only the town or city in which it was located. We put these stations down, and it would be too expensive to provide programs every day up to the excellence of the programs we do provide in the large stations, so we linked these up by ordinary wire to our London program. But here is the difference in England: As technical men, responsible for the technique of our own station, we are not, of course, responsible for those trunk lines outside. I put a signal on the wire, and the Government does the rest, and it sometimes arrives at the other end. As a matter of fact, the service, considering it has grown up in the way it has, is an extraordinarily good one.

Another function of the royal station is that you are able to give a local program from that station. Every city, of course, thinks it is just a little bit better than the next one, and if they can talk about it on their radio, it pleases them. So we give these stations over to local civic functions, etc. In Sheffield, they give the annual talk of the master of that city, or in Liverpool someone speaks treating of cotton prices, etc., all the things that appertain to the locality. They use that station to create local interest, whereas if there had been some impersonal, large, high-powered station, it would have bored Liverpool, for instance, horribly, to have to listen to the superlative merits of Glasgow or Manchester! So then we had the royal stations and main stations, and with that establishment, I estimate that, taking crystal reception as a basis, out of the forty-three million people we serve, exactly fifty per cent. could get a

TIME SIGNALS FROM "BIG BEN"

Are frequently broadcast from 2 LO, at London. The photograph shows engineers for the company with a portable microphone, pulling in the sound. At the start and conclusion of some of the international broadcasting in November, time signals from this clock were sent out

signal on an ordinary simple crystal set; and they do. They use the crystal set to a man. You would be amazed to see the extent to which this simple set is used. I should think that the crystal set represents forty-eight per cent. of the fifty per cent. mentioned. Nearly everybody has a crystal set. They love it. They put it in the corner, and sit all night listening.

DEMOCRATIC BROADCASTING

BUT still feeling that broadcasting should be democratic so that anybody, anywhere, with anything to listen on, could get it, we came to the conclusion there were still large areas unserved by main or royal stations. We have just secured permission to erect a super-power station, to reach all areas not previously served by main or royal stations. This station, which has been running experimentally in England for the last three months, is a station of twenty-five kilowatts power, about twenty-two kilowatts in the antenna, at least so the designers told me. This station has a crystal range of exactly one hundred miles. It works on a wavelength of sixteen hundred meters, which was wrested from the Government under great pressure. We have found out the value of the longer wavelength in that you suffer neither from fading, night distortion, or jamming. The station does not send out stuff banked up in the middle and falling off at the ends, and at the long distances, four and five hundred miles, the station is very adequate. I listened myself in Scotland, and with a single valve reaction I was able to hear that station every night clearly. The only trouble was static. And there's another slight trouble, and that is with the strength falling off slightly at night. But on the whole that station is very successful. And down along the coast we feel that we have solved our problem once for all, and everybody, everywhere is given a strong, adequate signal.

You may ask about the variety in the program. The variety is in the program. We block the program out to cater from the meanest intelligence up to the highest high-brow. We vary our selections from the more humble *Rhapsodie Hongroise* of Liszt up to the classical *Yes, We Have No Bananas*! We have tried to keep the *Yes, We Have No Bananas* side of the thing down just a bit, however, and our great criticism is that we are sending much too highbrow programs. Well, as a matter of fact, it is a subtle compliment to pay to anybody to give him something rather above him, and we have found it immensely successful.

SEVENTY PER CENT. USE CRYSTALS

WITH the high-power station, we may say that seventy per cent. of the population of Great Britain is served by crystal; and while the manufacturers may not be quite so pleased about it, at any rate the people whom we are serving are, and we feel that the manufacturer has got a great field, because he will be able to concentrate on the one thing that needs concentration, that is, the perfect quality, the perfect transmitting of sound between the studio and the drawing room or kitchen. That is what we are working on, not to listen to the distant signal, but more to get perfect programs, perfectly reproduced. And that is more or less the line that we are working on at the present time. We have a different problem, a different temperament, but that is what we are doing.

I should like to say a word on the linking up of the two continents. We did last year, as you know, broadcast probably more than

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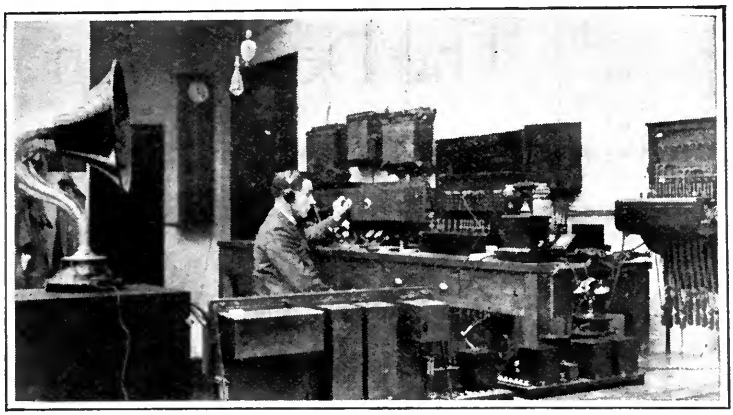
LADY TERRINGTON

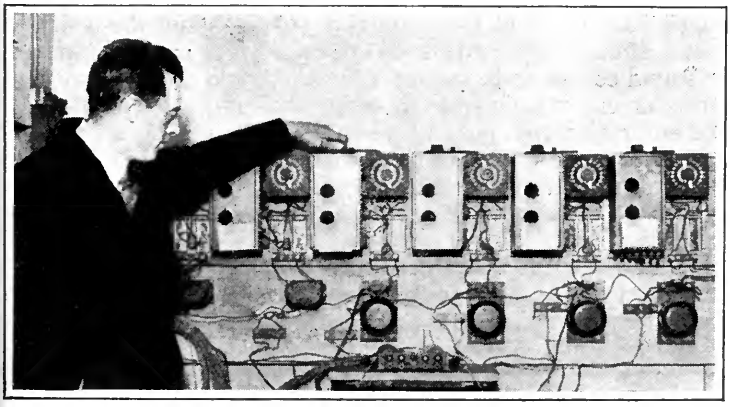
M. P. for Wycombe, Buckinghamshire, listening to a British Broadcasting Company program

any other organization has ever done in the world. We were trying to receive signals from America! We tried to pick up the various hundred meter stations, and occasionally a reply did come through, and occasionally we did have a sort of guessing competition as to whether it was a brass band or a piano. We did broadcast this, and it made a tremendous sensation in England; and on one particular and historic occasion signals from East Pittsburgh were received in England rebroadcast, and sent to South Africa, a distance of nine thousand miles! We do feel that the future of broadcasting must be intimately connected with the strengthening of friendly relations between the continents thus bound together by sound. And what could be more ideal than that America and England should be linked together by this mighty force, inasmuch as they are both English-speaking people, and they will probably, after a little practice, be able to understand one another.



THE CONTROL ROOM OF THE BELFAST STATION
Call letters 2 BE, one of the newest of the British Broadcasting Company chain

There is no doubt, however, in the minds of engineers that there is only one thing to do if we are to link up the two countries, and that is purely on the engineering side. It's an amazingly long way across the Atlantic. I have just crossed it. And it seems to me that to make that journey in $\frac{86}{100}$ part of a second will take a great deal of push behind the traveler. And one thing we must concentrate on is the question of having high-power stations to link up the two continents. Of that there can be no possible doubt. We are absolutely ignorant of transmissions at long distances at night. But it seems to me that inasmuch as the amateurs of both countries have spoken to each other with about two watts, by c. w., as reported in our press, we feel that we can deal with 150 up to 200 watts, and it might be possible to get communication between the two countries; and if we did, it would stimulate a great interest on both sides of the water. If we could be certain on occasion of hearing some of your most interesting pronouncements, and you could listen to us drawling away, we would find that radio really had tremendous possibilities for good, and it would tend toward our understanding each other a little better than we sometimes do. And I think that, with the English-speaking people, at any rate, radio has a great future. It must be so.



CAPTAIN ECKERSLEY
Chief Engineer of the British Broadcasting Company, at the relay apparatus in the London headquarters. Programs are frequently given in the London studio and relayed by wire to the other stations in the chain. The purpose of this is to allow the owner of a crystal receiver to hear strong signals from London. The apparatus in the photograph is necessary to "boost" the signal strength to overcome the resistance in the wire lines connecting the stations

The Decision in the "Who is to Pay for Broadcasting?" Contest

A Prize of $500 Was Awarded to H. D. Kellogg, Jr., of Haverford, Pa.

FOR three months since the close of the contest "Who Is to Pay for Broadcasting?" the judges have been going over the great number of manuscripts submitted for the prize. Suggestions there were of all kinds, and the problem of deciding which one of all the group was the best was not found at all easy. The judges were carefully chosen to represent all branches of thought which could possibly be concerned with the broadcasting problem. They were, Professor J. H. Morecroft, president of the Institute of Radio Engineers (1923-4); Major J. Andrew White, former editor of the *Wireless Age* and well-known descriptive broadcaster; Harry Chandler, publisher of the Los Angeles *Times* and owner of KHJ; Frank Reichmann, a Chicago radio manufacturer and an old-timer in the field; Dr. Royal S. Copeland, United States Senator from New York, representing the public point of view; A. S. Lindstrom, chairman of the Pacific Radio Trade Association; Zeh Bouck, one of the best known radio authors in America; and Charles H. Porter, Chicago, secretary of the Radio Manufacturers' Association.

In the May, 1924, RADIO BROADCAST, the purpose and rules of the contest were announced. It was then said that "a workable plan which shall take into account the problems in present radio broadcasting and propose a solution" was desired. A plan was wanted which should propose a practicable and workable solution of the present complex radio situation. Very nearly one thousand manuscripts were submitted to the judges.

The complete prize-winning plan will appear in the March RADIO BROADCAST. In brief, it calls for the public to shoulder the cost of broadcasting by means of a stamp tax on each vacuum tube and crystal bought by the consumer for his radio set. Radio broadcasting, avers the author of the plan, should be placed on a sound economic basis and to be so, should pay its way, precisely as other forms of entertainment. In order that radio secure the best possible available entertainment, broadcasting should be put on a paid contract basis. Tubes have a life commensurate with the service they render, the prize-winner claims, which makes them an "index of broadcast consumption." The number of tubes was considered to be an excellent index of the cost of the set and the distance over which it would receive. It was finally proposed that a newly created Bureau of Broadcasting administer the fund to be collected from this tax. Stamps purchased by the tube manufacturers from the Bureau of Broadcasting would be affixed by the manufacturer of the tubes, and the amount of tax to be paid would be determined from statistics compiled by the Bureau.

Neither the American Radio Association, under whose auspices the contest was conducted, nor RADIO BROADCAST which offered the $500 as a prize necessarily concur in the suggestions offered by the winner, Mr. H. D. Kellogg, Jr., of Haverford, Pennsylvania.

Later numbers of this magazine will contain some interesting comments on this entire question of who is to pay for broadcasting.

A Winder for Small Inductances

How to Build and Use a Device to Wind Efficient, Concentrated Inductances Which May be Used in Various Radio Receivers—How to Wind the Coils for the RADIO BROADCAST Six-Tube Second Harmonic Super-heterodyne

BY ALLAN T. HANSCOM

MANY readers have been greatly interested in the second harmonic super-heterodyne described in RADIO BROADCAST for November, 1924. One of the central features of that six-tube receiver is the concentrated inductances. These are wound by a special machine which is described here. The construction of this device is not especially easy and had best be assumed by those readers who are adept at using a lathe and similar tools. In addition to the method of assembling the winder, complete information is given on the number of turns and dimensions for the intermediate frequency and oscillator coils for the six-tube, second harmonic super-heterodyne.—THE EDITOR.

SO MANY requests have come to the writer for constructional data on the small honeycomb coils which are used in the six-tube super-heterodyne described in this magazine for November, 1924, that a description of the method by which these coils are made should prove interesting.

In the first place, some of the more important requirements for any inductance to be used in radio work should be considered.

LOW DISTRIBUTED CAPACITY

DISTRIBUTED capacity in an inductance greatly increases the resistance of the inductance at the higher frequencies. The direct current resistance of an inductance is an inverse function of the wire size. By this we mean that the resistance of a coil of coarse wire is less than a similar coil of fine wire, but with coarse wire the distributed capacity in-

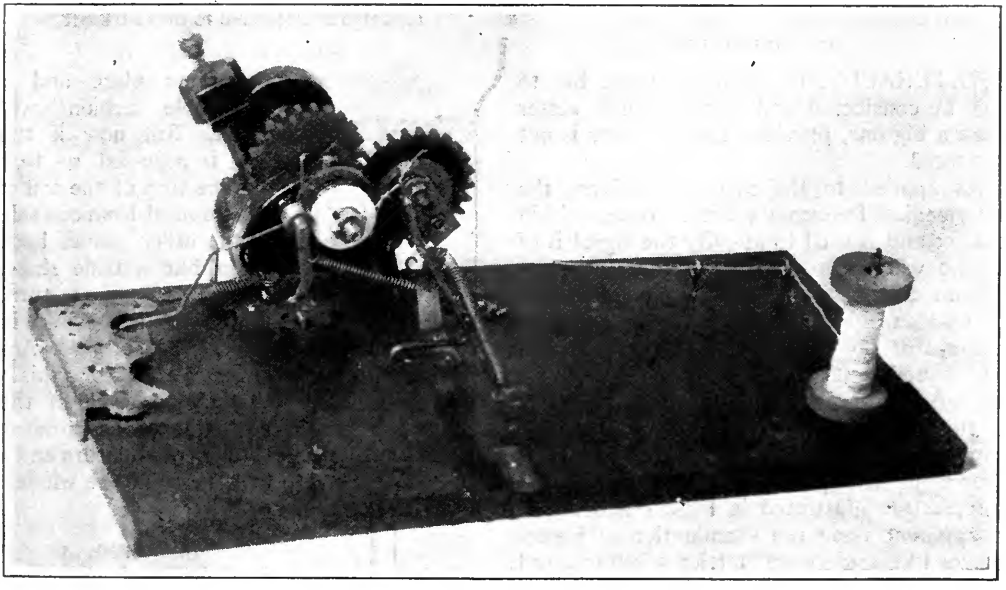


FIG. 1
A photograph of the completed coil winder

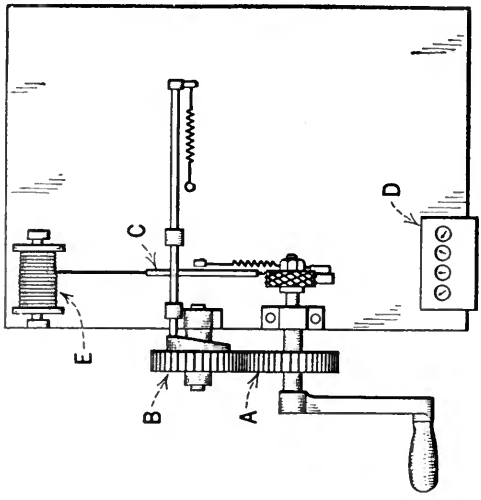


FIG. 2

The arrangement of the various parts on a baseboard. A coil gear; B nozzle feed gear; C feed nozzle; D turn counter; E spool of wire

creases so that the net gain is not as large as it would seem.

