Radio Broadcast

ARTHUR H. LYNCH, EDITOR

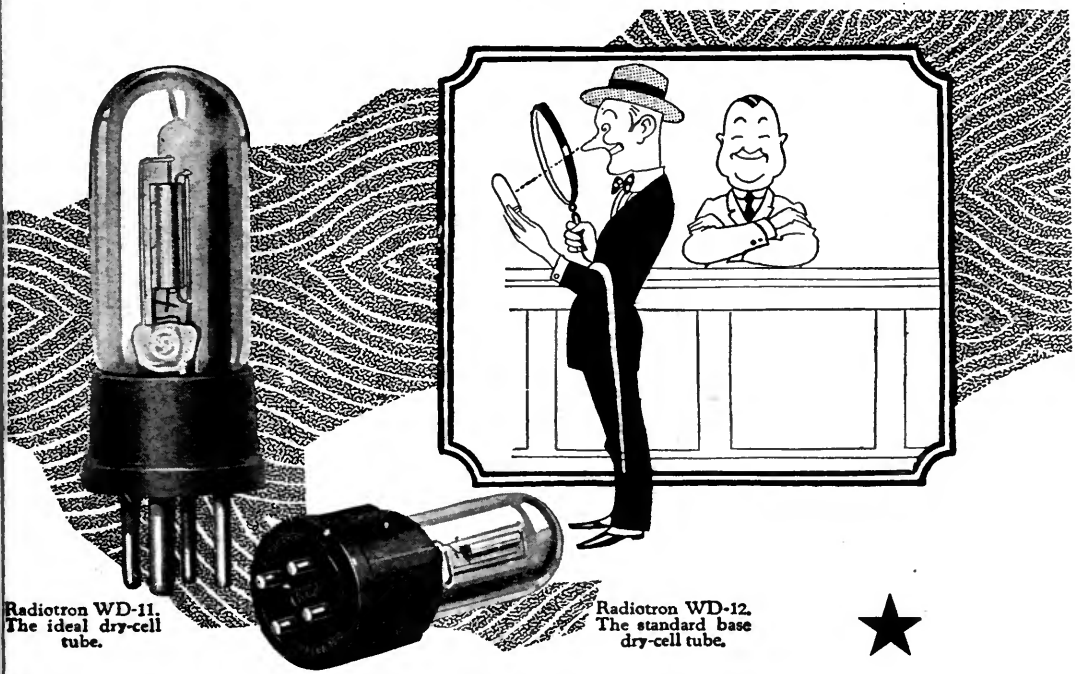
MARCH, 1925

F. N. DOUBLEDAY, *President* — NELSON DOUBLEDAY, *Vice-President* — S. A. EVERITT, *Treasurer*
ARTHUR W. PAGE, *Vice-President* — RUSSELL DOUBLEDAY, *Secretary* — JOHN J. HESSIAN, *Ass't. Treasurer*

Doubleday, Page & Co.
MAGAZINES
WORLD'S WORK
COUNTRY LIFE
GARDEN MAGAZINE & HOME BUILDER
RADIO BROADCAST
SHORT STORIES
EDUCATIONAL REVIEW
LE PETIT JOURNAL
EL ECO
THE FRONTIER

Doubleday, Page & Co.
BOOK SHOPS
NEW YORK: LORD & TAYLOR BOOK SHOP
PENNSYLVANIA TERMINAL ARCADE
LONG ISLAND TERMINAL ARCADE
38 WALL ST. AND 55 LIBERTY ST.
ST. LOUIS: 223 NORTH 8TH STREET
4914 MARYLAND AVENUE
KANSAS CITY: 920 GRAND AVENUE
TOLEDO: LASALLE & KOCH
CLEVELAND: HIGBEE CO.
NEWARK: 34 PARK PLACE

Doubleday, Page & Co.
OFFICES
GARDEN CITY, NEW YORK
NEW YORK: 120 WEST 32ND STREET
BOSTON: PARK SQUARE BUILDING
CHICAGO: PEOPLES GAS BUILDING
SANTA BARBARA, CALIFORNIA
LONDON: WM. HEINEMANN, LTD.
TORONTO: OXFORD UNIVERSITY PRESS



Radiotron WD-11. The ideal dry-cell tube.

Radiotron WD-12. The standard base dry-cell tube.

★

For *Distance* — the *tube* is important

Radiotrons WD-11 and WD-12 are the same except for the base.

Radiotron WD-12 has a standard navy type base. Use it to change your set to dry battery operation. Ask your dealer today.

Radio reception is not only a question of power, but of sensitivity to weak signals—and *clear* amplification. Radiotrons WD-11 and WD-12 are sensitive to the extremely feeble signals from distant stations—are silent in operation—and economical. They are famous for radio frequency amplification as for audio frequency—and detection. Get *genuine* WD-11's or WD-12's. Look for the name Radiotron and the RCA mark.

RCA

This symbol of quality is your protection

Radio Corporation of America

Sales Offices:

233 Broadway, New York — 10 So. La Salle St., Chicago, Ill.

28 Geary St., San Francisco, Cal.

Radiotron

REG. U. S. PAT. OFF.

★ Tested and approved by RADIO BROADCAST ★

THE PRINCIPALS IN A BIT OF HISTORIC BROADCASTING

The top photograph was taken in the studio of WEAF, *New York, on the evening of January 1 when two recording artists of the Victor Talking Machine Company, broadcast through a chain of eight stations. The Victor Company, through its New Year's night broadcasting, is the latest of the large phonograph companies to allow its stars to broadcast. Several weeks before, the Brunswick Company allowed a number of its own recording artists, members of the Metropolitan Opera Company, to broadcast. Calvin Childs of the Victor Company, Lucrezia Bori of the Metropolitan Opera Company, Gwendolyn McCormack, (daughter of John McCormack), and John McCormack are in the upper photograph. The insert shows Graham McNamee who capably announced the event*

RADIO BROADCAST

Vol. 6, No. 5 March, 1925

New Fields for Radio

The Next Will Be a "War in the Air"—A Consideration of the Possibilities that Radio Has Brought About

By D. C. WILKERSON

IT WAS almost inevitable that such an art as radio—for so is the science of radio now classified—with so many new and undeveloped channels for expression, would carve a way into the rank of indispensable resources for national protection and aggression.

In the late World War, the pressure of combat was so tremendous and immediate that a leisurely investigation of the possibilities of radio was impossible, and it was only during the latter days of the war that the full measure of its advantages were practically realized.

At the beginning, there were few vacuum tubes in use by either of the Allied or Central Power field or naval forces. This De Forest invention had not received the attention nor had it been developed enough through experiment to make it a worth-while adjunct to military intelligence. The two-electrode Fleming valve up to 1914 had enjoyed considerable vogue, but it was unstable, and was regarded more as a laboratory toy than a practicable work-a-day device.

The French, Italian, German, and English electrical engineers, under the incessant demands for better and more reliable means for establishing and maintaining radio communication in the surges and stress of the battle front, started developing the vacuum tube with a vengeance, and by the time that the United States entered the war in 1917, had covered considerable ground in the development of the vacuum tube. Parallel with foreign efforts in this direction, the Western Electric, General Electric, Westinghouse, De Forest, and Bell Telephone engineers were beginning to produce real results with the three-element tube and they had made for the United States Government a fairly stable and reliable product.

—Photograph Courtesy U. S. Air Service

CLUMSY AËRIAL ELEPHANTS

Such as this "blimp" will be easy prey for the radio-controlled airplane, equipped with incendiary bombs or bullets

The vigorous plunge of our forces into the front line trenches rekindled the enthusiasm of

the Allies, and the liaison established between the practical engineers of the above mentioned companies and those of the nations aligned against the Central Powers, brought about quick changes and some real advances.

At the close of the War, the reputation of the vacuum tube had advanced to a high plane. As a means for radio reception it had proved its excellence, and its use as an oscillator and a transmitting agent had begun in earnest. Its use as a generator enabled many of the front line engineers to "get the jump" on many a zero-hour attack by the Germans, and it also served as an excellent "scrambler" for the German attempts to maintain radio communication at the front.

Following the rapid development of the vacuum tube itself came the circuits designed to use it. Some of these were the reflex, the super-heterodyne, the super-regenerator, and the neutrodyne. All of these helped attain greater selectivity, hence a greater degree of secrecy in communication. Later, have come the circuits of Meissner, the junior Hammond, and Senator Marconi.

PEACE-TIME ADVANCES AID WAR

IN EVERY case where peace-time advances are being made in the radio art, that development has a place among the resources for war. For ten or twelve years a tremendous amount of laboratory and experimental work has been done toward achieving a practical control of distant mechanisms by means of radio waves. In the United States Patent Office are anywhere from two to three hundred patents all bearing on this branch of the art, and probably three or four times as many applications not yet passed upon by the government staff of experts, as patentable.

The proposition of distant control has many peace time uses. Railroad train cab-signal and control mechanisms can be operated by means of radio. Great unit power plants located at distant points from the zone of power delivery are going to require some means of radio communication and control. Our coast-line lighthouses and beacons are going to figure in a radio control development. In the near future, the transcontinental air mail will require radio tell-tales, showing positions of mail carrying units at some central point, as the volume of business by air mail requires a more complex control and intelligence system than its present incomplete development allows. In the event of aërial passenger and freight movement of any consequence there will be an immediate need for practical intelligence and control mediums.

Certainly in time of war, the nation which is able to keep in the air, and control the flight of mechanical engines of death will be able to sway the tides of combat in its favor.

A recent dispatch from England told that the Royal Aircraft Forces there are making

MASON M. PATRICK

Major General, United States Army, Chief of Air Service

Since the War, the great advance in the development of radio has been followed with interest by the Army Air Service. It affords a rapid and accurate means of communication between forces behind the guns, on the land, sea, and in the air. Experiments have proved that airplanes can be operated by radio without pilots on board them. *It is believed to be possible that a number of airplanes may thus be directed and controlled from a single plane or from a control station, guided on their course and that from them bombs may be dropped when the attacking plane is over its target. Aërial torpedoes may likewise be made to find their mark. While great progress has been and continues to be made in this method of distant control of war machines, there seems to be likewise a further large field for experiment in hampering or preventing the radio operation of these engines of destruction and it is possible that this may tend to a still further radio development.*

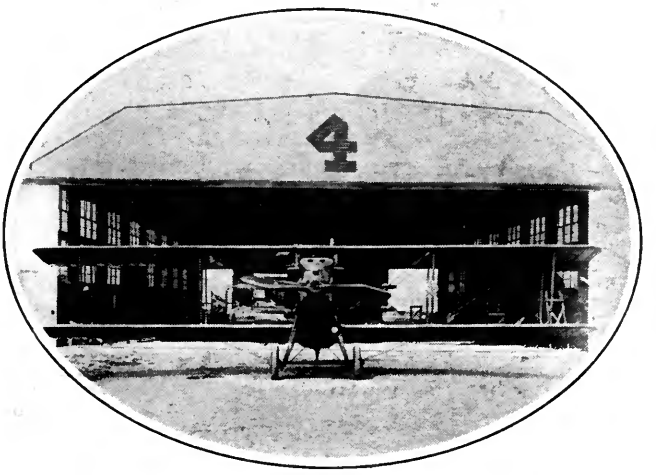
I am interested and glad to note the stimulative effect of the publication of articles and data of this character by such magazines of the excellent quality of RADIO BROADCAST.

great progress in the control of pilotless planes controlled by wireless waves. In the same dispatch it was stated that the launching of aërial torpedoes or "winged bombs" was being attempted and that some measure of success in control of their flight over a limited distance was accomplished.

These military developments are naturally shrouded in mystery, protected with every artifice of secrecy available. Without doubt, every modern nation is participating in experimental work of this class, for the overwhelming tactical advantage of success in this field would weigh heavy should another international war break out once more.

ARMY OFFICERS ARE SANGUINE

MAJOR-GENERAL MASON M. PATRICK, Chief of the U. S. Army Air Service, in an address before the Franklin Institute at the occasion of the recent celebration of the centenary of that organization stated to that distinguished assembly that the Army already had an "automatic pilot" device which flies airplanes without anyone aboard. He added that the step toward radio control was but a short one. He also said that he expected within a short time to see our military forces flying whole fleets of these planes, operated by a few men in a central control station. These fleets could be maneuvered to carry on attack against enemy cities and military units.



— Photograph Courtesy U. S. Air Service

WILL PLANE SUCH AS THIS, RADIO-CONTROLLED, MAKE FRONT LINE TRENCHES UNTENABLE?

At the same meeting, Major-General George O. Squier, late Chief Signal Officer of the Army expressed his belief that within a short time, "manless planes" carrying sleep-producing gases sufficient to put to sleep a whole nation for forty-eight hours, could be sent into action as a means for stalemating war.

Such startling predictions by conservative military men are most worthy of consideration, but thus far none have touched upon the further developments which must follow the practical achievement of mechanical flight. The success of the radio-controlled aërial torpedo guarantees the parallel success of the radio-controlled bombing plane, the gas spreader, the reconnaisance camera plane, and the combat plane. The operating technique of the one lends itself readily to the control of the other.

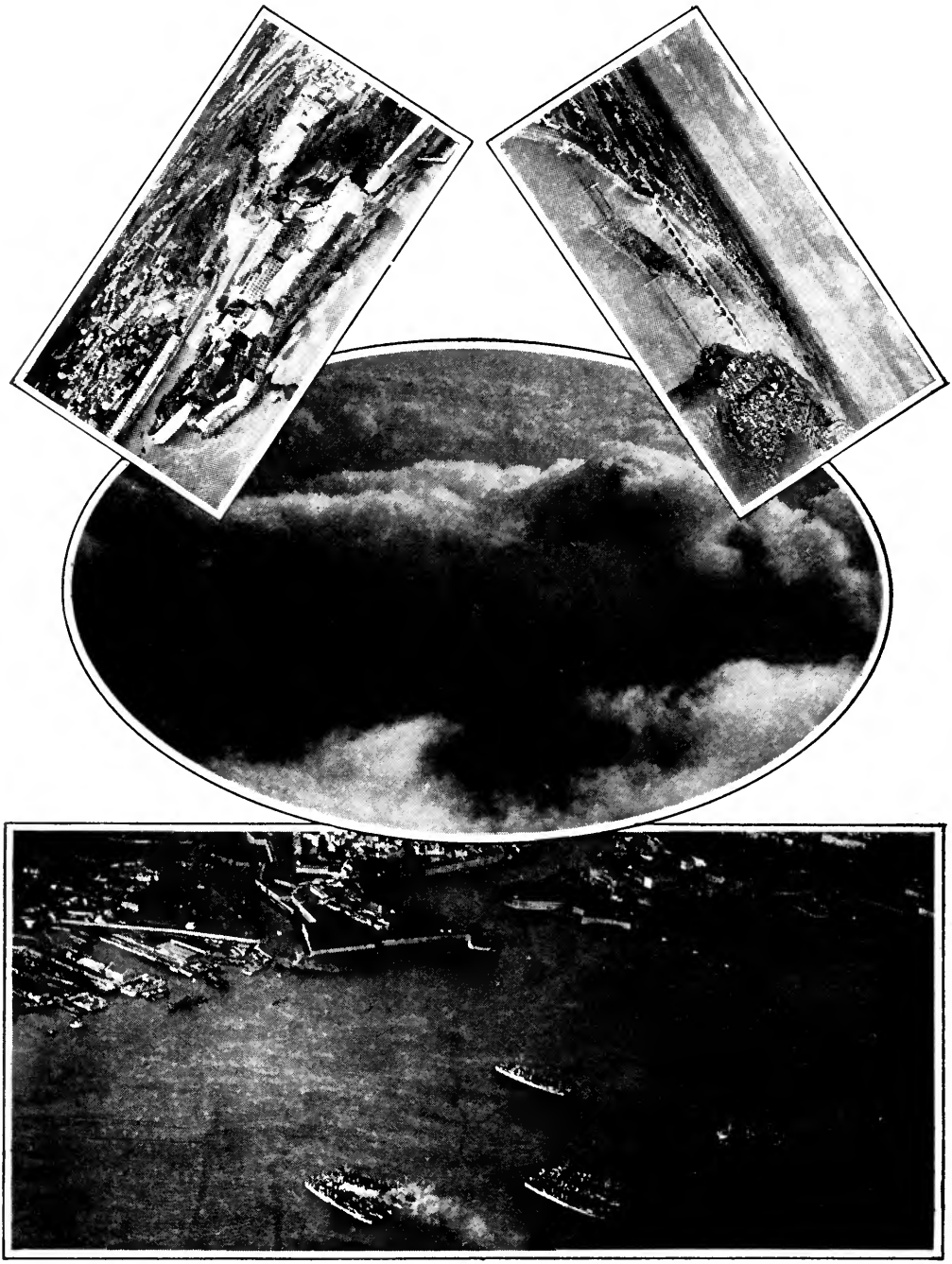
With the development of lighter-than-air gases of poisonous nature, for repelling aërial reconnaisance and attack, and with the proper development of anti-aircraft barrage fire, the predicted mortality of flyers and pilots will be higher than in any previous war.

In addition to the estimated government investment loss of $25,000 for every pilot killed while flying, the lost benefits of his services amount to even larger figures. A live, trained pilot is worth considerably more than the cost of his training. The perfection of radio-controlled mechanical flight means a saving of seasoned flyers for more important uses, which cannot be furnished by automatic pilots.

Entirely aside from the Army developments, the Navy is working with radio-control. The Navy needs the automatic pilot and the controlled-flight airplane for a hundred different purposes.

WHAT THE NAVY NEEDS

IT WILL have to protect its battleship and battle cruiser fleet without which there are no bases from which to conduct flights. It will have to produce aërial smoke-screens, to conduct raids against attacking lighter-than-air and heavier-than-air bombing fleets, and to serve as the extended "eyes" of the fleet, to guarantee against inefficient position maneuvering. The latter can prove very disastrous, as the battle of Jutland so clearly demonstrated.



—Photographs Courtesy U. S. Air Service

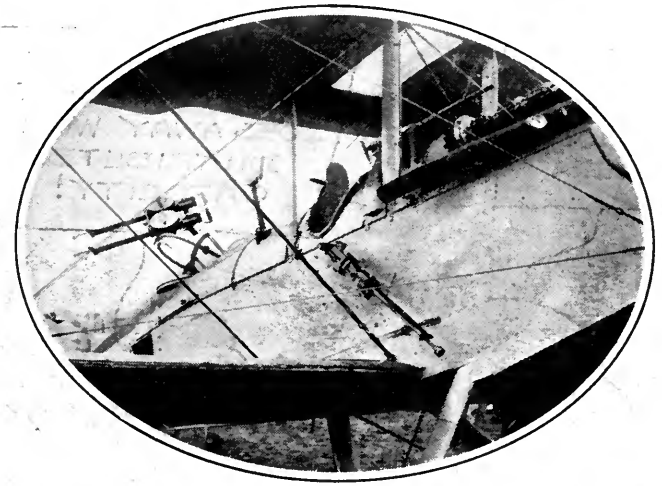
CLOUD BANKS CAN HOLD NO TERRORS FOR THE RADIO-CONTROLLED PLANE

The radio-controlled camera plane could be utilized to take aërial photographs such as these and return them safely to headquarters with valuable data on enemy forces. These shown here were all taken in the regular manner by the Army Air Service photographers in France during the War

Radio-controlled mechanism can be called on to conduct underwater attack, to maneuver torpedoes to their destination, and to make whole mine fields "live", when, for instance, a fleet retreat is required to be "covered," by newly sown mines.

Another new use of the radio control mechanism will be its application in penetrating enemy mine fields. During the late war there was devised and used by the British Navy an invention known as the "paravane," or "otter gear." A ship thus equipped was able to steam right through an enemy mine field, and provided it did not strike a mine bow-on, the otter gear, swinging out from its side, armed with huge steel jaws, snipped the anchor cable of any mine encountered. The mine, then released from its anchoring weight, bobbed harmlessly to the surface, where it was detonated by watchful guards placed along the decks with rifles.

Steel underwater sharks, entirely radio-controlled, could easily be equipped with "otter gear," and can cut swaths through a mine field so that attacking ships can steam to enemy ports. An enemy zone can be placed in such condition that no enemy ships can maneuver there because of the danger from their own mines to their own ships.



—Photograph Courtesy U. S. Air Service

THE PROMISE OF A THREAT

Is dimly concealed in the armament of this airplane. It is theoretically possible to control the firing of the guns and releasing of bombs as well as to guide the flight of an airplane equipped for radio control

IMPORTANT APPLICATIONS OF RADIO CONTROL

NOT the least important among the developments hinging upon the successful completion of the distant control of mechanisms by radio, is the handling of decoy aërial fleets, and decoy battleships. It is a known fact that the British Admiralty completely fooled the German scout submarine commanders when they built facsimile copies of the superstructures of the Grand Fleet on the discarded hulls of pre-dreadnaught ships, and operating these decoy ships in waters far removed from the location of the Grand Fleet in Scapa Flow. There will always be a need for decoy vessels of the sea as well as of the air, and their operation will adapt itself quite well to radio control mechanisms. The U. S. S. *Iowa* was maneuvered by rudimentary radio control apparatus in battle evolutions three years ago.

With radio-control, it will be quite feasible to deploy great squadrons of tanks in concentrated battle front, to batter a hole in a dangerous sector.

Mechanical land mines, underground gas bombs, incendiary flares, and short-distance catapulted detonating devices containing all three of these elements lend themselves to control by radio. An occupied area about to be abandoned, can be rendered absolutely untenable for long periods of time by intermittent explosions controlled by radio from a distant point.

At recent frequent intervals, some very interesting stories of ammunition magazine explosions and disastrous fires caused by radio waves have appeared in the press. Many of the soundest scientists refuse to credit theories of that sort. People in general have ceased to wonder at the miracles of radio, and expect much greater marvels than the art to-day is capable of attaining. This blasé attitude has restrained radio progress to some degree. It may be that powerful transmitting stations, broadcasting radio waves of high frequency, can cause currents to flow in external circuits in such a way that sparks are produced of sufficient strength to do damage. However, when one considers the thousands of circuits, telephones, telegraph wires, and house-lighting, immediately adjacent to these powerful transmitting stations it is not hard to assume that

radio energy, picked up from some powerful transmitting station, would burn out such circuits, or else seriously disturb their normal operation. This does not seem to be the case, and it can be inferred, if no better proof is available, that these stories of ammunition explosions are purely imaginary.

More to the point, and far closer to realization, is the imminent completion of successful aërial flight controlled by radio and mechanical means as outlined and as noted by the authorities quoted here. Whether or not these means now being developed will find their first practical use in the arts of peace or in the arts of war remains a question that only the future can answer. We only know that the means are available, that the energies of governments and of many private individuals are being directed toward the rapid solution of the problems presented, and that so far a fair measure of success has rewarded these efforts.

The wonders and mysteries wrapped in the radio art are gradually, but nevertheless surely, being unfolded, and the hand and mind of man are making use of their solution in ever widening circles of industrial, economical, social, and military activity.

OBSERVATIONS OF THE RADIO LIFE: NO. I

Selecting a B-Battery Eliminator

What to Consider in Buying a B-Battery Subsitute—A Helpful Discussion of Moot Points of Economy, Operation, and Value

By PHIL FAY

SO MANY different kinds of current tap devices, widely varying in price and operating characteristics, have been offered the public, that a prospective purchaser, uninitiated in the technical phases of radio and electrical engineering, finds it difficult to make a choice. The usual recourse—that of consulting a friend who has one—is rarely available in the case of the current tap devices because few or none of the manufacturers have yet reached a volume of production which is very great.

To secure satisfaction, it is absolutely necessary to select a B-battery eliminator which is adapted to your particular set and power circuit. A current tap device suited for use with a three-tube set frequently gives about as good service with a five-tube receiver as a bicycle tire with a Ford car.

A further complication is added to the situation by reason of the fact that radio salesmen are not yet sufficiently experienced with these devices to make sound recommendations. If the binding post on a current tap device reads 100 volts, they unhesitatingly state that its output is 100 volts, while as a matter of fact, with some current tap devices it may vary between 40 and 275 volts, according to the set with which it is used. Hence the prospective purchaser will do well to make a little study of the subject before making an investment as large as one for the average receiving set, lest he find his purchase a liability rather than an asset.

In general, there are four qualities to consider, which determine the value of a current tap device to its user. They are:

1. The degree of silence with which it operates
2. The life of rectifier tubes and their upkeep cost
3. Its adaptability to different types of receiving sets, and
4. Its safety with respect to shock and fire.

Batteries and Battery Eliminators

The storage battery has been in use for a long time in lighting the filaments of radio receiver tubes. This secondary source of energy in fact has been used for that purpose ever since the vacuum tube was invented. More recently, however, the storage battery has been used as a source of plate potential with considerable success. The storage batteries which were used with tubes were for a long time simply those designed and used for lighting and automobile ignition purposes, but such batteries have their shortcomings. New storage cells have been designed especially for radio circuits and are to be had on the open market.

The public has heard much and so far seen little of the devices designed and sold to replace batteries. Most prospective users are timid about purchasing these devices because they are not sure that they will perform as well as batteries. Mr. Fay's article is of genuine interest and contains facts which have been found after actual test of the various methods of voltage supply for tubes.

—The Editor.

SILENCE IS GOLDEN AND DESIRABLE

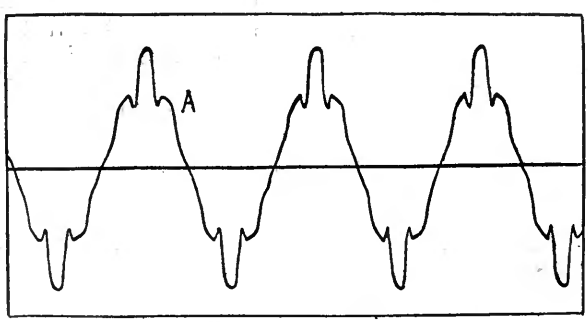
THE first quality of a current tap device which you must verify is the silence with which it operates. At first sight, this may appear to be a simple matter—a few moments of listening at a radio store. A purchaser may conclude that a certain device is silent because it was demonstrated to his satisfaction, but upon connecting it up at his home, he may find it extremely noisy. Often the dealer or manufacturer is then accused in the mind of the purchaser of having a demonstrator superior to the product sold to purchasers. But this is quite unfair to dealer and manufacturer. A current tap device which may work perfectly in one electric circuit may be entirely unsatisfactory in another because of difference in its electrical qualities. The general impression that all 110 volt 60 cycle alternating current is

electrically identical, no matter where secured, is unfortunately erroneous.

There are many differences between one power circuit and another. First, there are wide variations in voltage at different hours of the day and night ranging between 100 and 120 volts. These are not noticeable in the brilliancy of electric lights or in the operation of ordinary household equipment, largely because this apparatus unlike radio equipment, is not especially sensitive to voltage variations of this amount. In a current tap supplying a radio set line voltage differences are of the utmost importance.

Another factor, which enters into the matter of successful current tap operation in one's particular location, is the voltage wave form delivered by the generating system supplying the alternating current. The theoretical sine wave, with its smooth variations, is a laboratory product only; alternators supplying power lines have individual characteristics which cause humps of differing intensity, to occur in the voltage at harmonics of the 60 cycle frequency. Engineers state that no two generators have ever been built that have precisely the same voltage curve and that an expert can recognize the wave form of a particular generator with the same degree of accuracy that a detective identifies the criminal by his finger print.

Such variations in wave form have no effect upon the ordinary loads, such as motors and electric lights, but a vacuum tube rectifier is so highly responsive to these digressions from the sine wave, which often assume proportions larger than the voltages induced in the antenna system by strong incoming signals, that satisfactory reception with the current tap may be impossible. Consequently, one current tap device, silent when supplied from one light socket, may be objectionably noisy in another.



