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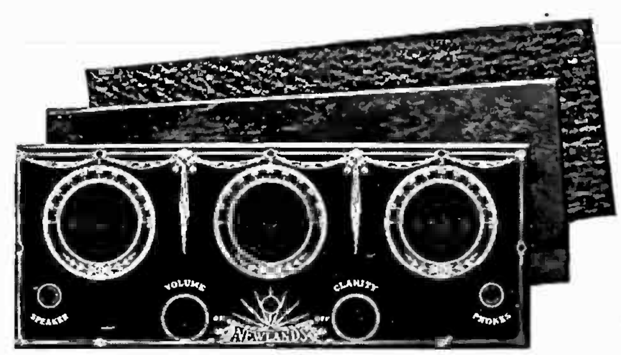

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RADIO BROADCAST

WILLIS K. WING, Editor

JUNE, 1926

KEITH HENNEY, Director of the Laboratory

JOHN B. BRENNAN, Technical Editor

Vol. IX, No. 2

CONTENTS

BEHIND EDITORIAL SCENES

MUCH interest has been aroused on both sides of the Atlantic by the press announcements of successful transatlantic radio telephony, combined with the regular wire line system. Aside from that other startling feat—the transmission of photographs by radio, it is doubtful if any radio achievement has attracted as much recent attention, or given rise to as much speculation about the future, as has this development in the transatlantic field. One of the first questions naturally asked is, "How is it done?" Edgar Felix's article, in this number, tells just what the technical background of this remarkable telephonic achievement is.

Professor Morecroft explains in the leading article in "The March of Radio" this month just what the much-discussed crystal frequency control is, which should answer the questions of many radio experimenters. . . . On page 121, appears an article on the "Radio Broadcast Lab." Circuit, which we guarantee will provide the experimenter with some constructional ideas of an altogether different sort from those he usually finds in radio publications.

THE Listeners' Point of View this month contains the amusing and very true and keen observations of some of our best-known humorists, including the irrepressible Will Rogers. . . . Those who have had opinions without any actual facts about the "blanketing" effect of high power broadcasting stations will be interested in Howard Rhodes's article about tests made by the technical staff of RADIO BROADCAST in and around Bound Brook, New Jersey, the home of WJZ. . . . Particular attention is called to the complete list of Canadian and American broadcasting stations which is so arranged that it may be clipped out and kept for constant use in booklet form. The list is as complete and accurate as it is possible to make it. Another innovation appears in the RADIO BROADCAST Laboratory Information Sheets which, beginning with this issue, take the place of the former "Grid" department. The announcement of the expansion of the Laboratory services on page 175 should also be of great interest to our readers.

THE July RADIO BROADCAST, on sale June 15, will contain an article describing the use and construction of a combined high-quality amplifier and B current supply unit. There will also be other announcements of great interest to all those interested in short-wave work. A Radio Club of America paper, dealing with improvements in radio receivers, is also on the July schedule. Julian Aceves, research assistant to Professor Pupin of Columbia University, is author of the paper. Another article for the home laboratory experimenter, written by Keith Henney, will appear in an early number of RADIO BROADCAST and describes the use and construction of a useful heterodyne wavemeter, an instrument which is of great value around the laboratory of the home experimenter.

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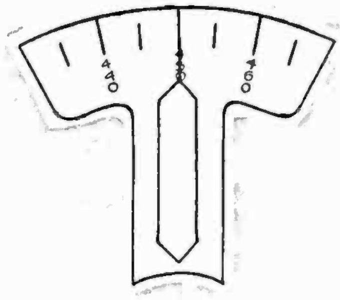

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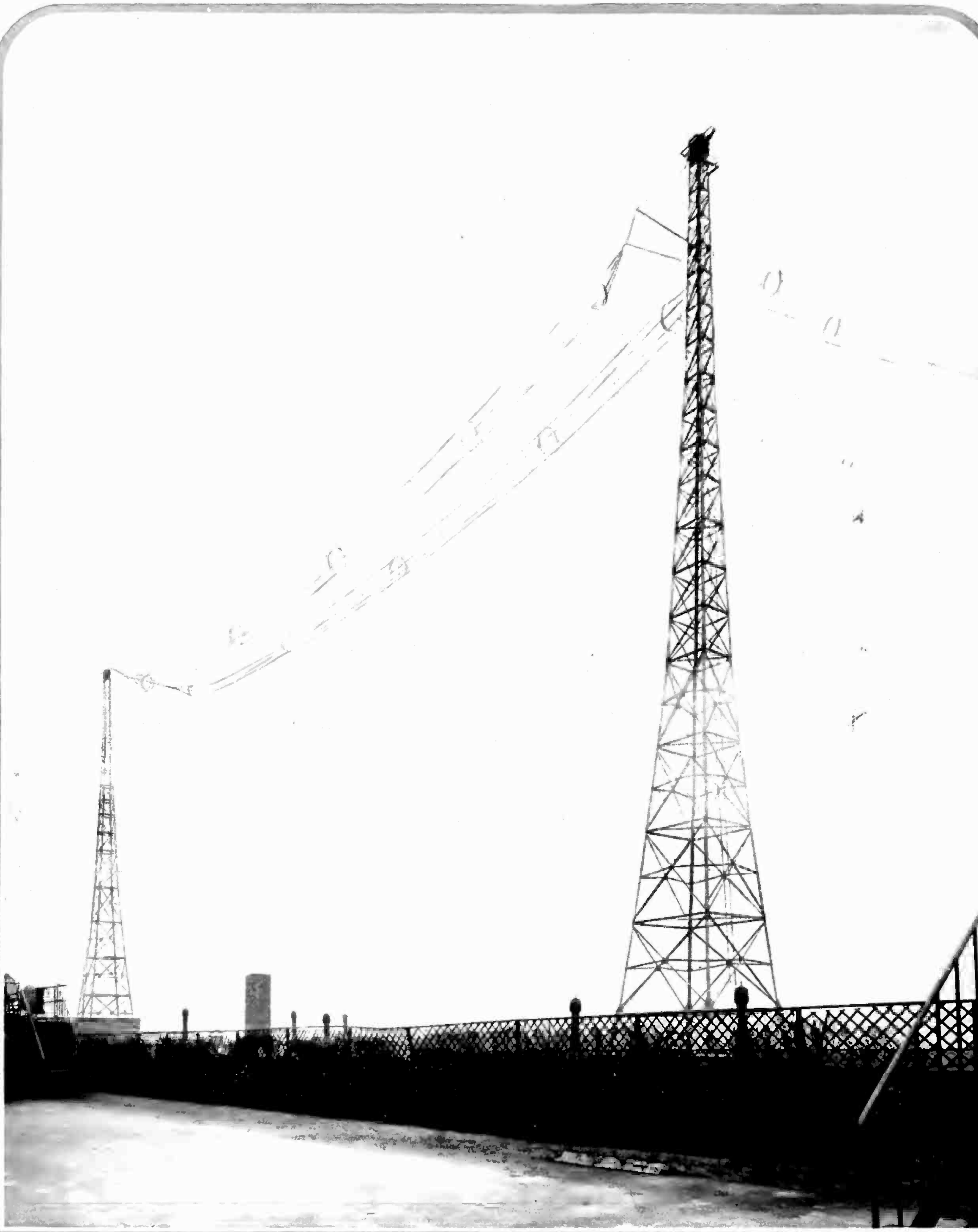


THE ANTENNA SYSTEM AT 2 LO, LONDON, THE MAIN BRITISH STATION

The "parent station" of the British Broadcasting Company system has its towers located atop Selfridge's store, Oxford Street, London. The antenna is 125 feet high. Many British listeners are content with simple crystal reception, using head phones. This station, in common with the other main stations of the system, gives a crystal range of about twenty five miles. Signals from this antenna have been received frequently in the United States and Canada, mainly during the three International Radio Broadcast Tests

RADIO BROADCAST

VOLUME IX NUMBER 2

JUNE, 1926

How New York Talks to London

The Story of a Wonderful Radio Engineering Accomplishment Due to Many and not a Single Individual How the Principle of "Single Side Band" Transmission Made Possible Transatlantic Telephoning A New Triumph for the Vacuum Tube

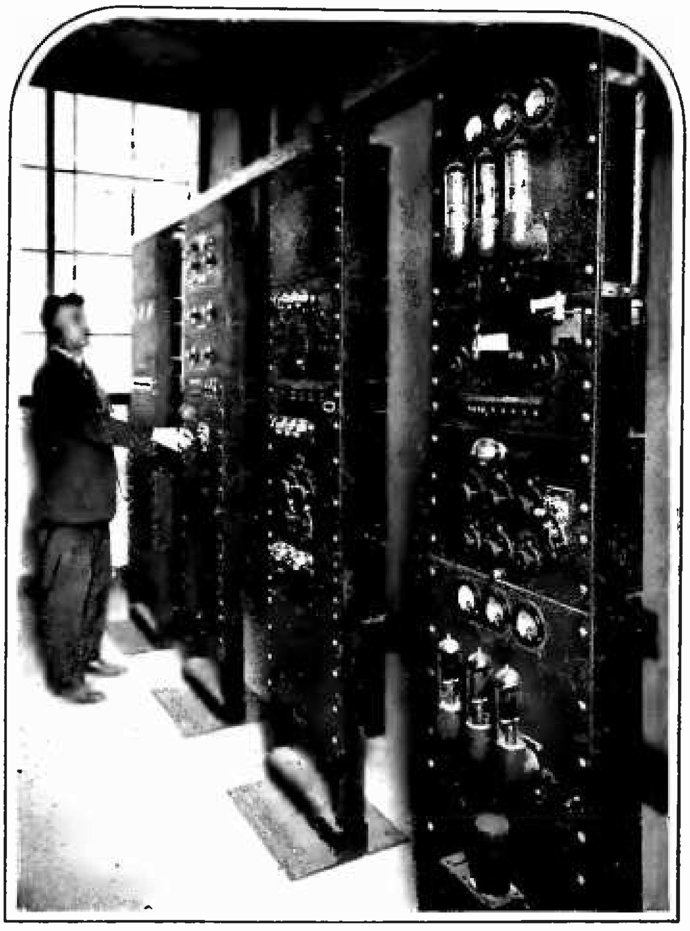
By EDGAR H. FELIX

HISTORIANS have leaned heavily on Samuel Morse's "What God hath wrought," and Alexander Graham Bell's "Come here, Watson, I want you," in describing the first telegraph and the first telephone. But the recent demonstration of two-way transatlantic telephony, exactly fifty years to a day after Bell delivered his famous message to Watson, produced no significant sentence to inspire future generations of high school essayists. Instead, twenty or thirty newspaper men on this side of the Atlantic conversed with an equal number of their confreres on the other side about the weather, short skirts, and prohibition. No one utilized the opportunity to crystallize the significance of the occasion in an apt and epigrammatic phrase.

But the reason is not hard to find. The first telegraph and telephone were largely the products of a single individual's effort; their contribution, the successful solution of a problem pursued in the face of pioneer difficulties. The transatlantic telephone, on the other hand, is the product of hundreds of creative minds. No one man may point to it as his achievement, for, in the equipment installed by the America, Telephone and Telegraph Company, the Radio Corporation of America, and the British Post Office, literally thousands of inventions and processes, each contributing its part to the success of transatlantic telephony, are utilized.

It was an extraordinary radio telephone which accomplished these results, not a mere overgrown super-power broadcasting installation. A fairly new principle was applied, known as single side band transmission.

Engineers can understand exactly just how single side band transmission works, but to the layman it is simply another new phrase added to radio's growing vocabulary. Its methods are complex but what they accomplish is easy to comprehend. Only one-fourth to one-sixth the power is required to transmit a given distance; it occupies only one-half the wavelength band required by the usual broadcasting transmitter, and it is less subject to fading than the older methods of radio telephone transmission.



THE LOW-POWER UNITS

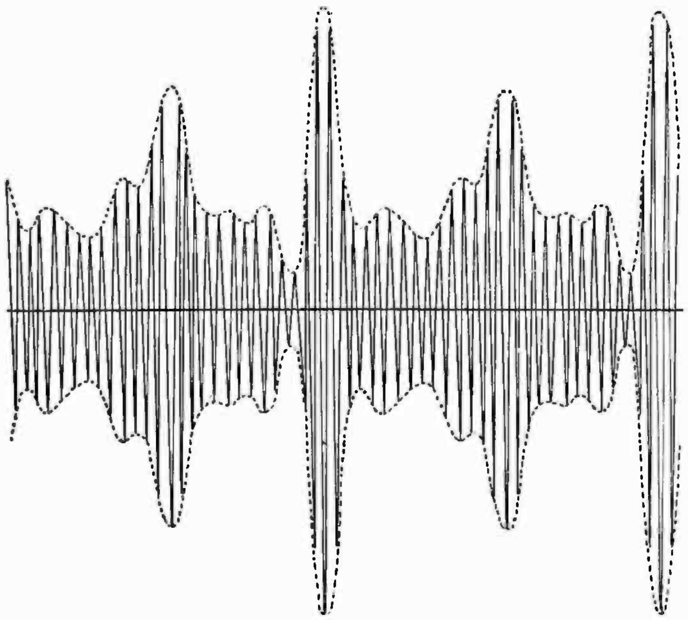
Of the Rocky Point transmitter. The speech input, modulating, filter, and amplifying panels, are depicted. The operator is regulating the volume of the incoming speech from New York by means of a potentiometer

But what is single side band transmission, and how is it accomplished? You probably know that when speech or music is heard from your receiver, it is responding to a carrier wave, varied in intensity by the process of modulation, to accord with the sound waves at the broadcasting studio. The carrier wave acts as the bearer or carrier of the audiofrequency currents. But what you actually hear with your radio receiver is the result of modulation.

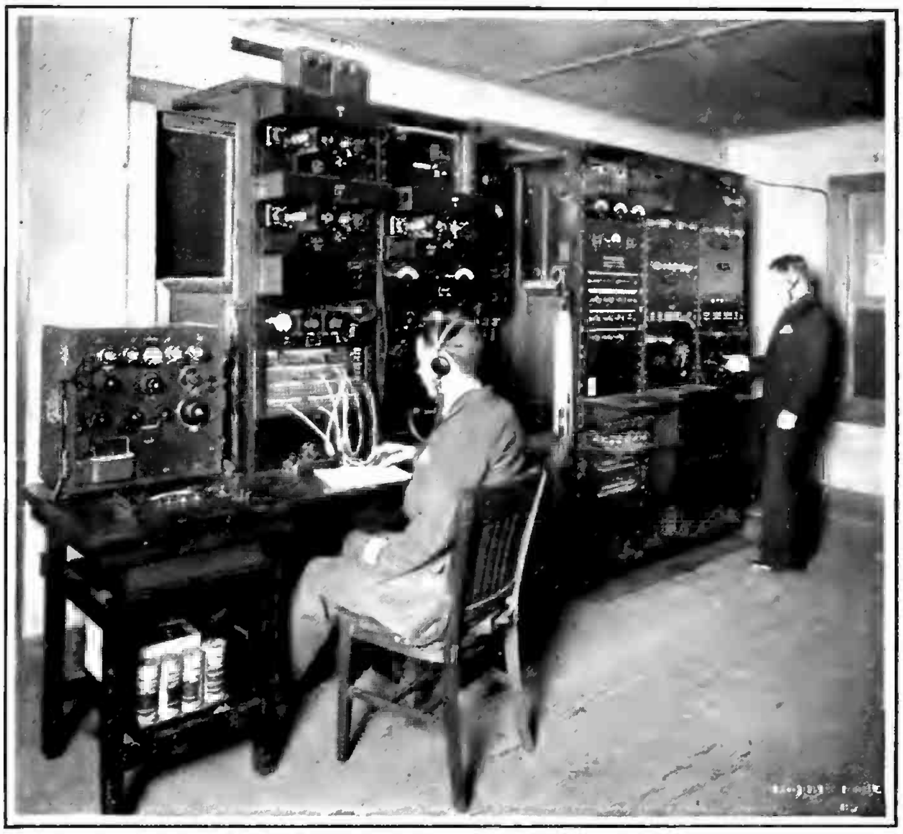
In your experience of fishing for long distance stations with a regenerative receiver, you have often heterodyned the carrier wave of a far-away stranger without being able to "clear up" the signal to make it intelligible. Inveterate distance enthusiasts often become dyspeptic from exasperation if frequently subjected to this experience. What they are after is modulation, not carrier. Single side band transmission accomplishes the remarkable feat of transmitting only modulation, suppressing the carrier before it reaches the transmitting antenna.

Perhaps we can make this more clear by an analogy. Suppose you have a gold coin, deeply engraved with both faces alike, which you wish to reproduce at a distant place. In order to reduce the cost of the sample coin you would naturally slice it in half, since the design on one side, being the same as that on the other, would serve as a satisfactory model. Still greater economy is affected by making the sample slice of the coin just thick enough to include the deepest part of the engraving. The indentations in the coin correspond to the variations in the carrier wave produced by modulation. As long as these variations are transmitted, we have all that is necessary.

Carrying the analogy still further, to reproduce the coin at the distant place, it is necessary to restore it to its normal thickness, in order to have a coin exactly like the one of which it is a replica. This, too, is one of the requirements in the reception of single side band transmission. A local oscillator, set precisely to the suppressed carrier frequency, is necessary to restore the carrier in the receiver. This feature contributes to the secrecy attainable by the new system.

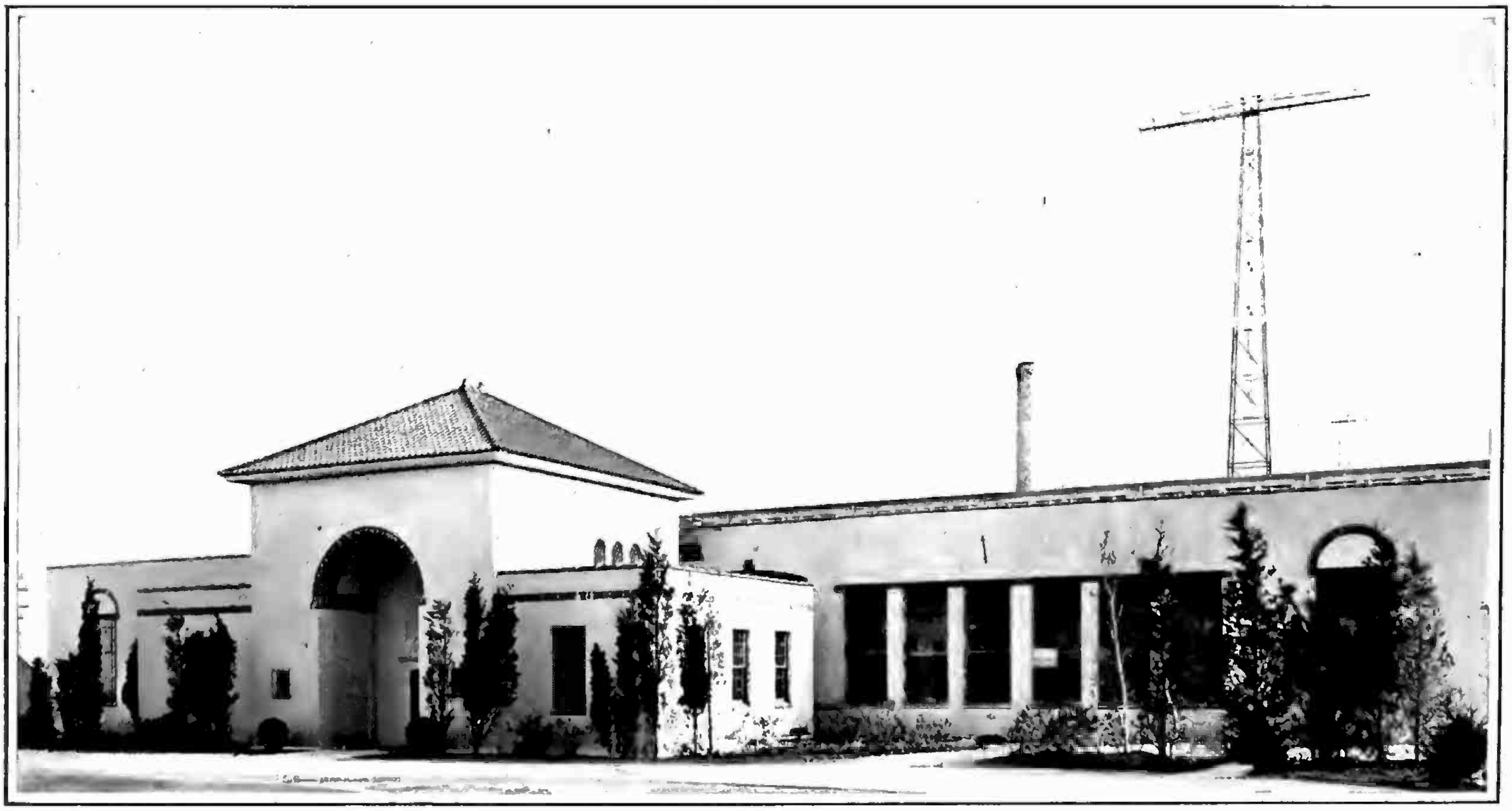


A MODULATED RADIO FREQUENCY WAVE
Would look like this if we could see it. As the author points out, modulation is really twice accomplished. Both the upper and lower components of the carrier wave are varied

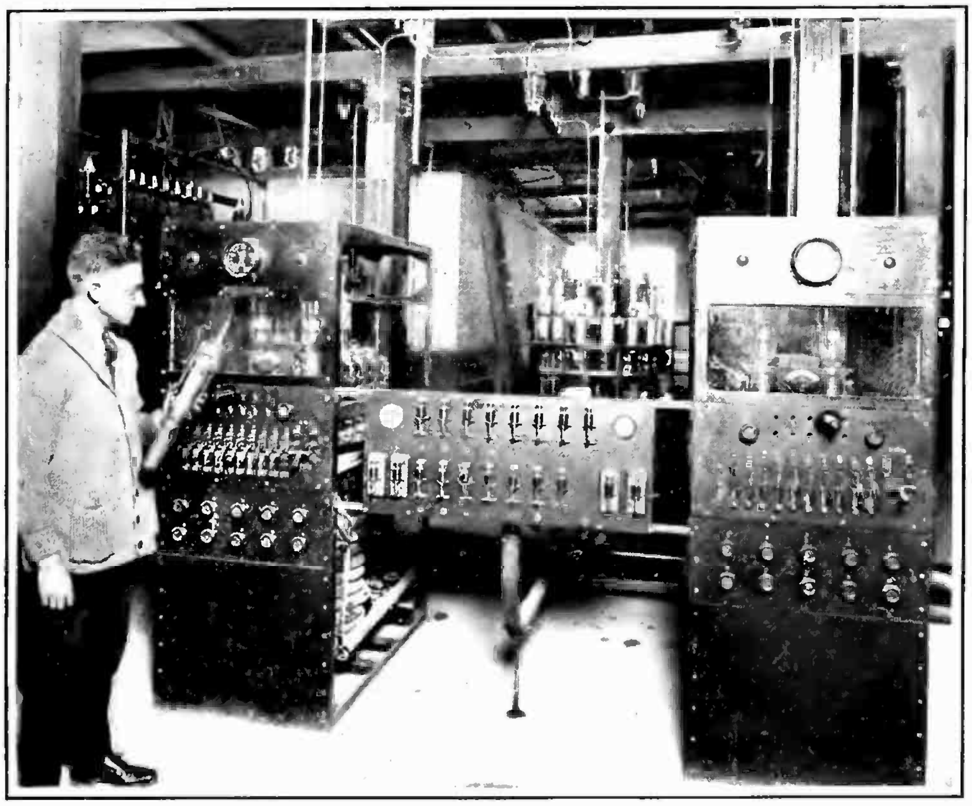


THE RECEIVING EQUIPMENT IS SHOWN HERE
To the right the operator is adjusting the apparatus which is used to pick up Rugby's signals, while the gentleman sitting is responsible for the wire line circuit to New York. The necessary oscillator for restoring the carrier wave to the incoming single side band impulses is incorporated in the receiving equipment to the right

The sine curve, representing the carrier wave, is familiar to almost every broadcast listener. So is the effect of modulation upon the carrier. But observe, in the accompanying diagram, that modulation is really twice accomplished in that both the upper and lower components



THE POWER STATION AT ROCKY POINT, LONG ISLAND
In this building are housed the commercial radio telegraph transmitters in addition to the radio telephone used for the transatlantic experiments



TWO AMPLIFIER UNITS

Or the high-power section of the transmitter. The ratings of the amplifiers are 15 kilowatts, and 150 kilowatts. A circular bank of water-cooled tubes may be seen in the background. The position of these amplifiers with relation to the rest of the equipment can be followed by referring to the picture diagram on page 114

of the carrier wave are varied in accordance with the speech or music. In fact, if you have a receiver which tunes with exceptional sharpness, you may have observed that there are two places on the dial, extremely close together, at which you hear a station with maximum volume. These two modulated waves are called the upper and lower side bands. In single side band transmission, only one of these side bands is radiated into the ether.

HOW THE TRANSMITTER WORKS

BRIEFLY, the transmitter works somewhat as follows: A telephone transmitter is used to secure an audio frequency current which is an electrical equivalent of the sound waves fed into it. For intelligible conversation, a frequency band from 300 to 3000 cycles in width is required. This is used to modulate the output of a low power oscillator set to 33,000 cycles a second. The output of this oscillator, when modulated by speech, has the usual two side bands, the lower from 30,000 to 32,700 cycles and the upper from 33,300 to 36,000 cycles. The next process is to pass this carrier and two side bands through a filter which suppresses the upper side band. The lower is now used to modulate the output of the second oscillator working at a much higher frequency, 88,500 cycles. When two alternating currents are combined in this way, a carrier and two side bands are again produced. The upper side band is equal to the sum of the combined frequencies (i. e. 30,000 to 32,700 plus 88,500 or 118,500 to 121,200) and the lower to their difference (i. e. 30,000 to 32,700 minus 88,500 or 55,800 to 58,500). The two side bands are so widely separated that they are easily filtered. The lower side band, 55,800 to 58,500 cycles, is isolated by a filter, and fed to a series of power amplifiers.

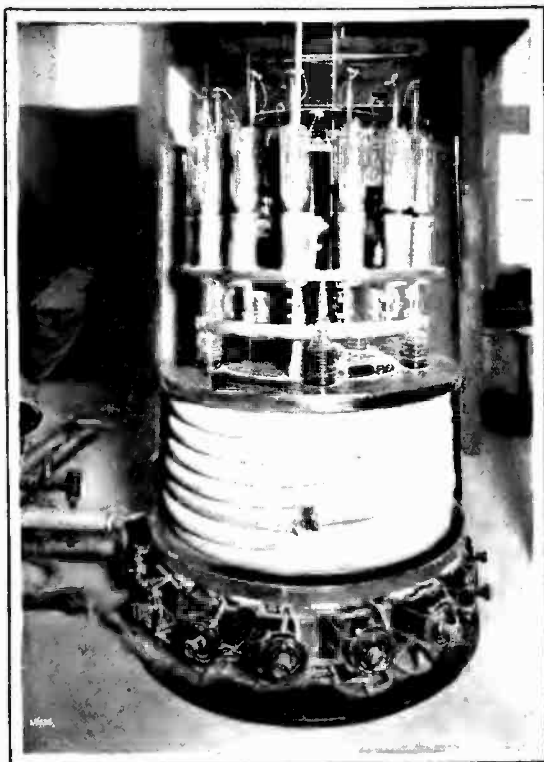
Up to this point, only feeble currents have been used to produce the single side band of the desired frequency. This desired side band having been isolated by successive modulation and filtering is now amplified by three power amplifiers, a 750-watt, a 15-kilowatt and, finally, a 150-kilowatt unit. The output of this huge amplifier energizes the antenna system at Rocky Point, and about 100 kilowatts of power is radiated into the ether. The diagram on page 114 clearly explains the operation of the transmitter.

The illustrations show the various instruments which accomplish these progressive steps. The picture on the first page shows the low-power parts of the transmitter. The two panels at the left comprise the speech input equipment, which is connected with the telephone circuit to New York. The operator is adjusting the volume by means of a potentiometer. These and the next panel include the two oscillators and filter systems which secure the desired lower side band between 55,800 and 58,500 cycles. At the right is the panel containing the low-power amplifiers, which increase the side band to the 750-watt power level.

The upper picture on this page shows the 15-kilowatt and the 150-kilowatt amplifiers. The many fuses provide protection to the filament circuits. Above the fuses are a series of plugs, through which the plate current of each tube may be measured. The panel shown in the center of the picture switches in timing and recording mechanisms by means of which the hours each transmitter tube is used is automatically recorded. A close up view of a bank of 15 water-cooled power amplifier tubes is shown in the middle picture on this page. Note the elaborate water-cooling arrangement necessary to dissipate the heat generated by the tubes.

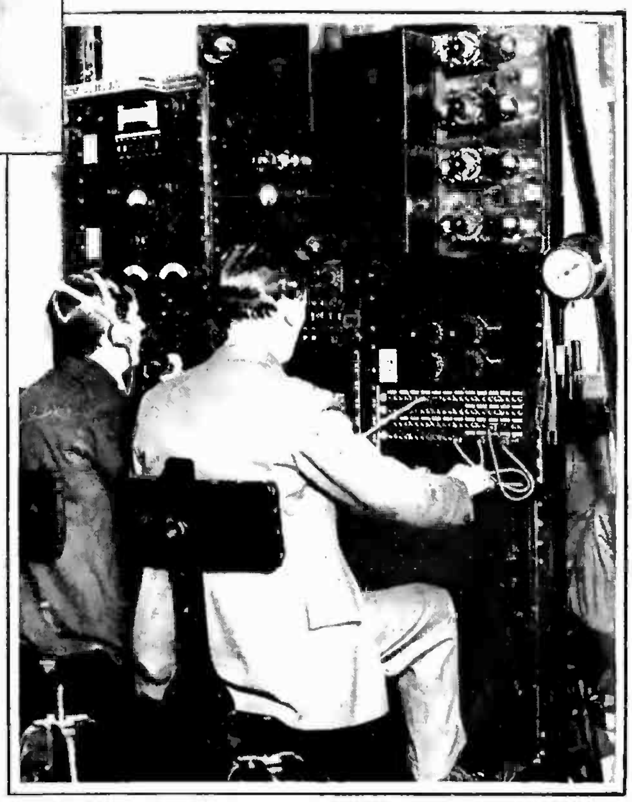
THE WATER-COOLED TUBES

ALMOST as essential to transatlantic telephony as the development of single side band transmission, are the high power water-cooled tubes. In the accompanying picture of one of these

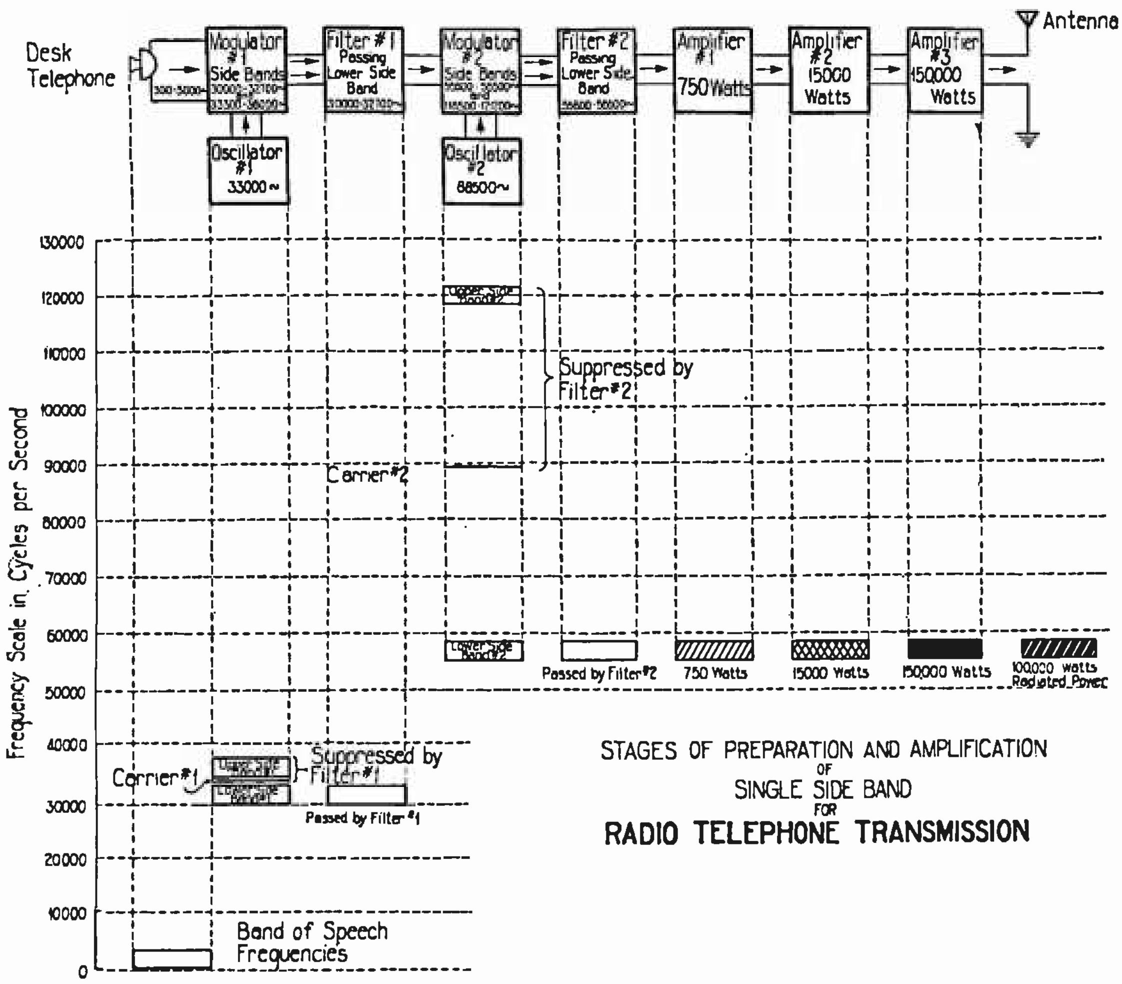


FIFTEEN WATER-COOLED TUBES

On a circular bank, are shown above. The lower picture, to the right, shows the telephone control board in the General Post Office in Queen Victoria Street, London. It was from this point that British newspaper men recently spoke to their American brotherhood by means of the transatlantic radiophone



tubes, half of the plate has been cut away in order to reveal the rugged filament, which draws 750 watts, and also the grid controlling the electrons which flow to the plate. The plate serves as the outside of the tube. This element cannot be sealed within a glass tube, as is done with smaller tubes, because glass would melt under the high temperatures generated by these huge power tubes. The lower half of the tube is immersed in water circulated by a pump. Those parts of the tube showing through the glass are the supports for the elements, and conducting terminals for the grid and filament connections. A considerable length of hose is required to insulate the plates of the tubes which are (the plates are, of course, electrically connected to the water jackets) at from 6000 to 10,000 volts above ground potential. The plate potential is secured through high-voltage transformers and rectified by two-element water-cooled tubes. Perhaps the most difficult problem which had to be met in the design of these tubes was a method of sealing the copper plate to the glass in order to maintain the vacuum within the tubes throughout the range of temperatures encountered.



HOW THE SINGLE SIDE BAND SYSTEM WORKS

Is clearly shown in this picture diagram. By reference to the amplifier part of the diagram, it will be seen that the output power of the Rocky Point station is considerably greater than that of any comparatively simple broadcasting station

THE RECEIVING APPARATUS

IN ONE of the accompanying photographs may be seen the receiving apparatus, a highly efficient yet altogether unconventional unit. The amplification equipment necessary to convey the received matter to New York by wire line, is also shown in this illustration. The three units at the right comprise the radio receiving equipment, including the necessary oscillator which restores the carrier wave. The two panels at the left include the line amplifiers and the switchboard by which the correct line to New York is selected for conveying the received signal, and the necessary service wires for intercommunication purposes. At the far left is the testing equipment for the wire line circuit to permit undisturbed speech between the receiving point in Maine and in New York. The B batteries shown are used to secure an unfluctuating voltage for test purposes, should it be required.

Considering that ten kilowatt broadcasting stations are frequently heard in Europe, it may seem surprising that 150 kilowatts of single side band transmission are required for transoceanic telephony, especially considering that the new method of transmission is four to six times as efficient as the old. But there are vast differences between occasional freak reception and the requirements of reliable commercial communication. The signal strength is very closely dependent upon the amount of light and darkness over the course which the signals follow. Unlike a copper wire conductor carrying an electric current, the medium through which radio waves are transmitted varies greatly in efficiency under different conditions.

During the winter, when the least variation is encountered, the average minimum signal strength required for good reception across the Atlantic is six micro-volts per meter, and runs up to 150, a ratio of about 25 to 1. The variation of disturbing noise, even in winter, follows as wide a ratio. Fortunately, the noise level falls during the day, when the signal volume also falls, and this factor serves to enhance the possibilities of reliable transmission. Magnetic disturbances still further aggravate the variabilities of the ether medium. With so many conditions contributing to the vagaries of the ether, it becomes easier to see why relatively immense power is required to accomplish reliable transatlantic telephone trransmission.

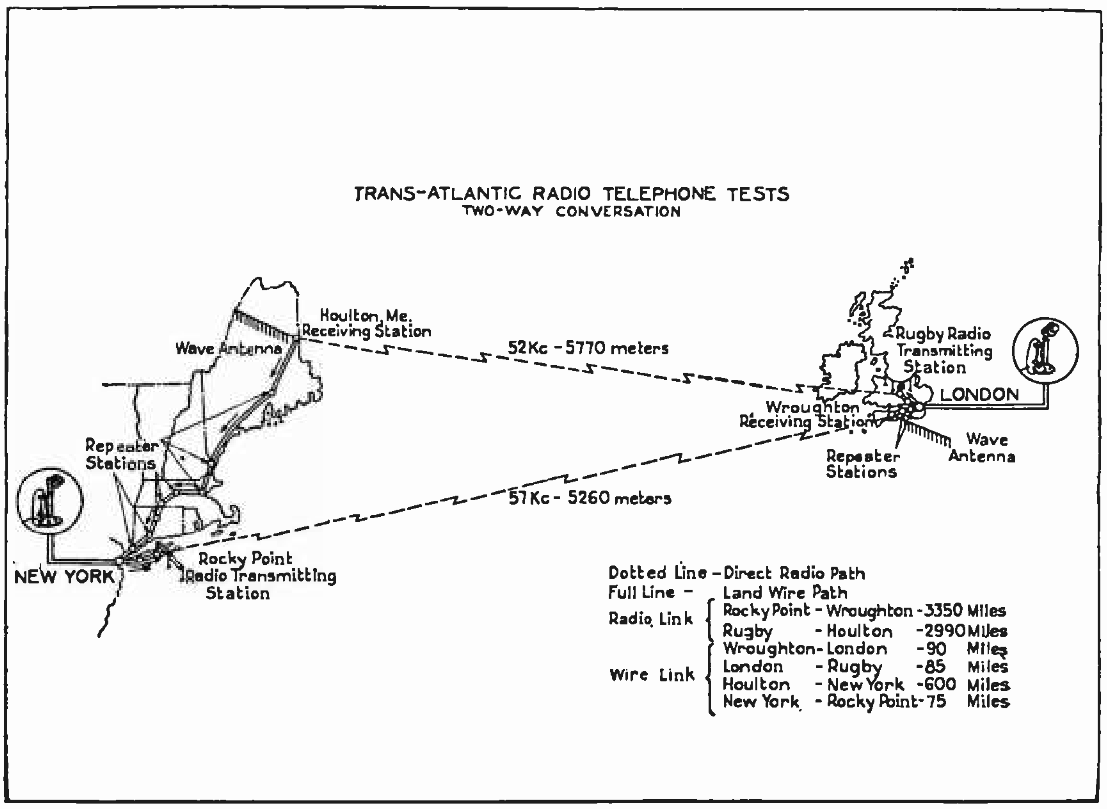
An indication of the difficulties of the problem to be met is given by the varying power requirements to obtain an equally loud signal under all conditions. Night time transmission in winter requires but little power—a few kilowatts. When it is sunrise in England and still night over here, much greater power is necessary. When heavy summer static prevails, a tremendous power increase over that required under the best winter conditions, is necessary. The engineers who have been carefully measuring signal strength at all hours and seasons estimate that 10,000 times as much power is needed to force a signal of the same volume and quality when the worst conditions prevail, as compared with that required under the most favorable.

Nevertheless, the single side band transmitter already installed has maintained a fair degree of reliability even under the relatively poor conditions. The proof is graphically shown in the percentage of test words understood in England as transmitted by Rocky Point during March, 1924. Between midnight and noon, the percentage is generally better than 95, but during the afternoon, when the sunset effect begins to manifest itself, there is a marked falling off in intelligibility.

One might suppose that this falling off in strength during the afternoon would be so pronounced in the summer afternoons as to decrease the value of the transatlantic service almost to nil. However, even during the experimental essays of these tests, on the worst afternoons, it has been possible to understand enough of the words to supply by implication those missed. Two-way communication has the advantage that repetition may be requested in an emergency.

COMMERCIALIZATION UNLIKELY YET

ALTHOUGH the recent experiments have been highly successful, telephone officials are unwilling to make definite predictions as to the likelihood of regular commercial transatlantic telephony, when,

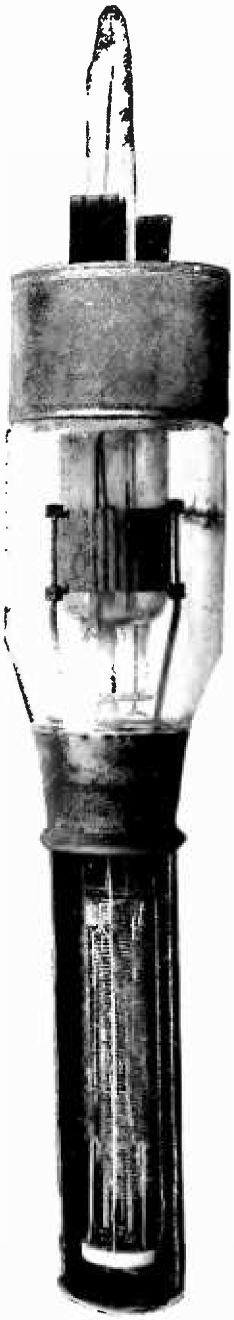


A BIRD'S-EYE GLIMPSE OF THE ROUTE FOLLOWED BY THE RADIO WAVES

As they hurtle from Rocky Point to England. Note the frequent repeater stations which are necessary to boost up the telephone conversations as they travel the wire lines. The main receiving stations, both in England and America, are some distance from the transmitters, but wire connecting lines enable persons at both Rugby and Rocky Point to listen-in to the conversations coming from across the Atlantic

THE NUCLEUS

Of the whole transmitter consists of the water-cooled tubes, an example of which is here shown. The plate element has been cut away to show the grid and filament which, ordinarily, are hidden from view



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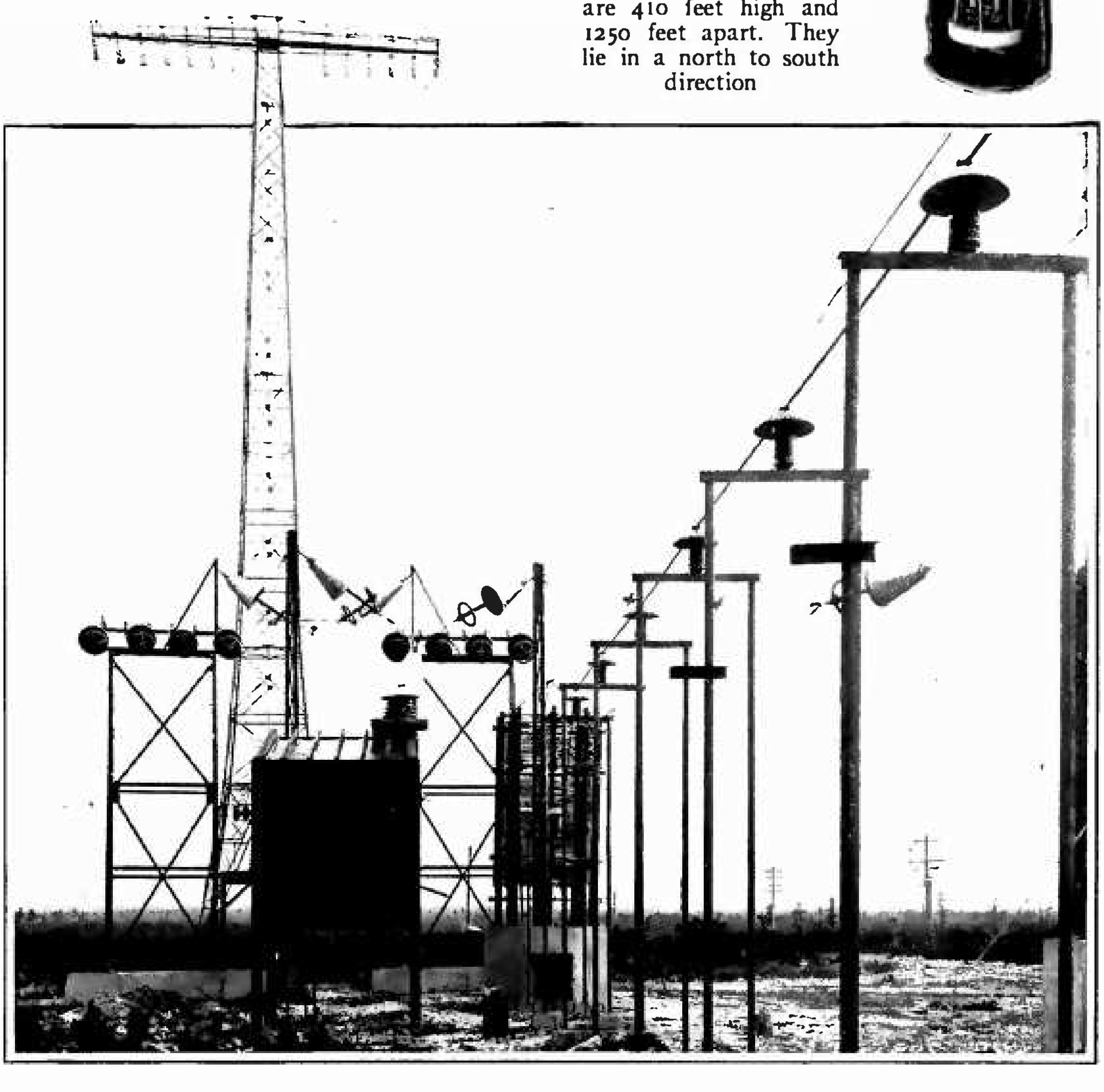
to speak to someone in Europe, you need merely call the long distance operator and give her the usual information. It must be born in mind that the tests were conducted by engineers who have devoted several years to the design and maintenance of the experimental single side band transmitter. To be commercially practical it must be within the province and ability of commercial personnel to maintain and operate the complex equipment.

For ordinary messages of greeting, the apparatus of to-day is adequate, when conditions are favorable, but the commercial possibilities of transatlantic telephony will not be fully realized until the system is perfected to a degree that it can be used without flaw for business, news, and official conversations. This requires an adequate degree of secrecy, adding still further complications. Means have already been developed, however, for attaining the same degree of secrecy in radio transmission as is possible for wire communication. Undoubtedly, this work can be successfully applied in single side band transmission.

It is idle to speculate upon the possibilities of better human understanding which will follow widespread international telephone communication. Political divisions have grown larger in direct proportion to improvements in communication. Tribes cemented into nations when roads were built and when ships began to travel the seas. The telegraph and telephone has expanded nations to the size of continents. Perhaps the new influence of the radio telephone will play a vital part in cementing nations all over the earth into a single harmonious whole. The least that may be said is that international telephony will help to better mutual understanding; mutual understanding means more tolerant adjustment of differences, and that, in the last analysis, means greater stability and more enduring peace.

A CLOSE-UP OF THE ANTENNA SYSTEM

Six towers, one of which is shown below, support a six-wire system. The towers at Rocky Point are 410 feet high and 1250 feet apart. They lie in a north to south direction



THE MARCH OF RADIO

By J. H. Morecroft

Past President, Institute of Radio Engineers

How Crystal Frequency Control Works

WE HAVE seen and heard much lately about frequency control of a radio station by means of crystals, but apparently the statements and descriptions have been such that no simple idea of the principle involved has been made.

The two possible crystals to use for this purpose are Rochelle Salt and quartz. The peculiar property which these crystals possess has to do with their change of shape when put into an electric field, such as that which exists between the plates of a condenser in an operating radio set. There are others of the so-called piezo-electric crystals, but they show the effect to a minor degree only. Quartz is really the only one available because Rochelle Salt is so fragile.

Imagine then a small plate of quartz which has been properly cut from a quartz crystal. If tinfoil is pasted on the two faces of the slab and these two pieces of tinfoil are connected to a B battery, the slab may lengthen and become correspondingly thinner. The amount of lengthening is extremely small; it can be disclosed only by the most accurate measurement. If the B battery is connected with the tinfoil plates in the opposite sense, that is, battery terminals are interchanged, the slab will shorten (where previously it lengthened) and correspondingly grow thicker.

The reverse of this process is also true. If the slab of quartz is stretched lengthwise, its tinfoil plates, now connected to a sensitive voltmeter instead of to the B battery, show that a charge has been developed on them; the voltmeter deflects by an amount proportional to the stretch of the slab. If the slab is compressed lengthwise, the voltmeter again shows the development of a charge, but it is now in the reverse sense, that is, the voltmeter may deflect backward.

From what has been said, it is seen that if an alternating voltage is applied to the tinfoil plates, the quartz slab will alternately lengthen and shorten with the same frequency as that with which the voltage alternates. Furthermore, this lengthening and shortening of the slab will of itself generate an alternating voltage on the tinfoil plates.

Now, a small quartz slab acts just the same toward vibrations as a large metallic rod, such as a street car rail. Imagine one of these is suspended in the air by a couple of stirrups; if it is struck on the end with a hammer it will give out a characteristic tone, the same tone every time it is struck. This is called the characteristic vibration, or natural longitudinal vibration, of the rail. It will vary with the length of the rail, being a higher note the shorter the rail.

There are other modes of vibration for the rail, some of them pretty complicated. In the case of a small slab of quartz, there are two principal natural vibrations, that fixed by the length of the slab and that fixed by its thickness. The natural vibration rate (longitudinal) for a slab two inches long, one inch wide and an eighth of an inch thick is about 50,000 vibrations per second; if the slab is only one inch long, the natural vibration is about 100,000 per second. The vibration fixed by the thickness of the quartz is generally much higher than that fixed by its length.

The frequency of the natural vibrations of one of these pieces of quartz is remarkably constant. Quartz seems to show no fatigue, as do the metals, after vibrating a long time; neither has change of temperature much effect on this frequency of vibration. In fact it seems as though the natural frequency of a piece of piezo-electric quartz may be one of our fundamental physical standards at some future date.

There are two or three ways of making

The photograph heading shows the antenna, masts and station house of the Berlin broadcasting station at Witzleben. The tall tower is 135 meters high and the other 80. A duplicate station has already been erected at Munich. Cables connect the station with the studio in the city.

one of these pieces of quartz serve as a frequency standard for a radio station. The simplest connection uses the quartz in the grid circuit of a small tube, there being a suitable coil in the plate circuit. Between the grid and filament connection there is a small condenser-like arrangement, say such as would be made by using two nickels held about one sixteenth of an inch apart. Between the two nickels a small quartz slab is placed, and when proper filament current and plate voltage are applied to the tube, it oscillates at a frequency fixed by the natural mechanical vibration frequency of the quartz slab. If the piece of quartz is not a very good piece (piezo-electrically), the plate circuit, should have a condenser in parallel with its coil and the plate circuit tuned to a frequency approximately the same as the natural mechanical frequency of the quartz. The quartz, however, and not the tuned plate circuit, will fix the frequency of oscillation. The small crystal-controlled tube is used to excite a larger one which in turn may directly control the station frequency. The final power controlled may be measured in kilowatts, but the frequency of this great amount of power is being controlled, to perhaps one part in a million, by a piece of quartz about the size of a quarter.

Pending Radio Legislation

AS THE radio legislation awaits definite action by Congress we begin to wonder if the present year's activity in getting bills formulated and under way is to be as futile as was last year's. Surely Congress can see that the regulations of 1912 are insufficient to deal with the present situation and that there is a real and insistent demand for some regulation which can take care of to-day's difficulties. The Secretary of Commerce, capable as may be the present incumbent of that office, is practically helpless when confronted by an important radio question. Congress is not performing its required function if it leaves Secretary Hoover with his present severely limited power in radio matters.

Senator Dill recently gave an interview in which he expressed some interesting and some rather drastic ideas. He says:

> The question has arisen during our consideration of the bill as to whether the regulation of radio should be entrusted to the Secretary of Commerce, or to any other one man. It is my belief that at the present stage of development the details of administration should remain with the Department of Commerce, but that a non-partisan commission should be established with authority to pass finally upon questions which may be referred to it by the Secretary of Commerce or any one else. The decisions of this commission should, of course, be subject to review by the courts.

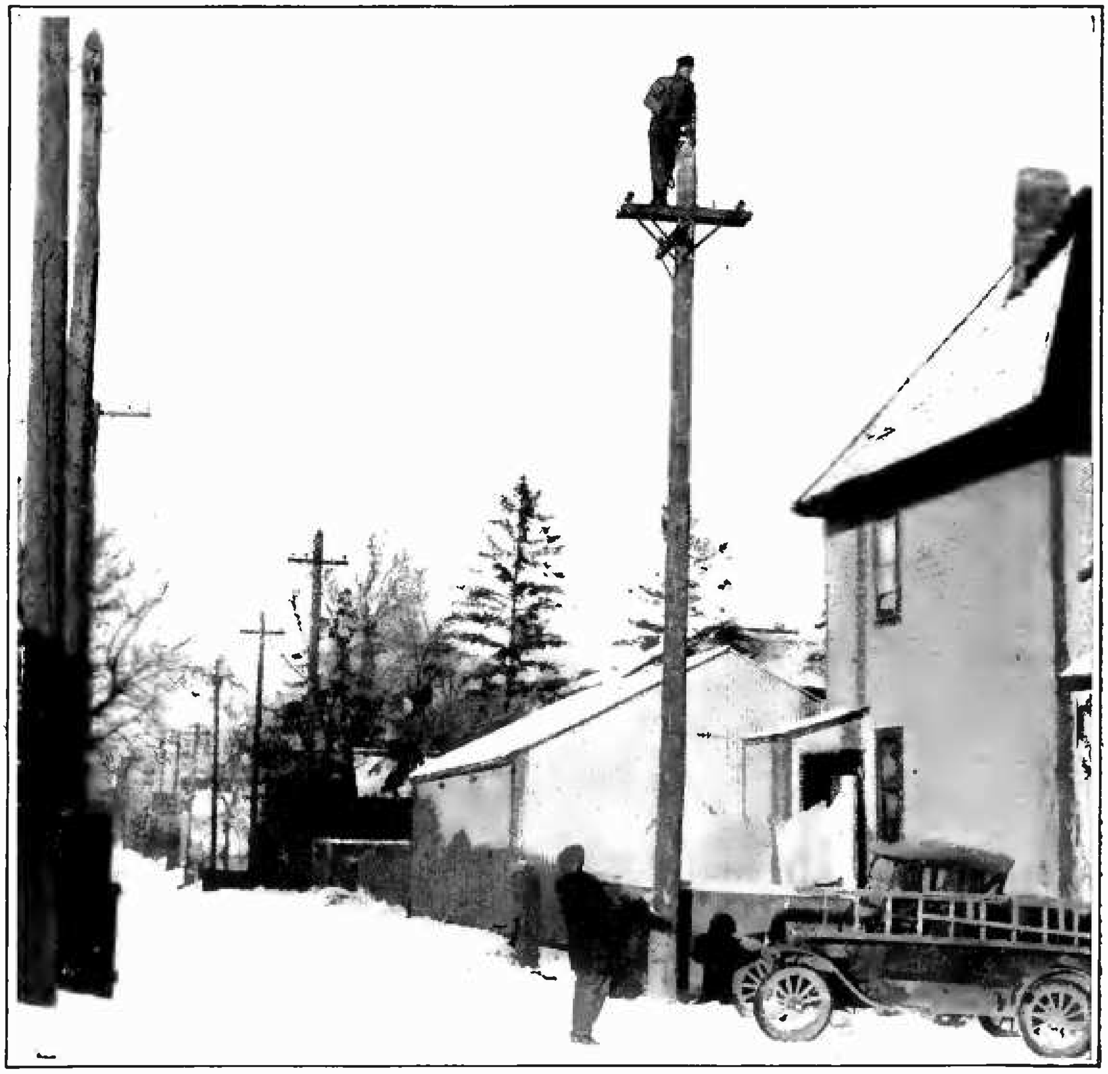
He goes on to suggest a new division of stations, according to their power into "national" and "local." He recommends that for the national stations most rigid standards be set up and that in view of the extra expense and usefulness of such stations their channels be kept completely free from interference. The local stations will in general send out material of especial interest to those in its vicinity; the amount of power required is small and as a result many such stations, in Senator Dill's opinion, could operate on the same wavelength. He confesses to no expert knowledge on the question but speaks from the point of view of an enthusiastic fan. The wave band from 1500 kc. to 1071 kc. (200 to 280 meters), he says, is at present practically useless because of the interference between the many class A stations operating within these frequency limits.

One of his suggested remedies is to put all the local stations on a very few channels; by limiting the amount of power allowed to such stations (and possibly materially decreasing the number of such stations) he feels that three or four channels should suffice for all the local stations in the country. Such a scheme certainly could not be put into successful operation to-day with the present number of such stations, as long as they use the reasonably high powers which they do.

Senator Dill then recommends that the wave band from 2000 kc. to 1500 kc. (150 to 200 meters) should be taken over for the use of these local stations. The amateurs, from whom the band would be taken, would still have their band from 100 meters down, he says. He further predicts that they would "cheerfully give up the 150 to 200 meter band to the greater service of the public as a whole." Now such a suggestion should come from a committee of technical experts, not from a legislator, and furthermore we would like to hear from the amateurs themselves rather than to take Senator Dill's prediction of their feeling in the matter.

Even should the broadcast band be extended to as high as 2000 kilocycles (150 meters), most of the receivers on the market today would be useless for receiving them.

It is interesting to observe that Senator Dill's idea regarding the division of stations into the two classes mentioned above is already working itself out. A few of the stations of the class of WEAF, WJZ, WGY, KDKA, and similar ones are rapidly becoming known among listeners as national stations whether they are so legislated or not. We certainly agree with Senator Dill that whatever change may be made in frequency allocation, the channels of these high class stations should never be encroached upon; in fact, any move to change conditions in this lower part of the frequency band should be to pull out the undesirable stations rather than add new ones.



INSTALLING AN ANTENNA IN WINNIPEG, MANITOBA
The local telephone company grants the right to use a telephone pole for $6 a year and their linemen erect the antenna for a small sum

Important Radio Patents at Present in Litigation

THERE are at present being tried in the courts, several of the important radio patents, the decisions on which may very materially affect the radio business. The Armstrong idea of regeneration, insofar as it relates to oscillating tubes, is being contested by the government in a suit in the state of Delaware. Armstrong's priority over other inventors apparently depends altogether upon a sketch of a supposedly regenerative circuit, which was accompanied by practically no explanatory disclosure. Should this sketch be proved by the government's experts to be no true disclosure of the regenerative principle, there is a possibility that the Westinghouse Company may lose one of its most valuable radio patents.

The Radio Corporation has just finished a suit in the Federal Court of Brooklyn against one of the Hazeltine licensees. The Garod Company was the defendant in the suit, but the Hazeltine Corporation undertook the defense of its licensee and Hazeltine himself served as expert for the Garod Company. The Radio Corporation based its suit on its possession of the Rice and Hartley patents, both of which it controls. They attempted to show infringement by the Garod Company.