NUMBER OF TURNS

THIS depends entirely on the inductance value which we wish the finished coil to have and because the wavelength is proportional to the square root of the inductance (other things being equal). The number of turns depends entirely on the use for which the coil is designed.

SIZE OF COILS

NATURALLY, the factor of space has to be considered and a small coil is better than a big one, provided the efficiency is not sacrificed.

As applied to the super-heterodyne, the intermediate frequency which is created within the set and is used to amplify the signal is of such a value to make necessary large inductances. Small coils wound "scramble fashion" on wooden or bakelite forms are not practical because of the difference in inductance and distributed capacity between the coils, even though they are wound with the same number of turns. In endeavoring to solve this problem the writer devised the machine which is shown in the photographs. The essential features are illustrated in Figs. 1 and 2. It is apparent upon the examination of inductances like spiderwebs, lattice windings, and commercial honeycomb coils that the biggest gain results from the fact that the wires are not close together where they run parallel. This results in a very much lower distributed capacity. Obviously, in order to wind a coil which shall be self-supporting, it is necessary that the feed for the wire should travel sideways back and forth while the coil is being wound. The relation between the speed of rotation of the coil and the speed of the side travel of the feed is what governs the angle at which the successive turns of the coil will intersect, if the nozzle which feeds the wire travels across the face of the coil and back to the original starting point in exactly one turn of the coil, then the wire will always fall in

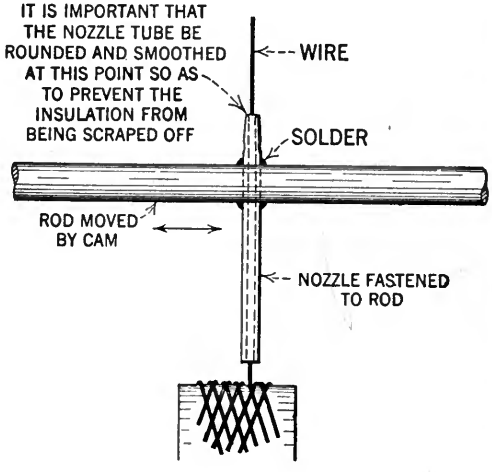


FIG. 3

Shows how the tubular nozzle is mounted and soldered to the cam shaft

the same place and a "scramble fashion" will result. But now if the feed is adjusted so that for one turn of the coil it has traveled from one side to the other, comes back again but a trifle short, crossing the first turn, then the effect shown in Fig. 4 will be created. Another way of stating this is that for one cycle of the feed, the coil has rotated through one full turn and a little more in the winder.

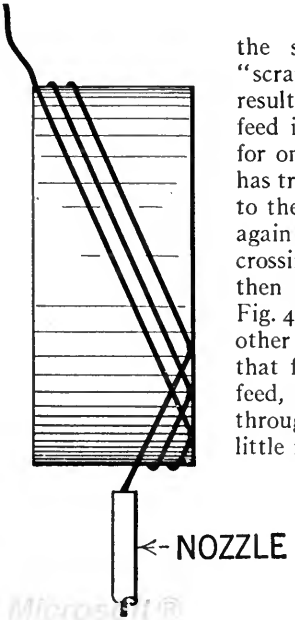


FIG. 4

The standard type of honeycomb coil winding produced by the coil winder

As illustrated this result is obtained by the ratio of the gears A and B. The gear A being on the same shaft with the coil, its rotating is the same as that of the coil, while the gear B being larger than the gear A, turns more

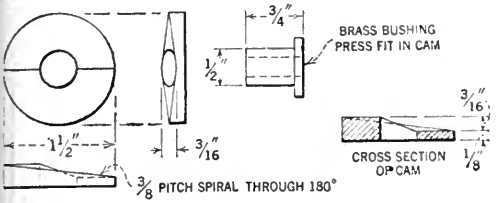


FIG. 5

A working sketch of the cam, the most important unit of the entire device

slowly. Fastened to the gear B is a cam which operates the nozzle C. The shape of this cam is very important. The rate of travel of the nozzle should be constant with practically no time-interval at the end of the travel when the direction is reversed. Therefore, the ideal shape of the cam is that of a straight spiral through 180° and the reverse spiral through the remaining 180°. There is absolutely no way that this cam can be cut except on an end milling machine with a double motion. Any up-to-date machine shop has this equipment and the actual cutting of the cam is a very short process after the milling machine is set up. Fig. 5 is a working sketch of this cam. Its lateral reciprocating action is plainly illustrated in Fig. 6.

THE WINDING MACHINE

OF COURSE, it is absolutely necessary that there is no end play in the mechanism. The shaft on which the coil is wound must run absolutely true in order to prevent

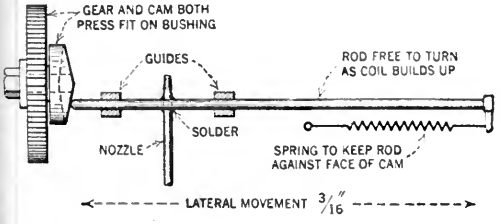


FIG. 6

Illustrates the function of the cam and nozzle

the wire from slipping on the edges of the coil while it is being wound. D in Fig. 2 represents a counter which counts the number of turns being wound. This is likewise almost a necessity because it is very easy to make an error in attempting to count and wind by hand. The writer used a motor with a worm drive with a gear on the main shaft, but any form of drive would serve the purpose.

In using the machine, the wire is first fastened on the end of the shaft and allowed to wind twenty or thirty turns on the bushing D which is clamped on the end of the shaft with a nut. At this point the machine is stopped and a piece of adhesive tape $\frac{1}{8}$ of an inch wide is laid across the bushing with the sticky side up as in Fig. 7. Then the counter is set at zero and the desired number

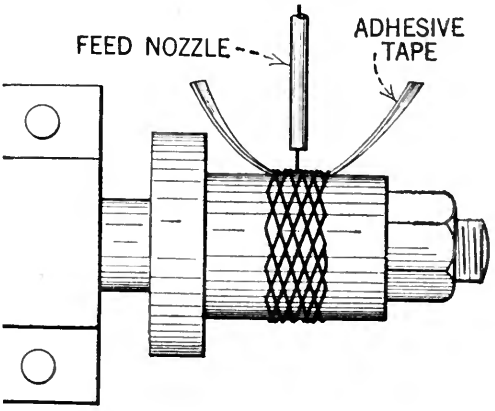


FIG. 7

Preparing the coil for binding with adhesive tape

of turns are wound on. After this, the adhesive tape is brought up over the outer edge of the coil to hold the last turn and the bushing with the coil on it is removed from the shaft. After driving the bushing out of the coil the first twenty or thirty turns are removed from the inside and the finished coil is dipped in a mixture of acetone and celluloid.

By varying the shape of the cam which con-

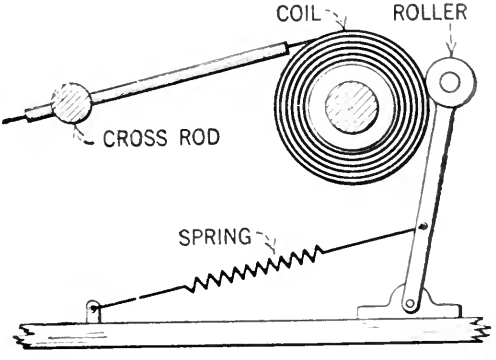


FIG. 8

A detail showing how the roller with spring tension keeps the layers in place

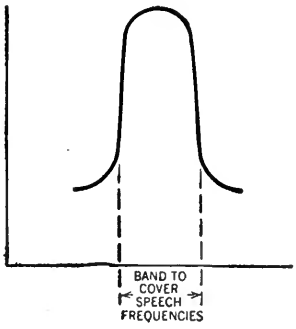


FIG. 9

A curve showing the range of audible frequencies covered by the Hanscom coils

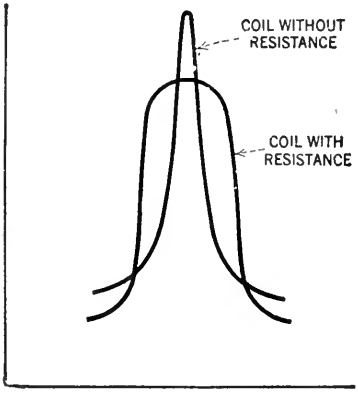


FIG. 10

Illustrates the difference between the Hanscom and other coils, the latter having the tendency to distort by reason of the side bands being chopped off

trols the feed mechanism various effects can be produced, but for average work a $\frac{3}{8}$ of an inch spiral has been found satisfactory. This produces a coil which is $\frac{3}{16}$ of an inch thick. In winding certain kinds of wire it was found advisable to use a roller with a spring tension against the outer edge of the coil as in Fig. 8.

For the intermediate frequency circuit of the super-heterodyne, the writer has used two coils in series, each containing about one thousand turns of No. 36 wire with a .00025 mfd. condenser across the two coils. Various kinds of inductances can be wound on the machine, providing the hole at the end of the nozzle is large enough to permit the wire to run freely through it.

ADVANTAGES OF THESE COILS

THE greatest advantage of these coils is their small size. The magnetic field caused by the coil is naturally small and they can be mounted without much fear of coupling effect with other parts of the apparatus.

In any form of radio inductance designed for reception of music and speech, it is necessary to cover a band of wavelength sufficient to avoid distortion of the voice or music. This is illustrated in Fig. 9 and in the coils designed by the writer this is obtained by the

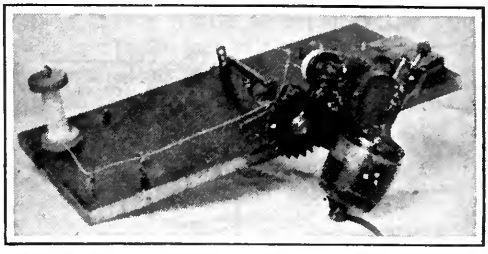


FIG. 11

Shows a rear view of the winder. A worm-drive motor supplies the means for rotation

resistance in the coils which tends to broaden the tuning sufficiently as illustrated in Fig. 10.

To those who are experimentally inclined, the construction of a coil winder as described will be diverting. The writer can assure those who attempt it that they will wind many coils and near coils before the results are entirely satisfactory. This is not said to discourage those who might desire to build it, but rather as a word of warning. Stick to it and it will work!

THE WINDING DATA FOR THE HANSCOM 'SUPER' COILS

INTERMEDIATE-FREQUENCY transformer—Primaries:—In the first stage, the primary coil consists of 500 turns of No. 36

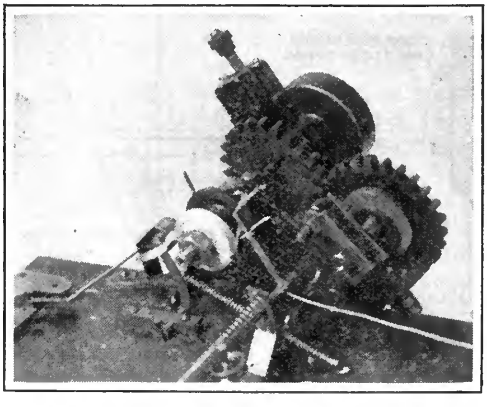


FIG. 12

The nozzle and cam units are clearly shown. An oscillator coil is on the winding bushing

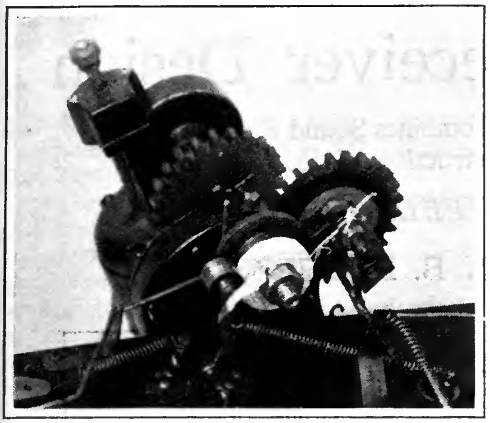


FIG. 13

Another view of the cam and nozzle. Here, also, is shown the method of obtaining tension on the roller bearing, provision for binding and the counter details

s. s. enamel wire. The second stage coil consists of 600 turns of the same wire and the third stage coil consists of 1000 turns of the same size wire.

Secondaries:—Connect two coils in series, each consisting of 1,000 turns of No. 36 s. s. enamel wire for each stage. The first stage coil is tuned by two .0005 mfd., micadons while the second and third stage coils are tuned by a .00025 mfd. micadon, one for each stage.

Oscillator Coils, Grid Circuit:—Two coils are connected in series. The number of turns for these coils depends upon the size of the oscillator tuning condenser and usually varies between 125 and 160. Double cotton covered wire varying in size from No. 24 to No. 28 may be satisfactorily used.