THE OUTPUT OF A COMMERCIAL ALTERNATOR
Installed in the average power house which furnishes the alternating current used for house lighting and power purposes

POWER TRANSFORMERS AFFECT CURRENT

ANOTHER important cause of changes in wave form are those due to saturation of the iron core of transformers placed along the line to step down the line voltage to the value required by consumers. At certain loads, this effect may accentuate harmonics to a surprising degree, while at other hours and loads, they may fall to a point where they are not annoying. Hence a discriminating purchaser will not only test a current tap in his own home but will continue it over a sufficiently extended period to make certain that it will give satisfaction at all loads and conditions of his power circuit. Because of the newness of current tap devices, many dealers are willing to permit such a test and to refund the purchase price if satisfaction is not secured in your home.

These considerations with respect to variations in power supply should not lead the reader to conclude hastily that a current tap device cannot be made to work. If it is provided with suitable adjustable inductances, capacities and resistances, its characteristics may be adapted to these constantly changing conditions.

In judging the effectiveness of a current tap device in your particular location, it is also necessary to remember that power lines are excellent conductors of currents of radio frequency, as evidenced by the successful development of antenna plugs for use in place of aerials, and the transmission of radio programs over power lines, by the "wired wireless" method.

Those who live in or adjacent to buildings having elevators or electric motors have frequently heard the annoying hum which is radiated from the power lines and picked up by the antenna system. In some cases, it is necessary to wait for the offending elevator to complete its trip before satisfactory reception, even from local stations, can be secured. When using a current tap device you make a direct connection with the power conductors supplying such elevator motors, amplifying the resulting noises through vacuum tubes and feeding them to the most sensitive circuits of your receiving set. The interfering noises from such sources are therefore tremendously increased. Every time a light is switched on and off in the building, a decided click is heard, although noise from

this source is not nearly as annoying as that from high speed motors.

DISTORTION ON HARMONICS OF POWER SUPPLY

WHEN loud speaker reception is attempted, the faint residual hum heard with the current tap device is not annoying. Usually the signals from local stations are considerably stronger than the residual hum. Quality of reception is affected only upon harmonics—that is, in the case of 60 cycle current, 120,180,240,300 cycles, and so on. At these frequencies, the volume is somewhat louder than normal because the signal is reinforced by the pulsations in the power line. Thus if a scale is played at the same intensity at the broadcasting station, your receiver will respond at the same intensity, excepting at these harmonic frequencies, which will be increased in proportion to the residual hum and the amplification applied. The difference between this distortion and that produced by a poorly designed amplifying transformer is that the resonant points in the former case are very sharp, while with the latter they are quite gradual and cover wider frequency bands.

Even the best of current tap devices, entirely satisfactory for local reception, cause considerable noise where the amplification level is raised. Since local reception is the principal use to which receiving sets are put, a slight residual hum is not serious. But as soon as the amplification level is raised for the reception of distant stations, the hum increases. When a device is demonstrated connected to a receiver, it is advisable to increase tickler coupling or filament brilliancy so that maximum amplification is obtained. This will protect you against a device which is only suitable for reception from near by high power stations.

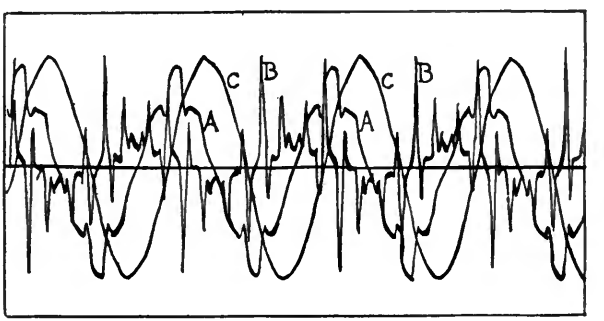
UPKEEP EXPENSE WITH THE CURRENT TAP

INASMUCH as the current tap device is purchased in order to eliminate B battery expense, the purchaser must be certain that the current tap device will prove an economy. If a current tap is suited to the load for which it is used, there is no reason why it should not be economical. On the other hand, tube renewals, with a poorly designed current tap device, may be several times the cost of B batteries of good quality and of the current capacity for your receiver.

Overloading a vacuum tube is fatal to its life. Life tests have shown that a *5 per cent. overload in filament voltage may cut in half the life of a tube*, which practically doubles the cost of maintenance. This condition can be overcome in a current tap, if means be provided to control the filament voltage of the rectifier tubes. By all means select a current tap device which is equipped with means of controlling the filament voltage, for without it economy is quite impossible. It may appear that a properly designed current tap supplies the tubes with the correct filament voltage without requiring adjustment, but this, unfortunately, is not the case.

Assume that you have a current tap designed to furnish exactly five volts to the rectifier at 110 volts of current supply. In the early evening hours when there is the heaviest drain on power supply, it is usual that the supply drops to 105 volts and consequently, the rectifier filaments are being furnished with only 4.56 volts—a considerable underload. This permits of maximum filament life. But by 10.30 P. M., the voltage of the power line is likely to increase to 120 volts, because the load upon it has decreased. It is characteristic of power systems that as the load falls the voltage increases. Consequently there are constant fluctuations in line voltage at all hours of the day and night.

At 120 volts, the filament supply is 5.45 volts, or approximately 10 per cent. overload, *sufficient with most tubes to cut their*



THE EFFECT

Of inductive and capacity loads on the regulation curve of a typical commercial power house alternator. These loads are such demands as are ordinarily made by normal power-consuming devices. The variation in voltage is clearly indicated. These varying demands result in an uneven voltage being delivered to the power-consuming device. This effect is not serious with the incandescent lamp and the usual household device, but the accompanying article shows its effect on a radio receiver using battery eliminators

life to one fourth. Hence, no matter how conscientious the manufacturer, he cannot make a current tap suitable to all conditions, unless it is equipped with a filament voltmeter and means of regulating the voltage supplied to the rectifier tube filaments. A device which works perfectly under laboratory conditions may in your service completely belie all life and silence tests. In order to increase output, many current taps are so designed that even with normal voltage the filaments are considerably overloaded and operation on increased voltages, which obtain late at night, make tube life a matter of hours instead of hundreds or thousands of hours.

OVERLOADING FILAMENTS IS EXPENSIVE

THERE is a basis which permits the elimination of certain current taps without further investigation by reason of the fact that their tube equipment is such that it is under no circumstances economical. A current tap equipped with UV–201–A tubes has a definite limit to economical output. To quote John F. Rider, a radio writer in "The Laboratory Scrap Book," New York *Sun* Radio Section, Oct. 18, 1924:

> The 201–A tube has often been recommended for the rectifying medium in B battery eliminators. Unfortunately, however, while it does function as a rectifier and may be utilized as such, its current output is so limited that its application to this type of work is very poor—that is, if one is desirous of utilizing the unit in conjunction with a multi-tube receiver.
>
> In order that the B battery eliminator may be a success, it is necessary that its current output be at least twice the total possible current drain of the tubes used in the receiver with the maximum plate voltage applied. Having both equal is impractical, as a strong signal will increase the drain beyond the normal value, and the moment the drain is in excess of the supply the voltage of the latter will undergo a considerable drop.
>
> The current output of the average 201–A tube when used as a rectifier and arranged so as to supply about 120 volts is about 20 to 22 milliamperes. With several tubes which were tested the maximum rectified current was only 18 milliamperes. In addition, it was necessary to maintain the filament brilliancy above the value specified by the manufacturer, thus greatly decreasing the life of the tube. To attempt to use a rectifying arrangement of this type with a receiver that draws 30 or more milliamperes is out of the question, hence it is necessary somehow to increase the current output of the B battery eliminator.

It may appear at first sight that the use of two tubes (as is done on practically all devices) may double the output. But indeed this is not the case, for one tube functions during one half of the cycle and the other tube during the other half. A five-tube set, for instance, may draw as high as 25 milliamperes, and consequently a supply of 18 milliamperes, which is the maximum output, even with considerable overloading, that UV–201–A tubes can be expected to deliver, it is quite out of the question that satisfactory results may be had. The total output must be at least 30 milliamperes, or else there will be distortion in the received signal.

Another type of tube which is sometimes used by experimenters, is the Tungar rectifier, familiar through its use in battery charging devices. This device is designed to supply a heavy current at low voltages. It is not a high vacuum tube but filled with a gas that is easily ionized so that it can become a conductor of considerable current. Consequently when it is used with excessive voltages it has the unstable characteristics of gas tubes and the effect on the life of the filament is disastrous.

"S" tubes do not have any of these disadvantages. However, they are designed for use with radio transmitters to deliver high voltages and small currents. A current tap made with s tubes is likely to overload the receiving set unless extraordinary precautions are used. A very high voltage is necessary to make these tubes work and it is not wise for the novice to wear headphones so intimately associated with an s tube requiring 750 volts as plate potential. Damage to the set may be repaired but ear drums are irreplaceable.

ADAPTABILITY OF THE CURRENT TAP DEVICE

SO FAR, we have seen that a current tap device must be suited to power line conditions and that the tubes must be able to supply the necessary output. These conditions can be met through the selection of a current tap device of the proper characteristics. The third condition—adaptability to your particular set—can be met in the same way. But the user must keep in mind the fact that the same device will not work with the same satisfaction with all other receivers. Inasmuch as there is a comparatively large investment involved in the purchase of a current tap, it is essential it give service over a period of years. For instance, an economical five-tube receiver used 500 hours a year can be supplied with B batteries for five years for $75.00 if heavy duty batteries be used. A current tap costing $50.00 suited to the load so

that the tubes last fully a year, would require 4 renewals at $8.00 each, or $32.00, making a total cost for equipment and tubes for five years of $82.00. Hence, assuming economical upkeep for the current tap, five years must pass before the expenditure for the eliminator becomes less than that necessary for B batteries. You must be sure that your present receiving set with the present type of tubes will satisfy your requirements for a period of at least five years. Otherwise B batteries will serve you better than a current tap device.

The reason that a B battery eliminator is not adapted to different kinds of sets is that its voltage output varies with *the load which is drawn from it.* For instance, a certain current tap device was measured under varying conditions of load, without change of the voltage in the current supply from the power mains. At 1 milliampere it furnished 180 volts of plate current; as the load increased to 15.5 milliamperes, the voltage fell to 90; at 25 milliamperes, the average drain of a five-tube set, the voltage furnished was but 40 and at 32 milliamperes, the voltage was zero. On the second stage of amplification, the voltage was too low to give the best results and the load so near the peak output that the distortion was noticeable.

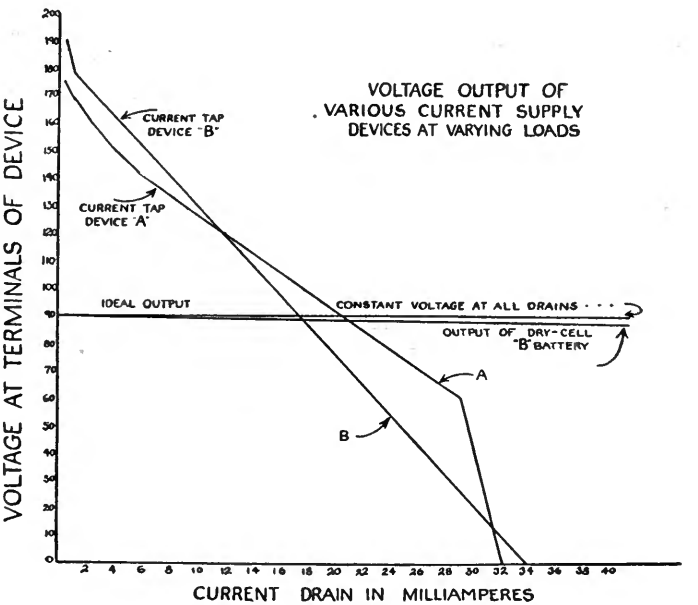
This particular device gave 100 volts plate supply at 13 milliamperes which is a good output for an economical four-tube set using UV–201–A tubes.

In selecting a current tap device, therefore, measure its voltage when supplying the plate current needed for your set. If this falls somewhat below the rated voltage of the device, select another make of current tap which is better suited to your requirements.

FACTOR OF SAFETY

NATURALLY, there is a little hesitancy on the part of those not accustomed to dealing with high power electric mains to connect a pair of headphones, directly or indirectly, with a source of kilowatts of energy. A well designed current tap device having insulated binding posts and concealed wiring, exposes its user almost to no danger, except when one turns the lighting current on and off. If you turn off the filaments of your receiving set with the current tap device still in operation, all load is of course removed from it. The output of the rectifier tubes is merely supplied to the condensers and inductances which form the filter of the current tap device and high voltages are quickly built up, unless the output terminals of the tap are short circuited by a resistance through which these voltages may leak off. Some devices are so equipped; others are not. If, after having turned off the tubes of the receiving set, your next act is to turn off the electric light switch supplying the current tap, this charge remains in the filter condenser, seeking a place to discharge. Then, if you proceed to change the wiring of your receiving set or touch the B battery binding posts, you will have an excellent opportunity to test the effect of a high voltage upon your system.

A simple precaution, however, will practically eliminate this danger. First, always turn off the current tap from the power mains *with the receiving set in operation.* Be certain that you and all the members of your family understand this. Second, short circuit the output mains, *after turning off the supply mains,* before you touch the wiring of your set. In



A CURVE

Which shows the voltage output of various current supply devices (B battery eliminators) plotted against the current drain caused by a receiver in milliamperes

this way, you will avoid the danger of shock.

Another source of danger in the current tap is fire due to overheating. Never operate a current tap device without someone in the room. When current taps were first placed on the market, life tests were made at a laboratory and one of these devices was left on all night. A fire which did several thousand dollars damage resulted. Had someone been there, warning through fusing wires would have been given in time to turn off the device.

A well designed current tap device presents none of these dangers. You can determine this for yourself by looking for the stamp "Approved by the Board of Fire Underwriters" on the device which you select. This mark appears on every piece of apparatus which has been inspected and approved by the board as safe for household use. There are scores of well-known manufacturers of household apparatus. Select a current tap made by one of these, for they have learned the results of placing unsafe apparatus on the market by painful experience.

The convenience of having plate potential always available is certainly worth a little care in the selection of a current tap device.

Satisfy yourself on these points and you will find your investment justified:

1. Is the current tap device silent when connected with *my* receiving set *in my own home?*
2. Does it use tubes capable of furnishing the current which *my set* requires with economy in tube renewal?
3. Is there means of regulating the voltage input of the device so as to compensate for the variations in power supply?
4. What voltage does the current tap device supply to *my set* and is it sufficient to give good results and not too high to be a source of danger when connected with headphones?
5. Is the current tap device approved by the Board of Fire Underwriters?

RADIO PERFORMERS IN PERSON

At a children's hospital. The Radio Franks, who are well known to radio listeners went to perform in person for these crippled children, who before had only known them as voices over the air

Who Is to Pay for Broadcasting—and How

The Plan Which Won RADIO BROADCAST'S Prize of $500 Offered for the Most Practicable and Workable Solution of a Difficult Problem

BY H. D. KELLOGG, JR.

RADIO broadcasting, to be placed on a sound economic basis, must pay its way as do other forms of entertainment. It should be paid because of, and in proportion to, the value of the entertainment provided. And the payment should be made by the consumer, that is, the owner of the receiving set.

Under present conditions, what is entertainment for the radio fan is a subtle source of advertising, in the great majority of cases, for the broadcasting station. And advertising foots the bill. This inconsistency between the purpose of the broadcaster and the radio listener, and the differential between the source of payment and the actual consumer, has led to recognition of the fact that the economic foundation for broadcasting must be rearranged.

While it is apparent that a certain proportion of the expense of present-day broadcasting can continue to be borne by appropriations for the advertising received, and that artists who wish to receive the advertising that their performances bring them will perform free, still the highest type of broadcasting cannot be financed indefinitely on this basis. To secure the utmost excellence in talent, talent which needs no advertising, the performers or artists must be paid. And further to insure that program directors shall secure the best entertainment possible, untrammeled by any commercialism or advertising for the broadcasting station, the operating expense of the station should be paid directly by the radio audience.

H. D. KELLOGG, JR.

Of Haverford, Pennsylvania, winner of RADIO BROADCAST'S $500 Prize Contest. A tax of $2 on each tube and $.50 on each crystal used in a receiver is proposed by this plan, and the funds so raised to be administered by a Federal Bureau of Broadcasting

A YEARLY CHARGE—TO THE RECEIVER

A CHARGE, then, must be collected from each owner of a radio set, on a yearly basis, sufficient to pay the annual expense of the broadcasting received. The fair and equitable way to apportion the sum each owner shall pay is on the basis of the value and range of his set and the amount it is used. We would not expect the owner of a crystal set with its limited range and sensitivity to pay as much to the broadcasting fund as the owner of a many tube super-heterodyne.

The amount paid by the radio owner should be compulsory—in other words, it should be the equivalent of a box office charge. No theatre could support the cost of regular performances open to the public in a sound and business-like way through voluntary contributions. A fixed and definite amount must be collected from each individual in the audi-

ence before entering the theatre. And likewise the owner of a radio receiving set, with his power to tap in on many sources of entertainment, should be made to pay his share of the entertainment received, commensurate with the range of his set and the amount it is used.

Probably the best index of the range and cost of a set lies in the kind and number of its tubes. In a crystal set it is difficult to pick out any one satisfactory index of its value or use. The crystal should no doubt be taken as the index here. A charge, then, on the tubes or crystals purchased, and included in the purchase price paid by the owner of the receiving set, is the method here suggested for meeting the cost of broadcasting. Why these articles rather than any other should be taken as the criterion in laying the charge will appear from what follows.

THE TUBE IS THE INDEX OF THE SET

IF EXCEPTIONAL cases be excluded, it may be said that the tubes used in receiving sets to-day have a life closely commensurate with the service they render. Two similar tubes giving identically the same service may not last each as long as the other. But in the long run, tubes of reputable manufacture in ordinary service will last a time closely enough concurrent with their usage to serve as a basis for the owner's share of the broadcasting he receives.

With crystals the relation between use and useful life is not so satisfactory. Crystals do in time lose their sensitivity as detectors and have to be discarded. But statistics will be needed to determine accurately how long the different crystals now in use for radio reception may be expected to give satisfactory service before requiring replacement. No doubt considerable data on this subject is already available. Although this mode of guaging "broadcasting consumption" for this type of set, which it is believed involves the majority of receiving sets of to-day, is not wholly satisfactory, still no better criterion is apparently available.

In a tube set, the number of tubes is an excellent index of the cost of the set and of the range over which it can receive. Thus a broadcasting tax on tubes will affect more the owner of the expensive set who should be required to pay more, because he is able to command a broader choice of program than the owner of the less expensive set, who is correspondingly less able to pay the larger tax. Crystal sets do not as a rule involve very expensive equipment and in any event their range is usually limited, and hence a sliding tax scale here is not particularly to be desired.

A Summary of the Plan

I. Radio broadcasting must pay its way.
II. Person who must pay is the consumer—the radio listener.
III. Most satisfactory mode of payment is a definite charge applied to every owner of a receiving set in proportion to range, value and amount of use of set.
IV. This charge must be compulsory—a "box office" charge.
V. The best index of the range and value of a set lies in the kind and number of its tubes. In a crystal set, the crystal is the best apparent index.
  A. Life of tubes and crystals represents with reasonable accuracy the amount of use set has.
  B. Number of tubes is index of diversity of broadcasting programs at consumer's disposal.
  C. Levy can be readily applied to tubes or crystals in form of stamp tax collected from manufacturer and paid by final purchaser.
  D. Apportionment of tax greatly simplified and evasion minimized.
VI. Yearly tax not excessive and should not harm the industry.
VII. Only possible administrator of the super-broadcasting fund is the Federal Government.
  A. Problem national in scope.
  B. Private interests would require monopolistic powers.
  C. Administration of broadcasting fund not particularly liable to political corruption.
  D. Importance to Government of controlling broadcasting stations as means of directing public opinion.
VIII. Concrete illustration shows how $18,000,000 a year may be raised by stamp tax for super-broadcasting purposes.
IX. Government will take over some existing stations and build others by bond issues amortized from broadcasting fund. Immediate fund obtained by collecting tax from sets now in use.
X. Conclusion that super-broadcasting for, and paid by, the consumer places broadcasting on its rightful basis.

A TUBE TAX IS READILY APPLIED

THE most important feature of a broadcasting levy applied to tubes and crystals is the readiness with which it can be applied. A stamp affixed to the article, or applied as a seal to the package by the manufacturer lends itself to the requirements of a strict enforcement measure. A concurrent feature is that the work of supervision and apportionment of the tax is greatly simplified. It is difficult to apply a tax to a radio set, which may consist of antenna, ground, batteries, amplifier, loud speaker, and innumerable other components or accessories. To levy a tax on all of these articles would be a clerical task of unnecessary magnitude that would make the expense of collection excessively high.

Since the manufacturers of tubes is so nearly a monopoly, under the existing patents on these important products of the radio industry "bootleg" manufacturing or evasion of the tax would be difficult. Conversely, the tax on tubes would be simple and easy of application and enforcement. With crystals, however, the situation is not so simple. The production of these articles might be made into a monopoly, thus facilitating the application of the stamp tax at the point of manufacture. Or a few large wholesaling houses might be given control of the entire supply and the stamp tax applied there. It is not inconceivable that the requirement be laid down for the affixing of a stamp representing the tax at the time of sale to the ultimate consumer. But a tax collected from the manufacturer, provided there are not too many manufacturers, could be more readily enforced and is therefore most desirable.

The effect of a tax as outlined upon the radio industry is problematical. It would depend largely upon the additional cost of tubes and crystals to radio fans. In a later paragraph, the yearly budget needed for broadcasting purposes is briefly discussed, and the amount required from each owner of a receiving set does not seem excessive. The economic stability accorded to broadcasting by the plan outlined should soon carry the industry farther forward than ever before.

THE GOVERNMENT SHOULD ADMINISTER THE FUND

THE most practicable administrator of the broadcasting levy outlined is obviously the Federal Government. It is inconceivable to require manufacturers and producers of tubes and crystals to collect a stamp tax and turn it into a pool or fund held as a monopoly for and by private interests. The problem is clearly national in scope. It is outside the control of individual states and if run by private interests would require the granting of dangerous monopolistic power. The work of administering a national broadcasting service is not particularly susceptible to political corruption. With full publicity of all accounts, mishandling of the funds in trust would certainly be difficult. And the public would be a daily judge of the quality of entertainment provided. The tremendous value to the Government of having broadcasting stations continuously under its control in times of

Is This the Solution?

This plan of Mr. Kellogg's, which received the prize of $500 offered by RADIO BROADCAST, won over some thousand others which were submitted. The judges were, Professor J. H. Morecroft, president of the Institute of Radio Engineers (1923–4); Major J. Andrew White, formerly editor of the *Wireless Age* and well-known descriptive broadcaster; Harry Chandler, publisher of the Los Angeles *Times* and owner of KHJ; Frank Reichmann, a Chicago radio manufacturer and an old-timer in the field; Dr. Royal S. Copeland, United States Senator from New York, representing the public point of view; A. S. Lindstrom, chairman of the Pacific Radio Trade Association; Zeh Bouck, one of the best known radio authors in America; and Charles H. Porter, Chicago, secretary of the Radio Manufacturers' Association.

The officials of the American Radio Association, under whose auspices the contest was conducted, do not feel that this plan is the final word in the matter of "who is to pay?" and neither do the editors of this magazine. The broadcasting problem cannot be settled as easily as this plan proposes, although without doubt there is much to be said for Mr. Kellogg's plan. One of the chief stumbling blocks is the setting up of a federal bureau of broadcasting which seems to be contrary to the entire trend of radio development. We believe that anything which smacks of too centralized federal control or censorship would be resisted as much by the public as by all those administering radio to-day. Next month we shall print an interesting discussion on the entire subject.

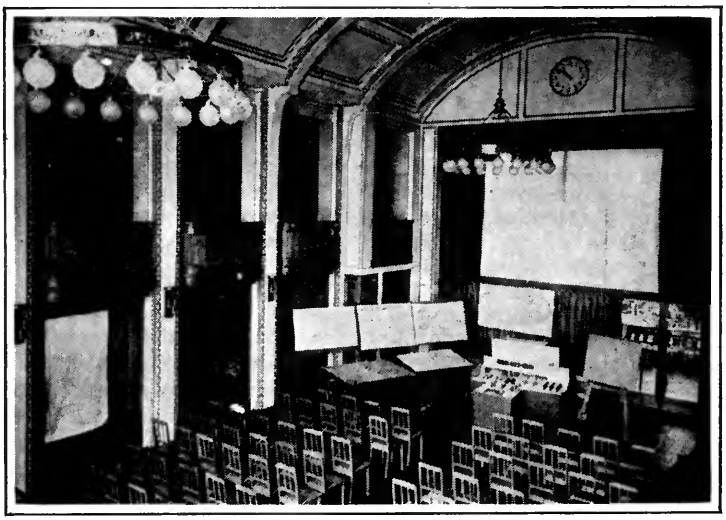
—THE EDITOR.

emergency, or even in ordinary times, to crystallize and direct public opinion and thought, cannot be overemphasized.

Broadcasting under this plan would then be conducted from twenty-five or fifty high power stations throughout the country. How these may be financed can be indicated by a brief illustration. Tubes and crystals should be rated according to their quality, durability and service. A stamp purchased from the Government Division of Broadcasting should be affixed by the manufacturer to the article or its container. The amount of the stamp should be set, in accordance with statistics compiled, such that each tube will bear $2 of the broadcasting budget for the year. Similarly, the tax on each crystal sold may be apportioned so that each crystal will bear 50 cents of the broadcasting budget for the year. If we assume 4,000,000 tube sets with an average of two tubes each and 6,000,000 crystal sets in operation, the returns from taxes set at this rate would be $19,000,000. Taking $1,000,000. as the cost of collection, $18,000,000. would remain to be distributed among some twenty-five or fifty stations, allowing each $720,000 or $450,000 respectively, per year.

It will no doubt be found desirable, in installing super-broadcasting, to take over many existing stations, though no attempt should be made to prevent present stations from broadcasting on the same basis as heretofore. New stations which may later be installed can be financed by bond issue amortized from the general broadcasting fund. A sizeable amount of the initial expense of taking over existing stations can conceivably be collected from the present owners of receiving sets as a retroactive inclusion under the collection of the stamp tax on later sales, though the payment could not be enforced without popular support. This would greatly hasten the advent of super-broadcasting, however, which otherwise would have to wait for sufficient accumulation of returns for the normal sales of tubes and crystals before it could be instituted.

It should be understood that while super-broadcasting will place before the public daily, the best talent, entertainment, lectures and concerts available, in a way that is now largely impossible, still the payments to artists for broadcasting service should not be as high as for public performances. There is not the expense involved for the performers in the broadcasting of a concert, either at the time of a public performance or at other times, that accrues for the public performance alone. In the case of many lectures or addresses, the only expense should be that of transmission. The important feature of super-broadcasting paid by the radio listener-in is that it places broadcasting on the firm foundation of direct, paid service to the consumer and insures every day the best possible programs from well-equipped stations, unencumbered by advertising or other irrelevant considerations.



THE LARGEST GERMAN RADIO STUDIO
At Nauen, near Berlin

"As the Broadcaster Sees It"

By CARL DREHER

Drawings by Franklyn Stratford

The Rising Tide of Microphones

WE ARE proud to present the first article in Mr. Dreher's series, "As the Broadcaster Sees It." For some time the great number of engineers and others interested and responsible for broadcasting have needed a place where their problems could be presented and discussed—perhaps even solved. The broadcasting field is getting so large and varied that intelligent comment, help, and suggestion should be of great interest to those in the field, those who are thinking of entering it, and those who are simply watching from the outside. The listening public will discover that Mr. Dreher has gathered together information which is highly interesting and essentially worth reading and also presents criticism of great value. The series will not be too technical nor too popular. We hope this series sets up some sympathetic oscillations among our readers.—The Editor.