Hazeltine showed experiments to prove to the court that the Hartley patent was practically inoperative for the circuits used in broadcast reception. After he had completed his tests, Waterman, an expert for the Radio Corporation, showed experiments to prove that it was operative. The court has the two demonstrations to consider in rendering its opinion. The decision in this case will probably be withheld until other evidence is before the court.

The Hazeltine Corporation has haled the A. H. Grebe Company into court and that case is now under way. The Grebe "Synchrophase," it is claimed, is a neutralized set which infringes the Hazeltine patents. The Grebe Company claims it does not infringe any patent at present in force.

The validity of the negative C battery and the grid leak patents is also soon to be tested out in court. The C battery patent, bought from Lowenstein by the A. T. & T. Company, and the grid leak patent, granted to Langmuir, are both controlled in the radio field by the Radio Corporation, and the Grebe Company has been selected by the R. C. A. as defendant in these suits. Another patent, that of Mathes, in which the grid is held negative by the voltage drop due to filament current flowing through a resistance, is also involved in this suit.

The above four or five patents mentioned as at present in litigation come very near to being basic patents in radio apparatus as it exists to-day.

Something About "Supersonics"

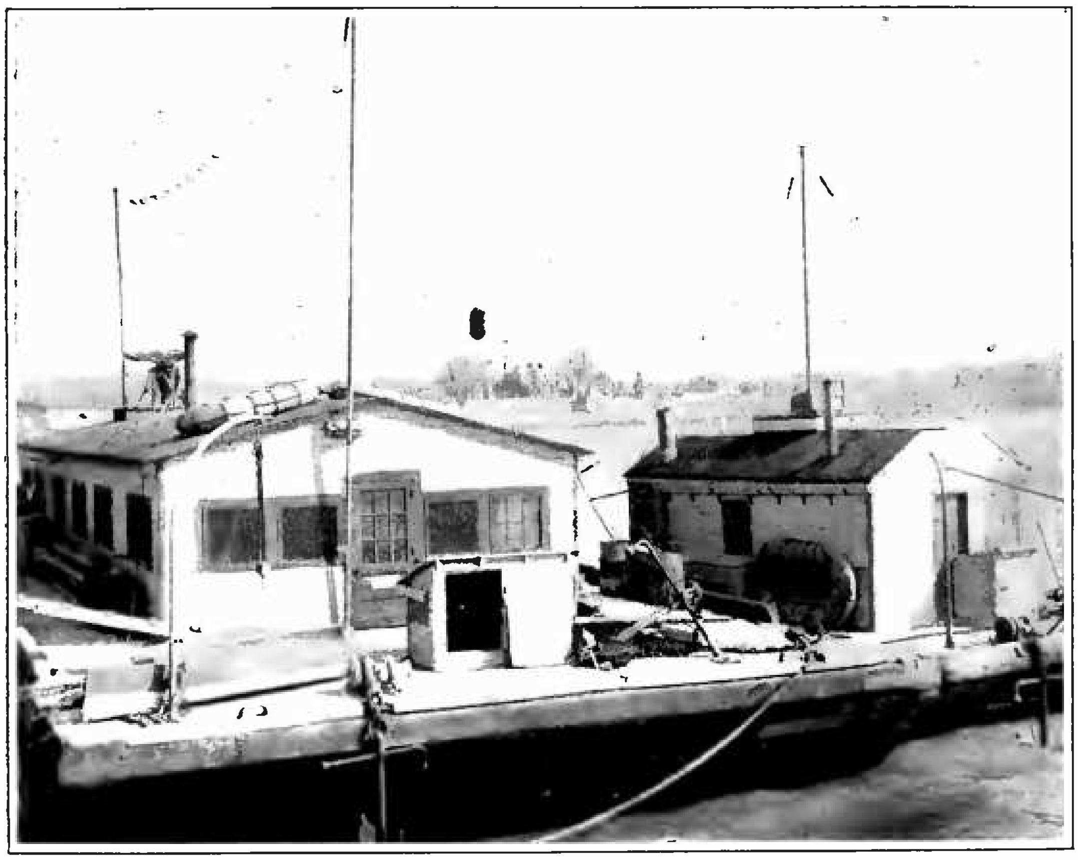
WHAT purported to be an interview with Dr. H. C. Hayes of the Naval Experimental and Research Laboratory at Bellevue, on the Potomac River, was featured a short time ago, the special achievement acclaimed being the alleged invention of the transmission of ultra-audible sound waves through water. By ultra-audible was meant sound waves so high in frequency as to be beyond the human hearing.

Some of the marvellous features of these sound waves brought two or three columns of newspaper comment. The fact that they are inaudible and to that extent secret, that they may be made to travel in straight lines instead of scattering in all directions as does ordinary sound, and many others of its remarkable characteristics were lauded as the discoveries of the Research Laboratory staff.

That is not the fact and we publish this statement of fact in fairness to those who did the work. During the war, a group of scientists, principally from Columbia University, was assigned the problem of ultra-audible sound and in the Navy files are complete accounts of all the properties now hailed as inventions of the Naval Research Laboratory.

Those scientists were sworn to secrecy by the Naval authorities on all the work they had done, otherwise the scientific journals would have received clear and authentic reports of this most fascinating branch of acoustics.

If the Naval Research Laboratory wants to make more discoveries on the action of sound of this nature (up to 200,000 vibrations a second) it would do well to consult the files of the Navy Department for the years 1917-18. The most remarkable properties of these supersonic soundbeams, as given in the reports mentioned above, have not yet been made public in so far as we know.



PART OF THE NAVAL RESEARCH LABORATORY AFLOAT

Sound barges on the Potomac, near Washington, where experiments are in progress, designed to perfect the super-sonic telephone for undersea communication. As Professor Morecroft points out, much research on super-audible sound waves was carried out by Columbia University experimenters and others, during the recent war

What About Libel by Radio?

WE ARE all of us very adverse to a censorship of radio channels—freedom of speech is one of the foundation stones of our Constitution and any measure which threatens to encroach on this feature of American liberty at once arouses our antagonism.

But a situation has now arisen which demands some analysis and action and when the probable legislation is passed we shall again be reminded that "liberty" as our radical element interprets it, isn't quite the same thing as most of us take it to be. While the Constitution grants to each of us liberty of speech and action that liberty is guaranteed in so far as the speech and action do not interfere with the rights of others. The rights of others are generally overlooked by those who insist upon complete liberty for themselves.

In our country it is a crime to write libellous matter and it is punishable by fines and imprisonment. This is as it should be. We are at liberty to write only that which does not interfere with the rights of others. The spoken word, however, is generally not a cause of action for slander—the slanderous remarks must be written. The reason for this distinction is evident when one considers how difficult it would be to prove conclusively what a man said. What a man has written, however, is there for the judge and jury to see for themselves.

How about slanderous remarks spread over the radio channels of the country? Does the injured man have no legal redress if his reputation is besmirched in the hearing of a million of his countrymen? Evidently here some new regulation is required and it looks as though it might soon be forthcoming. Representative Blanton of Texas proposed an amendment to the White Bill which makes it a crime to utter scandalous remarks over a radio channel. This, the House did not incorporate in the final form which reached the Senate. According to the Blanton amendment any person who utters a libel or scandal by radio may be prosecuted either in the state from which it was broadcast or in any state where it was received.

A court in Oklahoma City already has a case before it, an action to which the Blanton amendment would apply. Station KFJF, operated by the National Radio Company of Oklahoma City is in trouble because the pastor of a local church declared over this radio channel that Sheriff Friss had accepted a bribe not to enforce the Prohibition Law. The pastor is sued for $55,000 and the radio company for $20,000 in the libel action of the sheriff. As the law stands, the sheriff's action probably cannot be sustained, but with the proposed amendment in effect, the minister would have to prove his assertion or be adjudged liable for damages.

It has not yet been defined legally as to what extent the radio station is liable for the material sent out over its channels, but if the Blanton amendment becomes operative the law may make it a co-defendant with the scandal-dispensing speaker. This will make more necessary the precaution which most stations take at present to have their speakers read, from a written copy, whatever they have to say. Someone must have previously read over the copy and the station operator must check what actually goes out over his channels with the copy beforehand. If material departures are made by the speaker, the operator can shut off the microphone until the speaker comes back again to the material which he was supposed to send out.

Since the above was written the Oklahoma court has dismissed the Friss case, the lawyer for the defense putting up the plausible argument that the radio station was no more liable for scandal sent over its channel than was the telephone company for permitting a scandal to travel over its wires connecting the speaker's microphone to the radio station.

With the law as it exists at present, the dismissal of the suit was a foregone conclusion; courts are to see that the laws of the land are obeyed, but it is not their function to apply old laws to new and unforeseen circumstances. New regulations must be passed to meet new conditions and until they are, the radio station owner and the alleged slanderer are apparently beyond the grasp of the law.

When one considers the future and possible increase in censorship at our radio stations it becomes ever more evident that we must guard against a possible monopoly of the radio broadcast service. If the station owner is allowed to censor what shall and shall not be sent out over his channel, a combine of stations might become a dangerous factor in controlling a country's news. A monopoly of radio channels is not to be put in the same class with the wire telephone monopoly of the A. T. & T. Company. Such, we believe, functions for the direct benefit of the American public, but a broadcast monopoly would be a bird of entirely different hue.

Fees For Broadcast Music Should be Fixed

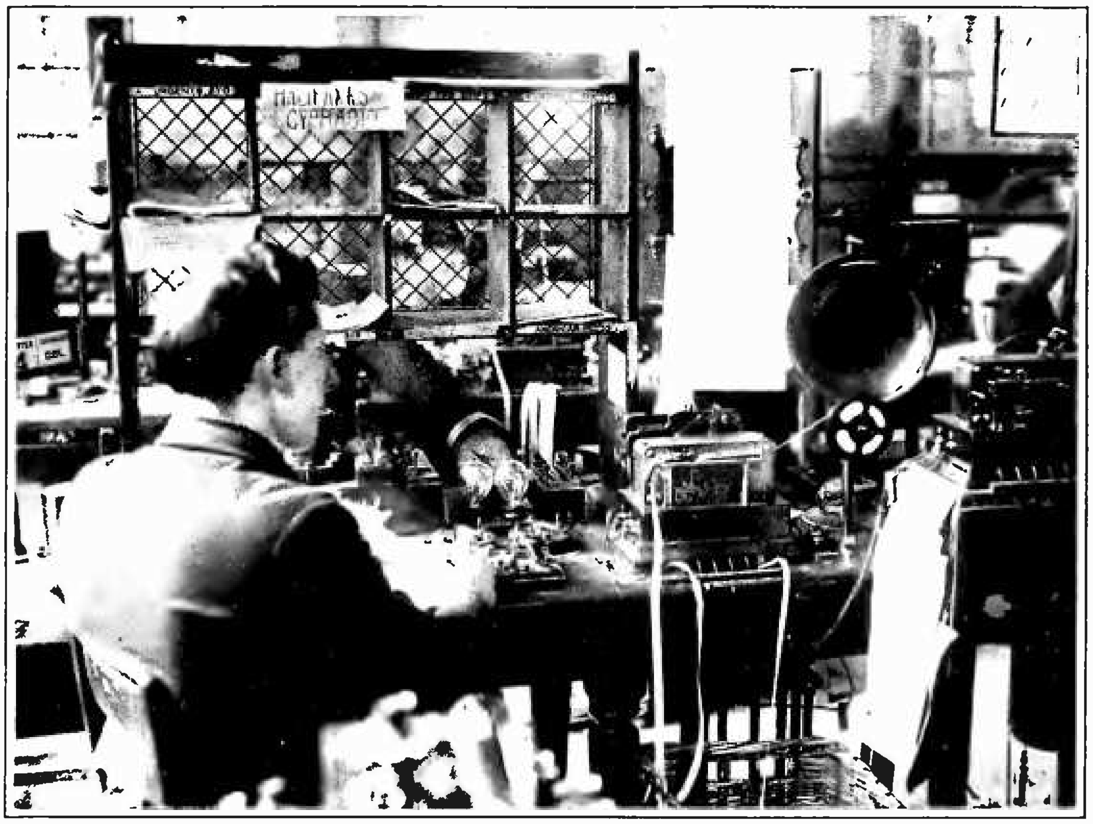
According to the National Association of Broadcasters, some radio stations are being charged extravagant figures for the privilege of broadcasting copyrighted music. Legislation at present under consideration will compel the broadcasting station to pay a statutory fee every time a copyrighted number is sent out, but nevertheless this legislation has the support of the broadcasters' association. This support is based on the theory that whatever tax the new law provides, the broadcaster will at least know what the performance is going to cost him. The station manager needs to devote perhaps ninety per cent. of his program to music, so that music they must have. The statement of the National Broadcasters Association gives us the unexpected news that some stations are at present being charged royalties of more than $25,000 in one year!

Can the Voice be Carried on Light Beams?

According to a news dispatch from Birmingham, Alabama, it seems as though radio waves may be somewhat affected when they travel through a beam of light. Some experimenters were manipulating a huge searchlight on the top of a high building and apparently their voices were carried to some of the radio antennas in the neighborhood. The report states that engineers of the General Electric Company are investigating the phenomenon to see if the effect is a real one and if so how it can be controlled.

There may be a real effect to be found; it has been known for a long time that an arc, such as is used in searchlights, could reproduce the human voice with a remarkable degree of fidelity. If the current from a radio receiver is passed through an arc light, which is already burning from the current supplied by a continuous-current generator, the arc will act as a very good loud speaker. (Of course precautions have to be taken not to burn up the radio set).

If then this effect is a reversible one, which seems very likely, voices in the vicinity of the arc will vary the intensity of the light beam in a manner corresponding to the sound waves. If, then, a beam of light does affect the radio waves traversing it, we could expect the voice of the arc



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A CORNER OF THE GENERAL POST OFFICE RADIO ROOM, LONDON

The photograph shows some of the automatic Wheatstone tape transmitters in use. The circuits here are London-Halifax, which is carried out on long waves via Leafield (Oxford), and Egypt. The operator is checking the signals as they leave the transmitting antenna many miles away, through the loud speaker at the right

HIRAM PERCY MAXIM

Hartford, Connecticut; President of American Radio Relay League, and of International Amateur Radio Union

(Especially written for RADIO BROADCAST)

"The broadcast listener thinks he has had a thrill when he hears the announcer of a distant station give his call letters and say what the next number of a program is to be. But it isn't any thrill at all compared to what the two-way communicating amateur enjoys when he works back and forth and holds two-way communication with the antipodes. That's the big thrill. And, that's the real office of radio. Listening is not even half of the game.

"Anybody can get into the amateur transmitting game. Learning the code is no stumbling block. On the contrary, it is an easy thing if a little help is secured. The great brotherhood of two-way communicating amateurs all over the world, is ready and anxious to help and to extend the warm hand of welcome.

"There is hardly a country in the world where there are no transmitting amateurs. In North America, we amateurs have our American Radio Relay League, and in foreign countries we have our International Amateur Radio Union. Our amateur transmitting brotherhood is organized on a world-wide basis, and is fast building up national and international friendships that are of very great value indeed."

operator to be heard in nearby radio receivers. Whether this possible effect is a real one, the engineers working at the task will soon let us know.

Increased Radio Appropriation for the Department of Commerce

IN RECOGNITION of the great increase of work loaded on the Radio Supervision Service of the government, Congress has increased the funds available for that service by about fifty per cent. over what it was last year. The budget allowed $354,000 for this work, but this has been cut to $335,000. Even so, it is $115,000 more than was provided for the present year's operation. Besides opening additional sub-offices in Dallas, Memphis, Los Angeles, Pittsburgh, and half a dozen other interior cities, money is provided for three new radio test trucks. With the additional inspectors provided for, it is anticipated that much closer watch can be kept on the broadcast channels to help eliminate avoidable interference.

The Month In Radio

THE award of a medal for "conspicuous service" with a selection committee composed of well known names in the world of science and public affairs has been announced by our excellent contemporary, *Popular Radio*. Their announcement states that "it shall be awarded without discrimination to all amateurs—men, women or children, of any race, nationality, color, or creed—through whose prompt and efficient action radio is utilized to perform an essential part in rescue work. The awards shall be restricted to non-professionals only." Communications should be addressed to Dr. E. E. Free, Secretary, Committee of Awards, *Popular Radio*, 627 West 43rd Street, New York City.

AN IMPORTANT change in Navy transmitter practice has been inaugurated at the Naval Training Station, Great Lakes. The use of the thirty-kilowatt arc transmitter, will be discontinued and all the traffic will be handled by a new triode outfit, generating a frequency of 8630 kilocycles (34 meters). If the use of this high-frequency transmitter proves as reliable as is now anticipated, the arc oscillator will be permanently dismantled.

This Great Lakes station is the first of the Navy outfits to rely solely on high frequency; it has been a pioneer in this work and so really deserves the honor of showing the other Navy stations the way.

This station effected communication with the U. S. S. *Seattle* when this vessel was in Honolulu harbor last summer, and also this was the station which kept in touch with Commander MacMillan when he was on the northern end of Greenland almost a year ago. All of that official Navy traffic was handled through this station.

For the last few months daily schedules of traffic with Washington have been carried out with various frequencies. It was found that 8630 kilocycles carried equally well day or night so that was chosen as the official frequency.

Interesting Things Said Interestingly

GORDON C. SLEEPER (New York; President, Sleeper Radio Corporation): "Only a comparatively few firms, suffering from unwise overproduction, have been guilty of the practice of 'jumping' accompanied by slashing price reductions, and the sooner they pass out of existence the better for everyone concerned. Reputable companies having the interests of the radio business at heart and themselves desiring to continue in it, have not and will not tolerate price cutting, and their good work in maintaining standards will be especially evident during this year.

"Radio has by no means even approached the sales saturation point, but I feel confident that the next twelve months will see that condition nearer in sight."

W. G. CADY

Middletown, Connecticut

Professor of Physics, Wesleyan University

(Especially written for RADIO BROADCAST)

"The oscillator plays the same part in the transmitter that a pendulum does to a clock. It determines the wavelength of the station where it is used. The reason for using the crystal as the master oscillator is that it makes a very much more constant frequency possible than could be assured without it. The fading of radio signals which amateurs find so troublesome is due, in part, to the fact that the wavelength of the broadcasting station is not constant but varies slightly. The quartz oscillator entirely does away with the variability of wavelength.

"Experiments with the crystals were begun in wartime when they were used in connection with the detection of submarines. A crystal which was mounted in a suitable case was submerged, and when it was connected with an electrical source it sent out a beam of high-frequency sound which came back as an echo from any submarine which happened to be in the neighborhood. The echo was received on the same crystal that sent out the sound.

"There are various circuits for quartz crystals in connection with vacuum tubes. Some of these are oscillating circuits for transmitting stations, while others are for the purpose of using the crystals as frequency standards for calibrating wavemeters and other measurements in the radio laboratory."

MME. SCHUMANN-HEINK (New York; opera and concert singer): "When I sang over the radio in New York the other day, my son, who is one of my most intelligent and severest critics, listened-in to analyze the radio reproduction of my voice. He told me afterward that he had actually heard me breathe in singing. I was horrified, for it is an unforgivable sin for a singer to let her breathing be heard.

"Now, my breathing could not have been heard by the keenest ear of an observer sitting in the first row of the orchestra. The microphone was only a few inches from me as I sang, and it therefore caught the slightest vibration. In other words, my radio audience, hundreds or thousands of miles away, heard me as though they were standing a few inches from me as I sang. This gives radio a wonderful advantage to hear the finest shading of tones and the details of the singer's technique."

The "Radio Broadcast Lab" Circuit

New Applications for the Toroid Coil -Another Experimental Article Introducing a Circuit of High Gain, Sound Design, and Unusual Efficiency—Another Fascination for the Home Experimenter

By KEITH HENNEY

Director, Radio Broadcast Laboratory

THIS article is the first of a series which describe a circuit which has been known and used in various fragmentary forms by a number of investigators. The original circuit is probably due to Dr. L. M. Hull. Betts and others of the Western Electric Company have also contributed much. A great deal of development and research, covering many months, has been done in RADIO BROADCAST *Laboratory, and in the form in which the circuit is now presented in this series, we believe confidently that the radio constructor will find a circuit which has more to offer than any design presented to him since the introduction of* RADIO BROADCAST'S *famous Roberts circuit. For efficiency—and that term is not used idly—it will be difficult to find any home constructor's circuit which can compare with it. This article presents the experimental background of the circuit and describes several models which can be built. Later articles will show exactly how to build a number of models which are decidedly worth waiting for. We present here enough material to keep the true home experimenter busy for some time to come.*
—THE EDITOR.

TO THE average home experimenter who possesses a laboratory of sorts, there appear to be two possible directions in which his energies may be spent. Either he conducts experiments for their own sake, or he works at many small tasks, with the completed whole—a receiver, let us say—in mind.

Suppose, then, that you are such an enthusiast to whom the series of articles appearing in this magazine for home experimenters has appealed. The experiments related so far have been for their own sake, although the apparatus described has been such that many applications exist for it. Suppose that you wish to design a new receiver. In what direction will you turn?

The home experimenter, having decided that he wishes to design a new receiver, will not depart from the general rule, which is that he likes to see concrete results of his day's work. He does not wish to blunder into a blind alley. He proceeds with caution.

Radio, as he looks at it, seems to be like a blackboard upon which new ideas are written daily, and as often erased. Some of the ideas are good, few of them are new. And up in the corner of the blackboard marked "do not erase" are the tried and true schemes that have come down through the stormy days of radio. The elimination of the super-heterodyne, the tuned radio frequency amplifier, the regenerative detector is not expected. Further than that, what can one say?

The home experimenter, then, reasons that he needs a new idea, and he knows beforehand that he will not likely stumble upon something that will completely overthrow existing conditions in the radio engineering field. His reasoning will probably be something like the following.

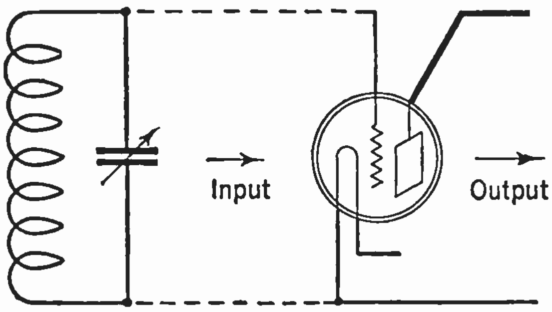


FIG. 1

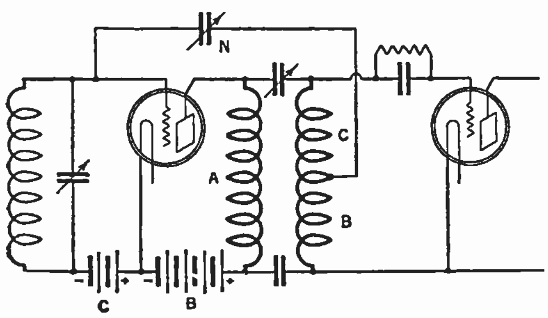
The fundamental unit around which every radio receiver is built. A coil and a condenser will have considerable voltage across it when properly tuned, and this voltage when applied to the input of an amplifier will be considerably augmented. The extent of the amplification depends upon the inductance and resistance of the coil

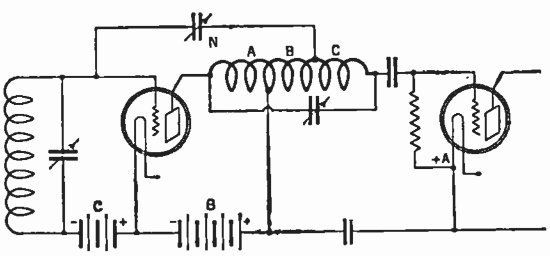
Practically all new ideas that radio schemers have are due to the desire to improve either the quality of reproduction or the selectivity and sensitivity of the radio frequency part of their receivers. Present day high quality transformers, the use of properly constructed and operated resistance amplifiers, the introduction of semi-power tubes and the general application of cone speakers of high quality leave little to be expected from the low frequency end of a set. But many people believe that the radio frequency part of receivers is a closed book.

If the home experimenter will look over the radio writings of the last few months—which is a good idea in itself—he will find considerable mention of toroid coils, and he may wonder if all the conflicting statements are correct. Probably, if he has been interested in radio for any length of time, he will know that the toroid is not a new idea, but that coils of this nature have been employed in the telephone industry for years. Its migration into the field of radio frequencies was thought of by many people—witness the fact that a good half-dozen appeared on the market practically simultaneously. And the experimenter will find that some of the articles, written evidently by people who know, state that the toroid has no business in the radio industry.

To dispute the right of the toroid coil to a place in the radio sun requires that the complainant have a clear picture of what he asks of a coil, and upon this point many people seem to have hazy ideas.

The experimenter will sit down and draw a picture of the fundamental radio circuit, a coil and a condenser with their terminals connected together. He will attach to these terminals, the grid and filament of a vacuum tube, as shown in Fig. 1. He will note that he has the input circuit of a high frequency amplifier. What he wants, then, is to find out the relation between the





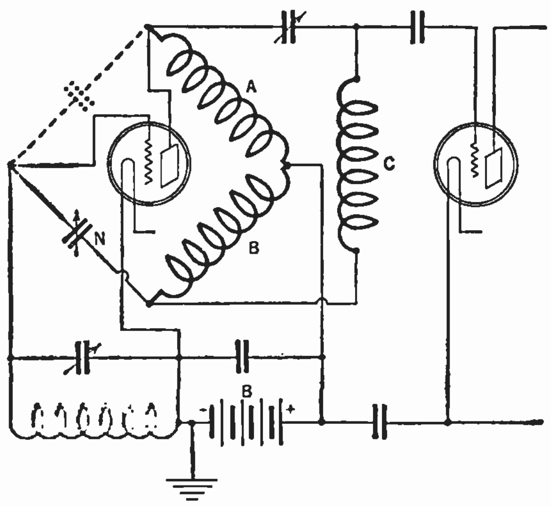
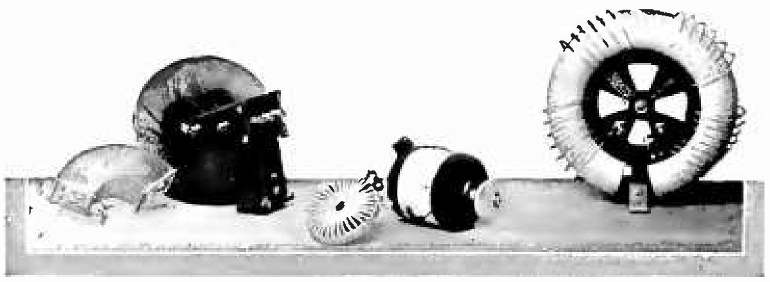


FIG. 2

These circuits are all the same, drawn differently—and depending upon the source of their popularity, their names differ too. The first is the original Hull circuit appearing in *QST*, the second is the newspaper and *Radio* version, and the third is the so-called "Bridge" circuit



RADIO BROADCAST Photograph

FIG. 3

Three methods of introducing voltages into toroid coils. One, Bremer-Tully, uses an extra coil placed inside the toroid proper, Naxon uses turns placed outside the toroid, and the Radio Foundation coils have an external coupling coil

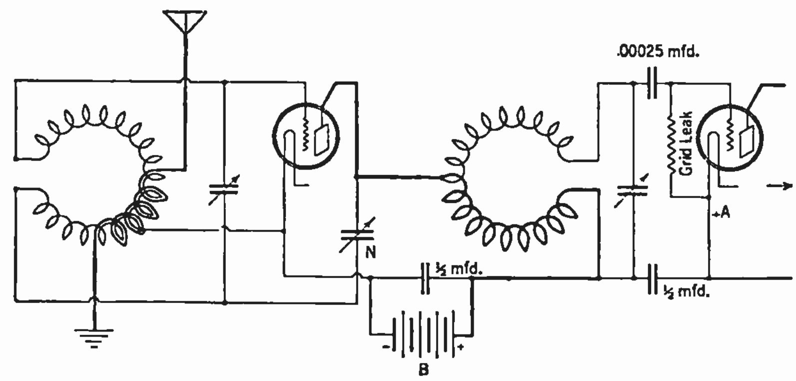


FIG. 4

A toroid receiver circuit which uses no additional coupling coils but which utilizes part of the detector coil to introduce energy into the detector circuit. A similar system was used in the RADIO BROADCAST "Universal" receiver

amplification he can get from this combination of gear and the kind of coil he uses.

THE GAIN IN R. F. AMPLIFIER COILS

FORTUNATELY the business of determining the effect of using a good or bad coil has been done for the experimenter and the work described in RADIO BROADCAST many months ago by Harry A. Diamond, in April, 1925. This nice piece of research was performed by H. T. Friis and A. G. Jensen of the Bell Technical Laboratories, and has been generally neglected by many experimenters and writers.

In this paper, the fact is demonstrated that the voltage gain of such a coil-condenser combination is a function of the inductance of the coil and the square root of the resistance of the circuit. Since most of the resistance exists in the coil, it behooves the experimenter to reduce the resistance as much as possible—but this factor is not so important as many writers would have us believe. In fact, the statement that toroid coils are less efficient than solenoids need not bother the builder of good receivers at all, for the difference in gain between a toroid coil amplifier and one using a solenoid of the lowest resistance will not be audible to the human ear.

If the experimenter is equipped, he can perform the illuminating experiments himself of determining what voltage amplification he may secure, but he may also use Friis and Jensen's formula to do the same thing. These engineers state that the maximum voltage amplification possible is as follows:

$$K\ max. = \frac{\mu}{2} \times \frac{L \times 2\pi f}{\sqrt{R_p \times R}}$$

where R_p is the tube impedance
μ is the tube amplification factor
R is the resistance of the circuit
L is the inductance of the coil
f is the frequency

He should use this formula and the data below, which are for two types of coils taken from Sylvan Harris's article in *Radio News* for January.

R_p = 12,000 ohms (201-A)
μ = 8
R = 10.3 (solenoid)
= 18.8 (toroid)
f = 1000 kilocycles
L = 300 microhenries.
K (toroid) = 17
(solenoid) = 20

Thus the experimenter may see that the difference in gain between the best solenoid and the average toroid is not so great as many would like to prove, and when one couples this fact with many of the other advantages of the toroid he will see that there are few difficulties in the path of a good toroid receiver.

These difficulties, however, exist and the experimenter should not fall into the error of jamming a toroid into any existing circuit with the assumption that it will work properly. It can't be done. This article and those soon to follow will show how the toroid *can* be used in a circuit whose performance is astounding.

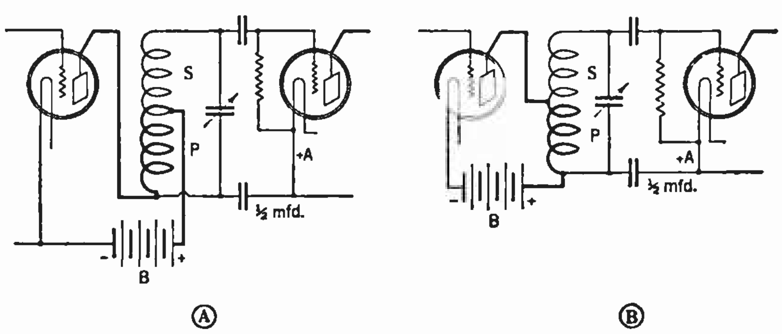


FIG. 5

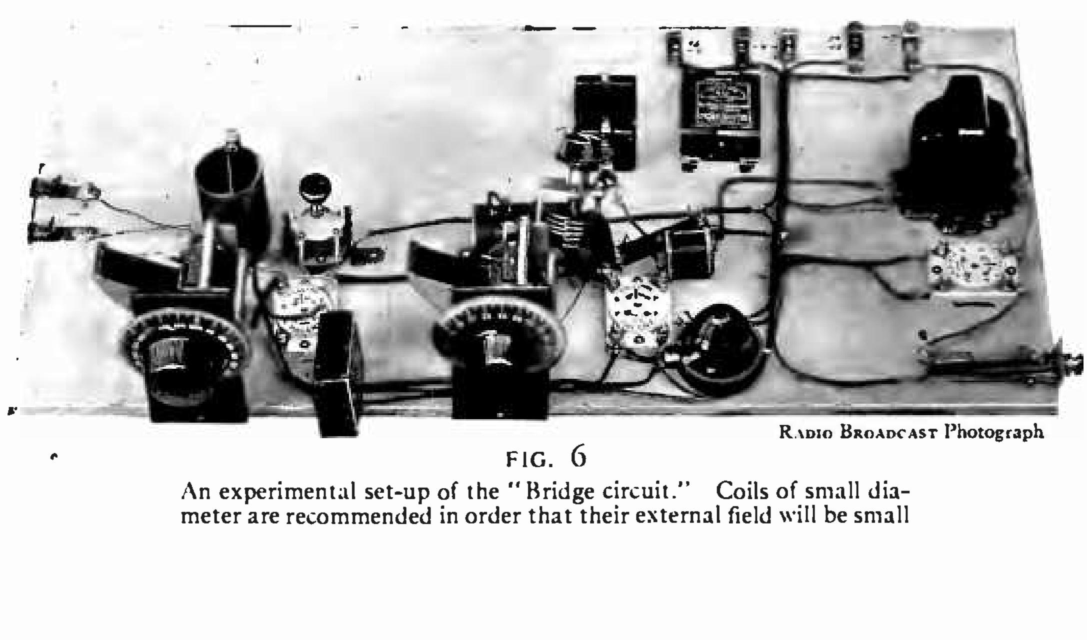
These drawings show how the Hull and the "Universal" systems differ. In the Hull circuit, the plate coil has been reversed

USE AND ADVANTAGES OF THE TORIOD COIL

THE great advantage of the toroid coil lies in its restricted field. This means that energy from the coil is not likely to expand about the coil itself and interlink with other fields, and by the same token it is difficult to get energy into the coil. For this reason, a circuit in the neighborhood of powerful broadcasters is not so likely to be disturbed by local signals except those arriving at the receiver through the proper means—the antenna. The fact that the field is restricted indicates that the coils may be placed closer to metal end plates of condensers, closer to wires carrying radio frequency currents of wrong phases, and even closer to each other without the many troubles incident to inter-stage coupling.

The use of toroids makes possible the conservation of space, the maintainance of the resistance of circuits at their lowest point, the reduction of "pick-up" from external sources, the prevention of inter-stage coupling by stray electromagnetic fields, and naturally makes neutralization of high-gain amplifiers a much simpler problem. All of these things are possible, of course, provided that proper precautions are taken, and provided that the experimenter does not play with an inherently unstable or unbalanced circuit.

Now for a little history. In the January, 1924, *QST*, Dr. L. M. Hull described a circuit that promised considerable voltage amplification. It was brought to the



RADIO BROADCAST Photograph

FIG. 6

An experimental set-up of the "Bridge circuit." Coils of small diameter are recommended in order that their external field will be small attention of several radio experimenters with the result that the circuit is now variously used and variously named. It has come to the Laboratory in many guises, among them being the "Betts" circuit, the Western Electric Bridge circuit, the R. F. L. circuit, and on the Pacific coast it is probably known as the Best circuit.

Fig. 2 is a compilation of several of these circuits, including Doctor Hull's original scheme shown in *QST*. Although many have claimed credit for connecting an amplifier-detector coil as Doctor Hull has done, it is believed that he should get whatever glory there is in it. The circuits in this Figure are really all the same thing, drawn differently.

Although the Hull circuit was not originally designed for toroid coils, it has lent itself to their use with peculiar effectiveness. The chief trouble with toroids at present is that few people seem to know how to get energy into them without spoiling all of their good qualities. Fig. 3 shows several methods. The conventional inductive coupling with external coupling coil is bad since it introduces large capacity and resistance losses. Inductive coupling by means of a separate plate coil is not so good since it results in two fields, a strong one due to the tuned circuit and a weak one due to the plate circuit. Neither of these coils are complete toroids and naturally the field is not so constricted as one wishes.

In Fig. 4 is a circuit which may be used. There is but one intertube coil which is a complete toroid tapped for the plate inductance. If this system is used, the ordinary Hazeltine method of neutralization can not be used and other resources must be drawn upon.

In Fig. 5, the Hull method is contrasted with the circuit of Fig. 4. It will be noted that there is little difference between the two circuits. In the Hull method, the plate coil has been reversed. Although they look much alike, there are certain structural advantages of the second which make it worth while. In the first place, a condenser may be used to isolate the plate and grid coils as far as d. c. and low frequency a. c. are concerned. This makes it possible to light the filament of the first tube from a. c. In the second case, the Hull arrangement makes it possible to add regeneration to the detector without extra coils.

In other words, the toroid coil receiver which can most successfully be operated is a stage of radio-frequency amplification added to a regenerative detector—the heart of the "Aristocrat," the Roberts, the Browning-Drake etc. The first coil may be a loop, a solenoid, a toroid or any type of inductance, while the amplifier-detector coupling is a toroid of only one winding.

WHERE TO TAP THE COIL

THE question of greatest importance at this stage of the home experimenter's departure upon the development of a new receiver is to determine the correct place to tap the toroid coil. This problem involves a knowledge of the input impedance of the detector tube and the output impedance of the amplifier tube, the number of turns on the coil, the inductance of the coil, and the frequencies to be received.

Considerable work was done by the writer in RADIO BROADCAST Laboratory and Cruft Laboratory at Harvard to determine the proper turn ratios, and the data below is based on the empirical formula that the correct ratio between the grid and plate coils is as follows.

$$N = \sqrt{\frac{55{,}000}{R_p}}$$

where N is the turn ratio
Rp is the plate impedance

The plate impedance of various tubes with 90 volts on the plate and negative 4.5 on the grid and the turn ratio follows

Type Tube	Rp	N	
12	18,000	1.75	
199	22,400	1.57	
201-A	13,000	2.00	
112	6,000	3.00	
High-mu	30,000	1.35	@90 volts B and 1 volt C

These facts must be noted in connection with the above data. The greater the turn ratio, that is, the fewer number of turns in the plate circuit, the sharper will be the tuning, and the lower the amplification. The lower the plate impedance of the first tube, the greater will be the amplification, and naturally the greater the amplification constant of the first tube the greater amplification. Using a high-

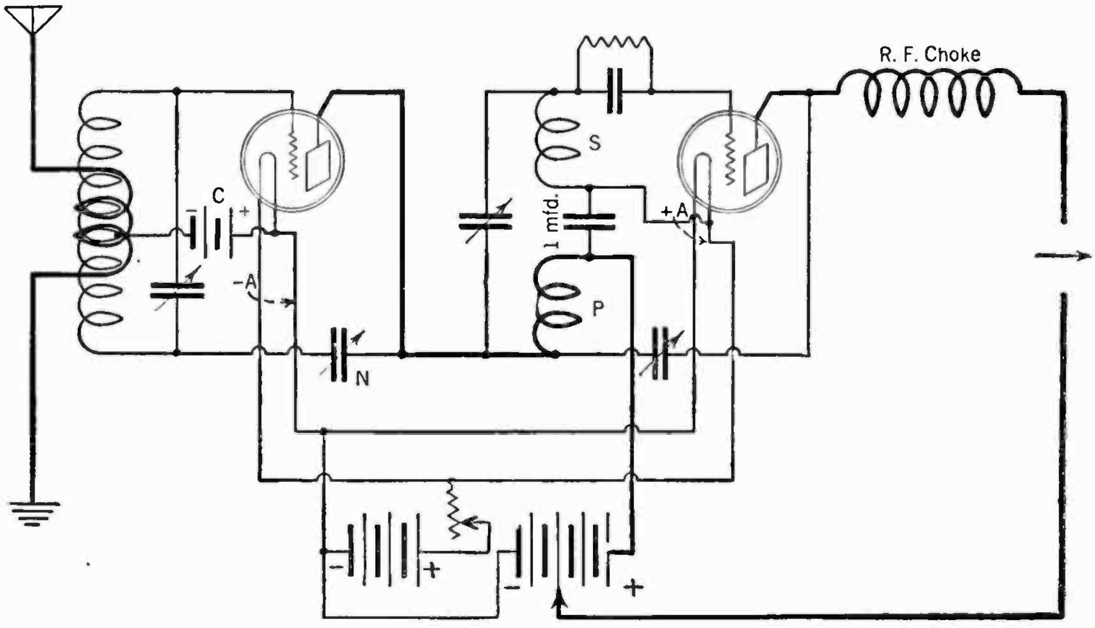
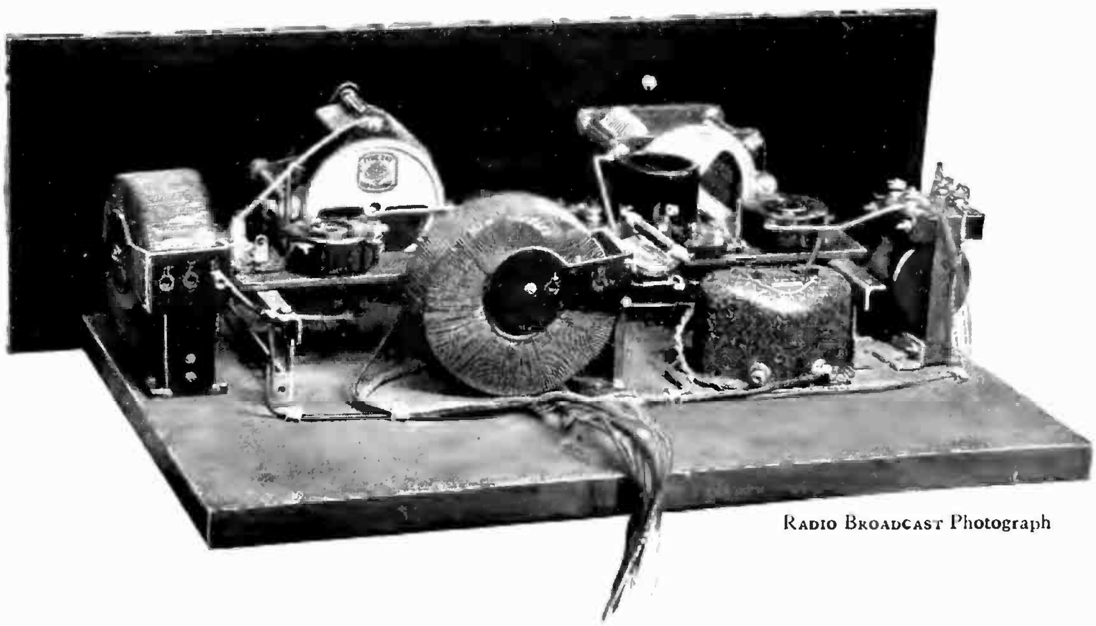


FIG. 7
The Toroid Receiver circuit containing all the modifications to bring all previous circuits up to date. This circuit employs the Rice system of neutralization, condenser feed-back to introduce regeneration into the detector, and an isolating condenser in the detector coil so that a. c. may be employed to light the amplifier filament



RADIO BROADCAST Photograph

FIG. 8
Two Bremer-Tully toroids are used in this complete receiver. The coils are "doctored" somewhat to make them suitable. The inner plate coils have been removed and the proper taps made so that connections may be made at the correct points. The choke coil for regeneration is situated directly under the detector socket and unfortunately cannot be seen in this picture. It is wound with No. 36 wire on a cotton thread spool

Important Facts Concerning the Circuit

Type of Receiver Circuit
1 stage tuned neutralized radio-frequency high gain amplifier, regenerative detector.

Audio Amplifier
Any good type of audio amplifier may be connected to the detector output.

Neutralization
Rice

Regeneration
Capacity Feedback

Circuit Origin
Hull; Bell Telephone Laboratory Engineers

Coils
Toroids, solenoids, diamond weave, etc. Any satisfactory tuner coil may be used in the antenna circuit.

Tubes
199's or 201A's satisfactory.

Parts Required
2 sockets, 2 coils, 2 tuning condensers, 1 feedback condenser, 1 neutralizing condenser, 1 filament control, 1 output jack, 1 isolating condenser, 2 choke coils, 1 grid leak and condenser.

The size of the tuning condensers employed will depend entirely upon the size of the coils used. The standard commercial coils usually take a .0005-mfd tuning condenser. The isolating condenser is 0.5-mfd and the grid condenser .00025-mfd. A 15-plate midget condenser is satisfactory for regeneration and a neutralizing condenser of the three-plate type is suitable for use in the circuit.

mu tube requires that there be practically as many turns in the plate coil as in the grid coil to get maximum amplification—which will be somewhat greater than with a low impedance tube such as 201-A—and the selectivity will suffer accordingly.

Fig. 6 is an experimental model of the "bridge" circuit built in the RADIO BROADCAST Laboratory to determine whether the circuit was practical or not. The diagram of connections is given in Fig. 2. It will be noted that the amplifier is neutralized by tapping into the interstage coil. This scheme represents a circuit that will work and in nearly every case it will be exceptionally sharp and with considerable sensitivity. There is the difficulty, however, that it cannot be neutralized unless everything in the circuit is placed properly and is of the correct value. The amplifier tends to oscillate until the detector is turned to it when enough energy is extracted to stop oscillations. In other words, the set tends to "lock" into the frequency that is desired and other signals have great difficulty in breaking through the two tuned circuits.

The receiver whose circuit is shown in Fig. 2 will give any home constructor many thrills. As an adventure into circuit building, it is strongly recommended. For the reader, however, who wants a set he can build with the certainty that it will work easily and surely, it cannot be recommended.

EXPERIMENTING WITH THE CIRCUIT

THE home experimenter is encouraged to try the "Bridge" circuit and then to progress to that shown in Fig. 7, the ideal form. It has all of the advantages of which toroids are capable and few of the disadvantages. Neutralization is effected by the Rice method which makes the amplifier practically independent of the detector circuit. With low loss coils, proper spacing of wires carrying radio frequency currents, and shielding if necessary, an amplifier with a large voltage gain will result.

There are many interesting points about the circuit that are worthy of discussion. Considering the detector inductance, it is seen that it consists of a coil which has been physically divided into two parts which are connected together, as far as radio frequency currents are concerned, by a large by-pass condenser. This condenser has the same position in the circuit as the by-pass condenser across the B batteries and if all leads are short and direct and at least a 1.0-mfd condenser is across the B battery, it may not be necessary.

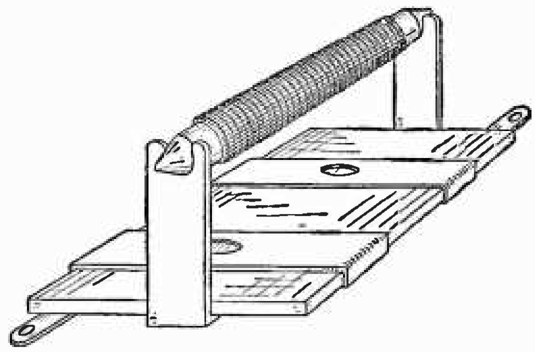


FIG. 10
One method of making a trap for the amplifier circuit. Sufficient wire is wound on the grid leak tube to tune to the offending frequency with the .00025-mfd condenser. A nail placed inside the tube broadens the tuning sufficienctly so that the number of turns is not critical

It is better, however, to include this condenser, which may be as small as 0.1-mfd at the coil terminals so that the coil itself is as nearly complete as possible. The tuning condenser is placed across the entire coil and only part of the voltage developed is applied to the grid. This represents a slight loss which is not noticeable, especially since regeneration is used in this circuit.

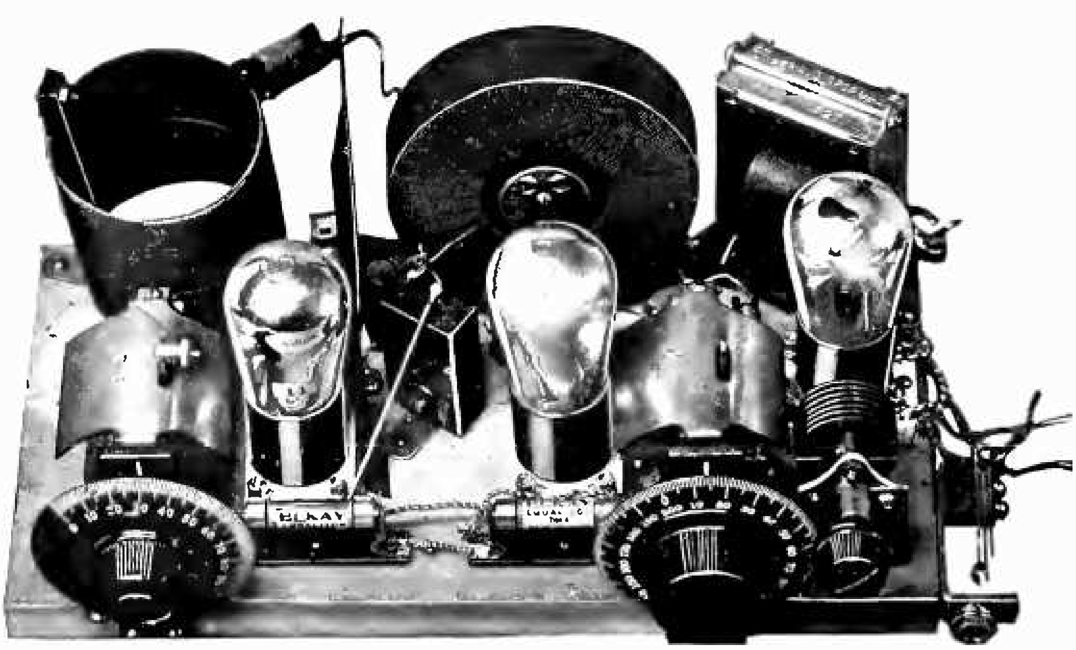
The radio frequency choke may be wound of small wire in slots in an insulating form as shown in the February RADIO BROADCAST on page 443 or it may be a spool on which about 400 turns of No. 32 insulated wire are wound. In the Laboratory, choke coils have been wound with the wire from an old spark coil. Coils which may be used are manufactured by the Samson Electric Company, and one is shown in Fig. 6.

The condenser connecting the plate of the detector tube with the lower end of the detector coil may be any of the small "junior" condensers now on the market. The maximum capacity depends upon the size of the choke coil and it must be large enough so that the detector will oscillate on the lowest frequency (longest wavelength) that is to be received. If the choke is very large, a smaller feed-back condenser may be used. If the choke and condenser are too small, tuning somewhere in the broadcast frequency band, erratic results will be obtained. It may cause the detector to oscillate at some frequencies and not at others, or it may be necessary to introduce more capacity to stop the detector from oscillating. Fig. 8 shows a complete receiver using two toroid coils.

Fig. 9 shows a Laboratory model of this receiver in which is used a choke coil wound of 400 turns of No. 36 enameled wire on an ordinary cotton thread spool. Regeneration is smooth and quiet in this circuit.

The wire which connects the plate of the detector to this condenser is "hot" and it must be kept away from other wires carrying radio frequency energy.

The Rice system of neutralization is employed, making the amplifier and de-



RADIO BROADCAST Photograph

FIG. 9
This receiver uses Samson condensers which make a compact receiver possible, an All American toroid and a Superaudioformer. It is a complete three-tube set on a baseboard 6 by 12 inches. Note the condenser which connects the two parts of the detector coil as well as the copper shield between the antenna coil and the toroid

tector circuits practically identical with regard to the placing of inductances and capacities. The center tap on the antenna inductance must be within one or two turns of the center if exact neutralization is to be attained.

The isolating condenser and the tuning condenser of the detector circuit must be well insulated, or the batteries will be shorted if the condenser shorts. The same may be said of the neutralizing condenser of the amplifier, which should be fixed at the proper point and not varied as is common on many receivers now in use.

A NEW ANALYSIS OF TROUBLE IN THE R. F. AMPLIFIER

IF LOW loss coils are used for the amplifier, a trap may be necessary in the mid-tap of the antenna secondary. The trap is necessary for stabilizing the circuit and is useful and frequently necessary in all r. f. amplifiers using Rice neutralization. If the receiver seems to be inoperative, no signals coming through, or if the amplifier seems to oscillate without regard to the neutralizing condenser, or if a plate meter shows that the first tube is taking a large plate current, this tube is probably oscillating at a very high frequency.

This frequency is usually in the neighborhood of 3748 kc. (80 meters), and is controlled by the "leakage" inductance of the coil and the capacities attached to it. What actually happens is the following. The tuning condenser is practically a short circuit for the very high frequencies. In other words, the coil is an inductance with its two ends connected together. If the coupling between the two halves of the coil were perfect, the resultant inductance when the ends were connected together would be zero. Actually, however, the coupling is not perfect, the resultant inductance is not zero, and the circuit resonates to this leakage inductance and the capacities attached to it.

A trap tuned to the oscillating frequency and placed in the mid-tap will solve the difficulty since it puts enough loss into the circuit, at that frequency, to stop oscillations.

There are several methods of making this trap. One is to wind about 100 turns of fine wire on a dowel rod and to tune this inductance by means of a small condenser until oscillations cease. This tuning condenser may be two six-inch lengths of annunciator wire soldered to the two ends of the coil. These wires are twisted, constituting a condenser, until the proper capacity is found.

Another method consists in removing the "works" from a grid leak and winding about 100 turns on the glass tube. This inductance is then slipped into a .00025-mfd. condenser with grid leak mountings and wire removed or added until stability is attained.

If this trap is found necessary at all, the set cannot be neutralized until the trap is properly tuned, and little that is done to the remainder of the circuit will affect the frequency at which this amplifier oscillates when it is on oscillation bent. This is a phenomenon that has never before been described as far as the writer is aware. Coupling between amplifier, grid, and plate coils has no effect upon it, and in the Laboratory, a mid-tap coil a yard away from the plate coil and connected to the tube through twisted leads still caused the amplifier to oscillate. At times, the amplifier tube has taken as much as 20 milliamperes with 90 volts on the plate and negative 4.5 on the grid until the trap in the mid-tap had been properly fixed.

This trap circuit will tune sharply, and to make it more effective, some resistance should be added to broaden out its resonant frequency. This may be done by using resistance wire, or by placing an iron nail or screw in the grid leak tube. The first trap the writer made was constructed of wire wound on an iron nail hammered into the base board. Wire was added until oscillations ceased.

Something You Don't Know About Your R. F. Amplifier

IN SPEAKING of radio-frequency amplifier circuits, which use Rice neutralization, Mr. Henney analyzes a peculiar, phenomenon, which, to our knowledge, has never before been suggested.

"If the receiver seems to be inoperative, no signals coming through, or if the amplifier seems to oscillate without regard to the neutralizing condenser, or if a plate meter shows that the first tube is taking a large plate current, this tube is probably oscillating at a very high frequency.

This frequency is usually in the neighborhood of 3748 kc. (80 meters), and is controlled by the "leakage" inductance of the coil and the capacities attached to it. What actually happens is the following. The tuning condenser is practically a short circuit for the very high frequencies. In other words, the coil is an inductance with its two ends connected together. If the coupling between the two halves of the coil were perfect, the resultant inductance when the ends were connected together would be zero. Actually, however, the coupling is not perfect, the resultant inductance is not zero, and the circuit resonates to this leakage inductance and the capacities attached to it.

A trap tuned to the oscillating frequency and placed in the mid-tap will solve the difficulty since it puts enough loss into the circuit, at that frequency, to stop oscillations."

OPERATING THE CIRCUIT

IT IS not difficult to neutralize this amplifier if proper precautions are taken. It is best to start experiments with a 199 type tube as the amplifier and to learn all the tricks with this tube. Then one may graduate to a higher gain tube like a 201-A which is more difficult to neutralize.

The detector is made to oscillate and a carrier wave is picked up. The neutralizing condenser is varied until tuning the amplifier condenser does not change the pitch of the beat note.

Less trouble will be had in neutralizing and controlling the set if both coils are toroids. Battery leads should be twisted and made into a cable, keeping them away from grid leads and radio frequency leads.

Commercial types of toroid coils may be adapted for use in this receiver without difficulty. It is only necessary to tap the coil in the proper place. It is not necessary to remove additional coupling coils which are provided by the manufacturers.

Coils may be wound on a rectangular form on which is placed some adhesive tape or absorbent material which is covered with collodion before the form is removed. The coil is then wound about a cylindrical center which makes a solid core.

It may be remarked here that toroid coils furnish an excellent use for enameled wire—and what experimenter is there who has not longed to use a supply of such wire that has been in the laboratory for a long time?

These coils have a low distributed capacity and will tune to a wide range of frequencies. Commercial coils are wound to be used with .0005-mfd condensers although there is no reason why they cannot be made for smaller capacities.

The present article will be followed with another giving exact constructional details of a complete toroid receiver of exceptional gain. Methods will be shown of winding traps, choke coils, and of operating the amplifier filament from alternating current.

It is hoped that home experimenters who assemble the circuit will give the Laboratory an opportunity to hear of their difficulties or successes.

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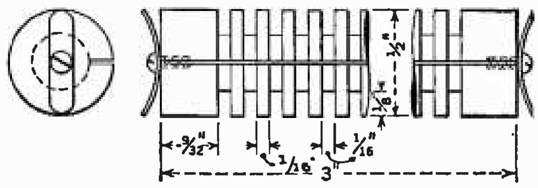


FIG. 11

The specifications for the choke coil for use in the Lab circuit are given above. Twenty slots are provided wherein No. 36 dcc. or enameled wire is wound until the slot is filled. The lead is then conveyed to the adjacent unfilled slot which is filled in the same manner.

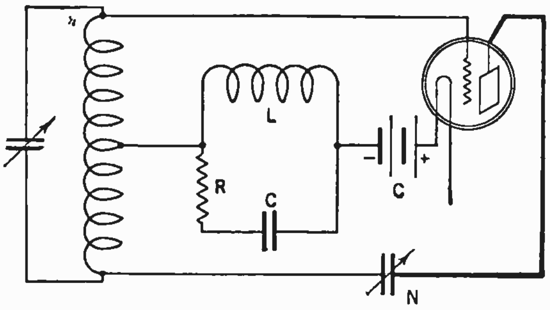


FIG. 12

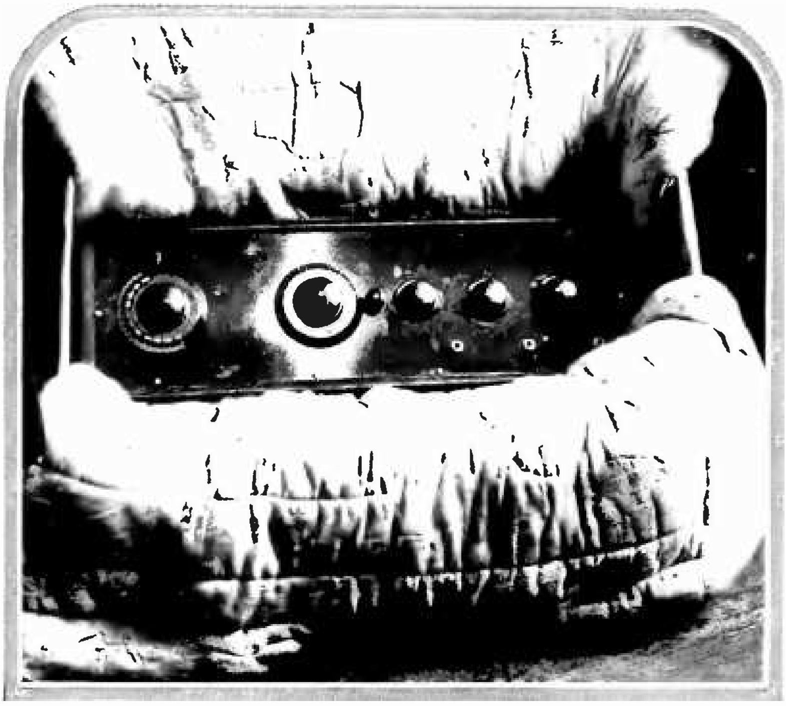
The position of the tuned trap in the mid-tap of the amplifier

How to Pack Radio Sets for Shipment

How Manufacturers Avoid Broken Cabinets, Damaged Coils, Tubes, and Sockets—Suggestions for the Amateur Who Ships His Own Set

By STANLEY W. TODD

American Railway Express Company



HOW NOT TO PACK A RADIO RECEIVER

A woolen blanket will not afford sufficient protection for a set when shipped

A RADIO enthusiast who has gained quite a reputation for his skill in set construction, recently spent many days making a set for one of his friends who lived in another city.