Plate circuit:—Connect two coils in series, using the same size wire as for the grid coils. As few turns as are necessary to make the tube oscillate uniformly over the entire range of the

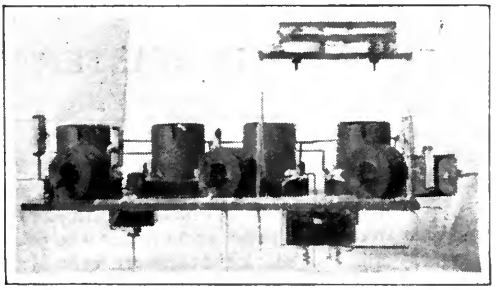
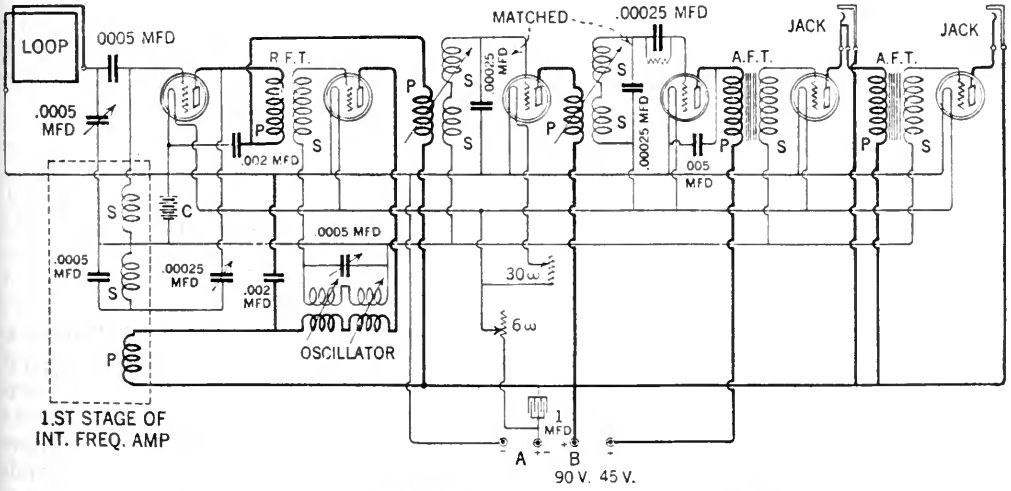


FIG. 14

A completed set of intermediate-frequency amplifier coils mounted in position in an I. F. unit of a second harmonic super-heterodyne receiver

oscillator condenser are used. This number varies between 50 and 75. The inside diameter of the coils is approximately $\frac{5}{8}$". The overall dimensions of a single coil are $\frac{3}{16}$" x $1\frac{1}{2}$".

It is important that the .00025 mfd. condensers be matched. A small variable neutralizing condenser may be shunted across one of them and varied until the values of both are equal. This may be considered as one of the minor and semi-permanent adjustments of the receiver.



A CORRECTED CIRCUIT DIAGRAM OF THE SECOND HARMONIC "SUPER"

Minor corrections have been made, particularly in that the by-pass condenser on the first audio-frequency primary is connected from the plate to the negative filament lead instead of as shown on page 44 of RADIO BROADCAST for November, 1924

Problems of Receiver Design

How the Super-heterodyne Combines Sound Elements of Design—Theory of Construction of the "Super"

WHAT MAKES THE WHEELS GO 'ROUND: X

By WALTER VAN B. ROBERTS

IN THIS interesting article, part of Mr. Roberts' series of clear explanatory articles about radio and all its works, the author has not tried to cover the entire field of receiver design, but he has explained some technical points about the super-heterodyne receiver so well that no reader who prides himself on his theoretical knowledge should miss it. This is the tenth article by Mr. Roberts which explains radio theory and practise in his own clear fashion. This first appeared in our magazine for March, 1924.

—THE EDITOR.

IF ALL transmitting stations used the same wavelength (and took turns working) reception would be a much simpler problem. For the receiving set might have as many tuned circuits as the designer had any use for. The owner of the set would not need to change any of the adjustments so there would be no disadvantage, from the operating point of view, in having a very complicated circuit. The idea of the super-heterodyne is simply this: build the very best possible receiving set to work on a fixed frequency (what ever frequency it is easiest to work with), then build a frequency changing device that receives signals on a tuned loop or other antenna and changes their frequency to that for which the receiving set is designed. When tuning-in a station with this combination only two adjustments are necessary: the loop should be tuned to the incoming radio waves, and the frequency changing device should be set to change the frequency to that at which the receiving set is designed to work. Yet in both sensitivity and selectivity this combination has all the advantage given by the large number of tuned circuits and many stages of amplification that can be used in the fixed frequency receiving set.

It is possible that other circuits may be invented in the future that are cheaper or easier to build than a super-heterodyne, but it seems impossible that any could be made to work better because the super-heterodyne can be made ideal from the operating point of view. By taking the trouble to cut condenser plates very accurately to special shapes, the two condensers that have to be changed in tuning-in different stations could be worked simultaneously by a single knob, which leaves nothing to be imagined in the way of simplicity of tuning.

78. BAND FILTERS

IF THE fixed frequency used is fairly low, the fixed frequency receiver can be made to respond equally well to a band of frequencies sufficiently wide for high quality, and yet not respond at all to frequencies lying only slightly outside of this band. This is ideal selectivity and is achieved by the use of a band filter in the fixed frequency receiver. A band filter

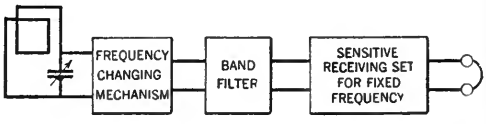


FIG. 65

is a complicated combination of inductances and capacities that allows free passage of frequencies lying inside a given band, but stops all frequencies lying outside that band. Band filters can not be made to select a narrow band from among very high frequencies and so can only be used after the frequency changer has changed the incoming radio signals down to the lower frequency at which the receiver is designed to work. Fig. 65

shows schematically the operation of the super-heterodyne system.

79. HOW THE FREQUENCY-CHANGER WORKS

FIGURE 66 shows a typical frequency changer. Let $e_s \sin st$ be the voltage of signal frequency picked up by the tuned loop. Let $e_h \sin ht$ be the voltage of the heterodyne oscillator's frequency picked up by the small coil coupled loosely to the heterodyne oscillator. The grid potential of the tube is the sum of these two and the C battery voltage, so the plate current will be

$i_p = K [B + \mu (C + e_s \sin st + e_h \sin ht)]^2$
$+$(small terms that we need not consider here.)
$= K [(B + \mu C) + \mu (e_s \sin st + e_h \sin ht)]^2$
$= K (B + \mu C)^2$ which is direct current
$+2k\mu (B + \mu C) (e_s \sin st + e_h \sin ht)$ which are amplified currents of the signal and heterodyne frequencies.
$+k\mu^2 (e_s^2 \sin^2 st + e_h^2 \sin^2 ht)$ which reduces to direct currents and frequencies twice the signal frequency and twice the heterodyne frequency.
$+2k\mu^2 e_s \sin st\, e_h \sin ht$ which is the only term we have any use for, because it splits up into two parts, one of them $— K\mu^2 e_s e_h \cos (s + h) t$ which is the sum of the signal and heterodyne frequencies, and of no interest to us, but the other is $k \mu^2 e_s e_h \cos (s—h) t$ which is the new frequency that we are going to use. The tuned circuit that connects to the fixed frequency receiver picks up only this frequency. It is obvious that this new frequency can be adjusted to any desired value by simply adjusting the frequency of the heterodyne oscillator. For instance, suppose the fixed frequency receiver is built to work at 100,000 cycles and the radio waves are coming in at a frequency of 1,000,000. If we adjust the heterodyne to oscillate at 900,000 cycles the new frequency will be the difference of the two, or 100,000, which is just right to be picked up and received by the fixed frequency set. On the other hand if the heterodyne oscillator is adjusted to 1,100,000 the difference will again be 100,000 so that there are evidently always two possible settings for the heterodyne condenser either of which produces the proper frequency for the fixed or intermediate frequency receiver. Sometimes there is less interference experienced when using one of these settings than the other but usually it makes no difference. From the coefficient of the new frequency term it is evident that its strength depends upon the amount of voltage picked up from the heterodyne oscillator as well as the signal itself. Hence this should be made large by making the coupling to the heterodyne oscillator sufficiently close. The C battery voltage should be greater than the heterodyne voltage in order to keep the grid at all times negative. The best C and B battery voltages and best coupling can be most simply found by experiment.

80. PROBLEMS OF "SUPER" DESIGN

IN THE actual construction of a super-heterodyne, we are caught between two fires. On the one hand, if we build the fixed, or intermediate-frequency receiver to operate at a fairly high frequency, say one or two hundred kilocycles, we will have difficulty in making it sensitive and selective enough. On the other hand, if we use a very low intermediate frequency, say 30 kilocycles, we are

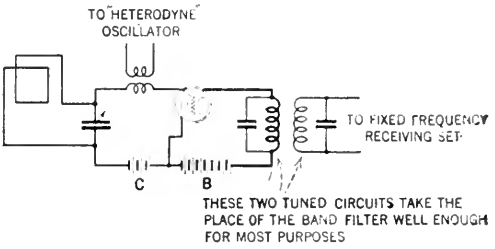


FIG. 66

likely to run into two troubles. The first is that the quality tends to be bad on account of the selectivity being too great, and the other is that unpleasant complications occur in operating the set, due to the signal and heterodyne frequencies being so nearly equal. As the heterodyne condenser is varied there may be a click when the heterodyne frequency passes the value for which the signal circuit is tuned. Also, the same setting of the heterodyne condenser will often bring in two different stations at once whose frequencies are really different by twice the intermediate frequency used, and when the latter is very low, these two frequencies are too close together for the signal circuit or loop to select one to the exclusion of the other.

In view of these considerations three courses seem to be open: (1) to effect the best compromise between the advantages and disadvantages of high and low intermediate-frequency amplification, the choice depending upon what is desired of the set and the location where it is to work, (2) to use the best intermediate frequency for amplification and quality and use a frequency changing device employing special circuits so arranged that only

one station can be received with a given heterodyne condenser setting —and hence conversely only one heterodyne condenser setting will bring in a given station—and (3) to use *two* intermediate frequencies, first a very high one to avoid the complications of tuning that accompany the low "I. F.", then by means of another heterodyne (this one being fixed once for all) changing down to the best frequency for quality and selectivity and amplification. As there are obvious objections to all three courses, it cannot be said that the goal has yet been reached, although the super-heterodyne *method*, the idea having the bulk of the receiving set working at fixed frequencies and requiring no tuning adjustments, does not seem capable of improvement.

The chief fundamental methods of reception have been outlined but no attempt will be made to discuss all the circuits in use as nearly all are merely combinations of the methods discussed. For example, regeneration can be combined with the neutrodyne type of amplification by putting a variometer in the plate circuit of the detector tube. Again, the fixed frequency receiver of a super-heterodyne set may make use of neutrodyne amplification and reflexing.

Captain Larkin on Radio

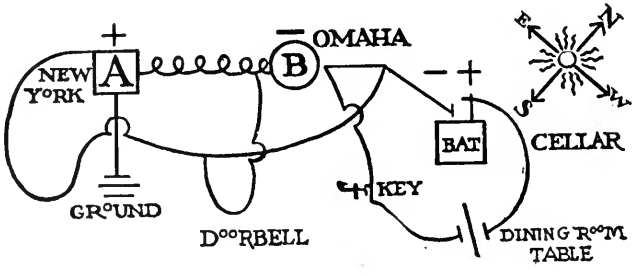
CAPTAIN LARKIN, one of the many heroes in "Mr. and Mrs. Haddock Abroad" by Donald Ogden Stewart, finds himself locked in a watertight compartment of his own vessel while showing some of his portly and pompous passengers about the ship. Several of the passengers suggest means of escape, but the suggestion of the Captain himself is by far the most masterly. He, like the Sheriff of Nottingham in "Robin Hood" has brought his "massive brain and eagle eye" to bear, and his solution of the dilemma is radio. The following diagram and conversation are reproduced from the book which is copyrighted by George H. Doran and Company, 1924.

"Well," said the Captain, "my plan rather ingeniously makes use of radio. Have you got a piece of chalk, Mrs. Gerrish?"

"I think so," said Mrs. Gerrish, feeling in her pockets.

"Here's one," said Mrs. Haddock. "Is yellow all right?"

"Yellow will do, I think," said the Captain, and taking the chalk he drew a rather complicated diagram on the side of the wall, somewhat as follows:



THE RADIO DIAGRAM THAT SOLVED THE PROBLEM
How to escape from a water-tight bulkhead

"Now," he said, "do you know anything about radio?"

"My son got Pittsburgh one night," said Mr. Haddock, "but there was a lot of static."

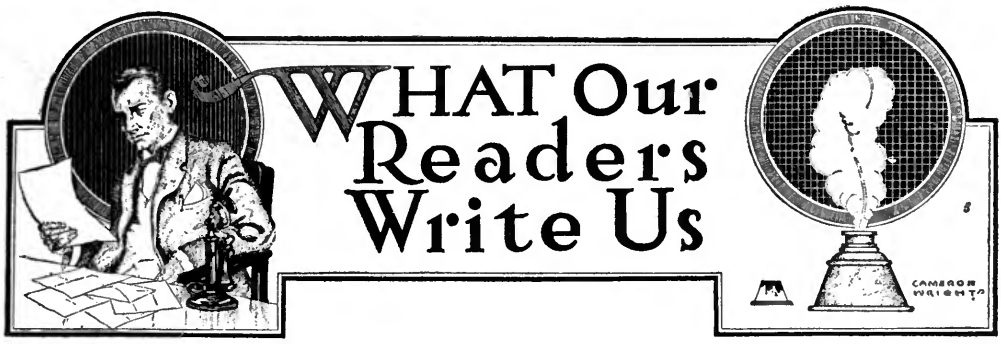
"What were they playing?" asked Mrs. Gerrish.

"It was some sort of a jazz band," said Mr. Haddock.

"I like opera best," said Mrs. Gerrish, and she hummed a few of the more important notes from "Faust." "That's from "Rigoletto".

HOW TO SELECT A B BATTERY ELIMINATOR

IS THE subject of an interesting article which will appear in an early number of RADIO BROADCAST. There are many points to be considered in purchasing and operating a current-tap device, and this article, written by a radio man of long experience, will be of great value to prospective purchasers.



A Word from an Enemy—of the Single Circuit

IT IS growing more and more plain that the enemies of the single-circuit receiver are legion and are increasing in numbers and in intensity of their opposition. As has often been remarked about the unfortunate widespread use of the single circuit set, abolishing it is so largely a matter of militant public opinion that results come a bit slowly. RADIO BROADCAST has in the last two years, lost some "friends" by its constant advocacy of the abolishing of the radiating receiver, chiefly among advertisers, be it said. It is interesting to note that now, very very few single-circuit receivers are marketed by manufacturers who make even faint claims to be reputable.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR.