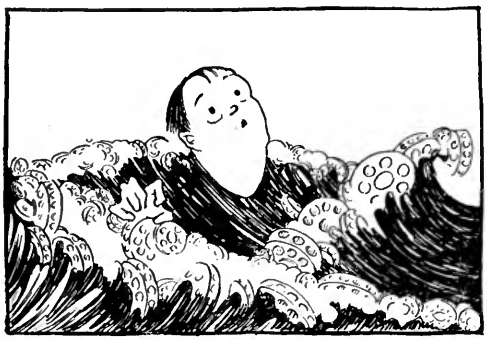
IN BROADCASTING a speaker from a public auditorium, how high should the microphones be placed? It is a grave question, my masters.

The accompanying photograph, showing President Coolidge delivering an address in Baltimore, is an extreme case. The two microphones were placed almost head-high, and must have obstructed the view of many persons in the space below the speakers' stand. From the broadcaster's angle the situation is an ideal one. It is possible to obtain decidedly better quality and naturalness of speech, in the case of a quiet and restrained orator like the President, with the microphones at head-level and fairly close to the speaker's lips. In this way the higher tones of the voice, the harmonics which are so important in the production of consonant sounds and delicate inflections, but whose energy is comparatively small, are retained and passed on to the amplifiers. These higher frequencies are easily lost. Generally speaking, with the microphones waist-high, quality of transmission will be slightly inferior. A fair compromise would seem to be at about the level of the speakers' chests. The pick-up is good enough for all practical purposes, and there is no interference with a clear view of the face of the man on the platform. Both the physically present part of the audience and the radio listening portion will be satisfied.

IDEAL PLACING FOR THE MICROPHONE

Few broadcasters are able to arrange as favorable a placing of the microphone as was arranged for this speech of President Coolidge. Where the microphone is so favorably placed, excellent speech quality results

The opposite extreme to the case discussed above is in theatrical broadcasting. Usually the only pick-up permissible is in the footlights, ankle-high. The speakers are distant from the mi-



the rising tide of microphones

crophones, and they move around as they talk. To obtain perfect quality under these conditions is out of the question; to do a reasonably good job is an achievement. In spite of the transmission difficulties, broadcasting from the stage is one of the most popular program features that a station can handle. The prerequisite, however, is careful selection of the shows to be broadcast. Generally speaking, the more music the play contains, and the less dialogue, the better it will broadcast. But the engineers will never be really happy, in broadcasting from the stage, until microphones the size of a dime, suspended on No. 30 steel wires, can be placed all over the proscenium. And we are a long way from that, with high quality microphones $3\frac{1}{2}$ inches in diameter, and weighing $2\frac{1}{2}$ pounds apiece, without the housings. We may admire, without attempting to emulate, the bold Baltimore broadcasters who set their transmitters before Mr. Coolidge's nose, and we may pray to be delivered from pick-ups where nothing is seen—and little heard.

Radio Transmitters for All

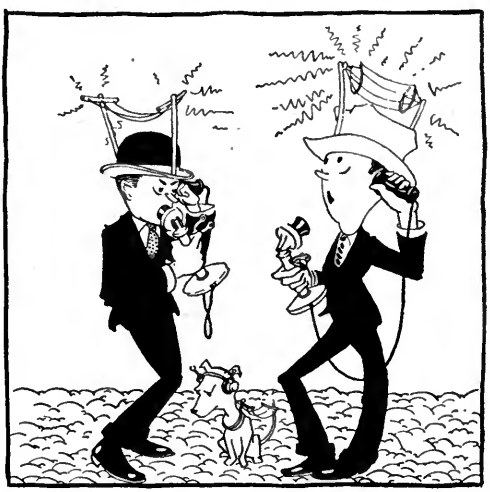
A FAVORITE subject of newspaper writers and cartoonists and prophets in general is the coming day when radio telephone transmitters will be carried about, as umbrellas are now. Portable sets like these will make possible continuous communication between individuals, and release them from dependence on restricted means of contact at a distance like the present-day wire telephone and telegraph. An example of this type of prophecy is the following excerpt from a recent editorial in the New York *Journal:*

". . . This writer has received . . . an excellent little receiving set contained in a matchbox. Using that set as a receiver, President Coolidge's speech was heard distinctly. Soon each man's hat will contain an apparatus enabling him to talk to his wife at home—an excellent thing if it helps his wife to keep track of him."

Leaving out of consideration the moot point brought up by the last clause in this quotation, we may point out that the whole contingency is very remote. The popularization of radio *reception*, and the development of highly sensitive portable *receivers*, have led many people to forget (if they ever knew) that there is a fundamental difference between transmitters and receivers. The receiver is a low-power apparatus, in the same class as a microscope or the human ear. Dealing only with small amounts of energy, it may in special forms be made small and inconspicuous. But a transmitter, in all known systems of radio, is power equipment, in the same class as a subway train or a rock crusher. In general, power means size.

Take the present 500-watt broadcasting equipment used by Class B broadcasting stations. The power of these sets is none too great for effective program distribution in a large city. Witness the considerable "dead" and weak areas which every urban station has in its own vicinity. Yet the motor required to drive such a set is a six horse power proposition, and the total weight of the transmitting equipment would tax the strength of an elephant. Carry it in your hat, indeed!

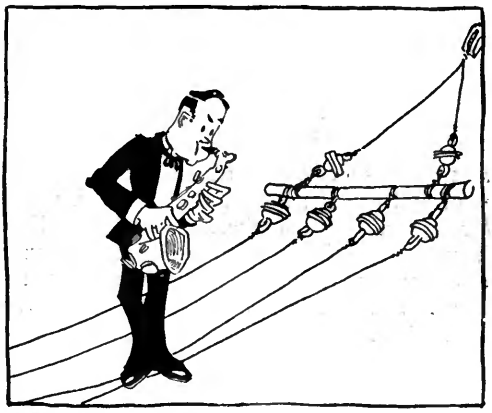
Then there is the limited traffic-carrying capacity of the luminiferous ether—bless it!—or whatever agency does carry radio messages from one place to another. The advent of



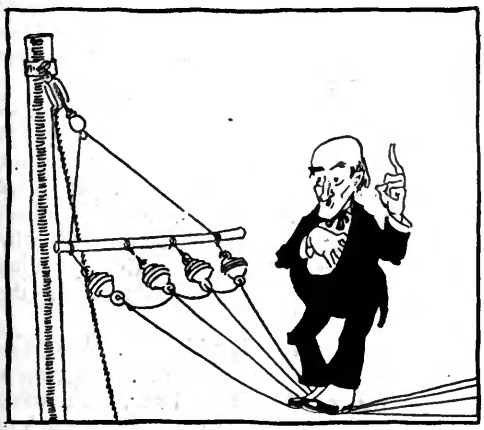
radio transmitters for all

broadcasting, as engineers know, has increased the already severe congestion in the ethereal highways. Marine radio is being forced down, amateur radio up, in the frequency scale. The art is not free from station interference in any of its branches; the problem is one which is taken up at every radio conference. What, then, would happen if every citizen got him a transmitter, when, even now, with one transmitter to about every sixty thousand persons in the United States, interference problems arise? We leave the answer to the feature writers, who are less troubled by such details than we are.

Of course, there is the development of short-wave transmission to be taken into account. Here a great supply of new wavelengths and traffic channels is opening up. And it may also be pointed out that, while power normally involves size, in the case of firearms, for example, great power is secured in very compact form by extreme concentration of force. Furthermore, radiation varies as the fourth power of the frequency, and thus one may view short wave, high frequency radio as a vaguely analogous concentration process, with the added factor that these short waves may be directed in a beam instead of being diffused in all directions. Admitting these arguments as interesting and pertinent, nevertheless, to the engineering sense, the transmitter-in-the-hat development is a thing almost as remote as the Milky Way. Universal radio communication between individuals, without the agency of corporate, public service facilities, may arrive some day, but that the communication companies, wire and wireless, will rake in dividends for a few centuries first, is a safe forecast. The development of a practical system of telepathy is just as probable, and telepathy is talked of glibly in much the same way, yet, to the writer's knowledge, no concrete demonstrations of the phenomenon have ever been given. It may exist, it may develop and supersede the laborious and costly forms of electrical communication which have been worked out in the last hundred years—but the vice-presidents and general managers of communication systems are not losing any sleep over that possibility. The possession by every individual of a radio *receiver*—that, of course, is another matter. That is already at hand.



one station specializes in jazz



serious speeches are broadcast

The Differentiation of Broadcasting Stations

AT PRESENT all the broadcasting stations are trying to please everybody. This is not to say that all the programs are alike in point of quality, for as a matter of fact the large metropolitan stations are able to attract a better class of performers and to supplement these with out-of-the-studio broadcasting of a superior order. As yet, however, no station seems to have made a serious effort at specialization.

In the field of printed periodicals we find a great range of contents and policies, with each magazine creating its peculiar atmosphere and catering to a particular class of readers. There are the vendors of fluffy stories, the "quality magazines," critical periodicals, humorous papers, political reviews, and so on. Each is supported by a certain clientele with its special interests. Each has a reputation for presenting such and such material so and so, readers buy accordingly, writers market their

output accordingly. You can tell a man by the magazines he reads. As yet there is no corresponding development among the broadcasters. There is some tendency in that direction, but it is only a tendency as yet. One station in New York City, owned by vaudeville and moving picture interests, caters mainly to vaudeville tastes; it specializes in jazz, popular songs, dance orchestras, and the like. Two other stations, run by large public service corporations, go after dignified banquets, informative talks, symphonic concerts, and the like. Still, the latter two stations broadcast many hours a week, and when summed up it is seen that they do distribute a large amount of popular material. The similarities of the various broadcasting stations, in the matter of program material, are more marked than are their differences.

We cannot say positively that broadcasting will take the same course as magazine publishing. There are obviously economic factors involved, and the economics of the radio business are not the economics of the publishing business nor of any other business. At present, in fact, the economics of radio might be termed *sui generis*—in a class by themselves. But there is in both fields the necessity of attracting a sufficiently large audience. One cannot print a magazine for a dozen readers (except perhaps in Greenwich Village), nor can one broadcast for two hundred listeners, generally speaking. And here the question of national (super-power or chain-station) as against local broadcasting is of interest. The cost of a national or section wide broadcast distribution, whether from a single high power station or a chain of smaller stations radiating the output of a single microphone, must be so high that a very large audience is essential. The program will have to appeal to a vast army of listeners, and a proportionately wide range of tastes. The general structure may be expected to resemble that of the magazines of large circulation, and undue specialization will hardly be feasible, owing to its effect in restricting the "circulation" of the station. The smaller local stations, on the other hand, especially those in metropolitan locations, may find it advantageous to narrow and concentrate their appeal. There are probably enough radio listeners in and around cities like New York and Chicago to support a station devoted to dramatic broadcasting, say, or chamber music, or some other particular field. Such a station might broadcast only once a week, or it might be used by special interests on certain recurring days, the plant being thus fully utilized by a number of different broadcasting agencies, each with an individual cultural, political, or economic motive. It is probable that some such tendency will become more and more apparent as the art advances, and the importance of broadcasting as a medium of conveying entertainment and information is brought home to people as yet untouched by it.

Broadcasting and the SOS

SHORTLY after 5 P. M. on December 17, 1924, a steamship, sight unseen, name unknown, poked her nose into the waters of New York Harbor and called a land station with her radio transmitter. The call letters she signed were SWS, a combination which, with the changing of a single dot to a single dash, becomes SOS, the international radio distress call which takes precedence over all other human agitations of the ether on land or sea.

Whether it was a slight stuttering of the key on the part of the operator of the good ship, or a trifling inaccuracy in reading on the part of the vigilant radio electrician at NAH of the Brooklyn Navy Yard, that SWS *was* changed to an SOS. NAH blared out a general QRT which, in the radio lingo, is a peremptory summons for everybody to shut up immediately or sooner. At 5.15 all the broadcasting stations went off the air in the middle of jazz selections, market reports, interviews with celebrated bootleggers, and advice to the lovelorn. A pall of silence hung over the harbor, and telephones were pressed to thousands of pairs of cauliflower ears while thousands of auditory nerves strained to hear who was sinking and where. The suspense was broken when the SWS piped up to report that all was well and that her call was not a distress signal. NAH retired from the scene. Traffic was resumed at 5.21.

SWS is the call, according to the books, of the Greek steamer *Chelatros*. Boy, page the King of Greece and ask him whether he can't find a less delicate combination of letters for his merchant fleet. SGS, SMS, and a few others also would not be missed. Better still, why not introduce a little logic into the prevailing distress call routine, as regards taking the broadcasters off the air?

In some cases, that is a blessing. If a painless method could be found of keeping some broadcasters off the air until say, 2024, when we shall all be dead and beyond the reach of terrestrial loud speakers, that would be fine.

But there is no discrimination under the present system. Let an sos go out, or the alarm be raised that some one thinks he heard one, and all broadcasters, good and bad, are supposed to take their carriers off the air instanter. It does not matter what their wavelength is, nor where they are situated.

Actually, nothing of the kind happens. The inland broadcasters don't go off the air. I have listened during a number of Atlantic sos shutdowns, and heard about all the broadcasting stations west of the Alleghenies going full blast and modulating 120 per cent. In fact, as Professor Jansky pointed out at the Third Annual Radio Conference, most of the hinterland telephone stations don't even keep a 600-meter watch. They don't know when a ship sends out an sos, much less go off the air for it.

This may be most reprehensible, but it is none the less sensible. What chance has a 20 watt, 230 meter, peanut-roaster broadcaster in Cabbage Corners, Iowa, of interfering with the disposition of a distress call on the high seas, with all traffic relative thereto being handled on 600 meters? About as much chance as the whistle of the traffic cop on the corner of Fifth Avenue and 42nd Street, New York City.

The fact is that the present system is merely a hangover from the old marine days of radio. It has no more rationality than any other attempt to solve the radio problems of to-day with the Berne Convention of 1912. The idea was that sometime, somewhere, a broadcasting station might interfere with an sos. But the fact is that most of the broadcasters, owing to their wavelength and position, cannot conceivably interfere.

The officers of the Federal radio inspection service, have done their best under difficult conditions with insufficient appropriations. Furthermore, while the letter of the regulations covering sos calls remains unchanged at this writing, it is said that some modification of the existing system is being considered If so, this article is in line with a widespread feeling that the rules should be better adapted to present-day radio.

Of course, compared to the safeguarding of life at sea, a task which is enormously facilitated by ship-to-shore radio, broadcasting is a luxury. Better that all broadcasting should cease for an hour or two, than that the life of a single seafarer or passenger should be jeopardized. But, if the two things have no connection, or if a formula can be worked out whereby all risk of interference with sos traffic by broadcasters can be obviated, then it is nonsensical to interrupt a concert by a Chamlee or a Philharmonic Orchestra because a tramp steamer 2000 miles away has lost her rudder.

The most comprehensive scheme would be to separate the lower end of the frequency band devoted to broadcasting from the upper end of the frequency band assigned to marine traffic to such an extent that, assuming the use of decent tuning equipment, neither could interfere with the other. That will ultimately be accomplished. It will be a good thing for both services. The process is already well under way in the United States, where marine traffic has been removed from the 300 and 450 meter waves during the evening hours by regulation of the Department of Commerce.

Now, all sos calls are sent out on 600 meters. The Berne Convention provided for a 300-meter distress wave for small vessels, but in recent years no one ever heard of an sos signal on this wave, and no one listens for one. One has to look out for 600 meters only. That is one thing we know. We also know a few things about interference. We know what band of frequencies various types of tuners, from excellent to very poor, will admit. We know the effect of power on the strength of a signal. We also know the effect of distance—that the strength of the field, under the most favorable transmission conditions, apparently falls off inversely as the distance. What, then, is to stop us from developing an empirical formula which will separate the sheep from the goats, which will discriminate between stations which may conceivably interfere with sos traffic, and those which cannot possibly do so?

I have gone into the calculus and, after vast travail and figuration, brought back such a formula with me. Here it is—

$$I = \frac{(F-500)^2 \quad (100+D)}{10 \; P}$$

Where I is the sos index of the broadcasting station. When I is less than 700, the station is required to keep a 600 meter log and to go off the air on hearing an sos.

F is the frequency of the station in kilocycles.

D is the distance in kilometers from the nearest coast station handling marine traffic. This includes the Great Lakes.

P is the power in watts delivered to the antenna.

As the wavelength of the broadcasting transmitter approaches that of marine traffic

(600 meters; 500 kilocycles), I becomes very small. If F is actually 500, I will be zero, even with a power of one watt in an antenna 2000 miles from seaboard. But in general, as D increases, and as the power decreases, I becomes larger. The formula discriminates against broadcasting stations using high wavelength and high power, and which happen to be close to the oceans or the Great Lakes, since these are the ones which are apt to interfere with distress signal traffic.

The table below gives the results of the application of this formula to a number of New York City broadcasters. As D, when small, has little effect on the result, it was taken uniformly as 10 kilometers (6.2 miles) in these calculations.

SOS INDEX OF SEVEN NEW YORK CITY BROADCASTERS

STATION	WAVE-LENGTH METERS	FREQUENCY KILOCYCLES	ESTIMATED POWER WATTS	SOS INDEX
WNYC	526	570	1000	54*
WEAF	492	610	1500	89*
WJZ	455	660	750	375*
WJY	405	740	750	845
WOR	405	740	500	1267
WHN	360	833	500	2440
WGBS	316	949	500	4455

The dividing line in New York City, it will be seen, lies between WJZ and WJY, WOR, the former requiring an sos watch, while the latter two broadcasters are absolved. The figures show the working of the formula quite clearly. With the same order of power in the antenna, and lower wavelengths, the likelihood of interference with marine traffic becomes even less and the value of the index increases sharply.

The effect of distance from deep water is illustrated in the second table:

SOS INDEX OF SEVEN INLAND BROADCASTERS

STATION	WAVE-LENGTH METERS	FREQUENCY KILOCYCLES	ESTIMATED POWER WATTS	DISTANCE KM.	FROM	SOS INDEX
KDKA	326	920	5000	480	Atlantic	2050
				190	Lakes	1025
WCAE	462	649	500	480	Atlantic	2575
				190	Lakes	1287
KYW	536	561	1000	10	Lakes	41*
KSD	546	549	500	820	Lakes	442*
WIP	509	589	500	60	Atlantic	253*
WWJ	516	581	500	10	Lakes	144*
KOA	323	928	1500	1300	Pacific	10000

A few remarks about the above table: KDKA and WCAE are both in Pittsburgh, Pennsylvania. KDKA's power is assumed on the basis of a Class D development license. It will be seen that in spite of KDKA's higher power, WCAE has somewhat the higher index, owing to the longer wavelength. The index was computed in the case of Pittsburgh for both the Atlantic coast and the Great Lakes.

In the case of WIP, Philadelphia, there is a question whether D should not be reckoned with reference to NAI, the Naval station in that city, rather than Tuckerton, New Jersey (WSC), the nearest marine station actually on the Atlantic. The U. S. Supervisor of Radio of the district would decide such questions.

KOA, Denver, Colorado, has the highest index of any of the stations figured. KOA could use 21.5 kw in the antenna, on 323 meters, and still keep his sos index below the dividing line; but if he put 22.0 kw into the antenna he would have to stand a watch. No matter how low the wavelength, any one who goes up in power indefinitely will come to a point where the formula requires him to watch out for sos calls.

The advantages of injecting order and intelligence into the sos-shutdown situation would be twofold. First, the broadcast listeners would always be sure of entertainment from at least some of the locals, even when an sos was abroad. That is of comparatively slight moment. What is of great moment is that with a reasonable system the law could be stringently enforced. Those broadcasters whose index numbers were below the required figure could be compelled to keep a *continuous* 600-meter watch; if, when an sos went out, they did not go off the air, the operators should have their licenses summarily revoked. The fellows in the Middle West, or on low waves and low power anywhere, would be let alone. The present regulation, requiring two minutes listening in every fifteen, and everybody in the whole United States to shut down when an sos is transmitted off the coast of Portugal, is ineffective, unenforced, and unenforceable; it's a joke.

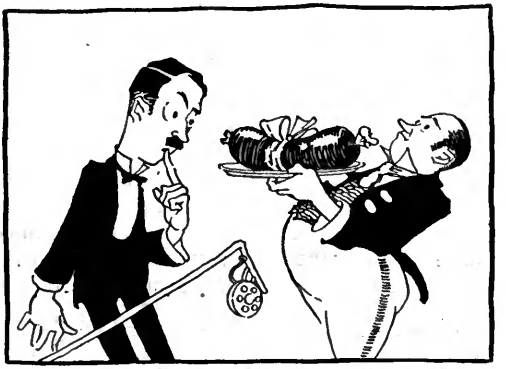
This is not to say that the mathematical formula given above is worth anything. Perhaps the mystic line of demarcation should be, not at 700, but at 500 or 900. A committee of competent radio engineers could decide that soon enough. The formula may be shot full of holes; the fact will remain that the problems of radio should be settled, not by oratory, tradition, and fiat, but by the application of engineering intelligence. A formula with an adequate security margin can be devised, just as safe values are calculated for the iron girders of a bridge. If a committee of a few

*These indices being below 700, the stations in question would be required to observe an sos watch.

men like Dr. Alfred N. Goldsmith, Mr. John V. L. Hogan, Dr. Louis W. Austin, Prof. J. H. Morecroft, and Mr. W. D. Terrell, should devise such a formula, or any equivalent system of classification, and, being put into practice, the same should cause interference with an sos message, the writer will gladly allow his friends in the marine service to conduct him to Seagate, immerse him in the Atlantic, and hold his head under water while he recites the last four books of *Paradise Lost.*

Zoölogical Note in Report of a Field Event at WJZ

Everything O. K. except a dog barked during the announcements.



monthly prize for broadcasters

Our Announcers' Bulls Prize Contest

EACH month RADIO BROADCAST will offer a handsome prize to the announcer who makes the most original and startling bull on the air during the preceding thirty days. Many prizes have been awarded to the most virtuous, most handsome, and most popular announcers in various localities, but this is the first time in the history of broadcasting that a prize is offered for the great, glowing bulls which are constantly brought forth by members of the fraternity.

Our readers are invited to make a note of such horrible errors as come to their ears, and to send them to this department, giving station of origin and time of perpetration. All contributors whose reports are published will receive honorable mention. In case of a dispute between the announcer and the listener as to the wording of the alleged bull, or other facts, the parties in the controversy will be privileged to fight with broadswords on the Mall in Central Park, New York City, or on the tennis courts in Golden Gate Park, San Francisco, according as to which terrain is most convenient. The conductor of As THE BROADCASTER SEES IT will referee the duel and in every case take out the survivor to dinner.

In order to guard against an overwhelming avalanche of contributions, the contest is limited, until further notice, to announcers of broadcasting stations of 500 watts power or over. We regret that the bulls of midge or mosquito broadcasters cannot receive notice at this time.

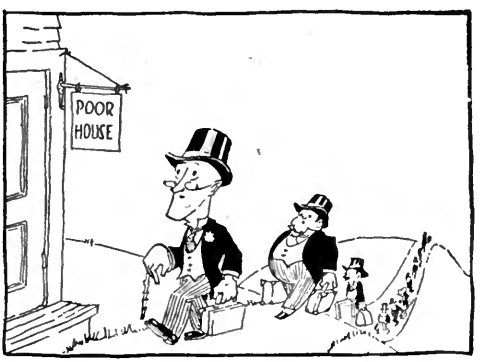
The prize for the coming month will consist of a handsome leberwurst bologna, i. e., sausage, six inches long, two inches in diameter. We look forward to spirited competition between our most popular Lotharios of the air for this desirable possession. The prize will be changed every month. For the guidance of contributors the following sample bulls, all plucked from prominent New York stations, are placed on exhibition:

One talented young man called the Philippines a principality.

The same gentleman declared that a certain soprano, who was then holding forth in his studio, had "received many commendable criticisms." Read it again if you don't get it the first time.

Another announcer released this one—"In just a moment you will have the pleasure of listening to the last number played by the Flathead Orchestra."

Open the gates, let the toreadors descend into the arena. On with the bulls!



radio amateurs at the poor house?

Those Talented Amateurs

OUR worthy contemporary, *Popular Radio,* in giving the record of a young man who is going on a trip around the world as a wireless operator, informs us that he "has been actively identified with the

American Radio Relay League, the Radio Club of America, the Institute of Radio Engineers, *and other groups of dyed-in-the-wool radio amateurs* [Italics ours].

This is terrible. We are shocked to discover that Messrs. De Forest, Elwell, Hazeltine, Marconi, and Sarnoff, to mention only a few of the Fellows of the Institute of Radio Engineers, have been working all these years for nothing, as dyed-in-the-wool amateurs. How shall they provide evening gowns for their wives, and gasoline for their Packards? Will no one take up a collection for these gentlemen, and for us, and for all the members of the Institute? Will no one organize a relief expedition to take us over the hills to the poorhouse?

Progress

IN 1824, the introduction of steam railroads being proposed, many good citizens cried out in alarm, declaring that all vegetation would be destroyed along the right of way, that the passengers, whirled along at the dizzy speed of twenty miles an hour, would be unable to breathe, while persons and objects near the tracks would be swept under the wheels by the tremendous suction. Wasn't the stage coach, which had been good enough for their fathers, good enough for them? If steam carriages were introduced, they didn't know what would become of the country.

In 1924, the construction of higher powered broadcasting stations being proposed, many good citizens cried out in alarm, declaring that their receiving sets would become useless, that the local stations would be drowned out, that the ether would be monopolized, and that the radio industry, if not the Republic, would go down to ruin.

However, the viewers-with-alarm of 1924 ride behind steam locomotives, and the six remaining stage coaches are in the museums.

Item for Radio Critics

AT THE Metropolitan Opera performance of *Carmen* on the evening of Nov. 27, 1924, Mr. Martinelli, the Don José, tripped over his sword and fell full length; Miss Easton, singing Carmen, dropped her dagger while threatening one of the other cigarette girls; and in the third act a canvas mountain fell over and hit the gypsies.

Yet people expect radio to be perfect.

Text for Opponents of Broadcasting

And when he had opened the seventh seal, there was silence in heaven about the space of half an hour.

Revelation, 8:1.

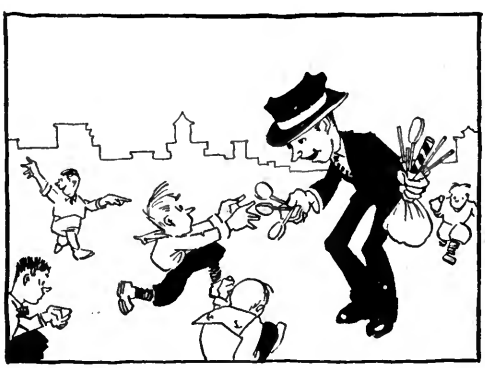
Blame It On Radio!

VIENNA, Nov. 15 (Associated Press)—The establishment of a regular service of radio concerts and entertainments by the post office department has resulted in what is called the first case of radio insanity on record here.

A 46-year-old lithographer complained to the police that the whole world was talking about him. He said that he was connected with a radio receiver and could distinctly hear people in every part of the globe gossiping about him. He asked, pitifully, to be disconnected from the radio.

Radio had gone to his head, and he was placed in an insane asylum for observation.

—New York *Times*.



new short waves are being handed out

"I turned my desk into a radio foundry."

Radio Heaven Via the Roberts Circuit

The Cartoonist of the Philadelphia *North American* Finds Solace and Comfort in the Roberts Knockout Set—Confessions of an Artist Turned Radio Fan

BY W. R. BRADFORD

THE Roberts circuit?" asked my desk buddy: "You already have the Smith circuit, the Jones circuit, the Mackadoo circuit, and you'll find that any old circuit by any name will squawk the same. How many circuits do you want, you octopus?"

"Only one" I replied: "But that circuit must be the one I am looking for. My constant looking for that circuit has necessitated many trips to the occulist. Listen; they say that regeneration is the equal of two stages of radio frequency. Now if one stage of r. f. can be added to regeneration, this ought nearly to equal three stages of r. f. If the howls of the lost souls that usually result from such an Old Home Week of these "Up-peppers" of radio, if these howls can be neutralized into giving the effect of a lion and lamb lying down-together why, that ought to be a ring-dingler arrangement, what?"