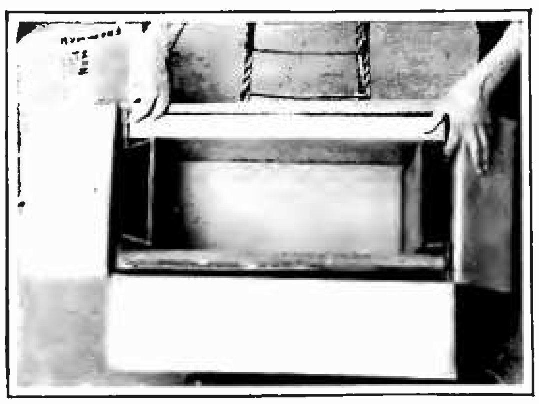
When it came to the final step of preparing the set for shipment, this fan took an old woolen blanket and wrapped the set in it, and then put it in a wooden crate. That was ideal packing, he argued, for, of course, it would be all that was necessary for protection, and would prevent the fine mahogany cabinet he had gone to some pains to get, from being scratched or marred.

But on arrival, it appeared that the set had suffered severely by the trip, and when the tubes were put in the sockets and the battery connected, not a murmur came from the loud speaker. The man for whom it was made at once communicated with the builder and claimed that the express company had treated the shipment pretty roughly in getting it to him.

An express company supervisor, who had given much study to the rather difficult problem of packing radio shipments properly, was brought into the case. When he examined the container and found that only a heavy blanket had been used to cushion the set against the normal shocks and jars of transportation, he knew just where the trouble lay. It was apparent that the blanket offered little protection of this sort, which is considered absolutely essential in every good radio "package."

The average builder of a radio receiver, amateur or professional, handles a set very gingerly in carrying it around. He would consider it quite a problem if he had to take it a great distance by hand, always fearing that the fine inside adjustments would be disturbed. In transit, a shipment may be handled thirteen or fourteen times. Proper cushioning has been found to be the only way by which the effect of such shocks and jars can be neutralized.

It took some time for transportation experts and box manufacturers to determine what was necessary to be done to pack radio shipments so that they would ride safely. This led to the development of what is known as the "air cushion carton," which most of the large radio manufacturers are now using. These are usually made to fit each particular size of set, and



COMMERCIAL PACKING FOR A MANUFACTURED SET

Inside the larger packing carton, usually made up of corrugated material, is placed more cardboard so arranged as to provide an air cushion completely around the set

the cushions, so called, are merely corrugated board, scored or bent in such a manner as to provide at least a two-inch open space between the inner wall of the outside carton and the top, sides, and bottom of the set. The shipping unit is thus a box within a box.

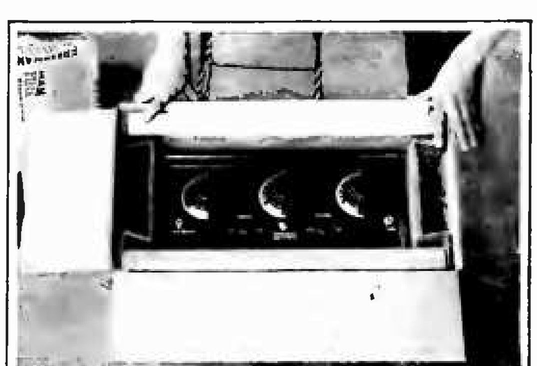
The air cushions hold the set in suspension and prevent the jars which the shipment may encounter in transit from reaching the delicate instrument inside. When put upon a flat surface, the cushions prevent the air from escaping, and that gives a spring-like quality, absorbing the shocks and holding the instrument tightly so that it cannot shift. Some manufacturers have taken the additional precaution, where the sets are unusually large or heavy, to place the carton in a crate.

Most of the damage to radio sets, the express companies find, is encountered not when the manufacturer ships his receivers to his dealers, but when the latter reforward the sets to customers, after having taken them from the original package and replaced them again for shipping. They are not always familiar with the trick of putting the cushions in the proper positions so that they serve the purpose of offsetting jars in transit, as intended. Fans who make their own sets, of course, are less familiar with the importance of air cushions and much trouble is encountered by transportation companies in handling their radio shipments.

PROPER SHIELDING AGAINST BUFFETING

IT SHOULD be emphasized that neither loose excelsior nor paper used for cushioning absolutely neutralizes the shocks of ordinary handling, because when it is crushed down, especially if a wooden box is used, practically every jar of a serious nature is transmitted to the set. There are too many fine adjustments in the average receiver not to cause some trouble, if extreme care in handling is not encountered, especially when the cushioning feature is disregarded.

Damage often occurs to some of the handsome cabinets used by manufacturers because of the inherent weaknesses of the



PLACING THE RECEIVER IN THE BOX

Air cushions are arranged on all sides. The only step yet to complete is the placing of the corrugated pasteboard on top of the panel material. The grain of the wood in the end pieces of a cabinet, for instance, should run crosswise and not lengthwise. Otherwise, when the end pieces are grooved out where the back panel fits, the wood is weakened and a slight shock will cause the ends to split with the grain. If the cabinets are made of green wood or unseasoned lumber, similar trouble may develop.

Panel breakage used to be quite common, because in a good many sets some of the necessary parts, like condensers, heavy coils and the like, were hung from the rear of the panel without support. In transportation, this weight proved too much and a cracked panel sometimes resulted. In the sets of to-day, with the large use of sub-panels and the tendency to place the heaviest parts on the base, the panel is given much more consideration, and, therefore, rides without often encountering trouble.

Of course, common sense dictates that the tubes should not be left in the set when a receiver is shipped, nor should any loose equipment be placed in the cabinet. Obviously batteries should be sent separately

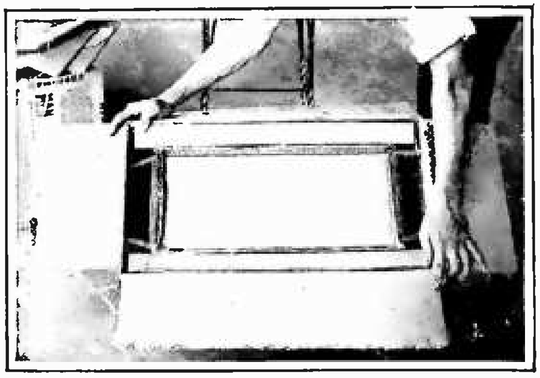
THE TOP AIR CUSHIONS

In this particular type of carton fit snugly over the panel of the receiver protecting the dials and the face of the panel. When shipped, this receiver will have cushions on all sides, thus reducing the chance of damage to an absolute minimum

and there are special ways for packing both dry cell batteries and wet storage batteries. Practically all of the manufacturers are using individual cartons for B batteries, thus removing any danger of short circuiting, while the standard crate for a storage battery is so made that it must always be handled "right side up." Such crates or boxes are made so that expressmen will have something to take hold of in handling them.

Much trouble in transportation has been encountered in handling shipments of loud speakers. The bell or horn of the type in most common use is made of wood or fiber, and is classed as "fragile." The parchment disc type cannot stand much rough handling. Most manufacturers use cartons made for their particular type of loud speaker, and most instances of damage in shipments have come in the reforwarding of them by dealers and individuals.

Here again the air cushion idea has helped to solve the problem. Express companies recommend the use of cartons sufficiently large at least to allow one inch on the bottom and top of the mouth of the bell. The base should be packed separately either in another carton or in a separate compartment in the carton holding the



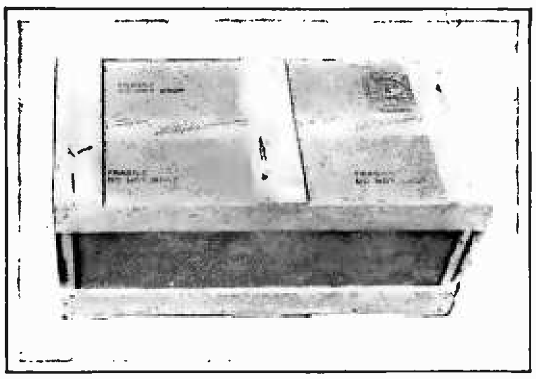
BEFORE SEALING THE CARTON

Note how the receiver is completely and firmly suspended by its interior case. The normal shipping jars will not dislodge the apparatus or damage the cabinet if similar precautions are taken whether or not the receiver is manufactured or home built. The amateur shipper may not be able to produce a box as workmanlike as the ones from the box factory, but he can easily apply the same principles and be sure of adequate protection for his set when it is shipped

bell. A hole should be cut in the cardboard which fits into the carton, to hold the neck of the horn firmly. At least one cushion or filler should protect the mouth of the bell from coming up against the bottom of the carton. "Fragile" labels and one "This Side Up" label on the top, assure proper treatment in transportation.

SHIPPING RADIO TUBES

AS TO the packing of radio tubes, the leading manufacturers have adopted standard cartons which have proved satisfactory. These usually comprise a corrugated collar with a felt wrapping to be



SHIPPING CASE FOR A 30-POUND SET

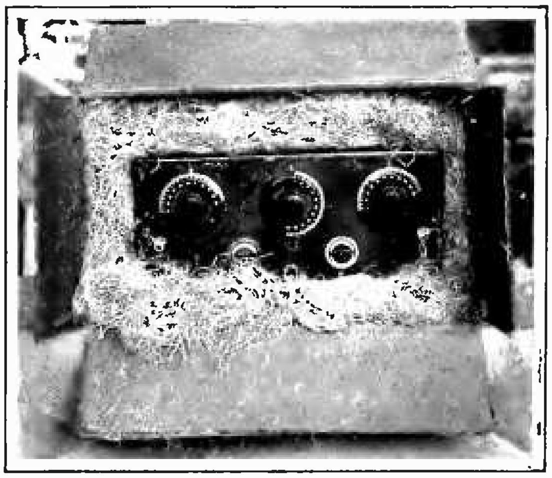
Receivers which weigh more than 30 pounds will travel more safely with a light wooden crate around the corrugated packing case

placed around the tube, and the whole inserted in a special carton. This carton is not expected to prevent a tube from being smashed in case of an accident, but it is strong enough to protect the tube from injury, if it is held firmly, allowing no play in the package, and provides a cushion of some sort to protect the tube from shocks and jars.

Despite all precautions taken, there are still some cases of filament breakage. As this slender wire is less than one-fourth the diameter of a human hair, a slight jar may break it. A heavier shock will disturb or disarrange other elements inside of the tube, causing short circuits in the tube.

A fan who ships a tube only protected by the carton that he buys it in from the dealer is taking a big chance, as it was not intended to serve as a forwarding carrier. A tube carton should be placed in another strong container large enough to allow several inches of excelsior on all sides of the tube carrier. Tubes that have been used for any length of time should not be shipped, as the filament is exceedingly brittle even though the tube may still function, and may not stand handling.

In the express business, the employees have been so frequently cautioned regarding the need for extreme care in handling all kinds of radio shipments, that this traffic to-day is being given special attention.



SHIPPING THE HOME-MADE SET

Transportation companies prefer the use of air-cushion cartons, but where these cannot be obtained, the best packing material to use is excelsior. At least three inches of this material should be placed all around the receiver to insure safety in transit

A good many of them are radio fans themselves and know how delicate the set construction usually is.

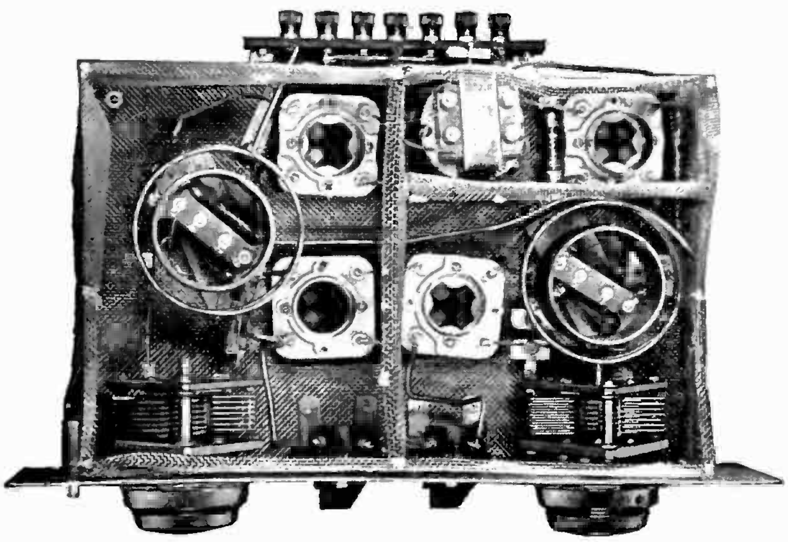
Even though prices of receivers generally are lower than they were a year ago, it is undoubtedly false economy to attempt to skimp on the proper packing materials that will insure the set being properly handled in transit. If the average fan would give the same time and care to the packing of the set as he does to the construction and hook-up, much of the breakage encountered in the movement of the radio traffic would be avoided.

The transportation companies are seeking the coöperation of the public with the proposal, which seems to be fair, that if a radio shipment is packed with due regard for its fragile and breakable character, they will do their utmost to handle it properly during its travels.

Some Entrants in the $500 Prize Contest

A few of the Sets Submitted in the RADIO BROADCAST-Eveready Contest for a non-radiating Short-Wave Receiver

THE illustrations on these two pages depict some of the many interesting short-wave sets that have been received in the RADIO BROADCAST-Eveready contest for a non-radiating receiver to operate on the short amateur waves. With the close of the contest, the process of elimination is actively under way, and the winners will probably be announced in the July number of RADIO BROADCAST. This contest was announced for the reason that practically all short-wave sets now in operation radiate more or less violently, and since it has long been the policy of this magazine to frown on "bloopers," it has not been possible to describe in the editorial pages of the magazine a simple and efficient receiver for the higher frequencies.


RADIO BROADCAST Photograph
THE ENTRY OF W. S. PRITCHARD, CLEVELAND, OHIO

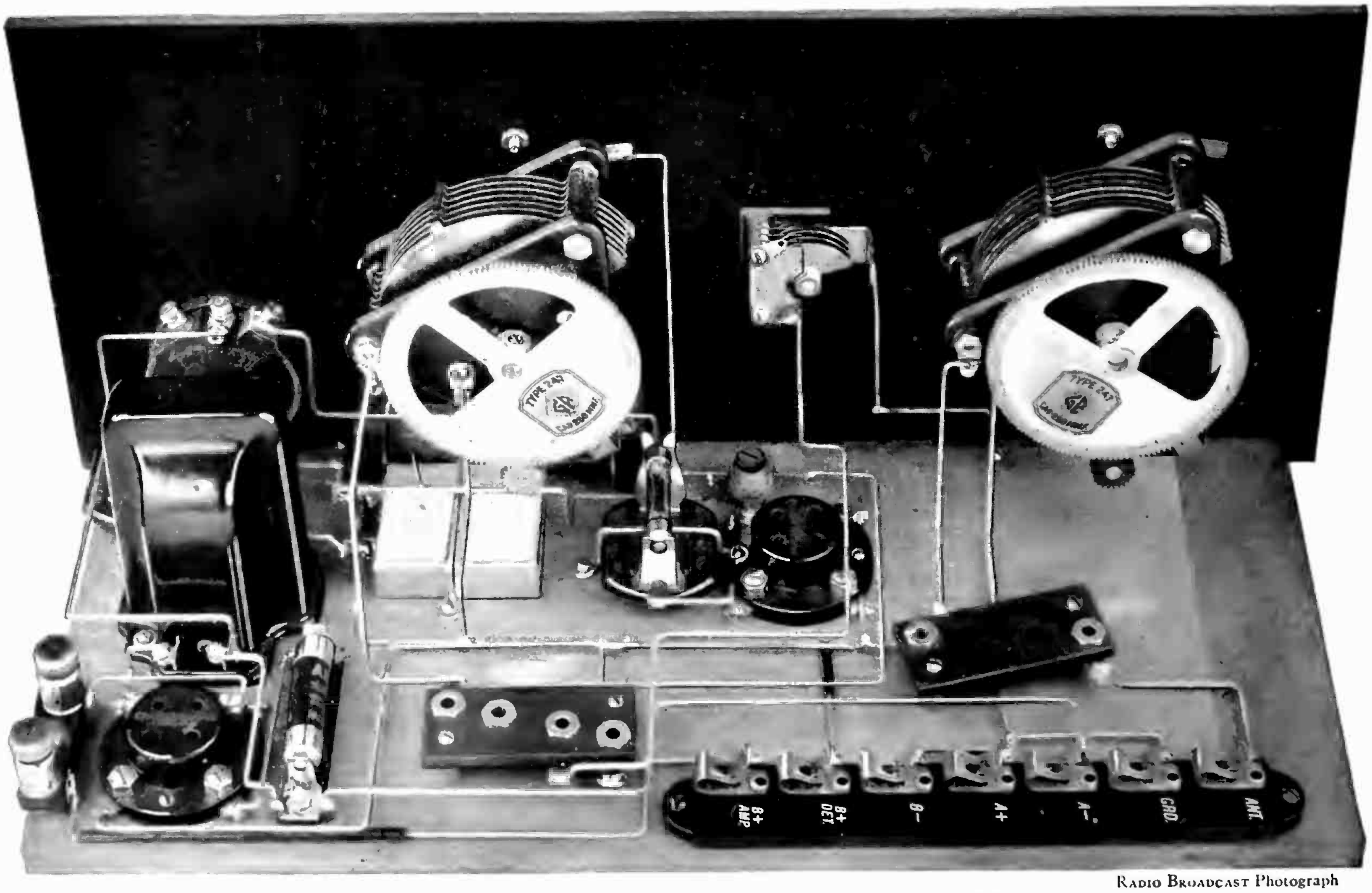
From the manuscripts submitted, fifteen have been chosen as the most promising from the standpoint of their non-radiating qualities, simplicity of construction and operation, and originality. From these fifteen, the judges will choose the three that seem to possess the highest qualifications, and these three will be described in RADIO BROADCAST.

The receivers illustrated here are not chosen with any particular idea in mind, except to show characteristic receivers. They indicate nothing whatever of the relative merits of the fifteen from which the final choice will be made.

The receiver at the left came from W. S. Pritchard, of 4300 Euclid Avenue, Cleveland, Ohio, and uses four tubes, two detectors, an oscillator, and one stage of audio-frequency amplification. Complete shielding is used to eliminate stray couplings and, although the photograph does not show it, there is a brass cover for the receiver, making it a very attractive piece of work.

The receiver below was constructed by L. W. Hatry, 46 South Marshall Street, Hartford, Connecticut—one who has long been known in the amateur game. This receiver is typical of the excellent construction that appears in the best amateur sets to-day, and gives in good detail the relative arrangement of parts, including the disposition of the sockets for the plug-in coils.

On page 129 are three more short-wave receivers, the one in the upper right representing the product of Mr. J. Kriz, 1628 Riggs Place, Washington, D. C. It is a three-tube set with a stage of radio frequency amplification before the detector. The amplifier and detector operating at radio frequencies are tuned with a gang condenser, so that tuning is a simple matter, in fact no more



RADIO BROADCAST Photograph
THE ENTRY OF L. W. HATRY, HARTFORD, CONNECTICUT

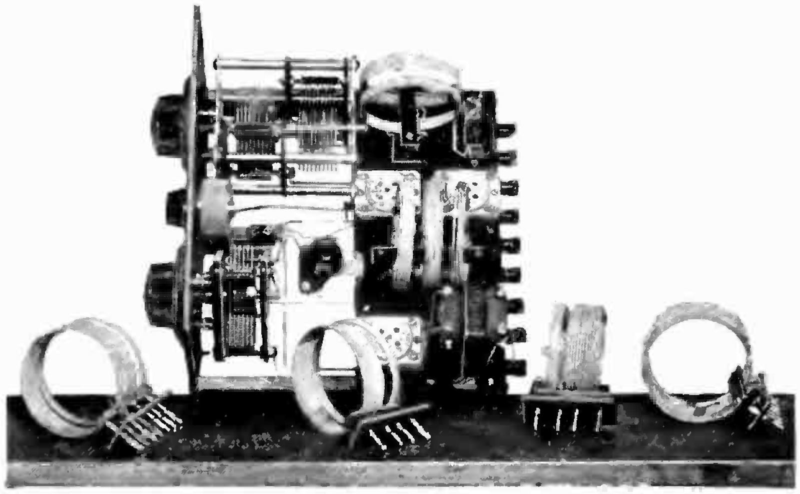
complicated than with the ordinary Reinartz set. In the RADIO BROADCAST Laboratory it seems to have a penchant for southern stations, as XDA, Mexico City, has been heard pounding away at a great rate for many successive evenings.

The second receiver on this page was built by Robert H. Freeman, East Orange, New Jersey, and is a four-tube set. It shows an excellent arrangement of parts, with a minimum of gear between the coils and condensers.

The receiver below was constructed by another well-known amateur, F. Cheyney Beekley, Glastonbury, Connecticut. In this case, the apparatus is mounted on a metal sheet which has been bent so that it forms a continuous shield, a part of it being used as panel and a part as base board. A Silver-Marshall coil is used as inductance, and all parts carrying radio frequency currents are kept well away from the shield.

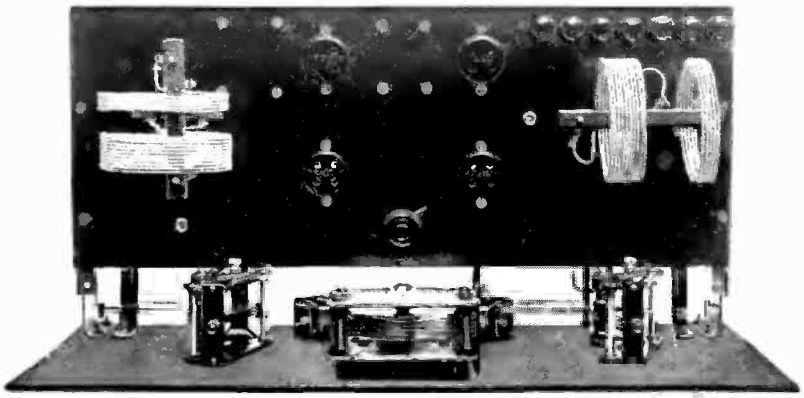
As this is written, tests are under way to determine the relative sensitivity and freedom from objectionable radiation of the various receivers. A fixed oscillator of low power is installed in the Laboratory and signals from it are picked up at the shack which houses 2 GY, about 400 yards distant, and the audibility measured. All receivers are compared with a Reinartz circuit set temporarily used as a standard and which has proved to be very sensitive and simple to handle.

The first test for radiation is a simple one. The receiver is made to oscillate with 90 volts on the detector, and is attached to an antenna at the Laboratory. If its signals can be heard at the shack it gets a poor rating with regard to radiation. It has been found that the Reinartz receiver puts R3 signals into the shack under these conditions, and it forms one method of communication between the Laboratory and 2 GY. If the signals from the receiver cannot be heard, the distance is decreased until they are audible and equal in strength to those of the Reinartz, and then points are awarded. While there is no reason why any operator should use 90 volts on the detector tube, such practice in our tests will determine conclusively the maximum distance at which the receiver will cause trouble to other listeners.



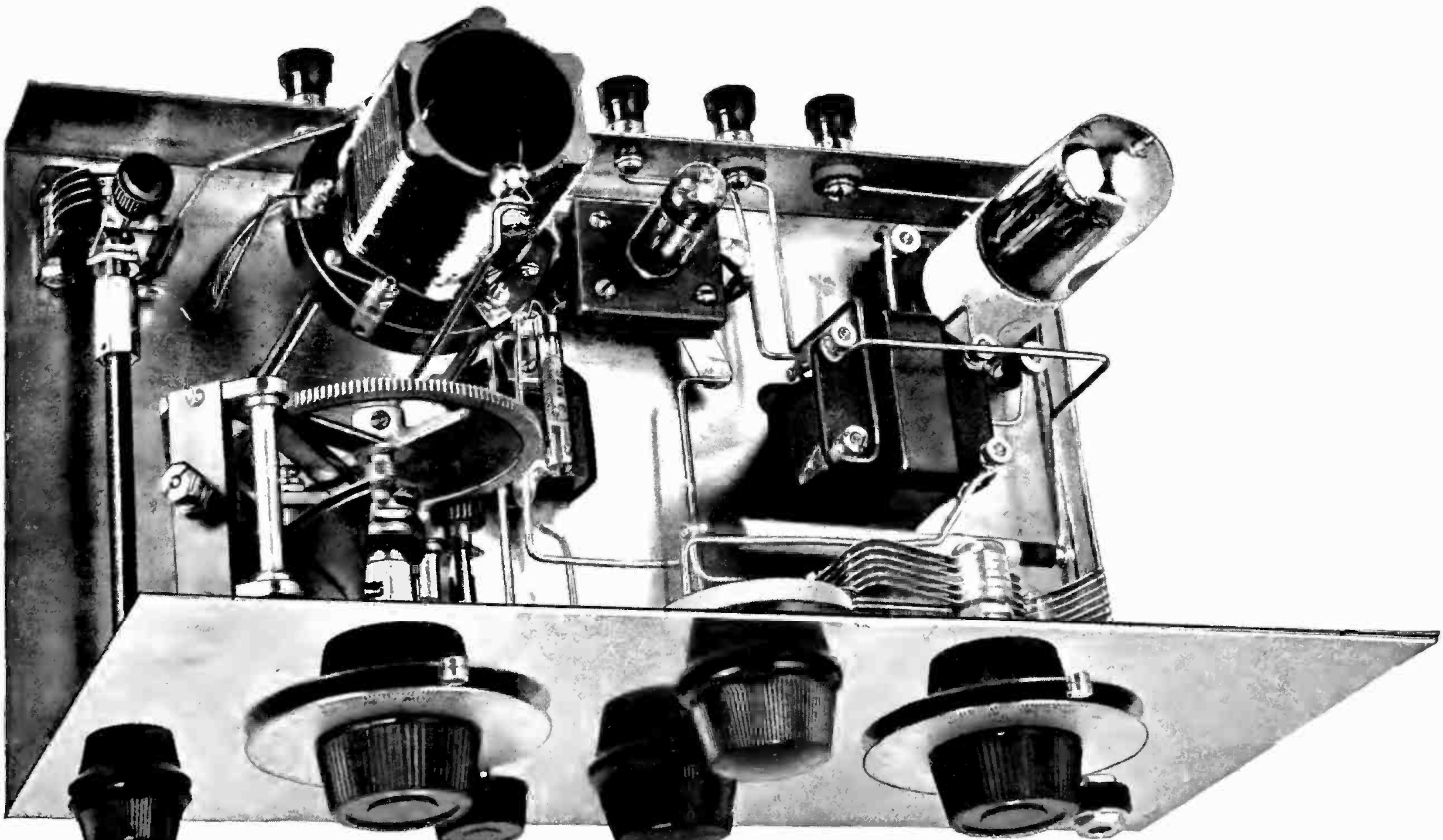
RADIO BROADCAST Photograph

SET SUBMITTED BY J. KRIZ, WASHINGTON, D. C.



RADIO BROADCAST Photograph

CONTEST RECEIVER OF ROBERT H. FREEMAN, EAST ORANGE, NEW JERSEY



RADIO BROADCAST Photograph

ANOTHER SET, SUBMITTED BY F. C. BEEKLEY, GLASTONBURY, CONNECTICUT

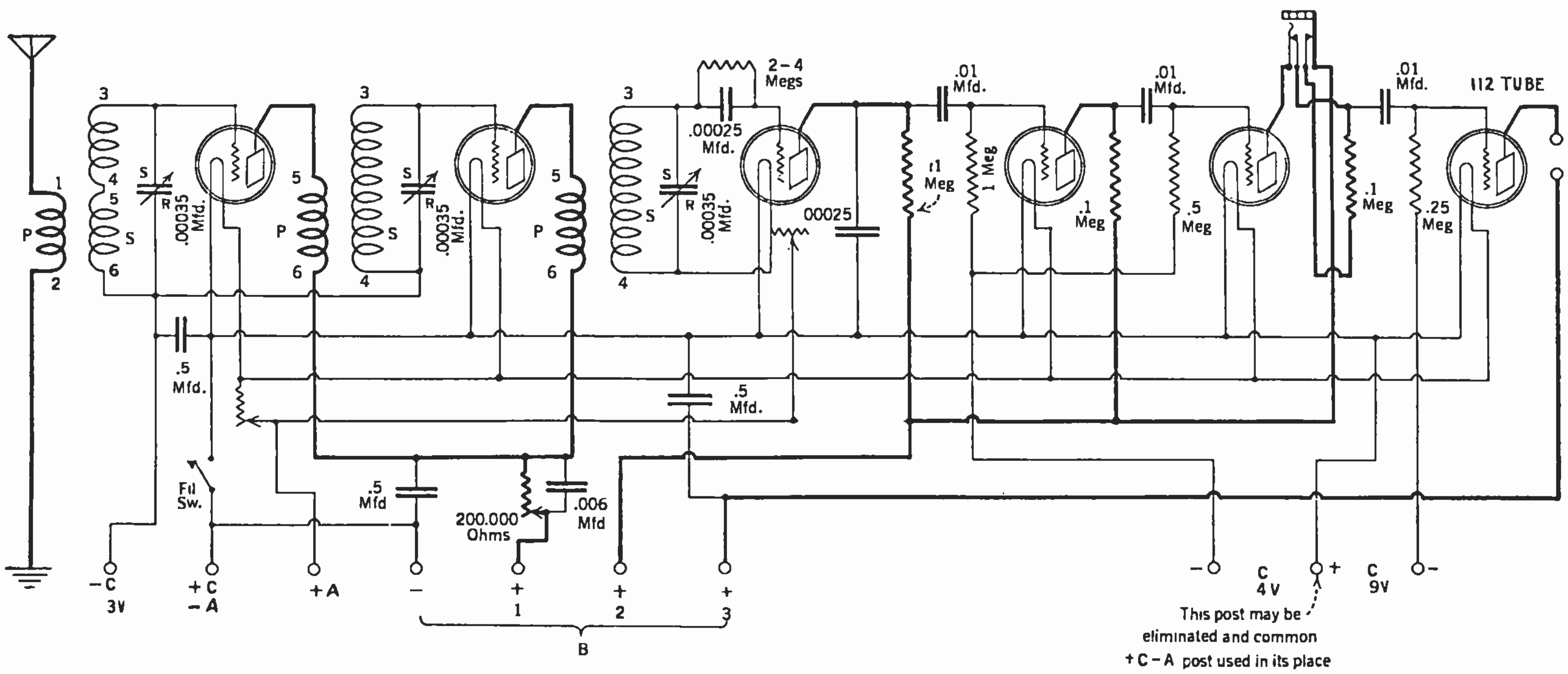


FIG. 1

The modified Silver circuit employing a grid leak and detector, r. f. oscillation control, and separate C and B battery connections is shown here. The changes are more evident when one compares this circuit with the original circuits appearing in the November, 1925, and January, 1926, RADIO BROADCAST or with the circuit shown in Fig. 9, page 132. The B battery terminals, 1, 2 and 3 are for the 90, 90-135 and 135 volt taps of the battery respectively

Progressive Modifications in the Silver Model 1926 Receiver

Changes Which Will Improve This Receiver, Built by Many Readers of RADIO BROADCAST

By THE LABORATORY STAFF

"I HAVE made several changes in the Model 1926 Silver receiver (described in RADIO BROADCAST for November, 1925 and January, 1926), all of which have added to the selectivity, sensitivity and tone quality of the receiver." This, in the main, is the gist of numerous letters received by RADIO BROADCAST. The writers usually complete their letters with a brief outline of the changes made.

In the RADIO BROADCAST Laboratory, we have been conducting some very interesting experiments of our own on this receiver. Our report, with which is blended much of the valuable information gleaned from those who have built and experimented with this set undoubtedly will aid those who have had and are having considerable difficulty in making their own model of this set work properly.

In all probability, it will be found helpful to provide the receiver with a terminal strip having 12 posts. It is doubtful whether the majority of manufactured battery cable cords have enough leads so that it alone may be used to connect the receiver to all the batteries used. Several of the terminal posts may be eliminated or one lead may be used for several purposes, as in the case of the—A—B+C lead or post. This would reduce the number of battery leads or posts to eight, since there are two+C posts to be provided for. By including small blocks of C battery within the cabinet and directly wired to that part of the circuit to which it applies, the number of battery leads may be cut to five: 1. minus A minus B; 2, plus A; 3. plus B 45; 4. plus B 90; 5. plus B 135. Reference to the modified circuit diagram, Fig. 1, will make this suggestion quite evident.

IMPROVING DETECTOR SENSITIVITY

ONE of the main changes in the receiver proper is the replacement of the detector C battery with the more standard grid leak and detector. In including the grid leak and detector in the circuit, it is merely necessary to disconnect the wire leading from the detector secondary to the grid post of the detector socket and insert in this opening, the grid leak and detector. A .00025-mfd. condenser is satisfactory and is shunted by a leak of 2 to 4 megohms. The lower side of the detector secondary coil, terminal No. 4, does not connect to the minus C line but is brought directly to the positive terminal of the detector socket. These changes are shown in Figs. 1, 2 and 3.

The next change comes in connecting the lower end of the r.f. plate coils of the first and second stages directly together and then leading this junction to one side of the 500,000-ohm variable resistance which previously has been disconnected from its original place in the circuit. The other side of the resistance connects to a separate B battery terminal or cord. It is well to by-pass the variable resistance when in its new position with fixed condenser ranging from 0.006 mfd. to 0.05 mfd. Where this change is found unsatisfactory in that the control of oscillation is over only a small part of the 500,000-ohm resistance, then it will be necessary to substitute for this unit, one having a maximum of 200,000 ohms. See figs, 6 and 7.

TABLE I

TUBE	USE	B VOLTAGE	C VOLTAGE
201A type	in the r.f. circuit	67.5 or 90	— 4.5
" "	1st a.f. (Transformer)	90	— 4.5
" "	1st and 2nd a.f. (Resistance)	90	— 1.5 to —3
High-Mu	1st a.f. (Resis. and Imped.)	90 to 135	— 1.5 to —3
"	2nd a.f. (Resis. and Imped.)	90 to 135	— 1.5 to —3
112 type	Last a.f., Power	135	— 9
		157.5	—10.5
		180	—18
		225	—22.5
210 type	Power Stage	250	—18
		350	—27
		425	—35
120 type	Power Stage	135	—22.5

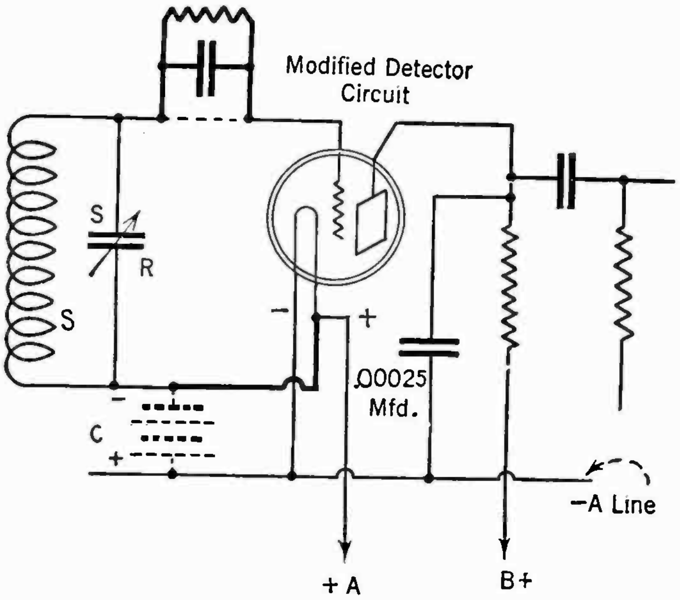
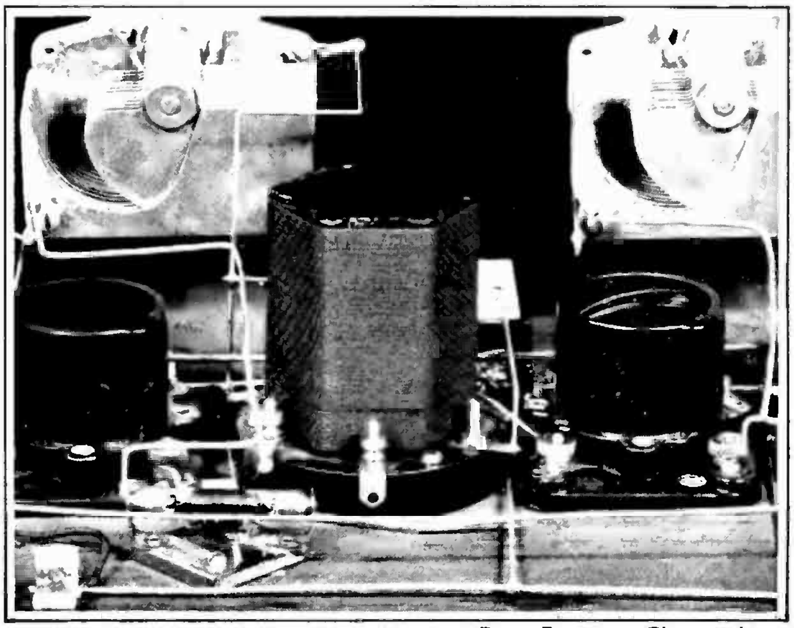


FIG. 2
In substituting a grid leak and condenser for the C battery method of detection, the return or lower side of the detector secondary circuit must connect to the positive terminal on the detector tube socket. These changes are outlined here

FIG. 3
One of the simplest changes is in substituting a grid leak and condenser for the C battery method of detection. The connections for the change are outlined in the circuit Fig. 2



Radio Broadcast Photograph

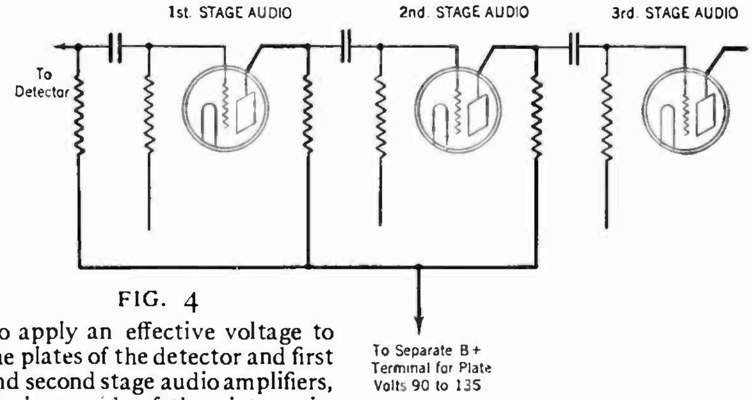
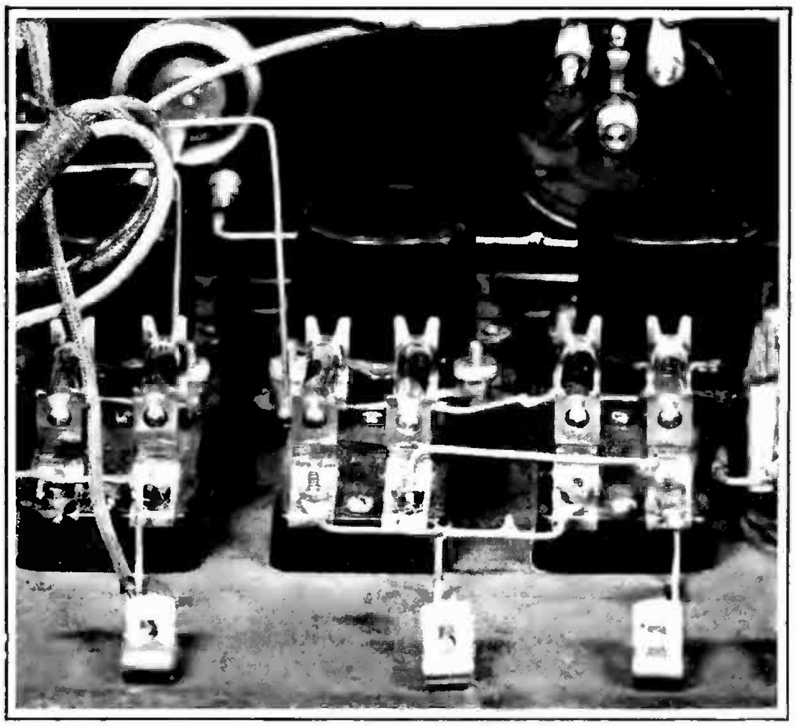


FIG. 4
To apply an effective voltage to the plates of the detector and first and second stage audio amplifiers, the lower side of the plate resistances are connected to a separate B battery terminal post as shown here. Since in the loud speaker circuit, there is no high resistance, the plate of the last tube has a full 135 volts applied to it



Radio Broadcast Photograph

FIG. 5
Since it is not possible to make use of the battery cable cord for all the terminals, it is necessary to employ more terminals for the additional battery connections. These are provided by the use of the Fahnestock clips as shown

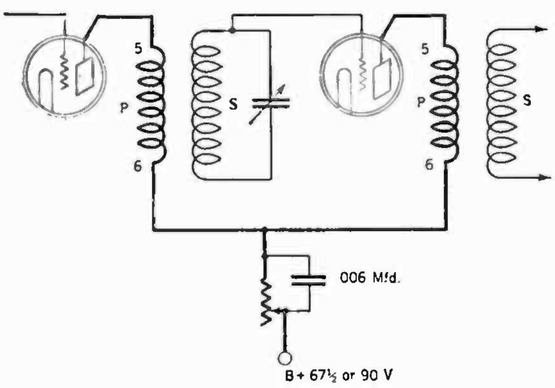
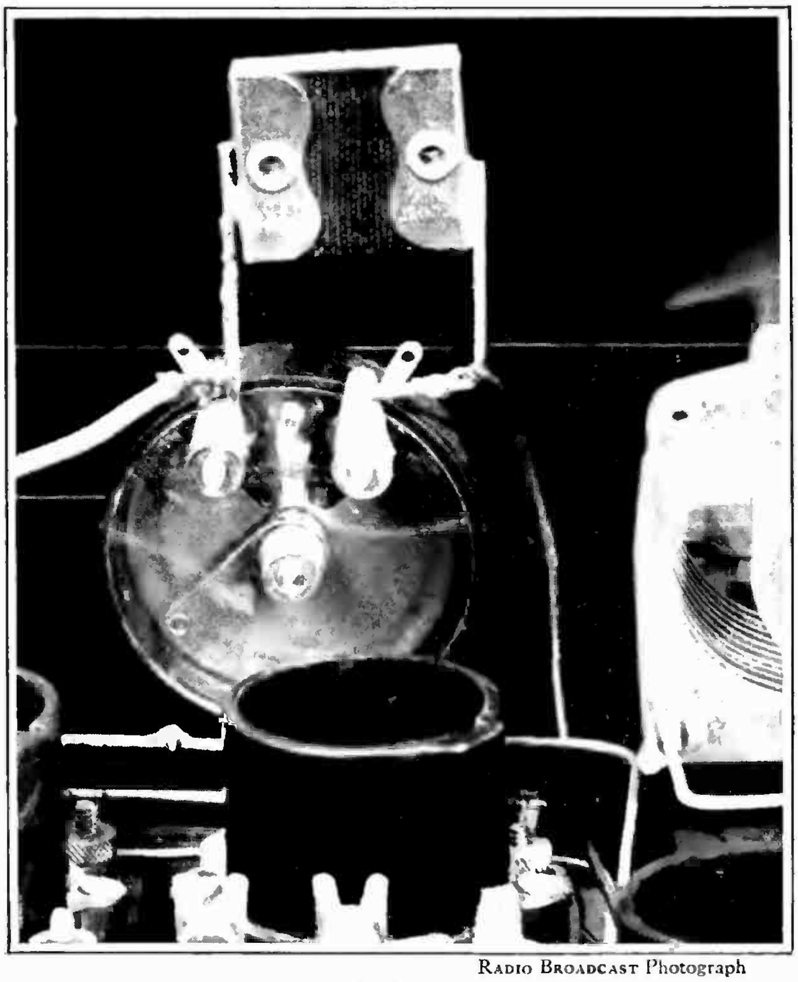
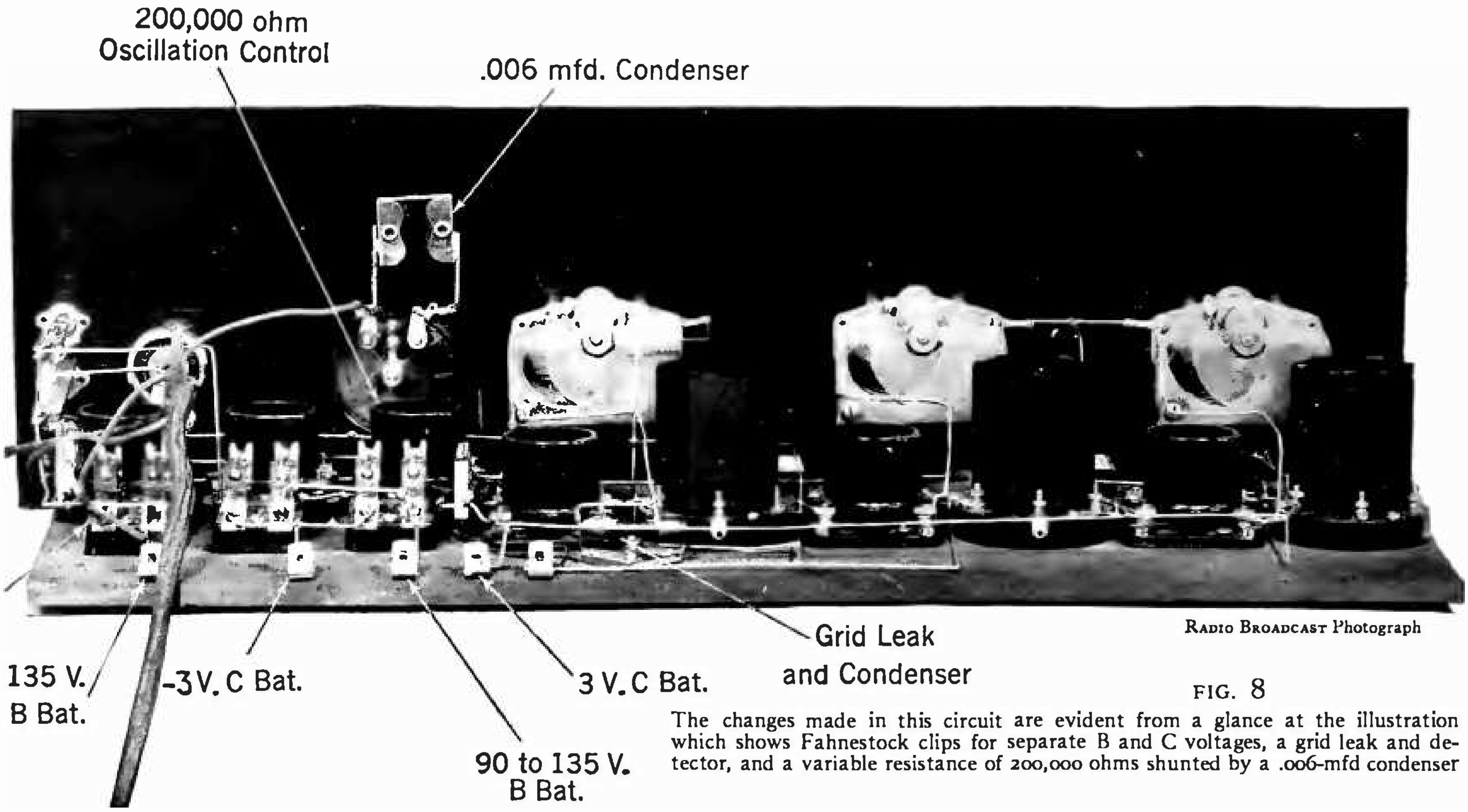


FIG. 6
To control satisfactorily, oscillation in the radio frequency stages, a variable high resistance unit is connected in the radio frequency plate circuits as shown. This resistance, for best results, should be by-passed by a fixed condenser. Various values may be tried. That suitable in Radio Broadcast's Laboratory tests was an .006-mfd fixed condenser. The 500,000-ohm variable resistance employed in the original Silver circuit will usually be found unsatisfactory in the modified circuit. One having a maximum of 200,000 ohms such as the Centralab No. 201, or 203 is recommended



Radio Broadcast Photograph

FIG. 7
The position of the variable resistance is not changed in the modified receiver. Merely replace the 500,000-ohm unit for one having a maximum of 200,000 ohms



RADIO BROADCAST Photograph

FIG. 8

The changes made in this circuit are evident from a glance at the illustration which shows Fahnestock clips for separate B and C voltages, a grid leak and detector, and a variable resistance of 200,000 ohms shunted by a .006-mfd condenser

PROPER B BATTERY FOR THE PLATES OF THE AMPLIFIER TUBES

WHERE resistance - coupled, audio-frequency amplification is employed, the plate return side of the detector and first and second stage plate circuit resistances connect together and then lead to another separate terminal or cord. This is so that B voltages in excess of 90 may be applied to the first two stages of resistance audio amplification without affecting the radio-frequency amplifiers. In the original circuit diagram, the connections were such that not more than 90 volts could be applied to the plates of the first two audio amplifier tubes without, at the same time increasing the r.f. plate voltage. This change is outlined in Figs. 4 and 5.

The plate return of the last audio stage should connect to its own terminal for a separate B voltage, which may be still higher than for the first two stages. In this last stage a semi-power tube may be employed to the best advantage.

In all the stages, both r.f. and a.f. it is decidedly necessary to be sure that one uses the correct C battery as indicated in Table 1.

These same changes as made in the resistance audio amplifier will hold good for both transformer and choke coil audio amplification with the exception that in these cases, lower B voltages will be found satisfactory. In the latter two types of audio amplification named, a separate connection from the plate circuit of the detector tube will be found necessary to prevent the detector from continuously oscillating. The extra lead may well connect to the 45 volt B plus terminal of the B battery.

In summing up, then, the modifications which will be found beneficial are:

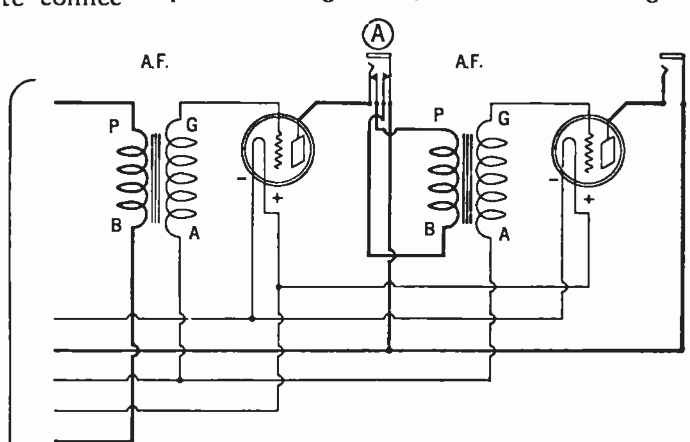
1. Provide separate leads for first and second r.f. stages, first and second audio stages, and last stage; also detector stage, if other than resistance coupled amplification is employed.

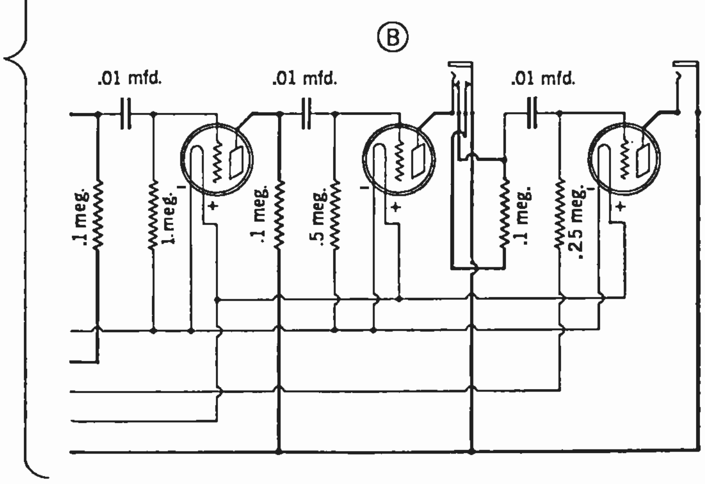
2. Insert a 200,000—or 500,000-ohm variable resistance in series with plates of both r .f. tubes and B battery terminal.

3. Eliminate C battery for detector and replace with grid lead and detector.

4. Use proper C battery voltage on r.f., first and second a.f. and last a.f. stages.

5. Use a semi-power tube, with proper B potential and grid bias, in the last audio stage.





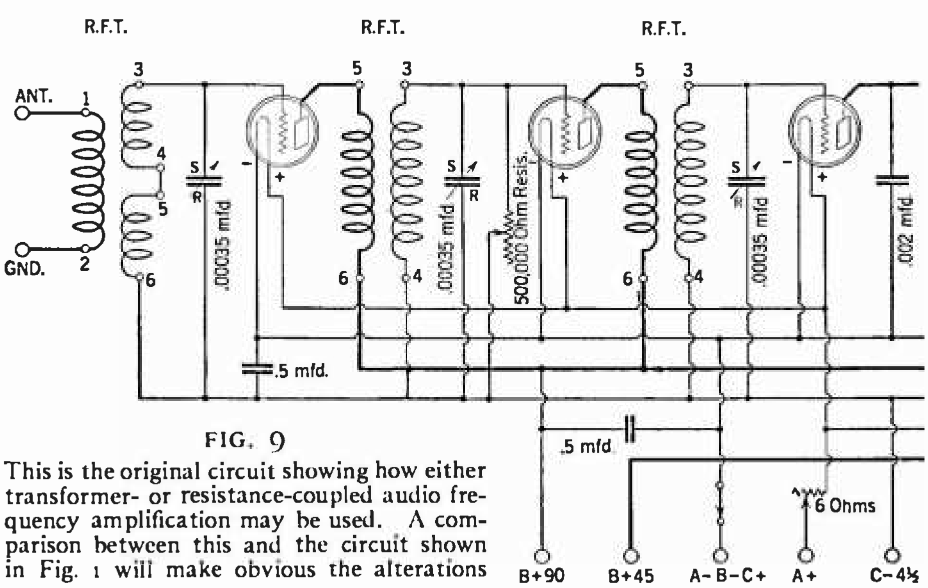


FIG. 9

This is the original circuit showing how either transformer- or resistance-coupled audio frequency amplification may be used. A comparison between this and the circuit shown in Fig. 1 will make obvious the alterations

Conducted by — John Wallace

Why it is Difficult to be Funny Over the Radio

THAT radio programs are improving in quality, even the most lugubrious crape-hanger must admit. And we make haste to admit it. The healthy condition of competition existing where several hundred broadcasters are daily vieing for the listeners' cherished ears has, of necessity, resulted in a considerably higher level of entertainment.

Need we say that them kind words do not apply as a blanket compliment to the whole brotherhood of broadcasters. Many stations are just as bad as they were two, three, or four years ago. But the stations that have progressed have done so by such leaps and bounds that, even though a minority, they have greatly boosted the average rating of broadcast fare.

Nor does the encomium apply to all departments of broadcasting. Certain types of program have improved while others have lagged behind. By far the greatest advance has been in music, both high- and low-brow. We doubt if radio will ever offer any better jazz bands than it now furnishes (though, with the help of the jazz composers it may well offer better jazz music). There are highly skilled syncopators to be heard from every part of the country.

And real music is being heard more and more frequently. A fair smattering of the best symphony orchestras are regularly on the air. The roll of opera stars and concert artists who have been heard once or oftener has reached amazing proportions. Sports announcing is another program item that has evinced great progress. Others could be enumerated.

But tossing aside, for the moment, our horn, and picking up our hammer, we point, with tears behind our eyelids, to one type of program that has improved nary a whit. And that is the "humorous" program. All great art, unless it be too infernally sublime, has an element of humor in or about it. But radio, the most loudspoken "art" of this Age of Progress is lamentably devoid of this enlivening feature.

This is due to one of two things: either the program directors haven't been spending enough sleepless nights cogitating on this subject, or—it is inherently impossible to put across humor through the medium of radio. Which of these reasons is the correct one we have not yet doped out. Perhaps you have? At any rate we'd be very much interested in hearing your opinion on the subject.

Occasionally, very occasionally, we hear something that reassures us that humor is broadcastable. For instance we have howled heartily at Ford and Glenn. The "Happiness Boys," Billy Jones and Earnest Hare, who hold forth over WEAF Friday nights, are consistently funny. And there are a few others. In speaking here of humor we have in mind specifically monologues and wit-and-repartee skits, and do not mean to include humorous songs or humorous musical skits, which get by partly on the strength of the music.

In support of our alternative solution of the problem it might be observed that the radio audience differs from the theater audience in that it is not a "crowd." It presents no "group mind" to the radio entertainer, and hence is a difficult thing to deal with. We refuse to laugh at a radio wise-crack for perhaps much the same reason that we don't laugh out loud at a funny paper we are reading in the street car. The contagion that sweeps a laugh through a vaudeville house is denied the listener-in. Efforts of the radio clown to inject the element of *rapport* by laughing with his audience invariably meet with dismal failure. Nothing in the world sounds more mournful and mirthless than a loud "haw haw" as conveyed by radio.

WILL ROGERS

One of the best known stage humorists in America, whose opinions on humor by radio are presented in this department this month. Entirely parenthetically, Mr. Rogers is reported to have returned from Florida with the remark that the real flower of that state is now the all-day sucker

As to what the humorists themselves have to say on the subject, we append the following report compiled by Myra May from interviews with three prominent comedians, Billy B. Van, Will Rogers, and Joe Cook.

"The hardest thing for the comedian to bear in mind when talking over the radio," says Mr. Van "is that the audience is looking at him through ears and that he must appeal to them through their mental eyes. This means that he can't shamble out with an awkward gait and look around him with a bewildered expression while the spectators take in the details of his baggy trousers, enormous shoes, red nose and absurd little hat cocked on one side of his head. He can't depend on any stage properties to bring out an obscure point. He has to attract the attention of his audience immediately and explain his properties as he goes along.

"He is allowed much less leeway than on a stage. He can not walk away from the microphone and leave his invisible audience wondering what he is doing. He can only do his work as well as possible, secure in the knowledge that good work will hold the people who listen-in as surely as it holds those who sit in front of the footlights.

"There are, moreover, certain very positive 'don'ts' that govern radio humorists. Diction must be perfect, voice resonant and every syllable clearly enunciated. Much of this is accomplished by word substitution, because certain words do not carry well. The letter 's' for example never goes over the air distinctly. So that if the comedian is telling a story where on the stage he would use the word 'string,' he must substitute 'twine' for the benefit of his radio audience.

"In telling a joke, there is always the grave danger that the point won't be clearly emphasized. Perhaps the last sentence which usually contains the pith of the story will be distorted and the listeners will have waited in vain for the humor. They will have endured the long-winded explanation that led up to the climax and then missed the whole point. As a result, the radio comedian tells his story much more directly than he would on the stage, he can not allow any rambling from the main point, any loitering by the wayside and yet he must not be too abrupt, too direct.

"Radio, however, has brought a great contribution to humor in that it has clarified the jokes of the professional merrymaker. Where a slight innuendo, a double meaning that was slightly *risqué*, could be used on the stage, it is absolutely taboo on the air. Only the cleanest of clean humor, entirely free from suggestion, is permissible. Considering the millions of people that may be listening-in and the little children that are probably part of the audience, this is right and proper.

"The comedian is considerably hampered by this very diverse audience. He can not tell witticisms that appeal locally, he can not tell stories that hold a race, a class or a religion up to ridicule, he can not make a pun that is complicated, he cannot jest of things which are not familiar to the every day life of his hearers."