I wish to compliment Mr. Willis K. Wing on his excellent summing up of "The Case Against the Radiating Receiver," but if it is in order, I would suggest a final point with which he might have rounded out his remarks on the single-circuit receiver.

Even if it were not for its severe radiation, the single-circuit set is not even selective enough to merit its consideration as a broadcast receiver. The recent Department of Commerce ruling calling for a compulsory quiet hour from 7 to 10.30 P. M. on the part of amateur stations was necessitated by the fact that at that time the single-circuit was the commonest type of receiver in use. This was not on account of the fact that amateur continuous wave stations actually created interference themselves, but simply because the single-circuit users were not able to tune the near-by stations out, which is, in a sense, unfair to the amateur.

This affliction of broad tuning which also gives the same trouble when the receiver is in a few miles of a broadcasting station, is caused by the fact that when resistance is included in an oscillatory (tuning) circuit, the tuning of that circuit is made broad. In the single-circuit tuner, the coil, condenser, and antenna are all connected together as to form one circuit, hence the name. Unfortunately, however, antennas have resistance, and most of those built for broadcast reception have comparatively high resistance, so that the antenna being included in the circuit through which the signals enter the detector causes the tuning to become broad. When the tuner is set for a broadcasting station, any other transmitter being operated in the neighborhood on almost any other wavelength will be heard, probably all over the dial.

The remedy for this is to "loose couple" the set; in other words, to bring the antenna and ground leads to a separate coil to be coupled to the grid tuning coil. The honeycomb coil tuner is the outstanding representative of this method of construction, and the so-called three-circuit regenerator as well.

H. S. G., Kitchener, Ontario.

A Radio Samaritan

IT IS most interesting to notice how the gospel is reaching all through the country and how the feeling against the squealing or radiating receiver has taken practical form. People, wherever possible, are getting to do something about this unfortunate situation rather than merely holding forth at great wordy length.

Editor, RADIO BROADCAST
Doubleday, Page & Company,
Garden City, L. I.

DEAR SIR.

Since reading your article "The Case Against the Radiating Receiver" in the October RADIO BROADCAST, I came across this notice in our local paper.

B. N., Gloucester, Massachusetts.

RADIO CONDITIONS IN GLOUCESTER LAST NIGHT

Conditions were good last night. Most stations came through strong. There was very little fading and static.—R. P. M.

WARNING

If the person in the vicinity of Center Street who tunes in morning, noon and night and never gets the station clear without squealing, will please call at my shop, 101 Main St., with his or her radio set. I will make the necessary adjustments and changes in the set free of charge, so that above party will enjoy his radio more, and others in this neighborhood may enjoy theirs also.

R. P. MERCHANT.

QUESTIONS AND ANSWERS

WHEN YOU WRITE THE GRID . . .

Don't fail to enclose a stamped, self-addressed envelope with your inquiry if you expect a personal reply.

Don't be impatient if you do not receive an immediate answer. Every letter is answered in the order of its receipt. Do not send a second letter asking about the first.

Look over your files of RADIO BROADCAST *before asking a question which might have been covered in a previous issue.*

Don't ask for a comparison between manufactured apparatus. The addresses of manufacturers of articles used in the construction of apparatus described in RADIO BROADCAST *will be given on request.*

Don't include questions on subscription orders or inquiries to other departments of Doubleday, Page & Co. Address a separate inquiry to The Grid.

Don't send us a fee for answering your questions. The Grid Department is maintained for the aid and convenience of readers of RADIO BROADCAST *and there is no charge for the service.*

QUERIES ANSWERED

WHAT IS THE TROUBLE WITH MY ROBERTS RECEIVER WHEN IT IS POSSIBLE TO RECEIVE WITH THE DETECTOR TUBE REMOVED FROM ITS SOCKET?
C. J. S.—Brooklyn, N. Y.

WILL YOU PRINT A SIX-TUBE CIRCUIT FOR USE WITH A LOOP?
G. H. —Chillicothe, Ohio.

I WOULD LIKE A RADIO-FREQUENCY, REFLEX, AUDIO-FREQUENCY, CRYSTAL DETECTOR CIRCUIT EMPLOYING THREE TUBES.
T. L. G.—Philadelphia, Penna.

MAY I HAVE A DIAGRAM FOR A ONE-CONTROL ONE-TUBE REFLEX CIRCUIT?
L. B.—Austin, Texas.

HOW ARE JACKS USED IN RADIO CIRCUITS?
J. P. N.—Savannah, Ga.

I WOULD LIKE A POWER AMPLIFIER CIRCUIT EMPLOYING PUSH-PULL TRANSFORMERS.
E. T. J.—Detroit, Mich.

HOW MAY I PREPARE A CALIBRATION CURVE FOR MY RECEIVER?
C. M. D.—Springfield, Mass.

EXPLAIN HOW I MAY MAKE A CHANGE-OVER SWITCH FOR TESTING RECEIVERS.
A. C. F.—Freeport, L. I. N. Y.

TESTING THE ROBERTS CIRCUIT

A GLANCE at any of the Roberts Knockout circuits will show us that they are composed of two very important units, namely the neutralized radio-frequency amplifier and the regenerative detector. The audio-frequency amplifier addition is either of the audio-transformer or the resistance-coupled type or a combination of both. Just now we are interested in the two-tube tuner. Not a few questions similar to C. J. S.'s have been received and we endeavor to clear up the situation with the following explanation.

It is quite evident that the radio-frequency amplifier, in this case, is functioning as a detector unit rectifying the incoming signal without the aid of the regenerative detector. In Fig. 1 is shown a circuit that will aid in putting the entire receiver

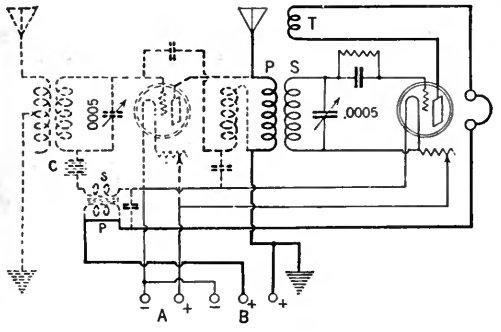


FIG. 1

into proper operating condition. Here, the radio-frequency amplifier with reflexed audio amplifier is eliminated from the main circuit so that the result is a straight three-circuit regenerative receiver. The primary of the audio-frequency transformer is shorted and a pair of phones inserted in series in the plate lead of the detector tube. The first tube is removed from the socket and the antenna and ground are connected to the plate terminal of the first socket and the B90 post, respectively. By bringing the tickler close to the secondary and rotating the variable condenser, a regenerative squeal should be heard in the phones and if the detector responds correctly, carrier waves of transmitting stations will be tuned-in. If this is not the case then the coils should be inspected for reversals of connections, or reversals of windings. The grid leak and condenser may be defective or the tube is not making proper contact with the socket blades. By means of a progressive trouble-elimination system it is possible finally to make the necessary corrections so that the first tube in the radio-frequency amplifier circuit may again be thrown in and the operation observed. Other trouble-shooting suggestions were contained in the January, 1925, GRID.

A SIX-TUBE LOOP SET

FOR those who want a multi-tube radio frequency amplifier-detector-audio-frequency amplifier circuit with preferably one tuning control, the circuit shown in Fig. 2 is suggested. A receiver employing such a circuit may be easily constructed as a portable set, having the batteries contained in the cabinet as a part of the receiver. A loop consisting of about 12 turns of No. 18 d.c.c. wire wound on a 2 ft. square frame, shunted by a .0005 mfd. condenser will effectively cover the broadcast range of wavelengths. The use of an antenna and coupler is inadvisable as the chances for radiation are too great. The radio-frequency transformers to be used in this circuit are of the untuned type having an average wavelength range of 200 to 550 meters. If it is desired, the tuned type of transformer with a variable condenser shunting each secondary may be employed, but the tuning becomes increasingly difficult for each stage used. The potentiometer allows the circuit to be adjusted to its most efficient point of operation and also controls to a large degree the tendency of the receiver to oscillate. As a further oscillation control it may be necessary to connect the return lead of the grid circuits of the second and third tubes to the potentiometer arm.

A THREE-TUBE R. F.-A. F. REFLEX RECEIVER

MR. T. L. G. asks for a circuit consisting of two stages of radio-frequency amplification, crystal detector, one stage of reflexed audio-frequency amplification through the second stage of radio and a stage of straight audio. This circuit appears in Fig. 3. One rheostat of ten ohms is sufficient for controlling all three tubes. The radio-frequency transformers used are standard neutroformers, the secondaries of which are shunted by .00037 mfd. condensers. The audio reflex transformer should be of a low ratio as should the stage of straight audio. A C-battery is inserted in the reflex stage and the last audio stage for stabilization purposes. Two jacks situated in the circuit as shown allow the use of two or three tubes. In this circuit it is absolutely essential that a good crystal be used for satisfactory results. UV-201-A's are used throughout.

A ONE-CONTROL, ONE-TUBE REFLEX RECEIVER

FIGURE 4 shows a revamped one-tube crystal reflex receiver having one control. The coupler T1 may be the standard variocoupler obtainable on the market or it may be of the type employed in the RADIO BROADCAST one-tube Knockout receiver

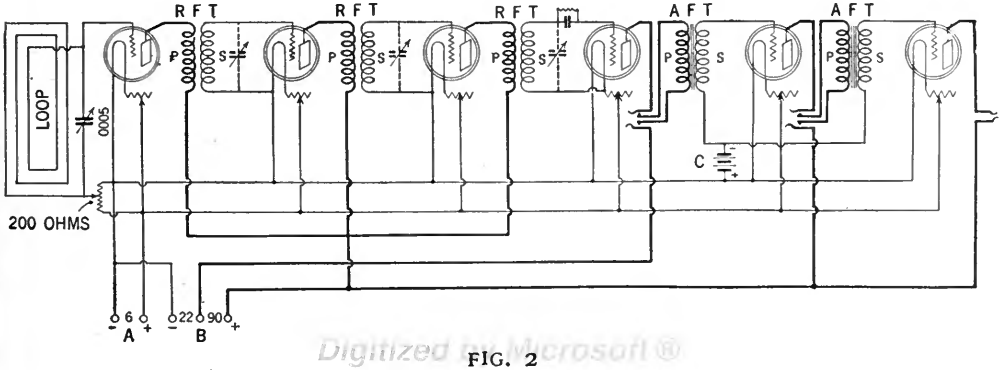


FIG. 2

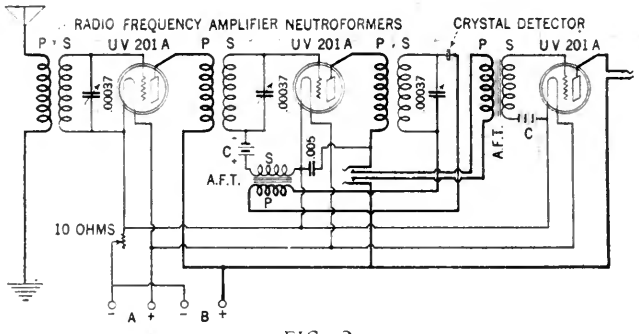


FIG. 3

as explained in the April, 1924, Radio Broadcast. The radio-frequency transformer T2 is of the untuned type and covers a wavelength range of 200 to 550 meters. Much of the instruction as outlined for the three-tube circuit of Fig. 3 may be followed in the construction of this receiver. Especial care should be exercised in the selection of a suitable audio-frequency transformer and crystal.

JACKS, AND HOW THEY ARE USED

THERE are as many types of closed circuit jacks as there are manufacturers of them. It should be remembered that jacks are used for the sole purpose of providing a mechanical cut-in on any part of a radio circuit. In the natural progress of things, jacks came to be used in more elaborate ways. One manufacturer produces 14 different kinds of jacks. Not all of them can be explained here but several of the more well-known type are illustrated in Fig. 5, A and B. In A, the several styles are outlined and their use is depicted in B. For the output jack in the stage of an amplifier or a plain detector circuit we have that as shown in 1. This is called the single open-circuit type. In 2 is shown a single-closed circuit type permitting the throwing in or out, automatically, of the primary of a transformer. Another method of performing the same operation is shown in 3. That shown in 4 is fundamentally the same as that shown in 1 except that a filament control is included which breaks the filament circuit when the plug is withdrawn from the jack.

In 5 we have practically the same as that shown in 2 with the addition of the filament control as explained. The method of controlling one or more filament circuits by means of jacks is shown in 6.

A PUSH-PULL POWER AMPLIFIER

IN THE construction of a push-pull amplifier, the selection of satisfactory parts plays an important role. In fact, the ultimate successful operation of the unit depends upon this consideration more than anything else. The input stage audio transformer should have a low ratio, say 2 to 1, so that the voice and music is not unnecessarily distorted before it reaches the push-pull transformers. The action and theory of operation have already been explained in past issues of Radio Broadcast and will not be repeated here. The suggested circuit is shown in Fig. 6. Any standard type of tubes may be used in a unit of this kind but of course UV-201-A's or better still, power tubes such as the 202 or the W. E. 216-A will be more suitable for this type of work. The value of C battery will vary in proportion to the amount of B battery used. A table of C battery voltages was included in The Grid for January, 1925. For the tubes suggested 120 to 150 volts B battery will be sufficient.