Desk buddy admitted it was so, but said: "Yes, but——"

"I don't care" I said: "I'll keep on running

radio hostel, and the first thing you know, I'll be entertaining an angel as a boarder, unawares."

This silenced him. It likewise silenced the other sour-grapers in the art department.

A look around in my "laboratory"—an unused corner for which no other use could be found, disclosed most of the parts necessary for the trial. Any one who has wasted as much time in radio as I have, has enough truck lying around to flotsam anything that will jetsam up in radio for many moons to come.

Back of my desk stood a five-tube tuned r. f. set which was always resorted to when the many "wonder" circuits became "duds," which was almost always. The main wonder of these wonder circuits is that we keep on falling for them, with such loud and resounding thuds. Chumps, every one of us. (Little did that r. f. set know that it was to be ousted by the Roberts circuit!)

It seemed that everybody in the building had heard of the Roberts set. At the request of all hands, I turned my desk into a radio foundry where all could get an eyeful of the proceedings:

> You can hear the snip of pliers
> As their jaws bite into wire,
> Hark! The charcoal pot is cracking—
> Solder irons are in the fire;
> But—a new condenser's needed—
> Lack of funds a stumbling block?
> No! By old Grandfather Gridleak,
> We will hock the kitchen clock!

Everybody offered suggestions, from the Big Boss, down to the window cleaners. It was clear to see that this was considered a family affair.

THE ROBERTS ON A DRAWING BOARD

ONCE stung, the wise man looks out for wasps. In consequence I first hooked up the Roberts on the back of an old drawing board. Ten minutes later I was tearing it down in feverish haste, and had started building it carefully.

I used the manufactured coils. Few of us can make such neat windings, and a sloppy looking coil is the nux vomica of radio land. However, I made a few changes in the taps of the primary coil, as follows: 17 turns of No. 22 enameled wire, with taps at turns 5, 7, 10, 13, and 17. This covered all the wavelengths I was interested in, and eliminated quite some dead end effect. I also increased the coupling between primary and secondary. It was $\frac{3}{8}$" I made it $\frac{7}{8}$". This made a razor-like sharpness in tuning that was as cheering as getting money from home. When you understand this set was to be used four miles from ol' woo, which has a roar like a dinosaurus, you will understand my quest for the last squeak in selectivity.

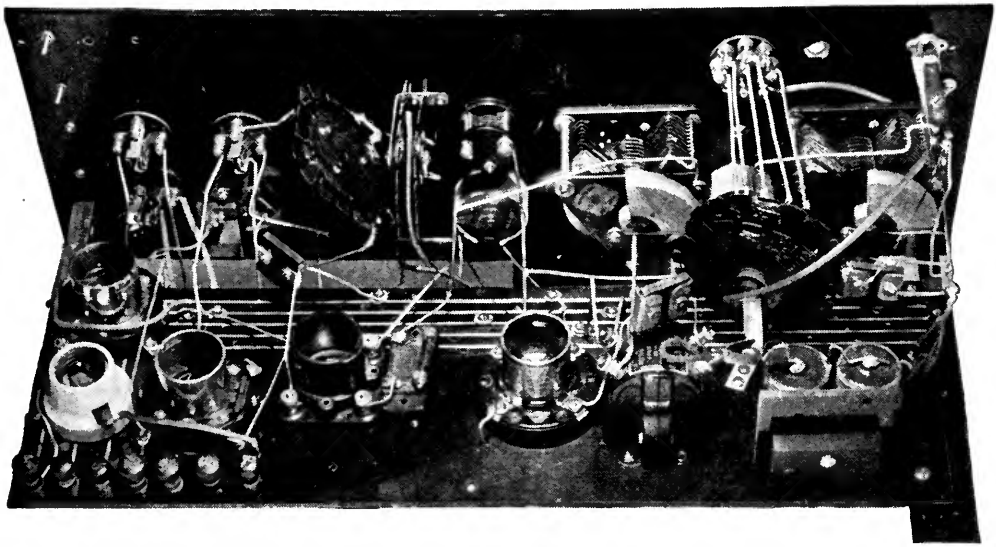
A new form of base came out at this time in which the circuit leads were imbedded in the panel, in grooves. At convenient intervals are holes, to which connections are made with a machine screw and washer. This makes an orderly manner of distributing wires, allowing short leads, so desirable in cutting down resistance. Well tightened, these connections make sure contact, something not always true in a soldered joint. The push-pull transformers were mounted underneath the base, thus making more breathing space up aloft. Some of our radio troubles are caused by crowding. Too many dogs in one manger—and nobody gets any rest. You know it.

I found in a small variable neutralizing condenser just the little touch that makes a radio fan glad he is alive. With this condenser, distant stations can be lifted up to the point of loudest audibility. As a matter of fact, one can go pretty far toward controling regeneration with it. It is far more shipshape than the "Granddaddy Longlegs" arrangement of spaghetti and bus bar, and I am most emphatically for it.

The mounting that comes with the ready

Where the Cynics Gather

Is usually in a newspaper office, and since a lot of the fourth estate have become radio enthusiasts, much of their cynicism has been directed toward radio and some of its works. From the time that the Roberts Knockout receiver was first described in this magazine for April, 1924, we have received great numbers of letters telling of the experiences of many builders of this set—some serious, some humorous, but all decidedly interesting. As Mr. Bradford confesses in his article, he has lately managed to take some of his spare time and devote it to the compelling art of radio. His experiences with the Roberts Knockout receiver are so typical of others and his relating of them so interesting that probably more than one constructor whose hands often curl lovingly around pliers and soldering iron will chuckle an appreciative chuckle when he reads this.—THE EDITOR.



THE RECEIVER

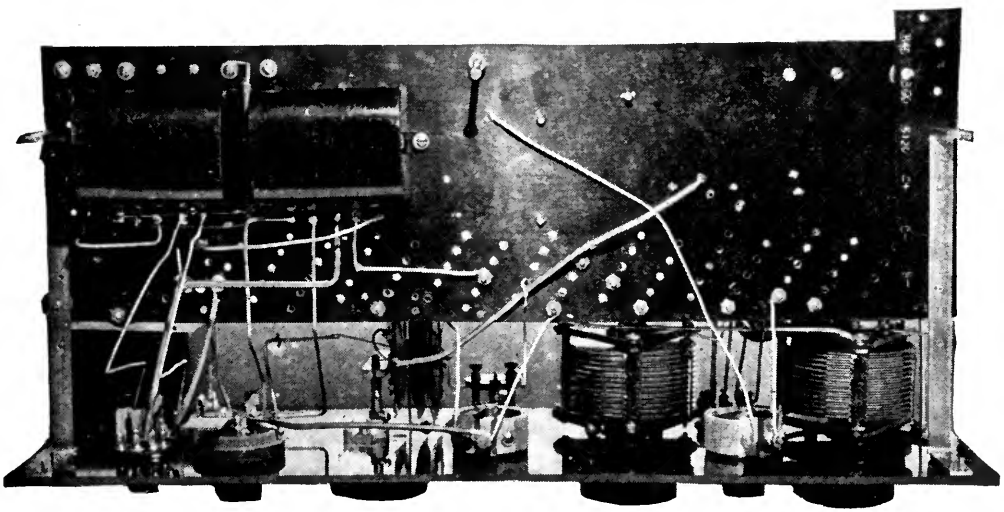
Constructed by Mr. Bradford who has incorporated some interesting changes in the four-tube circuit originally described in RADIO BROADCAST for September, 1924

made coils is a bit amateurish, so I constructed a more manageable mounting, wherein space was saved, and better control effected. These are little details one will work out for oneself. The answer in radio seems to be—the desire for a certain thing is generally the father of the deed that gets it.

You will notice generous width of panel, nine and a half inches. This made the easiest hooked up set I ever worked on. As a matter of fact, I think I whistled "Buffalo Gals" most of the time when assembling it. Thus, I am sure of a rebate from The Gods What Am, having made a record for profanity on all the other sets I ever constructed. (How many? —I'm ashamed to tell you!)

THE ROBERTS ON A LOOP

MY FIVE-tube r. f. set worked fine on a loop. I had an idea the Roberts would have something to say along this line, so I arranged a double jack that cut out the antenna



UNDERNEATH THE PANEL

Of Mr. Bradford's Roberts receiver. Push-pull transformers have been mounted underneath to save space on top

coils when the loop was plugged in. Our building is a twenty-one story affair, of steel girders, yet the Roberts has pulled in on the loop, WGY, WEAF, and KDKA. WGY and WEAF, could only be heard when the locals were not on, for our two local stations are not more than five blocks away from my window!

"Now" said everybody: "You have SOMETHING! For heaven's sake, leave it alone!"

Did I leave it alone? It was but natural that I should try to paint the lily. Ha! I would put one over, even on old man Roberts himself! Another stage of audio was added before the push-pull. Did you ever see a pup that bit into a hornets' nest? I was him. The result was a devils' chorus that would have warmed the heart of old Pluto himself. Squeals. Howls. Demoniacal chuckles. All the red-faced hyenas of the infernal regions were using my Roberts for a speaking tube. (Fortunately, this attempt was made at my own home, otherwise, my stock in trade as a "radio expert" would have suffered in the estimation of my office mates.)

Still, in the opinion of cartoonists I am a "radio expert." In the opinion of radio experts I am—well, some kind of a cartoonist, probably. There you are.

I have tried the Roberts on all the tubes a fan would use. Works fine on all, with the biggest rumpus, on the 6-volters, of course. Clarity of tone is one of its biggest selling points.

Using a loop, at my home, in West Philadelphia, WDAF, Kansas City, and WCAL, Northfield, Minnesota, have arrived on the Roberts, using phones. Nice, hm?

THE HORRIBLE MIXTURE
Of cartoonist and one too many audio

A RARE PHOTOGRAPH
Of a demon discovered and photographed by Mr. Bradford. This imp is seen in a particularly quiet pose, observing the personified device used by the author of this article guaranteed to destroy this menace

So far, it has not been tried on an outside antenna. When I get around to it, I shall chloroform the landlord and erect an outside antenna, whereupon, I expect to tune-in London, and get an earful of "How to Make Chow Chow by Radio" from Cross and Blackwell, in Soho Square.

In the accompanying photograph of my receiver, you will notice an ordinary electric light socket at the left on the base panel. When a 25-watt bulb is inserted in this socket, which is wired in series with the B minus lead, "Inkus Buhjinkus," the Eskimo imp, can jes' hang around all he wants to. Tubes simply can't blow with this life saver in. This has saved the humble writer much spondulix, for tubular kohinors are worth in the neighborhood of $4 per groan. (Note the photograph of Mr. 25 watt-er giving Inkus Buhjinkus the merry ha-ha.)

WHAT HAPPENENED IN PHILADELPHIA

I PUBLISHED a short account of my experience with the Roberts in the Philadelphia *North American*, the paper I am tolerated on. I had to bribe one of the office stenographers to help answer the raft of correspondence that followed. To my knowledge, there has never

been a set that has caught on like the Roberts has done. Given good material, and care used in assembling and wiring, "success waits on radio appetite," so to speak.

One of my neighbors, aged 71, built a Roberts, and swears he is 10 years younger, through pure joy. (And I know a lady fan, who "rolls her own" who swears she will kiss Walter Van B. Roberts on sight—and were I Roberts, I shouldn't disguise myself on that threat).

And me? Oh, I have no time for anything but my Roberts. The battery charger is buzzing all the time, and the stockholders of the electric company have all bought fur overcoats.

Oh, faithful and willing set, you have warmed the cockles of my heart.

But—alas. There is always a ghost at the banquet. The cat and the canary mope in jealousy, and Betterhalf has gone in for the movies. It's a habit now.

Where is mother? At the movies.
Where is Dadah? At his set.
He is tuning-in for England
Which he hasn't gotten—yet;
Mother's lonesome—mother's frantic
And she threatens—a divorce!
But that's futile, for like nature—
Radio will run its course.

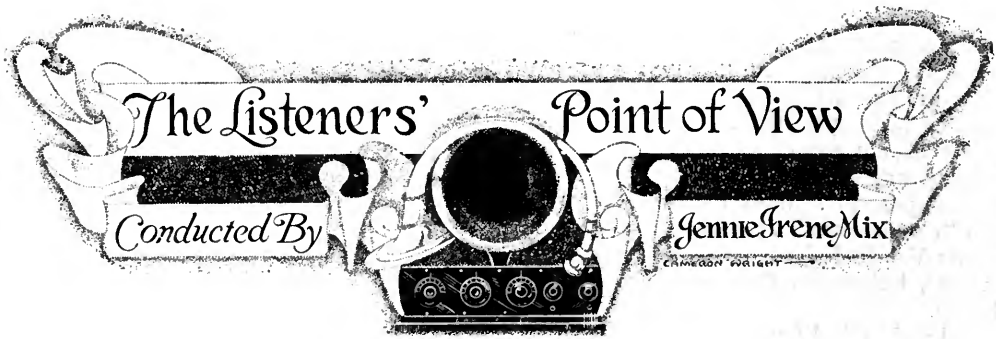
An obliging enthusiast bought my five-tube r. f. set. Good bye, ol' top, you were a good old wagon, but the Roberts—the Roberts is a Rolls Royce. *Pax vobiscum!*

Well, that's the end of that; Now for the fireworks.

Roberts, Roberts, you're a blessing,
For your set, in any dressing
Makes of radio, a heaven,
With your neutralizing "leaven."
Gone—is rumpus in the feedback—
(Due to demon's teeth, on hardtack?)

Amen. Do it with a Roberts.

IN THE CARTOONIST'S LAB
The assembly is listening to the Roberts Knockout "telling 'em"



At Last—Great Artists Over the Radio

THE expected happened when the phonograph companies began to feature their artists over the radio. Many who are equally familiar with the music and the radio game knew that in time the phonograph manufacturers would relax from their autocratic attitude in forbidding any of their artists to broadcast and would realize that in refusing to use the microphone as a means of advertising they were neglecting a rich opportunity.

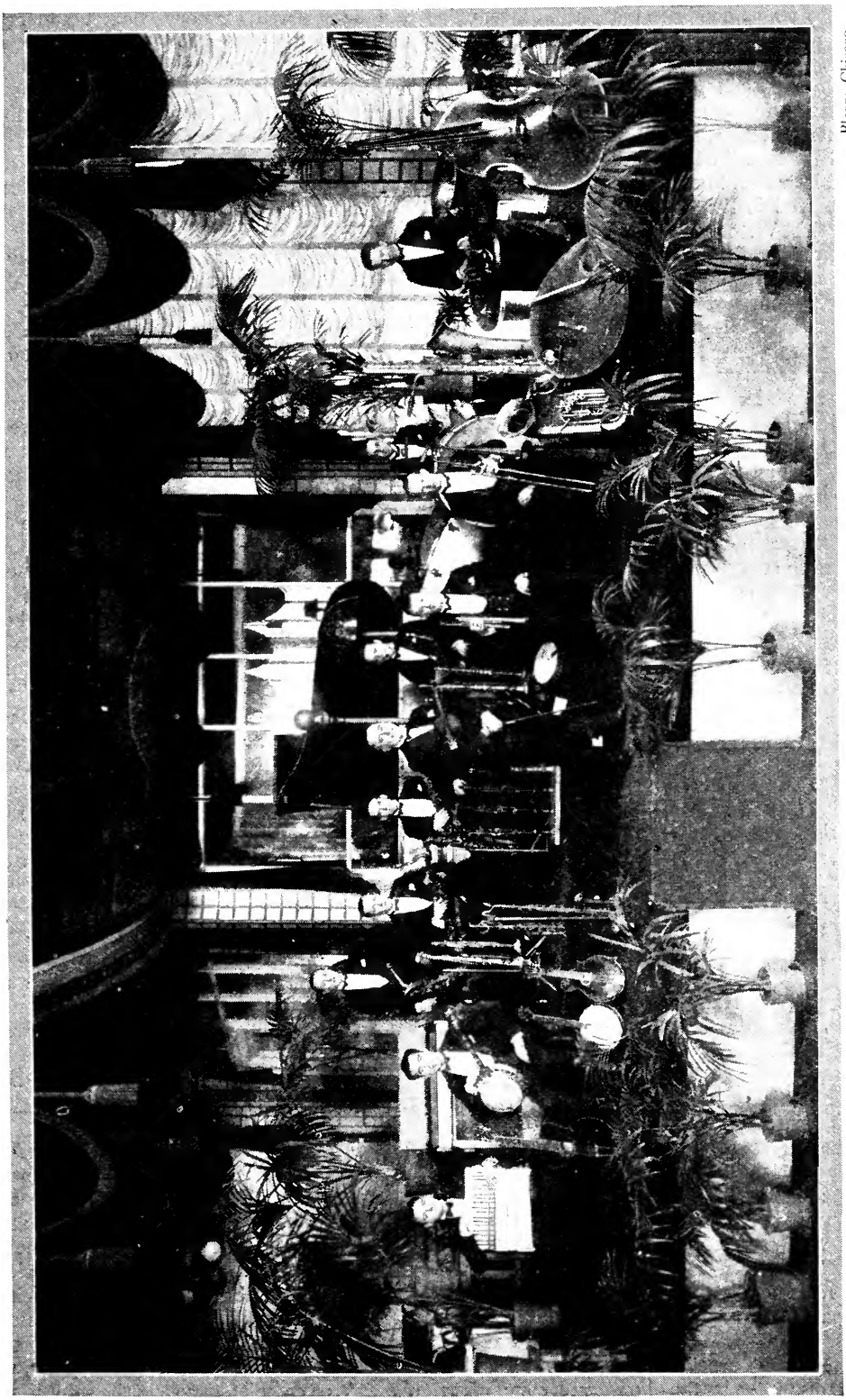
Still, the change came rather suddenly. To the Brunswick-Balke-Collender Company goes the credit of taking the initiative in what is the most significant development in radio programs since broadcasting was started.

To be sure, the Brunswick firm had somewhat prepared the way by making records of the chief hits of some of the popular radio singers and players, and advertising them as radio favorites, thereby selling many of the records. But that was quite different when that company suddenly sprung on the public the news that Florence Easton, one of the leading sopranos at the Metropolitan, Mario Chamlee, who holds a position as tenor of equal prominence at the same house, Elly Ney, pianist, and the Cleveland orchestra, would be heard in the first of three programs to be given by Brunswick recording artists during December.

Then came the Victor Talking Machine Company with the announcement that on New Year's night they would present Miss Lucrezia Bori and John McCormack in the first of a series of radio programs to be given by their artists. One would have thought, in reading many of the papers after this performance that never before in the history of radio had the great stars in the musical world broadcast. This was a deep injustice to the Brunswick Company and the artists they had up to that time presented before the microphone. The first program of the Brunswick artists in all respects equalled and in some ways excelled the first Victor program. But then, no intelligent person was beguiled by the newspaper reports into the belief that the Victor program was the first one of its kind broadcast. We have no issue to raise with the Victor people regarding this matter. Our complaint is against the press, which did not state the case completely. We believe in fair play.

There has been no end of discussion in the papers regarding whether these artists who have so far been heard on the Brunswick and Victor programs, are or are not paid. The Victor Company has announced that all of their artists are giving their services for these initial experiments. But this is a matter with which the public has no concern. It is a business question to be decided between the recording companies and their artists. For this entire scheme of the Brunswick and Victor companies in putting their singers and instrumentalists on the radio is a business proposition, and it is quite right that it should be. They are out to sell records, and let us hope that they will sell so many more of them than ever before that they will feel they can never desert the microphone as a means of advertising. If, on the other hand, they do not find that the returns justify the expense involved, a large public will have had the opportunity to hear artists they could never have heard in any other way.

True, with radio in its present uncertain



THE ORIOLE ORCHESTRA OF CHICAGO FREQUENTLY HEARD THROUGH STATION WEBH

Bloom, Chicago

state so far as good production is concerned, some may have failed in trying to hear the artists so far featured on these programs. But to one such person there are no doubt hundreds to whom the voice, the instrument, the interpretation, came through with a clearness that brought keen satisfaction.

But let us not lose our heads. It was amusing to read in the New York *Times* the day after this Victor program was broadcast, a wail from William A. Brady over the vacant seats in the theaters New Year's night. According to him, every one had stayed at home to hear this concert. The theater faced ruin. Even when great stars were not broadcasting, the theater crowd stayed at home to listen to the music broadcast!

If Mr. Brady thinks that any one who knows a good play when he sees it is going to stay away from the theater when a good play is on because he prefers to hear radio music, then Mr. Brady's knowledge of radio music is exactly equal to a cipher.

No, let us not lose our heads. These programs put on by the phonograph companies are going to help radio music tremendously. But they are not going to dominate. Just as every city in the country of any musical ambition has a few concerts of superlative importance each season, with the remainder of the musical attractions of far more than average merit, so it will be with radio, even if all the phonograph companies go into the business of broadcasting. We need these great artists to sing and play for us, and equally, if not more, we need the near great, those who are also artists, but not of world fame. It is such as these who are going to raise radio music to a standard where it can command the respect of those with artistic ideals.

It must be borne in mind that not all the programs put on by the phonograph companies will be given by famous concert and opera stars. Artists who make "popular" records will be heard as well—but then, when you are out to advertise your wares, if you are wise, you are going to advertise all of them and not just the *de luxe* variety.

Underwood & Underwood, New York

MARCEL DUPRÉ

The great French organist who has been broadcasting from WJY and several connecting stations. He is here seen at the Wanamaker concert organ in New York where he played all his programs

When Talented Music Students Broadcast

ONE feature that is becoming conspicuous on the programs of some of the best conducted broadcasting stations, is the presentation, by a music teacher in the city where the station is located, of a program given by members of his or her master class. Some excellent programs of this nature have been heard from WCX, Detroit, since that station moved to the Book-Cadillac Hotel while still keeping relationship with the Detroit *Free Press*. If a teacher's master pupils do him credit when heard over the radio he thereby has had at his disposal an advertising means more far-reaching than he could attain in volumes of the written word. We are glad to record that WCX is not alone in having successfully featured such programs.

A Protest Against Bad Taste and Bad Judgment

MANY requests have been received by the conductor of this department to enter a protest in these columns against the campaign conducted by station WOS, Jefferson City, Missouri, to raise money for Harry Snodgrass, "King of the Ivories," so that he might have a fund with which to start life anew after leaving the Missouri State Penitentiary.

Among these letters, all from strangers, was one that so completely covers the subject that

Apeda, New York

MME. ELLY NEY AND FLORENCE EASTON

Mme. Ney, pianist, who in private life is the wife of Willem Van Hoogstraten, conductor of the New York Philharmonic Orchestra, was one of the star attractions of the radio program broadcast by the Brunswick Phonograph Company recently. Mme. Easton is a leading soprano at the Metropolitan Opera House and also appeared on the Brunswick program which was the first ambitious large scale broadcasting ever to be arranged by a phonograph company

it is here quoted in full as the best means to show the consensus of opinion of a large public. If wos knew just how large that public is, those in charge of that station might do some worrying.

The letter, which is from A. O. Weiss, of Copperhill, Tennessee, reads:

I have followed with interest your articles in RADIO BROADCAST. You represent, probably, the first effort in radio to keep it clean and on a high plane. God knows, your work is necessary and should be amplified.

I—or rather, we were listening to a program from wos, Jefferson City, to-night. It was a solo program, by Harry M. Snodgrass, a convict in the Missouri State Prison. It would seem that they are running a benefit for him, and his musical numbers were interspersed with announcements of letters and telegrams contributing money for his benefit. He is to be released shortly.

He collected, by this means, several hundred dollars. I have no fault to find with this. He is an entertaining chap on the piano, the Coney Island kind of an entertainer. There are plenty of him over the country. I will confess that I sometimes enjoy him myself. However, what I do find fault with is the exalting of a criminal over the radio, and the detrimental effect it must have on children. I have seven. They know that this man is a criminal, and they hear him called "The King," and hear of the money being sent in to him. This is absolutely *bad!* I know nothing of his crime. I am no Puritan. I would gladly help him to regain his mental health. But I seriously object to such propaganda as wos has put forth in his behalf being broadcast into the homes of decent Americans. We need our moral foundations a sight more than we need Harry M. Snodgrass's music.

Such a letter needs no comment. It will inspire the respect and admiration of all those who give the matter intelligent thought.

How Much Jazz Is Enough?

BUT if this degradation of broadcasting brought protests to the present writer, they were exceeded in number and virulence by those that came soon after Christmas denouncing the jazzing by an orchestra at station WTAM, of "Silent Night, Holy Night." Some beneficent fairy kept us from tuning-in on that sacrilege, and for a time we hotly denied that such a thing could have occurred. But the evidence that poured in was irrefutable.

Jazzing "Silent Night, Holy Night"—to what base depths the mind of man can sink!

From all over the country come endorsements of the policy of this department in

fighting for good radio music. Note, these excerpts from a letter received from Captain W. C. Mahoney, Fort Benning, Georgia.

I believe I can speak for the average broadcast listener, for I am neither a highly educated musician, nor am I entirely ignorant of the effects of good music. Neither have I an objection to a reasonable amount of modern music in its place. I do however believe that if the broadcasting stations at large would adopt a plan of putting on programs that contained more high class music and eliminate so much jazz, that they and the entire public would benefit thereby.

There follows a warning that every radio manufacturer and dealer should take to heart:

The public is not only getting tired of so much jazz, but is getting disgusted, and the radio business at large is certainly going to see a marked reaction unless the broadcasters wake up to the fact that the general public is demanding programs of higher grade music.

Captain Mahoney then goes on to call attention to the fact that the Crosley Station at Cincinnati is making a feature of what, for a better term, we must call classical music. He also speaks of Zion City, that never puts on any jazz at all, every program being harmonious—whether classical, semi-classical, or religious. With this we heartily agree. This station is always above the average in everything it does. Many of the religious programs are beautifully chosen and presented, while the secular programs might be taken as models by a dozen stations not far distant from Zion City.

Then, from Edgar Felix, who has been as close to broadcasting behind the scenes, as any man in this country, comes congratulations on our attitude toward radio programs. He was until lately publicity director for station WEAF, the American Telegraph and Telephone Company, and is now with N. W. Ayer and Son. He writes:

During the last few weeks, in the course of some experimental work in receiving set design, I have had occasion to listen to the programs of scores of broadcasting stations all over the country. It is obvious that the average manager conceives the radio audience to be a most preposterous group of frivolous jazz enthusiasts. As station after station is tuned-in, we are treated to the painful strains of the weeping saxophone, or the tearful ballad entertainer. The preponderence of this type of program is well nigh overwhelming.

On the other hand, when I was with WEAF, I remember that we felt the mail response to the programs of the Philharmonic Orchestra broadcast was a decisive indication that there is a large element preferring classical music. And the response to the ballad programs . . . given during the Eveready Hour, brought numberless letters showing that the people prefer good ballads to the sentimental trash so often broadcast under the name of ballads.