Says Will Rogers: "Talkin' over radio is like talkin' over the footlights. When I'm most serious, people think I am tryin' to be funniest. Lots of times gags I could swear would get a big laugh, fall perfectly flat. You never can tell what is going to strike the public funny. Generally I make up my gags as I go along. Best ones I ever pulled come to me all of a sudden while I was killin' time trying to think of something to say.

"'Swinging a rope is all right,' I remember saying, 'when your neck isn't in it. Out West where I come from they won't let me play with this rope, they are afraid I might hurt myself.' Well, the audience started to laugh and forgot to look at the lariat. I was saved. After that, I started to make remarks regularly until the time come when I hardly did anything with my lariat.

"Now when I talk over the radio, I sure don't need a rope. Course, I can't hear whether the folks are laughin' at my gags, but that's a pretty good thing after all. I jest imagine they laugh, whether they do or not, and that way puts some heart in my act. If I was to hear them not laughin', it'd like to break my heart."

Joe Cook made his radio debut not long ago.

"At first I found myself talking too fast because I was rather nervous," he confesses, "but inside of about three minutes, I had caught the spirit of the thing. I felt as though I were really talking direct to my audience. Throughout the whole time I was on the air, I was deathly afraid I was mechanical, that I sounded as though I were talking into a record instead of joking with a real flesh and blood audience.

"I don't want to pose as a radio expert, for I have really had very limited experience. So far, however, I have told the same stories through the microphone that I tell over the footlights. In time, I believe that there will be specialized humorists who will write material especially for the radio. This material will probably be very much cleverer and more subtle than the usual line of patter in use to-day, for when you appeal strictly to the ears and lack even the prop of personality, you must create proportionately brighter quips to hold your audience.

"My radio act is practically the same as my stage, except that I try to put more unction in the former. On the stage, I can juggle with balls, bottles, ladders, musical instruments; on the radio, I can juggle only with my voice and play the musical instruments."

JOE COOK

Who tells his opinions of the difficulties of "putting over" humor on the air. Mr. Cook, a favorite on Broadway, is perhaps best known for his impersonation of the four "Hiwayians"

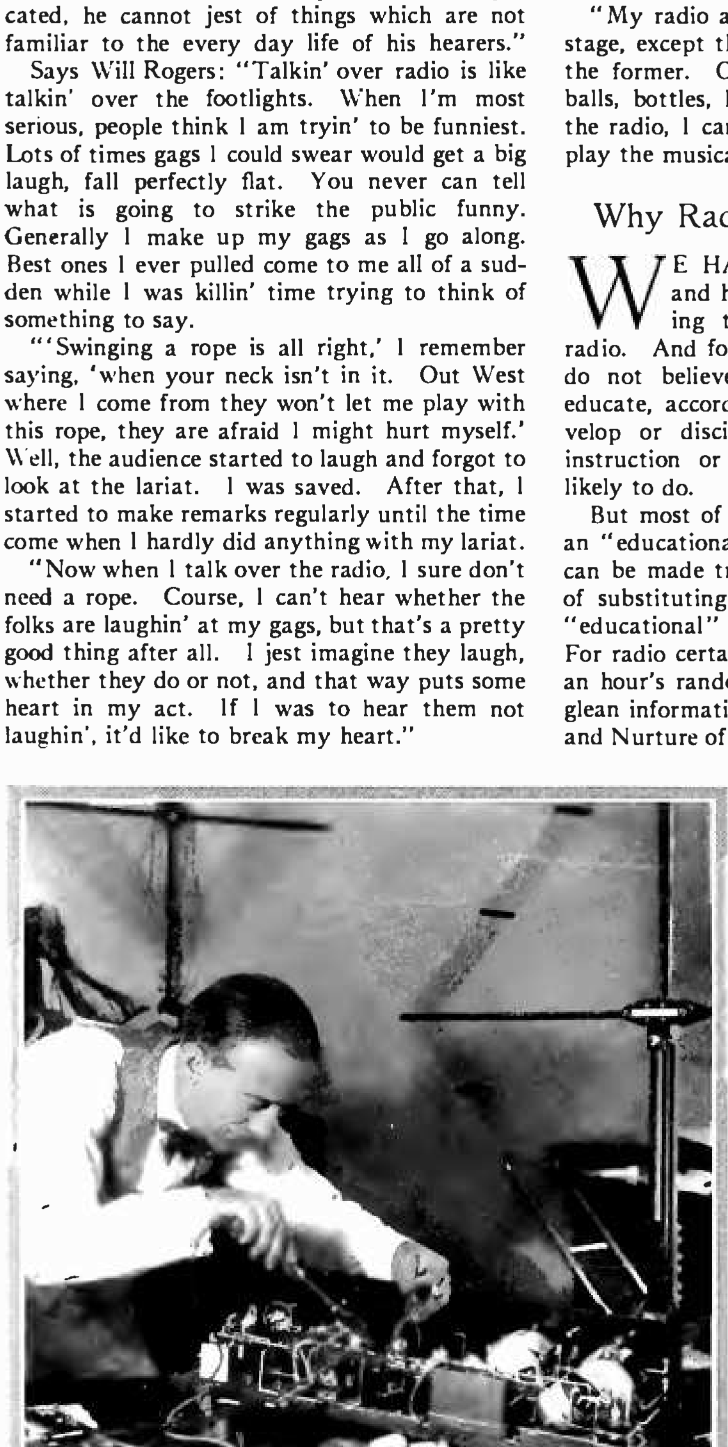
Why Radio Cannot "Educate"

WE HAVE never emitted loud whoops and hurrahs in these columns concerning the educational potentialities of radio. And for the very simple reason that we do not believe that radio can educate. To educate, according to Mr. Webster, is to "develop or discipline the mind by systematic instruction or training." This, radio is not likely to do.

But most of the blah we read about radio as an "educational" factor is sincere enough, and can be made true enough by the simple device of substituting the world "informational" for "educational" wherever the latter appears. For radio certainly can inform In the space of an hour's random dial twisting we are likely to glean information on any subject from the Care and Nurture of White Mice to Efficient Methods of Lubricating a Traveling Crane.

While we are still skeptical about the ultimate value of the thousand and one radio extension courses offered by many colleges throughout the country, we are quite amenable to the arguments offered by one Joy Elmer Morgan of the National Educational Association in favor of the use of radio as an ally of primary education. For the fact that radio is a puny educational force while standing on its own legs doesn't argue that it can't be put to some good use with some better established educational medium to cling to.

Mr. Morgan urges that radio receiving sets be given a place in the class room. Among the 25,000,000 school children in the United States, he points out, there are probably a million who are studying approximately the same thing at the same time. Says Mr. Morgan:



BILLY B. VAN

Another humorist artist with words and ideas. His impressions of the possibilities of humor on the air are quoted for the first time

It would be possible to take some selection in literature that every child should know and have it read by some such master voice as Julia Marlow's. It would be possible on holidays, such as Washington's Birthday, to have noted authors read from their own selections. No child could listen to Edwin Markham read his noble poem, "Lincoln the Man of the People," without getting a fuller appreciation of Abraham Lincoln and a finer feeling for poetry.

It would be possible to have musical selections, both vocal and instrumental, played to a national audience of school students. Geography could be made a rich adventure by introducing frequent talks by men and women who had recently visited areas which the children were studying. There are also large possibilities for radio in the improvement of instruction. More than half the teachers of the United States have had less than two years of training beyond the four-year high school.

Were there a radio in every school, it would be possible to broadcast master lessons and recitations in various subjects which would be rich in suggestions to younger and inexperienced teachers. There is another angle that is most important. Teaching is an arduous occupation. There are long hours of uninterrupted strain. To break this strain a few times during the day by genuinely helpful inspirational material over the radio would enable the teacher to come back into the day's work with fresh vigor. These are just a few of the possibilities.

Mr. Morgan does not mention it, but Oakland, California has conducted an experiment (through KGO) in the use of radio in teaching in the schools, with results that the Oakland school authorities declare to be most satisfactory. In fact the situation in Oakland has passed the experimental stage and the system has been adopted as a fixture. A nation wide extension of this practice seems inevitable.

Of course we who learned our three R's in the dark ages before radio need have no fears that the infant generation of readers and writers and arithmeticians is going to learn any more with radio's help than we did without it. But still, we in our day, didn't have to risk our slender young necks on the way to and from school dodging speeding automobiles. so it seems only fair that the children of the machine age be entitled to whatever of good machinery has to offer.

Let the normal schools hasten to offer a course in The Quick and Careful Tuning of Radio Receiving Sets. Perhaps it might be given by radio!

FREDERICK WILLIAM WILE

Washington special correspondent and political observer, who broadcasts decidedly interesting talks every Thursday evening through WRC and WJZ. His subject is "The Political Situation in Washington," and if you enjoy keen observation and well done verbal reporting, you had better hear him

Esperanto as the Interational Radio Language

WE HAVE yet to be convinced that Esperanto either can or should be made an international language. Our prejudice against this coined auxiliary tongue is based on several, what we consider good, reasons. But we have a sincere respect for the tenacity of the Esperanto propagandists, who certainly have little personally to gain by its promulgation.

We are in receipt of a letter from Robert S. Woolf, American secretary of the International Radio Association, from which we quote:

There is but one solution to the problem which confronts successful world-wide broadcasting, and that solution is the idea of an international, auxiliary language. From the time of the Roman Empire there have been thoughts and schemes for a single world tongue; many have been invented, tried, and found wanting—but there is a language which in actual practice has been proved suitable. That language is Esperanto.

In its grammar and its system of word-building, Esperanto is the extreme of simplicity. An educated person can learn it well for reading, writing and speaking in three months of ordinary study. After a few hours' study one can take up correspondence in the language with interesting people in all parts of the world, thereby materially increasing one's knowledge and international viewpoint.

Particularly in radio use Esperanto has been found to be the only suitable world language. Beginning with a speech from WJZ in Newark, June 19, 1922, about Esperanto as the coming world language, the number of stations broadcasting about and in Esperanto has grown proportionately with the increase in the number of radio stations. In 1922, five discourses about Esperanto were broadcast in America and Europe. In 1923 about fifty such items were on the air, more than two hundred in 1924, and during 1925 approximately twenty stations on both sides of the Atlantic have broadcast regularly in Esperanto. Many stations have been giving lessons in the language on the air, in the United States such lessons being broadcast by WRNY of New York, the station of *Radio News*, which magazine has been an ardent supporter of Esperanto as the only suitable auxiliary language for international radio use. A recent report from Germany states that every station in that country is now giving a weekly program in Esperanto.

What the Listeners Say They Want

THE management of station WJZ during the last two months circulated 10,000 questionnaires covering all of the important phases of broadcasting, so that the impresario in making up the programs would know just what the public most desires in the form of radio entertainment. The questionnaires were sent to all who wrote to the station reporting on reception of the 50-kilowatt transmitter.

The questionnaire was impersonal. No one was asked to sign his name. Each questionnaire was accompanied by a stamped addressed envelope. More than 4000 were completely answered and returned to the station. The results have been tabulated, under the direction of statistician, and they show what broadcast listeners prefer to hear on the radio.

Classical music was 33 per cent. more popular than jazz.

The answers revealed that orchestral music is the most popular. The other instrumental music is rated as follows: bands, symphonies, violin, organ, piano, 'cello, saxophone and cornet. In the instrumental group, quartets were half again as popular as trios and twice as much in favor as duos.

Relative values of the service end of the programs showed news is 25 per cent. more popular than time signals and sports, which ranked second and third respectively. National and local news broadcasts ranked about equal in importance. The other service features were voted for as follows: stock reports, financial reports, road conditions, agricultural information and cotton reports.

The most popular sport broadcast in the United States is baseball, according to the questionnaire. Baseball was 10 per cent. higher than football, which received the second highest vote. The other sporting events ranked as follows: boxing and horse racing. Hockey did not show up well in the votes submitted by listeners in this country, but the Canadian answers placed hockey in first place as the favorite sports broadcast and horse racing was second. Baseball received a few Canadian votes. Canadian votes for football were very few.

Travelogues ranked far ahead in the field of talks. Scientific topics were second, with the other subjects voted for as follows: politics, health, literary, economics, art, debate, forum, and beauty.

The questionnaire clearly shows that men announcers are more popular than women announcers. Several spaces on the questionnaire were provided so that radio fans could make comment on the art of announcing. The general complaint was that the announcers do not give the station call letters frequently enough. Some complained that there are too long pauses between selections and that the announcers in many cases talk too fast. Other suggestions offered to improve announcing were: Stop the announcers from trying to be humorous; make the announcers be brief and eliminate broadcasting lengthy descriptions of selections or the life story of the composer.

There seems to be a preference for programs broadcast by a chain of stations linked with a city station where there are plenty of artists. One listener expressed the opinion of many with the answer. "Better programs are generally put on by a chain of stations than any one station can promote." A number of Pacific Coast listeners commented upon the fact that it would be a good plan to have a chain of stations in the Far West linked by wires with New York.

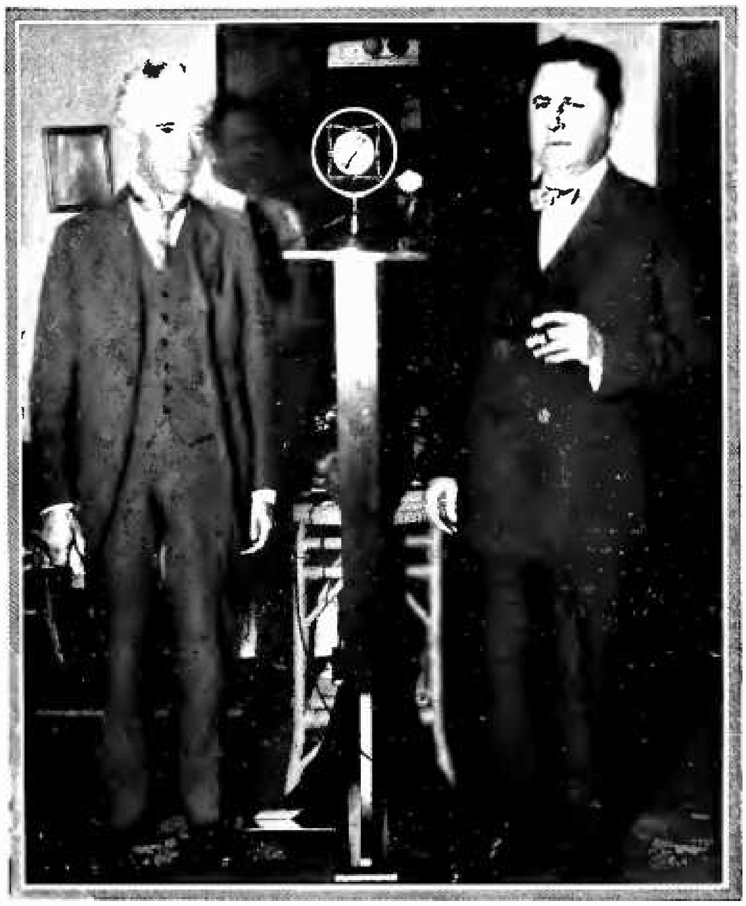
Broadcasting of church services on Sunday were commended by many who answered the questionnaire. Many specified their religion but did not express a desire for any particular denominational service on the radio. KDKA's church service won special mention in many cases.

Concerning Radio Plays

PRAISE from Heywood Broun, a keen observer and critic, as quoted from his column in the New York *World:*

I am less sceptical than I was once about the potentiality of broadcast drama. I have heard several plays upon the radio and never with delight. But recently John Drew appeared during the Eveready Hour and when he did a snatch from "Rosemary," dramatic illusion was established. He did succeed in making a situation become alive and take on poignance. Given sufficiently high skill on the part of the performer, it is extremely difficult to set a boundary and say, "Beyond this point the radio is ineffective."

And the following remarks by George Arliss,



JUDGE K. M. LANDIS AND WILLIAM WRIGLEY, JR.

They are lending their august presence to the studio of KFWO at Santa Catalina Island, California. Just why, Major Lawrence Mott, owner of the station (try to find him in the picture), failed to inform us

THE A & P GYPSIES

Who are one of the steady features of the week's radio program heard through WEAF, WEEI, WJAR, WCAP, WWK, and WCCO every Monday evening from nine to ten, Eastern Time. The orchestra is under the direction of Harry Horlick

who makes sanguine prediction that the radio play is destined to be a greater dramatic art than the motion picture:

The great value of the radio play, is that it brings to its listeners what the motion picture never can give, the literature of the theatre. It is rather easy for most people to visualize the setting, or surroundings in which a story takes place. But it is almost impossible for them to supply the conversation, which, after all, is the literature of the drama.

In the plays of Barrie, of Pinero, or O'Neil, the charm lies in the spoken words. When they are produced in pictures the audience sees only the story in its proper setting, flitting across the screen. They must supply the conversation themselves, out of their own experience, in their own vernacular. But the radio play will retain all this charm, and the intelligent, sympathetic listener will be able to create on the stage of his own imagination the setting for the story.

Mr. Arliss is of the opinion that, to get across to an audience, an actor must be seen, not merely heard. He does not look forward to successful professional actors ever becoming "radio stars" beloved by thousands of far away fans. Continues Mr. Arliss:

I doubt if, over the radio, there will ever be enough difference between the thousand-dollar-a-week man and the hundred-dollar-a-week man to attract the successful actors to the radio "stage."

Until some way is devised of making the radio play a profitable commercial proposition, I think it will be always a Little Theatre movement. Perhaps, if a great company were formed, with the finest actors, the best plays with which to work, and only those could listen in who have that company's machine, the radio play would take the same place as the motion picture or the theatre. But on the whole, I am inclined to believe that the radio play will be for the small, uncommercial theatre group. That will not prevent it from becoming a great art, however.

Neither the radio nor the moving picture can ever take the place of the theatre. The Theatre is the only complete art. But of the two, the radio play will be most satisfying to those who love the drama for its literature. Neither the radio play nor the moving picture play will ever hurt the real theatre; rather, I think, they will go hand in hand. The radio and the moving picture will stimulate the interest and appreciation of the public in the possibilities of the theatre itself.

Communications

Mr. John Wallace,
Radio Broadcast,
Garden City, New York.

Sir:

I have been interested in your "Listeners Point of View" columns, and in the February issue, I noted "Readings in Foreign Languages." The other evening while looking up a German word in the dictionary and listening to some station who was broadcasting in a foreign language it suddenly occurred to me to get a dictionary of that language, pick out some word used frequently and hear just how it was pronounced. The result was startling and I picked out several more with equal satisfaction. And now when I see those words I can pronounce them quite easily. If that linguist would tell his listeners what he was going to read on a certain night and hour from a certain station we could get the article and follow his reading and gain a great deal more than in any other way, even if we didn't understand any of it at first.

J. C. Finney,
Nashotah, Wisconsin.

Mr. John Wallace,
Radio Broadcast,
Garden City, New York.

Sir:

I often wonder why the broadcasting stations so seldom furnish harp music. The harp always broadcasts its music well, and its tones are so sweet and pleasing that it cannot but be a great favorite with most everybody. Probably the greatest radio treat I ever had was when, about a year ago, a harp ensemble of forty harps was broadcast from New York by one of the best stations. We have plenty of saxophone, harmonica and "old time fiddle" music, but the harp, the grandest of all musical instruments, seems to have been put upon the shelf. Can't we persuade some of our accommodating program directors to take it down, dust it off, and hunt up someone who can tickle the strings occasionally. Then I'll be ha-a-a-a-a-ap-py!

H. G. Reading.
Franklin, Pennsylvania.

Mr. John Wallace,
Radio Broadcast,
Garden City, New York.

Sir:

Why wouldn't it be a good idea to let us have some folk songs once in a while, oftener, if possible? Gee, with that ancient and honorable name of yours, I'd be strong for the "hundred pipers and a' and a'" and all the rest of the Scottish songs, reels and strathspeys. These, to my way of thinking, contain the very soul of music.

What is more inspiring than "The Cock o' th' North," more tender than "A Pretty Girl Milking Her Cow" (Irish) and for sheer loveliness try and equal "Annie Laurie."

Colin F. Morrison.
Wayne, Michigan.

Broadcast Miscellany

THE versatile Graham McNamee of WEAF's staff added no little interest to our nightly ear work, some time ago, when he read a group of verses, among them Gray's "Elegy" and Kipling's "Boots," to a decidedly rousing musical accompaniment. We learned later of at least four bridge games he broke up with his impassioned and hypnotizing recital of the mad "Boots."

KFNF at Shenandoah, Iowa, we were informed by certain publicity material, broadcast for thirty consecutive hours on its birthday. Yours for larger and longer days! When, with the millennium, comes the forty hour day, we shall utilize the extra sixteen hours for lying in bed of a morning.

ARRANGEMENTS are being made, we are told by KOA, whereby all important athletic matches and contests throughout the country will be relayed to Denver by a network of leased wires and flashed over the microphones. To what extent they will be handled in detail or play-by-play, however, will depend on the nature and general interest of the attraction, it was said. In the case of golf, tennis, and other tournaments, it was expected that a summary of final returns would be sufficient.

WE DID not hear "The Miracle" as broadcast by WGBS during the New York run of the spectacle, but have just recently heard it broadcast from the Auditorium theater in Chicago by WGN, and tender it sundry palms as one of the best things of the year. Of course the success of the broadcast was mostly due to the enormous appeal of the play itself, but a none the less large share of praise must go to the radio technicians who made possible its aërial presentation with so little diminution of effectiveness. "The Miracle" being preëminently a spectacle and feast for the eye would seem, off hand, to be poor material for the radio. But its story is of such simple dramatic effectiveness that it lost nothing in the telling by Bill Hays, the WGN announcer. And the colorful music, the chanting, the hymns, and the roars, shouts, and cries of the 600 or more persons who took part in the production were ably transmitted, which, we opine, was no mean engineering feat.

THE "Eveready Hour" heard through WEAF, WEEI, WFI, WCAE, WGR, WWJ, WOC, KSD, WJAR, WCCO, WTAG, WGN, WEAR, and WSAI at 9:00 o'clock (E. S. T.) each Tuesday evening we have come to count among the pleasantest of radio's offerings. For instance there was the program of old time "Sob Ballads" of thirty years ago. The interpretation of these heart-renderers by the Eveready artists was in delightful burlesque fashion. Among the songs were such as: "Break the News to Mother," "After the Ball", "The Picture Turned Toward the Wall" and "The Bird in the Gilded Cage."

ARRANGEMENTS have been made by WRC, at Washington, to broadcast week by week the adventures and experiences in the African Jungle of the exploring party headed by Dr. William M. Mann, director of the National Zoölogical Park, which set out last month under the auspices of the Smithsonian Institution, in coöperation with Walter P. Chrysler, automobile manufacturer.

The accounts of the adventures will be contained in letters written by Dr. Mann to the radio audience of WRC, and rushed to the United States from the interior of the African wilds. They will be read in connection with the "Zoo Talks" and broadcast under the direction of Doctor Mann, and Austin H. Clark, of the Smithsonian Institution, during the past year.

Doctor Mann is an explorer of international fame, having been associated with many of the greatest scientific expeditions in Central and South America. In 1914 he visited Egypt, the Sinai Peninsula, Palestine and Arabia with Dr. John C. Phillips, collecting specimens of mammals and birds. Later he was in charge of the Mulford expedition to the Amazon Valley and across South America to collect and study plants used in the manufacture of drugs and to make zoölogical collections.

A year ago Doctor Mann began the radio presentation of weekly notes of interest from the National Zoo and discussions on the habits and idiosyncrasies of the animals, most of which are very familiar to the residents of Washington and visitors to the Capital City.

THE dance tunes of other years are being revived successfully on the air by William Spencer Tupman's Hotel Mayflower Orchestra through WRC. In each of the Tuesday Night "Melody Hours," played by the orchestra for the radio audience, three of the most popular dance tunes of the last fifteen years are presented without announcement of titles. Weekly prizes for naming the numbers are offered. The "Melody Hours" are broadcast from 10:30 to 11:30, E. S. T., every Tuesday night from the Mayflower Gardens of the Mayflower Hotel.

CHICAGO has all too few "indirect advertising" programs—which is unfortunate, as programs of such origin form the very backbone of radio entertainment. There is, however, the "Federal Master Artists Series" broadcast each Friday evening at 9:00 through KYW. This series is financed by the Federal Electric Company and prominent among its offerings have been two concerts by the Jacques Gordon String Quartet, an able organization whose members are recruited from the Chicago Symphony Orchestra.

THE following yarn has been wandering about in the public prints. It has long been divested of any evidence of parentship or authorhood, so we, in turn, will "steal" it. It has to do with a housewife, inexperienced at dial twisting, who attempted to tune-in a cooking lesson program with this startling result:

Hands on hips, place one cup of flour on the shoulder, raise knee, depress toes, and wash thoroughly in one half cup of milk. In four counts, raise and lower left foot and mash two hard-boiled eggs through a sieve. Repeat six times, inhale one-half teaspoon salt, one teaspoon baking powder, and one cup of flour. Then breathing naturally, exhale and sift. Attention. Jump to a squatting position of quick time. Twist sideways and forward right and left as far as possible and beat egg swiftly and briskly, arms forward over head. Raise the cooked egg with the flour and in four counts make a stiff dry dough, which is stretched at the waist. Thighs flexed, lay flat on the floor and roll into marbles the size of a walnut. Hop to a straddle in boiling water but do not boil at a gallon. After ten minutes remove and wipe with a rough towel and serve with fish soup.

THE effort of the officials of the Bakelite Corporation and station WJZ to determine the makeup of the Bakelite hour by a series of four test programs resulted in a tied vote. The four types of program submitted for approval were: 1. Concert artists assisted by a small orchestra; 2. Grand opera; 3. a varied program of classical and semi-classical selections by mixed instrumental and vocal soloists; 4. Chamber music concert. The first three named received an equal number of votes. So at present the Bakelite hour is being varied each Sunday. A set type of program will, however, eventually be selected from the three.

WHETHER the various "Music Festivals" being held at this time of the year in various parts of the country are being broadcast we can not, at present writing, foretell. We know that definite plans have been made by KOA to broadcast Denver's far-famed Music week celebration and annual spring festival. And efforts are being made to arrange for the broadcasting of the North Shore Music Festival at Evanston, Illinois. If the many similar "festivals" of equal or lesser importance throughout the country are tapped by radio, as they should be, the last two weeks of May and the first two weeks of June will come to be the most musical period in the year's radio offering.

JAZZMANIA" a radio play by Dailey Paskman, director of WGBS, has proved one of the best novelties offered by that station. It is in the form of a dramatic and musical fantasy. Jimmy Kemper, of vaudeville fame, is co-author and takes the principal rôle. Mr. Paskman (who collaborated with Rudolf Friml on "Chansonette," a recent song hit), composed a number of original lyrics specially for "Jazzmania." Another repetition of the fantasy seems likely and is worth watching for.

THE prominent vaudeville singers, Van and Schenck, are among the latest recruits to the ranks of broadcasting artists. They are appearing three times a week before the microphones of WMCA.

IN ORDER that those who live in the Metropolitan area may know something about current theatrical conditions in other cities of the United States, Oliver Sayler, well known critic, who has been a regular feature at WGBS ever since the station has been operating, has left New York on a tour of the country. Each week Mr. Saylor will report by wire on plays on the road, this report to be read at the regular time for his "Footlight and Lamplight" series —every Thursday evening at 8:30.

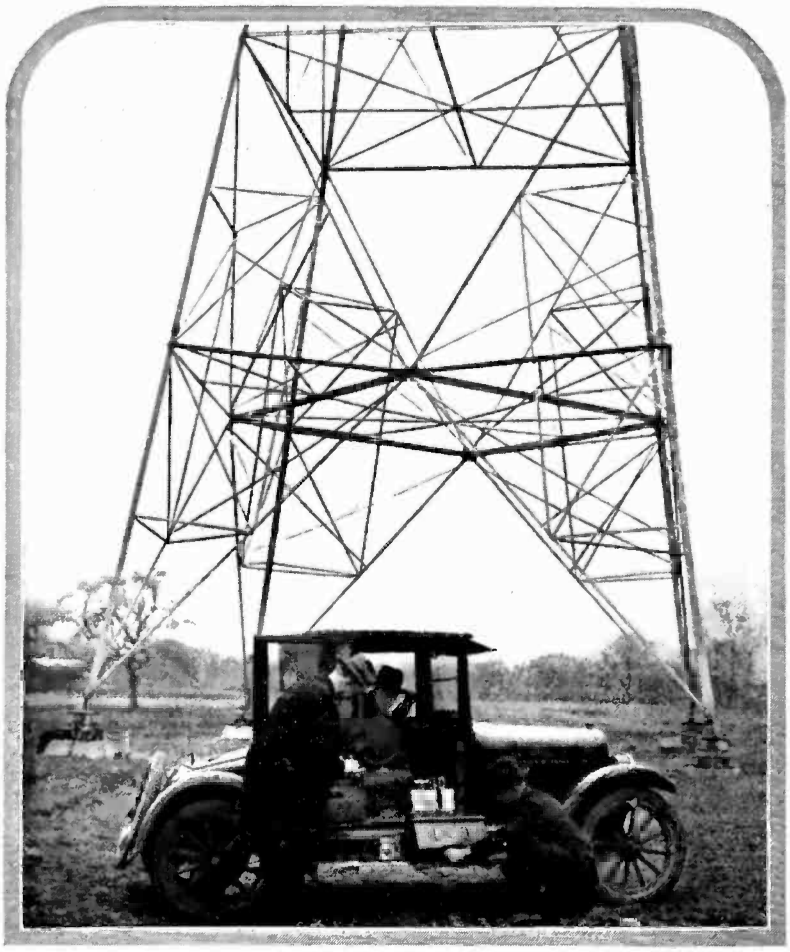
THE WEAF SHAKESPERIAN PLAYERS

Who have been heard, to the tune of much favorable comment, through WEAF every Saturday evening at 8:15 in tabloid presentations of Shakespeare. Back row, left to right: Geral Stopp, Katherine Emmet, Laurence Cecil. First row: Alfred Shirley, Margot Lester, and Charles Webster

Cutting Out the Locals

Results of Actual Field Tests With Wave Traps on a High Power Station—The Second of Two Articles Showing How Receivers Can Be Made More Selective—How to Build a Radio-Frequency Amplifier and Adapt it to Your Receiver—High Power Broadcasters Need Not Cause Interference

By HOWARD E. RHODES



UNDER THE SHADOW—WJZ'S TOWERS

Making interference tests under the great towers of station WJZ at Bound Brook, New Jersey. Shielded receivers and other radio sets which were really selective could tune out the station even at this location

IN A series of articles concerned with interference from local stations there is naturally forced into the discussion the question of super-power (so-called) and its effect on local reception. This question has received a great deal of publicity lately in the press and in radio publications. In Radio Broadcast, not many moons ago, Carl Dreher, writer of "As the Broadcaster Sees It" took up the cudgel for super-power; and stated the case in this wise: "Everybody is increasing power who has the money, because it is the next sound technical step." We are not going to discuss the theoretical points that enter into a consideration of high power; but are going to confine ourselves to the practical results of super-power. For, concludes Mr. Dreher, "After all, we can talk ourselves dry and in the end the issue will be decided by performance."

It is generally agreed that high-power stations should be located in the country as far from any town as is conveniently possible, so as to reduce to a minimum the number of persons affected. The field strength of a high frequency wave bears an inverse relation to the distance from the source (neglecting the effects of various kinds of absorption) so that the field strength rapidly decreases within a comparatively small area around the transmitter.

It is quite evident then, that if the transmitter is located in the country, the amount of trouble it causes will be comparatively small and the only persons who will be seriously affected by it are those living within one or two miles of the transmitter. Beyond this distance, the signal strength has decreased to a point where it is a very simple matter to eliminate it with any selective receiver. It is, therefore, only within this comparatively small area that any special arrangements must be used to eliminate the signal.

Radio Broadcast felt the need of obtaining some actual data on high power and its effect on reception, so a series of experiments were undertaken, designed to show whether it is possible to cut out interference when the receiver is located a comparatively short distance, say one or two miles, from the interfering transmitter.

The field tests by the technical staff of Radio Broadcast were made at a point about $1\frac{1}{2}$ miles from the transmitter of WJZ located near Bound Brook, New Jersey. This station has a capacity of 40,000 watts, and during our tests was presumably operating on full power.

There were two major points to be determined:

1. How successfully could the signal be eliminated?
2. Did the high powered signals have any blanketing effect on the signals from other stations?

HOW THE "HIGH-POWER" TESTS WERE MADE

THE tests were made on an ordinary four-tube unreflexed Roberts receiver and in order to eliminate WJZ, a wave trap was used. There was nothing unusual about the receiver and it was operating on an antenna having a horizontal run of about 50 feet and a lead-in of about 30 feet. The open end of the antenna was pointing toward the station, which was an advantage over having the closed end point toward the source of interference, since reception is notably poorer in the direction of the open end.

In the first place, a resonance curve was taken on a wave trap. The trap used was a General Radio instrument and is shown in Fig. 2. Many other commercially available types are equally satisfactory. The resonance curve was taken using an audibility meter. The curve, therefore, does not represent any electrical quantities but is actually a direct indication of the audibility of the signal. From the curve it is evident that within 20 kilocycles the audibility decreases to about 10 per cent. of the original value, indicating that the band of frequencies neutralized by the trap only extended about 20 kilocycles on either side of resonance. In order to obtain this curve it was found necessary to use the trap conductively coupled, with the entire coil of the wave trap in the antenna circuit as shown in Fig. 4. Taps are provided for use when the trap is inductively coupled to the antenna, but if so connected, it was found impossible to eliminate the signal. The same test was

Radio Broadcast Photograph

FIG. 2

A wave trap manufactured by the General Radio Company. This unit is not only useful as a trap but is also an excellent wavemeter

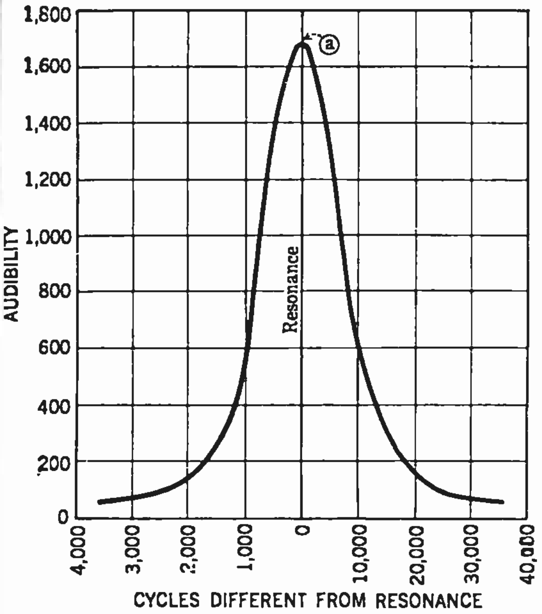


FIG. 3

An audibility curve showing how the strength of an interfering signal is decreased by the use of a wave trap

made with several other traps including the Accuratune, made by the Mydar Radio Company, and the Filtrola, manufactured by the All-American Radio Corporation.

The major reason for using the General Radio instrument in taking the data contained in this article was that it uses a calibrated condenser, which was essential in making these measurements. After the tests with the General Radio and other wave traps mentioned above, a home made trap was tried and results were quite satisfactory in every way. A home made unit, very easy to build, is illustrated in Fig. 8.

It is supposed by some that a high power station would have a blanketing effect on reception in the vicinity in that the existence of very strong signals in the ether would in some way or other neutralize the signals from other stations so as to make their reception very difficult. In our tests no such effects could be noticed. WOR, separated from WJZ by approximately 80 kilocycles, could easily be tuned-in without any interference. Broadcasting from a Philadelphia station located 60 times as far away as WJZ, and having only 1 per cent. of the power could be tuned-in without difficulty.

BLANKETING AND INTERFERENCE ISN'T NECESSARY WITH HIGH-POWER

THESE tests, we believe, show quite conclusively that a high power station need not cause excessive interference. A certain amount of co-operation between the company operating the station and the public is, doubtless, necessary, and it seems logical that the operating company should take cognizance of the interference which has been created by the operation of their station and do whatever they can to help in the way of supplying information, investigating complaints, etc.

There are several factors contributing to the opposition to high-power. One of these is the fact that broadcasting started on low power. Low power meant two things, first, that very sensitive receivers were necessary in order to obtain reception if the receiving point was located at any distance from the transmitter; and secondly interference from near-by stations was not serious except in a very restricted area quite close to the station. The result was that many receivers were made with no means of eliminating local interference. Consequently, the advent of high power caused many listeners to raise a loud cry of protest because of the interference produced, while many others immediately settled down to the problem of its elimination and constructed wave traps. Opposition from these individuals soon disappeared and the only objectors left were those, who, with no acquaintance with radio, felt that the interference could not be eliminated. So we had letters to newspapers, petitions to Congress, and a general rumpus all out of proportion to the importance of the question. There was talk of blanketing effect of high power and so on. At the beginning a lot of us got excited and no one did anything.

After the noise somewhat subsided it became evident that the problem and its solution was not as serious as was first thought. The excitable souls found out that by the use of simple wave traps they could do what some very sensitive receivers seemed unable to do. And so, with the installation of this simple device, a great deal of the agitation subsided.

In the vicinity of New York, most of the complaints were lodged against WJZ. If this station had opened on some hot summer night, when the static was strong it would have been welcomed with open arms by many of its now bitter opponents. We should realize the advantage of being located near a powerful broadcaster, for it is the one thing that will make summer reception at all pleasant. Now there is only one good way to get rid of static and that is to have enough signal energy coming down

RADIO BROADCAST Photograph

APPLYING A WAVE TRAP PRACTICALLY

A wave trap in a home in Bound Brook, New Jersey, attached to a five-tube, one-control set is successful in tuning out WJZ not a mile away. The photograph was taken when one of the staff of RADIO BROADCAST Laboratory visited Bound Brook to test the operation of wave traps in a locality where they are needed

RADIO BROADCAST Photograph

DIRECT HELP FOR THE LISTENER

B. S. McCutcheon showing a Bound Brook resident how to use a wave trap successfully. Mr. McCutcheon's job is to investigate every letter of complaint by visiting the home of the complainant and studying the situation. He has been able to help the listener-in in 90 per cent. of the 900 cases he has investigated

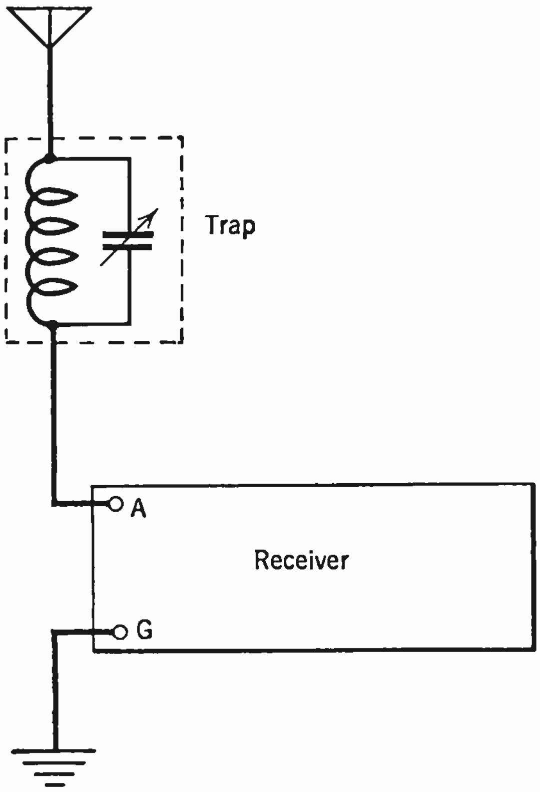


FIG. 4
How the wave trap was connected to obtain the curve in Fig. 3

through the antenna completely to drown out any noise.

These remarks concerning high-power were brought about by a consideration of the problem at hand; the elimination of interference. The first article of this series appeared in the April RADIO BROADCAST and described the construction and operation of wave traps, such as were used in the Bound Brook tests.

HOW TO ATTAIN SELECTIVITY AND INCREASED SENSITIVITY

HOWEVER, a wave trap merely functions to increase selectivity and it is evident that it would be somewhat better not only to increase the selectivity but also at the same time to increase the sensitivity of the receiver. This would make it possible to cut out the interfering signals and also to receive signals from more distant stations. We shall now describe a unit which will accomplish these two things. It should first be clear as to what is meant by selectivity and sensitivity.

The selectivity of a receiver is a measure of its efficiency as a filter of electrical waves. In other words, the whole idea of "tuning" is so to adjust the electrical characteristics of the tuning elements to reject all frequencies except the desired one. The completeness with which undesired frequencies are eliminated depends upon the resistance of the tuned circuit. The lower this resistance is the better will be the selectivity.

The perfect filter for a broadcast receiver would have a characteristic like that of Fig. 5 which represents an ideal band-pass filter. It should be noted that the sides are vertical so that all frequencies outside of the band *a-b* are completely attenuated. Practically, with the single radio tuned circuit it is not possible to obtain a filter with such a frequency characteristic. Fig. 6 shows how an actual unit differs from the hypothetical case of Fig. 5. With a low resistance circuit, a curve like A is obtained; if the resistance is made ten times as large, the characteristic changes to that of curve B. In taking these curves, the input voltage was constant so that the ratio of the currents at frequency f indicates considerable decrease in efficiency caused by high resistance units. Hence the importance of well designed low resistance circuits.

Now, if the receiver is to be selective, it must have a sharp resonance curve—but not too sharp—for, from the point of view of exact quality, a very high degree of selectivity must not be attained, since that does not permit the equal transmission of all the side bands of the carrier wave which carries the voice frequencies. Fulfilling this one and only requirement for selectivity—namely, that the resonance curve of the receiver be sufficiently sharp—has nothing to do with sensitivity.

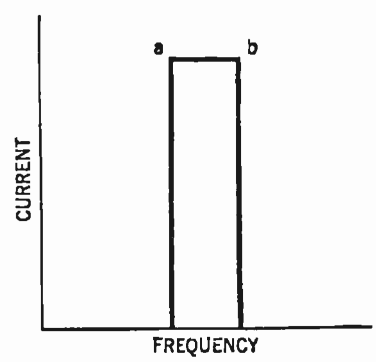


FIG. 5
An ideal resonance curve for a radio receiver

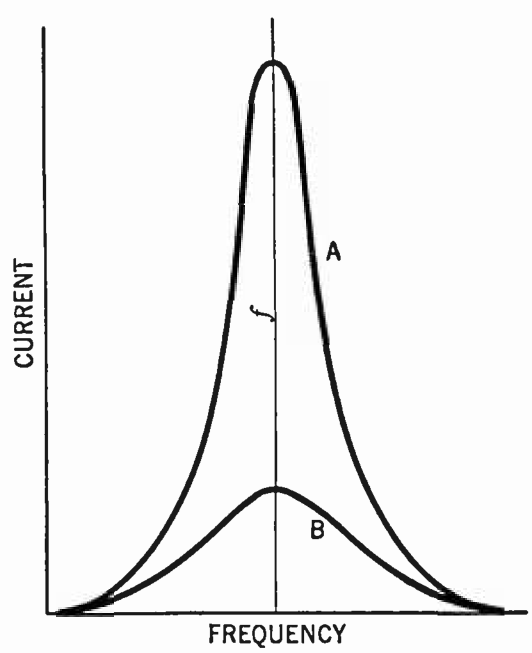


FIG. 6
The reason for the use of low loss circuits. Curve A is obtained from a low resistance tuned circuit, and curve B from another circuit with ten times as much resistance

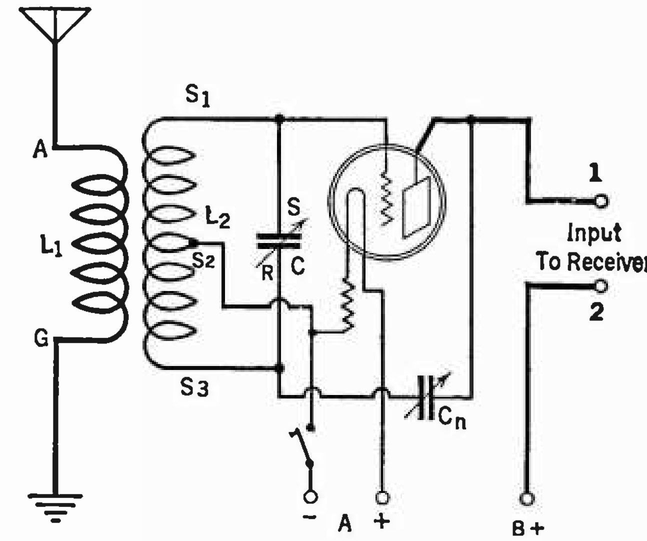


FIG. 7
A diagram of a radio-frequency amplifier which will increase the efficiency of many receivers

As selectivity was a measure of the receiver's efficiency as a filter, so sensitivity is a measure of its efficiency in the amplification and detection of radio frequency energy. A receiver using several stages of tuned radio frequency is an example of sensitivity obtained by use of amplification and the regenerative detector is an excellent example of sensitivity through the use of an efficiency detector circuit. The radio-frequency amplification of a receiver is the ratio of the voltage on the grid of the detector to the voltage picked up by the antenna and it is this ratio that determines the sensitivity.

ADDING A RADIO-FREQUENCY AMPLIFIER

THERE is a comparatively simple method whereby both the selectivity and sensitivity can be increased at the same time, which involves the use of an additional stage of tuned radio-frequency amplification. This can easily be accomplished in connection with practically any type of receiver in use so that it affords an excellent method of increasing the efficiency of a receiver.

An excellent manufactured radio-frequency unit designed for use in this manner is the Penetrola, made by the Walbert Manufacturing Company of Chicago. It is possible to connect this unit to a receiver without any changes whatsoever. The Penetrola is illustrated in Fig. 13.

A home-made radio-frequency unit adapted for use in this connection is shown in Fig. 7. This design proved to be excellent from the standpoint of adaptability to existing receivers with a minimum number of changes. The completed unit is shown in Figs. 8 and 9. It was constructed in the Laboratory.

The following notes are given for those wishing to duplicate the RADIO BROADCAST model.

The parts used in the model are as follows:

L_1, L_2,—General Radio Coil, Type 277 D
C—Cardwell .0005-mfd condenser.
Cn—Hammarlund midget condenser

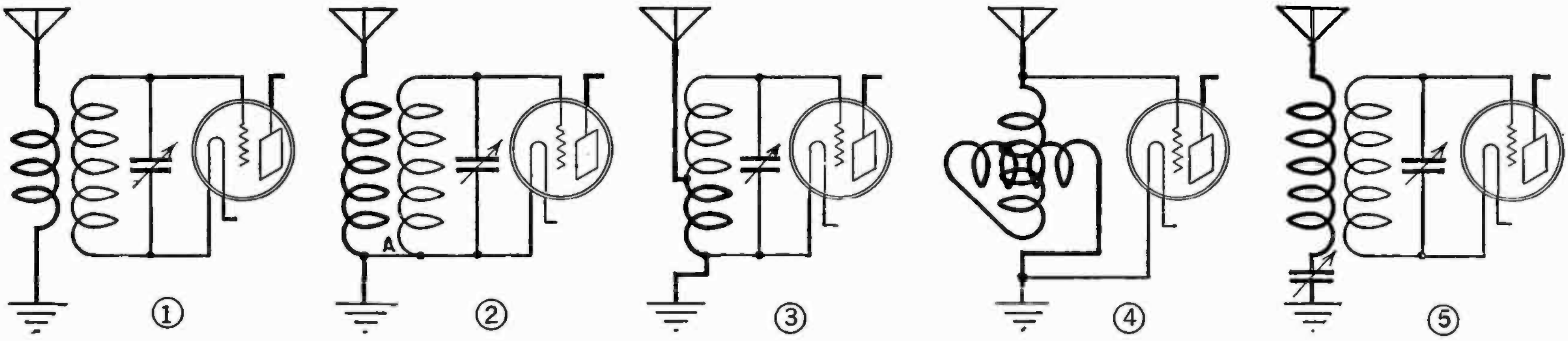


FIG. 8
One of the diagrams in this Figure is the type of antenna connection used in your receiver. The diagram Fig. 11 shows the adaptation necessary to include an r. f. amplifier-wave trap.

1—Amsco socket
Miscellaneous parts, wire, screws, binding posts, etc.
1 panel and cabinet 7″x 8″
1 Rathbun dial
1 Filament switch

The apparatus listed above need not necessarily be used. Any standard parts will give entirely satisfactory operation.

Those wishing to construct a home made coil should adhere to the following specifications:

L L—60 turn coil of No. 22 wire on a $2\frac{1}{2}$-inch tube. Tap the coil at the 21st turn from the filament end.
L_1—15 turn coil of No. 22 wire wound over the filament end of the secondary.

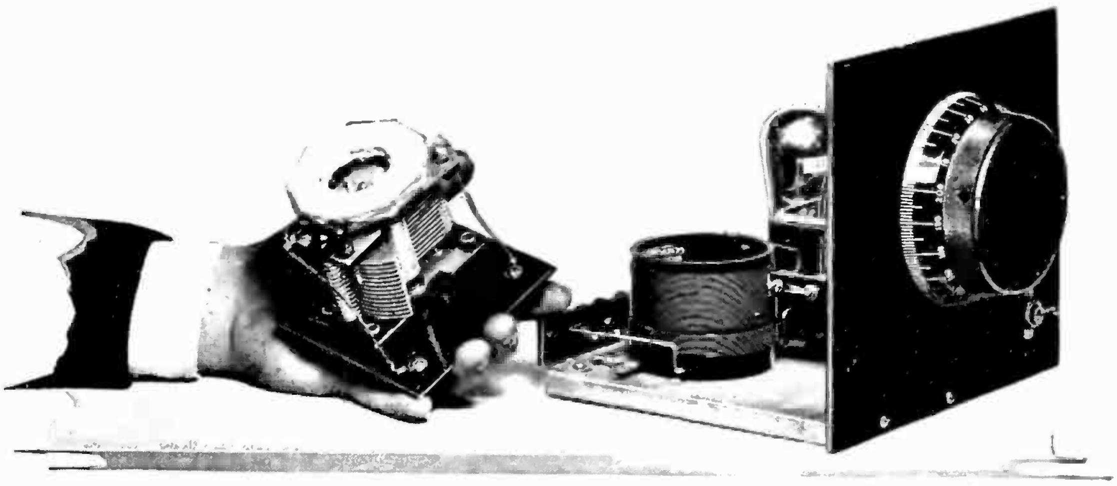
APPLYING THE UNIT TO YOUR RECEIVER

THE location of the various parts is shown clearly in Fig. 12 and no difficulty should be had with regard to the placement of units. If duplicate parts are purchased, the panel layout of Fig. 12 can be used.

In wiring the unit, make all leads to the grid and plate as short as possible, otherwise it is apt to be difficult to control spurious oscillations. The actual circuit is very simple and no other special instructions need be given. In order to adapt the receiver to the unit, some slight change is necessary.

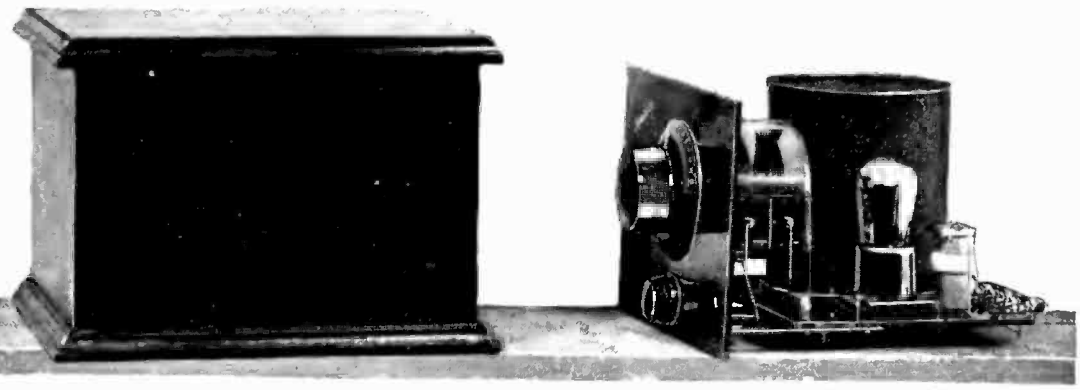
The antenna system of a receiver is usually connected by one of the methods illustrated in Fig. 8. In Fig. 11, we have revised these circuits so as to indicate what changes are necessary in order to attach the radio frequency amplifier. Readers should determine what type of antenna circuit is used in their receiver and then locate it in Fig. 8. The numeral preceding the notes given below refers to Fig. 8 so that the notes concerned with any of the circuits can readily be found.

(1) This is the simplest receiver to which to attach the r. f. amplifier — Disconnect the antenna and connect the antenna terminal of the set to terminal No. 1 of the amplifier. Then remove the ground terminal to binding post No. 2. If an antenna series condenser is used (indicated by dotted lines in the



Radio Broadcast Photograph

FIG. 9
The left-hand picture shows a home made wave trap that can be used to eliminate interference. The right-hand picture shows a model of a radio-frequency amplifier



Radio Broadcast Photograph

FIG. 10
The "Penetrola," a completely enclosed radio-frequency amplifier, which will greatly increase the sensitivity and selectivity of a receiver

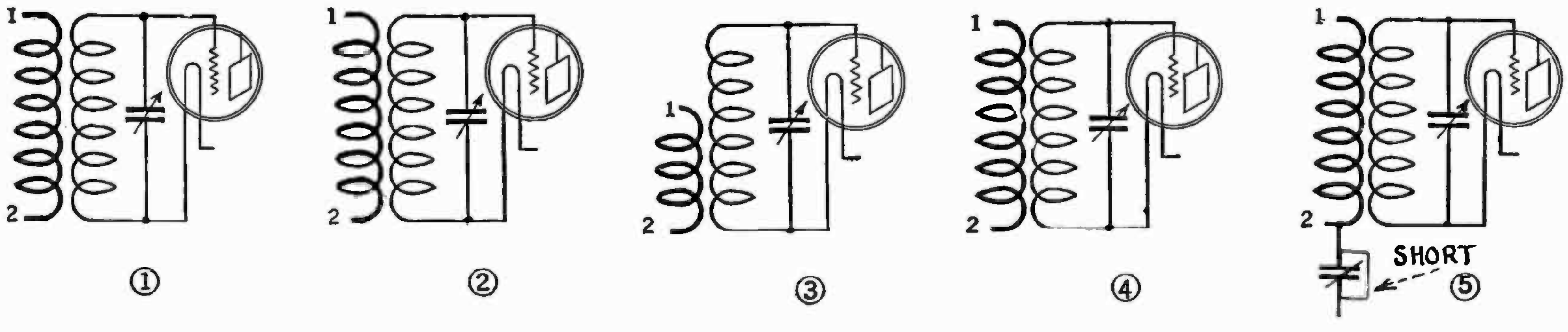


FIG. 11
The circuits of Fig. 10 revised so as to permit the use of a radio-frequency amplifier

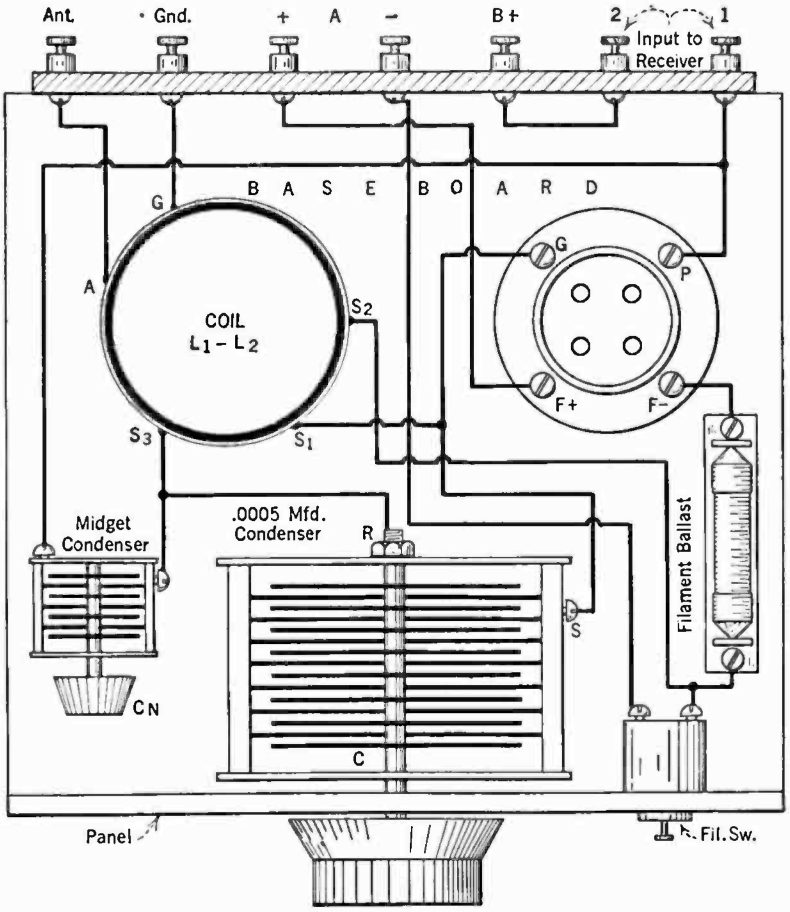


FIG. 12
Apparatus layout of the radio-frequency amplifier
Refer to Fig. 7 for the schematic diagram of this unit

drawing) the connection to terminal No. 1 should be made from the side of the condenser which connects to the coil.

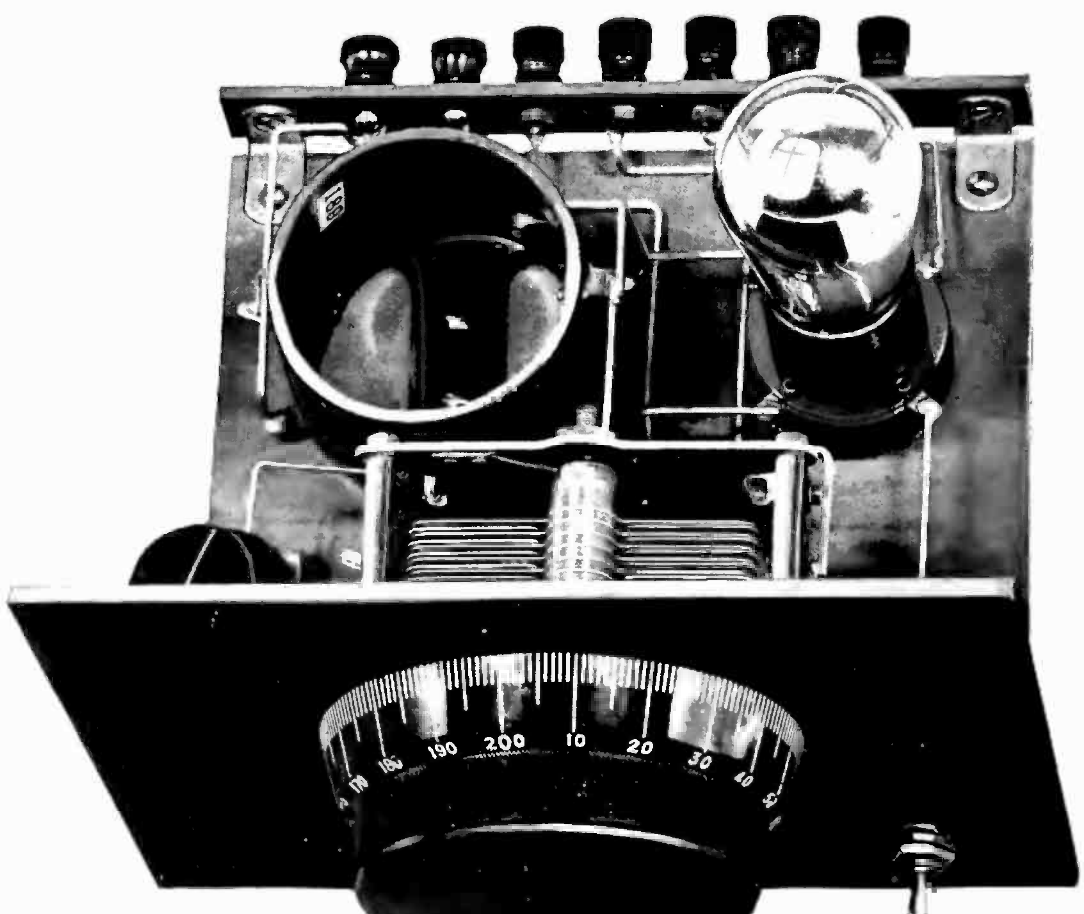
(2) This circuit is practically the same as No. 1 with the exception that there is a connection between the antenna coil and the secondary winding marked "a" on the diagram. This connection should be removed and then the circuit is a duplicate of No. 1. This connection must be removed in order to prevent short-circuiting the B battery.