CALIBRATION CURVES

ALMOST any type of receiver may be charted and calibrated so that a graphical curve is produced that may be used for reference purposes. Instead of rumaging through numerous papers having dial settings numerically listed, it is much easier and more efficient to refer to the ship-shape wavelength curve that also helps you to locate new station positions on your tuning dial. Neutrodyne and tuned radio-frequency receivers, superhetrodynes, and crystal reflex receivers furnish the most accurate curves. In the regenerative type of receiver, several combinations of inductance and capacity will tune to the same station and the curve system of tuning is not so dependable or reliable. A specimen of a wavelength graph curve is shown in Fig. 8. The several points marked on the diagonal line indicate station positions. For instance 492 meters, WEAF, is located on the vertical border to the left; running across horizontally on the 492 line we note where it is intersected by the diagonal line. Then, coming down vertically, it is found that this position is equal to 81 on a 100 segment semi-circle of the dial. This base line is comparative to and indicates the markings on the dial. To prepare a wavelength curve it is well to have commercial graph paper that is obtainable in most stationery shops. The dial markings are laid off at regular, equal intervals along the base line and the wavelength range, usually from 200 to 600 meters is laid off in a

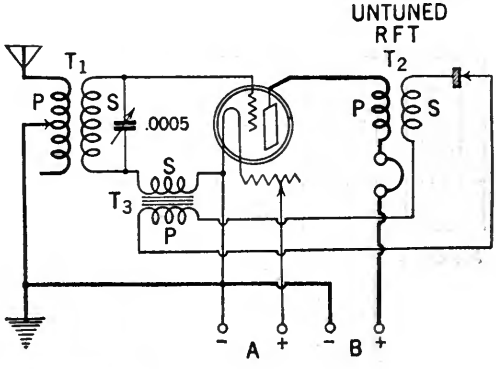


FIG. 4

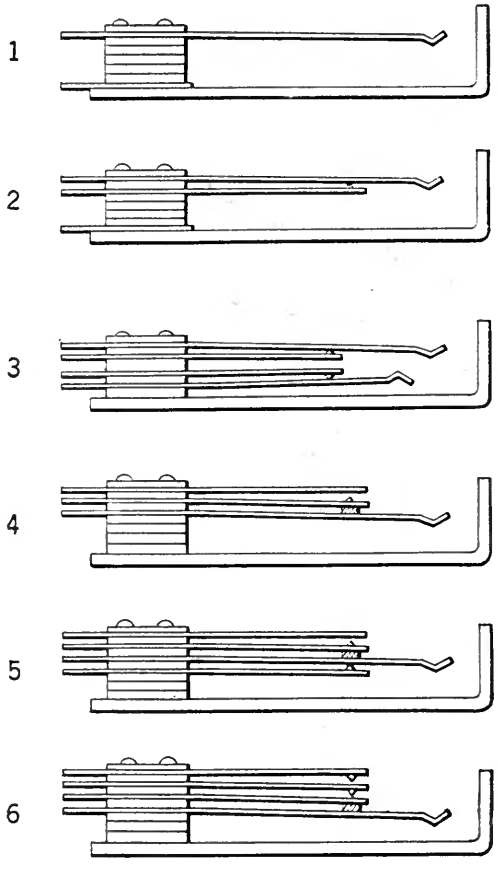


FIG. 5A

like manner on the vertical left border line or vice versa. Beginning at the lower wavelengths, the dial position for the stations tuned-in on the receiver are located by cross-reference continuing until the maximum setting has been obtained. A line is then drawn from point to point resulting in a continuous curve. Not all curves will be very straight as the settings at the lower wavelengths are crowded closer together than at the higher settings. The curve shown in Fig. 8 is an exaggerated example to serve as an illustration. A more correct form is shown in Fig. 7.

BATTERY SWITCHES FOR TESTING SETS

IN MAKING comparison tests between radio sets, it is advantageous to have a double throw switch by which either of two sets may be quickly connected to the antenna and ground and to the batteries. The arrangement of a switch to do this is complicated by the fact that various manufacturers use different methods of connection between the A, B, and C batteries.

Considering only two plate voltages and one bias voltage, a nine-pole double throw switch would seem to be required in order to prevent short circuit of the

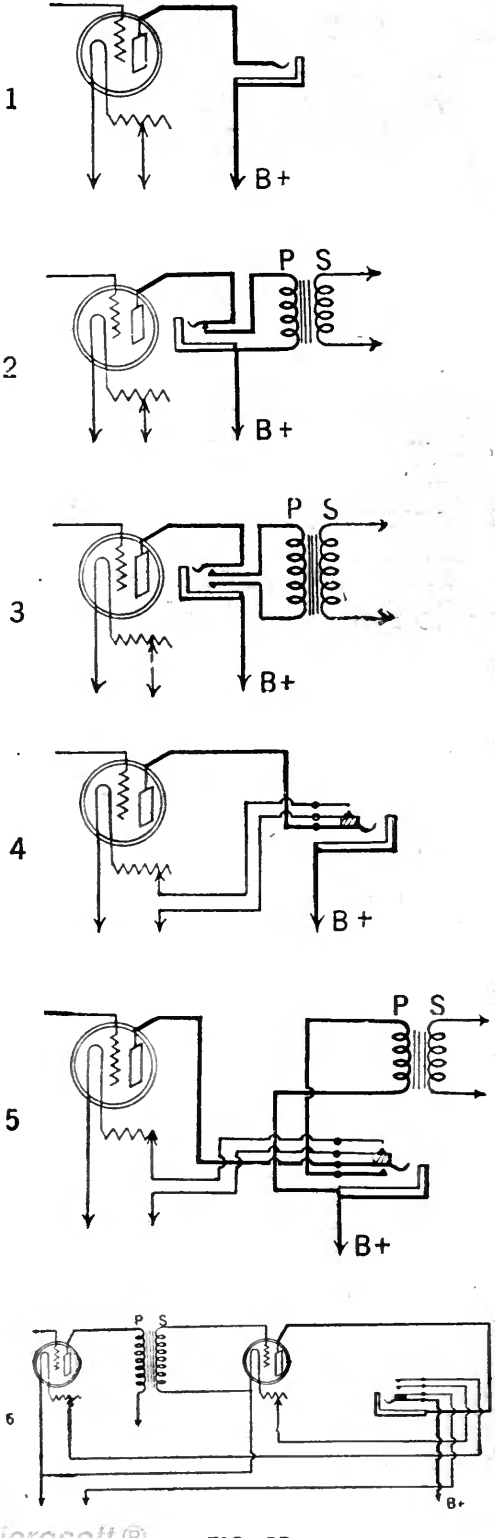
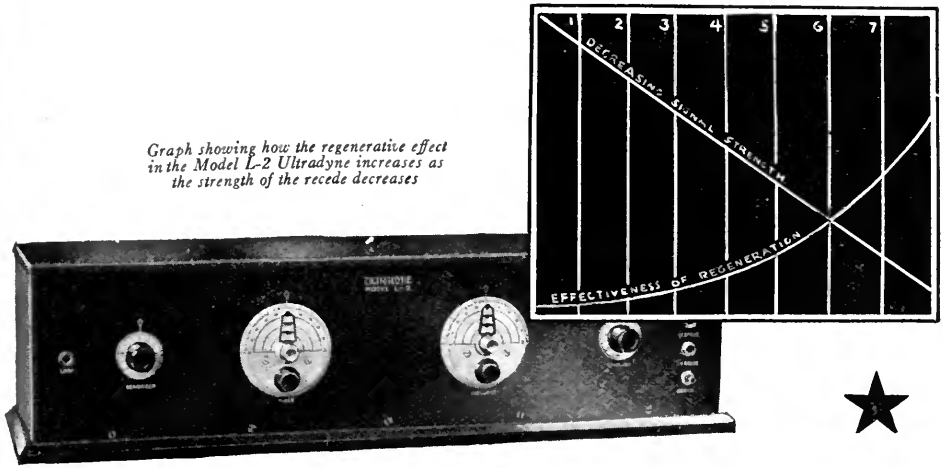


FIG. 5B



Graph showing how the regenerative effect in the Model L-2 Ultradyne increases as the strength of the recede decreases

Why the ULTRADYNE Gets Distance on the Loud Speaker!

UNLIKE other Super-radio receivers, the Ultradyne, with its exclusive use of the "Modulation System" and special application of regeneration, is capable of detecting and regenerating the faintest signal, making it audible on the loud speaker.

The regenerative effect in the Ultradyne increases as the strength of the signal decreases, until the signal becomes so weak that no amount of amplification will make it audible.

A radical advance in radio engineering and the latest development of R. E. Lacault, E.E., A.M.I.R.E., Chief Engineer of this Company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

You will marvel at the unusual selectivity, sensitivity and range of this new Model L-2 Ultradyne.

The ULTRADYNE Kit

consists of 1 Low Loss Tuning Coil, 1 special Low Loss Coupler, 1 type "A" Ultraformer, 3 type "B" Ultraformers, 4 matched fixed Condensers.

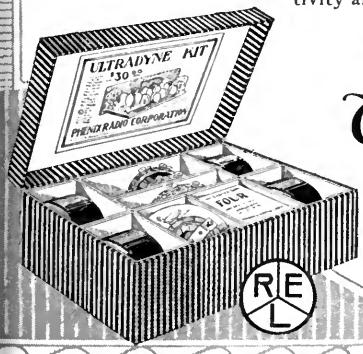
To protect the public, Mr. Lacault's personal monogram seal (R.E.L.) is placed on all genuine Ultraformers.

$30.00

How to Build and Operate the ULTRADYNE

32-page illustrated book giving the latest authentic information on drilling, wiring, assembling, and tuning the Model L-2 Ultradyne Receiver.

50c



Write for descriptive circular

ULTRADYNE
MODEL L-2

Phenix Radio Corporation
5-7 Beekman Street
New York City

★ Tested and approved by RADIO BROADCAST ★

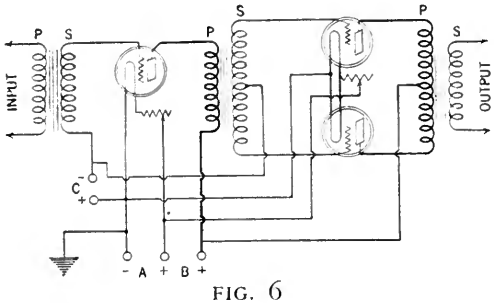


FIG. 6

batteries due to differences in inter-connection in the sets. These nine points would be:

Antenna 90 45 -B +A -A +C -C Ground

An investigation shows that a six-pole switch can be made to do the work, because the 90 volt, the 45 volt, and the -C are all insulated in any receiver. These three points can therefore be omitted from the switch and terminals can be provided for them to which all the sets may be permanently connected as indicated on the instruction card. The switch will then carry:

Antenna -B +A -A +C Ground

This arrangement has the further decided advantage that terminals can be provided for various B and C battery voltages and the sets under test can be connected directly to these terminals. For example, terminals can be provided for 22, 45, 90 and 135 volts B battery and for $4\frac{1}{2}$ and 9 volts C battery. Inasmuch as opening the switch disconnects the -B and the +C, and disconnects the A battery entirely, from all sets, there is no possibility of a short circuit, due to differences in inter-connections.

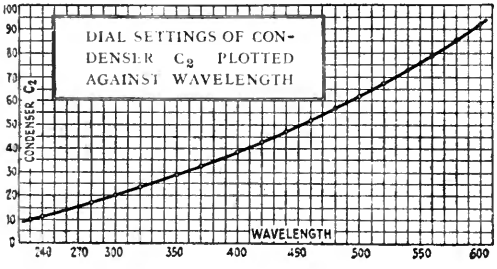


FIG. 7

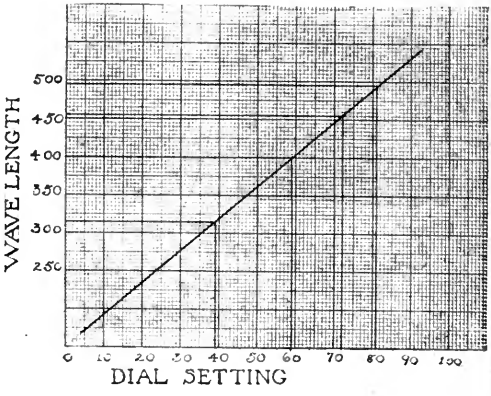


FIG. 8

EXCLUSIVELY IN RADIO BROADCAST

MUCH interest has recently been aroused by the announcement that photographs have been successfully transmitted across the Atlantic, and from point to point in this country by radio. As everyone realizes, the successful transmission of photographs means that one could send practically as well complete printed pages. Signatures to valuable documents could be exchanged, as could photographs of the documents, at great distances. The other possible applications of this new branch of radio are pretty well known. RADIO BROADCAST *has arranged to print a series of articles describing a method of radio transmission which has never yet been published. Experiments have been in progress for more than two years, along lines totally different from those of the Jenkins system and the Ranger system, of the Radio Corporation. These articles will contain some very startling revelations from the point of view of radio photograph transmission. There is no announcement we have made in many months which should so interest the reader who prides himself on following the latest developments in the field.*

Dry "B" Batteries are an economical, dependable and convenient source of plate current!

No. 770. 45-volt extra large vertical. For heavy duty only. The ideal "B" Battery for use on multi-tube sets. Price $4.75.

★

Scientists constantly improve battery quality

EVEREADY "B" Batteries today contain more electricity, more service, more satisfaction than ever before.

Processes evolved by the scientists of the Union Carbide and Carbon Research Laboratories, Inc., when put in effect in the Eveready factories, are responsible for this great accomplishment.

At the same time the factories have effected a still higher standard of workmanship. A system of inspection that is a marvel of efficiency was inaugurated. The results, gratifying beyond measure, were accomplished with a speed and completeness that have few parallels in industry. The final tests showed more electricity, more battery service, greater Eveready satisfaction without increasing battery sizes *and with a substantial reduction in price.* "B" Battery operating costs, using the new Eveready, in most cases show a reduction of at least one-half.

There is an Eveready Radio Battery for every radio use.