Bain, New York

LUCREZIA BORI AND JOHN MCCORMACK

Recording artists of the Victor Talking Machine Company, who broadcast through a chain of eight stations on New Year's night. Miss Bori is a member of the Metropolitan Opera Company and Mr. McCormack is the famous concert singer. The phonograph company announced that its entry into the broadcasting field was purely an experiment and if successful would be continued for its advertising value

You are no doubt by this time familiar with the new announcement form used by WBZ: "This is WBZ, New England." Regarding which the Springfield *Republican*, in an editorial, has this to say:

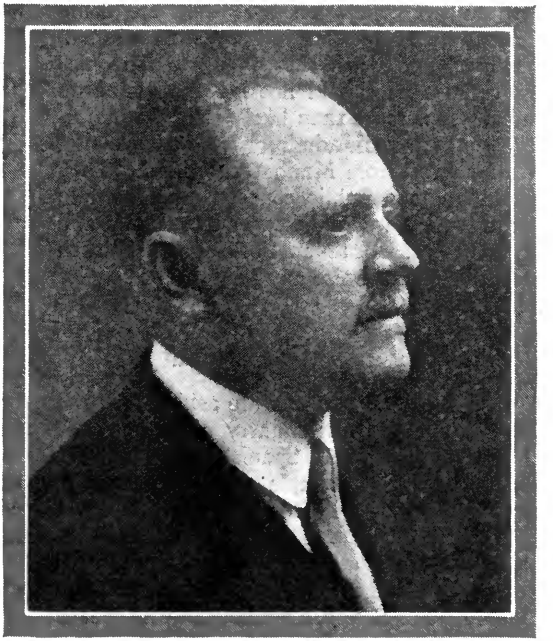
"The Springfield devotees of the radio are bound to consider it rather small business for the management of WBZ deliberately to omit from its announcements the fact that the broadcasting is actually done from this city. To say, 'This is WBZ of New England,' is not fair to

proud Springfield, and it is not giving the listener-in elsewhere a bit of the essential information that seems to be given in the case of about every other broadcasting station in the country."

After agreeing that the Westinghouse Company may, from its point of view, have good reasons for thus slighting Springfield, the editorial concludes with the pointed comment:

"The broadcaster does not have to name the city in every other breath, as he has been accustomed to name the Westinghouse Company, but, in all fairness, it ought to be plainly stated, as is done in the case of other stations, that the broadcasting is done from Springfield."

To which we wish to add that, as it comes over the radio, "WBZ of New England," sounds plainly silly. One would think that WBZ was trying to claim that it had a broadcasting station in every city, town, village, and hamlet in New England, or else was the only station in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. (Are the states all there? It's a long, long trail back to school days.)



CLARENCE W. ALLEN

Director of the Church Community Chorus which broadcasts every Sunday from WJZ. Mr. Allen often gets his listeners-in to sing with him, but how he does it is a mystery to many of us

In the radio column on the editorial page of this same edition of the *Republican*, the writer forecasts one of the phases of a radio Utopia when he says that at the time any really notable musical performance is being given over the radio all interfering stations should remain quiet. Whether a play, an opera, a symphony, or a string quartet is being given, it ought to be possible to hear it as a whole and with the minimum of mechanical interference and extraneous noise. "Such an experience," concludes the article, "once a month would be of more solid value than a surfeit of scraps from many tables."

Wait, five or six or seven years, and not only may such good things as this come to pass in broadcasting, but even greater things.

G. B. S. at the Microphone

ONE man reading a play to a radio audience is not a success even when that man is Bernard Shaw and the play is his own, according to the reports published in the London papers after Shaw had read his *Flaherty, V. C.*, from the London station of the British Broadcasting Company. Yet all acknowledged that he carried off his task with superb ability. The trouble was that the audience could not visualize all the people he tried to impersonate simply by a change of voice. Radio has its limits and it is not going to eat up the theaters and the concert halls and the opera houses as some alarmists would have us think.

Lopez at the Metropolitan

MR. Hurok, concert manager, and manager of the Lopez Orchestra, uttered a loud complaint against radio after a concert recently given at the Metropolitan Opera House by Vincent Lopez and his orchestra of forty pieces. The attendance was small. Mr. Hurok blamed it on the fact that the Lopez Pennsylvania Hotel supper-dance programs are broadcast.

It seems not to have occurred to Mr. Hurok, first that very few people would go to the Metropolitan Opera House, a place of vast expanse, to hear any orchestra of forty pieces. And second, that the public upon which he would draw for this concert could hear Lopez in his natural environment at the Pennsylvania any night. Perhaps they would go to the Metropolitan to hear Paul Whiteman—once. But from this Mr. Hurok should not

rush to the conclusion that they are going there to hear any other jazz orchestra of small numbers, and when they failed to patronize his concert he should not lay the blame on radio. It is more than likely that the majority of Lopez's radio admirers, and he has many, live far away from Manhattan Island. They would go to a public concert given by him because they would be eager to see him and his orchestra. But New Yorkers have no such incentive to patronize any paid public concert he may give.

They Talk Fast in Cuba

THE Cuban stations are asking that the stations in this country give their call letters in both Spanish and English. That would be a simple matter, and there seems no reason why the request should not be granted. But among the reasons that prompt this request, explain the Cuban stations, is that the American announcers talk so fast no one, not even a Spaniard who speaks English——can understand anything that is said.

But have you ever tuned-in on a Cuban station when some Spaniard was making a speech? His speed would put the most fluent announcer in this country to shame, even if the American announcer were trying to make a record for speed.

French Efforts to Pay for Broadcasting

THE United States is not the only country that is struggling with the question, "Who is to Pay for Broadcasting?" The *Compagnie Française de Radiophonie* of Paris recently sent out an appeal for financial support to those who previously had expressed interest in their programs. Prefacing a coupon which the contributor could fill out with his name and address and the amount to be contributed for the year 1924, was the following statement:

In England, the Broadcasting Company is remunerated indirectly by the listeners by means of rents, or dues, payable to the General Post Office.

In France the administration of P. T. T. asks for itself only one franc from the listeners for dues, so that the *Compagnie Française de Radiophonie,* which neither constructs nor sells any apparatus, must assume considerable expense in order to maintain five hours of broadcasting daily, to which tens of thousands in France and foreign countries listen. What you wrote us some time ago, and for which we thank you, makes us know that you appreciate our programs. If you wish to have a share in our expenses, and also coöperate in the improvements we have in view, we shall be greatly obliged to you.

Such a plan could be made to work more readily in France than in this country because over there the number of broadcasting stations is small as compared with the number on this side of the water. How this plan is progressing we have not yet heard. It is not new. It has more than once been brought up as a possible solution to the financial problems of broadcasters in this country, and has wisely been abandoned as impracticable, for the reason that the contributions would be but a temporary means of support with complete uncertainty as to what might be forthcoming in the future.

Credit and Appreciation for Radio Accompanists

ACCOMPANISTS for radio singers and instrumentalists get almost no credit for their work. The truth is that quite often the accompanist is better than the one he accompanies. It is a thankless job, even on the concert stage. It must be a discouraging job behind the scenes of radio, except in those cases where the accompanist is the official pianist of the studio, when this task comes as simply part of the day's work.

FROM Dorothy Doane Haynes, of Winfield, Kansas, comes a cheerful letter stating that, in her opinion, broadcasting is taking on a much more satisfactory aspect. One of the cases in point she cites to prove this is: "Why! KFKX doesn't even say 'radiocasting' any more!"

IT IS so long now since Christmas that probably few people can remember what gifts they received. But every one who listened-in to the Christmas carols must have rejoiced to have a radio set in his home. The highest praise is due all the leading broadcasting stations in the country for the carols and other forms of Christmas music they gave the public an opportunity to hear.

How to Wire Your Home for Radio

A Central Location for the Receiving Set and Proper Connecting Mains to the Various Rooms Is the Plan

By JAMES MILLEN

THE ideal location for the radio set in the modern home is difficult to find. Of course, there are "tea-wagon loop sets" which may be wheeled from room to room with only slight inconvenience, Some multi-tube ones are fairly portable, since a handle is attached to the cabinet. It is often inconvenient in the average home to attempt to take such an outfit to an upper floor at different times throughout the day as might be most desirable should some unfortunate member of the family be confined to the sickroom.

We don't generally put a handle or wheels on the furnace, coal bin, and ash cans and then take them from room to room in order to have heat where we most want it at any particular time. Why not, then, permanently locate the radio set in some convenient spot (not necessarily the cellar, of course) and "pipe" the output to the several places where its presence may at times be most desirable, such as the living room, front porch, dining room, den, or kitchen. As the cost of a half dozen or even fewer high grade loud speakers is in most cases prohibitive, neat and inconspicuous outlet boxes may be provided in their stead. Then it will merely be necessary to move one loud speaker about the house, plugging it in in much the same manner as an electric heater or other such appliance.

The location of the set itself could then be in some secluded spot, which good engineering practice would proclaim as best suited for long distance reception or, if the owner prefer, the set might well be kept in his workshop where one set of batteries could supply any receiver or receivers he might have there.

How can it be done? Will the reception be just as loud and clear with the loud speaker so far removed from the set? How can the volume be changed without going to another room and re-adjusting the set? In the next few paragraphs an attempt will be made to answer these questions as well as some of the others which may have already come to the reader's mind.

HOW TO MAKE THE INSTALLATION

THERE are, no doubt, a few ambitious persons who will prefer to "snake" the wires between the walls and above the ceilings, but most of us will be satisfied to run the wires along the cellar ceiling and up through small auger holes to the desired outlets. The wire may also be concealed behind the picture moldings or neatly tacked along the top of the base boards. Many good ideas about making this wiring may be obtained by examining your telephone installation. The main thing is not to run parallel too closely to exposed electric light wires or *un-grounded* BX cables, in which electric light wires are run. The best wire to use is a double No. 18 bell wire.

The Radio Mohammed

Is brought easily to the radio mountain if he wire his house according to the suggestions of Mr. Millen in the accompanying article. Very frequently it is inconvenient for a radio receiver to be taken from room to room in one's home and from one floor to another. If outlet wires be strung as this article outlines, only the loud speaker need be transported. Of course, the receiver has to be tuned and the variable voltage adjustments made before the outlets are used, but that, in general, is no especial hardship. If the experimenter is especially interested, it will not put him to much trouble to arrange a system so that when the loud speaker plug is removed from the outlet base the filament circuit of the receiver is opened. Some experimenters may even wish to arrange a distant control system so that the set may be tuned from a distant point.—THE EDITOR.

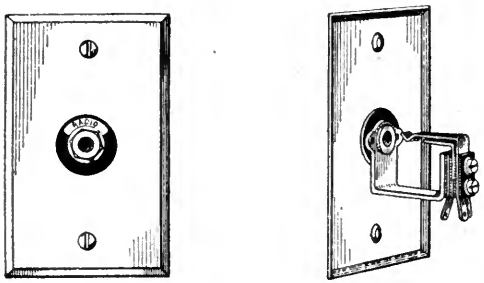


FIG. 1

One type of baseboard outlet box which can be used for connecting the loud speaker to the radio set which is located in a central spot in the home. Front and back views are shown in the sketch

This wire comes with a fairly heavy insulation. It is not twisted and is contained in one cover so it is very easily pulled through small holes without excessive jamming.

PLACING THE OUTLETS

THE outlets may be rigged up in any number of ways, depending upon the individual tastes of the builder. Where a box is to be "sunk" into a wall, then a standard brass

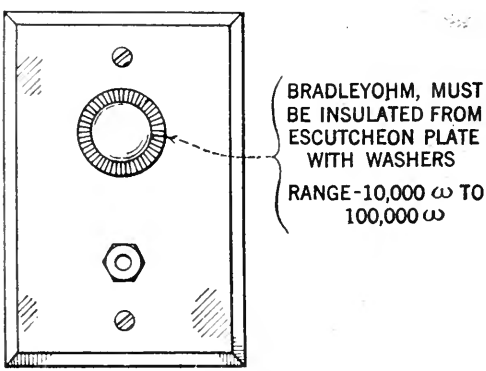


FIG. 2

An outlet which can be built up, containing a variable resistance to regulate the volume delivered to the loud speaker. Where a resistance is mounted in each outlet box, it is unnecessary to regulate the receiving set directly, once it is tuned to a given station

escutcheon plate with a jack as obtainable on the radio market (Fig. 1) may be employed. Otherwise a plain brush-brass escutcheon plate such as used with the ordinary two-button push switches may be fitted up with a jack and variable resistance for controlling the volume. (Fig. 2). The resistance is shunted across the line and should preferably be connected so as only to be active when the loud-speaker plug is in the jack. In order to accomplish this it will be necessary to re-arrange the contacts on the standard jack, or to use a series instead of parallel circuit. (Fig. 3). If no provision is made for automatically tak-

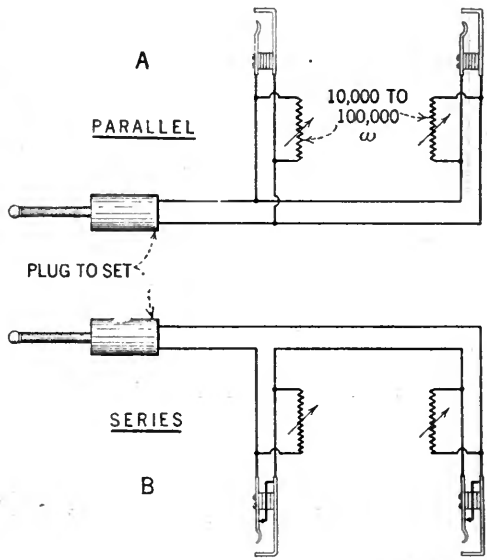


FIG. 3

Two ways of connecting the outlet feed wires to the radio set. A controlling resistance is necessary to regulate volume. The series connection in "B" is recommended because the extra blade on the jack automatically short-circuits the variable resistance in the circuit when the plug is out of the jack

ing care of the resistance connection, it may be necessary now and then to examine the connections in the radio-house-wiring to find what resistance is connected and which is causing the lack of volume. It is, however, always easily found.

A much more easily installed outlet consists of a small box with a flexible cord connection. This may be placed on a table, window sill, or even the floor. Should no volume control device be desired, then an enclosed jack of the type shown in Fig. 5 may be used.

TROUBLE ELIMINATION

SHOULD trouble due to whistling occur when the loud speaker extension line is being used, it may be rectified either by shifting the lines or using a low impedance speaker and installing the transformer at the receiving set end of the line.

REMOTE CONTROL

A CONSIDERABLE field for some interesting experimental work is available to the fan who cares to arrange a remote control so

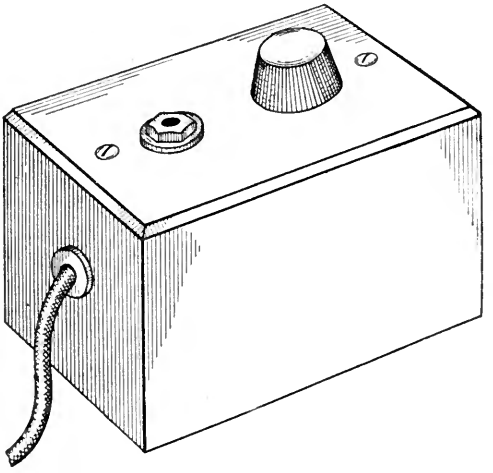


FIG. 4

A compact outlet box containing the variable resistance and jack, with a long flexible lead going to the output of the receiver. This arrangement can be used where the experimenter does not desire to install the baseboard feed circuit

that the set may be turned on or off, or, for that matter, tuned-in on any of the stations which come in with loud speaker volume. As remote control will interest but few, no effort has been made here to discuss that problem. In general, the difficulties of such an arrangement, when used by the average broadcast listener, far outweigh its advantages.

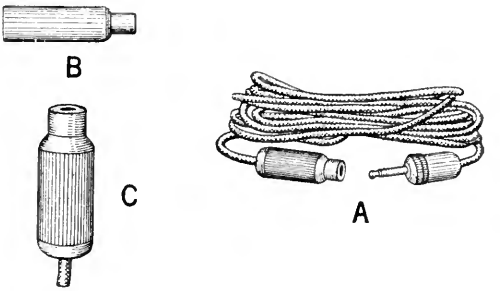
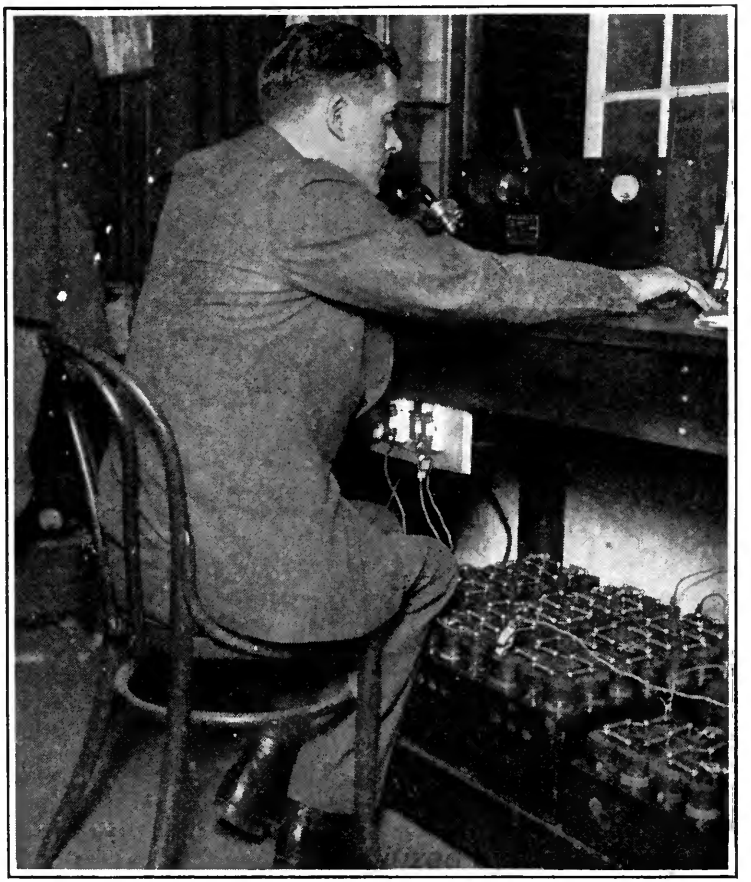


FIG. 5

A long cord with plugs, such as these sketched can be used by listeners who do not care to use any of the other methods suggested in the article



IN THE RADIO BROADCAST LAB

The Radio Corporation twenty-watt tube transmitter whose plate supply is furnished by a three hundred and fifty volt bank of Presto-lite storage B batteries

MR. WINSTON CHURCHILL

Making a political address in England in which a public address system and radio broadcasting are being used to spread his voice over great distances. Political addresses are much the same the world over, and the microphone and loud speaker are now accepted as a necessary adjunct. Mr. Churchill is Chancellor of the Exchequer in the present English cabinet

THE MARCH OF RADIO

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

Hoover's Suggestions for New Radio Regulations

APPARENTLY feeling that the power at present vested in him is not as well defined or as inclusive as he would like to have it, Herbert Hoover, Secretary of Commerce, has suggested to Representative White that he prepare a short bill (the wording of which Mr. Hoover gives) instead of attempting any broad regulation of radio at this time. The bill Mr. Hoover suggests asserts that the people of the United States are entitled to the inalienable possession of the ether within the confines of their coun-

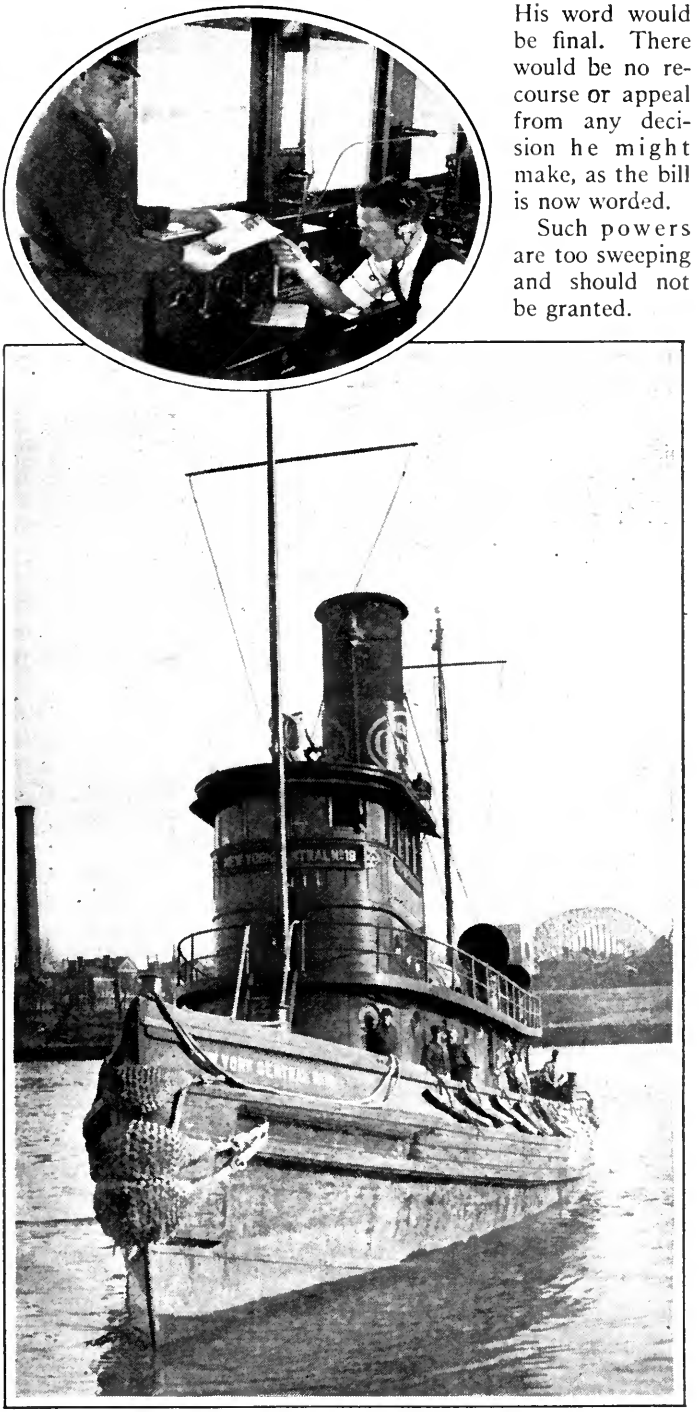
try, and then amends the Radio Act of 1912 to read:

> The wavelength of every radio transmitting station for which a license is now required by law, its power, emitted wave, the character of its apparatus, and the time of transmission, shall be fixed by the Secretary of Commerce as in his judgment and discretion he shall deem expedient, and may be changed or modified from time to time in his discretion.

Such wording certainly relegates plenty of power to the Secretary of Commerce—far too much, in the opinion E. F. McDonald, Jr., President of the National Association of Broadcasters. Says Mr. McDonald: "I have unbounded confidence in him (Mr. Hoover) and would be in favor of putting this tremendous power into the hands of the Secretary of Commerce on one condition, and that is, that Mr. Hoover give to the radio broadcasting industry a guarantee that he will live for 100 years and that he will serve as Secretary of Commerce for that hundred years. In other words, Mr. Hoover, we don't know who your successor is going to be!"

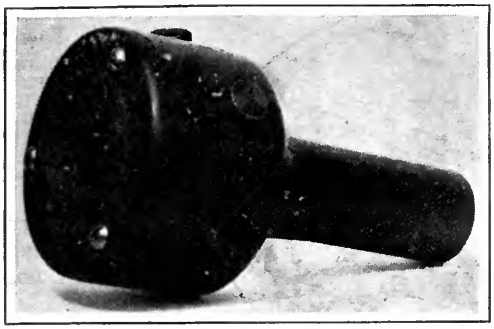
Mr. McDonald's point is well taken. The actions and policies of Mr. Hoover during the last few years have given the radio broadcasters every confidence in his judgment, and all of them would cheerfully abide by his decision in any matter he deemed it wise to regulate, but to confer on any Secretary of Commerce such Napoleonic power as this brief paragraph would do, seems certainly unwise. His word would be final. There would be no recourse or appeal from any decision he might make, as the bill is now worded.

Such powers are too sweeping and should not be granted.



DISPATCHING HARBOR TUGS BY RADIO

Is being tried by the New York Central Railroad in New York harbor. The Company anticipates saving much time by being in constant touch with the captain of each tug. The inset shows the radio cabin and tube transmitter which operates on 660 meters. Because of the small space available, the radio apparatus is installed in the pilot house



THE FIRST TELEPHONE RECEIVER WITH A PERMANENT MAGNET

The case is of wood. The diaphragm is made of an old tin-type with an iron magnetic core around which the wire coil was wound. This receiver was made by Professor A. E. Dolbear while he was a student in Ohio Wesleyan University at Delaware, Ohio. It was recently brought to light again in the University's physics laboratory

Mr. Hoover's letter covering the transmittal of his suggested bill to Mr. White shows how well he has grasped the essentials of the radio industry as it exists to-day. After reviewing the advances and changes during the past year, all of which indicate the inadvisability of governmental regulation at this time, he says: "I hope that another year's experience will show what direction of legislative course must be pursued. Meanwhile I feel that we would gain by allowing the industry to progress naturally and unhampered except by the maintenance of a firm principle of governmental control of the ether and the elimination of interference so far as possible."

An Epoch in Broadcasting

SETTING a rapid pace for 1925 broadcasting to follow, WEAF announced that through coöperation of the American Telephone and Telegraph Company, The Victor Talking Machine Company, and the various artists involved, January 1st and succeeding nights saw the inauguration of a great broadcast experiment. On that evening John McCormack and Lucrezia Bori, two of America's best-known operatic stars, gave a program of arias and favorite old songs which all radio listeners hailed with delight. These were exactly the type of programs which we have always visualized for broadcasting. To be sure, lots of folks can enjoy jazz and second-rate humor, but many of us prefer other than vaudeville programs. To suit a million people who are listening, a program of variegated character is required, but in this program lovers of real music had their turn. It was suggested that if this experiment was successful, more programs of like quality would follow.

The artists who have agreed to assist in this new phase of broadcasting, all of them Victor artists, are Alda, Bauer, Bori, DeGogorza, DeLuca, Fleta, the Flonzaley Quartet, Gordon, Jeritza, McCormack, Martinelli, Matzenauer, Ponselle, Schumann-Heinck, Scotti, Whitehill, Paul Whiteman, Crooks, and the Shannon Quartet. There are still a number of well-known Victor artists who have not yet agreed to broadcast, but it is quite likely that if the quality of WEAF's transmission keeps up to its present high standard and the public show a real appreciation of the programs rendered by the artists who have already agreed to broadcast, the others may join in to give us, the "dead-beat" audience, broadcast entertainment to which we are not at all entitled by any right of payment, but which we shall welcome nevertheless.

Radio Dispatch for Harbor Tugs

WHERE other means of communication fail, let radio be used—seems to be a logical dictum by which to allot different communication tasks to the different possible mediums. Certainly contact with moving vessels can most conveniently be had by radio and we believe that the attempt of the New York Central Railroad Company to handle its harbor traffic by radio is justifiable. The company operates forty-three tug boats in New York harbor and undoubtedly this harbor traffic could be speeded up if the chief tug dispatcher could talk to his captains whenever he wanted to. Although the experiment is being started on a 660 meter wave, it seems as though a much shorter wave would have been preferable, much below the normal broadcast range. As the distances to be covered are small, probably a 5-watt set operating at, perhaps, 20 meters might do the work very well, certainly much better than the channel at present being used.