(3) In order to adapt this circuit to the new unit, it is necessary to add a new winding to the antenna coil. This winding should consist of 15 turns of No. 22 wire wound over the filament end of the secondary winding. One end of the coil would then be connected to terminal No. 1 and the other end to terminal No. 2. The antenna connection is of course removed from the secondary coil.

(4) Practically the only method of adapting the circuit to the amplifier is by removing the variometer and substituting in its place a coil of the same type as in the former circuits. Revised, it appears as in No. 4 Fig. 11.

(5) This circuit is very easily changed over. Connect terminal No. 1 to the antenna terminal on the receiver. Terminal No. 2 should connect to the other end of the antenna coil. An optional method is illustrated in Fig. 11 where the antenna tuning condenser C has been shunted and connection made directly to the ground terminal.

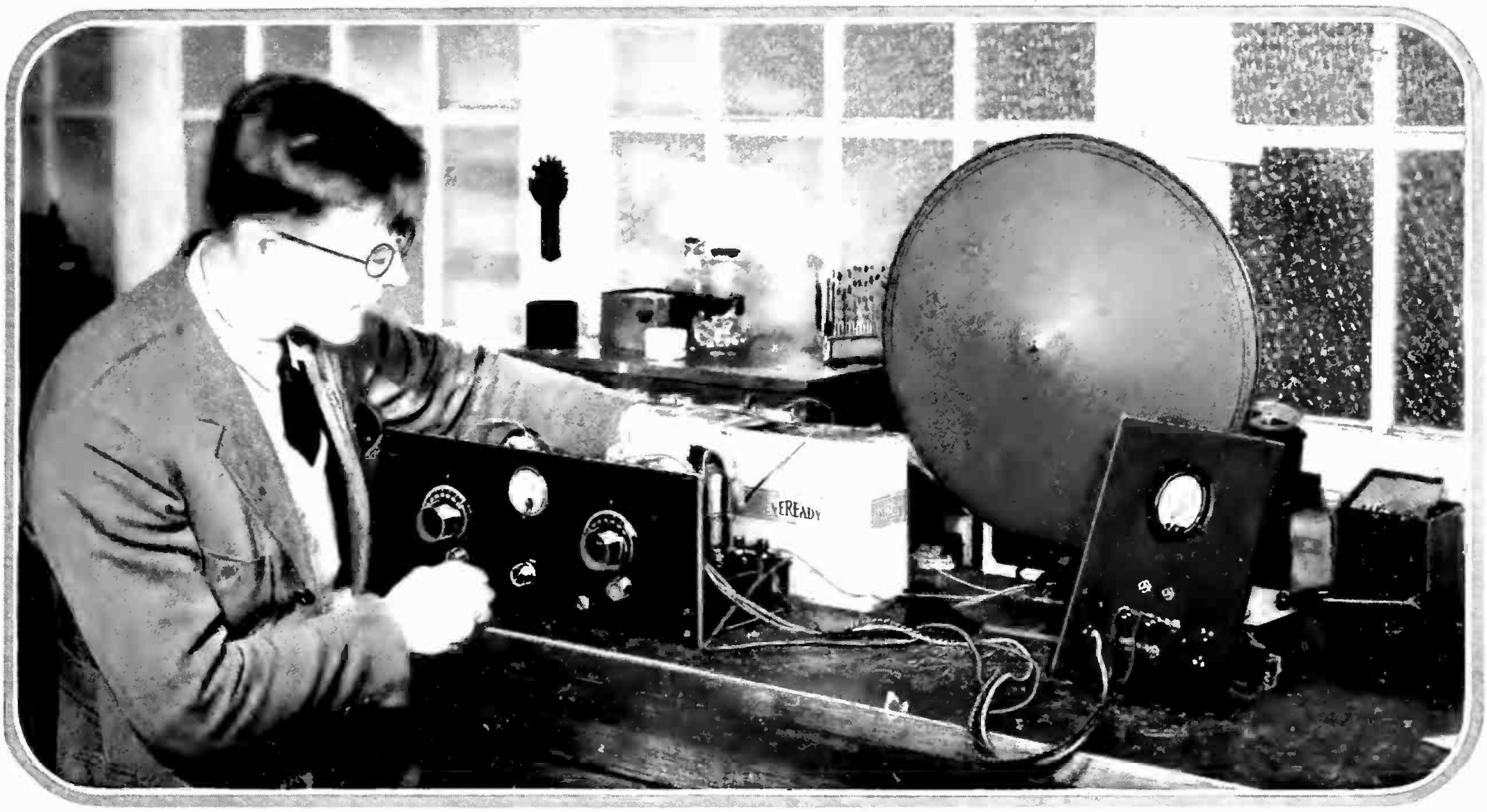
After the necessary changes have been made, the batteries can be connected. Remove all the tubes before this is done so as to prevent damage in case an error has been made. When you are sure everything is correct, the battery terminals on the new amplifier unit should be connected to the corresponding terminals on the receiver. Finally, the antenna and ground should be connected to the correct binding posts. The receiver and amplifier can now be turned on and the set operated in a normal fashion. The Rathbun dial will cause the straight-line capacity condenser to tune as though it were a straight-line frequency unit so that all stations will be evenly separated over the entire 200 degrees of the dial.



Radio Broadcast Photograph

FIG. 13
Another photograph of the amplifier illustrated in Fig. 8

A Simple Set Tester for the Home Laboratory



THE TESTER IS HERE SHOWN IN USE IN THE "RADIO BROADCAST" LABORATORY

An Easily Constructed and Inexpensive Tester for the Home Experimenter Which Should Simplify Testing of Circuits and Receivers—Its Construction, Operation, and Applications

By SID GOODWIN

Radio Editor, Portland, Oregon, "Telegram"

THE job of trouble shooting in any piece of radio apparatus is not at all pleasant, but after the novelty of building receiver after receiver has worn off, the home constructor will find that the addition to his equipment of a simple trouble shooting device will be well worth a few hours spent in constructing it.

Besides preventing a ruffled temper, this unit expedites the matter of locating trouble in radio receivers by means of several throw-over switches and a triple-scale voltmeter. Parts that are defective may be located quite easily and new parts, before being placed in a receiver, may be tested to determine whether or not there are any defects in the manufacture.

Usually when a receiver will not work, the constructor first checks his wiring and then after that inspects each individual piece of apparatus employed in the assembly. Much depends in such a test upon the individual's experience and intelligence to know where and what to look for. To build the trouble shooter described here requires no special effort on the part of the constructor except that he be able to understand the simple wiring and assembly of the instrument itself. Merely by placing a prepared plug in the socket of a receiver from which one of the tubes has been removed it is possibe to note the action of the various circuits by flipping the switches on the front of the trouble shooter panel.

What The Tester Will Do

1. Show an open grid circuit.
2. Show an open plate circuit.
3. Indicate the voltage applied to each tube filament.
4. Indicate the plate voltage for each tube of a receiver.
5. Test fixed and variable condensers for short circuits.
6. Test coils for open circuits.
7. Test audio transformers for open circuits.
8. Test phones and loud speakers for open circuits—and in so doing, will guide you in locating the faults in your radio receiver.

In this way it may be determined whether or not the grid circuit is open, whether or not the plate circuit is open, or it may be observed whether the B battery applied to the socket is of incorrect polarity. Filament voltage may be determined and polarities of the various batteries indicated. Once an incorrect reading is obtained, it is plain that trouble exists in that part of the circuit in which the switches are connected.

The plug, to which is attached four flexible leads, each about four feet long, may be made from parts found in the junk box. A round piece of wood of the diameter of the tube socket shell may be smoothed over with sand paper; machine screws fastened in the base and holes drilled from the top down to the tops of the screws are enough to make connection to the leads. Or better yet, if an old tube is handy, the glass may be broken away and removed entirely from the shell and the leads soldered to the prongs on the inside of the shell. A wooden plug to fit inside the shell may be prepared to serve as a handle. A socket adapter will serve the purpose of a plug admirably. The leads attached to the prongs may be led up through a central hole bored in the wooden handle part of the plug.

The voltmeter employed in the trouble shooter constructed in Radio Broadcast Laboratory is a Jewell, triple range, No. 88160, type 55, having three scales as follows: 0-8 volts, 0-80 volts, 0-160 volts. That employed in the model constructed by the author is also a triple range type as follows 0-7.5 volts, 0-30 volts, 0-120 volts. The former is undoubtedly better since it allows readings of voltages in excess of 135 which is often used in audio amplifier circuits.

Two anti-capacity switches of the type manufactured by the Federal Company, bearing the number 1424W, are satisfactory as the controls which are operated from the panel front to connect the meter into the various parts of the circuit under test.

Six pin jacks are arranged in hexagonal form, and another pin jack is placed at the center. These are for making connection with the flexible cords which lead to the test clips, and the specially prepared plug which fits into the socket of a radio receiver.

All these units are mounted on a panel 8 x 10 inches, which if desired, may be fastened to a box or base.

The materials required for the construction are as follows:

1 Panel 8 x 10 inches.
2 Anti-capacity switches (Federal No. 1424W).
7 Pin Jacks.
7 Terminal Pins.
1 Voltmeter. Triple scale (Jewell type 55 or 55-88160).
1 Plug constructed as described 28 feet flexible lead wire, bus bar, etc.

No panel layout is necessary since the position for the various parts may be changed to suit the fancy of the constructor. The several photographs will serve as a guide to those who wish to duplicate exactly the construction described here.

After the parts have been assembled and wired in accordance with the circuit diagram, Fig. 4, which, by the way, is a rear view of the trouble shooter, the device may be put into operation.

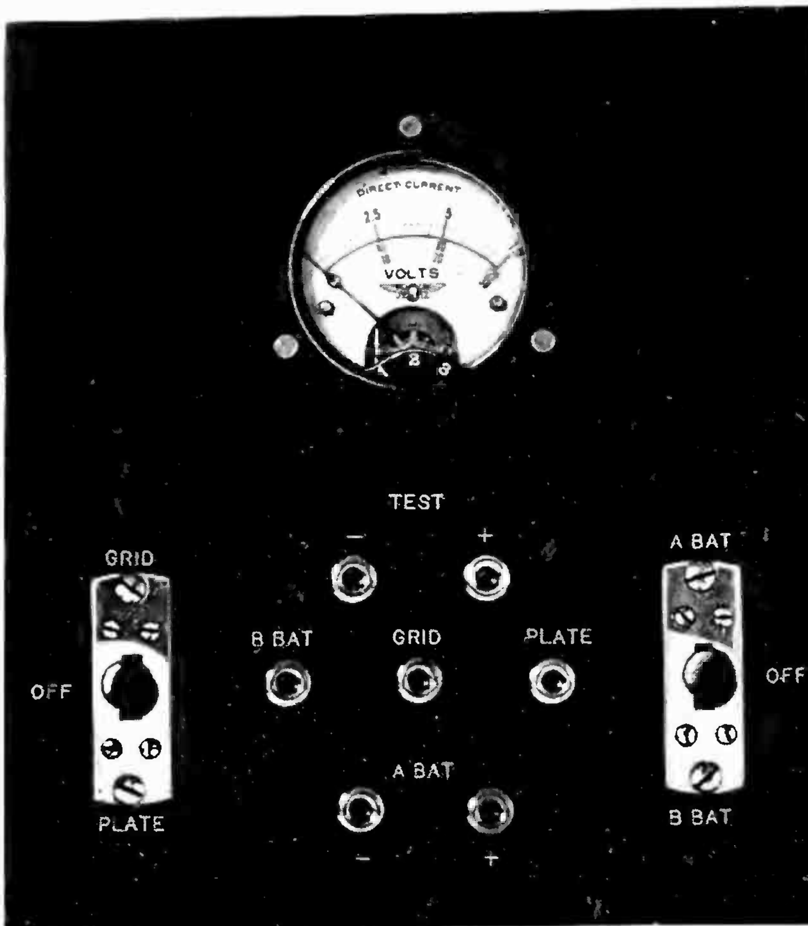
HOW TO OPERATE THE TESTER

The two top pin jacks marked Test, minus and plus, are connected directly to the volt-meter so that a reading on the intermediate scale is obtained when a 45-volt block of B battery is added to the circuit in which is included the piece of apparatus under test. This is shown in Fig. 3. Where it is desired to test for continuity of circuit, a reading of the voltmeter will indicate a complete circuit. In case a condenser is to be tested then no reading is desired since the condenser itself presents an open circuit to the flow of direct current from the battery. By inserting a pair of phones in the circuit it may be noted whether or not the condenser is noisy or leaky.

The leads from the plug, are connected to their respective pin jacks, namely Grid, Plate, minus A and plus A. The pin jack marked B battery connects by the fifth flexible lead to the high voltage side of the B battery. Before inserting the plug in the socket of a radio receiver, the two anti-capacity switches should be in a neutral position. Then after the plug is inserted, pushing the lever of the left switch upward will produce a reading on the voltmeter which by means of its scale adjuster has been turned to the high scale reading. Such a condition indicates a continuous circuit for the grid circuit part of the tube circuit under test. When this same lever is pushed downward, the plate circuit is thrown into the meter circuit, and should there be no reading; obviously an "open" is present.

The switch at the right is for measuring A and B voltages. By shifting the position of the clip of the lead emanating from the B battery tip jack, the voltage of individual sections of the B batteries may be measured. It should be remembered that no voltage should be measured which is calculated or one suspects to be higher than the scale of the meter employed.

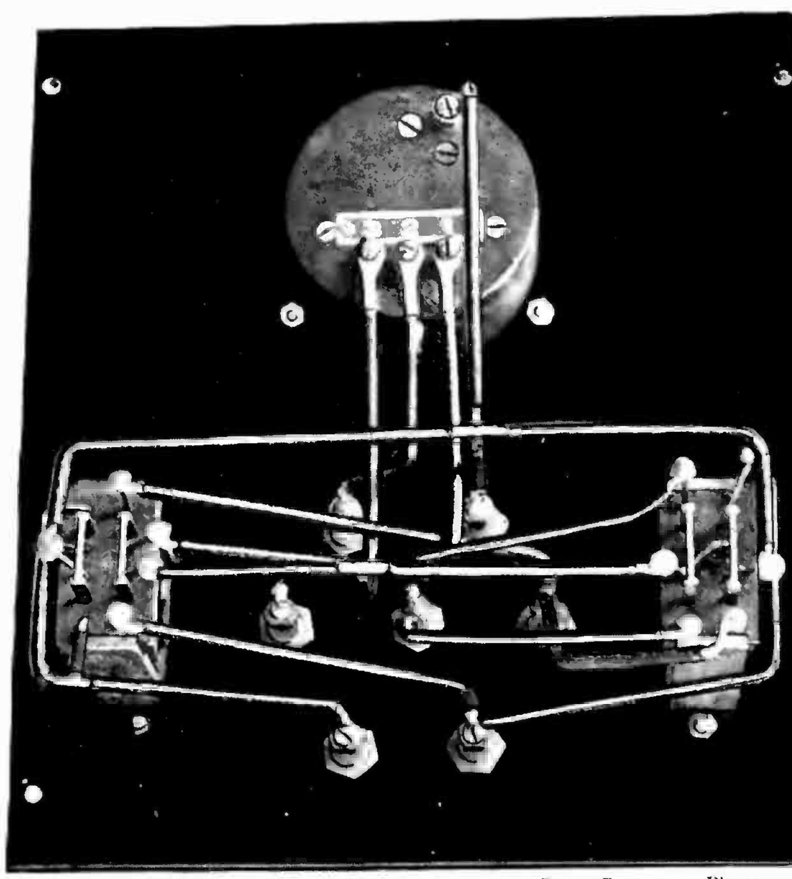
When filament voltage is



Radio Broadcast Photograph

FIG. 1

The front or panel view of the tester shows the placement of the switches, pin jacks and flip-switches. The panel size is 8" x 10". No panel layout is shown, as each constructor may approximate the layout shown above to conform with the parts he chooses to employ



Radio Broadcast Photograph

FIG. 2

A rear view of the tester discloses the fact that simple point-to-point connections make the wiring of the device not difficult, and easy to check

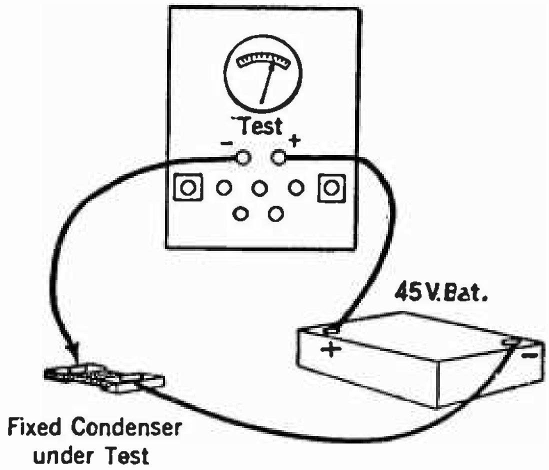


FIG. 3
A picture-diagram of the method employed to test condensers with the aid of the pin jacks labeled "test." Coils, transformers, phones, and numerous other radio articles may be tested in a similar fashion

measured it is possible that the meter will read backward. This may be corrected by reversing the position of the two leads terminating in the minus and plus A tip-jacks.

When the plug is inserted in the detector tube socket, no reading will occur when the left hand switch is tilted upward to read continuity of circuit for the grid circuit. This is because the grid condenser produces a virtual open circuit, and it is necessary to short it out with a clip or piece of wire to obtain a reading.

This trouble shooter will only indicate the circuit in which there is error. After this manifestation, it is necessary to conduct a minute inspection of that part of the circuit indicated by the test as defective actually to locate the source of trouble.

Considering that without such an instrument, the radio set builder must slowly check and inspect each part of a wired receiver, with the attendant possibilities of incorrect checking, the device described here is one that should grace the equipment cabinet of all dyed-in-the-wool experimenters because of its very evident time-saving qualities. The total cost of the tester should not exceed $20, and may run less if the constructor is able to use some parts he has already on hand.

Suppose that an actual test is to be made of the original two-tube Roberts receiver, which employs a stage of tuned neutralized radio frequency amplification and a regenerative detector whose output is reflexed through the first tube to be amplified at audio frequency. When the plug is inserted in the first socket and the switch on the front of the tester panel is thrown to the "Grid" position, it indicates, if a reading is obtained, that not only is the tuner secondary winding continuous but that the secondary of the audio reflex transformer is unbroken. Since the C battery in this part of the circuit is so connected that its voltage is added to that of the battery employed to obtain a multi-reading, it is obvious that at the same time an indication is obtained which will tell whether or not the C battery is in a top notch condition.

When the switch is thrown to the plate circuit, the continuity of the plate coil winding is manifest.

Inserting the test plug in the detector socket, the grid leak and condenser must be bridged by a clip or other connection to short it out of the circuit before a reading can be obtained for the grid circuit. In the plate circuit, the continuity of the circuit will be evident for both the tickler coil and the primary of the audio reflex transformer when a reading is obtained.

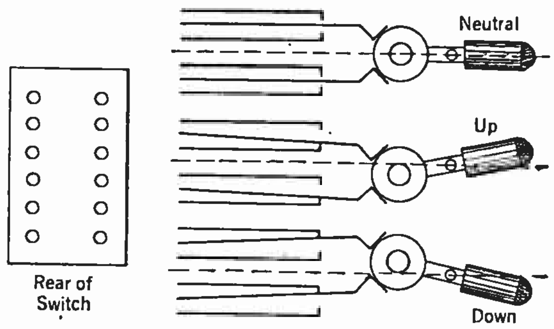


FIG. 5
The three positions which the flip-switches may assume. When the handle is pressed upward, the cam arrangement forces the blades downward into contact with the lower fixed blades of the switch and when pushed downward, the action is just the opposite. When the handle is in a horizontal position then no contact results.

A glance at Fig. 6 will show how the meter of the tester is thrown into the grid or plate circuit.

When the test terminals of the instrument are used, a pair of phones may be inserted in a series circuit, and an additional check will result where it is not always possible, because of the high resistance of some radio apparatus, to obtain a reading on the voltmeter. When the circuit under test is satisfactory, a click will be heard in the phones.

Another use for the test terminals is to determine the approximate resistances of various units by a voltage drop calculation. We will suppose that it is desired to determine the resistance of a large coil such as the secondary of an audio transformer. Several things must be known. First, by reading the voltmeter, determine the exact value of the voltage source in volts. Then determine the voltage when the unknown resistance is included in the circuit. With these values, the formula $R_X = \frac{R_V(E_B - E_V)}{E_V}$ may be invoked. Here R_X is the unknown resistance, R_V is the resistance of the voltmeter, which may usually be obtained from the manufacturer; E_B is the battery or source voltage; and E_V is the voltage reading on the voltmeter. An audio transformer will often seem satisfactory when tested for continuity although a short in its windings exists. A test of its resistance will, however, prove conclusive.

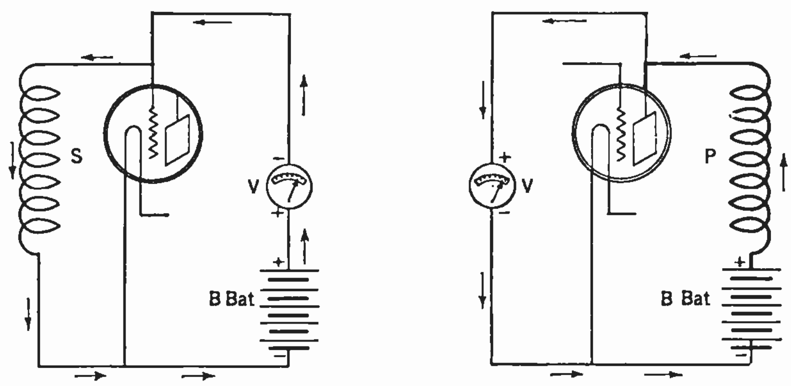


FIG. 6
Here at the left is how the circuit looks when the switch on the front of the panel is thrown to the "Grid" position. At the right the circuit indicates the connections when the same switch is thrown to the "plate" position. The A and B switch merely causes a reading of the voltage of either filament or plate batteries

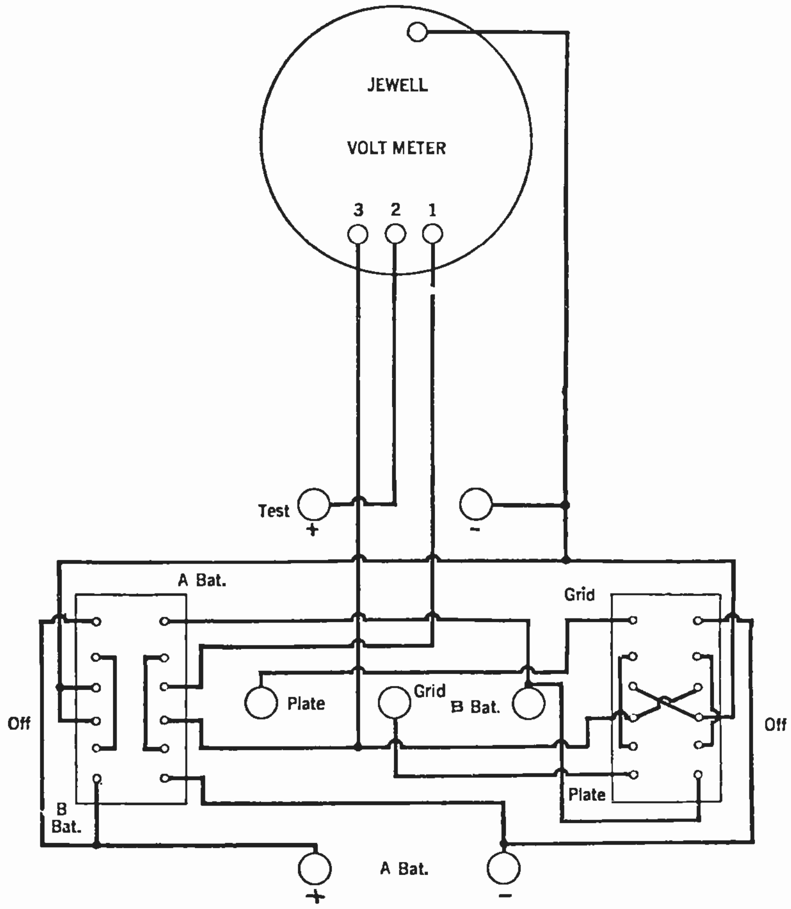


FIG. 4
The wiring diagram for the tester as viewed from the rear. Bus-bar, covered with spaghetti tubing, will make your tester look, as far as wiring is considered, like this circuit diagram, presenting a pleasing appearance

NEW APPARATUS

A Short Description of Some of the Radio Parts and Accessories Which Have Been Tested and Approved by the "Radio Broadcast" Laboratory

SCANNING the advertising pages of a popular radio magazine reminds us of our childhood days when, at Christmas, we gazed into the tinsel bedecked window, brightly illuminated, of the largest toy emporium on Main Street. We were amazed at the multiplicity of the goods offered us. And so with the modern radio fan. He cannot help but notice the many new and distinctive radio devices set out for his scrutiny and deliberation.

To list and illustrate all, or even a goodly portion of such devices, is rather impossible in such a limited space, but a few that have been tested and approved by the Radio Broadcast Laboratory are depicted here.

Manufacturers, it can easily be seen, are bent on simplifying the operation of the radio receiver, and at the same time there is a very evident trend toward beautifying the appearance of the complete radio installation both inside and outside the receiver cabinet.

The Acme Trickle Charger, shown below, makes possible the recharging of one's storage battery after the set is switched off for the night. It is a compact instrument measuring only about 5 x $3\frac{1}{2}$ x $5\frac{3}{4}$ inches, and operates from 110 and 115 volts a. c. The charging rate is .5 ampere.

For the home constructor interested in the super-heterodyne, the St. James 280 kc. intermediate-frequency amplifying transformers will offer something brand new and of decided interest. The transformer primary and secondary coils, which are of the honeycomb type, are enclosed in an air evacuated glass tube resembling a radio vacuum tube in a socket.

From the L. S. Brach Company come two fine additions to radio equipment. The Brach lightning arrester will appeal, especially for summer use, to all who desire a serviceable device which will dissipate the electrical charges that might collect in the antenna. A lightning arrester of an approved type is a good investment, since it makes of the antenna system a very efficient protection against lightning. The second device received from this company is a charging resistor control which may be used for regulating, by means of a calibrated resistance, the rate of trickle charge of A storage batteries, and reduces this function to the mere turning of a switch.

Cardwell's new taper plate condenser is a distinctive contribution to the radio market. It is different from most of the s.l.f. condensers in that the straight line curve is obtained by the use of tapered plates which vary the air space between the rotor and stator plates as the former is rotated, without employing the long, slender plates as is common with most s.l.f. condensers.

Two types of meters offer to the laboratory man and home radio enthusiast a means of checking up on the conditions of his batteries, the A, B, or C. The Hoyt meter, shown on the top of the first page, is of novel pattern. With it, five different sets of readings may be taken by merely turning the meter in its support for each individual range. One connection to the meter is common, while the second connection goes to one or other of the remaining binding posts, depending upon which reading is desired. The possible readings are as follows: 0–75 volts; 0–150 volts; 0–7.5 amperes; 0–15 milliamps.; and 0–75 milliamps.

The Cellokay meter has been designed for telling the actual state of the A battery when its terminals are applied across the latter's posts. A direct reading is obtained which tells at a glance whether the battery is "Full," "Half-Full," or "Low."

From the Richard Davis Company we have received a combined loop and Timmons cone arranged in a very attractive style. It is possible to rotate the loop on two axes thereby adjusting it to the actual plane of the wave front of the intercepted radio wave. In short, this device combines both the input and output units of a receiver—the loop and speaker.

The man building his own plate-supply unit will find the Tobe Deutschmann B Block of especial interest. Gathered into one can are all the condensers that are necessary for the filter and by-pass circuits of a plate-supply unit. Appropriate binding posts afford means for connections to two 1-mfd. sections, two 2-mfd. sections, and one 8-mfd. section.

The three gang condenser of .00035-mfd. capacity for tuning three circuits simultaneously, is manufactured by the United Scientifiic Laboratories, Inc. Novel vernier adjustments on two sets of the stator plates make it possible to compensate for slight differences between the coils in a three-circuit receiver.

The Walbert .00035-mfd. variable condenser indicates a tendency prevalent among manufacturers toward dust proof enclosed condensers. Considering that much can happen in the way of noise production caused by dusty, dirty plates in a variable condenser, this is a step to be commended.

Those fans who have contemplated the purchase of a Bosch cone loud speaker will be interested to know that the Bosch Magneto Company are putting out one of their cones with a wicker work front to harmonize with summer porch furnishings. The Laboratory has not been given the opportunity to test the Bosch cone.

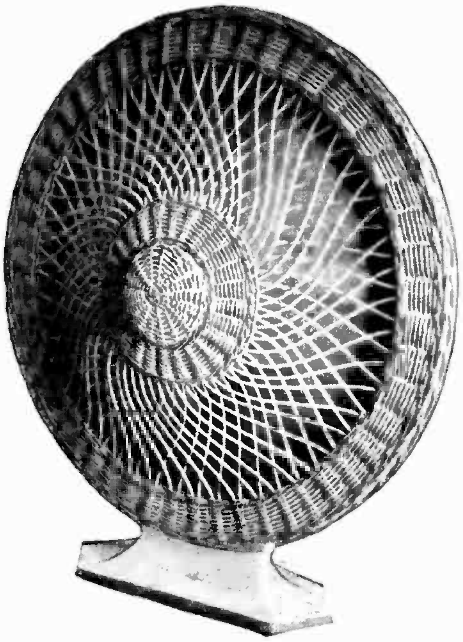
THE ACME TRICKLE CHARGER

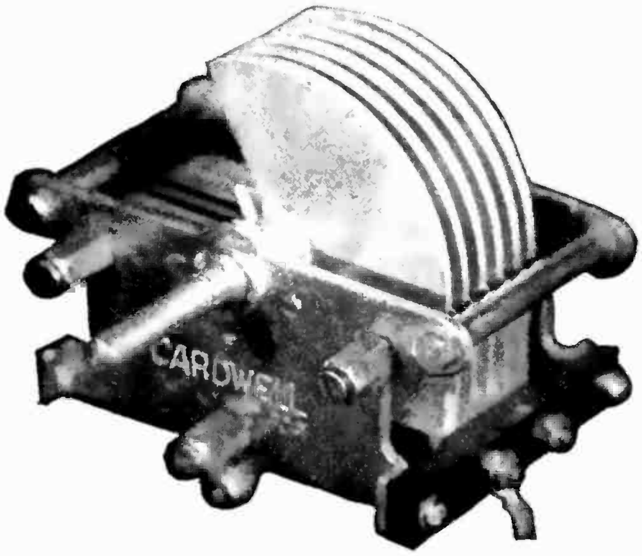
Photographs by Radio Broadcast

BRACH'S LIGHTNING ARRESTER

AN R. F. TRANSFORMER

THE NEW BOSCH CONE

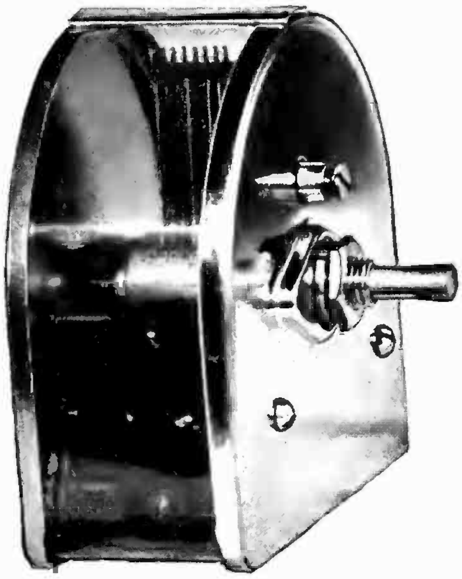


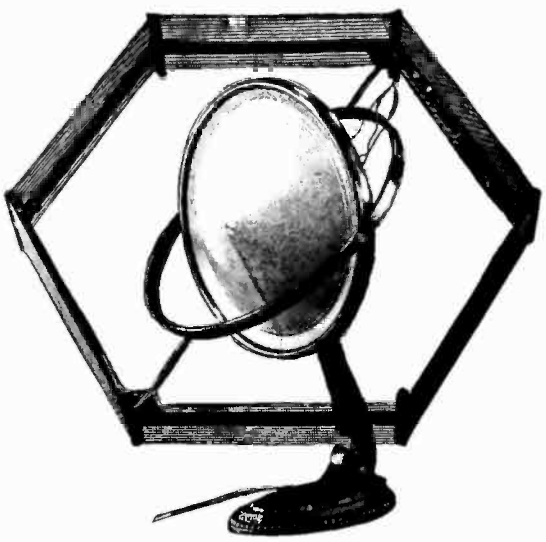


Photographs by RADIO BROADCAST

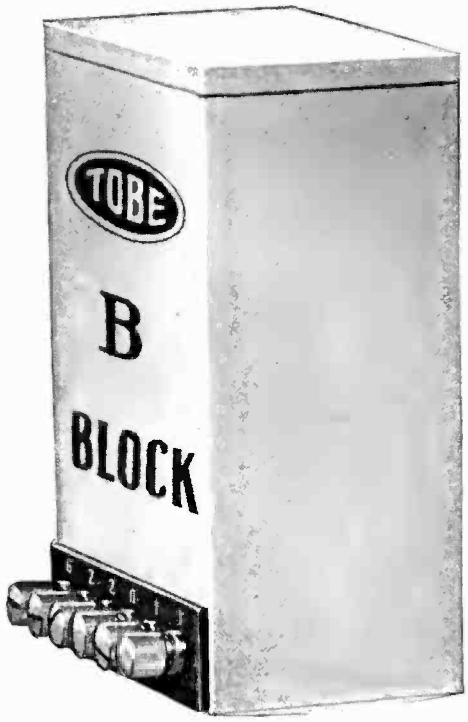
CARDWELL'S TAPER PLATE CONDENSER

A DUST-PROOF CONDENSER
—WALBERT'S

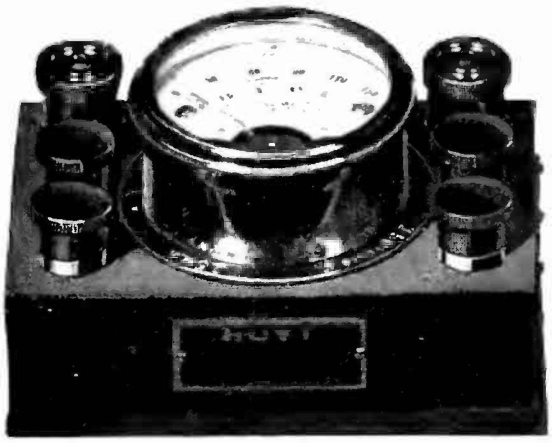




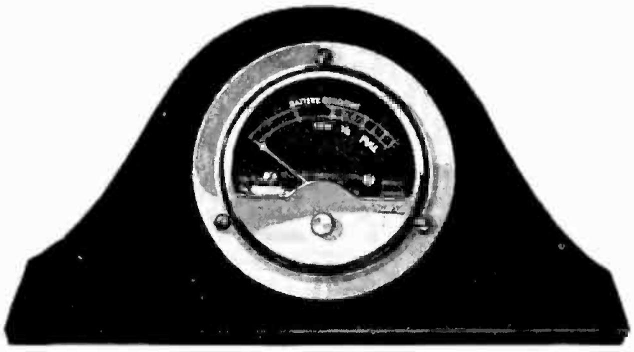
A COMBINED LOOP AND TIMMONS CONE

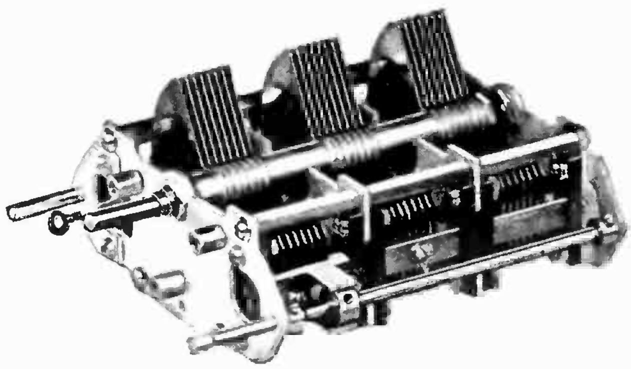


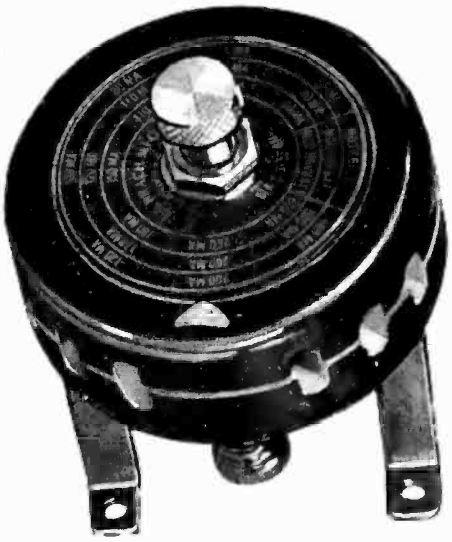
THE TOBE DEUTSCHMANN
B BLOCK



HOYT'S "ROTARY" METER







THE CELLOKAY METER

By connecting it across the A battery, the needle will indicate the condition of the battery by pointing to either "Low," "Half," or "Full." To the right, Brach's charging control—suitable for trickle chargers

A TRIPLE GANG CONDENSER

It is a production of the United Scientific Laboratories (U. S. L.). To compensate for slight differences in the coils employed (which are naturally matched as closely as possible), two groups of stator plates have verniers

How Radio Wire Lines are Equalized

Technical Practice in England and America—Details of the Operation of American Broadcasting Stations—The Rôle of the Engineer in Radio—Comment of Interest to Broadcasters and the Public

"AS THE BROADCASTER SEES IT"

By CARL DREHER

Drawings by Stuart Hay

THE elementary theory of loss of high frequencies in audio transmission over wire lines and cables, and simple methods of correction or equalization were discussed in the May RADIO BROADCAST. The treatment of this subject will now be continued with a description of a number of types of equalizers in common use in broadcasting.

First, however, it should be understood that in line correction, as in politics, there is no universal remedy or panacea. Each case requires individual treatment, depending on the nature and length of the circuit, terminal apparatus, and transmission requirements. Open wire lines, consisting of wires strung on crossarms fastened to poles, require the least degree of correction, since the capacity is relatively low. Such lines, of course, are not as reliable in sleet or wind as aërial or subterranean cables, in which a large number of pairs are bunched and encased in some suitable protective covering, such as lead, or insulating fabrics possessing the requisite mechanical strength. On the other hand, a cable, with the two sides of a pair in contact (insulation to insulation, that is) and also close to other conductors has a much higher capacity per unit length than an open wire pair with the two wires separated by several inches or feet of air. As a result, the attenuation, or loss of energy, is much greater for a given distance, and likewise the loss of higher frequencies is not as easily corrected.

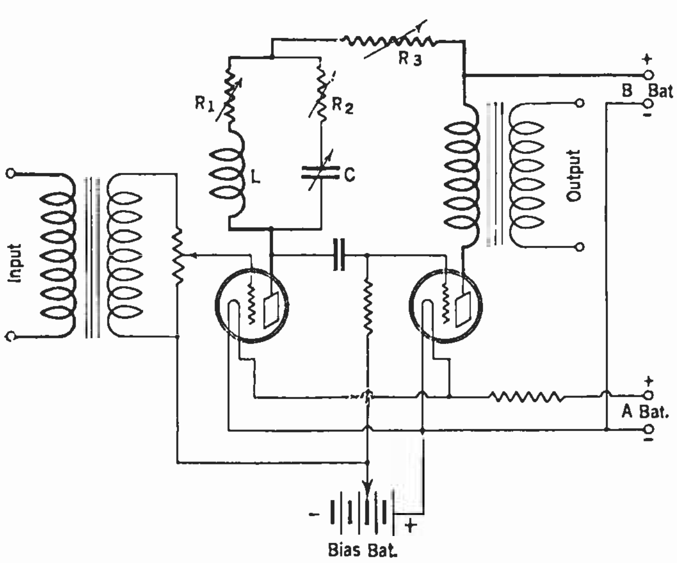


FIG. 1
British practise in line equalizing

In one instance a 225-mile circuit between two cities, almost all open wire, has a "cable equivalent" of 12 miles. That is, this actual 225-mile run of open wire corresponds to 12 miles of standard cable, with a resistance of 88 ohms and capacity of 0.054 microfarads per loop mile, and the 12 miles of standard cable may be used as its equivalent in all calculations. Another circuit between the two cities contains 23 physical miles of cable, in three sections, the rest being open wire. This circuit has a cable equivalent of 40 miles, and is correspondingly harder to equalize. The type of cable is also a factor. In the second case cited above, the cable sections are what is known as five-pair, 14 gauge paper lead cable, which means that there are five pairs of wires, size No. 14 B. & S. copper, the wires insulated from each other by paper covering, with a lead sheath over all.

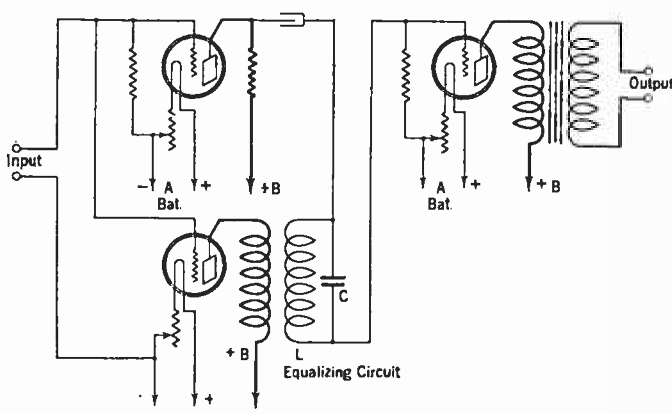


FIG 2
The Weinberger amplifier "flat" to 4000 cycles and "rising" from 4000 to 10,000 cycles

The only type of cable adaptable to broadcasting use is "paired" cable, in which the two wires of a circuit are twisted, and sometimes shielded, to avoid inductive interference from other circuits. "Straight-laid" cable, in which the circuits are not isolated in this way, cannot be used for audio transmission. Even a short section will ruin an otherwise quiet line.

Fig. 1 shows a type of equalizer disclosed in an article on "The Design of a Broadcasting Station," by A. G. D. West, Assistant Chief Engineer of the British Broadcasting Company, published in the *Year Book of Wireless Telegraphy and Telephony* (The *Wireless World, London*). This is designed to equalize between 50 and 8000 cycles per second, and represents English practice in this field. The range of the variables is not given.

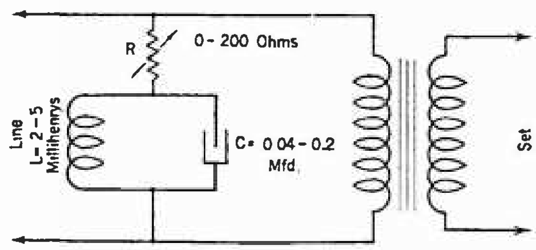


FIG. 3
Shunt equalizer for radio wire lines common in the United States

Fig. 2 shows a correcting amplifier designed by Mr. Julius Weinberger to give a characteristic, flat up to 4000 cycles, and rising from 4000 to 10,000 cycles. This is described in Mr. Weinberger's "Broadcast Transmitting Stations of the Radio Corporation of America," *Proceedings of the Institute of Radio Engineers* Vol. XII, No. 6, Dec., 1924. The rising characteristic is derived from the resonant circuit LC, tuned to 10,000 cycles, with a capacity C equaling 0.00025 mfd.

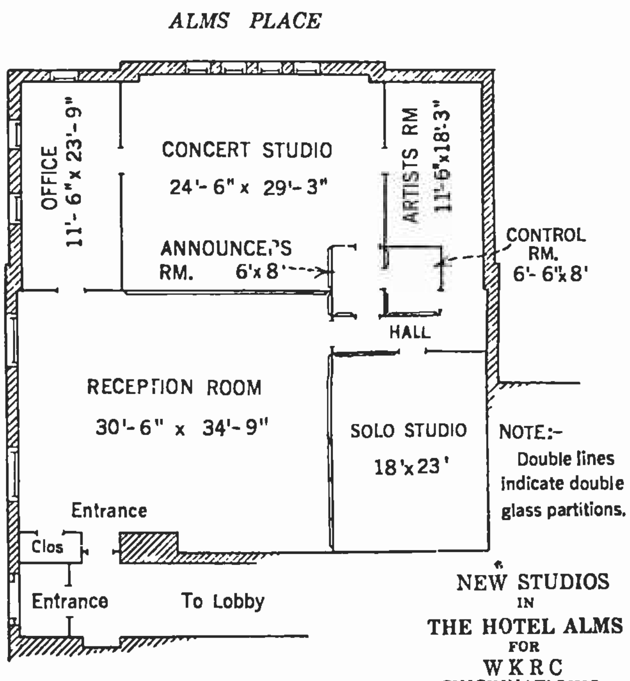
The simple shunt equalizer used generally in this country is shown in Fig. 3. A typical range of constants is given. The theory of operation is simple. The coil-condenser circuit is resonant to some high audio frequency, say 5000 cycles. Across its terminals it presents a very high impedance to currents of this order of frequency, so that it has little effect on their strength and they pass on undiminished to the input equipment. For currents of low frequency, the coil L is practically a short circuit. The combination is therefore an equalizer, dropping out the excess of low notes and retaining the high. The series resistance R regulates the degree of equalization. When the entire resistance is out, leaving the shunt circuit bridged directly across the line, equalization is at a maximum. So is the loss in signal strength, which must be compensated for by amplification.

Among the Broadcasters

WKRC

THE sketch shows the new studio layout of WKRC of Cincinnati, in the north wing of the new Hotel Alms. The 125-foot towers are on the roof of the building. It is said that the arrangement shown was not decided on until two of the officials of the staff had visited twenty-six broadcasting stations in the United States.

The space occupied by the WKRC layout



NEW STUDIOS IN THE HOTEL ALMS FOR WKRC CINCINNATI, OHIO

is about 3600 square feet. This area includes a large orchestration studio, solo studio, control room for the studio director and announcer, a separate operating control office, a private office for the studio director and engineer, a promenade, artists' lounge room, and a large reception hall. Both studios and the announcer's control office are glass-enclosed to permit visitors to watch the broadcasting.

The ceilings of both studios are to be sound-proofed with felt. The walls will be constructed of double thicknesses of sound insulating material, so that each studio will be effectively isolated. The finish will be white, and the acoustic composition used will give the effect of blocks of caen stone. Italian period furniture, suitable draperies and paintings will complete the arrangement.

WENR

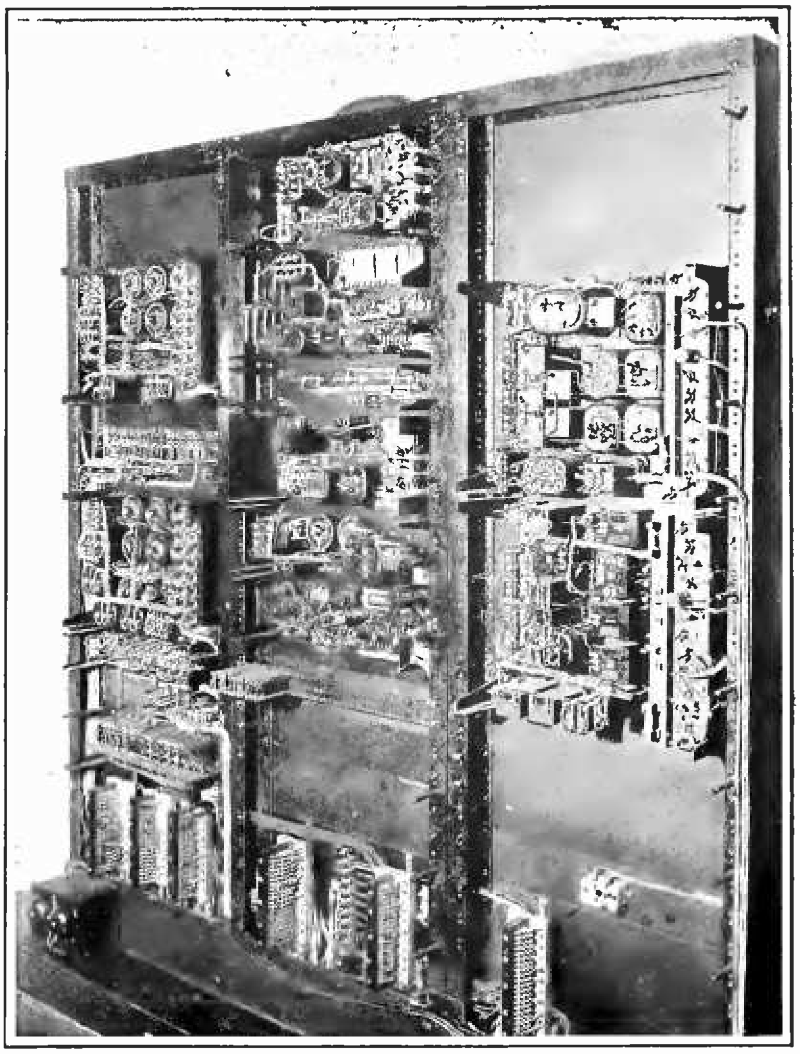
OUR photograph of the new downtown studio of WENR, operated by the All-American Radio Corporation, located in the Kimball Hall Building, Chicago, is not printed to show the two pretty girls and Frank Westphal, the studio director and announcer, but to give technically inclined readers an opportunity to observe the method used to reduce the reverberation time of the studio. Instead of deadening the room by means of drapes, an equivalent acoustic effect has been secured by means of the solid absorbing material used for the walls.

But who put the microphone on the piano? We will wager that none of the operators were around when that photograph was posed.

A NEW STUDIO OF WENR, CHICAGO WHICH HAS A NOVEL WALL TREATMENT

WBAL

YOU are next invited to gaze on the studio control panels (rear view) of WBAL, Baltimore, Maryland. Apparently not all the equipment was in when this photograph was taken. There is enough, however, to enable you to understand why a broadcasting station gets out of order once in a while.



REAR VIEW, STUDIO CONTROL PANELS—WBAL, BALTIMORE

WEAF

ONE of the best known regular features on the air is the Sunday night Capitol Theatre broadcast through WEAF, New York and its chain. The smooth and perfectly controlled job invariably turned

"HE WAS A GENIUS—HE FREQUENTLY SAID SO HIMSELF"

out is no accident. One of the reasons, we are told, is that two of the control engineers assigned to cover the evening program listen to the Sunday afternoon performance in company with the assistant conductor of the theatre, taking notes which later guide them in producing a first-class piece of work in transmission.

It may also be of interest to consider the amount of equipment tied up whenever the big duck, WEAF, and all the little ducklings, to the number of about fifteen, are connected together by wire lines. According to Mr. George F. McClelland, Manager of Broadcasting for WEAF, 9300 miles of wire are used to carry an important program from the Atlantic coast to stations east of the Missouri River, from Minneapolis on the north to St. Louis on the south. The currents travel through underground circuits and over 124,000 telephone poles. The telephone lines, as originally designed and installed, were intended only for transmission of the essential frequencies of speech. The lines used for broadcast transmission must be equalized over a far greater range, in order that natural speech and music may be delivered to the various stations on the chain. About one hundred men cover the transmission, not only in the broadcasting stations themselves, but at twenty-four repeater stations along the lines, where the audio currents are boosted in order to maintain proper quality and margin over noise.

WHT

THROUGH Reeve O. Strock, the chief engineer, WHT reports the installation of a "mixing panel", a device such as was described in the April, 1926, RADIO BROADCAST, to secure greater flexibility in balancing musical ensembles. The report does not give much in the way of circuit details, but it is stated that five studio microphones and all incoming lines may be put on the air simultaneously in any volume proportion desired.

The Rôle of the Engineer in Radio

IF I were entirely ignorant of radio conditions, in a technical sense, wanted to buy a good receiving set, and had no means of getting expert counsel, I should adopt the following curious procedure. Instead of listening to salesmen, who, in my unprepared state, would probably merely befuddle me with their talk, or reading advertisements, which nearly always start with the claim that the set advertised is the eighth wonder of the world, I should try to find out what percentage of their gross income various manufacturers devote to research. When I had discovered the one with the highest ratio in that regard, I should look over a list of his sets, buy the most expensive I could afford, and let it go at that. I might not end up with the best receiver I could buy for the money, but I rather think I would. Neglecting all the other factors involved, the single consideration I have suggested would probably set one on the right path.

The fact is that in radio, as in every other field, one is not apt to get something for nothing. And progress must be bought like everything else. One manufacturer turns out a better product than another, as a rule, because he spends more in finding out how to make his machines superior. It is really astonishing how many radio manufacturers have gone into production on a formidable scale, advertised extensively, sent out an army of salesmen, and invested a gold-mine in the whole structure, when they really had nothing to sell. The product itself was the last thing they thought about. A radio receiver, to them, was a radio receiver. An engineer was anybody who said he was an engineer and could get a few other people, who also said they were engineers, to say that he was an engineer. If he was given the title of Chief Engineer, then all doubt was dispelled. The man was a genius—he frequently said so himself—and that his words dripped with wisdom was proved by the fact that he always spoke in such intricate and technical terms that the promotors of the enterprise could not make head or tail of what he said. All that remained was to put his masterpiece into a fancy box and wait for the money to roll in. . . . Sometimes the creditors have received as much as twenty cents on the dollar.

In this day of high pressure salesmen, well nourished advertising agencies, fifty-thousand-a-year executives, scientific management, expert industrial prophets, and all modern improvements, it is well to remember that our little radio world rests on the shoulders of only one Atlas, the engineer. Or, if you prefer Biblical to mythological figures, do you remember the injunction to build your house upon a rock? If so, you have a better memory than many of the radio set manufacturers whose stock issues dropped from the twenty dollar to the fifty cent class during 1925. Look into the cause of these sad declines, and you will find them many and various, but there is one factor which turns up in seventy-five per cent. of all wrecks, and that is poor or mediocre engineering. The thing started wrong, and it would be a miracle if it had ended right. And miracles occur in hagiology, seldom in radio.

What, then, is this engineer, whose horn I blow so loudly? It has been said that an engineer is a man who can do with one horsepower what any fool can do with two; and that is not a bad definition. Going back a step, we find that this efficiency arises from superior quantitative knowledge. The engineer knows definitely where he "is at" and where he wants to go. But so does a shop-foreman. Going back another step, it appears that the engineer's proficiency rests on the organized body of technical knowledge handed down to him through the various sciences from which his art is derived. He knows his underlying physical theory, is able to express it mathematically, that is, succinctly, exactly, and generally, to confirm it by measurement, and finally to apply it practically to his machine. The engineer is to the cut-and-try set constructor what Oscar of the Waldorf is to a chef in a hash-house.

The necessity for design and production engineers is obvious, since they must be depended on to get out the product. The department which is more likely to be neglected is that of research and development. Instead of parting with the necessary cash for a development division, some short sighted executives think they can get away with it by imitating their competitors. This has two disadvantages. One is that the competitors may not be worth imitating. The other is that the copying firm is always a year or so behind the copied. The proper procedure is to originate when one can and to adapt good ideas derived from competing sets, when expedient, and as far as business ethics will allow. All manufacturers keep an eye on competing sets, and know their good and bad points quite as well as they know the strength and weakness of their own equipment. That is, all manufacturers who are not asleep, and in industry, as when one is freezing, sleep is death. If you walk into the laboratory of a manufacturer of loud speakers, you will find every model of loud speaker on the market, some intact and some taken apart. Furthermore, there will be characteristic curves of all these instruments, showing how some of them lose the low frequencies, some the high, and some both, and depicting the various humps and troughs which make them what they are. But the enterprising manufacturer and his engineers do not spend much time chuckling over the faults of competing makes; they try, rather, to evolve something superior to anything hitherto known, and to surpass themselves as well as their rivals. And this holds for all the numerous parts and complete sets on the market; in every case the firms interested fall into two main classes: those who strive for improvement and those who are satisfied to copy the leaders. The former class is also found to be soundly financed, while the camp-followers generally skate on thin ice. Good research is one of the elements of sound financing; it is insurance against dropping behind in the race for technical supremacy, which, in the last analysis, determines profits.

Sound engineering is as important in development and operation of broadcasting stations as in the manufacture of receiving equipment. The two fields are analogous, development having its place in each, followed by production in one case and operation in the other. There has never been a first class broadcasting station without a first class development division behind it. If you see a station that remains unchanged from year to year, all you may safely conclude is that it may have been a good station once. It is not only a matter of apparatus, but also of sound methods in operation. Tests and procedures must be carefully planned or a smooth performance on the air need not even be hoped for.

If the engineering is unsound, no amount of brilliant program work will make up for that weakness. An instance: a very important dinner was to be broadcast. In addition to the speakers at the banquet, it was necessary to furnish public address service in the banquet hall on the entire output of the broadcasting station. That is, programs from other cities were to be broadcast and simultaneously made available through the public address system to the diners. The best method of handling this was to feed the public address system continuously from the control room amplifiers of the station.

As a new amplifier system was being installed at the hotel, it was impossible to test the lay-out until a few hours before the dinner was to start. Then, to the consternation of everyone, the combination of public address and broadcasting station audio amplifiers howled lamentably as soon as the connections were made. The diagnosis was simple—coupling between the pick-up microphones and the loud speakers in the banquet hall. The tables were all set up, the speakers' platform had been placed, nothing remained but to bring on the food. But without the public address and radio service the banquet would have been, as the boys in the shipping room say, a flop. What was to be done? It was a problem that had to be solved in a hurry. One of the engineers looked around in the annoying, ruminative way these bipeds have in such situations. He observed a small balcony, which he inspected thoughtfully. He went under it and clapped his hands. He went back into the middle of the room and clapped them some more. He directed an assistant to stand under the balcony and slap his palms together enthusiastically, while the first engineer stood at the far end of the hall and listened. He then had a microphone placed under the balcony. The assistant spoke to it. The system reproduced without howling. "If the speakers' table is placed in the lee of that balcony," remarked the engineer, "you will get public address service. Otherwise not." And immediately all the king's horses and all the king's men were set to moving the speakers' table under the balcony, and the banquet was run off successfully. The incident was not an unusual one. In the last analysis, if the engineer's part of the show is sick, the whole show is sick. If he crashes, all is lost. He is the foundation and the framework. Let the elegant gentlemen in the superstructure remember that.