Insist on Eveready "B" Batteries.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY HOUR
EVERY TUESDAY at 9 P. M.
(Eastern Standard Time)
For real radio enjoyment, tune in the "Eveready Group." Broadcast through

WEAF	New York	WJAR	Providence
WEEI	Boston	WFI	Phila.
WGR	Buffalo	WCAE	Pittsburgh

EVEREADY
Radio Batteries
–they last longer

★ Tested and approved by RADIO BROADCAST ★

New Equipment

DE FOREST LOUD SPEAKER

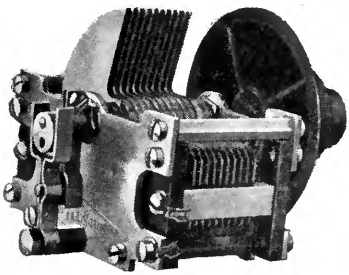
A reproducer of good design and quality which compares very favorably with other speakers of the same price range. It delivers good volume on both speech and music, still maintaining good tone quality. Made by the De Forest Radio Company, Jersey City, New Jersey. Price $25

ANTENNAPHONE

A very neat indoor aerial. It is only necessary to place your house telephone upon the antennaphone plate and connect the lead to the antenna binding post of your receiver. Made by The Antennaphone Co., 90 West Street, New York City. Price $1.00

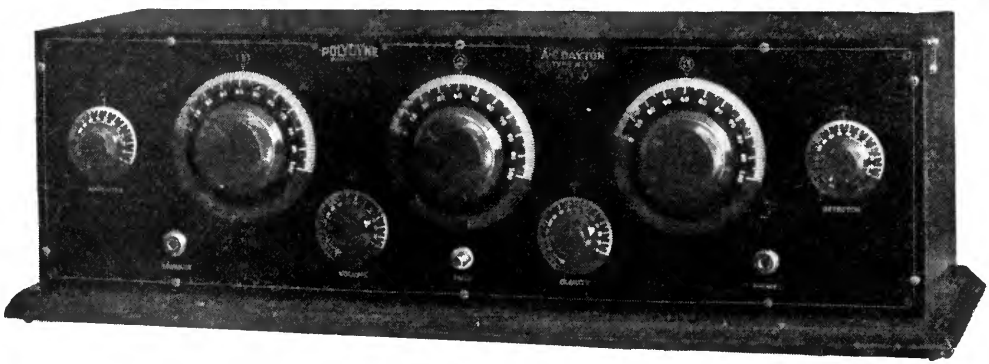
NATIONAL BATTERY

This is a 24-volt unit wet B battery of good construction. The connectors between the several cells protrude above the sealing so that it is possible to tap off at any desired voltage. Made by the National Lead Battery Company, 1704 Roblyn Ave., St. Paul, Minn.



U. S. L. CONDENSER

A well made instrument which has a good capacity range. The vernier action, which shows at the back of the condenser, is controlled by the small knob acting through the center of the main dial. Made by The United Scientific Laboratories, Inc., 92 East 10th Street, New York City



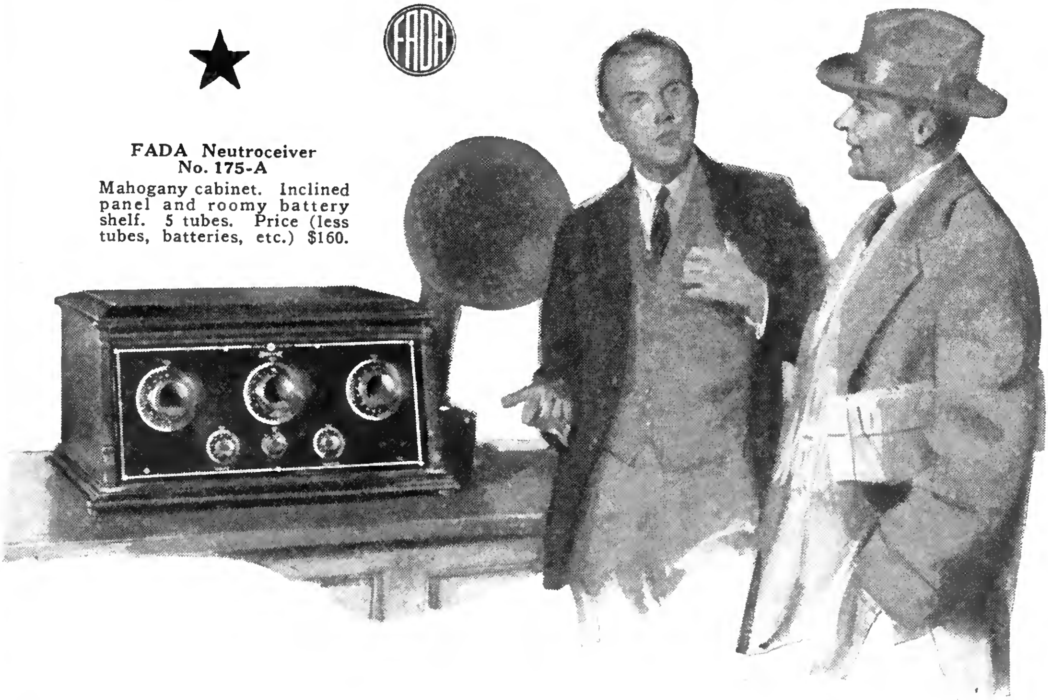
THE A-C DAYTON XL-5

A five-tube set using tuned radio-frequency, detector and audio-frequency amplification. The radio-frequency transformers are of special design. Very satisfactory performance is possible with this receiver. Made by The A-C Electrical Mfg. Co., Dayton, Ohio. Price $115

PERFECTO SOLDERING FLUID—A convenient and satisfactory, non-acid soldering flux that insures positive soldered joints. John Firth & Co., 25 Beaver St., New York City

FADA Radio

★



FADA Neutroceiver
No. 175-A
Mahogany cabinet. Inclined panel and roomy battery shelf. 5 tubes. Price (less tubes, batteries, etc.) $160.

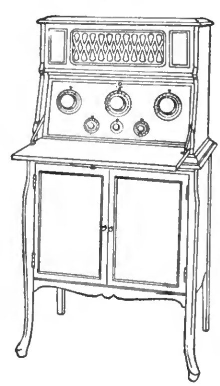
Indecision vanishes when you hear the FADA

RADIO shopping ends triumphantly when you find the FADA. People who know radio and have conducted comparative tests say that the Neutroceiver is the best they have ever tried. Have the FADA Neutroceiver demonstrated in your home. Listen to its marvelously faithful reproduction. Tune in a distant station yourself loud and clear and see how easy it is. Observe the beautiful cabinet design. You will exclaim: "At last! This is just the radio set I want!"

If you prefer a set with self-contained loud speaker, the FADA Neutrola Grand meets your desire in this respect, as in all others. Whether FADA Neutrodyne receivers are the first or the fifteenth make you investigate, they will be your final choice. Through the FADA Neutrodyne your radio wishes become realities. See your dealer.

LICENSED BY INDEPENDENT RADIO MANUFACTURERS, INC.
NEUTRODYNE
REG US PAT OFF
PAT. MARCH 27 1923 AND APRIL 1, 1924
HAZELTINE PATS NOS 1450080 AND 1489228
OTHER PATENTS PENDING
F.A.D. ANDREA INC. 1581 JEROME AVE. N.Y.C.

E. A. D. ANDREA, INC., 1581 JEROME AVENUE, NEW YORK



FADA Neutrola Grand
No. 185/90-A
The five-tube Neutrola 185-A, mounted on FADA Cabinet Table No. 190-A. Price (less tubes, batteries, etc.) $270.

Among Our Authors

THE cover of this month's RADIO BROADCAST was done by Remington Schuyler, who is a well-known painter of outdoor scenes. Mr. Schuyler is regarded especially highly for his authentic canvasses of Indians. The February cover, with the R–B Lab as its subject, was "done from life." The masts and radio cabin are faithfully portrayed, but the bulk of the Doubleday, Page & Company buildings, some five hundred yards away, have been omitted from the painting.

MYRA MAY writes: "For the last ten years I have been trying to understand just what makes an automobile run. Just as I was reaching a point where I understood the difference between a clutch and a snubber, along comes radio, with its confusion of grids, antennae, and heterodynes. Up to date, I have learned that if you use your fingers for a plug, you move your hand away quickly. That lesson so well learned, I haven't the heart to go further into the subject."

WILLIAM P. GREEN, whose second article on "The Way of the Transgressor" appears this month, has done some very effective work in keeping the advertising and sale of radio goods in the path of the righteous. His headquarters are in New York.

JULIAN KAY, an old-time radio worker, has just finished his requirements for a doctor's degree in physics at Harvard University. We expect soon to print more of his eminently readable and interesting radio articles.

DUDLEY SIDDALL

DUDLEY SIDDALL admits that he was born in Kalamazoo, Michigan. It is an interesting fact that few non-Michigan residents can pronounce that name with the loving drawl peculiar to the native. Mr. Siddell discovered New York in 1919 and found that Wall Street celebrates more business holidays than any other place in the United States. His greatest achievement, he says, was to spend fifteen years in newspaper work without once being a copy-reader. He is now in the advertising business and enjoys breaking the news to newspaper men that "I used to be a newspaper man myself."

D. S. KNOWLTON

WHEN the Union Trust Company, in Cleveland, decided to establish a broadcasting station, Don S. Knowlton from the bank's advertising department was drafted to arrange the musical programs and was later put in charge of the station.

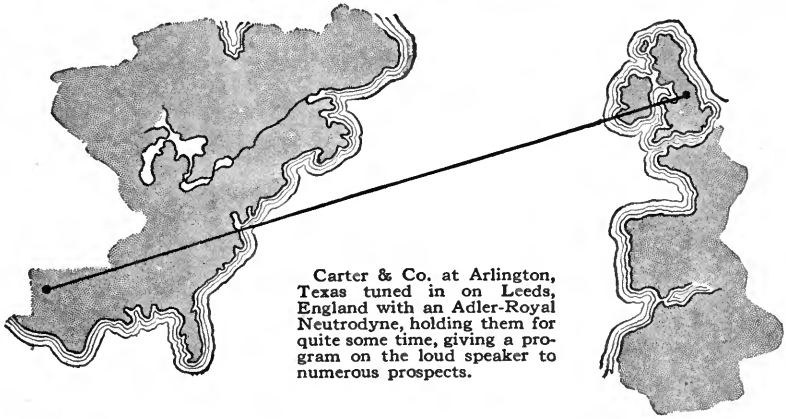
ZEH BOUCK had the even tenor of his way greatly broken up the other day when he observed in the *Radio Service Bulletin* of the Department of Commerce, that Senatore Marconi had been granted an English patent on "bean transmission." Mr. Bouck is wondering just why the noted Italian has forsaken applied physics for applied cookery.

JOHN C. DAVIDSON is a commercial radio engineer whose experience in the field dates back to very early days. Since broadcasting came into popularity, he has been devoting his talents to the design of radio parts, some of which, especially a fixed crystal detector, are widely used.

ALLAN T. HANSCOM is a resident of Woonsocket, Rhode Island, and a graduate of the engineering school of the University of Pennsylvania. His article in the November RADIO BROADCAST on a second-harmonic super-heterodyne has attracted wide attention among that great group of radio enthusiasts who are intensely interested in anything to do with that highly efficient receiver.

CAPTAIN P. P. ECKERSLEY is the man responsible to the British radio public for their radio programs, being chief engineer of the British Broadcasting Company. Much of the material in his article was presented to the recent Radio Conference in Washington, called by Secretary of Commerce Herbert Hoover.

Two Big Radio Thrills



Carter & Co. at Arlington, Texas tuned in on Leeds, England with an Adler-Royal Neutrodyne, holding them for quite some time, giving a program on the loud speaker to numerous prospects.

YOUR first thrill with an Adler-Royal neutrodyne will be the magic spell of D.X. as station after station comes in clear as a bell with the slightest change in dial settings. No matter how much you know about radio, the performance of Adler-Royal will be a remarkable radio experience for you. The selectivity you had hoped for has really been accomplished.

Then, as your own log grows, you will be more discriminating about the quality of what you hear. You will begin to appreciate what Adler-Royal really is and this will be your biggest thrill. Your daily paper will be your program. You will learn to depend on Adler-Royal absolutely.

The Neutrodyne principle is so far perfected in Adler-Royal that even in the hands of a novice its selectivity and pure tone qualities are almost automatic. Its operation is as simple as setting a clock. There are no squeaks, squeals or howls to ruin radio enjoyment. Adler-Royal has conquered the mysteries of the air.

Seek a Service Dealer

THE dealer from whom you buy a radio set is quite as important as the set you buy. On his service to you, much of your enjoyment of a radio set will depend. It will pay you to turn the corner into Main Street to find the Adler-Royal dealer. He is appointed by us on his pledge to give purchasers the best of every service. On Adler-Royal, you get the guarantee of a high-class dealer to back up ours.

ADLER MANUFACTURING COMPANY, Inc.
General Sales Office: Dept. C3, 881 Broadway, New York City
Factories: Louisville, Ky.

ADLER-ROYAL

Phonograph and Radio

ADLER-ROYAL NEUTRODYNE
Model 199 Table Type used with dry cells. Batteries concealed in cabinet. 5 tubes (199), Cabinets walnut or mahogany. Price $165.

Licensed by Independent Radio Manufacturers, Inc. NEUTRODYNE Pat. March 27 1917 and April 1, 1919 Patents Nos. 1,450,080 and 1,455,218 Other Patents Pending. Pat'd U.S.A. 1917

Send this coupon to-day for your free copy of Adler-Royal Book and Log

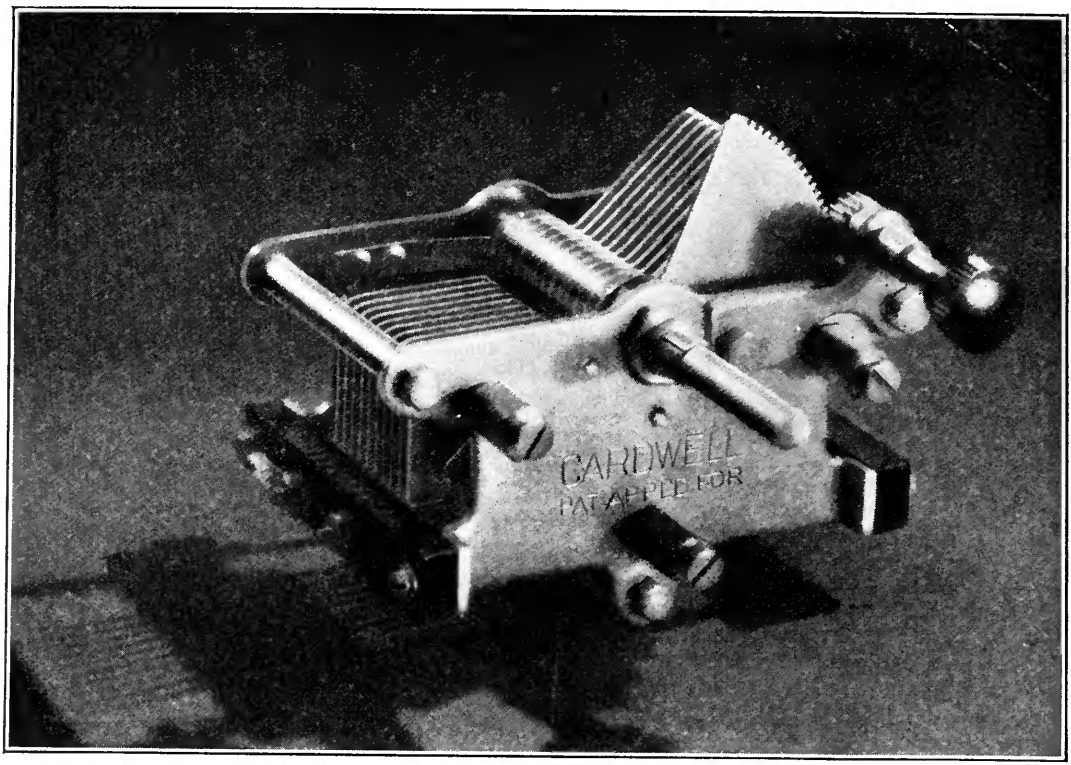
ADLER MANUFACTURING COMPANY
Dept. C3, 881 Broadway, New York City

Please send me my copy of the Adler-Royal Book and Log.