How to Calibrate Your Receiver

THE latest list of "standard frequency" broadcasting stations put out by the Bureau of Standards is well selected to help the radio enthusiast who wants to construct an accurate calibration curve for his receiving set. Of the following stations, whose frequencies reach right through the broad-

cast range, none has an average deviation from its specified frequency by more than two tenths per cent. This means an accuracy much better than that to which the dial of the ordinary receiver can be set. Here are the stations:

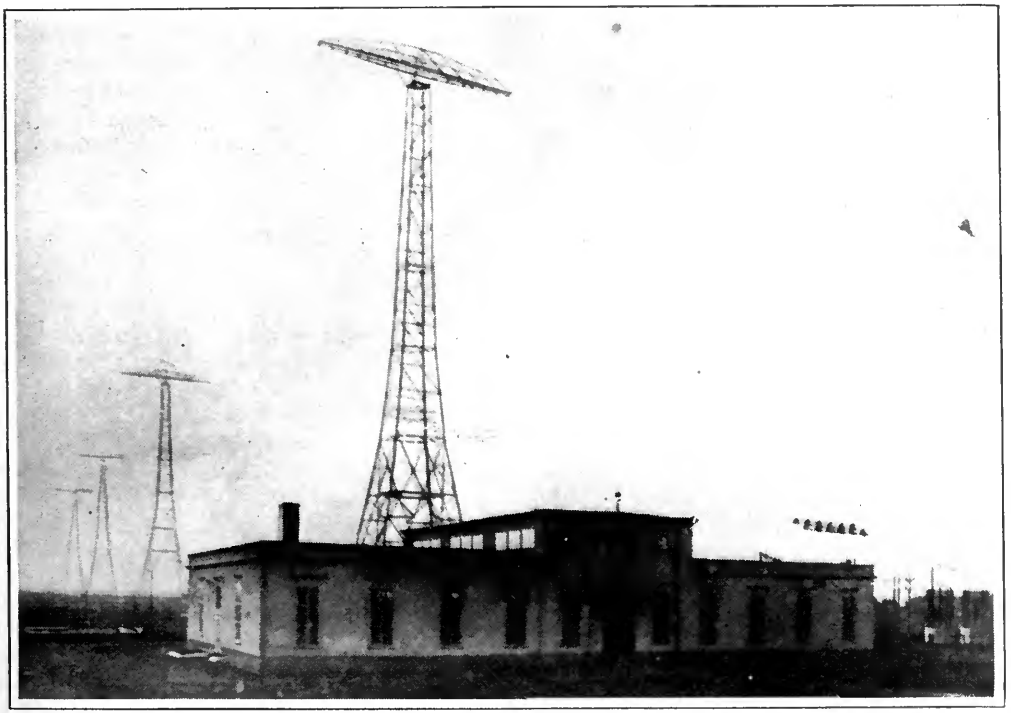
WWJ	Detroit	580	kilocycles
WCAP	Washington	640	"
WSB	Atlanta	700	"
WGY	Schenectady	790	"
WBZ	Springfield	890	"
KDKA	Pittsburgh	920	"

Of course for any one within hearing distance of the Bureau of Standards Station, WWV in Washington, or station 6XBM at Stanford University, their standard wavelength signals periodically sent out on a definite schedule, are even more useful for calibrating purposes.

A New Toll Broadcaster

TO ANY ONE having an interest in economics it is a puzzle to discover the raison d'être for some of our broadcasting stations. We are told by some newspaper men that the use of their broadcasting station for the dissemination of news seems to have actually decreased their circulation, besides costing them at least $25,000 a year for maintenance. There has been some talk that soon there will be no more broadcasting licenses issued and they don't want to be on the outside when such a situation arises. It may turn out that broadcasting will prove profitable at some time in the future. Why does a street railways system, for example, want to operate a broadcasting station? It is difficult to see how it will make people ride in the street cars any more, as a result of the operation of the company's station.

To the ordinary business man there is one type of station that might give a real reason for existing, that is, the station which attempts to pay its way by renting its facilities to clients who wish to have their name and products gently called to the attention of a shy public. It is very interesting nowadays to observe the advertising salaams and bows made to the broadcast listener before the brand of coffee or batteries is mentioned. It makes the listener quite appreciate himself to notice the deference



SWEDEN'S NEW RADIO TRANSMITTER

At Grimeton, near Gothenburg. The four hundred foot towers extend in a line for a mile and a half. This station is one of those in constant communication with Radio Central at Rocky Point, Long Island. All these stations use high power and a wavelength of approximately 17,500 meters (about ten miles long)

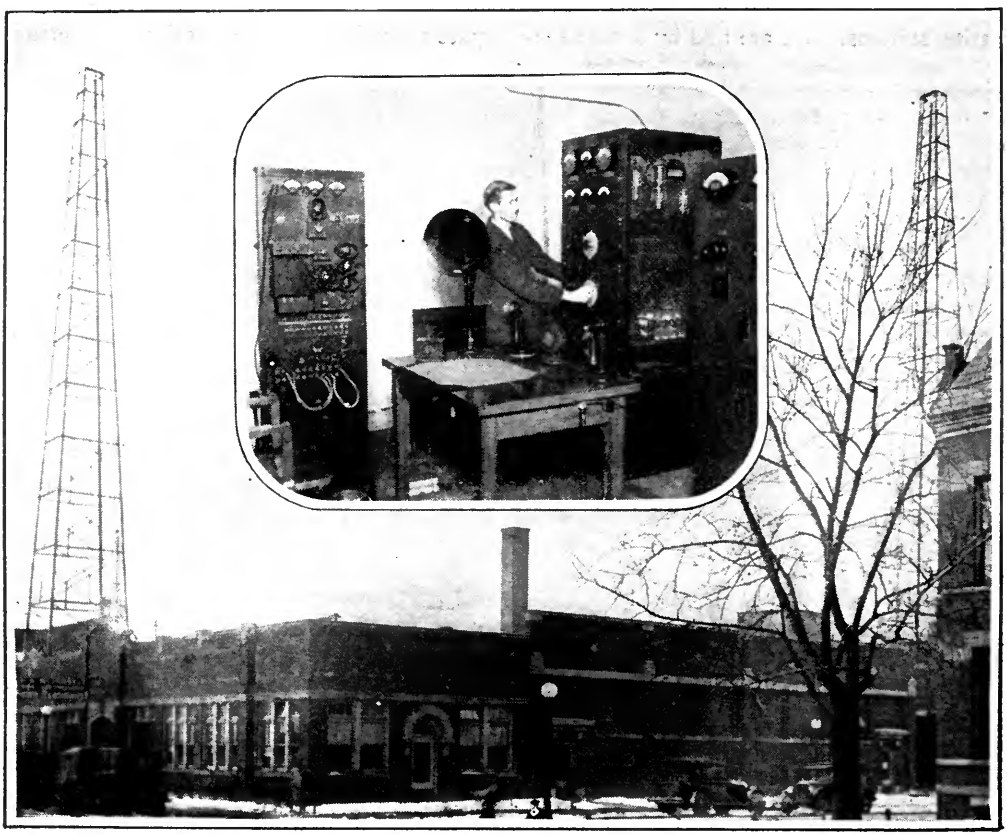
with which his attention is called to the antics of soapy twins or happiness vendors. It seems likely that a new brand of psychology will soon be offered in college curricula—that of the unseen audience.

New York has a station which thus endeavors to increase the sales of candy, cigarettes, soap and what not; Los Angeles has one, and now Chicago has started out on the great adventure. The *Southtown Economist* station, WBCM, is to make the attempt to become self-supporting by commercial advertising of the gentle sort referred to above. This new 500-watt station will be on the air every evening (and possibly daytime too) and will continue its progress until midnight and later. Their program staff will include skilled writers who will get up programs to attract the public's attention to the products they will be asked to buy.

These advertising stations are really not as bad as many listeners anticipated they would be. The quality of this advertising material must continually improve because otherwise people will not listen. So we wish to WBCN success—which will be directly proportionate to the quality of the entertainment it associates with its advertising.

And Now Courtship by Radio

IF YOU can't get married by the regulation courtship methods, try radio. It may be that your voice has such a mellow and appealing quality that if not accompanied by the negative effect of an unattractive physiognomy, girls might fall in love with you. Then, after they've fallen, perhaps meeting you even in person might not be able to shake them free from their love-spell and the battle is thereby won. Then again, whereas one's voice might not be appreciated by the home-folks, in an audience of several hundred thousand there may be a susceptible Miss who falls for it. This seems to have been the case recently when the dulcet tones of Mr. Thomas



A NEW CHICAGO BROADCASTER

Station WBCN, operated by the *Southtown Economist*. The owners of this station plan to attempt toll broadcasting, such as is done by WEAF and other stations

Malies (of Pittsburgh) penetrated the New York apartment of Miss Dorothy Hess (of Chicago). A short time afterward they met and were married, and lived happily ever after, we suppose.

Canadian Stations Joined by Wire

WE KNOW with what success the broadcasting network in the United States is gradually being extended. At first it was only a Presidential address, or event of similar national importance that seemed to warrant the use of a large wire network to tie in several broadcasting stations, but continually increasing interest in broadcasting and continually increasing excellence and utility of programs makes it a foregone conclusion that the association of wire networks and radio stations will be of ever increasing occurrence.

Canada has now entered into this field and for the first time three of her stations were recently tied together to radiate the same program. In Canada, it appears that the railways have been most influential in forwarding radio broadcasting. The Canadian National Railways has offered much of the best material which has been broadcast in Canada including musical, educational, and utilitarian subjects. The railways have also installed receiving equipment in their best trains, so that travelers are kept reasonably well in touch with national events as they speed across the continent.

This first tie-in experiment involved stations in Montreal, Ottawa, and Toronto, and the program was sent out from CNRM in Montreal, when an able address was made by Sir Henry Thornton, president of the company.

HOW RADIO RESISTANCES ARE WOUND

This precision machine which was in operation at the recent Chicago radio show made strips of resistance varying from three to seven hundred ohms. Like other components in radio receivers, most resistances are wound by machinery, very accurately and quickly

Radio and the Church

A NEW YORK newspaper recently printed an interview with three of the best known ministers there who had been preaching over radio channels for the last year or two. The interviewer sought their views as to the effect of radio on church attendance. The final answer to that question has not yet been given. The best known radio preacher in America, Dr. S. Parkes Cadman, made the interesting comment that his father, who preached continuously for sixty years, did not reach during his whole lifetime as many listeners as the son reaches by radio in a single Sunday afternoon. All three of the preachers interviewed spoke of the vast increase in their congregations, as certified by the thousands of letters received from every part of the country. Wherever these three speak the church is filled to overflowing and many cannot get in to hear them. And because of their eloquence, religious conviction, and sincerity of appeal, radio can never decrease church attendance as far as they are

C. H. MURCHLAND

Telegraph operator for the United Press at the Dayton, Ohio, *Herald* receiving press dispatches by radio broadcasting during a recent storm which struck down press wires. Broadcasting has frequently come to the aid of newspapers in an emergency caused by a storm since it was first used in this connection by the Detroit *News* in 1921

concerned. People come to their churches not so much to get religion as to get the speaker's view on religious questions—they want their religious convictions to be deeply rooted in their inner consciousness and appreciate consciously or unconsciously that these magnetic and powerful speakers can bring this about much more thoroughly than would result from any analysis and study of their own. So that if the evidence of such men is to form the basis of our judgment, we must admit that radio is a great assistant to the church—thousands and thousands who cannot get into the church do nevertheless hear these scholars discourse on Christ's philosophy and examine critically the question as to what things are really worth while in our modern complex life.

Many meetings are held outside of the church doors, says one of the ministers interviewed, to listen to his sermon over the radio at points far distant. Do these radio listeners also attend their own church services? or have they forsaken their own comparatively mediocre leader to listen to one of much greater power? Before we can really tell what effect radio has on church attendance we must interview many of these less gifted preachers whose congregations may have fallen off as rapidly as the metropolitan preachers' have increased. So let's interview the country pastor whose flock can listen every Sunday to S. Parkes Cadman or Harry Emerson Fosdick over the radio channels, what the effect of radio on church attendance has been, and see if his views agree with theirs.

Another Antiquated Transmitter Scrapped

THERE is no doubt that broadcasting is making progress; only last month we spoke of the spark signals from the United States Mail tug *President* in the port of New York carrying on its sometimes heavy traffic by means of a spark set which spilled its energy promiscuously throughout the broadcast range. During the past month the Government has decided, after pressure brought by the American Radio Association, to scrap this outfit and install a vacuum tube transmitter in its place. A 200-watt tube set, which will send out practically all of its energy on one wavelength, will be used to replace the one kilowatt spark set at present used. Orders for the purchase and installation of the tube transmitter have already been placed by the Post Office Department.

Wavelengths Will Not Be Changed

THE recent National Radio Conference recommended to the Secretary of Commerce certain changes in the assignment of wavelengths to the various broadcasting stations. It was the opinion of the conference members that interference could thereby be lessened. Soon after the conference disbanded, it became evident to officials of the Commerce Department that the suggested plan had already become obsolete, because of the rapidly increasing number of broadcasting stations, and the consequent demands for wavelength assignments. The present "rush to broadcasting" will not continue very long according to the ideas of some of these officials, and any change in wavelength assignments had better wait until that time.

The complete upset of the re-allocation plan has apparently convinced those responsible for radio regulation that the art is changing so rapidly that a general re-assignment at this time would be useless and should not be attemped until the conditions in the broadcasting world have become more stable. We are inclined to agree with one official who expressed the opinion that many people are getting broadcast licenses who don't want them, and that as the art progresses the number of stations will decrease rather than increase, thereby automatically eliminating

much of the interference which caused the recent radio conferees to suggest the wavelength changes.

The High-Power Arc Loses Favor

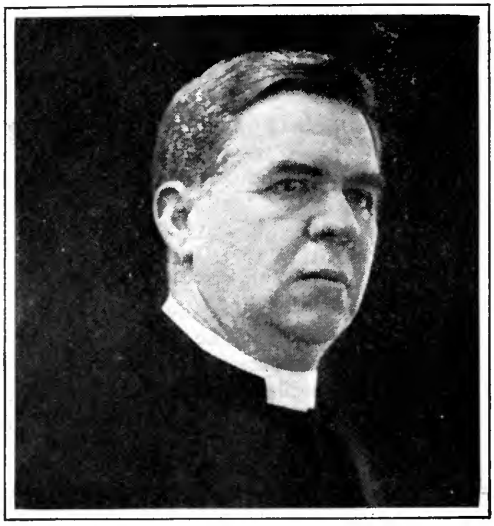
AFTER the General Electric Company secured the contract for the installation of a high-powered tube telegraph transmitter at Mare Island, California, it seems sure that the day of the high-powered arc station has gone. There have been available two methods of getting large powers (in hundreds of kilowatts) for continuous wave telegraphy: the high frequency alternator developed by Fessenden and Alexanderson, and the oscillating arc developed by Poulson and Pedersen and built in America by the Federal Telegraph Company. The Navy Department has installed large arcs for its principal transmitter, and they have proven very effective and reliable in their operation.

The arc is not, however, a very efficient generator of high frequency power, feeding into the antenna, as it does, less than half as much power (in the form of alternating current) as is delivered to the arc itself in the form of continuous current power. Because of its low efficiency, great quantities of water must be circulated around the arc and through the electrodes to keep it sufficiently cool. This defect, of course, doesn't worry the broadcast listener at all, but another characteristic of the high-powered radio arc is very obnoxious to those radio listeners who happen to live within a few miles of such a station. Besides sending out its own wavelength (and another one quite close to it called the compensating wave) the arc sends out an appreciable amount of power at all kinds of wavelengths some of them right in the broadcast channels. These stray wavelengths do not come in the broadcast receiver as pure notes but as noise or "mush". So exasperating is this interference that the great Navy arc at Annapolis shuts down two hours each evening so that radio listeners in that part of the country can avail themselves of the entertainment sent over the broadcast channels.

It has been known for two or three years

BROADCASTING THE MAKING OF A MOTION PICTURE

In a New York studio. Vincent Lopez is at the left with the baton and Ann Pennington is dancing atop the piano. The dance music, is used in the scenario and it was broadcast by WJZ. The announcer made appropriate explanations while the action for the camera was going on



DR. S. PARKES CADMAN

Pastor, Central Congregational Church, Brooklyn

"The scope of my Sunday broadcasting has been greatly extended. . . . Thousands of letters of appreciation come to me from the Eastern States. And when I visit the cities, towns, or villages throughout this vast region I not only meet people who listen regularly to my sermons but who are familiar with my voice.

"We are coming to understand more fully the possibilities and limitation of broadcasting. It is a fascinating problem which well repays study and analysis. If one uses the radio merely to preach special doctrinal views he will fail. On the other hand, if he uses radio to broadcast the great basic principles of religion and of the welfare of the world, he finds in it an agency of unprecedented value."

© New York *Times*.

now that large water-cooled triodes could effectively replace the arcs, and now this change is actually going to take place. Four 20-kilowatt triodes operating in conjunction with each other to feed power into the antenna will replace a 300-kilowatt arc and will permit more satisfactory and reliable communication, according to the engineers responsible for the new installation. But from our standpoint, the beauty of this new triode outfit to replace the arc is due to the absence of "mush". The oscillating vacuum tube is practically free of those spurious oscillations which are responsible for the great interference which the arc causes, and for this alone the radio listeners are truly grateful that the Government is to scrap its antiquated arc transmitters and to keep in line with the march of radio.

Hoover Not For a Radio SalesTax

RECENTLY a Washington dispatch, which at once received wide publicity, stated that in an interview Secretary Hoover had proposed a two per cent. sales tax to support radio broadcasting. Such a proposal at once brings up all sorts of difficult questions, such as, how to enforce the collection of the tax, and still more difficult, how equitably to distribute it. So it seemed that the eminent engineer-Secretary was becoming more of a theorist than an engineer. The truth was, however, that the Secretary did not make the suggestion attributed to him, neither was he in favor of agitation in behalf of such legislation. We believe that a sales tax or a licensing scheme is not the way that the cost of broadcasting is to be met in America. We have yet to find it.

Interesting Things Interestingly Said

WILLIAM A. BRADY (New York City; theatrical producer, speaking about the recent broadcasting by stars of the Metropolitan Opera Company, and others): "Radio constitutes the greatest menace the theatre has ever faced, and so far as I know, the theatre is doing nothing whatever about it. I am seated now in a room with a group of people and we are listening free of charge to a concert which I can only describe as gorgeous. Why should any one be foolish enough to go to a theatre under such circumstances? The trouble is not with those who sit at home and hear McCormack and Bori; the fault is entirely with men who control the theatre.

"We engage these various artists and pay them to work for us. Why should they be permitted to ruin our business by giving free radio entertainments on the side?"

DAVID SARNOFF (New York City; vice-president and general manager, Radio Corporation of America, speaking about coming events in radio): "Within a reasonably short period of time it will be possible for people in New York or London, or people in the United States and England to converse with each other by radio telephony across the ocean. . . . We know how to build sending machines that will send messages and carry the human voice. We also know how to build receiving apparatus which will receive these waves on the other side. We know how to perform stunts in radio photography and the like, but we don't know much about what happens between the send-

ing and receiving machines in the great outdoors that separates them. There's where we must look for additional information."

JOHN McCORMACK (New York; phonograph recording artist and concert star, speaking of his impressions after broadcasting for the first time): "I like it. You know I have had plenty of experience in making records, but this beats it. Somehow you seem able to visualize an audience better in broadcasting and you can sing to them directly. After you get the hang of it, it's easy."

LUCREZIA BORI (New York; Metropolitan Opera Company, speaking of her first broadcasting experience): "Oh, I just thought of those 6,000,000 people out there somewhere listening and I was scared to death. I generally sing to four or five thousand and it's very different. It's odd what a feeling you get when you see that little instrument in front of you. I had to fight to keep myself from tightening all up, but after I got well started I forgot all about it."

JUDGE S. B. DAVIS (Washington; Department of Commerce): "The short wave has found its place in commercial and amateur transoceanic communication and in transmission both at home and to places across the seas. In domestic use it is a rival of wire interconnection. I consider interconnection, in whichever mode effected, almost essential to the future of broadcasting if we are to look at radio as a means of service to all our people all the time. It ultimately means national programs, nation-wide utterances, more valuable subject matter and that great happenings in which our people have so vital an interest will be available to everybody. . . . It is transforming broadcasting from a local to a national service."

S. O. MARTIN (New York; president, Sonora Phonograph Company, Inc.): "There has recently come an increasing demand for phonographs and radio-phonographs. We believe that phonograph companies must make a proper connection with the radio industry, since the situation in regard to radio is not at all a question of whether or not the phonograph business will be extinguished by radio, but on the contrary how far the phonograph business can safely ally itself with radio. . . . Now that radio is being dressed up in appropriate cabinets, it is becoming a drawing room feature instead of an attic experiment."

A. H. SCOVILLE (Cleveland; vice president of the Union Trust Company, coöperators with the Goodrich Rubber Company, owners of station WEAR): ". . . In establishing our broadcasting station, we have attempted to demonstrate that radio broadcasting to-day is an important cog in the industrial machinery of our country. I really feel that broadcasting, in its importance, is second only to the introduction of rural free delivery for the farmer, and I make that statement advisedly because with our own broadcasting station we have placed the farmer in the position of a man with a private bond ticker in his office. . . . We look on our station as a means of knitting together the Fourth Federal Reserve District with all its banks and all its people together into a compact whole. We try to keep them thoroughly informed at all times of the major news of the financial world."

GEORGE C. FURNESS

New York: Chairman Battery Committee, Associated Manufacturers of Electrical Supplies

"The responsible manufacturers of dry B batteries have made such marked improvement that to-day's dry B battery operating costs are at least fifty per cent. lower on the average than those of a year ago. The reduction is greatest on those sets with a heavy B battery drain. Here the costs are often only one third of the former figures. A year ago it was sometimes necessary to renew B batteries after two or three months' use. To-day, under the same conditions, they will last from four to six months. These developments resulting in lower operating costs for the radio public have come about in several ways. There has been a real improvement in the design of the regular size B batteries which has brought about greater uniformity and longer life. In the second place, extra large batteries, that is, those constructed with extra large cells, have been developed for use with the increasingly popular multi-tube sets and power amplifiers. Finally, the price of batteries has been reduced."

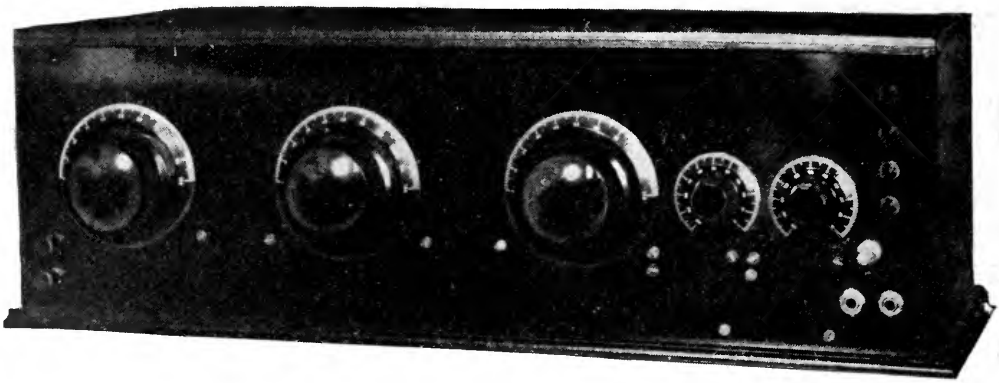


FIG. 1

A panel view of one of the first test models. The final form is practically the same with the exception that one rheostat instead of two controls all the tubes

A Good Four-Tube Receiver

Employing Neutralized Radio Frequency-Amplification, a Controlled Regenerative Detector, and Two Stages of Audio Amplification—An Efficient and Simple Receiver Using Cylindrical Inductances Which Can Easily Be Built

BY McMURDO SILVER

THIS receiver is no great innovation in the point of circuit design, for it employs the tried and true principles of radio-frequency amplification and controlled regeneration. As Mr. Silver brings out, his receiver is quite like the one known as the Knockout Roberts receiver, but this set uses cylindrical coils which, for some constructors, may be somewhat easier to build. The receiver produces results, for those in our laboratory on test, quite came up to the promises made by the author. The set has also something in common with that described by G. H. Browning in RADIO BROADCAST for December. Every part of the Silver receiver can be purchased in the open market and built and assembled by the constructor.—THE EDITOR.

DURING the last year and a half, there is no question but what the super-heterodyne receiver has been at the top of the list, from the point of view of the more experienced set-builders, but for those experimenters who desire "super" results on a small antenna, there have been only two other really satisfactory receivers to turn to, until the advent of the Roberts Knockout Reflex. These receivers were the neutrodyne, or those using some form of tuned radio-frequency amplification, and that good old stand-by, the now almost prehistoric regenerative receiver. The neutrodyne, after the "super", was the next most sensitive receiver, and with these two at the head of the list, the regenerative circuit has suffered a gradual decline in popularity. Now, however, there is a tendency to combine regeneration and r. f. amplification, and receivers built along these lines may in time, supplant both the straight regenerative receiver and the neutrodyne.

The reasons for this are very excellent ones. Tuned r. f. amplification offers many advantages, but the sensitivity of a receiver employing this type of amplification is not as great as it might be if the set itself is to be kept in a stable operating condition. This is because regeneration, unless it be controlled to some extent cannot be used. The sensitivity of such a circuit depends in a very large measure

upon the amount of regeneration used. The obvious thing to do is to combine some form of variable regeneration with stable radio-frequency amplification. If the r. f. amplifier is neutralized and the regeneration take place in the detector circuit, the result is an extremely sensitive, non-radiating receiver. In the more congested centers, the effect of the "bloopers" or radiating receivers is not becoming a menace, but *is* one, and most seriously interferes with satisfactory reception of broadcast programs.

The set to be described herein presents nothing radical nor does it incorporate any wild or so-called new ideas. It is, on the contrary, merely an application of sound design principles in an endeavor to produce a receiver which would embody all the advantages of the neutrodyne plus those of the regenerative receiver and with none of the draw backs of either type. Certain definite requirements were laid out before development was started:

1. The receiver must, when using a 75-foot out-door antenna give results equivalent to a good seven-tube super-heterodyne when operating on a loop, with respect to sensitivity, selectivity, quality of reproduction, ease of control and simplicity of assembly.
2. The set must employ a minimum number of tubes operating at maximum efficiency.
3. It must be non-radiating.
4. The equipment used must be as efficient as it is practically possible to make it.
5. The construction and assembly must be simple enough for any one to build.
6. The parts cost must be kept within reasonable limits.
7. An extensive course of "trouble-shooting" must be absolutely unnecessary. In other words, the set must work, if it is assembled properly, without trouble and experimenting on the part of the builder.

The general design is shown in Figs. 1 and 2. It will be noticed that the mechanical requirements come up entirely to what was planned for it. As for results, with the set located in Chicago operated with a 75-foot out-door antenna, stations on either coast may be brought in with loud speaker volume on the four tubes while all the locals are operating. Practically all tests of the receiver were conducted in a location midway between WEBH and WQJ, located approximately one-half mile apart. It was entirely possible to bring WGY operating on 380 meters through WEBH operating on 360, with no interference and it was possible to bring several 440 meter stations through WQJ operating on 448 with only a slight amount of back-ground interference. On the lower waves the selectivity was sufficient to separate KFNX, KFKX, WJJD, WTAY, and WTAS, all operating within a very narrow wave band. The selectivity was almost up to that of a seven-tube super-heterodyne and the volume with the out-door antenna was equivalent to that obtained with the "super" on a loop.

WHAT THE SET DOES

ADDITIONAL tests were then made to determine what the set would do on a 20-foot indoor antenna, and most satisfactory results were obtained—stations throughout the country being brought in with ease and in the case of all the more powerful ones, with loud speaker volume. The set was also tested for radiation and it was found that with the detector oscillating and beating on a given station that the same station could be picked up on a super-heterodyne about 25 feet away with no evidence that the four-tube set was oscillating.

The circuit employed consists of one stage of tuned r. f. amplification followed by a regenerative detector and two stages of audio amplification. The r. f. amplifier is neutralized to prevent oscillation and radiation, although where 199 tubes are used it is often

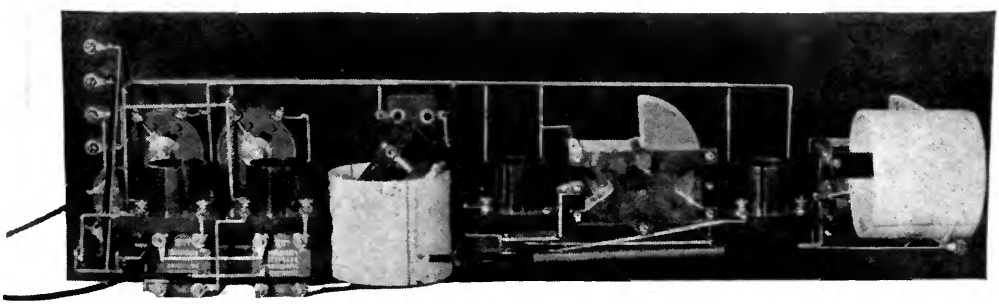


FIG. 2

The "works" of the four-tube set built by Mr. Silver. Note the connection of the neutralizer to the tap off of the vario-coupler secondary coil. All the parts are mounted on the panel and no baseboard is used

unnecessary to neutralize the set. The quality of reproduction was all that could be desired, either with storage battery or dry cell tubes and the difference in volume between 199's and 201-A's was only about 10 per cent., the sensitivity remaining substantially the same. See Fig. 3.