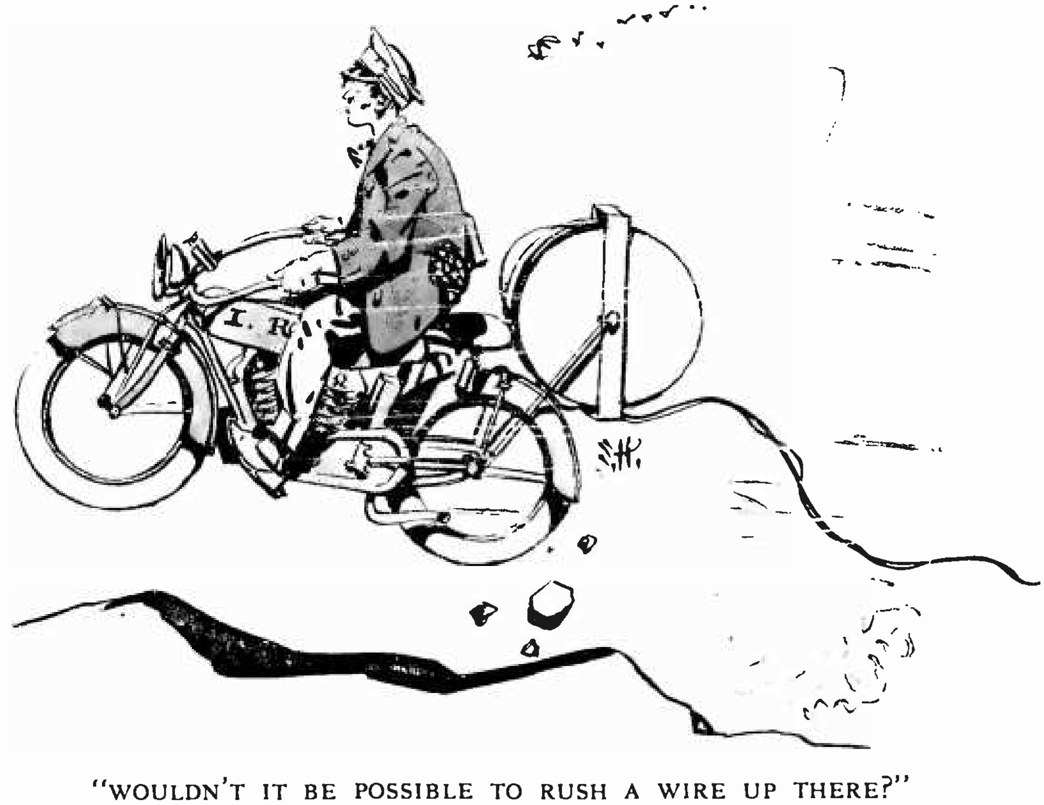
"Please Send Up a Wire"

SOME time ago, in this dizzy department of an otherwise respectable publication, I wrote a skit entitled, "The Laying of the Lines." This opus was my burlesque conception of a young woman radio critic's idea of remote control, derived from a paragraph written by the fair one (since departed from the radio ranks), in which she gave it as her opinion that the lines between New York and Schenectady must have been "carelessly laid" on one occasion when they became noisy during a concert. Pouncing on this phrase, I wrote a piece in which I pictured myself as "laying the lines" by rushing up the east bank of the Hudson with a roll of twisted pair under my arm. One must write about something.

Extravagant? Absurd? Even so. And yet it was brought home to me, the other day, that whatever nonsense one writes, it will be only a little more foolish than the sober thoughts in some people's heads. Attend, then, to a true story.

A movie actor, nationally famous and fabulously rich, had finished a new picture. For the sake of the publicity, the producer arranged to broadcast some scenes from the photoplay, with a musical accompaniment, and to add to the interest, the star was to speak from the studio to the radio audience.

The arrangements having been made in the usual manner, and the event scheduled for a certain evening, a telephone call was received at the broadcasting station on the afternoon of that day from a third assistant secretary of the cinema celebrity. The substance of it was that Mr. X desired to attend a prize-fight in Two Hundred and Twelfth Street (about nine miles from the studio) that evening, and would it not be possible to rush a wire



"WOULDN'T IT BE POSSIBLE TO RUSH A WIRE UP THERE?"

up there, so that Mr. X could broadcast without missing his diversion?

Yes, truth will beat fiction any day. The name of the miracle-seeking star will be given on application to any United States Senator.

Memoirs of a Radio Engineer. XII

"MY MAGAZINES SERVED SOMEWHAT LIKE A LOVER'S PICTURE OF HIS SWEETHEART"

MY ACCOUNT so far has been of urban amateur radio. I did, indeed, take radio with me on my vacations, but only in the form of magazines on the subject, manufacturers' catalogues, and the like. As I was going to school, I enjoyed a vacation period of some two months each summer, which was spent in the Catskills, as a rule. The radio reading matter which I took away with me served somewhat like a lover's picture of his sweetheart, and had the same limitations. After a month's absence from my receiving set, I usually felt a great longing to hear actual signals again, and there were several years when I returned to the city a week or so sooner than was necessary, because my craving for dots and dashes could no longer be restrained. A curious mania, and one which I scarcely comprehend to-day, although I remember it clearly enough. Presumably what killed it was an overdose of dots and dashes when I went into radio professionally.

In 1913, however, my family occupied a cottage in Bushnellsville, Greene County, New York, and my receiving equipment went up there with me. It consisted of a loose-coupler covering a range of from 300 to 3000 meters, approximately, galena detector, and 2000-ohm telephones, with the usual accessories. The water supply in the house came from a spring about 2000 feet distant, through galvanized iron pipe, partly on the surface and partly buried; this gave me a good ground. I strung a single-wire antenna to a tree about 250 feet from the house, and higher up the hill. I climbed the tree and my sister helped me on the ground. The height of the free end of the wire must have been around 40 feet, and it was practically parallel to the side of the hill on which the cottage stood, so that it had a slope of thirty degrees or so, reckoning from the horizontal, and fell into the class of sloping, or, as they were then sometimes called, "compromise" antennas. The lower end of the wire was supported by a tree about thirty feet high, and thence the lead-in dropped vertically to my window.

Bushnellsville is practically in the center of the Catskill range, about 120 miles northwest of New York City, with mountains for thirty miles and more in every direction. The elevation is 1600 feet above sea level, and the tops of the mountains rise 1400 feet higher. Under such unfavorable receiving conditions I had little hope of picking up daylight signals, and I never did. I listened often, but heard only static crashes, and plenty of them, because scarcely a day passed in this valley without a lightning storm of greater or lesser severity. But what I expected to get was the nightly press report of WSL, the Atlantic Communication Company's large station at Sayville, Long Island. This transmitter was a Telefunken spark set rated at 35 kilowatts. I don't know what the actual antenna power or "Turm Kraft," as the German engineers called it, amounted to—possibly something in the neighborhood of 10 kilowatts. Anyway, it was the powerful set of its time, and did a great business communicating with vessels crossing the Atlantic, which it sometimes worked as far east as Gibraltar. The wavelength was somewhere up in the two thousands, about 2800, if I recollect, and each night it sent several thousand words of press, starting around 8 P. M., at about 12 words a minute, including news items, baseball scores, and other items of interest. I was able to get a very readable signal from WSL, and copied him every night. In this way I had the baseball scores every night at about ten o'clock, when nobody else in Bushnellsville knew them until noon the following day, Then the mail, including newspapers, arrived by stage coach, the village being four miles from the nearest railroad station. Most of the natives knew nothing about radio, and believed that I secured the ball scores by some sort of necromancy.

Sayville was the only station I could get reliably. Time signals from NAA, Arlington, were weak, although generally audible at the 10 P. M. transmission. On 600 meters I heard a few ships, and WSC, the Marconi station at Siasconsett, Massachusetts. None of the New York city stations ever let out a peep as far as Bushnellsville was concerned. Mountain reception on a crystal was a different proposition from my city experiences, relatively close to WNT, NAH, and WCG. But, even as conditions were more difficult, the thrill of being in touch with the outside world was greater. There was a peculiar incongruity between the green clad hills and my antenna, and the mastery of space which radio communication gives to man seemed more remarkable in the hills than in the city, where mechanical appliances and triumphs are the regular thing.

In walking and driving about the Catskills in those years (1912-1914) I never saw another antenna. I have sometimes wondered whether I was the first to introduce radio into the haunts of Rip Van Winkle, in the summer of 1913. If there are any other claimants to the honor, let them speak now, or forever hold their peace.

¶ A regular portion of Mr. Dreher's department, "As the Broadcaster Sees It" is devoted to technical procedure in broadcasting stations. That section of his department is of especial interest and help to the many engineers and others engaged in the daily solving of problems of broadcasting. Mr. Dreher invites contributions from other broadcasting engineers, telling of kinks of operation, or any kind of short report on their daily technical experiences which will be helpful to those similarly engaged. All contributions accepted will be paid for at our regular space rates. We believe, also, that the technical side of the operation of a broadcasting station is of deep interest to the great body of radio experimenters as well as to those who make their living supplying broadcast service to the listener. The material appearing in this department is so written that it is sufficiently technical to be of help to the engineer, but yet not too involved for the average experimenter to comprehend.

MILES FROM ↓ TO →	BOSTON	CHICAGO	CINCINNATI	CLEVELAND	DETROIT	NEW YORK	PHILADEL-PHIA	PITTS-BURGH	ST. LOUIS
Atlanta, Ga.	930	590	375	550	595	745	660	520	470
Baltimore, Md.	350	600	420	315	405	170	85	200	730
Birmingham, Ala.	1050	580	415	615	640	855	775	610	400
Boston, Mass.	—	840	730	540	600	190	270	475	1100
Buffalo, N. Y.	400	450	395	175	215	295	280	180	655
Calgary, Alta.	2060	1370	1620	1645	1555	2000	1200	1755	1950
Chicago, Ill.	840	—	230	300	225	700	650	400	250
Cincinnati, O.	730	230	—	215	225	560	500	250	300
Cleveland, O.	540	300	215	—	75	400	350	110	480
Dallas, Tex.	1515	800	795	1000	990	1350	1280	1060	540
Davenport, Ia.	990	160	360	455	390	860	800	560	200
Denver, Colo.	1750	900	1080	1200	1140	1600	1550	1310	775
Des Moines, Ia.	1135	300	500	605	540	1010	965	710	265
Detroit, Mich.	600	225	225	75	—	475	435	200	440
Elgin, Ill.	870	35	280	335	260	740	690	440	255
Galveston, Tex.	1585	945	880	1100	1090	1400	1315	1125	690
Hastings, Neb.	1400	560	740	865	795	1265	1215	965	445
Havana, Cuba	1500	1315	1100	1250	1325	1300	1270	1215	1165
Indianapolis, Ind.	790	160	100	255	230	630	575	325	230
Iowa City, Ia.	1045	200	405	505	435	900	860	600	210
Joliet, Ill.	870	35	250	330	260	730	680	430	225
Kansas City, Mo.	1225	400	545	690	640	1080	1025	775	230
Lansing, Mich.	680	170	240	170	85	550	520	280	400
Los Angeles, Cal.	2560	1730	1875	2020	1950	2420	2360	2110	1565
Louisville, Ky.	815	270	90	300	310	645	570	345	245
Madison, Wisc.	925	120	370	405	325	800	760	520	300
Memphis, Tenn.	1120	480	410	620	615	950	870	655	240
Mexico City, Mex.	2300	1675	1600	1800	2120	2115	2035	1860	1420
Miami, Fla.	1280	1180	950	1085	1150	1100	1025	1010	1050
Milwaukee, Wisc.	840	80	320	335	255	725	690	450	325
Minneapolis, Minn.	1110	360	590	620	545	1005	980	750	465
Montreal, P. Q.	260	740	700	490	515	335	400	470	970
New Orleans, La.	1340	820	700	910	925	1150	1080	910	590
New York, N. Y.	190	700	560	400	475	—	90	310	870
Oakland, Cal.	2650	1820	2000	2115	2030	2500	2490	2240	1705
Philadelphia, Pa.	270	650	500	350	435	90	—	250	800
Pittsburgh, Pa.	475	400	250	110	200	310	250	—	550
Providence, R. I.	40	825	700	525	585	150	235	450	1000
St. Louis, Mo.	1100	250	300	480	440	870	800	550	—
San Francisco, Cal.	2650	1820	2020	2140	2065	2540	2500	2240	1715
Schenectady, N. Y.	145	700	600	400	460	150	210	350	900
Seattle, Wash.	2500	1710	1950	2000	1920	2400	2385	2115	1695
Springfield, Mass.	80	760	645	460	525	120	200	395	960
Tampa, Fla.	1160	1060	775	925	985	1000	930	870	855
Toronto, Ont.	440	425	400	190	200	350	340	225	640
Valparaiso, Ind.	815	45	200	270	210	670	625	370	255
Washington, D. C.	390	590	400	300	390	200	125	190	705
Winnipeg, Man.	1350	710	970	940	850	1295	1275	1050	845
Worcester, Mass.	40	800	700	500	570	155	235	435	985
Zion, Ill.	850	45	285	320	240	720	675	420	290

Sixteen

RADIO BROADCAST'S

Booklet of

American and Canadian Broadcasters

May 15, 1926

Arranged by

LAWRENCE W. CORBETT

Log Sheet

CALL SIGNAL	WAVE-LENGTH	FREQUENCY	DIAL 1	DIAL 2	DIAL 3	REMARKS

Fourteen

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
KFMX	Northfield, Minn.	890	336.9	500
KFNF	Shenandoah, Ia.	1140	263	1000
KFOA	Seattle, Wash.	660	454.3	1000
KFOB	Burlingame, Cal.	1330	226	50
KFON	Long Beach, Cal.	1290	233	500
KFOO	Salt Lake City, Utah	1270	236	250
KFOR	David City, Neb.	1330	226	100
KFOT	Wichita, Kans.	1300	231	50
KFOX	Omaha, Neb.	1210	248	100
KFOY	St. Paul, Minn.	1190	252	50
KFPL	Dublin, Tex.	1190	252	15
KFPM	Greenville, Tex.	1240	242	10
KFPR	Los Angeles, Cal.	1300	230.6	500
KFPW	Carterville, Mo.	1160	258	20
KFPY	Spokane, Wash.	1130	266	100
KFQA	St. Louis, Mo.	1150	261	100
KFQB	Fort Worth, Texas	1140 590	263 508.2	1000 }
KFQD	Anchorage, Alaska	1320	227.1	100
KFQP	Iowa City, Ia.	1340	224	10
KFQU	Holy City, Cal.	1380	217.3	100
KFQW	North Bend, Wash.	1390	215.7	50
KFQZ	Hollywood, Cal.	1330	225.4	50
KFRB	Beeville, Tex.	1210	248	250
KFRC	San Francisco, Cal.	1120	268	50
KFRU	Columbia, Mo.	600	499.7	500
KFRW	Olympia, Wash.	1370	218.8	50
KFSG	Los Angeles, Cal.	1090	275	500
KFUL	Galveston, Tex.	1160	258	50
KFUM	Colorado Springs, Colo.	1250	239.9	100
KFUO	St. Louis, Mo.	550	545.1	500
KFUP	Denver, Colo.	1280	234	50
KFUR	Ogden, Utah	1340	224	50
KFUS	Oakland, Cal.	1170	256	50
KFUT	Salt Lake City, Utah	1150	261	100
KFUU	Oakland, Cal.	1360	220	50
KFVD	San Pedro, Cal.	1460	205.4	50
KFVE	St. Louis, Mo.	1250	240	500
KFVG	Independence, Kans.	1270	236	15
KFVI	Houston, Tex.	1250	240	10
KFVN	Welcome, Minn.	1320	227	50
KFVS	Cape Girardeau, Mo.	1340	224	50
KFVW	San Diego, Cal.	1220	246	500
KFVY	Albuquerque, N. Mex.	1200	250	10
KFWA	Ogden, Utah	1150	261	500
KFWB	Hollywood, Cal.	1190	252	500
KFWC	Upland, Cal.	1420	211.1	50
KFWF	St. Louis, Mo.	1400	214.2	250
KFWH	Chico, Cal.	1180	254	100
KFWI	South San Francisco, Cal.	1330	226	500
KFWM	Oakland, Cal.	1450	206.8	500
KFWO	Avalon, Cal.	1420	211.1	250
KFWU	Pineville, La.	1260	238	100

Three

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
KDKA	East Pittsburgh, Pa.	970	309.1	Varies
KDLR	Devils Lake, N. Dak.	1300	231	5
KDYL	Salt Lake City, Utah	1220	246	50
KFAB	Lincoln, Neb.	880	340.7	1000
KFAD	Phoenix, Ariz.	1100	273	100
KFAF	San Jose, Cal.	1380	217.3	50
KFAU	Boise, Idaho.	1070	280.2	750
KFBB	Havre, Mont.	1090	275	50
KFBC	San Diego, Cal.	1390	215.7	50
KFBK	Sacramento, Cal.	1210	248	100
KFBL	Everett, Wash.	1340	224	100
KFBS	Trinidad, Colo.	1260	238	15
KFBU	Laramie, Wyo.	1110	270	500
KFCB	Phoenix, Ariz.	1260	238	100
KFDD	Boise, Idaho.	1080	278	50
KFDM	Beaumont, Tex.	950	315.6	500
KFDX	Shreveport, La	1200	250	100
KFDY	Brookings, S. Dak.	1100	273	100
KFDZ	Minneapolis, Minn.	1300	231	10
KFEC	Portland, Ore.	1210	248	50
KFEL	Denver, Colo.	1180	254	50
KFEQ	Oak, Neb.	1120	268	500
KFEY	Kellogg, Idaho	1290	233	10
KFFP	Moberly, Mo.	1240	242	50
KFGQ	Boone, Ia.	1330	226	10
KFH	Wichita, Kans.	1120	268	500
KFHA	Gunnison, Colo.	1190	252	50
KFHL	Oskaloosa, Ia.	1250	240	10
KFI	Los Angeles, Cal.	640	468.5	4000
KFIF	Portland, Ore.	1210	248	100
KFIO	Spokane, Wash.	1130	265.3	100
KFIQ	Yakima, Wash.	1170	256	100
KFIU	Juneau, Alaska	1330	226	10
KFIZ	Fond du Lac, Wisc.	1100	273	100
KFJB	Marshalltown, Ia.	1210	248	10
KFJC	Junction City, Kans.	1370	218.8	10
KFJF	Oklahoma, Okla.	1150	261	500
KFJI	Astoria, Ore.	1220	246	10
KFJM	Grand Forks, N. Dak.	1080	278	100
KFJR	Portland, Ore.	1140	263	50
KFJY	Fort Dodge, Ia.	1220	246	50
KFJZ	Fort Worth, Tex.	1180	254	50
KFKA	Greeley, Colo.	1100	273	50
KFKU	Lawrence, Kans.	1090	275	500
KFKX	Hastings, Nebr.	1040	288.3	5000
KFKZ	Kirksville, Mo.	1330	226	10
KFLR	Albuquerque, N. Mex.	1180	254	100
KFLU	San Benito, Tex.	1270	236	10
KFLV	Rockford, Ill.	1310	229	100
KFLX	Galveston, Tex.	1250	240	10
KFLZ	Anita, Ia.	1100	273	100
KFMR	Sioux City, Ia.	1150	261	100
KFMW	Houghton, Mich.	1140	263	50

Two

Log Sheet

CALL SIGNAL	WAVE-LENGTH	FREQUENCY	DIAL 1	DIAL 2	DIAL 3	REMARKS

Fifteen

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
KFWV	Portland, Ore.	1410	212.6	50
KFXB	Big Bear Lake, Cal.	1480	202.6	500
KFXD	Logan, Utah	1460	205.4	10
KFXF	Colorado Springs, Colo.	1200	250	500
KFXH	El Paso, Tex.	1240	242	50
KFXJ	Denver, Colo. (portable)	1390	215.7	10
KFXR	Oklahoma, Okla.	1400	214.2	15
KFXY	Flagstaff, Ariz.	1460	205.4	50
KFYF	Oxnard, Cal	1460	205.4	10
KFYJ	Houston, Tex. (portable)	1260	238	10
KFYO	Texarkana, Tex.	1440	209.7	10
KFYR	Bismarck, N. Dak.	1210	248	10
KGO	Oakland, Cal.	830	361.2	4000
KGTT	San Francisco, Cal.	1450	206.8	50
KGU	Honolulu, Hawaii	1110	270	500
KGW	Portland, Ore.	610	491.5	500
KGY	Lacey, Wash.	1220	246	50
KHJ	Los Angeles, Cal.	740	405.2	500
KHQ	Spokane, Wash.	760	394.5	1000
KJBS	San Francisco, Cal.	1360	220	5
KJR	Seattle, Wash.	780	384.4	1000
KLDS	Independence, Mo.	680	440.9	1000
KLS	Oakland, Cal.	1200	250	250
KLX	Oakland, Cal.	590	508.2	500
KLZ	Denver, Colo.	1130	266	250
KMA	Shenandoah, Ia.	1190	252	500
KMJ	Fresno, Cal.	1280	234	50
KMMJ	Clay Center, Neb.	1310	228.9	1000
KMO	Tacoma, Wash.	1200	250	100
KMOX	St. Louis, Mo.	1070	280.2	1500
KMTR	Los Angeles, Cal.	1260	238	500
KNRC	Los Angeles, Cal.	1440	208.2	250
KNX	Los Angeles, Cal.	890	336.9	1000
KOA	Denver, Colo.	930	322.4	5000
KOAC	Corvallis, Ore.	1070	280.2	500
KOB	State College, N. Mex.	860	348.6	1000
KOCH	Omaha, Neb.	1160	258	250
KOCW	Chickasha, Okla.	1190	252	200
KOIL	Council Bluffs, Ia.	1080	278	500
KOIN	Portland, Ore.	1410	212.6	500
KOWW	Walla Walla, Wash.	1170	256	500
KPO	San Francisco, Cal.	700	428.3	1000
KPPC	Pasadena, Cal.	1310	229	50
KPRC	Houston, Tex.	1010	296.9	500
KPSN	Pasadena, Cal.	950	315.6	1000
KQV	Pittsburgh, Pa.	1090	275	500
KQW	San Jose, Cal.	1300	231	500
KRE	Berkeley, Cal.	1170	256	100
KSAC	Manhattan, Kans.	880	340.7	500
KSD	St. Louis, Mo.	550	545.1	500
KSL	Salt Lake City, Utah	1000	299.8	1000
KSMR	Santa Maria, Cal.	1430	209.7	100
KSO	Clarinda, Ia	1240	242	500

Four

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
CKAC	Montreal, P. Q.	730	410.7	1200
CKCD	Vancouver, B. C.	730	410.7	1000
CKCK	Regina, Sask.	630	475.9	500
CKCL	Toronto, Ont.	840	356.9	500
CKCO	Ottawa, Ont.	690	434.5	100
CKCW	Durham Co., Ont. (Not Active)	910	329.5	5000
CKFC	Vancouver, B. C.	730	410.7	50
CKNC	Toronto, Ont.	840	356.9	500
CKOC	Hamilton, Ont.	880	340.7	50
CKY	Winnipeg, Man.	780	384.4	500
CNRA	Moncton, N. B.	1030	291.1	500
CNRC	Calgary, Alta.	Uses **CFAC** or **CFCN**		
CNRE	Edmonton, Alta.	Uses station **CJCA**		
CNRM	Montreal, P. Q.	Uses **CHYC, CKAC** or **CFCF**		
CNRO	Ottawa, Ont.	690	434.5	500
CNRR	Regina, Sask.	Uses station **CKCK**		
CNRS	Saskatoon, Sask.	Uses station **CFQC**		
CNRT	Toronto, Ont.	Uses station **CFCA**		
CNRV	Vancouver, B. C.	1030	291.1	500
CNRW	Winnipeg, Man.	Uses station **CKY**		

BY FOLLOWING these instructions, a sixteen-page booklet giving all the call signals, frequencies, wavelengths and power of American and Canadian broadcasting stations, together with a distance computation table and log, will result. Referring to page 153, it will be seen that the page has been divided up into four sections, each section representing a page of the completed booklet. This page is made up of pages one, three, fourteen, and sixteen of the booklet.

The pages should be cut from the magazine with a sharp razor blade as near to the binding as possible. Next, these two pages are carefully cut, each into two, the center horizontal line being taken as a guide. We then have four rectangular sheets, two consisting of original pages 153 and 154, and two of pages 155 and 156. The next procedure is to cut around each of these sheets on the border line. Thus the original page numbers, date, and magazine title will be removed. It is advisable to leave a slight border in this operation to allow for trimming up the finished booklet.

Each sheet is then folded down its center vertical line and the folios inserted within each other according to the page numbers printed.

Thirteen

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WTAQ	Eau Claire, Wisc.	1180	254	100
WTAR	Norfolk, Va.	1150	261	100
WTAW	College Station, Tex.	1110	270	500
WTAX	Streator, Ill.	1300	231	50
WTAZ	Lambertville, N. J.	1150	261	15
WTIC	Hartford, Conn.	630	475.9	500
WWAD	Philadelphia, Pa.	1200	250	250
WWAE	Plainfield, Ill.	1240	242	500
WWAO	Houghton, Mich.	1140	263	250
WWI	Dearborn, Mich.	1130	266	500
WWJ	Detroit, Mich.	850	352.7	1000
WWL	New Orleans, La.	1090	275	100

Canadian Broadcasting Stations

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
CFAC	Calgary, Alta.	690	434.5	500
CFCA	Toronto, Ont.	840	356.9	500
CFCF	Montreal, P. Q.	730	410.7	1650
CFCH	Iroquois Falls, Ont.	600	499.7	250
CFCK	Edmonton, Alta.	580	516.9	100
CFCN	Calgary, Alta.	690	434.5	1800
CFCQ	Vancouver, B. C.	730	410.7	5
CFCU	Hamilton, Ont.	880	340.7	500
CFCT	Victoria, B. C.	910	329.5	500
CFCY	Charlottetown, P. E. I.	960	312.3	50
CFDC	Vancouver, B. C.	730	410.7	10
CFKC	Thorold, Ont. (Not Active)	1210	247.8	75
CFMC	Kingston, Ont.	1120	267.7	20
CFQC	North Saskatoon, Sask.	910	329.5	500
CFRC	Kingston, Ont.	1120	267.7	500
CFXC	New Westminster, B. C.	1030	291.1	20
CFYC	Burnaby, B. C.	730	410.7	500
CHCS	Hamilton, Ont.	880	340.7	10
CHIC	Toronto, Ont.		Uses Station CHNC	
CHNC	Toronto, Ont.	840	356.9	500
CHSC	Unity, Sask.	840	356.9	250
CHUC	Saskatoon, Sask.	910	329.5	50
CHXC	Ottawa, Ont.	690	434.5	250
CHYC	Montreal, P. Q.	730	410.7	850
CJBC	Toronto, Ont.	Uses Toronto District Stations		
CJCA	Edmonton, Alta.	580	516.9	500
CJCD	Toronto, Ont.	840	356.9	50
CJGC	London, Ont.	910	329.5	50
CJKC	Burnaby, B. C.		Uses Station CFYC	
CJSC	Toronto, Ont.		Uses Station CKCL	
CJWC	Saskatoon, Sask.	910	329.5	250
CJYC	Scarboro Station, Ont. (not active)	1030	291.1	500

Twelve

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
KTAB	Oakland, Cal.	1250	240	1000
KTBI	Los Angeles, Cal.	1020	293.9	750
KTBR	Portland, Ore.	1140	263	50
KTCL	Seattle, Wash.	980	305.9	1000
KTHS	Hot Springs, Ark.	800	374.8	500
KTNT	Muscatine, Ia.	1170	256	500
KTW	Seattle, Wash.	660	454.3	1000
KUOA	Fayetteville, Ar.	1000	299.8	750
KUOM	Missoula, Mont.	1230	244	250
KUSD	Vermilion, S. Dak.	1080	278	100
KUT	Austin, Tex.	1300	231	500
KVOO	Bristow, Okla.	800	374.8	500
KWCR	Cedar Rapids, Ia.	1080	278	500
KWG	Stockton, Cal.	1210	248	50
KWKC	Kansas City, Mo.	1270	236	100
KWKH	Kennon Wood, La.	1150	261	500
KWSC	Pullman, Wash.	860	348.6	500
KWUC	Le Mars, Ia.	1190	252	50
KWWG	Brownsville, Tex.	1080	278	500
KYW	Chicago, Ill.	560	535.4	3500
KZIB	Manila, Philippines	1200	249.9	20
KZKZ	Manila, Philippines	1110	270	100
KZM	Oakland, Cal.	1250	240	100
KZRQ	Manila, Philippines	1350	222	500
KZUY	Baguio, Philippines.	833	360	500
NAA	Arlington, Va.	690	434.5	1000
WAAD	Cincinnati, Ohio	1160	258	25
WAAF	Chicago, Ill.	1080	278	200
WAAM	Newark, N. J.	1140	263	500
WAAW	Omaha, Neb.	1080	278	500
WABB	Harrisburg, Pa.	1470	204	10
WABC	Asheville, N. C.	1180	254	20
WABI	Bangor, Me.	1250	240	100
WABO	Rochester, N. Y.	1080	278	100
WABQ	Haverford, Pa.	1150	261	100
WABR	Toledo, Ohio	1140	263	50
WABW	Wooster, Ohio	1450	206.8	50
WABX	Mount Clemens (near), Mich.	1220	246	500
WABY	Philadelphia, Pa.	1240	242	50
WABZ	New Orleans, La.	1090	275	50
WADC	Akron, Ohio	1160	258	500
WAFD	Port Huron, Mich.	1090	275	500
WAGM	Royal Oak, Mich.	1330	225.4	50
WAHG	Richmond Hill, N. Y.	950	315.6	500
WAIT	Taunton, Mass.	1310	229	10
WAIU	Columbus, Ohio	1020	293.9	500
WAMD	Minneapolis, Minn.	1230	244	500
WAPI	Auburn, Ala.	1210	248	1000
WARC	Medford Hillside, Mass.	1150	261	100
WATT	Boston, Mass. (Portable)	1230	243.8	100
WBAA	West Lafayette, Ind.	1100	273	250
WBAK	Harrisburg, Pa.	1090	275	500
WBAL	Baltimore, Md.	1220	245.8	1000

Five

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WMAC	Cazenovia, N. Y.	1090	275	100
WMAF	Dartmouth, Mass.	680	440.9	1000
WMAK	Lockport, N. Y.	1130	266	500
WMAL	Washington, D. C.	1410	212.6	100
WMAN	Columbus, Ohio	1080	278	50
WMAQ	Chicago, Ill.	670	447.5	1000
WMAY	St. Louis, Mo.	1210	248	100
WMAZ	Macon, Ga.	1150	261	500
WMBB	Chicago, Ill.	1200	250	500
WMBC	Detroit, Mich.	1170	256.4	100
WMBF	Miami Beach, Fla.	780	384.4	500
WMC	Memphis, Tenn.	600	499.7	500
WMCA	Hoboken, N. J.	880	340.7	500
WMSG	New York, N. Y.	1410	212.6	500
WNAB	Boston, Mass.	1200	250	100
WNAC	Boston, Mass.	1070	280.2	500
WNAD	Norman, Okla.	1180	254	500
WNAL	Omaha, Neb.	1160	258	50
WNAT	Philadelphia, Pa.	1200	250	100
WNAX	Yankton, S. Dak.	1230	244	100
WNBH	New Bedford, Mass.	1210	248	250
WNJ	Newark, N. J.	1190	252	150
WNOX	Knoxville, Tenn.	1120	268	500
WNRC	Greensboro, N. C.	1340	224	10
WNYC	New York, N. Y.	570	526	1000
WOAI	San Antonio, Tex.	760	394.5	2000
WOAN	Lawrenceburg, Tenn.	1060	282.8	500
WOAW	Omaha, Neb.	570	526	1000
WOAX	Trenton, N. J.	1250	240	500
WOC	Davenport, Ia.	620	483.6	5000
WOCL	Jamestown, N. Y.	1090	275	15
WODA	Paterson, N. J.	1340	224	250
WOI	Ames, Ia.	1110	270	750
WOK	Homewood, Ill.	1380	217.3	500
WOKO	New York, N. Y.	1287	233	50
WOO	Philadelphia, Pa.	590	508.2	500
WOOD	Grand Rapids, Mich.	1240	242	500
WOQ	Kansas City, Mo.	1080	278	1000
WOR	Newark, N. J.	740	405.2	500
WORD	Batavia, Ill.	1090	275	5000
WOS	Jefferson City, Mo.	680	440.9	500
WOWL	New Orleans, La.	1110	270	10
WOWO	Fort Wayne, Ind.	1320	227	500
WPAK	Agricultural College, N. Dak.	1090	275	50
WPCC	Chicago, Ill.	1160	258	500
WPDQ	Buffalo, N. Y.	1460	205.4	50
WPG	Atlantic City, N. J.	1000	299.8	500
WPRC	Harrisburg, Pa.	1390	215.7	100
WPSC	State College, Pa.	1150	261	500
WQAA	Parkesburg, Pa.	1360	220	500
WQAC	Amarillo, Tex.	1280	234	100
WQAE	Springfield, Vt.	1220	246	50
WQAM	Miami, Fla.	1140	263	100

Ten

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WDAY	Fargo, N. Dak.	1150	261	50
WDBE	Atlanta, Ga.	1110	270	100
WDBJ	Roanoke, Va.	1310	229	50
WDBK	Cleveland, Ohio	1320	227	100
WDBO	Winter Park, Fla.	1250	240	500
WDBZ	Kingston, N. Y.	1290	233	10
WDOD	Chattanooga, Tenn.	1170	256	500
WDRC	New Haven, Conn.	1120	268	100
WDWF	Cranston, R. I.	680	440.9	500
WDZ	Tuscola, Ill.	1080	278	100
WEAF	New York, N. Y.	610	491.5	5000
WEAI	Ithaca, N. Y.	1180	254	500
WEAM	North Plainfield, N. J.	1150	261	250
WEAN	Providence, R. I.	1110	270	500
WEAO	Columbus, Ohio	1020	294	500
WEAR	Cleveland, Ohio.	770	389.4	750
WEAU	Sioux City, Ia	1090	275	100
WEBC	Superior, Wis.	1240	242	100
WEBD	Anderson, Ind.	1220	246	15
WEBE	Cambridge, Ohio.	1280	234	10
WEBH	Chicago, Ill.	810	370.2	2000
WEBJ	New York, N. Y.	1100	273	500
WEBL	United States (portable)	1330	226	100
WEBQ	Harrisburg, Ill.	1330	226	10
WEBR	Buffalo, N. Y.	1230	244	100
WEBW	Beloit, Wis.	1120	268	500
WEBZ	Savannah, Ga.	1140	263	50
WEEI	Boston, Mass.	860	348.6	500
WEHS	Evanston, Ill.	1480	202.6	10
WEMC	Berrien Springs, Mich.	1050	285.5	500
WENR	Chicago, Ill.	1130	266	1000
WEW	St. Louis, Mo.	1210	248	1000
WFAA	Dallas, Tex.	630	475.9	500
WFAM	St. Cloud, Minn.	1100	273	10
WFAV	Lincoln, Neb.	1090	275	500
WFBC	Knoxville, Tenn.	1200	250	50
WFBD	Philadelphia, Pa.	1280	234	5
WFBE	Seymour, Ind.	1330	226	10
WFBG	Altoona, Pa.	1080	278	100
WFBH	New York, N. Y.	1100	273	500
WFBJ	Collegeville, Minn.	1270	236	100
WFBL	Syracuse, N. Y.	1190	252	100
WFBM	Indianapolis, Ind.	1120	268	250
WFBR	Baltimore, Md.	1180	254	100
WFBZ	Galesburg, Ill.	1180	254	20
WFDF	Flint, Mich.	1280	234	100
WFI	Philadelphia, Pa.	760	394.5	500
WFKB	Chicago, Ill.	1380	217.3	500
WFRL	Brooklyn, N. Y.	1460	205.4	100
WGAL	Lancaster, Pa.	1210	248	10
WGBB	Freeport, N. Y.	1230	244	100
WGBC	Memphis, Tenn.	1080	278	10
WGBF	Evansville, Ind.	1270	236	500

Seven

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WBAO	Decatur, Ill.	1110	270	100
WBAP	Fort Worth, Tex.	630	475.9	1500
WBAX	Wilkes-Barre, Pa.	1170	256	100
WBBL	Richmond, Va.	1310	229	100
WBBM	Chicago, Ill.	1330	226	1500
WBBP	Petoskey, Mich.	1260	238	200
WBBR	Staten Island, N. Y.	1100	273	500
WBBS	New Orleans, La.	1190	252	50
WBBW	Norfolk, Va.	1350	222	50
WBBY	Charleston S. C.	1120	268	10
WBBZ	Chicago, Ill. (Portable)	1390	215.7	50
WBCN	Chicago, Ill.	1130	266	500
WBDC	Grand Rapids, Mich.	1170	256	500
WBES	Takoma Park, Md.	1350	222	100
WBNY	New York, N. Y.	1430	209.7	500
WBOQ	Richmond Hill, N. Y.	1270	236	100
WBRC	Birmingham, Ala.	1210	248	50
WBRE	Wilkes-Barre, Pa.	1300	231	100
WBT	Charlotte, N. C.	1090	275	250
WBZ	Springfield, Mass.	900	333.1	2000
WBZA	Boston, Mass.	1240	242	250
WCAC	Mansfield, Conn.	1090	275	500
WCAD	Canton, N. Y.	1140	263	250
WCAE	Pittsburgh, Pa.	650	461.3	500
WCAJ	University Pl., Neb.	1180	254	500
WCAL	Northfield, Minn.	890	336.9	500
WCAM	Camden, N. J.	1270	236	250
WCAO	Baltimore, Md.	1090	275	100
WCAP	Washington, D. C.	640	468.5	500
WCAR	San Antonio, Tex.	1140	263	500
WCAT	Rapid City, S. Dak.	1250	240	50
WCAU	Philadelphia, Pa.	1080	278	500
WCAX	Burlington, Vt.	1200	250	100
WCBA	Allentown, Pa.	1180	254	15
WCBD	Zion, Ill.	870	344.6	5000
WCBE	New Orleans, La.	1140	263	5
WCBH	Oxford (near), Miss.	1240	242	50
WCBM	Baltimore, Md.	1310	229	50
WCBQ	Nashville, Tenn.	1270	236	100
WCBR	Providence, R. I. (portable)	1430	209.7	100
WCCO	St. Paul–Minneapolis, Minn.	720	416.4	5000
WCLO	Camp Lake, Wis.	1300	231	50
WCLS	Joliet, Ill.	1400	214.2	150
WCOA	Pensacola, Fla.	1350	222	250
WCSH	Portland, Me.	1170	256	500
WCSO	Springfield, Ohio	1210	248	100
WCWS	Providence, R. I. (portable)	1430	209.7	100
WCX	Pontiac, Mich.	Now operating with WJR		
WDAD	Nashville, Tenn.	1330	226	150
WDAE	Tampa, Fla.	1100	273	250
WDAF	Kansas City, Mo.	820	365.6	500
WDAG	Amarillo, Tex.	1140	263	100
WDAH	El Paso, Tex.	1120	267.7	50

Six

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WQAN	Scranton, Pa.	1200	250	100
WQAO	New York, N. Y.	833	360	100
WQJ	Chicago, Ill.	670	447.5	500
WRAF	Laporte, Ind.	1340	224	100
WRAK	Escanaba, Mich.	1170	256	100
WRAM	Galesburg, Ill.	1230	244	100
WRAV	Yellow Springs, Ohio	1140	263	100
WRAW	Reading, Pa.	1260	238	10
WRAX	Gloucester, N. J.	1120	268	500
WRBC	Valparaiso, Ind.	1080	278	500
WRC	Washington, D. C.	639	469	1000
WRCO	Raleigh, N. C.	1190	252	100
WREC	Coldwater, Miss.	1180	254	10
WREO	Lansing, Mich.	1050	285.5	500
WRHF	Washington, D. C.	1170	256	50
WRHM	Minneapolis, Minn.	1190	252	50
WRK	Hamilton, Ohio	1110	270	100
WRM	Urbana, Ill.	1100	273	500
WRMU	Richmond Hill, N. Y. (portable)	1270	236	100
WRNY	New York, N. Y.	1160	258	500
WRR	Dallas, Tex.	1220	246	500
WRST	Bay Shore, N. Y.	1390	215.7	250
WRVA	Richmond, Va.	1170	256	1000
WRW	Tarrytown, N. Y.	1110	273	500
WSAI	Cincinnati, Ohio	920	325.9	5000
WSAJ	Grove City, Pa.	1310	229	250
WSAN	Allentown, Pa.	1310	229	100
WSAR	Fall River, Mass.	1180	254	100
WSAS	Wooddale, Ill.	1090	275	1000
WSAU	Chesham, N. H.	1310	229	10
WSAX	Chicago, Ill. (portable)	1120	268	100
WSAZ	Pomeroy, Ohio	1230	244	50
WSB	Atlanta, Ga.	700	428.3	1000
WSBC	Chicago, Ill.	1430	209.7	1000
WSBF	St. Louis, Mo.	1100	273	250
WSBT	South Bend, Ind.	1090	275	250
WSDA	New York, N. Y.	1140	263	250
WSKC	Bay City, Mich.	1150	261	100
WSM	Nashville, Tenn.	1060	282.8	1000
WSMB	New Orleans, La.	940	319	500
WSMH	Owosso, Mich.	1250	240	20
WSMK	Dayton, Ohio	1090	275	500
WSOE	Milwaukee, Wis.	1220	246	500
WSRO	Hamilton, Ohio	1190	252	100
WSSH	Boston, Mass.	1150	261	100
WSUI	Iowa City, Ia.	620	483.6	500
WSVS	Buffalo, N. Y.	1370	218.8	50
WTAB	Fall River, Mass.	1130	266	100
WTAD	Carthage, Ill.	1270	236	50
WTAG	Worcester, Mass.	1120	268	500
WTAL	Toledo, Ohio.	1190	252	10
WTAM	Cleveland, Ohio	770	389.4	3500
WTAP	Cambridge, Ill.	1240	242	50

Eleven

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WGBI	Scranton, Pa.	1250	240	10
WGBM	Providence, R. I.	1280	234	30
WGBR	Marshfield, Wis.	1310	229	10
WGBS	New York, N. Y.	950	316	500
WGBU	Fulford-by-Sea, Fla.	1080	278	500
WGBX	Orono, Me.	1280	234.2	500
WGCP	Newark, N. J.	1190	252	500
WGES	Oak Park, Ill.	1200	250	500
WGHB	Clearwater, Fla.	1130	266	500
WGHP	Detroit, Mich.	1110	270	1500
WGMU	Richmond Hill, N. Y. (portable)	1270	236	100
WGN	Chicago, Ill.	990	302.8	1000
WGR	Buffalo, N. Y	940	319	750
WGST	Atlanta, Ga.	1110	270	500
WGY	Schenectady, N. Y.	790	379.5	5000
WGWY	Minneapolis, Minn.	1140	263	500
WHA	Madison, Wis.	560	535.4	750
WHAD	Milwaukee, Wis.	1090	275	500
WHAM	Rochester, N. Y.	1080	278	500
WHAP	New York, N. Y.	1250	240	500
WHAR	Atlantic City, N. J.	1090	275	500
WHAS	Louisville, Ky.	750	399.8	500
WHAV	Wilmington, Del.	1130	266	100
WHAZ	Troy, N. Y.	790	379.5	1000
WHB	Kansas City, Mo.	820	365.6	500
WHBA	Oil City, Pa.	1200	250	10
WHBC	Canton, Ohio	1180	254	10
WHBD	Bellefontaine, Ohio	1350	222	20
WHBF	Rock Island, Ill.	1350	222	100
WHBG	Harrisburg, Pa.	1300	231	20
WHBH	Culver, Ind.	1350	222	100
WHBJ	Fort Wayne, Ind.	1280	234	50
WHBL	Chicago, Ill. (Portable)	1390	215.7	50
WHBM	Chicago, Ill. (Portable)	1390	215.7	20
WHBN	St. Petersburg, Fla.	1260	238	10
WHBP	Johnstown, Pa.	1170	256	100
WHBQ	Memphis, Tenn.	1290	233	50
WHBU	Anderson, Ind.	1370	218.8	10
WHBW	Philadelphia, Pa.	1390	215.7	100
WHBY	West De Pere, Wis.	1200	250	50
WHDI	Minneapolis, Minn.	1080	278	500
WHEC	Rochester, N. Y.	1160	258	100
WHK	Cleveland, Ohio.	1100	272.6	1000
WHN	New York, N. Y.	830	361.2	500
WHO	Des Moines, Ia.	570	526	5000
WHT	Deerfield, Ill.	1260	238	3500
WIAD	Philadelphia, Pa.	1200	250	100
WIAS	Burlington, Ia.	1180	254	100
WIBA	Madison, Wis.	1270	236	100
WIBG	Elkins Park, Pa.	1350	222	50
WIBH	New Bedford, Mass.	1430	209.7	30
WIBI	Flushing, N. Y.	1370	218.8	50
WIBJ	Chicago, Ill. (Portable)	1390	215.7	50

Eight

CALL SIGNAL	LOCATION	FREQUENCY IN KC.	WAVE-LENGTH IN METERS	POWER IN WATTS
WIBM	Chicago, Ill. (Portable)	1390	215.7	10
WIBO	Chicago, Ill.	1330	226	1000
WIBR	Weirton, W. Va.	1220	246	50
WIBS	Elizabeth, N. J. (portable)	1480	202.6	20
WIBU	Poynette, Wis.	1350	222	20
WIBW	Logansport, Ind.	1360	220	100
WIBX	Utica, N. Y.	1460	205.4	150
WIBZ	Montgomery, Ala.	1300	231	10
WIL	St. Louis, Mo.	1100	273	250
WIOD	Miami Beach, Fla.	1210	247.8	1000
WIP	Philadelphia, Pa.	590	508.2	500
WJAD	Waco, Tex.	850	352.7	500
WJAG	Norfolk, Neb.	1110	270	200
WJAK	Kokomo, Ind.	1180	254	50
WJAM	Cedar Rapids, Ia.	1120	268	100
WJAR	Providence, R. I.	980	305.9	500
WJAS	Pittsburg, Pa.	1090	275	500
WJAX	Jacksonville, Fla.	890	336.9	1000
WJAZ	Chicago, Ill.	930	322.4	1500
WJBA	Joliet, Ill.	1450	206.8	50
WJBB	St. Petersburg, Fla.	1180	254	10
WJBC	La Salle, Ill.	1280	234	100
WJBI	Red Bank, N. J.	1370	218.8	250
WJBK	Ypsilanti, Mich.	1290	233	10
WJBL	Decatur, Ill.	1110	270	500
WJBO	New Orleans, La.	1120	268	100
WJBR	Omro, Wis.	1320	227.1	50
WJBU	Lewisburg, Pa.	1420	211.1	100
WJJD	Mooseheart, Ill.	810	370.2	500
WJR	Pontiac, Mich.	580	517	5000
WJY	New York, N. Y.	740	405.2	1000
WJZ	Bound Brook, N. J.	660	454.3	Varies
WKAF	Milwaukee, Wis	1150	261	500
WKAQ	San Juan, Porto Rico	880	340.7	500
WKAR	East Lansing, Mich.	1050	285.5	1000
WKAV	Laconia, N. H.	1340	224	50
WKBB	Joliet, Ill.	1400	214.2	100
WKBE	Webster, Mass.	1300	231	100
WKBG	Chicago, Ill.	1390	215.7	100
WKRC	Cincinnati, Ohio	920 710	325.9 422.3	1000
WKY	Oklahoma, Okla.	1090	275	100
WLAL	Tulsa, Okla.	1200	250	100
WLAP	Louisville, Ky.	1090	275	20
WLB	Minneapolis, Minn.	1080	278	500
WLBL	Stevens Point, Wis.	1080	278	500
WLIB	Elgin (near), Ill.	990	302.8	4000
WLIT	Philadelphia, Pa.	760	394.5	500
WLS	Chicago, Ill.	870	344.6	5000
WLSI	Cranston, R. I.	680	440.9	500
WLTS	Chicago, Ill.	1160	258	100
WLW	Harrison, Ohio	710	422.3	5000
WLWL	New York, N. Y	1040	288.3	3500

Nine

New 1926-27 Trends in Radio

The "Truphonic" the New Donle Contribution to Better Amplification—New Localized Single Control Overcoming Existing Difficulties—Important Socket Improvements—These Anticipate Trends for the New Trade Year

Reported by DONALD WILHELM

CLEARLY, invention, engineering skill and manufacturing reliability are the factors that have told and will continue to tell Radio's story.

Every year has contributed its bit. The greatest contribution, for instance, of the last year probably consisted of better re-arrangement of parts inside and out of our millions of receiving sets. What improvements and new trade lines will set off 1926-27 from all other years is now the big news. For the technicians have all been hard at work. And the manufacturers are keen to serve the technicians. Heretofore both on occasion have been premature—have been "right" too soon. Obviously, many manufacturers lack the ability and capital to make deliveries in a dependable way. And many more risk patent difficulties that interrupt their plans.

But it is my privilege here and now to announce and to describe the contributions to be made by one company whose prestige and organization were established even before its central loyalties were diverted to radio parts. This company used to have for its slogan when molding insulation to all manner of needs, "You Design It, We'll Make It!" Now its slogan might better be, "We have Designed it—Here It Is!" So, when it makes such an announcement as the following, that announcement is news! In other words, when it devotes its New England plant, its high skill and unfailing facilities to improvements that are revolutionary, the radio public and the radio trade can safely take its accomplishments as final.

It is sufficient to repeat that of course a household word has for years been the word "NA-ALD."

Alden adapters, for instance, have made possible the practical use of power tubes in every vacuum-tube receiver now in use. And, past question, the power tube has afforded the opportunity greatly to improve quality reproduction by increasing gain and cutting down overloading.

Alden sockets and dials—a great family of them answering to an infinitude of uses—likewise long since established themselves as a kind of legal tender in the changing scheme of things.

It can be taken for granted, thus, to go no further, that the Alden Company at Springfield, Massachusetts, having been duly admired for its many efficiencies by such business magazines as *System* and *Factory* has the needed precision and reliability and standing to back up its announcement with deliveries scheduled to a day and hour.

But it needs to be added that this company has not been content with pacing its production to current needs and to limiting its field to areas amply consolidated. In other words, it has brought its established organizing genius to bear on the solution of problems of supreme importance to Radio with the result that its products will undoubtedly occupy larger space than ever on store counters, in wholesale departments and in catalogues, and in the radio receivers made by reputable manufacturers.

In preliminary fashion it is worth pointing out four major new contributions evolved by this company:

I. The Donle Truphonic reflects the interest we all have in improved reproduction. It is synonymous with a new means of amplification certain to have important results in 1926–27.

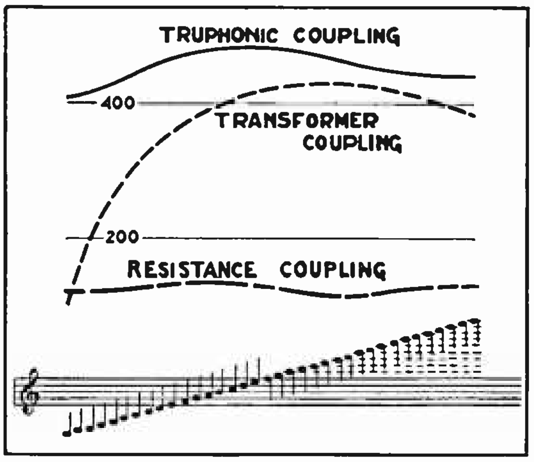


Chart showing superiority of remarkable new "Truphonic" coupling, which gives large and constant amplification over the entire musical scale. From this it will be seen that transformers usually give large but varying amplification, missing the low notes. Resistance gives constant, but small, amplification. While only the improved, Truphonic method has the advantages of both, without their defects, giving large and uniform amplification. Curves show input-output ratio of complete amplifying unit.

II. A new localized control condenser now in production is a sound and ingenious device with many specific advantages, one of which is that it can be operated as easily as one fingers any three contiguous keys on a piano.

III. Another Alden development consists of a new method of gang socket mounting, universal in its application by manufacturers and home-constructors, and economical in cost.

IV. The fourth major Alden development is a new cushion-mounted socket for vacuum tubes. Protected by the earliest patents, it is devised to provide an exclusive means to hold a tube out of physical contact with the base while providing adequate electrical connection.

The large usefulness and detailed advantages of these and other Alden products are of such strategic importance to the radio public and trade at the present time that the following descriptions of their functioning clearly are in order.

I. THE DONLE TRUPHONIC

Transformer, resistance and impedance amplification all have had their innings.

Transformer coupling when of the most costly type is fairly efficient.

Resistance coupling gives, in the opinion of many, the best quality of reproduction, yet it is not particularly efficient, requires extra voltage in B batteries and has the weakness of deteriorating elements.

The impedance coupling, rather expensive, gives markedly better quality than the transformer, being practically equal to resistance.

Now comes a new means of amplification superior to resistance coupling. With three tubes it has an amplification, practically free of all distortion, greater than the best audio transformer amplification with two tubes. This new coupling is so distinctive in performance that it merits a distinctive name—TRUPHONIC.

It is the invention of H. P. Donle, who has more than a hundred inventions to his credit, including the Sodion detector tube, the diamond weave coil and other devices which set this inventor apart as one of the greatest of tube experts.

The Truphonic was the result of definite mathematical calculations extensively tested out.

One of the tests, charted on the preceding page, shows graphically a definite superiority of the Truphonic over any other method of amplification yet evolved. The accompanying chart shows that it gives nearly as flat a characteristic as resistance with none of the objectionable distortion of transformer amplification. Still this chart does not adequately suggest what the Truphonic accomplishes when it is substituted for other couplings in any standard circuit, for the improved quality suggests the subtle but very definite difference that exists between the new Orthophonic and the old Victrola. Therefore it will not be surprising if the Truphonic extensively supersedes all existing forms of audio amplification couplings.

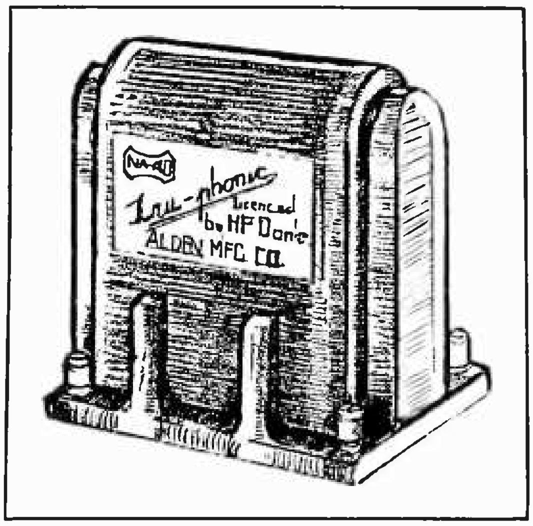
Now, much has been written, of course, on the subject of correct, undistorted or uniform amplification over the entire audio frequency band.

Those who have experimented with resistance amplification know its practical limitations. From a study of curves we know that transformer amplification magnifies the middle frequencies, leaving noticeable weaknesses in the low notes and overtones. Even when these distortions are not audible one has a vague and disquieting sense of the inadequacy of the music or speech rendered. On the other hand, the chart herewith shows the remarkably flat characteristics of the Truphonic, which affords faithful reproduction over the entire musical scale.

And again referring to the chart, one can see that Truphonic amplification gives more gain than resistance amplification. Those most familiar with resistance amplification best know its limitations.

Authorities agree that resistance coupled amplification will not supersede other methods, and call attention to the known fact that the gain per stage with resistance coupled amplification is not sufficient to merit its use throughout the audio end. As a matter of fact many sets designed to utilize the resistance method employ one or more stages of transformer coupling to get the required boost in audio signals.

The Alden Company feels that it is safe to predict that in view of the widely recognized inadequacy of audio frequency amplifiers many of the prominent set manufacturers will include the Truphonic in next year's models. The better service given by the Truphonic, its reasonable cost, its longer life and the economy it passes on to the user in lowered battery consumption make the wide popularity of Truphonic amplification a certainty. It requires no additional B batteries, needed in resistance coupled amplification. To put it simply: Its total cost, in view of its merits, is surprisingly low.



The Truphonic Amplifier, a great new invention for those who value quality reproduction

Truphonic, for many good reasons, is music up the street of the radio amateur. It affords room for an endless variety of experimentation with hook-ups already in existence. Various circuits which the radio magazines and newspapers have popularized will doubtless be modified to include the Truphonic amplifier. In addition radio writers cannot fail of having their interest evoked with resulting wide publicity.

II. THE NEW NA–ALD LOCALIZED CONTROL UNIT

Single-control tuning so simple that "grandmother can operate it" has long since been an ideal. Practically all the radio engineers in the country have given thought and effort to control so simple that a child might use it in the dark. And 'way back, of course, there appeared on the market various so-called single-control receivers with only one movable dial, though engineers knew that absolute single-control with only one movable dial was still a day dream.

To be sure, many factory-made receivers neat in appearance and featuring only one large dial in the center of the panel were offered to the public. Practice in many instances demonstrated, however, that these receivers, if satisfactory at all, were really controlled not by the "single" dial alone. One or more—and usually more—additional dials or knobs on the panel greatly affected the proper tuning of the set. These smaller knobs were intended to be vernier in their action. In fact they were often critical and hard to adjust. So, to put it simply, usually the so-called single control receiver was found in fact to be harder to operate than the receivers employing two or three dials of large and more convenient size.

The means employed, in the effort to attain single control, were multiple condensers mounted on a single shaft, all moving together, all controlled by a single dial.

The Hogan patent covers this general principle. It is a well-known fact that the method of using multiple condensers mounted on a single shaft involves a necessary compromise between flexibility of control on one hand and the single control idea on the other. Competent radio engineers have recognized the inevitable limitation this method of control puts upon the proper adjustment of the required tuning elements and that, working from this limitation, different compromise arrangements must be made throughout the receiver.

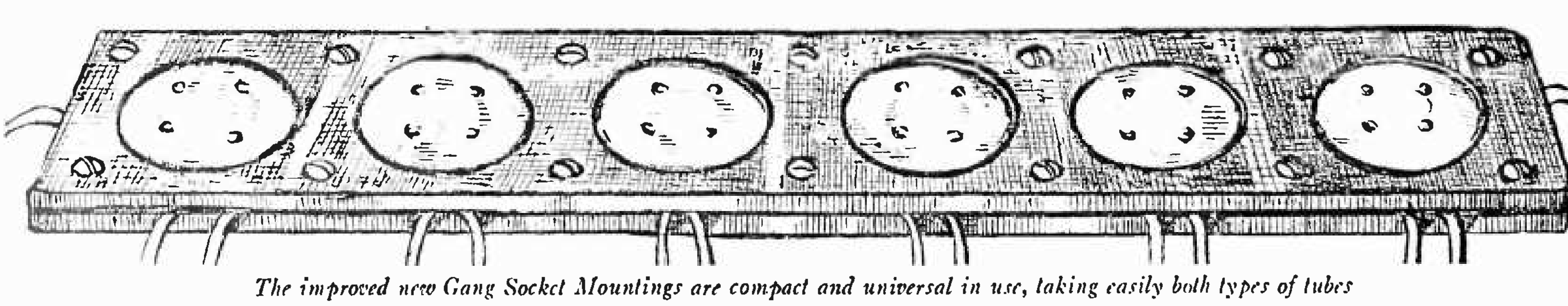
Really, the problem of evolving a simple method of utilizing all the advantages of single control without any of its limitations, still remained.

The Alden Company now believes that it has solved this problem, that its new localized control unit will answer to the large existing need.