Name.....

Address.....

★ Tested and approved by RADIO BROADCAST ★



"No fancy gewgaws to attract the eye and cause trouble in the end"

SO writes Mr. Henry M. Neely, Editor of RADIO-IN-THE-HOME. Mr. Neely adds:

"The present-day low-loss condenser approaches more nearly to a perfect instrument, the more nearly it approaches the design and workmanship of the Cardwell."

Simplicity is a distinctive characteristic of the Cardwell. There is no excessive bulk or weight—no intricate parts or complicated assembly.

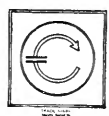
Other points of merit have been praised by many different experts. In fact, Cardwell condensers have received the universal approval of radio editors and engineers everywhere.

Cardwell condensers are rugged, free from play, noiseless and remarkably smooth in action. And there is nothing to work loose or get out of adjustment.

Cardwell invented the first "low-loss" condensers—a name originally applied only to Cardwells to distinguish them from ordinary varieties. Cardwell now makes seventy-six different types—a condenser for every requirement. Ask your dealer to show you his assortment.

A postcard brings you an education on condensers. Write today for the new Cardwell Condenser booklet.

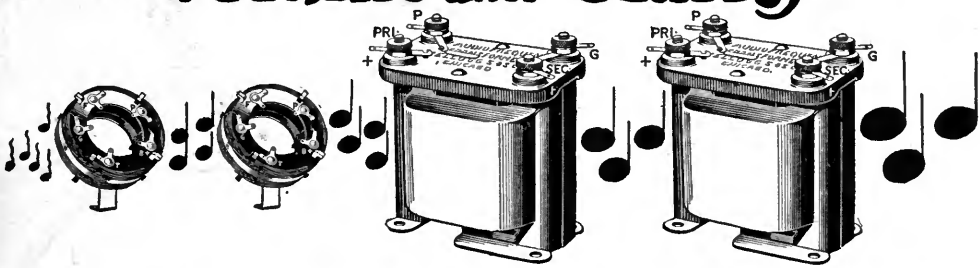
The Allen D. Cardwell Manufacturing Corporation
81 Prospect Street, Brooklyn, N. Y. ★

CARDWELL *(RADIO UNITS*  **UNITRADS** *OF MERIT)*

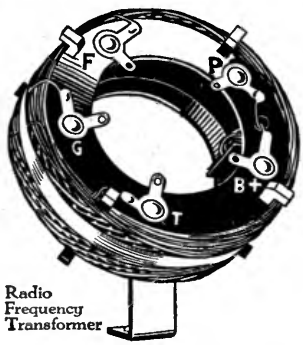
CONDENSERS — INDUCTANCES — TRANSFORMERS

★ Tested and approved by RADIO BROADCAST ★

Volume *and* Clarity



with Kellogg Transformers



Radio Frequency Transformer

A Radio Frequency Transformer of the aperiodic type suitable for all sets with which tuned radio frequency is desired. Also used for one stage of radio frequency amplification ahead of regenerative sets to prevent re-radiation.

Consider these points of superiority:

No dope to hold windings in place.
Soldered connections.
Mounting bracket holds coil at correct angle.
Minimum rubber used in form.
Lowest possible loss, with greatest transfer of energy.
Works with any .0005 condenser.
Secondary arranged with suitable taps for biasing features.

This transformer makes the construction of a radio frequency set an easy matter, assuring best possible reception with widely varying types of circuits, including reflex.

Built and guaranteed by Kellogg Switchboard and Supply Co.

No. 602 Radio Frequency Transformer
at your dealers for $2.35 each.

Kellogg Audio Frequency Transformers are the "stepping stones" of modern amplification.

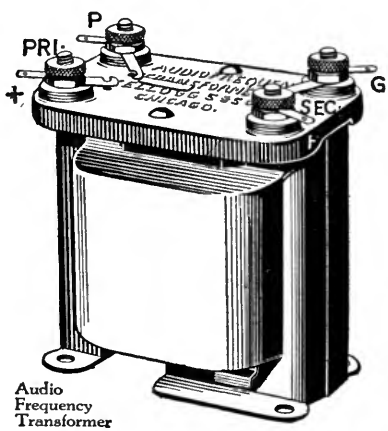
Clear, accurate reproduction assured over the entire range of the musical scale.

Plainly marked, accessible terminals.

It is acclaimed by test to be the best.

No. 501 Audio Frequency Transformer
Ratio 4½ to 1—
No. 502 Audio Frequency Transformer
Ratio 3 to 1—
$4.50 each

★

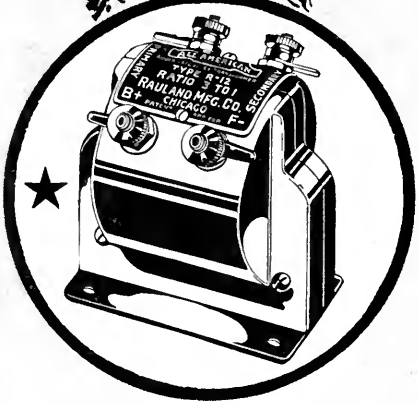


Audio Frequency Transformer

KELLOGG SWITCHBOARD & SUPPLY CO.

1066 WEST ADAMS STREET, CHICAGO

★ Tested and approved by RADIO BROADCAST ★



What *Reliable Radio* Means to You

An assurance that, when you try out a hook-up, you can rely on your instruments to give you a *fair test.* ¶ A knowledge that each part has been put to such searching tests that its proper performance, *under any conditions*, is assured. ¶ In short, a conviction that each individual part *will continue* to do its work *year after year.*

The RADIO KEY BOOK will acquaint you with the essential facts of modern reception. Ten cents—coin or stamps—brings the KEY BOOK

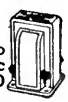
RAULAND MFG. CO.
Pioneers in the Industry
2652 Coyne St. Chicago

ALL-AMERICAN Guaranteed Radio Products

Standard Audio Transformers
3 to 1 Ratio, type R-12...$4.50
5 to 1 Ratio, type R-21... 4.75
10 to 1 Ratio, type R-13... 4.75

Power Amplifying Transformers (Push-Pull)
Input type R-30.....$6.00
Output type R-31..... 6.00

Rauland-Lyric
A laboratory grade audio transformer for music lovers. R-500.....$9.00



Universal Coupler
Antenna coupler or tuned r. f. transformer. R-140.....$4.00

Self-Tuned R. F. Transformer
Wound to suit the tube. R-199 $5.00. R-201A $5.00

Long Wave Transformer (Intermediate Frequency)
(15-75 kc.) R-110.....$6.00

10,000 Meter (30 kc.) Transformer
Tuned type (filter or input). R-120..$6.00

Radio Frequency Coupler (Oscillator Coupler). R-130 $5.00

Super-Fine Parts
Consisting of three R-110's, one R-120 and one R-130.... $26.00

All-American Reflex Receivers
(Mounted but not wired)
All-Amax Junior (1-tube) $22.00
All-Amax Senior (three-tube) $42.00

ALL-AMERICAN

Largest Selling Transformers in the World

★ Tested and approved by RADIO BROADCAST ★

Newport Owners Know What Tonal Quality is!

The Tonal Quality of the Newport brings to them the ineffable thrill of good music.

They have experienced those delightful little runs, fine gradations, and double stop work in Kreisler's "Caprice Viennois" which are so clear, well defined, and ungarbled in the Newport. The thunder of the organ as it runs the gamut of its mighty diapason is not new to them. They parade across the theatres of their minds every evening all the brilliance and charm of the virtuosi. They catch with ease those slight inflections of the voice that often mean so much when famous men speak. They make their Newports perform the acid test of Tonal Quality. They dial into the militant swing of Sousa's "El Capitan" or the "Stars and Stripes Forever." That they can distinguish the high trebles, the deep bass, the various instruments that go to make the action-stirring whole of this famous orchestration, is not novel to them.

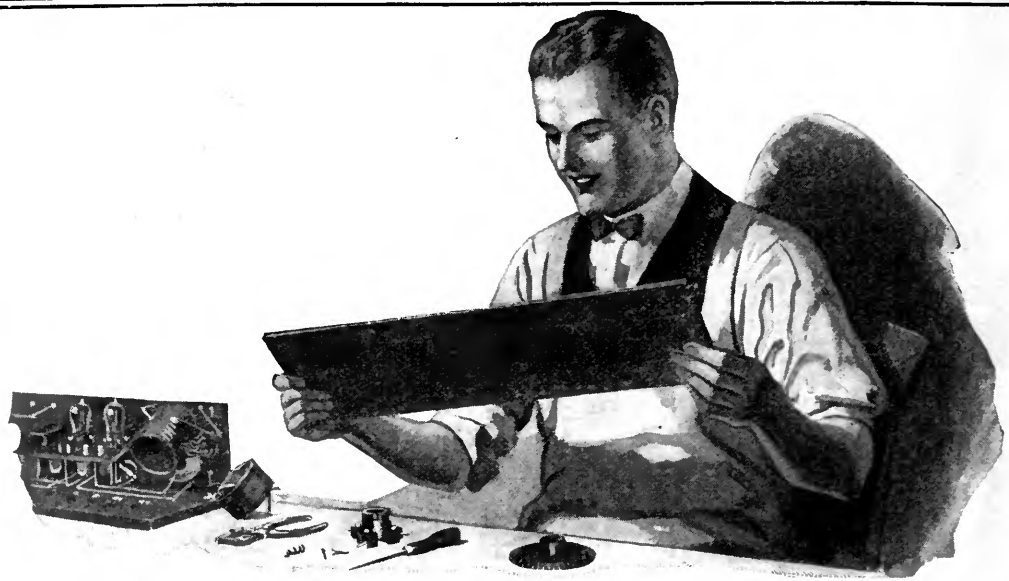
They know what Tonal Quality is!

The Newport is a Good Receiver
Built in a Piece of Fine Furniture

★ Newport Radio Corp.

250 West 54th Street,
New York City

★ Tested and approved by RADIO BROADCAST ★



Notice the rich finish on this panel —*built to order for radio*

A SURFACE that is good-looking and useful, too. That was one of the demands we made of the engineers who developed Radion especially *to order* for Radio purposes.

The high-polished, satin-like finish of Radion Panels does more than add to the beauty of your set. It keeps out dirt and moisture, thus preventing the possibility of causing short circuits from this source and reducing good reception.

Radion Panels resist warping. It's the easiest material to cut, saw or drill. It comes in eight stock sizes and two kinds, Black and Mahoganite.

Better performance will make it worth your while to ask for Radion by name and to look for the stamp on the panel and the name on the envelope. Radio dealers have the exact size you want for your set.

Lowest losses and greater efficiency

But the worth of Radion is not just on the surface. Authoritative laboratory tests give it the highest rating as radio-frequency insulation. It reduces surface leakage and leakage noises. This means lowest losses and greater efficiency, especially noticeable in super-sensitive circuits.

Other Radion Products

The same qualities of low-loss insulation and attractive appearance characterize Radion dials (to match panel), binding post panels, insulators, knobs, etc.—also the new Radion Built-in horn.

Send for booklet "Building Your Own Set"

Our new booklet, "Building Your Own Set," giving wiring diagrams, front and rear views, showing a new set with slanting panel, sets with the new Radion built-in horn, lists of parts and directions for building the most popular circuits —mailed for ten cents. Mail coupon to-day.

AMERICAN HARD RUBBER COMPANY, Dept. C-3, 11 Mercer St., New York City
Chicago Office: Conway Building
Pacific Coast Agent: Goodyear Rubber Co., San Francisco—Portland

RADION ★

The Supreme Insulation

PANELS

Dials, Sockets, Binding Post Panels, etc.

AMERICAN HARD RUBBER COMPANY
Dept. C-3, 11 Mercer St., New York City

Please send me your new booklet, "Building Your Own Set" for which I enclose 10 cents (stamps or coin.)

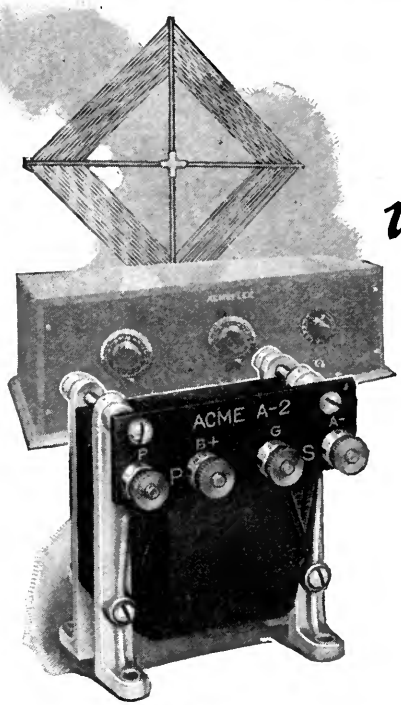
Name.....

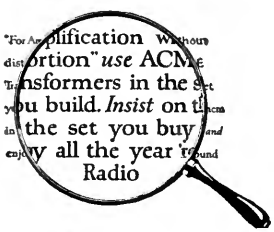
Address.....

City.....*State*.....

★ Tested and approved by RADIO BROADCAST ★

Be sure — that your transformers are giving you Amplification *without* Distortion





The Amplifying Transformer is the Magnifying Glass of Radio

★

Acme Transformers give maximum volume of sound, clearly and distinctly

WHEN you put a lot of time and money into a radio set you want to be sure that it will give the best results. You want to know that your set will bring in the stations so that you can enjoy listening and be proud to call in your friends. You want Amplification, but above all you want Amplification without Distortion. Be sure to use amplifying transformers that increase the sound without spoiling the quality.