The tuning inductances used in the set are very efficient. I believe they have about the lowest losses of any coils at present used for broadcast reception. They are supported entirely on air with the exception of the two bakelite strips which are approximately $\frac{1}{2}$ inch wide. The turns are held in place by means of five strips of adhesive tape which introduce practically no additional losses. Some tests were run off using the coils with and without a bakelite supporting tube and it was found that the sensitivity to weak signals using the air core coils was decidedly superior to that obtained when coils wound upon a bakelite tube were used. The coils are so located that a minimum of loss from surrounding material is introduced. Some question might arise in the mind of the reader when it is seen that one of the audio transformers is very close to the second detector grid circuit coil, but the losses introduced here are negligible, however. This would not be the case if the transformer were located at one of the open ends of the coil.

The entire assembly of the set is on a 7 x 24 bakelite panel. No sub-base is used. All parts are screwed directly to the panel itself which is extremely substantial and simple. At the left end of the panel is the r. f. tuning condenser which tunes the grid circuit of the r. f. amplifier. Next is the detector tuning condenser controlling the grid circuit of the detector tube. These two controls function in exactly the same manner as the first two controls on a neutrodyne receiver and may be logged in exactly the same fashion. The third control, or tickler, is what accounts for the extreme sensitivity of the set as it provides a means of varying the amount of regeneration used in the detector circuit.

THE PARTS REQUIRED

THE material used by the author to construct the set is as follows:

2 .0005 low loss condensers (Silver, Cardwell, or Duplex)
1 Low Loss coupler
1 Low Loss Antenna coil
4 Hoosick Falls panel mounting sockets.
1 Howard $6\frac{1}{2}$ Ohm rheostat
2 Thordarson $3\frac{1}{2}$:1 Transformers
1 Carter 102-A Jack
1 Carter 101 Jack
1 On-Off Switch
1 .00025 Mica condenser with leak clips
1 .002 Mica condenser
1 .0075 Mica condenser
1 2-Megohm grid leak
6 Insulated top binding posts
3 4″ moulded dials
1 7 x 24 x $\frac{3}{16}$″ bakelite panel
1 5″ length $\frac{1}{4}$″ brass tubing, spaghetti, lugs, bus bar, solder, etc.

Tools: Screw driver, pliers, soldering iron and hand drill with drills and counter-sink.

If the builder wishes, he may substitute other parts than those specified in the construction of the receiver, bearing in mind that they must be of as good quality as those specified and of approximately the same size and values.

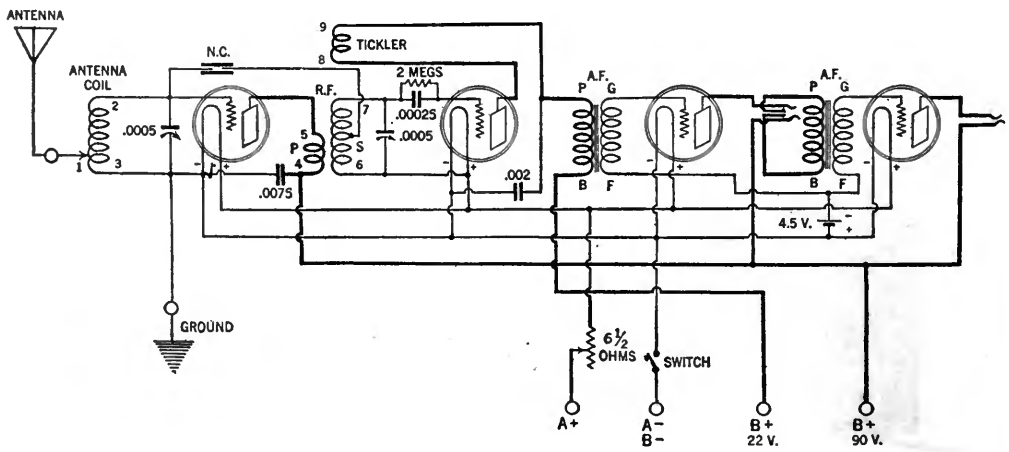


FIG. 3

The schematic circuit diagram. The various coil terminals are numbered for ease in indentification of wiring. Direct reference may be made to the numbers in this plan and those in Fig. 4

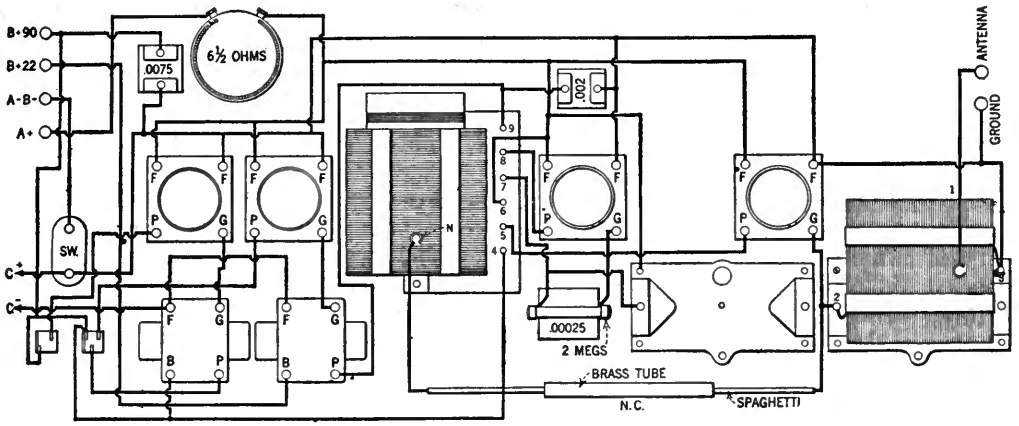


FIG. 4

A picture layout of the wiring. The parts are in relatively the same postion as shown in Fig. 2

Before starting with the assembly and immediately after the purchase of parts, they should be carefully checked and inspected to see that they are in first class condition. All bolts, screws, and springs should be tightened up so that no trouble will be encountered further on in assembling the set.

The panel should be laid out with a scriber and square following the diagram given in Fig. 5 if material as specified in the parts list is used.

After all holes have been located they should be drilled and counter-sunk where necessary. If desired, the panel may then be given a sanded finish by rubbing in one direction only with fine sand paper and oil until all traces of the original polish have disappeared.

DETAILS OF CONSTRUCTION

IF THE builder decides to wind the coils used in the set, the simplest method of doing it is to wind them upon a bottle approximately 3 to $3\frac{1}{8}$" in diameter and then break the bottle away from the coil. The method of doing so is to place five strips of adhesive tape lengthwise along the bottle, these strips being held down by two rubber bands at either end, the sticky sides up. Sixty turns of No. 20 double cotton-covered wire should be wound in place for the antenna coil with a tap taken at the fifteenth turn, the rubber bands may be removed and the ends of the adhesive tape, each strip of which should be approximately 6 inches long, may now be bound back over the coils to hold the turns in place. This will leave five bands of tape, each one running around both inside and outside of the coil and touching each turn on the inside and on the outside of the winding.

The stator coil of the vario-coupler is wound in exactly the same manner except that at one end of the tube fifteen turns of No. 30 d. c. c. wire are first wound on the bottle and then sixty turns of No. 20 wire put on over this. These fifteen turns are wound single layer, as close together as possible, and the 60 turn winding of No. 20 d. c. c. is put on starting directly over the first turn of the No. 30. When fifteen turns of the stator-secondary winding have been put in place, a tap is taken as on the antenna coil and 45 more turns then put in place. The tickler consists of a small bakelite tube approximately 2 inches in diameter and 1 inch long arranged so that it may be rotated at the end of the last coil made which is the farthest from the tap. The tickler should consist of between fifteen and twenty turns of No. 30 d. c. c. wire.

A more satisfactory way of supporting the coils would be to paint them with a good grade of insulating dope. In order to keep the losses low, however, an extra good grade of dope should be used. If the coils are made in this manner, 55 turns in the grid windings will be sufficient, instead of 60 turns, as the insulating compound increases the distributed capacity slightly.

For the vario-coupler two strips of bakelite may be used to clamp the stator coil together and they may project somewhat at one end. These two projecting ends may have a hole drilled through them which will accommodate a shaft to which the tickler coil is attached. Terminals may be machine screws run through one of the pieces of bakelite strip

which should be wide enough to project to about the edge of the coil whereas the strip inside the coil will be only $\frac{1}{2}$ inch wide.

ASSEMBLY

THE assembling may then be started by placing lugs on all instrument binding posts and mounting the parts themselves upon the panel following the scheme of Fig. 4. No wiring should be attempted before the b uilder has first studied the lay-out carefully and has turned the lugs in the directions which will permit of the shortest possible connecting wires. After this has been done, the variable condenser, coupler, and rheostats should be removed from the panel and the filament wires put in. These wires should be run along the panel at a point about two inches above a line passing through the socket bases. Small lengths of bus bar should be soldered to the main lines and carried down to the lugs on the sockets. It is advisable to cover this wiring with spaghetti. The antenna coil which has been previously wound should now be placed between two thin strips of bakelite about $\frac{1}{2}$ inch wide and $3\frac{3}{4}$ inches long. In the end of each of these bakelite strips a No. 18 hole should be drilled, placed $3\frac{5}{16}$ inches between centers and arranged so that when one strip is placed over the other the holes at either end will coincide. If $1\frac{1}{4}$ inch round head $\frac{6}{32}$ machine screws are put through these mounting strips at each end with a nut on the far side of the second strip, it will be possible to clamp the coil between the strips which rest on the winding at a point directly above one of the lengths of adhesive tape.

It will be noticed on the condenser that there are two holes used for small mounting screws on the back plate which are approximately on a line which would run through the rear shaft bearing. These screws should be removed, and after a second nut is placed on each of the $1\frac{1}{4}$ inch screws running through the coil mounting strips, these two new screws should be inserted in the holes in the condenser from which the original ones were removed. They may then be tightened up, care being taken to keep the nuts loose upon them until they have been entered at least $\frac{1}{4}$ inch into the condenser end supports. One nut on each screw may then be tightened up against the condenser end plate, and the second nut on each screw tightened up in the opposite direction against the bakelite strip. This will leave the coil clamped firmly between the two bakelite strips and mounted on the back of the condenser. In connecting this coil to the condenser, the end near the tap should go to the frame of the condenser if it is of the grounded rotor type and the end farthest from the tap should go to the statoi plates, which will in turn go to the grid of the r. f. tube. The tap itself leads to the antenna binding post.

It is very much simpler to purchase the coupler completely built up than to endeavor to build it, since its construction will involve the turning out of a special shaft, bearings and lock washers. For this reason it will not be taken up, although the winding data has previously been given, and if the constructor feels confident of his ability to build it, he will have sufficient knowledge to supply the mechanical coupling arrangement details suitable for his needs.

The r. f. condenser with its coil is then mounted at the left end of the panel and the detector condenser placed in the next position to the right, followed by the coupling unit which is located between the detector and first audio tube. The rheostat is also put in position and wired with one of its terminals to the positive A battery binding post and the other to the line connecting the positive filament terminals of all sockets. The balance of the set wiring presents no particularly difficult features and if care is used, a very neat job can be made of it. The stator plates of both condensers should be connected to the grid sides of their respective circuits.

TESTING THE SET

AFTER the wiring and assembly has been completed, the set is ready for test. If 201-A tubes are used, a 6-volt storage battery will be required and a 90-volt B battery tapped at either 22 or 45 volts for the detector. A $4\frac{1}{2}$-volt C battery will also be required for the audio amplifier. If UV-199 tubes are used, the B battery will remain the same, but the A battery should consist of three dry cells connected in series or if extra life is desired, six dry cells connected in series parallel.

The batteries should be connected to the set, and as they are connected no sparking should be noticed. If sparking is noticed it indicates that there is a short circuit in the wiring, which should then be very carefully checked. After the batteries are connected, a single tube should be inserted in the right hand socket and the rheostat just barely turned on. If the phone plug is inserted in the right hand jack a click should be heard and if a finger is placed on the grid terminal of this last tube either a click or squeal should result. If this

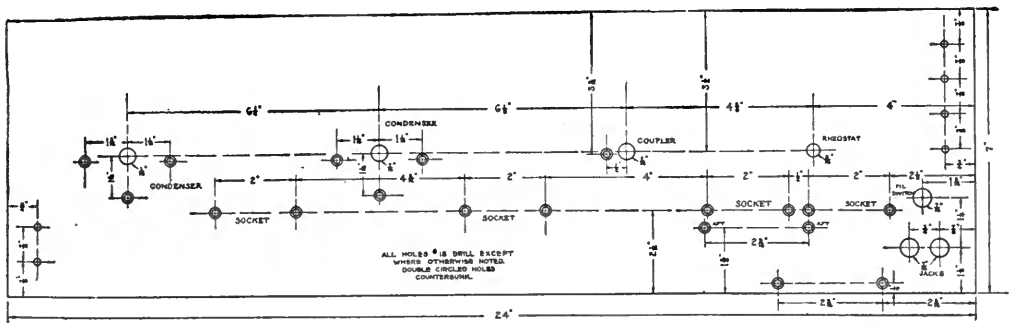


FIG. 5

The panel layout. Where other parts are to be used, it will be necessary to provide other mounting holes. The center holes then may remain as shown

is the case, it indicates that the wiring in this circuit is correct and the second tube should be inserted in the next socket. A click will be heard as it goes in and if its grid terminal is touched, a click or squeal will also be heard. The 2-megohm grid leak should be placed in the clips of the grid condenser and the detector tube inserted in its socket. Then with the detector condenser set at about 50, the tickler should be rotated and as it goes from 0 to 100, at some point along its scale a "plunk" should be heard. If, after this plunk has been heard the grid condenser is touched with the finger, a thud or squeal should result if the detector is oscillating. If the tickler is then set at zero, nothing but a click or squeal should be heard as the grid condenser is touched. If the thud is not heard at all, it is due to failure of the detector tube to oscillate. This may be corrected by reversing the leads to the rotor or tickler coil of the vario-coupler.

Now connect a ground to the ground binding post and an antenna to the small tap located on the stator winding of the coupler which also goes to one side of the neutralizing condenser, which will be connected later. This leaves out entirely the r. f. amplifier tube and gives a straight regenerative detector and two stages of audio amplification. For test purposes, the tickler may now be moved up beyond the point where a plunk is heard and the detector tuning condenser rotated until a "tweet" or squeal is noticed. This indicates a station and if the tickler is then set just below the oscillating point the signal will be heard with its true modulation.

ADJUSTING THE NEUTRALIZER

AFTER these tests have been made, the neutralizing condenser should be connected to the grid terminal of the first tube socket and to the tap on the stator winding of the vario-coupler. The neutralizing condenser consists of nothing more than two pieces of bus bar of equal length and so arranged that when soldered to the tap and grid terminal referred to and running in the same direction their ends will fail to meet by approximately $\frac{1}{4}$ inch. Both ends are inserted in a length of spaghetti which will, when run from the tap up to the grid terminal, serve to hold these two pieces of bus bar firmly in position. Before they are finally soldered in place, a small 5-inch length of brass tubing should be placed over the spaghetti and left entirely unconnected so far as the balance of the wiring goes. This completes the neutralizing condenser.

An antenna should now be connected to the antenna binding post of the set and the first or r. f. tube inserted in its socket. The rheostat should be approximately three-quarters on. The tickler should be set at zero and the tuning condenser at a position where a station was previously heard. The 5-inch brass tube should be pushed up toward one end of the spaghetti tube on which it slides and the r. f. tuning condenser varied around approximately the same setting as that of the detector condenser, when the station should be heard again. Stations should now be tuned-in over the entire range of the receiver, with the tickler at zero.

If the r. f. amplifier oscillates, the small piece of brass tubing should be slid down the spaghetti $\frac{1}{4}$ inch at a time until all tendency toward oscillation is eliminated. If it cannot be eliminated by moving this tubing along, this indicates that the primary of the r. f. transformer is improperly connected and the leads to it should be reversed. This primary is the small 15-turn coil located inside one end of the vario-coupler stator coil.

Another method of neutralizing the set would be to tune-in a fairly strong signal and then remove the first r. f. tube from its socket. A piece of paper should be placed over one of the filament pins and the tube replaced in its socket. Then, with the tube unlit, the signal will come through weakly and the brass tube should be slid along until the signal does not come through at all or at best with very poor intensity.

The receiver having been neutralized, there is nothing more to do, and in tuning it may either be operated with the tickler set at zero and the first two dials handled in the same manner as when tuning a neutrodyne, or the tickler coupling may be increased until the detector oscillates and a signal located by rotating the detector condenser until a whistle is heard. The detector condenser should be left set on the whistle and the r. f. condenser moved to a point where the whistle is strongest. If the tickler coupling is then reduced to just below the oscillating point and the two condensers readjusted very slightly, the signal will be heard with maximum intensity.

De Forest DV-3 tubes, which have the same characteristics of 199's may be used and will work in very nicely as they have standard bases and do not require adapters. WD-12's will also work in very well as they also have standard bases. It is probable that the neutralizing adjustment will not be at all critical if 199's or WD-12's are used.

TROUBLE SHOOTING

THERE is very little that can go wrong with the receiver or that might cause failure to function, and if it is assembled properly, there is no reason why it should not work. However, it is possible gradually to improve it slightly by following some of the suggestions outlined below:

Selectivity: If the detector tuning condenser is broad, it indicates the use of an insufficient amount of tickler coupling. It should be possible to make this control very selective indeed by bringing the tickler up to just below the oscillating point. If the r. f. tuning condenser is broad, this may be overcome by inserting a small fixed condenser, say .00025 or .0005 mfd. in series with the antenna which will, in effect, reduce the resistance of this circuit and sharpen its tuning very much. This will not be necessary except with a very long antenna, say over 125 feet.

Volume: If the detector can be made to oscillate and the receiver to tune sharply, poor volume may be attributed to trouble in the audio frequency amplifier and should be looked for in this section. Improper connections or misplaced C battery, would account for this. Individual location conditions will more probably be to blame, however.

Hand Capacity Effect: This will not be experienced if the stator plates of the condensers are connected to the grid sides of the circuit and if all by-pass condensers are wired in. The by-pass condensers are very important. The .002 mfd. by-pass condenser is quite important and should be connected from the plate terminal of the first audio transformer to either minus or plus side of the filament line.

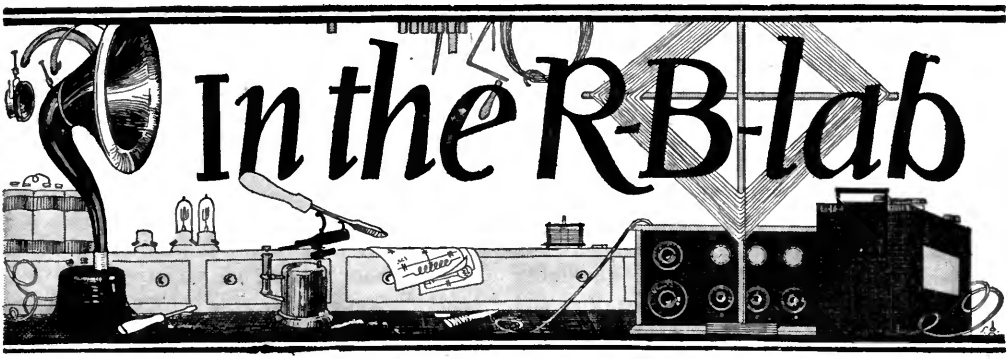
Squealing: This would be due either to too high a value of tickler coupling, failure to neutralize the r. f. amplifier, or more probably to the audio amplifier. If in the audio amplifier, it may be overcome by reversing the leads to the primary of the audio transformers or shunting the secondary of the audio transformers with a .00025 mfd. condenser or $\frac{1}{4}$ megohm grid leak, or both.

Noise: Noise in the set should be traced by first disconnecting the antenna. If it disappears it is picked up on the antenna and probably cannot be eliminated. If it persists, the first r. f. tube should be removed and so on down the line until it stops. If it stops upon the removal of some tube other than the last one, the noise is probably in its circuit. If it persists throughout the entire set it is due to some faulty common wiring, such as B battery, or A battery, rheostat, or socket contact.

Grid Leaks: A 2-megohm grid leak will be satisfactory for practically all tubes used, although it may be found that a 3- or 5-megohm grid leak will give a little better result on weak signals.

Tickler: The detector circuit should not oscillate until the tickler has been advanced to about 50 to 70 degrees on its dial. If it oscillates at some point below this, turns should be removed from the tickler coil until the oscillation point is brought within this range, if the builder wishes to do so, although this is not very important. If the detector fails to oscillate, reversing the tickler connections will correct matters.

Neutralizing: If the r. f. stage cannot be neutralized so that it does not oscillate, the leads to the primary of the r. f. transformer should be reversed. If this fails to correct matters, one or two turns should be removed from the primary, although this would be an extreme case.



APPLYING THE REGENERATIVE LOOP TO ANY SUPER-HETERODYNE

THE principle of the regenerative loop can be applied to practically any type of super-heterodyne receiver without altering the interior connections of the set. The "regenerative loop" is, as the name implies, a method of introducing regeneration into the first detector tube. This results in all the desirable characteristics of the regenerative circuit—i. e., increased sensitivity and response to distant stations, and greater selectivity. (Under certain conditions, such as operating in closed quarters as imposed by steel apartment houses in a large broadcasting center, the selectivity of the super-heterodyne operated in the usual manner falls short of its possibilities. This is due to distortion of the wave front by the surrounding walls and semi-conducting or refracting mediums. As a result, the loop is extremely unreliable as an indication of direction, the plane of the loop often being approximately 90 degrees to the expected angle, and most stations, regardless of direction, are received best at this one position.)

Regeneration in the loop can be effected in several ways. A somewhat common system, though not altogether satisfactory, employs a tickler coil situated within the loop. The adjustment of the tickler, however, affects the tuning of both the plate circuit (which inputs to the intermediate-frequency amplifier) and the grid circuit, when coupling is sufficiently close to secure satisfactory regeneration. A more common and satisfactory method is to alter the loop circuit into a regenerative system. This is a simple matter and quickly accomplished.

It is first necessary to add more turns of wire to the loop, say from one third to twice the number of turns used for normal tuning. A tap is brought out where the new turns connect to the old. The additional turns are wound in the same direction as the loop proper.

In many cases it will be found that the loop the experimenter is utilizing for straight reception has more turns than are necessary to cover the desired wave band and that the tuning condenser is only active up to about two thirds maximum capacity. Where this is true, it will probably be possible to tap the loop so that sufficient turns of wire are left on one side for regeneration. As before mentioned, from one third to one half the number of turns used in the tuning section are required in the additional or regenerative section.

The completed loop will have outlets for three connections, the upper terminal, the near-center tap, and the lower terminal. For simplicity in the

In the R. B. Lab This Month—

—How to apply the regenerative loop principle to any super-heterodyne.

—Using standard low-loss coils in the Roberts Knockout circuit.

—A receiver operating from 45 to 200 meters using the Roberts circuit and low-loss coils.

—A method for pre-determining how to connect the tickler coil in a regenerative circuit.

—Short laboratory notes of value and interest to the constructor and the experimenter.

following explanation, designate these respectively, as A, B, and C. "A" connects to the posts or jack prong on the super which leads through to the grid of the first detector tube, either directly or through the pick-up coil. A short inspection of the receiver will identify this lead. In the case of loop binding-posts, it is generally the upper one. "B" runs to the remaining loop post or prong. The connection leads through to the filament of the first detector tube. The upper part of the loop is now connected in the usual manner, exactly as the whole loop was before the change was considered.

"C" is now connected to one side of a variable condenser having a capacity not less than .00035 mfd. This will be sufficient, though if more convenient a larger condenser may be used. The condenser shown in the photograph (Fig. 1) is a Freshman mercury condenser, capacity .0005 mfd. The other and remaining side of the condenser is connected to the plate of the first detector tube. These connections are shown diagramatically in Fig. 2, where A indicates the usual loop connections in the Haynes and other super-heterodynes, and B the regenerative system.

The experienced reader will immediately identify the resulting circuit as the Hartley system, which becomes an oscillator as the condenser, C_2 is turned above the spilling over point. This system of producing oscillation is used in many transmitting stations. However, the receiving operator, utilizing regenerative loop reception should not permit the detector tube to oscillate. In this condition it is a radiator of interfering waves, which, though they are effective only over short distances, may still bother reception on another receiver located in the same building. Fortunately there is absolutely nothing to be gained by maintaining these oscillations, reception being impossible until condenser C_2 is turned down.

Tuning the "super" is only slightly more complicated with the regenerative loop. As regeneration is built up, a slight retuning of the loop or oscillator dial will be required. Regeneration will be most effective on distant stations.

Fig. 1 shows this system adapted to the Haynes simplified super-heterodyne, described in the March, 1924, Radio Broadcast.

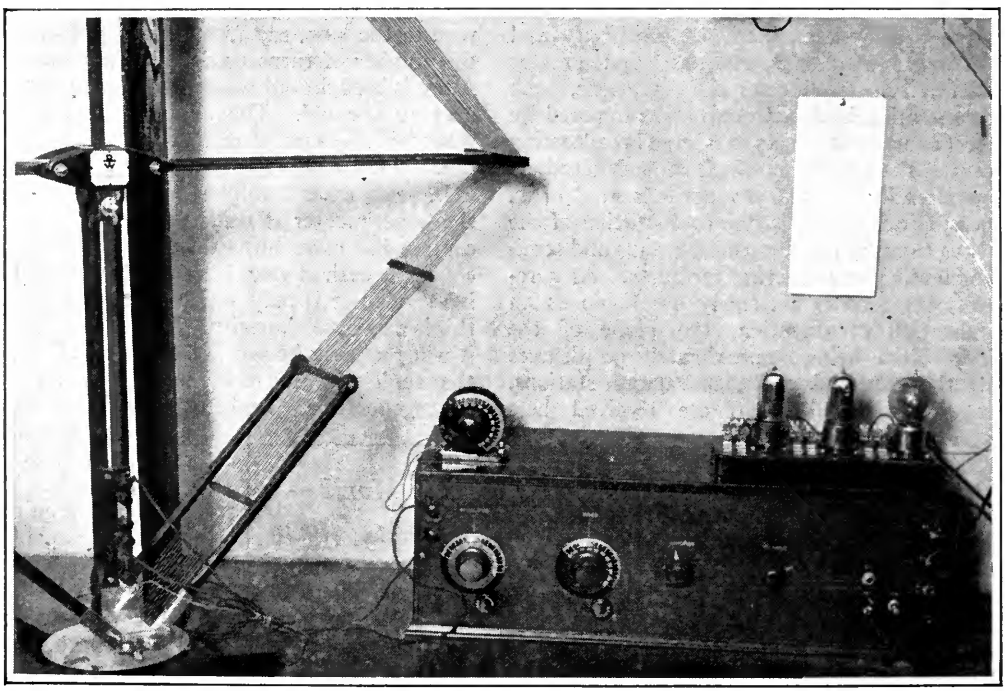


FIG. 1

The regenerative loop in operation. Note the three leads from the loop. The control condenser is above the oscillator dial. Three stages of resistance coupling are plugged in on the detector tube of this super-heterodyne. See January, February, and March, 1924, Radio Broadcast

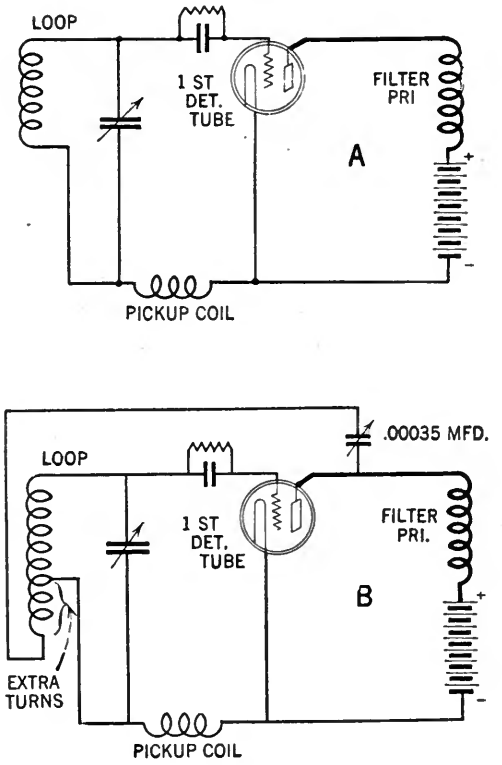


FIG. 2

"A" shows the usual loop connection in most superheterodynes. "B" indicates the additional turns and condenser which cause regeneration in the first detector tube. This arrangement is particularly advantageous on DX reception

LOW LOSS COILS AND THE ROBERTS SET

FIGURES 3, 4 and 5 illustrate the manner in which standard three-circuit low loss coils can be adapted to the Roberts Knockout circuit. In principle, the adaptation consists merely in supplying a neutralizing winding to the radio frequency output circuit. Either one or two low loss tuning units can be employed. If one set of coils is obtained, the substitution is effected only in the r. f. and tickler circuit, the usual spiderweb or similar antenna coupler being unchanged. With two units the complete system is made low-loss, from the antenna through to the audio output.