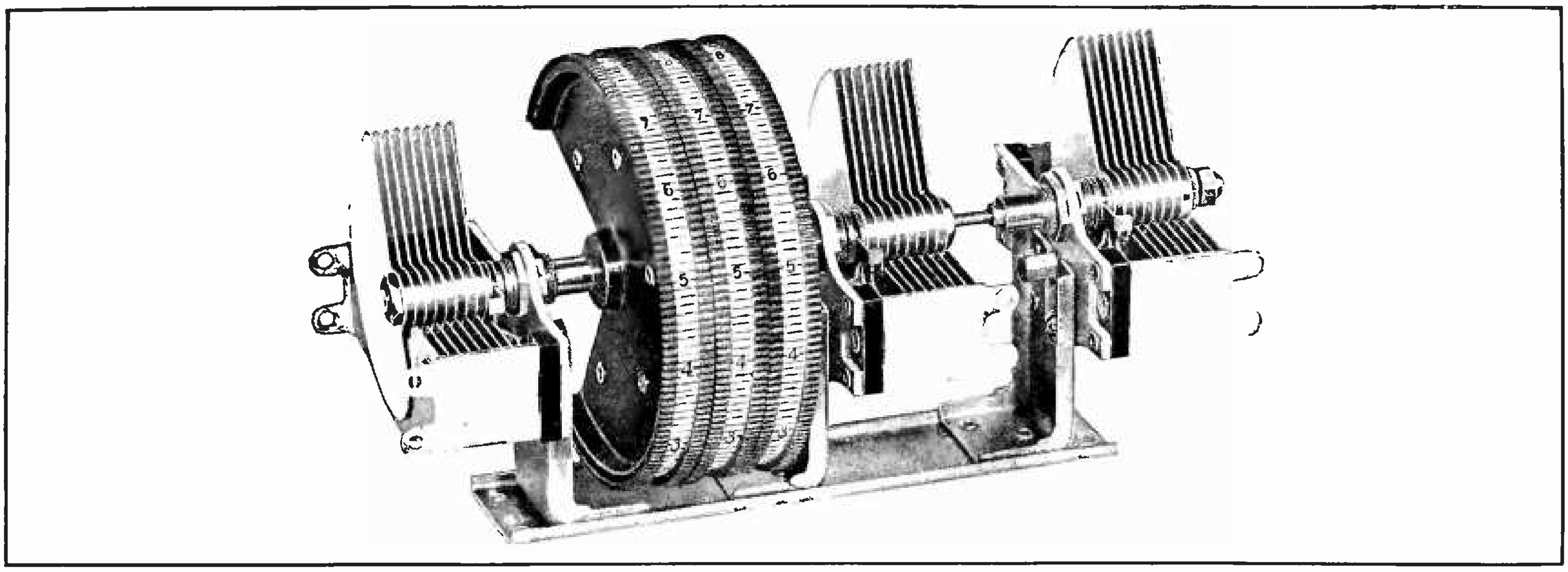
Heretofore the two concentric, independently controlled drums used on the Radiola Super Heterodyne have been the nearest approach to securing the practical benefits of single control without any of its weaknesses.

The Alden unit goes a step further. It employs *three* concentric drums. These overcome one of the disadvantages of the two concentric drums used on the Radiola Super Heterodyne—i.e., they do not stick together and prevent one from moving without the other. Instead, in the Alden unit, each moves freely on its own axis. Yet the three move together when desired as is customary with single-control dials.

This Na-Ald Localized Control Unit



The improved new Gang Socket Mountings are compact and universal in use, taking easily both types of tubes



This amazingly simple tuning device accomplishes all the good of single control, without losing the flexibility of separate controls. There is a drum for each condenser, and each drum moves freely separately, or in unison with the others. Called the "Na-Ald Localized Control Unit," it merits wide popularity among set builders

opens new possibilities for the electrical experimenter and the set manufacturer. It is pleasant for an engineer to realize that he can use three variable tuning controls and still retain all the advantages of single control.

These controlled drums carry a space for logging stations and a convenient means of indicating exact dial locations of stations in kilocycles and meters. The complete Na-Ald Localized Control Unit consists of three separate condensers with three tuning control drums mounted on a suitable bracket, complete and ready for use in building a receiver.

Each condenser is independent, being operated by a separate drum. There is no frictional connection between the drums, so each can be moved freely. This control, being new in its conception and its practical application, does not infringe existing patents on single control of several tuning units. License to use is conveyed by its sale.

The condensers and controlled drums are supported on a rigid metal bracket. The control drums extend beyond the maximum swing of the condensers and pass through the front panel for tuning. Since there is no direct connection to this front panel, the panel itself may be of any material desired —either of wood, of metal or of bakelite.

This unit greatly simplifies set construction. It may be assembled to brackets carrying a gang socket, sub panel or other desired equipment and simple wiring connections with a minimum of soldering. The whole set thus makes a very compact and rugged unit.

The unit, moreover, permits sharp tuning. The diameter of the drums is $4\frac{1}{2}$ inches—made purposely large to facilitate exact tuning. This large size also makes it possible to swing from the highest to the lowest wave lengths instantly, almost without physical effort, by a finger or two.

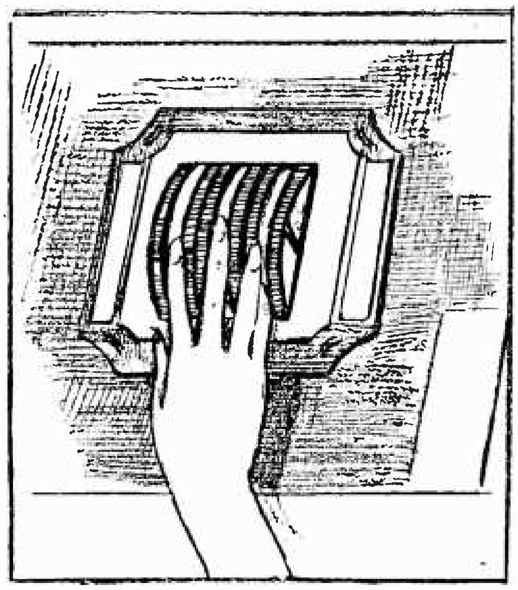
It is also made in a twin-dial model affording two variable tuning elements.

III. THE NEW NA-ALD GANG SOCKET MOUNTING

One of the principal items of labor involved in the construction of a receiver is the placing of tubes with their respective connections. Any improvement in this field clearly has wide application, answers to extensive needs.

Having specialized for years in the manufacture of sockets, it was logical for the Alden Company to devote itself to betterment of sockets with the result that out of its long experience it has evolved for the use of set builders a new gang socket mounting with conclusive advantages over any now on the market.

To begin with, the material and space required for the use of this new socket are reduced to a minimum so that this new Na-Ald mounting is unmatched for both convenience and economy. Further, the Alden Company long back—even before it began to manufacture radio products—were expert in the sound and economical



This gives a general idea of how the Na-Ald Localized Control Unit may be assembled to the panel. Also illustrating the wonderful ease it gives to tuning

production of the materials used for insulation. The laminated material developed for the new gang sockets is therefore molded in accordance with the dictates of long specialized experience, and is produced in a plant equipped for quantity production with a minimum of waste.

More to the point, this improved gang socket is new in principle.

In all set construction gang sockets utilize at least one connection common to each tube. By providing in advance an absolutely universal gang socket the new Na-Ald saves a vast deal of labor in eyeletting and soldering and other means for connection with independent contacts. In other words, the new gang socket provides a continuous strip of conducting metal from one end of the gang socket to the other. Moreover, a second common connector is provided for use in tapping the second filament contacts if desired, and these filament contacts can be tapped separately.

Another attractive feature of this new gang socket is that it takes both the old and the new type of tubes, making it universal in its application.

And in other ways these new Na-Ald gang socket mountings lend themselves to a variety of uses.

They render a positive service to the set builder in anticipating and solving in advance some of the hardest of mechanical and designing problems.

Working from them, since they are the last word in compactness and efficiency, engineers can devote their time and attention to details of greater importance affecting the physical arrangements of the other instruments within the receiver.

For every reason, thus, not the least of which is that the new gang sockets will greatly simplify the work of designers during the coming year, manufacturers and set constructors will welcome these compact and efficient mountings and recommend them as standard equipment.

They provide an attractive, convenient, self-contained unit.

It is to be added that an exceptionally high quality of workmanship is employed, and that all the connections are covered by the insulating material—are protected from dirt and moisture, which cause many sets to become inoperative or inefficient—and qualify under the recent ruling of the Fire Underwriters' Laboratory against exposed live metal connections on current operated sets.

IV. THE NEW NA–ALD CUSHION MOUNTED SOCKET

Radio constructors have long appreciated the advantages of cushion mounted sockets. But it has remained for Alden with its slogan—"It's the Contact that Counts"—to develop a mounting for this purpose that meets all requirements.

This new socket construction, moreover, is protected by the well-known Friedrich patent and others covering the principle of vacuum tubes held out of physical contact with the base by means of contacts which are also the electrical connections. And they also have protection covering the principle of socket construction in which there are openings for the prongs of vacuum tubes with metal strips pressing against the tube prongs, frictionally holding the tube in the socket yet allowing it to be withdrawn.

They take both types of tubes.

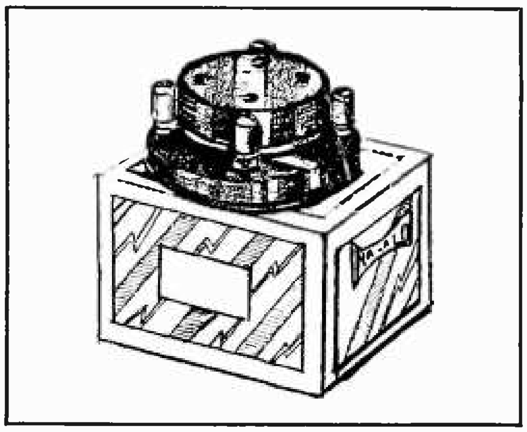
In all respects, therefore, they are as trouble-proof as engineering and productive skill can make a radio part.

THE COMBINED ALDEN LINE FOR ECONOMICAL RECEIVER CONSTRUCTION

These four major additions to the Na-Ald line are only part of the story.

Na-Ald dials, sockets, adapters and connectoralds have for years been legal tender in the radio market. The additions made to these established products, while affecting widely varied radio problems and opening many new opportunities both in engineering and in the manufacture of useful radio equipment, still are closely related one to another. They can be combined effectively.

Many set manufacturers will find that combining two or more of the Na-Ald units will not only effect economies inherent in each unit but will also prove a great labor and worry saver because of their practical interrelation.



A new addition to an illustrious family—the improved Na-Ald Spring Socket—no electrical contact between the tube and the set, other than the grid, filament and plate leads

The Na-Ald gang socket mounting can, of course, be used with the greatest ease for assembly in any equipment desired, but it fits especially well with both (or either) the Donle amplifier and the Na-Ald localized control unit.

A complete receiver using the Na-Ald devices assembles in a space of 7 x 12 inches. This great compactness need not reduce in any way the electrical efficiency of the receiver. Even in this small space there is room to include shielding where desired.

The localized control tuning device, affording the simplest and most perfect tuning control available; the Na-Ald Donle amplifier for the audio frequency end, a distinct advance over all existing methods; and the convenient gang socket mountings all, jointly and separately, adaptable to all standard circuits.

Thus the Alden line, already rich in utilities for set builders, is vastly broadened in its scope, solving in advance many of the knottiest problems of set design and construction.

DON'T OVERLOOK NA–ALD CONNECTORALDS

Of course, everyone—except one or two—has a set nowadays. Most of us have ordinary tubes in our sets, and all of us want the best possible results from our sets. But we all know that ordinary tubes when overloaded cause distortion, and the effect is like that of listening to someone who is overstraining his voice.

To put it simply: Because we all want the best results, and power tubes therefore, thousands have found great satisfaction in using Na-Ald Connectoralds.

To change over, in an instant, fron. ordinary tubes to power tubes it is only necessary to have on hand only three new parts: a B battery, a C battery and—a Na-Ald Connectorald which is provided with leads to these batteries.

No wiring whatever is necessary.

Produced as they are at low cost, easy to install, definite and certain in their results, Na-Ald Connectoralds were designed for wide use—and have found it.

The demand for them promises to be greater than ever during the coming year. Nearly all set owners want one! Every set dealer needs them—the company itself has had a busy time answering inquiries and getting connectorald shipments out on schedule. And a jobber might as well have a blank page in his catalogue as to fail to reserve ample space for them.

SET BUILDERS CAN COUNT ON ALDEN

A well-known set manufacturer telegraphed an order, recently, for a quantity of Na-Ald dials. Under stress of heavy commitments he wanted them "quick." But he was greatly surprised and pleased to receive his shipment in less than forty-eight hours. And he was even more surprised when he was told that his order was built up from raw materials to finished product in a day.

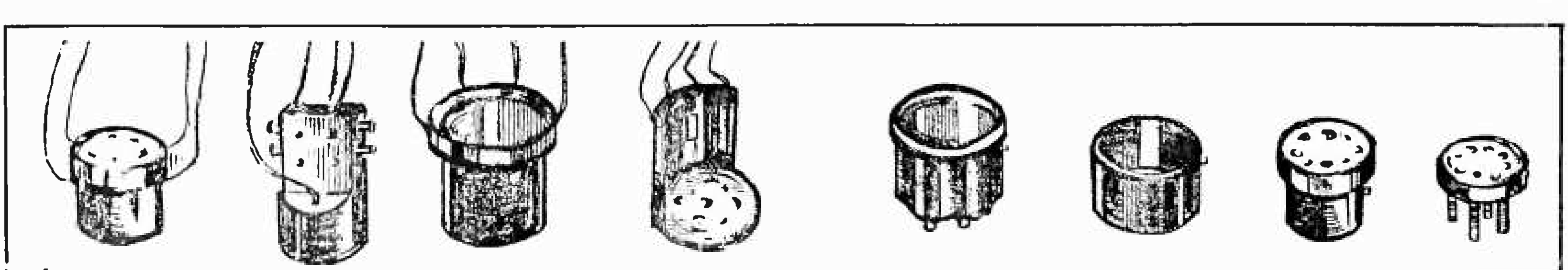
It is a fact that most of the Alden production *is* built up from raw materials to finished products in a day.

It is *paced*—the plant is geared throughout to systematic output typified by mechanical carriers flanked on both sides by swift-fingered girls doing their respective bits. It has a flexible and reliable labor supply. It has advantages in that it has on occasion been able to serve New York City jobbers as promptly as they could be served by New York City manufacturers. And it can supply New England, the Middle West, and the South by truck or express with certainty and speed.

This flexible yet carefully inspected service from a plant so well organized that it has a "vest-pocket shipping room," is without question an asset to the jobber or manufacturer who uses the Alden standard parts in his receivers.

He can bank on the certainty and promptness of Alden deliveries.

And he can bank on Alden financial standing and business methods as well.



Connectoralds and Na-Ald Adapters make possible the use of practically any tube in any set, including the new power tubes which add much power and greatly clarify the outcoming music or speech

B-POWER

By

NOE H. TYAR

In radio we sense a sort of subtle beauty that makes a distinct appeal to the imagination. Even experienced broadcast artists say they never face the microphone without a thrill, a thrill that comes with the realization of the wonderful wizardry of wireless.

No wonder they are willing to give of the best and finest that lie within their power. Surely no voice could be too clear, no note too pure, no harmony too perfect that is to be caught and thrown broadcast to the four winds, broken to a million pieces and each piece captured, amplified and reproduced in nearly instantaneous and perfect accord with the original.

Truly, the folk who work in the studio are living in an atmosphere laden with wonder and romance. But do not all those who come in contact with radio in all of its myriad branches feel the same awe? Does not the set owner experience much the same thrill when he tunes in a station as does the artist at the other end? And how about the men behind the scenes, especially the research workers who have made this marvel possible?

Let us make a visit to the Raytheon laboratory in Cambridge and get acquainted with the men who are actually doing the day by day research that is so essential to progress.

To those who visualize a laboratory as a dusty and cobwebby corner in a dark basement, the first glance in this up-to-date laboratory will be an eye-opener. Instead of some old, wizened, gray-haired eccentric peering through his horn-rimmed glasses at a test tube, we see a dozen bright eyed young men in as many different occupations.

One rather tall, studious looking chap is seen operating a sort of death-defying apparatus that splits the ear with intermittent crackling and hissing sounds. Suppose we investigate and see just what is accomplished by this affront to our ear drums.

Making Experimental Models

Upon approaching as near as seems safe without endangering our lives, we see that he is working on a row of half finished tubes which look very much

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like the standard Raytheons, with which we are familiar. The six or eight tubes on which he is working are minus the regular brass bases, and up at the top where we are accustomed to see a little glass tip, we now find long glass tubes which run up to an intricate system of glass piping.

Among the network of fragile glass tubing which composes this system, we see large glass bulbs supposedly filled with rare gases, queer looking mercury gauges which resemble huge thermometers bent all out of shape, and a swift running vacuum pump that pounds away doggedly in apparent disregard of the fact that nature abhors a vaccum. We turn to our complacent guide who assures us that the apparatus is simply a system to make up tubes for experimental purposes.

It seems that the building up of satisfactory gaseous rectifier is a rather complicated process. Among the most important of the operations is the one of "bombarding" which attracted our attention due to its ear-splitting noise. "Bombarding" a tube means that it is subjected to extremely powerful high frequency currents having a frequency of several million cycles per second. This brings the metal parts of the tube to a brilliant orange-white heat that drives whatever residual gases may have been in the metal out into the tube so that the vacuum pump may draw them out through the exhaust.

The bombarder is quite a heavy and complicated looking piece of apparatus which can be moved around the floor on wheels, but the active element which is used to heat the tube is simply a small coil of about 3" in diameter and a dozen turns. When the high frequency currents are running through this coil it will rapidly heat up any piece of metal which is held near it; glass, paper or even a match would keep quite cool even when put on the inside of the coil due to the fact that these articles are not good conductors.

After each of the several tubes in the process has been bombarded four times, the engineer adjusts several of the various stop-cocks in his system of glass tubing and we learn that he is now letting the desired amount of pure gases into the tubes. After this operation he directs the flame from a blow torch at the top of each bulb where it is joined to the tubing, and with a dexterous sweep of the wrist removes each finished tube with its vacuum tight tip carefully sealed by his torch.

"What will be the fate of these new rectifiers?" we ask, rather hoping that we have witnessed the first of a new line of Raytheon tubes which would some day revolutionize the radio market. Of course there is the possibility, it seems, but these are merely a half dozen of a thousand different models that have been made up and put to almost as many different tests during the past few months. From each experimental model some little detail is learned that helps in the production of Raytheons of greater ruggedness and reliability. But the fundamental and basic principle upon which rectifiers operate have been known for a long time and no revolutionary change in these principles can be expected.

Research, and Research Workers

Now let us take a look at some of the other activities. To investigate and understand them all would requre more time than is at our disposal, but we may at least get a smattering of what it is all about.

Out in one of the smaller rooms we find what looks like the realization of a radio experimenter's dream, with a few chemicals, a delicate balance scale, and other nameless apparatus thrown in for good measure. Over in an alcove we see a desk and table, and seated there two engineers earnestly discussing a sheaf of papers covered with figures and rough diagrams. It is here, we learn, that the fundamental work on the phenomena of gaseous conduction is done; work that may have no immediate value but yet is blazing the trail for the practical applications in the years to come. From the studies made here will come new applications of filamentless rectifiers in far different fields from those in which they are now recognized as leaders.

We are now introduced to the dark "sanctum sanctorum" where the glass blower does his work. He likes to have just the right amount of darkness so he can tell by changing colors of the glass just when it is ready for manipulation into some of the intricate bends and bulbs that are constantly in demand. A slight draft of air might have a bad effect on both the temper of the glass and the glass-worker, so we close the door quietly and proceed.

Out in the main room again we see a whole wall dotted with rectifier bulbs mixed with carbon lamps, all lighted to various degrees of brilliancy. It is here that the experimental models are put through their final test, a life test

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RAYTHEON

under heavy load to see how they will stand up in service. And it is on this test more than any other that the work of the laboratory staff is judged.

Upon taking an inventory of the laboratory personnel, we find that one man is a physicist of ten years' experience on gaseous conduction problems, five of these years in graduate work at Harvard University. Another is a professor of electrical engineering at M. I. T., in charge of graduate research at that Institution. Three of the staff are graduates of the same school with the degree of Master of Science, and three others are engineering graduates. Many of the practical production problems are solved by John A. Spencer, inventor of the Spencer "Click" Thermostat now used in automatic electric irons. Of equal ingenuity is his brother, P. L. Spencer, who has had many years of practical radio experience with the Wireless Specialty Company and the Submarine Signal Company. A competent and serious group of men is this. To know that they are devoted to but one main problem, the proper application of A. C. power to radio receivers, gives one confidence. But let us resume the rôle of observer, since we came to learn.

Maintaining B-Power Quality

Over here at another bench we see a young fellow putting a finished B-power unit through its paces. This seems rather strange since we understood that the Raytheon Company made nothing but the rectifier tube. And yet in a large steel cabinet near this bench we see some 15 or 20 B-power units of all shapes and sizes, some with meters, knobs, switches and taps and others with plain metal sides with the barest minimum of taps and controls. These units have been made by various manufacturers and they have been submitted for test and approval by the Raytheon laboratory.

The standard test consists of (1) measuring the output voltage at various loads on the detector, radio frequency and audio frequency taps; (2) detecting any hum or noises that may exist at any of the above loads on a sensitive electrical circuit; (3) testing the reliability of the controls and switches; (4) testing the condensers with several times the normal operating voltage to make sure of their ability to stand up in service and (5) a general inspection and test of the

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RAYTHEON

durability and quality of all parts used in the construction.

Let us stop for a moment to consider what this means to the average radio fan who has no laboratory facilities of his own to make such tests before selecting a B-power unit. It means that he now has a standard upon which he can rely. Of course different units will have different features and prices, backed as they are by many manufacturers in different parts of the country, but the buyer has the satisfaction of knowing that any Raytheon unit will do the job for which it is designed and rated. This is true not only of the complete units, but of the separate parts for home built units which have been tested and approved in the Raytheon laboratories.

In other words, there is one branch of the radio industry in which all products must reach a certain standard of performance before they are offered to the public. Not only does the Raytheon Company maintain rigid test and inspection of its own product, the rectifier tube, but it actually goes so far as to protect the consumer who buys a B-power unit using that tube.

The Raytheon Policy

The full significance of this policy and how it is carried out is not appreciated without some thought. One question that immediately arises is, "What prevents any manufacturer from putting out a Raytheon B-power unit, without having it tested and approved by the Raytheon laboratories?" In the first place any manufacturer of standing who values his reputation is glad to have his product tested by specialists who can offer suggestions as to its improvement. The reliable Companies do not wish to put out a unit that would not pass the most severe tests. They welcome this service by an unprejudiced organization.

If there are Companies who do not see the wisdom of this policy the Raytheon Company exercises its privilege of protecting the consumer by refusing to sell tubes to the offender. Even the most intrepid "bootlegger" would hesitate to put out a Raytheon B-power unit minus the tube and against the competition of approved units. All Raytheon tubes are sold through the Manufacturers of approved B-power units. In buying the complete unit with the Raytheon tube satisfaction is assured.

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Reliable Performance Always

Every baseball team has its "pinch hitter." He's the man who can step up and *perform* under any circumstances. And that is the way you learn to feel about your radio when it is equipped with a Majestic Super-B.

You get fine, clear tone in plenty of volume under all sorts of receptive conditions. The cost of operating your set, too, is reduced to the infinitesimal tenth of a cent an hour.

When you consider these advantages you will realize why engineers and technical experts who *know* radio equipment specify the Majestic Super B. Its technical superiorities are: Two chokes of 41 Henrys each and 20 microfarads of capacity in the filter circuit. The use of 30 gauge wire of low resistance for winding the chokes and transformer also permits voltage regulation of better control. Unusually large condenser bank smooths out every trace of ripple with a wide safety factor to spare.

Majestic Super-B Current Supply, complete with Raytheon Tube, capacity 1 to 12 tubes, including the use of new 135-150 volt power tubes.
110 volt, 60 cycle. Price $39.50

The Majestic Standard-B is a smaller B current supply unit, designed for sets having not more than 6 201A-type of tubes or 5 201A, plus one 112 type of 135-volt power tube.

Majestic Standard-B Current Supply, complete with Raytheon Tube. 110 volt 60 cycle. Price $32.50

GRIGSBY-GRUNOW-HINDS CO. ★

4550 Armitage Ave. Chicago, Illinois

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The *Radio Broadcast* LABORATORY INFORMATION SHEETS

INQUIRIES sent to the Questions and Answers department of RADIO BROADCAST *have heretofore been answered either by letter or in "The Grid." From this issue on, however, the latter department will be discontinued, and all questions addressed to our technical service department will be answered by mail. In place of "The Grid," we present herewith the first of a series of Laboratory Information Sheets. These sheets will contain much the same type of information as has appeared in "The Grid," but we believe that the change in the method of presentation and the wider scope of the information in the sheets, will make this section of* RADIO BROADCAST *of much greater interest to our readers.*

The Laboratory Information Sheets will cover a wide range of information of value to the experimenter, and they are so arranged that they may be cut from the magazine and preserved for constant reference. We suggest that the series of Sheets appearing in each issue be cut out with a razor blade and pasted on filing cards, or in a note book. The cards should be arranged in numerical order. Several times during the year, an index to all sheets previously printed will appear in this department.

Those who wish to avail themselves of the service formerly supplied by "The Grid," are referred to page 175, where it is explained in detail.

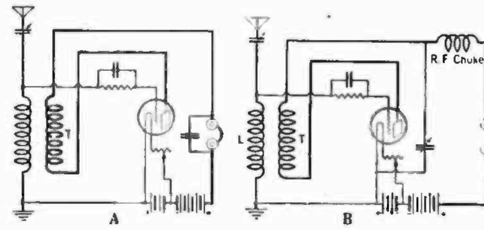
No. 1 RADIO BROADCAST Laboratory Information Sheet June, 1926

Regeneration

METHODS OF CONTROL

WHEN radio waves of the frequency to which the antenna circuit is tuned are being received the high frequency currents flowing in the coil produce high frequency variations in the grid potential which, in turn, produce high frequency currents (of considerably greater energy) in the plate circuit. If we could "feedback" some of this plate energy to increase the original potential applied to the grid, it might help to increase the original potential applied to the grid. This can be done in several ways. A very common method is shown in A.

The essential addition to the circuit is the coil in the plate circuit. This is called the "tickler" coil, and upon being brought up near the antenna coil its mutual inductance, or transformer action, affords a means by which energy from the plate circuit is fed back into the antenna circuit. The tickler must be connected the right way too, for if the connections are reversed its effect will be to reduce the antenna current instead of increasing it. If the coils are brought too close together, a point will be reached where more power is being fed back to the antenna circuit than is being dissipated therein. The tube is then said to be oscillating, and will continue to oscillate even if the radio waves cease coming in. The loudest signals are obtained just before the tube "breaks into oscillation." Signals can be received even while the tube is oscillating if the oscillation frequency is kept exactly the same as the carrier-wave frequency.



There are several methods of controlling feedback, either by a variable tickler as in A or by a variable resistance shunted across a fixed tickler coil. Another method is by the use of a variable condenser, as illustrated in B.

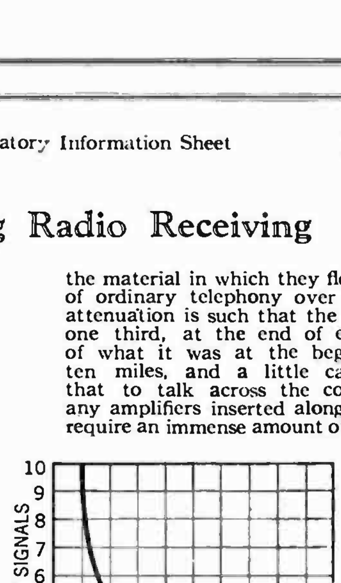
No. 2 RADIO BROADCAST Laboratory Information Sheet June, 1926

Factors Governing Radio Receiving

HOW THEY AFFECT DISTANCE

THERE are three main factors governing the distance that can be satisfactorily covered between a given transmitting station and a given receiving set. These can be stated as follows:

1. The amount of interference.
2. The inverse distance effect. As the radio waves spread out in all directions from the transmitting station their strength naturally decreases. At twice the distance, their amplitude is halved; at four times the distance, it is only one quarter, etc. This same fact could also be expressed by saying that the strength of the signals is inversely proportional to the distance. A curve illustrating this is shown in the accompanying diagram. The curve is based on ideal conditions, and neglects absorption by buildings, fading, etc.
3. The attenuation, which is quite a different thing. It acts simultaneously with the inverse distance effect to reduce the amplitude of the waves. Attenuation of the waves is due to their being dissipated in the form of heat. Whenever the waves strike any object in which they can produce electric currents, the currents are produced at the expense of the energy of the waves and heat up, to a minute degree, the material in which they flow. In the case of ordinary telephony over land wires, the attenuation is such that the current is about one third, at the end of every ten miles, of what it was at the beginning of those ten miles, and a little calculation shows that to talk across the continent without any amplifiers inserted along the line would require an immense amount of power. Yet, by the insertion of fifteen amplifiers or relay stations along the line, the attenuation law is prevented from "getting under way," and a ridiculously small power is enough for proper transcontinental land line telephony.



Excerpts from Telegrams:

"Tested your RFL-60 within two blocks of local 500-watt broadcasting station, using twenty-five foot wire on floor for aerial. We picked up stations all over the country and when local station came in tuned it out and picked up WSAI at 319 meters. The local station is 270 meters. This is the only set ever tested under these conditions that would tune this station out at any point on dials."—Decatur, Ill.

"We tested one of your new RFL-60 sets here in our building using an antenna about 75 feet long and directly under and parallel with our transmitting aerial. The exceptional selectivity of the Crosley receiver permitted us to tune out our station WTAX, just as easily as we would tune out a Chicago station."—Streator, Illinois.

"An RFL-60 tested in competition with other receivers of much higher price proved its unquestioned superiority. The new Crosley models offer the greatest values on the radio market."—Kansas City, Mo.

"The Model 4-29 is classed with the Trirdyn. Model 5-38 bringing in Pacific points with ample volume, using a Musicone. RFL-60 and 75 are very selective. Have separated distant stations on less than one degree on the dial. Have logged Mexico City and Pacific Coast Stations with plenty of volume."—Miami Fla.

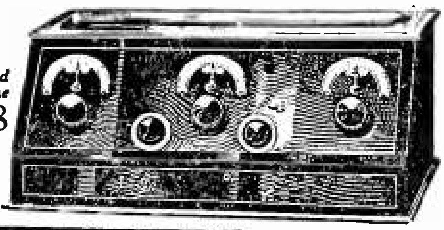
"The RFL sets outstripped much higher priced outfits. These sets bring in Canadian, Cuban and Mexican stations as easily as those on nearby states."—Glasgow, Ky.

What's the idea of keeping a fellow up all night foolin' around with that darned little 4-29?

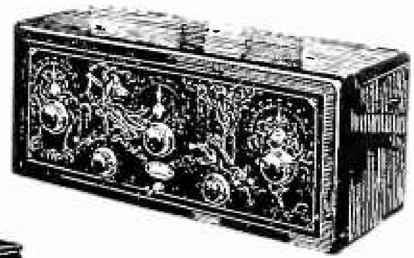
I've been in the radio game for seven years and was beginning to believe that there wasn't a set in the world that would keep me up late but when that little 4-29 started to pull in Houston, Texas and with such extreme volume I sat up and took notice.

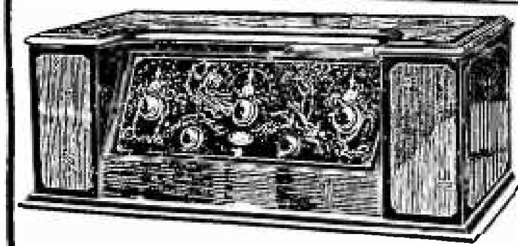
I got California stations with unbelievable volume last night. KFI came in so loud that it could be heard over a block on a Musicone speaker. I've gotten over one hundred and twenty-five stations in only three nights.—Spring Valley, Ill.

The Crosley 5-tube—5-38
All the volume, selectivity and purity of tone available in the best 5-tube set—plus the Crescendon $38

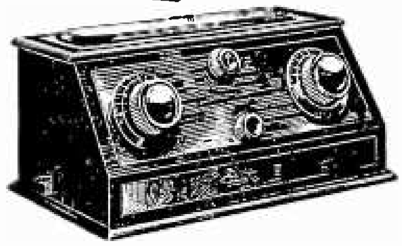


The Crosley 5-tube—RFL-60
A set of marvelous performance and beautified by the artistic decorative panel $60





The Crosley 5-tube—RFL-75
Simplicity and speed in tuning, fidelity of tone and decorative beauty, enhanced by the art panel $75



The Crosley 4-tube—4-29
In which the Crescendon is equal to one or more additional tubes of tuned radio frequency amplification $29

Prices slightly higher west of the Rockies

By Expressed Opinion of Fans The Greatest Radio Values Ever Offered!

Real performance! Amazing sensitivity and selectivity! Marvelous tonal qualities—inspiring volume. And surpassing beauty!

Read, in the column at the left, the enthusiastic comments of a few of the many radio fans who have *voluntarily* written or wired us their praise.

True radio values—at astonishingly low prices. Hear a Crosley Concert at your nearby Crosley dealer's.

For descriptive catalog write Dept. 20

THE CROSLEY RADIO CORPORATION, CINCINNATI, OHIO

Powel Crosley, Jr., President

Owning and Operating WLW, first remote control super-power broadcasting station in America

CROSLEY

BETTER · COSTS LESS

RADIO ★

for the Entertainment Corner

Manufactured under Armstrong U. S. Patent No. 1,113,149, or under patent applications of Radio Frequency Laboratories, Inc.

No. 3 RADIO BROADCAST Laboratory Information Sheet June, 1926

The Browning-Drake Receiver

ON SHEET No. 4 is shown a diagram of the popular Browning-Drake receiver, which, in its improved form, was fully described by Glenn H. Browning, one of the designers, in the December 1925, RADIO BROADCAST. The first article appeared in this magazine for December, 1924. Three stages of impedance-coupled audio amplification are employed in this circuit. The constants of the circuit as shown, are as follows:

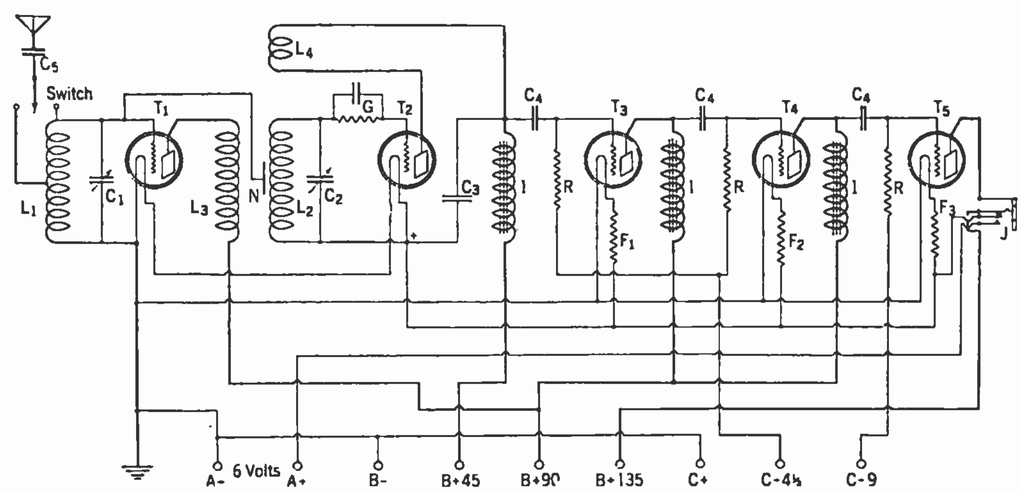
C_1—.0005-mfd. variable condenser.
C_2—.00025-mfd. variable condenser.
C_3—.00025-mfd. fixed condenser.
C_4—.0.1-to 1.0-mfd. fixed condenser.
C_5—.0001-mfd. fixed condenser.
L_1—46 turns No. 20 d.s.c. wire on a form 3 inches in diameter, with a center tap.
L_2—75 turns No. 20 d.s.c. wire on a 3-inch form.
L_3—24 turns No. 28 d.c.c. wire wound in a groove and placed under the filament end of the secondary.
L_4—20 turns No. 28 d.c.c. wire wound on a 2¼-inch form to fit in grid end of secondary (L_2).
I —100-henry choke coils.
R —1-megohm grid leaks.
N—Neutralizing condenser, consisting of a small brass disc about an inch in diameter, mounted so as to make its position, in relation to L_2, variable.
F_1, F_2, F_3,—Fixed filament control resistances to match the type of tubes employed.
J —Single-circuit filament control jack.
G —.00025-mfd. grid condenser and leak (6-megohm).
T_1, T_2,—Two UV-199 tubes.
T_3, T_4,—Two UV-201-A or High-mu tubes. If the latter are used, F_1 and F_2 may be omitted.
T_5,—Semi power tube.

Although choke-coupled amplification is shown in the diagram, the circuit may be used just as well with transformer or resistance-coupled audio stages. If the transformer-coupled form of amplification is desired, only two stages will be necessary for average requirements.

The center tap is employed on the antenna coil for use when one's antenna is in excess of 100 feet in length, but it is advisable to employ a single-pole double-throw switch at this point so that either antenna connection may be used without undue changes being necessary. The reason for this is that the capacity of the antenna has to be taken into consideration as well as its length.

No. 4 RADIO BROADCAST Laboratory Information Sheet June, 1926

The Browning-Drake Circuit



Complete data, on the sizes of the various units, used in this circuit appear in Sheet No. 3

No. 5 RADIO BROADCAST Laboratory Information Sheet June, 1926

Transformers

PRIMARY—SECONDARY RATIOS

THE ordinary commercial iron-core transformer consists simply of two coils of wire wound on the same core. So long as the secondary of such a transformer is open circuited, or connected to something with an impedance so high that not much current flows, we have a very simple relation between the voltage delivered by the secondary and that applied to the primary. This relation states that the ratio of these two voltages is the same as is the ratio between the primary and secondary turn numbers. A ten to one step-up transformer would be one with ten times as many turns on the secondary as on the primary.

A transformer corresponds to gears in mechanics. If by an arrangement of gears or levers we increase a mechanical force ten times, we know instinctively that we must expect the part of the arrangement that is exerting the "stepped-up" force to move ten times as slowly as the part where the original force is being applied. If we choose to gain in force, we lose correspondingly in speed, or else we could get "something for nothing." The electrical transformer is not a source of power. It merely changes the power put into it at one voltage into the same power (with a small percentage loss) at a different voltage. Hence, just as the speed went down in the mechanical case, so the current is less in the high tension or high voltage side of the transformer. The primary current is related to the secondary current as the secondary voltage is related to the primary voltage. An auto transformer is no different except that the winding having the fewest turns is merely a part of the other winding. Thus only one coil is required.

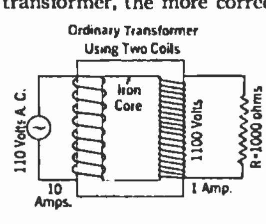
There are several simple formulas regarding transformers that are quite useful:

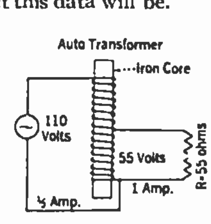
$$\frac{\text{Primary Turns}}{\text{Secondary Turns}} = \frac{\text{Primary Voltage}}{\text{Secondary Voltage}}$$

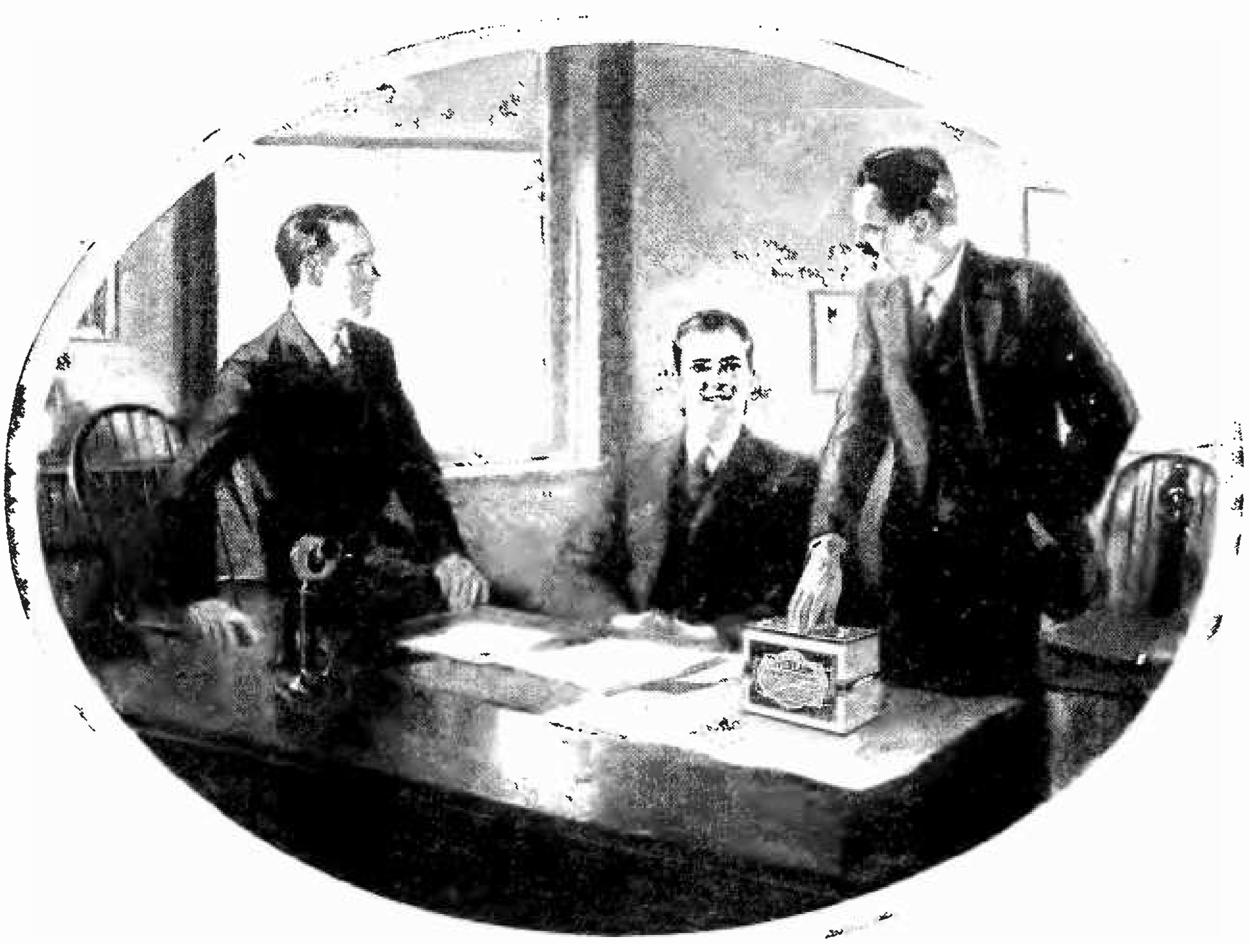
$$\frac{\text{Primary Turns}}{\text{Secondary Turns}} = \frac{\text{Secondary Current}}{\text{Primary Current}}$$

$$\frac{\text{Primary Voltage}}{\text{Secondary Voltage}} = \frac{\text{Secondary Current}}{\text{Primary Current}}$$

Values obtained by the usc of the above relationships will serve as fairly close approximations. In general, the smaller the load being supplied by the transformer, the more correct this data will be.







"I've just had a lesson in radio economy, and, believe me, it's illuminating" ★

"I WENT into my radio dealer's this noon for a couple of Eveready 'B' Batteries and said, 'Tom, give me a pair of Eveready 45-volt "B" Batteries No. 772's.'

" 'How many tubes in your set, Jim?' he asked.

" 'Five,' I answered.

" 'Then what you want is a pair of Eveready Layerbilt No. 486's.'

" 'Why?' I asked.

" 'Because the Eveready 772's are meant for sets having one to three tubes. With average use of the set, and used with a "C" battery*, they should last a year or longer. But on a five-tube set, with average use and with a "C" battery, they will only last about four months. Anyone with a four or five tube set should buy a pair of Eveready Layerbilts No. 486. Used with a "C" battery they should last eight months or longer.'

" 'Yes, but the 772's cost only $3.75 each,' I said, 'and the Layerbilt $5.50. There's some difference.'

" 'Well, figure it out for yourself,' said Tom. 'Two sets of 772's should last you about eight months, and will cost you $15. One set of Eveready Layerbilts should last about eight months, and will cost you only $11.' "

The simple rules for this satisfaction and economy are;

On 1 to 3 tubes—Use Eveready No. 772.

On 4 or more tubes—Use the Heavy Duty "B" Batteries, either No. 770, or the even longer-lived Eveready Layerbilt No. 486.

On all but single tube sets—Use a "C" battery.

When following these rules, the No. 772, on 1 to 3 tube sets, will last for a year or more; and the Heavy Duties, on sets of 4 or more tubes, for eight months or longer.

We have prepared a new booklet, "Choosing and Using the Right Radio Batteries," which we will be glad to send you upon request. This booklet also tells about the proper battery equipment for use with the new power tubes.

*NOTE: A "C" battery greatly increases the life of your "B" batteries and gives a quality of reception unobtainable without it. Radio sets may easily be changed by any competent radio service man to permit the use of a "C" Battery.

LEFT—*No. 486, for 4, 5 or more tubes.* $5.50.

RIGHT—*Eveready Dry Cell Radio "A" Battery, 1½ volts.*

EVEREADY
Radio Batteries
-they last longer

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night means Everyready Hour —8 P. M., Eastern Standard Time, through the following stations:

WEAF—*New York*	WSAI—*Cincinnati*
WJAR—*Providence*	WTAM—*Cleveland*
WEEI—*Boston*	WWJ—*Detroit*
WTAG—*Worcester*	WGN—*Chicago*
WFI—*Philadelphia*	WOC—*Davenport*
WGR—*Buffalo*	WCCO { *Minneapolis* / *St. Paul*
WCAE—*Pittsburgh*	
KSD—*St. Louis*	

★ Tested and approved by RADIO BROADCAST ★

No. 6 RADIO BROADCAST Laboratory Information Sheet June, 1926

Dielectric Constant

ITS EFFECT ON CONDENSER CAPACITY

THE capacity of a condenser depends upon several different factors, the most important of which are:—1. Area of plates; 2. Number of plates; 3. Distance between plates; 4. The dielectric or insulating material between plates.

The effect of the first three quantities on the capacity is easily calculated by means of formulas based on theory, but in order to determine the effect of the dielectric, it is necessary to conduct actual tests using different materials.

The commonest dielectric used in variable condensers is air, and its dielectric constant, or specific inductive capacity, is unity. For fixed condensers, one of the best dielectrics is mica, and it is used on practically all small fixed condensers for radio use, because of its low losses. When a voltage is impressed across a condenser, a certain amount of energy is consumed in the dielectric, and the smaller this energy loss, the better is the condenser. For the larger condensers, of one or two microfarads capacity, oiled paper is generally used. Its use helps to reduce the cost and the break-down voltage of such a condenser will be greater than if plain paper is used.

Solid dielectrics have the disadvantage that if they are once broken down and punctured, due to excessive voltage, they are rendered useless. However, if a liquid dielectric is used, this disadvantage cannot exist, and for this reason laboratory condensers of fairly large capacity quite frequently use castor oil as the dielectric. In this way it is not only possible to obtain variable condensers with a fairly large capacity (the capacity of any given condenser by the use of castor oil is made five times as great as it would be if air were used), but it is also possible to apply greater voltages without sparking between plates. The capacity of any given condenser is proportional to the constant of the dielectric that is used.

Some of the most common materials used as dielectrics are listed in the table given herewith.

Vaseline	Ebonite	Glass	Mica	Paraffin Wax	Porcelain	Quartz	Resin	Shellac	Castor Oil	Olive Oil	Petroleum Oil
2.0	3.0	7.0	6.0	2.5	4.0	4.5	2.5	3.5	5.0	3.0	2.0

No. 7 RADIO BROADCAST Laboratory Information Sheet June, 1926

The New Tubes

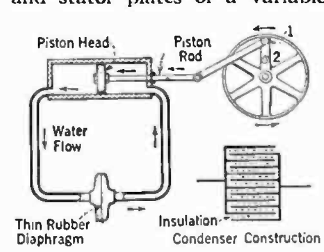
Type	A Battery Volts Supply	Filament Terminal Volts	A Battery Current (Amperes)	B Battery Volts, Detector	B Battery Volts, Amplifier	Negative C Battery	Plate Current (Milli-amperes)	Output Resistance (Ohms)	Voltage Amplification Factor
UX-199	4.5	3.0	.06	45	90	4.5	2.5	15,000	6.25
UX-200	6	5	1.0	15 to 25	—	—	—	—	—
UX-201-A	6	5	.25	45	90 135	4.5 9.0	3 4	12,000 11,000	8 8
WX-12	1.5	1.1	.25	22½	90	4.5	2.8	14,000	5.6
UX-112	6	5	0.5	22½ to 45	157 135 112 90	10.5 9.0 7.5 6.0	7.9 5.8 2.5 2.4	4800 5500 8400 8800	8.0 7.9 7.9 7.9
UX-120	4.5	3.0	.125	—	135	22.5	6.5	6600	3.3
UX-210	8	7.5	1.25	—	425 350 250	35 27 18	22 18 12	5000 5100 5600	7.75 7.65 7.5
	6	6.0	1.1	—	157	10.5	6.0	7400	7.5

No. 8 RADIO BROADCAST Laboratory Information Sheet June, 1926

Condensers

A SIMPLE EXPLANATION OF CONDENSER ACTION

THE accompanying diagram shows the construction of a condenser, and also a simple analogy for its action. The crank and piston arrangement, when rotating, produces an alternating current of water which fills the system. A thin rubber diaphragm prevents any direct circulation, but, by bending back and forth, allows alternating motion of the water. The greater the area of the diaphragm, the thinner it is, and the more flexible it is, the easier it will be to turn the crank to operate the piston. If (refer to the diagram) the piston connecting rod is hitched to point No. 2 on the drive wheel instead of No. 1, only half the force will be required to turn the crank, as the diaphragm will only be stretched half as much. Also, the current will be only half as great. But if, then, the crank be turned twice as fast, the speed of the water will be doubled so that the current is the same as before. This establishes a relation that holds good in the electrical case, namely, that if the frequency be doubled, or trebled, etc., the electromotive force required to produce the same current will be only one half, or one third, etc., as great. In the electrical case, corresponding to the diaphragm we have a sheet of some insulating material (dielectric) separating the two sheets, or sets of sheets, of the condenser. By increasing the area of the metal plates, thinning the insulating material (this corresponds to decreasing the spacing between the plates), or employing dielectric with a high "constant" (see Laboratory Sheet No. 6), the value of the applied voltage to produce a given current is proportionally decreased. Fixed condensers usually consist of metal foil cut up into small pieces which are connected together, and separated with mica or some other dielectric. There are two distinct sets of plates, corresponding to the rotor and stator plates of a variable condenser. The "capacity" of condensers used in radio circuits is usually expressed in microfarads, and if air is used as the insulating substance between the plates, the capacity in microfarads is approximately equal to the area of one of the plates (measured in square centimeters) divided by 11,300,000 times the distance between the plates (measured in centimeters). If other insulating material is used, it is necessary to multiply by its dielectric constant. The dielectric constant of mica, for example, is about 6.



From this explanation it is evident that current never actually flows through a condenser, but that it merely, we might say, collects on the condenser plates, and then returns back to the starting point.

Hammarlund Roberts

Acclaimed from Coast to Coast

Thousands Have Built It!

Testimonials on the Hammarlund-Roberts Receiver

1

Grandview, Washington

Last night I received PWX at Havana, Cuba on the loud speaker. Other stations that I get regularly are: WFGB at Atlanta, Georgia; WSM, Nashville, Tenn.; WGY, Schenectady, N. Y.; WSMB, New Orleans, Louisiana; CZE, Mexico City, Mexico. Ready to back your set against any other of the same size. Logged over 100 stations the first week. R. F.

2

Butte, Montana

During tests the Hammarlund-Roberts was installed in the Butte Radio Club Headquarters and dials set for 2LO. Immediately we were able to get through for a few moments, long enough to hear announcements made in English, German, and Spanish. This was followed by both instrumental and vocal music. M. R. C.

5

Wheeling, W. Va.

On January 25th, 1926, I picked up 7EAJ of Madrid, Spain. Reception was so loud and clear from the cone speaker, it was desirable to cut the volume considerably.
I have received CZE of Mexico City and PWX of Havana, Cuba; both of these stations I have received before these tests however.
I have logged over 90 stations and more are coming in all the time. N. E. C.

SIMPLICITY of assembly is an outstanding feature of the Hammarlund-Roberts receiver. Thousands of amateur builders in all parts of the country testify enthusiastically to the ease of assembling this circuit and express their delight at the results secured by their own handiwork.

The secret of their success lies in the flawless technique of every part entering into the assembling of this set. The Hammarlund-Roberts receiver represents the composite achievement of ten leading engineers, backed by ten of the best known manufacturers of radio parts. Every part is the work of a specialist and has been chosen because it meshes easily and yet efficiently with every other related part in the set.

After you have assembled this receiver you will want your friends to call around and judge for themselves your ability as a radio engineer. And your pride will be justified. The Hammarlund-Roberts receiver combines remarkable volume and sensitivity with an unusual degree of selectivity and tone quality. As for distance—you have on either side enthusiastic testimony by users of the Hammarlund-Roberts in all sections of the country. A perusal of these comments will revolutionize all your previous ideas of five-tube performance. Should you desire to verify any of these reports we will be glad to furnish you with full name and address on request.

7

Washington, D. C.

Each evening during the tests, I logged in no less than a dozen stations. However, regenerative sets absolutely ruined reception. I was able to make out only partly some station in South America operating at 300 meters. From results obtained I am sure that Hammarlund-Roberts is capable of Trans-Atlantic Reception. I feel that Hammarlund-Roberts is one of the best buys in radio today. G. J. A.
Electrical Engineer

9

Williamsport, Pa.

We have tested the Hammarlund-Roberts and find it to be exactly as you recommended. Surprising volume and very clear and deep tone, exceedingly selective. H. B. S.

10

Lansing, Mich.

On the first night of the Trans-Atlantic Tests, I had PWX, Havana, Cuba, on the loud speaker, so loud that it could be heard at times all over a six-room house.
Have not heard of anyone beating this record. I have ten witnesses to this reception. J. R.

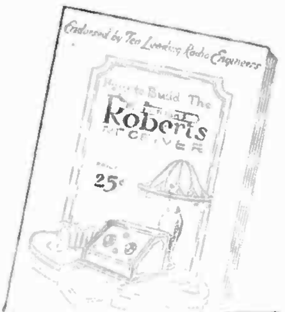
13

Morristown, Tennessee

I assembled the Hammarlund-Roberts Receiver in one day's time. The set is highly efficient and up to all claims made by you.
I have owned many factory built sets and will say that the Hammarlund-Roberts is superior to them all. This set is capable of building up tremendous volume without distortion and behaves like a thoroughbred.
I get New York, Atlantic City, Jacksonville, San Francisco, Montreal, Havana, Cuba, and Mexico City.

Hammarlund Roberts ★

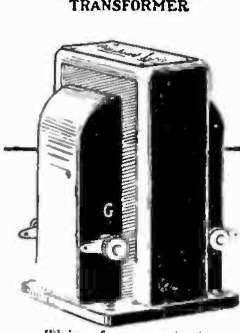
Hammarlund-Roberts 1182-A Broadway, New York City



SEND FOR THIS BOOK

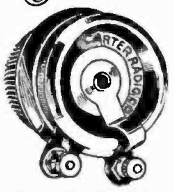
Contains step-by-step instructions on the assembly, wiring and operation of the Hammarlund-Roberts. Fully illustrated; most complete "How to Build It" radio book ever published. 25c.

Rauland-Lyric AN ALL-AMERICAN TRADE MARK TRANSFORMER

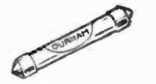


This famous instrument and other parts shown here are some of the quality units in the Hammarlund-Roberts.

Carter



RHEOSTATS



DURHAM RESISTORS

AMPERITE

UNION PHONE TIP JACKS

NA-ALD

DIALS and SOCKETS

★ Tested and approved by RADIO BROADCAST ★

"Now, I Have Found . . ."

A Department for the Exchange of Ideas and Suggestions of Value to the Radio Constructor and Operator

CONTRIBUTIONS to this department are welcome and those used will be paid for at the usual rates, that is, from two to ten dollars each. A prize of twenty-five dollars is given for the best idea used during each three-month period. The prizewinner for the last period was announced in the May RADIO BROADCAST. *Manuscripts intended for this department should not exceed about three hundred words in length, and should be typewritten. Little consideration can be given to manuscripts not typewritten. Envelopes should be addressed to this department,* RADIO BROADCAST, *Garden City, New York.*

A WOODEN STAND TO HOLD A MACHINIST'S DRILL

THE amateur mechanic, interested in obtaining additional service from a limited number of tools, will find in the wooden stand fixture illustrated in Fig. 1, a means for obtaining a wide extension of use from the hand type of machinist's drill.

With this fixture, and a hand drill secured to the frame structure, it is possible to do drilling work with great facility and accuracy. Drilling glass, deep drilling in steel, cutting with an expanding type of drill, and similar jobs requiring care and patience, are possible with this form of drill fixture.

The same fixture also permits of holding work horizontal, through tilting of the drill frame. This position enables small parts to be turned up from pieces of brass and steel rods, with a file for a cutting tool.

The merits of this stand will be evident to the user of the drill, but a main feature is the simplicity of its construction. A drill support block, A, is the means for holding the drill and permitting of its being moved endwise. Two guide blocks, B-B (into which A slides) are attached to an arm, C, extended outward from a vertical support, D. A single large wood block, E, forms the base. The base is hinged to the work-bench or other base by ordinary strap hinges, permitting of the entire structure being tilted.

Screws secure the several pieces of wood forming the frame, making a fixture that is readily fitted up in an hour or so, with only wood-working tools.

The dimensions, as will be evident from the drawing, will vary with the size of drill available.

GEORGE A. LUERS,
Washington, District of Columbia.

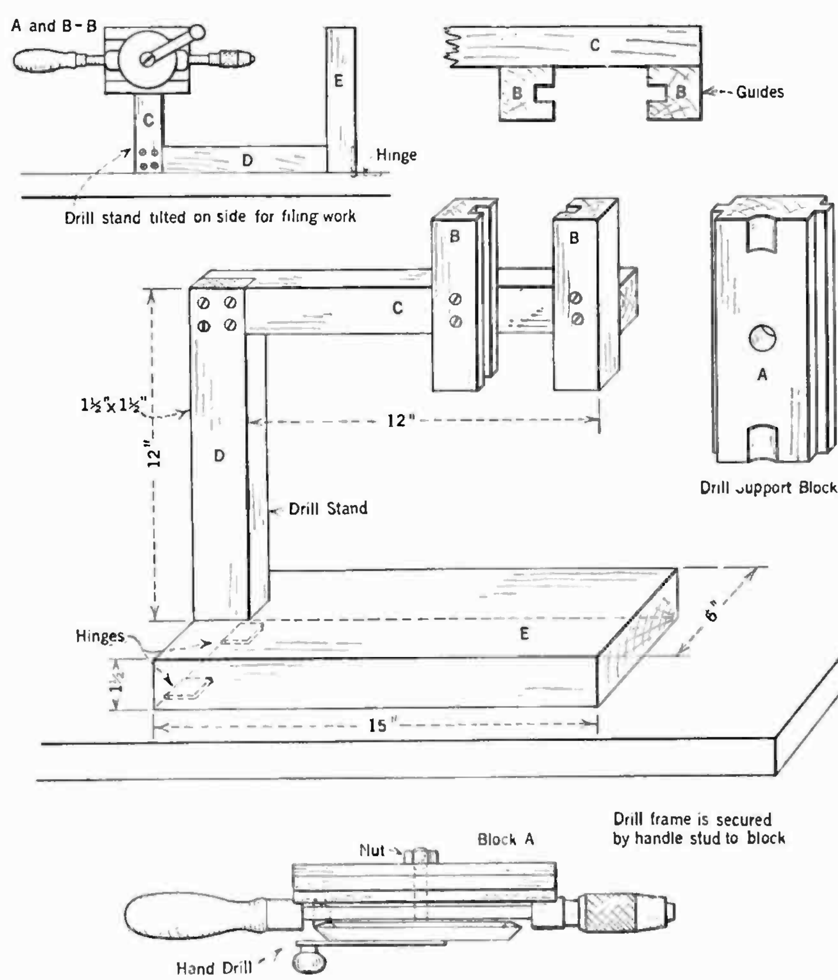


FIG. 1

A SIMPLE CONE LOUD SPEAKER ALTERATION

CONE speakers sometimes develop a buzz or rattle that cannot be overcome by ordinary mechanical adjustment. This will be especially noticeable on fairly weak volume, causing a blurring of voices. A practical and proven remedy is to apply a small daub of rubber cement of the sort that remains semi-flexible after drying thoroughly, around the needle shaft actuating the instrument, at the point of its connection with the cone tip. On the front side, back off the small nut on the shaft end enough to allow the cement to coat its surface, and dry before tightening the nut, forming thus a rubber washer. After tightening the nut, apply one more coating of cement over the nut and shaft end. Do not tighten the nut more than necessary, otherwise you are liable to cut through the first coating.