The Acme A-2 Audio Amplifying Transformer is the result of 5 years of research and experimenting. It gives amplification without distortion to any set. Whether you have a neutrodyne, superheterodyne, regenerative or reflex the addition of the Acme A-2 will make it better.

If you are not getting loud clear radio try Acme Transformers and note the difference.

Each transformer is tested and carries a guarantee tag. If you want Amplification without Distortion use Acme Transformers in the set you build and insist on them in the set you buy. (That's one of the big reasons why the Acmeflex Kitset gives such good results—it uses Acme Transformers.) Send for our 40-page booklet which explains how to get the best results by proper amplification and also contains a number of valuable wiring diagrams. It will help you build a set. Mail the coupon with 10 cents.

ACME APPARATUS COMPANY
Transformer and Radio Engineers and Manufacturers
Dept. F2 Cambridge, Mass.

Have the fun of making your own radio set

ACME
~ for amplification

ACME APPARATUS COMPANY,
Dept. F2, Cambridge, Mass.
Gentlemen:
I am enclosing 10 cents (U. S. stamps or coin) for a copy of your book, "Amplification without Distortion."

Name .....

Street .....

City ..... *State* .....

★ Tested and approved by RADIO BROADCAST ★

Mu-rad Triplex $75

3 Tube-Dry Cell Receiver

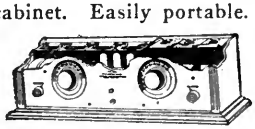
4-TUBE EFFICIENCY
Although only 3 tubes are used, all the efficiency of 4 tubes is attained by reflexing one tube. The circuit is one stage of radio frequency, two stages of audio frequency, and detector.

DISTANCE and SELECTIVITY
Real distance right through the strongest local interference with very simple tuning.

CAN BE LOGGED
Only two dials, the readings of which are always the same for each station, so that tuning is practically automatic.

NON RADIATING
Your set cannot interfere with your neighbors'.

CONVENIENT
All power from dry cell batteries, contained in the handsome mahogany cabinet. Easily portable.



NEW—not just in price, because there are plenty of low priced radio sets—but NEW in the value represented by the radio treasures it unfolds, and the sterling character of instruments and workmanship. A MU-RAD Receiver in every detail that has made the name MU-RAD trusted and respected everywhere.

Write for Literature

★

MU-RAD LABORATORIES, INC.
803 FIFTH AVE ASBURY PARK, NEW JERSEY

★ Tested and approved by RADIO BROADCAST ★

ERLA

Supereflex Means MORE POWER PER TUBE

Erla Supereflex makes tubes do triple duty. One tube actually does the work of three that would be needed otherwise. Three tubes do the work of five, unquestionably! That is why simple, compact, inexpensive Erla Supereflex receivers equal or surpass the performance of costliest, temperamental multi-stage radio sets.

More power, tube for tube, is basic in Erla Supereflex. Nothing else can "make up for it." Greater power in Erla Supereflex just simply means finer radio, which you can afford.

For you yourself can confidently build these matchless Erla circuits with Erla Supereflex *CIR-KIT*.

CIR-KIT is a complete array of Erla Scientific Precision Apparatus, especially created to make Supereflex possible. *CIR-KIT* provides clear, simple instructions for perfect assembly. Blueprints are full size. The panel is pre-drilled for you. The baseboard is marked to locate every unit accurately. The famous Erla Solderless Connectors do away with soldering entirely.

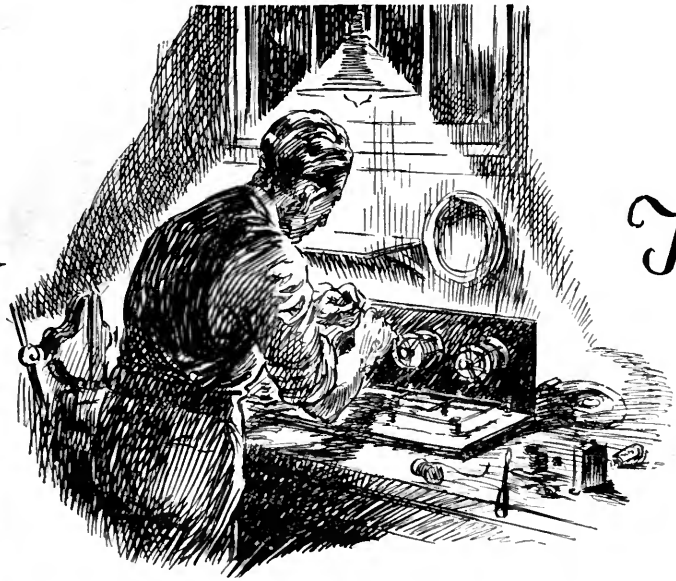
With screwdriver, pliers and *CIR-KIT* you are sure of a set that will make you proud, both for appearance and performance. The cost is very moderate. Yet the range, volume, selectivity AND TONE PURITY are rarely equaled at any price, because Supereflex does give you more power, tube for tube.

★

Electrical Research Laboratories
Department B 2500 Cottage Grove Avenue, Chicago

CIR-KIT

★ Tested and approved by RADIO BROADCAST ★



The Heart of the Radio

FAINT, trembling impulses are caught from the air and amplified thousands upon thousands of times. Finally transformed into audible sounds by your loud speaker, they are either painfully distorted or lifelike in purity of tone. Which it will be, depends largely upon your transformer.

For the transformer is of the utmost importance in your radio set. Each minute sound vibration coming from the detector is magnified and reissued with a stronger pulse—lending volume and clarity to your radio reception.

Jefferson Super Sensitive Transformers are designed to receive over the entire musical range without howling or distortion. Radio authorities the world over recognize the excellent performance of these wonderful transformers and specify their use in new circuits.

We shall be glad to send new circuits with complete working diagrams. Grimes 3XP Inverse Duplex, Jefferson Baby Grand 6 Tube Superheterodyne, Jefferson 8 tube Superheterodyne, and many others. Any of these will be sent upon receipt of five cents in stamps to cover postage.

★

Handled by the better dealers and jobbers. A superior transformer at a price attractively low.

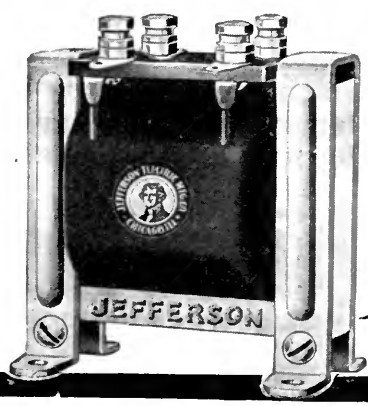
Jefferson Electric Manufacturing Co.

501 South Green Street CHICAGO, ILLINOIS

Manufacturers of

Radio Transformers
Bell Ringing Transformers
Sign Lighting Transformers
Automobile Ignition Coils
Jump Spark—Make and Break Coils
Auto Transformers
Testing Instruments
Toy Transformers
Furnace and Oil Burner Transformers
Oil Burner Ignition Coils

Special high and low voltage transformers



Jefferson Transformers

★ Tested and approved by RADIO BROADCAST ★

Here it is!

Hommel Broadcasting: listen!

"Business static hurts your cash register as much as weather static hurts reception."

Now, listen in carefully.

The HOMMEL Dealer Service Department was developed for the one particular purpose to help alleviate business "static." That Department is vitally concerned in furthering your interests—as a Hommel Dealer.

We work shoulder to shoulder with our dealers—not in competition with them. We wholesale only and carry only the most reputable radio equipment. All user inquiries and orders resulting from our national advertising are forwarded *promptly* to our local dealer.

In our new six-story building we carry larger stock, and have better facilities for serving you than ever before.

DISTRIBUTORS FOR
Radio Corporation of America
RCA
Westinghouse General Electric
Baldwin Brandes Burgess
Cardwell Crosley
Cutler-Hammer
Dubilier Fada Freed-Eisemann
Freshman Frost
General Radio Grebe
Haynes-Griffin Magnavox
Remler Rhamstine
U. S. Tool Western Electric
And other
leading manufacturers

We can't help you unless you ask us to. Write to-day for Hommel's Encyclopedia of Radio Apparatus 266-B. It's free and will help you.

WHOLESALE EXCLUSIVELY

LUDWIG HOMMEL & CO

929 PENN AVENUE — LUDWIG HOMMEL & CO — PITTSBURGH, PA.

★ Tested and approved by RADIO BROADCAST ★

The Trans-Atlantic CUP WINNER

Mrs. Edna M. Smith, of Springfield Gardens, Long Island, is the winner of the handsome silver cup, awarded for being the first to report reception of European broadcasts on a FREED-EISEMANN RECEIVER during the recent trans-Atlantic tests.

The winner was selected by "Radio Broadcast" Magazine, which was in charge of the arrangements, and verified the reports of reception.

Scores of other participants in the tests heard the following European stations on FREED-EISEMANN RECEIVERS:—

Paris, Petit Parisienne		Glasgow	5SC
Madrid	PTT	Aberdeen	2BD
London	2LO	Brussels	SBR
Bournemouth	6BM	Liverpool	6LV
Newcastle	5NO	Birmingham	5IT

For full sworn statement and fac-simile letters, write—

Freed-Eisemann Radio Corporation
MANHATTAN BRIDGE PLAZA, BROOKLYN, N. Y.

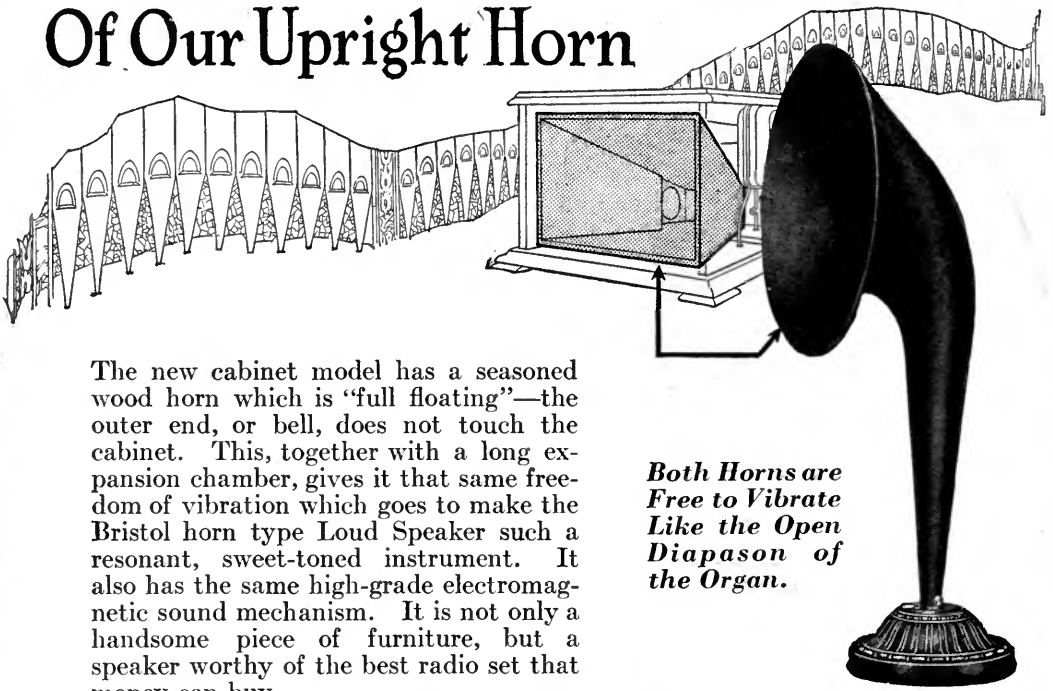
★

NEUTRODYNE

FREED-EISEMANN
RADIO RECEIVERS

★ Tested and approved by RADIO BROADCAST ★

It Has The Full Sweet Resonance Of Our Upright Horn



The new cabinet model has a seasoned wood horn which is "full floating"—the outer end, or bell, does not touch the cabinet. This, together with a long expansion chamber, gives it that same freedom of vibration which goes to make the Bristol horn type Loud Speaker such a resonant, sweet-toned instrument. It also has the same high-grade electromagnetic sound mechanism. It is not only a handsome piece of furniture, but a speaker worthy of the best radio set that money can buy.

Both Horns are Free to Vibrate Like the Open Diapason of the Organ.

Model S
Audiophone
$25.00

Rubber horn 14½" in diameter. Cast metal throat. Velvet mat finish of mottled bronze and gold.

Cabinet Model $30.00

Beautifully finished mahogany. Full floating wooden horn and cast metal throat. Musically, a companion to the finest set ever built; size 17 x 10 x 10¼".

There are five Bristol Loud Speakers, priced from $12.50 to $30.00. If not at your dealer's, write for Bulletin No. AH-3020.

Bristol AUDIOPHONE Loud Speaker

The Bristol Company *Waterbury, Connecticut*

FOR 36 YEARS Ask Any Technical Engineer MAKERS OF BRISTOL'S RECORDING INSTRUMENTS

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Tower's Scientific $2.95

Two Towers

As the Eiffel Tower stands as a monument to skilled engineering construction so TOWER'S Scientific phones stand as a monument to supreme radio achievement. ¶ Each phone is carefully tested and approved before it leaves the factory by a Government Licensed Radio Operator thus guaranteeing perfection in tone quality with a positive uniformity of volume.

TOWER'S Scientific Headsets are guaranteed to be made of the best materials money can buy—highest test enamel, insulated magnet wire, best grade five-foot tinsel cord, unbreakable caps, polished aluminum cases—using the famous scientific headband constructed for maximum comfort.

If your dealer cannot supply you, order direct, we will ship immediately Parcel Post C. O. D.

THE TOWER MFG. CORPORATION

98 BROOKLINE AVE. Dept. T BOSTON, MASS.

One of the seven wonders of the world.—The Eiffel Tower built in 1887-89 on the Champ-de-Mars contains 3 stories. Reached by a series of elevators, the platform at the top being 985 feet above the ground. In the top story is located the powerful Broadcasting Station F L.

The World's Greatest Headset Value

★ Tested and approved by RADIO BROADCAST ★