Glue will work satisfactorily for the volume usually required for best reproduction with cone speakers, but rubber cement is superior when low volume is desired.

A. H. KLINGBEIL,
Ashtabula, Ohio.

A WINDING FORM FOR LOW LOSS COILS FOR THE ROBERTS SET

THE winding form described below was used to make several sets of low loss coils for the Roberts hook-up and was found to work very nicely.

LIST OF MATERIAL REQUIRED

A piece of hardwood $2\frac{1}{4}$ inches in diameter and $1\frac{1}{2}$ inches thick.

An $\frac{8}{32}$ machine screw $1\frac{3}{4}$ inches long, with nut.

Thirteen pins $\frac{3}{16}$ x 4 inches long

Take the piece of hardwood and lay out 13 holes around the circumference $\frac{3}{4}$ inch from the edge. See Fig. 2. Drill a $\frac{3}{16}$-inch hole at each of the 13 points radially with the center. Now drill a hole at right angles to the thirteen holes, through the center, using a No. 18 drill. Then put the block in a vise and saw in half on the center line used to lay out the thirteen holes. After sawing clean up all the rough edges with a sharp knife or file; also put an assembly line, A, Fig. 2, on the edge so that the blocks will be assembled the same way each time. The form is now ready for use.

Put the blocks back together using the $\frac{8}{32}$ machine screw and nut to hold them; then insert the thirteen pins and tighten up the machine screw until the pins are all securely held in place. Wind the coil by going over two then under two pins until the required number of turns are in place. Now remove the machine screw and take the two halves of the block apart and you are ready to fasten the windings.

Weave cord through them, threading it in between the cross wires, removing the

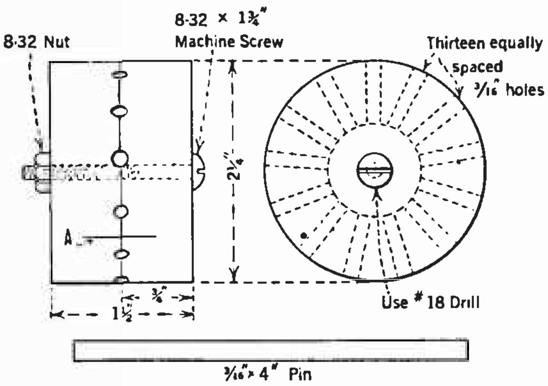


FIG. 2

pins one at a time after the wires are securely tied at each pin.

You will now have a self-supporting low loss coil, with only a small amount of cord holding it in place.

ARTHUR W. SMEALLIE,
Scotia, New York.

AN IMPROVED RADIO REPRODUCER

AT THIS time, when everyone is devoting energy to obtaining better quality of reproduction from his radio receiver, it seems proper that I should mention a new type of radio reproducer which I have developed for my own use. The quality of reproduction is wonderful because high and low notes are reproduced alike. The tone resembles that of the new "Orthophonic" Victrola, and the volume may be regulated by the volume adjuster on the phonograph. The diagram, Fig. 3, clearly shows the general idea of the reproducer.

I would suggest that a unit of good quality be used and that it be adjustable. Proceed as follows: Unscrew the cap of the loud speaker unit and lay the diaphragm, face up, on the table. In the exact center scrape the lacquer off and solder a 3-inch length of No. 14 wire. Make sure that the wire is in the exact center and perpendicular to the diaphragm.

Now replace the diaphragm and tighten the cap on the unit. With a pair of pliers bend up a half-inch length of the wire as shown in the diagram.

Next the unit should be connected to the phonograph. It may be used with any

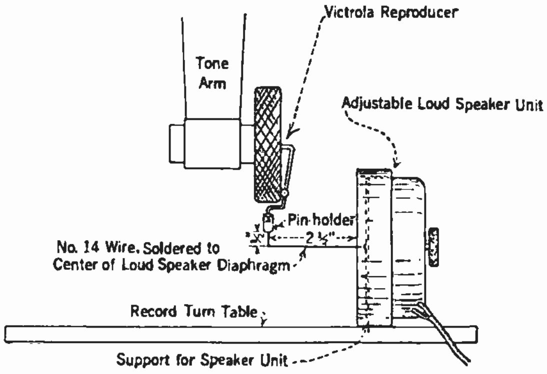


FIG. 3

make of phonograph providing that it is placed parallel with the reproducer on the phonograph; that is, so that the diaphragm in the loud speaker is parallel with that in the phonograph reproducer.

The loud speaker unit should rest on the turntable of the phonograph in a position so that the wire will fit into the needle receptacle of the phonograph reproducer. Next tighten the thumbscrew, holding the turned-up end of the loud speaker wire firmly in the needle receptacle.

With this type of reproducer you are utilizing the properties of your phonograph horn and reproducer, yet you may play your victrola at any time, by simply loosening the needle set screw and removing the radio speaker unit.

ALTON C. CHAMBERLIN,
Ballston Spa, New York.

A BETTER METHOD OF WINDING INDUCTANCE COILS

THE single layer solenoid coil, when supported by a minimum of dielectric, is one of the most efficient forms of inductances. One frequently sees directions for winding these coils and fastening the turns in place with strips of adhesive paper tape, such as grocers use to fasten packages. The trouble with this method is that the adhesive tape does not always hold firmly.

A coil which is much stronger mechanically may be made by using strips of paper which have been coated on one side with beeswax. From a piece of strong, good quality, paper, cut strips about half an inch wide and a little more than twice as long as the finished coil will be wide. Melt a little beeswax and, using a small brush, coat one side of each strip.

Wrap two or three turns of paper around the bottle or other cylindrical object which you intend to use as a form. Make the paper wrapping wide enough so it will project over one end of the bottle for several inches. Place the prepared strips, wax side out, at equal distances around the circumference of the bottle. Snap a couple of rubber bands over them, and everything will be held in place.

Start winding the coil about a fourth of the distance from the ends of the strips. After winding the required number of turns take the brush and paint some melted beeswax across the coil over each of the paper strips. Then run the tip of a fairly hot flatiron along the same place. The heat will melt the wax and it will run in between the turns, holding them firmly. Then bend over the ends of the paper strips and lay them along the outside of the coil, pressing them into place with the hot flatiron. They will immediately stick.

Now grasp the projecting end of the paper which was wrapped around the bottle and pull the coil and paper away from the bottle. Remove the paper from the inside of the coil, and the operation is completed.

The finished coil is strong enough for

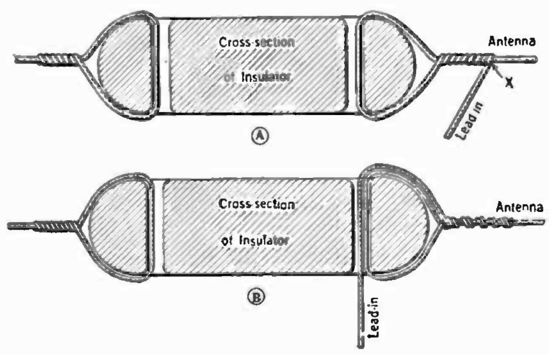


FIG. 4

any radio use. If several connections are made to it with bus bar, the bus bar will probably furnish all the support required to suspend it firmly in position in the radio set, and no hard rubber or other material need be used as a support.

H. Leslie Curtis,
Lakeport, New Hampshire.

HOW TO USE ANTENNA INSULATORS TO BEST ADVANTAGE

THE sketches in Fig. 4 show the right and wrong way of making the lead-in wire twist at the supporting insulators. In A, the wrong way, the chances are that, due to wear, the lead-in will break, necessitating repairs.

In B, the lead-in tension and friction is relieved by passing the lead-wire through the hole in the insulator.

S. P. Emerick,
Oswego, New York.

A COLLAPSIBLE ANTENNA

WITH the approach of summer readers might be interested in an idea for an antenna suitable for use in a canoe. This antenna is compact when not in use, and can be made in a short time. It is efficient too, as I have

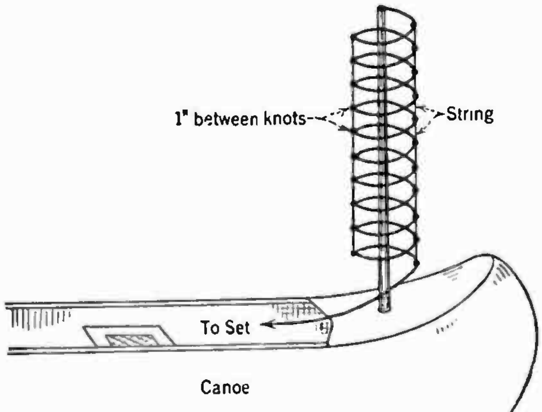


FIG. 5

received KOA on the loud speaker in Winnipeg on a home-made Browning-Drake the summer of 1925.

It consists of 50 turns of bell wire on a 4-inch tube, and, as I wound each turn on the tube, I knotted it with a string running down both sides of the coil, leaving about an inch space between knots. When the 50 turns are wound and knotted, remove the tube and an extended coil about 4 feet long will result, one end of which should be attached to the top of a sailing mast as in Fig. 5. When not in use, it can be gathered together and will not tangle.

For a ground, I used about 20 feet of 7-strand antenna wire, rolled into a hollow ball about 6 inches in diameter, and soldered wherever the turns crossed. This made an effective ground when towed through the water.

F. J. Moffatt,
Winnipeg, Manitoba.

A MARKER FOR BATTERY LEADS

MANY experimenters have occasion to use some kind of a marker for the circuits they are using in their experiments, and I have found the following method very satisfactory. Take a piece of flexible cardboard and cut into pieces about $\frac{3}{4}$ x $1\frac{3}{4}$ inches. Punch in each end a hole so that they will be about $1\frac{1}{4}$-inch apart and of such size that the wire will be free in it. Write on the card between the holes any information you wish, and thread the wire through the holes, passing the wire on the opposite side of the card from the writing. An example is shown in Fig. 6.

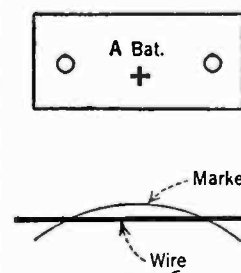


FIG. 6

V. H. Foy,
St. Louis, Missouri.

ELIMINATING OIL BURNER INTERFERENCE

THE motor on my oil burner set up a lot of interference in my superheterodyne, and as the burner seemed to want "to broadcast" every time I wanted to listen-in, I tried a good many different things to overcome it. Of course, I could shut off the burner by means of the thermostat, but that cooled off the house too much and made it uncomfortable for the rest of the household.

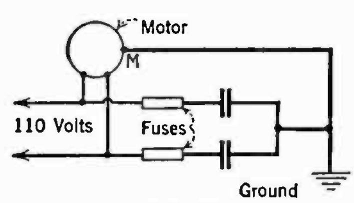


FIG. 7

Referring to the sketch, Fig. 7, it will be seen that two condensers of good sized capacity (I used 8.0 mfd.) are connected in series across the line, and the center connection grounded. The condensers must be connected across the line at the point where the interference is set up, otherwise no benefit will be derived. Another point: All wiring should be done with BX cable, and the casing grounded. The motor frames, M, and all casings around such electrical devices, must be grounded.

I found that this did away with all my interference.

James P. Baldwin,
New Britain, Connecticut.

New Services to Readers by the Radio Broadcast Laboratory

Technical Information Service to be Conducted by the Laboratory—Repair Service for Receivers—Calibration and Measurement Work

FROM this time on, all questions which were formerly sent to "The Grid" will be handled by the Technical Information Service, RADIO BROADCAST Laboratory. That service is maintained under the following rules:

1. All questions from subscribers to RADIO BROADCAST will be answered free of charge.
2. Non-subscribers to RADIO BROADCAST will be charged a fee of One Dollar for the Laboratory Technical Service.
3. All questions will be answered by mail and none will be published in RADIO BROADCAST.

The Technical Information Service of the Laboratory feels that it is important to define the scope of its service to readers. Although the Service is of very general help to our readers, there are certain demands which can not be met.

The Technical Information Service:

1. Cannot make comparisons between various kinds of receivers or manufactured apparatus.
2. Wiring diagrams of manufactured receivers cannot be supplied. This information can be secured from the various manufacturers.
3. Complete information cannot be given about sets described in other publications, but in all cases (wherever possible), inquirers will be referred to a source of information where the data can be obtained. In this connection, the monthly department in RADIO BROADCAST "The Best in Current Radio Publications" should be of great help, and should be consulted. That department records the most important constructional, technical, and general radio articles which appear.
4. Special receivers or circuits cannot be designed by the Technical Service.
5. Those who ask questions which cannot be answered in the scope of a letter will be referred, if possible, to sources where the information can be obtained.

In response to many requests, lists of the various groups of apparatus tested and approved by RADIO BROADCAST Laboratory will be mailed to all inquirers without charge.

REPAIR SERVICE FOR READERS

THE service of the Laboratory will be further extended to aid readers, and we are glad to announce the inauguration of the "Repair and Service Department, RADIO BROADCAST Laboratory." The Laboratory will undertake to repair and put in condition, for a moderate charge, receivers built by readers. Only sets which have been described in this magazine will be eligible for this service. In a later number of RADIO BROADCAST, the full scope of the Repair and Service Department, will be outlined. Those readers who now have sets which they would like to submit, should communicate by letter with The Repair and Service Department of the Laboratory, RADIO BROADCAST, Garden City, New York. Facilities are available to repair readers' receivers at once. The Laboratory has no wish to compete with local radio repair services, but many readers desire to submit their sets directly to RADIO BROADCAST for attention and we are glad to accommodate those who feel that their local facilities are not sufficient to help them out of any difficulties they may have experienced.

CALIBRATION AND MEASUREMENT

A THIRD service of the Laboratory which is available to readers, is the Calibration and Measurement Service. For a moderate fee, wavemeters, coils, transformers, etc., will be measured or calibrated by the Laboratory. Characteristics of tubes will be measured and the Laboratory is in a position to perform other similar services. Communications on this subject should be addressed to the Director of the Laboratory.

Our correspondence indicates that an increasing number of readers of RADIO BROADCAST are becoming interested in home experimental radio work. Many of these newly interested experimenters have been led into this work through Keith Henney's articles which appear from time to time in the magazine, telling how the constructor can build and properly use his own simple and reliable wavemeters, audio- and radio-frequency oscillators and other important valuable laboratory apparatus. The Calibration and Measurement Service should be of practical help to these home experimenters.

REPAIR SERVICE BLANK

Repair and Service Department
RADIO BROADCAST Laboratory,
Garden City, New York.
GENTLEMEN:

I am enclosing with this blank, a letter to the Repair and Service Department, RADIO BROADCAST Laboratory. I am not forwarding my receiver at this time but I desire to submit a receiver, which is a............,
described in RADIO BROADCAST for

- ☐ Repair
- ☐ Overhauling
- ☐ Rewiring
- ☐ Inspecting and Test
- ☐ ....
- ☐ ....

NAME.............................

ADDRESS...........................

TECHNICAL INFORMATION INQUIRY BLANK

Technical Service,
RADIO BROADCAST LABORATORY,
Garden City, New York.
GENTLEMEN:

Please give me fullest information on the attached questions. I enclose a stamped addressed envelope.

☐ I am a subscriber to RADIO BROADCAST, and therefore will receive this information free of charge.

☐ I am not a subscriber and enclose $1 to cover cost of the answer.

NAME................................

ADDRESS..............................

Why not subscribe to *Radio Broadcast?* By the year only $4.00; or two years, $6.00, saving $2.40. Send direct to Doubleday, Page & Company, Garden City, New York.

BOOK REVIEW

A Practical-Theoretical Book Especially for the Beginner

PRACTICAL RADIO. *By Moyer and Wostrel. Published by McGraw-Hill Book Company, New York, 271 pages (182 Illustrations). $1.75.*

HERE is a thorough description of the principles and practice of radio reception, written for the beginner, and avoiding too technical details whenever possible. The chief feature of the book is the large amount of practical data presented, such as the fire underwriter's regulations for radio equipment, tables of data on various tubes, instructions for reactivating thoriated filaments, a trouble shooting chart, detailed instructions for putting up an antenna, for making and using wave traps, and for making several types of radio receivers. Also directions are given for the proper care and use of batteries, a chronological tabulation of important events in the history of the art, and, in the chapter on transmission, a copy of the International Morse code with a list of conventional abbreviations, and the location of the various radio districts of the United States, is given. A good feature is the list of questions at the end of each chapter which quickly help to show the reader whether or not he has really understood what he has just read.

This is a second edition book, and in it has been incorporated much new material that brings it up to date. In several cases the new material considerably modifies the earlier conclusions. For example, the statement that audio frequency amplification is used more extensively at present than radio frequency amplification is now open to question, as the use of some form of radio frequency amplification is practically universal in commercial receivers. Likewise, soft tubes of the old type, requiring critical voltage adjustment, are no longer in general use, so that the amount of space devoted to them in the first edition is now somewhat out of proportion to their importance.

It is perhaps unfortunate that the explanation given of the action of the three electrode tube as a detector is so brief; a clear distinction between the detecting action and the repeating action of a tube is not easy to make to the beginner. Another thing that might well have been included in the list of causes of howling in audio-frequency amplifiers is acoustic feedback, which is one of the commonest causes. There are also a few technical points on which the reviewer is in disagreement with the authors. The statement that when regeneration is carried to the point of oscillation, signals will probably disappear, is not the case with ordinary tubes, though the quality of the signals will of course change. And the explanation of feedback coupling due to tube capacity, given under the heading "Tuned Plate Regeneration," seems to indicate that the grid-filament and plate-filament capacities provide a coupling between circuits. This is not so, and in other parts of the book where feedback through tube capacity is mentioned, the grid-plate capacity alone is specified, quite properly, as the coupling capacity.

The above points are of no importance to the general reader, and on the whole, the book is well written and its fund of useful information should make it a valuable addition to the radio library, not only of the beginner, but of the confirmed radio fan as well.

WALTER VAN B. ROBERTS.

A KEY TO RECENT RADIO ARTICLES

By E. G. SHAULKHAUSER

THIS is the eighth installment of references to articles which have appeared recently in various radio periodicals. Each separate reference should be cut out and pasted on cards for filing, or pasted in a scrap book either alphabetically or numerically. An outline of the Dewey Decimal System (employed here) appeared last in the May RADIO BROADCAST, *and will be reprinted in an early number.*

R110. RADIO WAVES. RADIO WAVES.
Radio News. March, 1926, pp. 1285 ff.
"Speech Currents in Radiophony," J. F. Bront.
The fundamental theory underlying the transmission of radio waves ,is given. Comparison is made between effects produced by pure induction at low and high frequencies, and radiation at various frequencies. At the high frequencies, a given amount of power at the transmitter will cause a greater disturbance at the receiver than at the low frequencies, says the writer. Diagrams illustrate the discussion.

R375. DETECTORS AND RECTIFIERS. ELIMINATORS, *B-Battery*.
Radio News. March, 1926, pp. 1290 ff.
"A B Eliminator from Matched Parts," George Ames.
Construction of the Raytheon B eliminator, using Acme matched parts, is shown. Data is also given on the proper voltages for C battery, using various tubes on different plate voltages. A list of parts recommended, diagram, and photograph, give the necessary details.

R374. DETECTORS, CRYSTAL. CRYSTALS FOR DETECTORS.
Radio News. March, 1926, pp. 1300 ff.
"The Crystal Classified and Analyzed," J. F. Corrigan.
A list of minerals which may be used for the purpose of rectifying high frequency currents, and giving the chemical composition of each, is given. The crystals are classified into three groups, and each group discussed. The groups are: 1. The elementary group of crystal rectifiers; 2. The sulphide group; 3. The oxide group.

R201.5. SHIELDING AND GROUNDING. SHIELDING.
QST. March, 1926, pp. 9–20.
"The Shielding Problem," D. R. Clemons.
Complete shielding of coils is impossible because a shield must then have zero resistance and an infinite area, states the writer. The degree of shielding depends upon the frequency, better results being obtained at higher frequencies, since current sheets are limited to a very small depth of the shield, and great thicknesses are not required.
Experiments conducted with unshielded coils showed the effect of increase in effective resistance when brought near to a condenser. The method of measuring the high frequency resistance of coils is clearly indicated and described. The resistance increase varies considerably with change in frequency. Placing the coil at least two inches from the condenser will result in practically no effect on the coil constants. Shields placed near coils, or connected directly to one end of the coil, increase the effective resistance to nearly 500 per cent., at the same time decreasing the inductance. Coils completely surrounded by shielding showed various changes in constants, depending on the size of the coil and the shielding box. Curves presented, indicate the changes. Several circuit diagrams are presented, one showing a tester for the shield material.

R460. DUPLEX AND MULTIPLEX SYSTEMS. MULTIPLEX RECEPTION
QST. March, 1926, pp. 21–23.
"Multiplex Short-Wave Reception," J. K. Clapp.
A scheme whereby several receivers may be operated simultaneously from the same antenna, is shown. With this arrangement, an operator may listen to several wave bands at the same time, making observations relative to wave band best suited to traffic under varying weather conditions, day or night. He may also be able to check wavemeters using fundamental and harmonic notes at the time that WWV sends out the standard frequency signals.

R342.5. POWER AMPLIFIER (TRANSMITTER). AMPLIFIER, *Power*.
QST. March, 1926, pp. 29–30.
"A Power Amplifier for the Low-Powered Transmitter," R. P. Turner.
A power amplifier to be used in conjunction with a master oscillator on high frequency telegraph transmitters, is described. It is said to be very effective in steadying the output frequency, and to add materially to better reception at the receiving end. This amplifier acts similarly to a r. f. amplifier in receivers. Circuit diagrams and constructional details are given.

R612. SHORT-WAVE STATIONS. NORTH POLE RADIO STATION.
QST. March, 1926, pp. 33–36.
"Amateur Radio to the North Pole Again," F. H. Schnell.
A complete description of the apparatus used on the Detroit Arctic Expedition, is given. The receiver and transmitter employ C–301–A tubes, and both sets are enclosed in aluminum boxes. The transmitter operates on two frequencies, 3750 and 7500 kc. (70 and 40 meters). The receiver covers ranges from 23,076 to 2776 kc. (13 to 108 meters). The whole outfit, including a 30-foot bamboo pole, weighs only 45.5 lbs.

R531.2. STATION CALL LETTERS. CALL LETTERS.
RADIO BROADCAST. April, 1926, p. 708.
"Short-Wave Stations of the World."
A complete list of more than a hundred short-wave stations situated throughout the world is printed, including call letter, location, frequency, and wavelength.

RADIO FANS, a one-year's subscription to Radio Broadcast will cost you four dollars, two years six dollars. Consider this expenditure as being a necessary investment on your part for the future development of your own knowledge of Radio.

R230. INDUCTANCE MEASUREMENT. INDUCTANCE OF FILTER CHOKE.
QST. March, 1926, pp. 39–41.
"Finding the Inductance of the Filter Choke," E. W. Berry.

A method of determining the inductance of choke coils used in filter systems after resistance and impedance have been obtained, is described. With the aid of the curve chart, the inductance is read off directly. The method of measuring the values needed, and sample calculations, clearly show the procedure used.

R110. RADIO WAVES. RADIO WAVES.
Popular Radio. March, 1926, pp. 207–212.
"A New Theory of Wave Transmission," E. F. W. Alexanderson.

The writer enters into a discussion on the relation between the electron, the ether, and magnetism, and proceeds to show that all the theories of radio waves heretofore propounded fail to explain certain radio phenomena. In the course of his researches into the mysteries of radio waves, the author developed a new theory which explains many of the old observations as characteristic behaviors of the horizontally polarized wave. This new theory, which accounts for fading and the erroneous results met with in direction finding, is studied with the aid of a mechanical model, as the several illustrations show.

R073. TRAINING OF OPERATORS. TRAINING OPERATORS.
Popular Radio. March, 1926, pp. 213–219.
"Radio as a Life Work," P. Boucheron.

The opportunities of the trained radio man in this new field of science and industry are outlined by the writer. Engineers are needed at high-powered transmitting stations used in transoceanic work, (1) as operators and supervisors of ship and other land stations, (2) as engineers for broadcasting stations, and (3) for purposes of developing the new science. The opportunities for the properly trained men are great in all branches of radio, says the writer.

R230. INDUCTANCE. INDUCTANCE.
Popular Radio. March, 1926, pp. 255–257.
"A Measurement Chart," R. J. Hoffman.

A chart is presented making the construction of toroidal coils a matter of simple calculations. The inductance equation is given, and a sample calculation worked out.

R240. RESISTANCE; DECREMENT; PHASE DIFFERENCE. RESISTANCE, *R. F. of Condenser.*
Phil. Mag. (London). Feb. 1926, pp. 428–432.
"Measurement of the Resistance of a Condenser at Radio Frequency," Chas. D. Callis.

An attempt is made at the absolute measurement of resistance of a variable condenser at a frequency of one million cycles per second. The method of measuring the r. f. resistance of a circuit is described. Since the high frequency resistance of a coil alone cannot be measured, as stated, a method was employed whereby two like coils were used in the circuit simultaneously, placed in such relation to each other that their combined resistance was equal to the resistance of one in the circuit. The equation evolved, and the curve obtained, are presented. Sources of slight error, and effect of different coil forms, are considered.

R113. TRANSMISSION PHENOMENA. TRANSMISSION PHENOMENA.
Phys. Review, Feb. 1926, pp. 189–215.
"The Propagation of Radio Waves Over the Earth," A. H. Taylor and E. O. Hulburt.

Larmor's theory of refraction due to the electrons of the Kennelly-Heaviside layer, does not explain the "skip-distances" for short waves. The range as a function of wavelength shows a minimum for about 200 meters, which suggests the introduction of a critical frequency term. If the effect of the magnetic field of the earth on the motion of the electron is taken into account, the modification of the Larmor theory necessary to fit it to the experimental facts is secured. A quantitative theory is here developed. The upper atmosphere is assumed to contain N free electrons per cc., and neglecting absorption, the dispersion is worked out for various modes of polarization of the radio waves. Then the skip distances are computed, making various assumptions as to the electron density distribution. Comparison with the experimental skip distances shows good agreement, and indicates that the radio waves which just reach the edge of the zone beyond are refracted around a curved path, reaching in the daytime a maximum height of from 97 to 149 miles. At this height, the electron density comes out close to 10^6 electrons per cc. At night, the electron density gradient is less, and the height is greater. These conclusions agree with physical conceptions from other evidence.

From the dispersion equation a value for waves of 60 to 200 meters is obtained, which indicates total reflection from the electron layers at all angles of incidence. From this result, combined with interference between various modes of polarization of the radio rays, a detailed qualitative explanation of many fading phenomena is presented.

Further conclusions obtained are that the ions in the atmosphere have little effect in comparison wth the electrons; that for longer waves, the Larmor theory is correct; that short waves are propagated long distances by refraction in the upper atmosphere and reflection at the surface of the earth, not by earth bound waves; that waves below 14 meters (21,426 kc.) cannot be efficiently used for long distance transmission.

R000. HISTORY. HISTORY.
RADIO BROADCAST. April, 1926, pp. 643–646.
"How Radio Grew Up," R. H. Marriott.

The writer traces the history of radio from the time of Loomis in 1872 to the year 1897, when Marconi interested a group of Englishmen in his radio devices. This period includes the experiments of Hughes, Dolbear, Hertz, Branly, Lodge, Tesla, Popoff and others. Following Marconi's early work in radio, the public soon became aware of the importance of this means of communication.

R386. FILTERS. WAVE TRAPS.
RADIO BROADCAST. April, 1926, pp. 686–688.
"Cutting Out the Locals," H. E. Rhodes.

A simple outline on the subject of interference elimination by means of tuned filter circuits, commonly known as wave-traps, is presented. The theory of the wave trap, just how and why it operates in eliminating or reducing interference, and data presented to explain the results obtained, are included in this article. The radio-frequency amplifier is considered an effective wave trap when properly built.

R131. ELECTRON TUBE CHARACTERISTIC CURVES; GENERAL PROPERTIES. VACUUM TUBES.
RADIO BROADCAST. April, 1926, pp. 658–663.
"The Tube and Its Best Uses," K. Henney.
The general theory and operation of vacuum tubes as detectors and amplifiers, is discussed. The testing and the practical operation of tubes is obtained by inserting proper resistances in the input and output circuit, as shown. The importance of static and dynamic curves is explained. The relative merits of transformer, impedance, resistance, push-pull and parallel operation of tubes, is considered. Loud speakers should be coupled to a circuit of proper impedance, either direct to the tube or through an impedance or transformer, in order to obtain true reproduction of signals. Discussion on the use of high-mu tubes, and facts concerning tube rejuvenation, are presented.

R344.4. SHORT-WAVE TRANSMITTING SETS. TRANSMITTER, *Short-Wave.*
RADIO BROADCAST. April, 1926, pp. 678–681.
"How a Portable B Battery Transmitter Works," RADIO BROADCAST Laboratory.
The results obtained with the short-wave transmitter used at 2 GY employing dry B battery supply and small input power, is outlined. Ordinary receiving tubes of various makes were used in the portable set, which employed the simple Hartley circuit. The details of construction, and records of transmission, are described.

R113. TRANSMISSION PHENOMENA. TELEPHONE TRANSMISSION PHENOMENA.
Proc. I. R. E. Feb. 1926, pp. 7–56.
"Transatlantic Radio Telephone Transmission," L. Espenschied, C. N. Anderson, and A. Bailey.
The paper reports upon measurements of radio transmission which have been made during the past two years in a study of the possibilities of transatlantic telephony. These measurements cover several different frequencies in the range below 60 kilocycles transmitted in both directions across the Atlantic, and represent probably the most comprehensive study yet made of any transmission path. An earlier paper described the special high power radio telephone system and the measurement methods employed in the tests, and gave certain preliminary measurement results. The relation which exists between diurnal and seasonal variations of signal field, and the exposure of the transmission path to sunlight, is shown. The conformity of the measured results to the values determined by formulas, is indicated. Interesting correlation is shown between abnormal radio transmission and magnetic storms.
The diurnal and seasonal characteristics of noise are shown to be generally similar to those of signal strength, and indicate the noise to be of tropical origin. The average frequency distribution of static is shown for various receiving stations. Signal to noise ratios are shown for both England and the United States for transmission on 50-odd kilocycles, together with the improvement afforded by a directional receiving system of the wave-antenna type.

R114. STRAYS (ATMOSPHERICS). ATMOSPHERIC DISTURBANCES.
Proc. I. R. E. Feb. 1926. pp. 133–138.
"The Present Status of Radio Atmospheric Disturbances," L. W. Austin.
The paper gives a résumé of our present knowledge concerning atmospheric disturbances. In Europe it is found that about 30 per cent. of these are due to thunderstorms, while a considerably greater percentage are associated with rain areas of some kind. In the United States, near the Atlantic Coast, disturbances in general come from the southwest, while on the coast of California they come from the permanent centers in the neighboring mountains. In the Middle West the direction is variable, depending on thunderstorms, rain areas, etc. In England, cathode-ray oscillograms have been taken of the atmospherics. The main disturbance is of audio frequency and usually aperiodic. Some of the curves show high-frequency ripples on the main waves. These may be real sources of atmospheric troubles.

R431. STRAYS (STATIC ELIMINATORS). MCCAA ANTI-STATIC DEVICE.
Radio. March 1926, pp. 11 ff.
"Refinements in the McCaa Anti-Static Devices," E. B. Patterson.
A detailed account of the operation of the McCaa static eliminator, is given. The theory of its operation, and the advantages derived from its use, are outlined. Constructional details are also presented, which the experimenter can follow in building one of these interference eliminators for his receiver. Circuit diagrams are explicit and complete.

R800 (621.314.3). TRANSFORMERS. TRANSFORMERS, *Design Data.*
Radio. March 1926, pp. 23–26.
"Design of Small Power Transformers and Filter Inductances," J. B. Dow.
Specifications, data, and formulas, for the construction of transformers and choke coils for use in B battery eliminators and amateur transmitters, are given. Typical examples accompany the equations for purpose of illustration. A full-page table gives design data for inductance coils with iron cores, from 0.05-to 0.50-ampere carrying capacity. A table giving measurements of copper wire and turns per square inch is included.

R344.4. SHORT-WAVE GENERATORS. TRANSMITTER, *Short-Wave.*
Radio. March, 1926, pp. 29 ff.
"A Baby Radio Transmitter," W. H. Hoffman.
The construction of a compact 7500-kc. (40-meter) transmitter using a UV-199 tube and dry cells for power supply is outlined. The circuit employed is the modified Colpitts. The particular circuit arrangement was developed by the Burgess Laboratories. The antenna system is adjusted to resonance by means of a flashlight lamp and battery, or a hot wire instrument. A loop may also be used for the 7500 kc. (40-meter) band, it having a single turn three feet on a side, a three-plate variable condenser and a three-inch coupling coil being in series.

R320. ANTENNAS. ANTENNAS.
Radio. March, 1926. pp. 35–36.
"Using the Right Transmitting Antenna," F. C. Jones.
Several types of short-wave transmitting antennas are discussed, and their method of operation outlined. The type of antenna to use depends upon the surroundings and local conditions, according to the writer. Photographs and diagrams of several types, are presented.

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R113. TRANSMISSION PHENOMENA. BROADCAST
Proc. I. R. E. Feb. 1926, pp. 57–131. TRANSMISSION PHENOMENA.
"Some Studies in Radio Broadcast Transmission," R. Bown, D. K. Martin, and R. K. Potter.

The paper is based on radio transmission tests from station 2 XB, in New York City, to two outlying field stations. It is a detailed study of fading and distortion of radio signals under night-time conditions in a particular region, which may or may not be typical. Night-time fading tests, using constant signal frequencies and bands of frequencies in which the receiving observations were recorded by oscillograph, show that fading is selective. By selective fading is meant that different frequencies do not fade together. From the regularity of the frequency relation between the frequencies which fade together, it is concluded that the selective fading is caused by wave interference. The signals appear to reach the receiving point by at least two paths of different lengths. The paths change slowly with reference to each other, so that at different times the component waves add or neutralize, going through these conditions progressively. The two major paths by which the interfering waves travel are calculated to have a difference in length of the order of 135 kilometers for the conditions of the tests. Since this difference is greater than the distance directly from the transmitter to receiver, it is assumed that one path at least must follow a circuitous route, probably reaching upward through higher atmospheric regions. Various theories to explain this are briefly reviewed. The territory about one of the receiving test stations in Connecticut, is found, under daytime conditions, to be the seat of a gigantic fixed wave interference or diffraction pattern, caused in part by the shadowing of a group of high buildings in New York City. The influence of this pattern on night time fading is discussed. It is considered a contributing but not the controlling factor. Tests using transmission from an ordinary type of broadcasting transmitter show that such transmitters have a dynamic frequency instability, or frequency modulation, combined with the amplitude modulation. At night, the wave interference effects which produce selective fading, result in distortion of the signals when frequency modulation is present. It is shown that stabilizing the transmitter frequency eliminates this distortion. A theory explaining the action is given. The distortions predicted by the theory check with the actual distortions observed.

A discussion of ordinary modulated carrier transmission, carrier suppression, and single side band transmission in relation to selective fading is given. It is shown that the use of a carrier suppression system should reduce fading.

R376.3. LOUD-SPEAKING REPRODUCERS. LOUD SPEAKER
Radio. March, 1926, pp. 32. CONSTRUCTION.
"Construction of a Simple Cone Type Speaker," E. C. Nichols.

The constructional details of a simple and effective loud speaker of the cone type, is given. The horn is made of paper, which is mounted in a chamois supporting ring and energized through contact with the diaphragm of a regular loud speaker unit. The whole arrangement is then mounted on a wooden frame. The method of adjusting the speaker for best results, is given.

R344.3. TRANSMITTING SETS. TRANSMITTER,
Radio. March, 1926, pp. 37–39. *50-Watt, 6 XAO*
"The 50-watt Transmitter at 6 XAO," G. M. Best.

Constructional details of station 6 XAO's 50-watt transmitter, operating on the high frequency band of 3750 to 30,000 kc. (80–10 meters), are given. The set is built in three parts, the aerial tuning circuit panel, the transmitting panel proper, and the power unit panel. The circuit diagram and arrangement of parts, including a list of material required, are presented.

R351. SIMPLE OSCILLATORS. OSCILLATORS,
Radio. March, 1925, pp. 39 ff. *Short-Wave.*
"Parallel Wire Short-Wave Oscillators," F. C. Jones.

Experimental results on frequencies below 60,000 kc. (5 meters) using vacuum tube oscillators in standard circuits, are outlined by the writer. Several types of oscillators, including amplifiers for use in connection with oscillators, are used on waves of 75 cm. length although they are said to operate on waves still shorter. For work on the 75 cm. band, a parabolic reflector is shown and described.

R113.5. METEOROLOGICAL PHENOMENA. WEATHER AND
Radio News. March, 1926, pp. 1256 ff. RADIO.
"Radio Forecasting," E. B. Rideout.

In the writer's opinion, the two most important things that enter into the influence of weather on reception are temperature and barometric pressure variations. The creation of electrical discharges, through mixture of hot and cold air, setting up static waves, together with developments of large storm areas, account for much of our poor reception due to fading and atmospherics. Typical results, based upon actual observations, are related.

R131. ELECTRON TUBES; GENERAL PROPERTIES. ELECTRON TUBES.
Radio News. March, 1926, pp. 1255 ff.
"What Happens in Vacuum Tubes," Dr. A. Katsch.

Although theoretical formulas have been developed covering the actions taking place within vacuum tubes, such formulas contain many generalizations, and it is necessary to depend to a great extent upon actual research and experimental work in order to determine what goes on within the tubes, declares the writer. Photographs are shown of the discharge glow of electrons in a partial vacuum.

R800 (533.85) VACUUM APPARATUS. VACUUM PUMPS.
Radio News. March, 1926, pp. 1282 ff.
"How Radio Tubes Are Evacuated," Dr. C. B. Bazzoni.

Methods of producing vacua are described. Simple and effective pumps are shown which may be used by the experimenter in evacuating his own tubes. Various types of pumps are classified as follows: 1. Water or steam injector air pumps; 2. Ordinary piston air pumps; 3. Oil-sealed piston air pumps of the Geryk pattern; 4. Oil-sealed rotary air pumps of the Trimount pattern; 5. Stationary mercury air pumps, of the Sprengel pattern; 6. Rotary mercury air pumps of the Gaede pattern; 7. Mercury jet diffusion air pumps, of the Langmuir pattern; 8. Rotary cylinder molecular pumps of the Holweck pattern. The principles of operation of these types is described. Particular details of the simple Guichard type of Sprengel pump are given. The writer states that vacua of the highest degree may be obtained with these simple types of pumps.

Weather Forecast Transmissions by Radio

THE following stations in the Illinois section send out regular weather forecasts and reports by radio. With the exception of NAJ and WGO, all reports are in telephony. Amateurs who receive any of these transmissions are requested to write to the Weather Bureau Office, Springfield, Illinois, and report on the quality and service, and say how distinctly the stations are received.

NAJ, Great Lakes . . 151 kc. 1988 meters
9.45 A. M. Morning Lake Forecasts.
4.00 P. M. Storm Warnings.
10.00 P. M. Evening Lake Forecasts.

WGO, Chicago . . . 337 kc. 890 meters
11.00 A. M. Local and Lake Forecasts.
4.00 P. M. Local and Lake Forecasts.
9.00 P. M. Evening Local and Lake Forecasts.

WLS, Chicago . . . 870 kc. 344.6 meters
9.00 A. M. Morning Forecasts, Special Warnings.
12.10 P. M. Same as 9 A. M.
Corn and Wheat Region Summary Wednesday.
12.00 NOON Aviation Forecasts Except Sunday.

KYW, Chicago . . . 560 kc. 535.4 meters
12.00 NOON† Morning Forecasts.
4.15 P. M.† Special Warnings.
10.00 P. M.† Except Monday—Evening Forecasts.

WAAF, Chicago . . 1080 kc. 278 meters
10.30 A. M. Morning Forecasts. Weather-Crop Summaries on Wednesday During Crop Season.
12.30 P. M. Repeated; and Saturday gives Weekly Forecast.
Except Sunday and Important Holidays.

WHT, Chicago . . . 1260 kc. 238 meters
11.30 A. M.† Morning Forecasts. Corn and Wheat Region Summary Wednesday.
12.00 MIDN'T Evening Forecasts. Except Sunday.

WJBC, La Salle . . . 1280 kc. 234 meters
12.30 P. M. Morning Forecast. Except Sunday.

WOC, Davenport . . 620 kc. 483.6 meters
12.45 P. M. and 2.00 P. M. Except Saturday (1.00 P. M.) and Sunday. Morning Forecasts, General Weather Conditions. Weather-Crop Summaries on Wednesday.
9.00 P. M. (Soon After) Except Sunday (9.45 P. M.) and Monday. Evening Forecasts; Special Cold Wave Warnings Sent as Flashes.

WEW, St. Louis. . . 1210 kc. 248 meters
10.00 A. M. Morning Forecasts, General Weather Conditions.
5.00 P. M. Special Warnings. Except Sunday.

KSD, St. Louis . . . 550 kc. 545.1 meters
10.40 A. M. Morning Forecasts, General Weather Conditions, River Stages.
12.40 P. M. Special Warnings
1.40 P. M. Repeated.
3.00 P. M. Repeated.
10.00 P. M. Evening Forecasts. Except Sunday.

KMOX, St. Louis . . 1070 kc. 280.2 meters
10.00 P. M. Evening Forecasts. Except Sunday.

†One hour earlier during Chicago "Daylight Saving."

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A Neglected Angle of the Radiation Question

By HAROLD JOLLIFFE

A RADIO receiver which is allowed to go into a state of oscillation while a station is being tuned-in, is the cause of the most potent and destructive of all forms of interference experienced on the broadcast band of frequencies.

One can, as a rule, get away from the pernicious roll and crackle of a severe static storm by tuning-in the powerful signals of the local stations; and if any interference created by two stations heterodyning each other is manifest, one may always seek another station which comes in at a point on the dial where this interference is not present.

But there is positively no surcease from the demoralizing shrieks and squeals of an improperly operated regenerative or oscillating radio frequency set. The attention-compelling warning of the fire engine is as soft music compared to the shrill, siren-like whistles and groan-like crescendos frequently issuing from the loud speaker. And, somehow or other, these destructive agents always seem to have the knack of arriving on the scene just at the critical moment when the zealous soprano has reached high C, or when the violinist is applying his best efforts to the last few notes of his number.

Many interesting articles have appeared from time to time in the various journals devoted to radio, showing how unnecessary interference created by an oscillating receiver may be avoided by the proper handling of the controls when a station is being tuned-in; and there is no doubt that if these instructions were carefully followed by all, the ether would not be the bedlam that it sometimes is. Other writers of constructional articles have gone a step further by pointing out the desirability of so building a set that a transfer of energy from the oscillating circuit to the antenna is prevented. As an example of this, we have the well-known Teledyne and Browning-Drake receivers, both these sets being equipped with a single stage of non-oscillating radio-frequency amplification. This allows the detector to be set into oscillation whenever desired, but at the same time isolates these oscillations in the detector circuit so that they cannot be radiated from the antenna. Hence, both these receivers, and others designed along similar lines, are generally referred to as non-radiating, which they are according to the present definition of the word.

Then there is a comparatively recent development, a "capacity-bridge" arrangement, designed as a unit by itself, the purpose of which is also to eliminate radiation from the antenna when it is connected between the antenna and the oscillating receiver. This method of preventing unnecessary interference is somewhat different from the one mentioned in the foregoing paragraph and probably more efficient. But the main point to remember is that both prevent radiation from the *antenna*. Note that I have stressed the word "antenna." The reason for this will become apparent in just a moment.

Now, it is obvious that the theory involved in both the above blocking arrangements is that so long as oscillations are prohibited from reaching the antenna but are confined to the receiver itself, radiation is entirely eliminated, and therefore no interference is caused to listeners in the neighborhood. From this, taking it at its face value, it would seem that the antenna—with the ground connection, of course—constitutes the only agency by which these oscillations may be radiated.

But is this true? Can any receiver of the os-

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cillating type be rightfully considered non-radiating even though it be provided with a blocking arrangement? Granting that we do eliminate radiation from the antenna, does the matter end there? Is the antenna system the sole medium through which a receiver may radiate?

No, it is not!

And here I wish to step out of the beaten track long enough to state that the *coils* of any type of oscillating receiver must be reckoned with!

This has long been known in theory and, if the space this phase of the radiation situation has been granted in the magazines may be taken as a criterion, then it would appear that this fact has been known in theory only. I do not recall a single article wherein the writer made any mention of it. No one, apparently, seems to have thought it worthy of even passing consideration.

RADIATION FROM COILS IS POSSIBLE

TESTS made by the writer indicate quite conclusively that an oscillating receiver does not depend wholly upon the antenna system for radiation, but that the coils in the oscillating circuits can and do radiate, and that this radiated energy may carry for some distance, and certainly create interference within a reasonable area, the extent of which can only be vaguely guessed at.

This is quite logical; in the very nature of things it couldn't be otherwise. And those who are willing to grant the theory but at the same time claim that the energy radiated by a small coil, or coils, would be so infinitely little as to be incapable of causing any appreciable interference, will have to give the subject more serious consideration.

We have only to remember the tremendous distances being covered by members of the amateur transmitting fraternity to realize completely just what a vacuum tube is capable of. Only recently were we informed of the accomplishments of an amateur in British Columbia. This gentleman, using an ordinary receiving tube and less than three-hundred volts of B battery for the plate voltage, actually succeeded in establishing communication with a brother amateur in Australia!

Then again, one constantly hears of amateurs who, with receiving tubes and only ninety volts on the plate, get a range of from ten to twenty miles, with good, strong signals at the receiving end. And bear in mind that this is with ordinary receiving tubes.

Consider, then, is it not logical to suppose that a small coil, perhaps four inches in diameter and wound with a large size wire, connected in the grid circuit of an oscillating tube, or three such coils (as in a two-stage tuned radio-frequency amplifier), will also send out a certain amount of energy? Why not? They are, in effect, miniature loop antennas, and it is a well-known fact that it is possible to transmit over short distances with a loop. A small coil, such as is generally used in present-day receivers, would send out a very weak wave, and although on the lowly crystal set it would probably make no impression, with most sets of to-day capable of extremely high amplification, the matter takes on a greater significance. The fact that it is not solely the power used at a transmitting station which determines the range of that transmitter but also the degree of radio frequency amplification at the receiving end, has been amply demonstrated in other branches of radio transmission.

RESULTS OF ACTUAL EXPERIMENTS

WHEN broadcasting commenced on a large scale a few years ago, and it was found that oscillating receivers became miniature transmitters under certain conditions, and so caused interference to neighboring receiving sets, no one thought that these radiations could possibly carry for any great distance. The writer recalls an article published over three years ago wherein its author stated that "such a receiver may cause interference to other listeners-in within an area of several blocks."

To-day, it is a generally understood fact that this range is perhaps several miles; no one knows exactly. But we do know that it varies in direct proportion to the efficiency of the radiating receiver and the sensibility of the receiver picking up these radiations.

And so, when a sensitive receiver, such as a super-heterodyne, a neutrodyne, or a Roberts is being employed at the receiving end, the matter of radiation direct from the coils of another set in the neighborhood assumes a serious aspect. And as the art progresses and receiving sets are continually improved upon and made more and more efficient, likewise this side of the radiation nuisance will become more acute.

Reference was made above to some tests made pertaining to this class of radiation. Briefly, they were as follows.

Using an oscillating two-stage tuned radio frequency set with only forty-five volts on the plates of all tubes, and employing neitner an antenna nor a ground—the equivalent of the most efficient blocking device—the writer caused so much interference to a friend with a five-tube neutrodyne set located approximately one hundred feet away, that it was an absolute impossibility for him to enjoy a concert from a station twenty miles distant. This was also done with a four-tube Teledyne set, the only difference being that the shrieks and howls were not so loud. This, of course, was due to the fact that the detector alone was responsible for the interference since the radio frequency tube was not oscillating, whereas with the tuned radio frequency set, all three tubes were oscillating.

Pooh! you say, that's only one hundred feet. True enough. But the radiations, especially those from the r. f. set, were received by the neutrodyne with such intensity that it is safe to say that they carried for several blocks at the least. It is quite possible that they carried all over the city.

It is, therefore, not a very difficult thing to realize just what this would mean in a very congested district where every other house boasts an antenna and where there are several receivers in one apartment building. Even assuming that none of the receivers could radiate directly from their antennas, those which could be made to oscillate would still create sufficient interference to make the air unhealthy for, no one knows just how far.

The whole thing boils down to the fact that the oscillating receiver is the bugaboo of good reception. And as long as we have these receivers, or no means of positively preventing all forms of radiation from them, radio broadcasting is not going to attain its highest pinnacle of development. And while it would be difficult to advocate the abolition of the regenerative receiver altogether, at the same time it is to be sincerely hoped that a few of our great scientists will turn their attention to this subject with perhaps worth while results.

(It is apparent from Mr. Jolliffe's remarks that many of the receivers which are sold with an almost iron-clad guarantee to the effect that they will not radiate, are capable of doing so by means of their coils. On the strength of such guarantees as the above, many owners of receivers permit their sets to squeal during the process of tuning-in, blissfully ignorant of the fact that they can be seriously annoying their neighbors. It is hoped that this article has made clear to these listeners that even the so-called "non-radiating" receiver will cause interference if not handled with meticulous care.—The Editor.)

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., required by the Act of Congress of August 24, 1912, of RADIO BROADCAST, published monthly at Garden City, New York for April 1, 1926. State of New York, County of Nassau.

Before me, a Notary Public in and for the State and County aforesaid, personally appeared John J. Hessian, who, having been duly sworn according to law, deposes and says that he is the Assistant Treasurer of Doubleday, Page & Company, owners of Radio Broadcast and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: *Publisher*, Doubleday, Page & Co., Garden City, N. Y.; *Editor*, Willis Wing, Garden City, N. Y.; *Business Managers*, Doubleday, Page & Co., Garden City, N. Y.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent. or more of the total amount of stock should be given.) F. N. Doubleday, Garden City, N. Y.; Arthur W. Page, Garden City, N. Y.; S. A. Everitt, Garden City, N. Y.; Russell Doubleday, Garden City, N. Y.; Nelson Doubleday, Garden City, N. Y.; John J. Hessian, Garden City, N. Y.; Dorothy D. Babcock, Oyster Bay, N. Y.; Alice De Graff, Oyster Bay, N. Y.; Florence Van Wyck Doubleday, Oyster Bay, N. Y.; F. N. Doubleday, or Russell Doubleday, Trustee for Florence Van Wyck Doubleday, Garden City, N. Y.; Janet Doubleday, Glen Cove, N. Y.; W. Herbert Eaton, Garden City, N. Y.; W. F. Etherington, 50 E. 42nd St., N. Y. C.; S. A. Everitt or John J Hessian, Trustee for Josephine Everitt, Garden City, N. Y.; Henry L. Jones, 285 Madison Ave., N. Y. C.; Wm. J. Neal, Garden City, N. Y.; Daniel W. Nye, Garden City, N. Y.; Mollie H. Page, Syosset, N. Y.; E. French Strother, Garden City, N. Y.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) NONE.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is...... (This information is required from daily publications only.)

(*Signed*) DOUBLEDAY, PAGE & COMPANY
By John J. Hessian, *Asst. Treasurer.*

Sworn to and subscribed before me this 1st day of April, 1926.

[SEAL] (*Signed*) William W. Thornton
(My commission expires March 30, 1927.)

WHAT OUR READERS WRITE

Broadcasting in Australia

IN THE December issue of RADIO BROADCAST appeared a list of Australian broadcasting stations as forwarded to this magazine by Mr. A. W. Watt, editor of Australian *Wireless Weekly*. Apparently there have been some slight alterations in the list since its publication, as the following letter will make clear. It is from Mr. J. Malone, chief manager of the Wireless Branch of the Postmaster-General's Department of the Commonwealth of Australia. It reads as follows:

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

I notice in your December issue a reference to our Broadcasting Stations' wavelengths which contain some incorrect particulars. The wavelengths and powers of the stations listed on page 224 should read as follows:—

CALL SIGNAL	WAVELENGTH IN METERS	POWER IN WATTS
2 FC	1100	5000
2 BL	353	1500 (shortly to be increased to 5000)
3 LO	371	5000
3 AR	384	1500
5 CL	395	5000
6 WF	1250	5000
7 ZL	417	3000
4 QG	385	5000

We are at present considering the reallocation of the wavelengths, and there are likely to be some slight modifications to permit of a wider frequency band being employed.

Trusting you do not mind my correcting these slight inaccuracies.

Very truly yours.
J. MALONE,
Chief Manager, Telegraphs and Wireless
Melbourne, Australia.

From an Old-Timer

HERE is a letter from an old-timer in the "wireless" game who was attracted by Mr. Baskerville's article of his experiences which appeared in the May RADIO BROADCAST.

Editor, RADIO BROADCAST,
Doubleday, Page & Company,
Garden City, New York.

SIR:

I was carried back to old times by Mr. Baskerville's article in the current RADIO BROADCAST. It recalled the days in the service of the old United Wireless, at 42 Broadway, when I worked with Baskerville, Murphy, Hughes, and Gregg, for several years. I wonder where John Murphy is to-day?

It was a great life in those days, equipping a ship one day, the roof of the Waldorf Astoria the next, and then off to Key West to install a station. I well recall being given the job of equipping the *Olivette* and *Mascotte* when down at Key West. These had been Sampson's dispatch boats during the Spanish-American war, were very fast, top heavy, and great rollers. It fell to my lot to equip these vessels while on the trip between Key West and Havana, and it was the hardest job I ever tackled. The rolling of the ships necessitated frequent trips from the wireless room to the rail, while the dining room had little attraction.

One morning, upon my arrival at 42 Broadway, I was informed by Mr. Murphy that it was up to me to leave for Porto Rico on a steamer leaving New York in three hours, to install a station there, and to procure from the Insular government permission and land to build it on. I left the office and, with a small handgrip as my only baggage, caught the boat as she was casting off her lines. I never built the station at Porto Rico, however, for shortly after, the old "United" became a thing of the past. That little incident helps to show what kind of a life we fellows led though.

Yes, it certainly was a great life, coming into intimate contact with governors, generals, admirals, haughty captains, plain spiggotys, dockrats, and above all, being a member of that bunch of good fellows—the old United Wireless.

And now, as I write, WJZ is booming in. What a contrast to the old days when a readable spark from a 10-kilowatt transformer, sending from Key West to Havana, was hailed with satisfaction and which the operator generally received over an illicit electrolytic detector which Hughes knew nothing about.

Very truly yours,
A. A. Weiss,
Copperhill, Tennessee.

Our Laboratory Articles

QUITE a few letters come into the office following publication of Keith Henney's articles in this magazine, expressing, as a rule, unqualified appreciation, and often offering suggestions for future subjects. Here are two typical ones. The first is from the ex-operator of CNRO, while the second is from a prominent tube manufacturer.

Editor, Radio Broadcast,
Doubleday, Page & Company,
Garden City, New York.

Sir:

Just a line to say that the last issue of "our magazine" is a knockout. The expression "The Leading Radio Magazine" hardly covers it. I would very much like to see more of Keith Henney's work, such as that which appeared in the December Radio Broadcast. This is the finest way of holding interest in the radio game. I would like to see a department for the experimenter, covering coil resistance, capacity bridges, etc. Keep up the good work.

Very truly yours,
H. A. Harries (9 BG)
Westmount, Province of Quebec.

Perryman Electric Company
North Bergen, New Jersey

Editor, Radio Broadcast,
Doubleday, Page & Company,
Garden City, New York.

Sir:

I take this opportunity of complimenting you on Mr. Henney's article appearing in the February Radio Broadcast under the heading "How to Judge and Use Vacuum Tubes." Never before have I read an article that was so concise, precise, and simple in its technical detail. The ordinary layman can grasp its meaning and fully realize the importance stressed on the proper use of radio tubes.

Very truly yours,
George H. Perryman.

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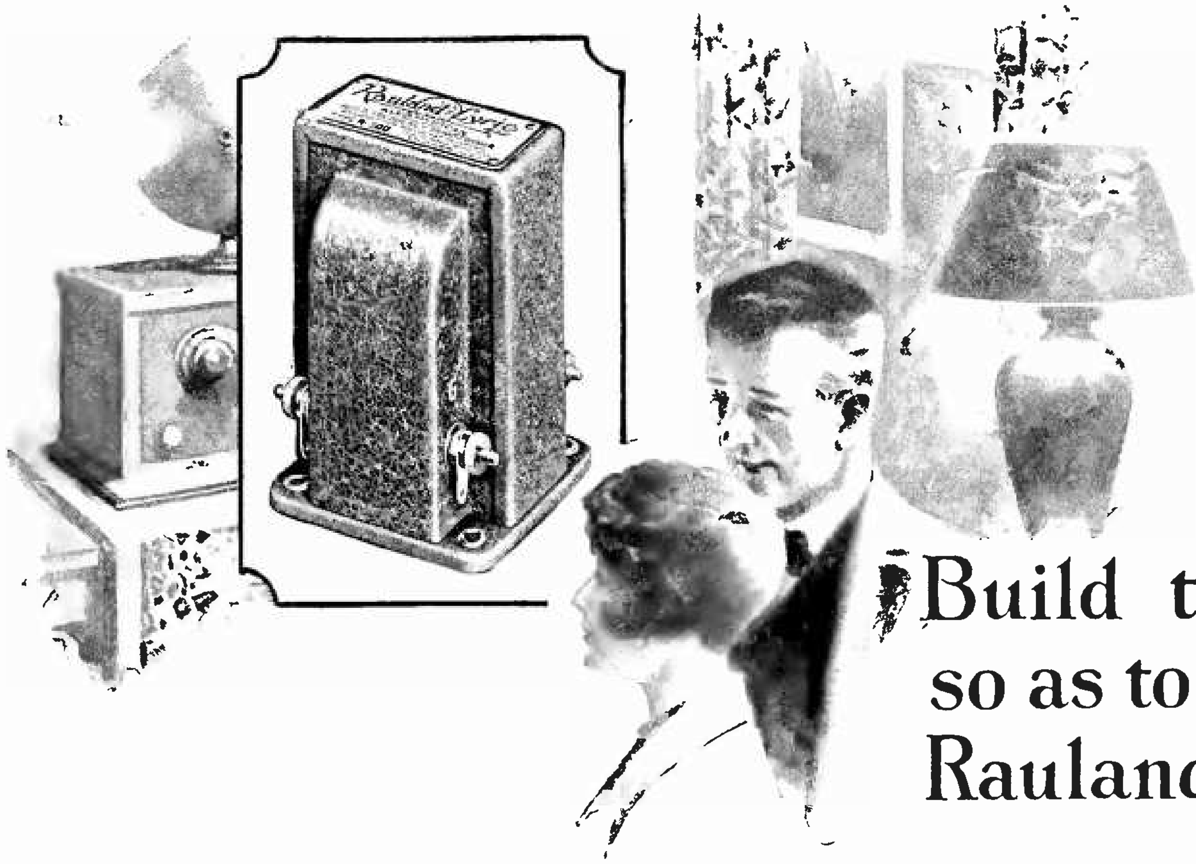

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