The units employed in experiments in The R. B. Lab were the "Lopez Low Loss Tuners." The same directions and manner of procedure hold good for other types.

USING ONE UNIT

IN SUBSTITUTING a single set of coils for the usual "N, P, S, and tickler" inductances, the primary of the low loss tuner arrangement is used as the transformer primary (P) and is placed in the plate circuit of the first tube. However, it is first necessary to wind either alongside or on top of the primary coil, the neutralizing winding. This consists of one more turn than the primary, wound in the same direction, with any convenient wire, such as No. 24. The beginning of the neutralizing winding is connected to the end of the primary, thus giving a common tap to the two coils, which is connected to the plus side of the B battery. The remaining terminal of the primary is wired to the plate of the r.f. tube and the end of the auxiliary winding to the neutralizing condenser. The secondary and tickler coils are connected in the usual manner.

USING TWO UNITS

WHEN a duplicate set of coils is employed, the procedure is slightly different. The antenna coupler is formed by removing the tickler coil from one of the units, thus leaving primary and secondary. These two remaining coils may be remounted in numerous ways that will suggest themselves to the experimenter. The tickler that has been eliminated from the first unit, is now substituted for the primary of the second unit, and a neutralizing winding wound upon it as already described. The number of turns on the tickler are generally more suited to the transformer primary requirements, than the primary designed for the antenna circuit.

Using these coils, the primary taps are eliminated, as the antenna primaries are generally of the semi-aperiodic type. The ground, in addition to running to the lower end of the primary, should be connected to the minus side of the A battery.

Figs. 3, 4, and 5 show how the coils used in this laboratory were mounted. Low loss coils are generally more bulky than the less efficient inductances, for which reason their disposal on the panel presents more of a problem. The shaft to the transformer primary (the upper coil in Fig. 4) has been removed, as there is no occasion for varying the coupling between the primary and secondary, and it is secured permanently by means of a metal strip. Other forms of winding, such as the diamond weave and spiderweb may be satisfactorily substituted for the basket weave coil illustrated.

A SHORT WAVE LOW LOSS SET

BY SIMILARLY utilizing short wave low loss coils, a highly efficient short wave receiver, similar to that described in the August number of RADIO BROADCAST can be had. A receiver of this type is operating successfully in the R. B. Lab on wavelengths between 45 and 200 meters. It was used in intercommunication work with amateur stations for checking up on European reception during the International Radio Broadcast Tests.

On the short wave set, the tickler should be so arranged that 180 degree variation is possible. It is, of course, impossible to secure satisfactory reception of short wave telephone broadcasts with the detector oscillating, and on the extremely high frequencies reversed feedback is generally necessary to stabilize the receiver. The tickler coupling must not merely be loosened but the coil must be turned around over ninety degrees.

It is somewhat contrary to expectations, and therefore interesting to note, that the Roberts circuit employing low loss coils, responds more readily to adjustments of the neutralizing condenser, and little or no experimenting is required to stabilize the system. Operating and other instructions remain the same as those suggested for the standard receiver.

For detailed information concerning the Roberts circuit and parts other than those just described, the reader is referred to any of the articles dealing with the set, or the "Knock-Out Book" published by RADIO BROADCAST.

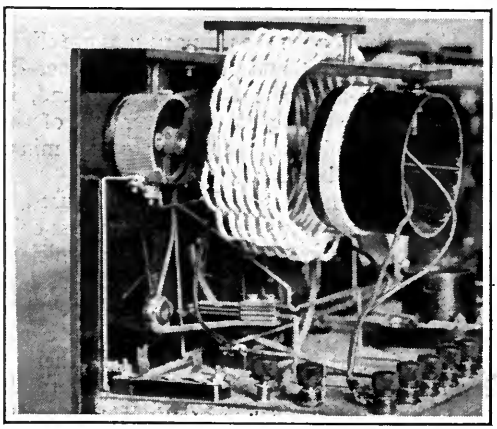


FIG. 3

Primary and secondary low-loss coils for the antenna coupler. These have been remounted from a standard three-coil unit

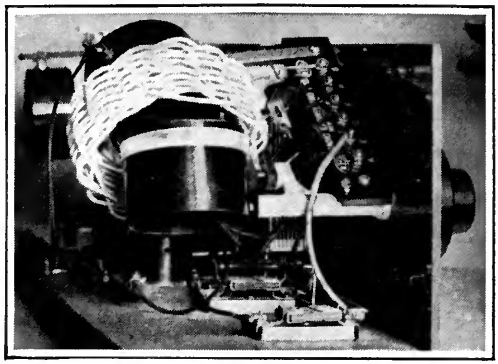


FIG. 4

The r. f. transformer and tickler coil. The primary shaft has been removed, and the coil mounted on the frame by a metal strip

HOW TO CONNECT YOUR TICKLER COIL

ARTICLES on the wiring and operation of tickler-feedback regenerative receivers are almost invariably accompanied by rather indefinite instructions as to the proper connections to the feedback coil. The reader has doubtless run across a phrase (which the writer has often written) explaining that if the set failed to regenerate the connections to the tickler were to be reversed. Thus the wiring of the regenerative apparatus was a fifty-fifty chance which, in consideration of a permanent job, was decidedly inconvenient.

There is really no reason why the exact manner of connecting the tickler coil should not be stated, for all doubt can be eliminated by a simple rule.

Regeneration is secured by tickler feedback when energy is fed back from a coil in the plate circuit of a vacuum tube to a coil, generally the secondary of a vario-coupler, in the grid circuit, in such a manner that the returned impulse is in the same or assisting direction of the existing grid impulse. When the directions are reversed, that is, when the feedback impulse is in a direction opposing the grid impulse, the effect is naturally reversed, and instead of regeneration we have a very noticeable weakening of the signal.

To one familiar with the laws of induction, these considerations will throw light on the situation. Let us assume that the incoming signal places a momentary positive charge on the grid. This will, of course, cause an increase in the plate current, with an expansion of the magnetic field about the tickler. This

motion of the flux will induce an appreciable e.m.f. in the secondary coil if the coupling is sufficiently close. If regeneration is desired, this e.m.f. must be such as to place an additional positive charge on the grid which assists the original charge. However, we know that an induced current is always in a direction opposite to that of the original or inducing current at moment of induction. This brings us to the very simply rule which may be relied upon to guide tickler connections rightly.

Take any regenerative circuit, and consider two distinct currents as flowing from the tube, one from the grid, through the grid coil or secondary to the filament, and the other from the plate, through the plate coil and battery to the filament. (These conditions, in an electronic analysis, often exist during reception). The drawings in Fig. 6 illustrate this conception of the two individual currents flowing from the grid and plate of the tube, the arrows indicating the direction of flow as we have suggested. The rule is (bringing the coils close together) that these two currents must flow in opposing directions—i.e., one set of arrows must point up and the other set point down.

The rule is further qualified as follows: When the coils are wound in the same direction (A) either clockwise or counter clockwise, the grid must connect to the beginning of the grid coil and the plate to the end of the tickler or, of course, vice versa. When the coils are wound in opposite directions, the grid and plate should connect both to either the beginnings or ends of their respective coils.

B, in Fig. 6, shows two coils wound in the same direction in which the requirement for regeneration has not been filled. The effect of this coupling, as explained, will be the opposite of regeneration.

LABORATORY HINTS

THE capacities of condensers used in radio circuits are generally given in microfarads, which means one millionth of the unit of capacity, the farad. The abbreviation for microfarad is "mfd." Thus, we often run across condenser specifications such as .001 or .0005 mfd. There has been a recent tendency to eliminate the decimal, and to consider these small capacities in micro-microfarads, or millionths of a microfarad. The abbreviation for this term is mmfd. Condensers having capacities of .00025 mfd., .00035 mfd. .0005 mfd. and .001 mfd. can be respectively described as 250 micro-microfarads, 350 micro-microfarads, 500 micro-microfarads, and 1000 micro-microfarads condensers.

AN EXCELLENT reamer for working panel material is a round file, $\frac{3}{8}$ inch in diameter at the large end. Enough of the tang is broken off so that the file can be grasped in a brace. Any hole in which the point of the file can be inserted can be reamed up to $\frac{3}{8}$ inch by turning the brace

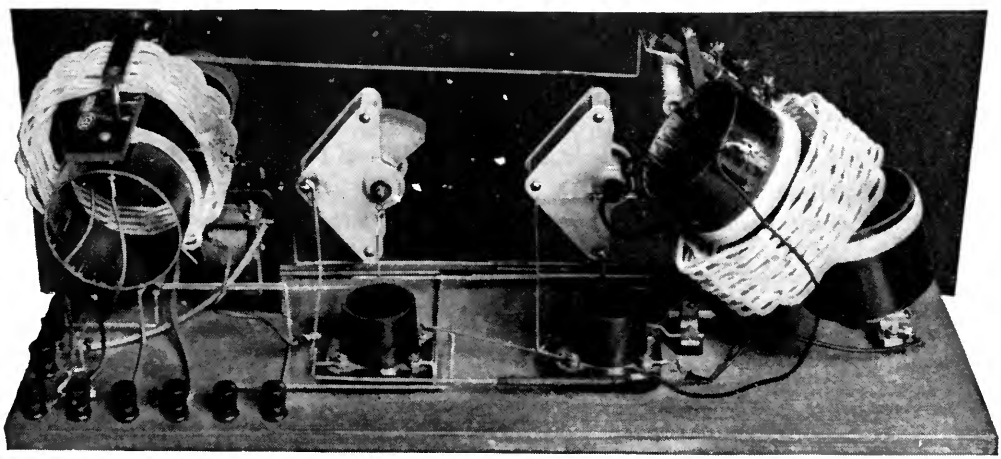


FIG. 5

Rear view of the low-loss Roberts, using adapted Lopez Tuners. This set is particularly easy to neutralize

counter-clockwise. If turned clockwise it will jam.

Holes reamed in this manner are very smooth and have little taper.

IN THE article on charging storage B batteries in the June RADIO BROADCAST, mention was made of the discrepancy between a hot wire meter and a d.c. meter in a common charging circuit. The a.c. meter will always give the higher reading, and a statement was advanced that this reading was to be preferred as being the more nearly correct value of the current flowing. This is erronious. The hot wire meter registers the root mean square or heating value of the current, and the d.c. meter the average value of the current. An electrolytic process, such as that functioning in a storage battery during charge, varies with the average current. That is, a two ampere charge applied for one hour, off for one hour, on for one hour, etc., is equivalent in electrolytic effect to that obtained by applying a one ampere charge continuously for the total length of time of the intermittent charge. It can be shown that in a pulsating current, the r.m.s. value is always higher than the average value.

In almost every other case where measurements are desired of a pulsating current, it is the r.m.s. value that should be observed.

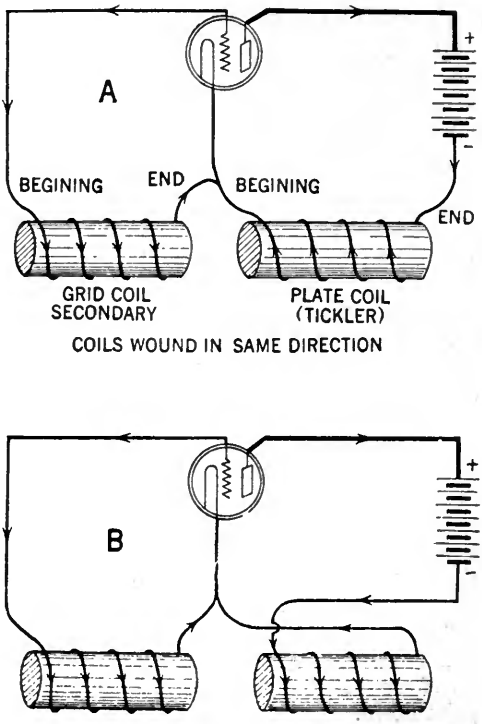


FIG. 6

How to connect your tickler coil for regeneration, in accordance with simple rules set forth in this article. "A" will regenerate. "B" will not.

Shall We Specify Parts?

The Policy of This Magazine in Publishing Construction Articles—A Note on Radiating Receivers

BY ARTHUR H. LYNCH

FOR some little while we have given a great deal of thought and consideration to the interesting subjects discussed in the letter we publish below. Similar questions to Mr. Musladin's have been asked us time and again. The answer is not easy, nor can it be made without reservations. We try to have the articles appearing in our magazine as near correct technically, practically, and ethically as human effort permits. You will find Mr. Musladin's letter of interest, and we will consider it below.

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

DEAR SIR:

The writer has been observing construction articles in radio publications and feels that there should be a general movement toward broader specifications of parts.

It is no secret, to be sure, that exact specifications are causing both dealers and jobbers considerable trouble. The layman in reading the articles justly believes that good results can only be obtained by following exact specifications, if exact specifications are published; and while it may or may not be the writer's intent to press that idea, nevertheless the ultimate result is that both dealers and jobbers receive hundreds of requests for materials not stocked in jobbing centers away from manufacturing centers, because of the fact that the particular item is not a nationally recognized standard.

From a personal standpoint I might say that we are very proud of the fact that we carry practically all nationally recognized standards. There is hardly a need of publishing a list of them, but it will suffice to say that such a listing would prove that it is our desire to serve the public in this particular territory with parts to which they should be entitled.

By way of detailed explanation, one might take the variable condenser situation. Is it not a generally accepted fact that the substitution of any of the wonderful examples of condenser construction now on the market will produce like results?

The audio transformer presents another case. Jacks, rheostats, binding posts, and similar items are certainly not subject to exact specifications. In cases where a company has succeeded in producing a very good patented item, and which will prove popular when presented to the public, the right of that company to subsidise, or themselves publish, an article is not questioned. In cases of this kind winding data or construction data should be given.

To come down to the real point of my letter, would it not be possible for editors to adopt some standard expression for use in terminating all such articles? My suggestion is as follows:

The above items were used in the author's described set, but substitutes of equally good materials will produce like results.

You are, of course, in better position to promote such an idea, and I believe you would have the thanks of those engaged in the radio business, and those who desire to see the business as a whole put on a strictly ethical basis.

Very truly yours,
ALEXANDER AND LAVENSON ELECTRICAL SUPPLY COMPANY, San Francisco, Cal.
By C. P. Musladin, Sales Manager

We try to give the reader every possible assistance in building receivers from the articles we publish. Wherever possible we name the parts used in building the receivers, and where similar units of other makes can be employed with equal satisfaction we say so. We try, as far as possible to describe only such receiving circuits as include parts of reputable manufacture, which may be purchased in all parts of the country. Where special parts, such as the coils for the Roberts circuit and the intermediate-frequency transformers of certain super-heterodynes are recommended, we insist upon authors supplying us with data concerning their construction as well as the names of units which may be substituted wherever possible. We cannot insult the intelligence of our readers by mentioning all the condensers which could be used in a given circuit, for instance. There are a great many good variable condensers on the market any of which—if of proper capacity—would work well in a circuit where a particular brand is mentioned. This is true of audio-frequency transformers, tube sockets, jacks, rheostats, panels, and similar products. As a general rule, any good parts designed for the same purpose may be interchanged in a well designed circuit.

We quite agree with Mr. Musladin. This magazine will continue to print construction

articles, specifying particular parts when necessary, and wherever possible indicating the use of standard products. But, for the time being, we must remember that the market is pretty well flooded with useless and poorly designed parts which we hope to save our readers from buying.

It is true that certain manufacturers subsidize writers to specify their units. Sometimes, perhaps, they are justified in doing so. Such articles are usually taken with a grain of salt by the reader and though they may make some temporary friends for the publication among those whose parts are specified, the usual result is unfavorable reaction on the part of other advertisers. In many instances the periodicals in question do not acquaint themselves with the performance of the receivers described and, as a result, many utterly useless purchases, and general dissatisfaction will result. As an instance of this: an experimenter sent us a very well written and very well illustrated article, describing a five-tube, single-control receiver some few months ago. The work was excellent. We asked for a demonstration. When the receiver came to our laboratory we were delighted with its appearance. Then we tried to make it work. Then we called for assistance from the designer. He tried to make it work. Then he began to make apologies. Imagine our surprise on seeing the description of this wonder appear on the front page of a certain newspaper radio section for which we had come to have a feeling of friendship because of the technical accuracy of the articles it published.

There are occasions, when the subsidized writer—usually signing his articles with a self-imposed "Radio Engineer"—really does describe something worth while and, even if he does load his literary efforts describing it with publicity which is supplemented by price lists and space in the advertising section, the intelligent reader will take it for what it is worth. We are quite certain that advertising contracts, secured by the offer of a certain amount of editorial comment per dollar are hard to renew. We want none of them. On the other hand it is equally unfair to the reader, who, in the final analysis pays the piper, for any periodical to withhold a description of a valuable addition to the radio field because it is not to be accompanied by advertising.

Our policy is governed by the value we believe the article under consideration will be to our readers. If it happens to stimulate the sale of reliable products, we believe it does the reader and the manufacturer a service, by bringing to the former a good product and the latter a customer. In doing this work, however, we try to maintain a perfectly fair stand in connection with products of a competing nature. It is only by such procedure we believe the industry will prosper.

THE BLOOPERS ARE AT IT AGAIN

IT IS rather significant that all of the letters considered here were received in the same mail. If we get many more, requiring such lengthy comment we may have to abandon the magazine and devote all our time to correspondence.

Mr. Guy M. Chase of Elizabeth, N. J., is responsible for the letter which follows, which, with our reply, seems to require no further comment.

Editor, Radio Broadcast,
Doubleday, Page & Co.,
Garden City, L. I.

Dear Sir:

On page 280 of the December issue of Radio Broadcast in an article by A. H. Lynch, there appear statements which are, to me, interesting.

Speaking of the absence of "squealing receivers" at the Radio Fair, the article lists, "all manner of tuned radio frequency receivers, reflexes, and super-heterodynes," with the intimation that they do not squeal.

I know of a certain factory-built five-tube tuned radio frequency receiver in this city, operated on a 100-foot outside antenna which is *always tuned by the squeals*, even on locals. With 90 volts on the plate, is not that a squealer?

Super-heterodynes operated on outside antennas, with a constantly oscillating tube as a part of the working of the set, seem to me to fall in the squealer class, with a vengeance. I know of improperly tuned neutrodynes likewise tuned by the squeals.

I read most of the radio magazines published and I set up and try out a great many circuits. There are few which will not squeal when improperly operated or improperly adjusted, at least, that is my experience.

My point is this. I have been impressed with the fact that most radio magazines are obsessed with the idea that only regenerative circuits *can* squeal. I have often heard a salesman tell a buyer that a neutrodyne set or a tuned r.f. set could not squeal. I think that is sheer fraud.

True, regenerative circuits can be so operated as to be a pest to all for miles around. Those who have recently listened for Europe can swear to that. But not all the squeals come from regenerative sets. (I except the single-circuit from any consideration, as it is, by all odds, the champion squealer.)

Using two coupled regenerative sets, of the so-

called Ambassador type, another person and I have used two antennas which are parallel and two feet apart for 40 feet, one being 40 feet long and the other 100. We tuned all over the scale and neither one of us heard a squeal from the other set. The other operator used a loud speaker and I phones and one a.f. stage. Coupled regenerative sets, like any other, can be operated without squeals.

I ask consideration of this point:

Any set, regardless of name, type, or price, which will produce a squeal in its own speaker or phones, also produces a squeal in near-by speakers and phones.

Very truly yours,
GUY M. CHASE, Elizabeth, New Jersey.

Mr. Guy M. Chase,
Elizabeth, N. J.

DEAR SIR:

Thank you very much for your interesting letter. We have not overlooked the very important matters that you discuss, but Rome was not made in a day and it is impossible for us to do much at one time.

One of the principal reasons for our International Tests was to demonstrate conclusively to the radio listeners that squealing receivers should be abolished. It makes no difference to us whether they be single-circuit or improperly balanced neutrodynes or super-heterodynes hooked up to an antenna.

Thank you for your coöperation.

Very truly yours,
ARTHUR H. LYNCH
EDITOR, RADIO BROADCAST

Then, along with Mr. Chase's letter and several thousand of a similar nature we have one from an old-timer—a man who was for some time a radio inspector for the Marconi Wireless Telegraph Company of America. We felt that editorial expression concerning this letter is a waste of time. No doubt ninety per cent. of you folks listened for Europe during our international tests and it is quite likely that most of you heard the racket to which Mr. Collison refers and no additional reference to the subject is necessary at this time.

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

DEAR SIR:

On Monday, Wednesday and Thursday nights of the International Test week, friend wife and I aided by a nine-tube super-heterodyne that has just been calibrated by Tyler, Rossiter, and MacDonald of New York City, deprived (and that's just what I mean to say), ourselves of sleep and almost ruined our sense of hearing not to mention our dispositions, in an attempt to pick up some of the European Stations.

And what did we hear?

Promptly at eleven o'clock, four million assorted squeals, whistles, whines, yowls, grunts, rattles. buzzes, ships working with spark sets with a decrement of something more than ten times what is allowed, chirping and twittering amateurs with little five-watt bottles (I dare any member of the A. R. R. L. to deny that his fellow members kept within bounds), and enough static to fill in the weak spots.

It's an outrage—I don't mean the static,—that's sent to us either from Heaven as punishment for our sins, or from Hades to plague us and must be accepted along with Income Tax Publicity, Near Beer, and Subway Rush Hour Riots.

But this oscillating receiver business is something that does not have to be endured. Newspaper publicity has not helped, because the average B.C. L. does not care a tinker's damn about the other fellow. Of what use is it for any person to invest several hundred dollars in a laboratory model super-heterodyne if some hi-jacking neighbor with a "one-tube-marvel" is going to smear the ether with noise.

Although the range of my super-heterodyne with a loop is considerably less than when used on an out-door antenna I would not think of putting it on an antenna because I know it would ruin reception for my immediate neighbors. I live in an apartment with several other B. C. L.'s and none of us annoy each other. That is because we have used our brains in a manner courteous to each other.

There is no way of getting under the skin of those who persistently sell parts which when assembled will cause radiation. They are of the same moral fibre as a bootlegger.

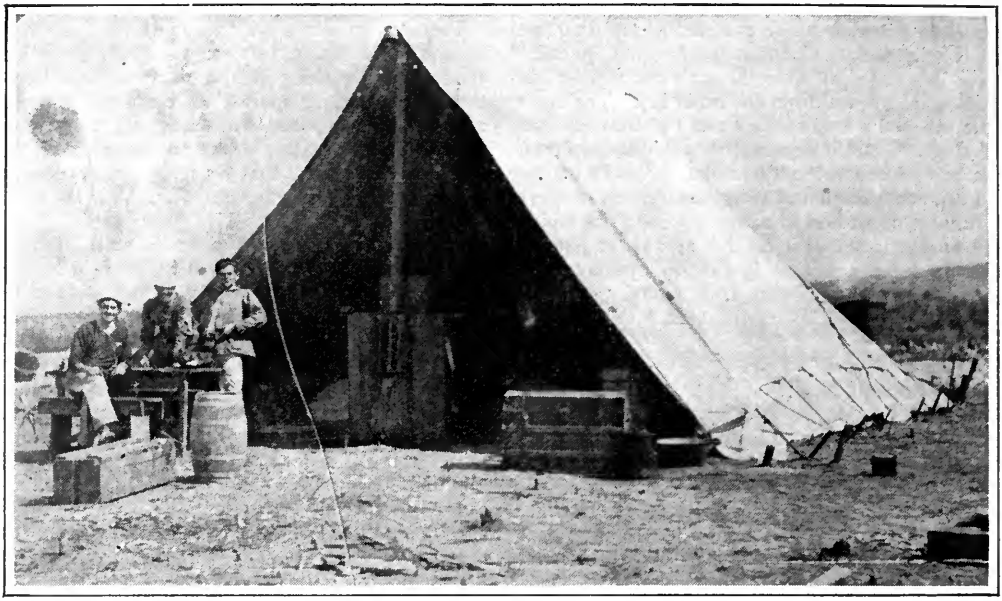
Every receiving set manufactured in the United States should be of a design approved by the U. S. Department of Commerce. All commercial radio apparatus must be so approved, so why not every other kind? This would remedy one source of trouble. Every installation connected to an outdoor antenna should be licensed by the Radio Inspector of that District and subject to his restrictions and orders. A one dollar license fee would not be a hardship and would more than pay for the cost of the extra inspectors needed. Periodic inspections might be arranged to check up the installations.

No doubt there will be many objections to this plan because it will curtail some "personal liberties." On the other hand I defy any person to defend the radiating receiver or the rights of any individual to use it.

The other remedy would be "super-powered" transmitters that would make the construction of such delicate and highly efficient receiving sets unnecessary.

No, I did not hear any European Stations.

Cordially,
PERCE B. COLLISON, Brooklyn, N. Y.



ON CUBAN SANDS

The party which installed the station had to live in tents for some time before other buildings could be put up to house them

How Wireless Came to Cuba

The Drama and Struggle of Strenuous Radio Times in the Jungle—Hitherto Unpublished Memoirs of High Technical and Human Interest —What Really Happened in the Early Days of Wireless Telegraphy

BY FRANK E. BUTLER

Former Chief Assistant to Dr. Lee De Forest

THE way we went about building a wireless telegraph station in 1905 was an entirely different procedure from that followed to-day when the modern radio engineer starts out to construct a broadcasting or any other type of radio station.

Instead of blue prints to guide us in those pioneer days we used only past "experience," and our stock of that was mighty limited. If past "experience" failed as a means of attaining further satisfactory results, then we relied upon patience and determination. These unscientific assets were all we had to help us in the working out of each new problem.

Up to this time, three high powered stations had been erected by Dr. Lee De Forest, one at the St. Louis World's Fair, one at Pensacola, and the third at Key West, Florida. These stations, while practically of the same design and construction, had presented in their building individual problems which had to be worked out These experiences had somewhat tempered our conceit as to what we thought we knew about installation. We began to realize the uncertainty of any set radio laws, and to expect anything to happen, or fail to happen.

This was the situation when I went to Guantanamo, Cuba, to erect the next in the series of five powerful stations to be built by Dr. De Forest for the United States Navy Department.

I sailed from Key West early in the spring of 1905 for Havana from whence I was to take a train overland to Santiago and from there embark once more by boat to within a few miles of my destination.

A brief stay in the delightful city of Havana

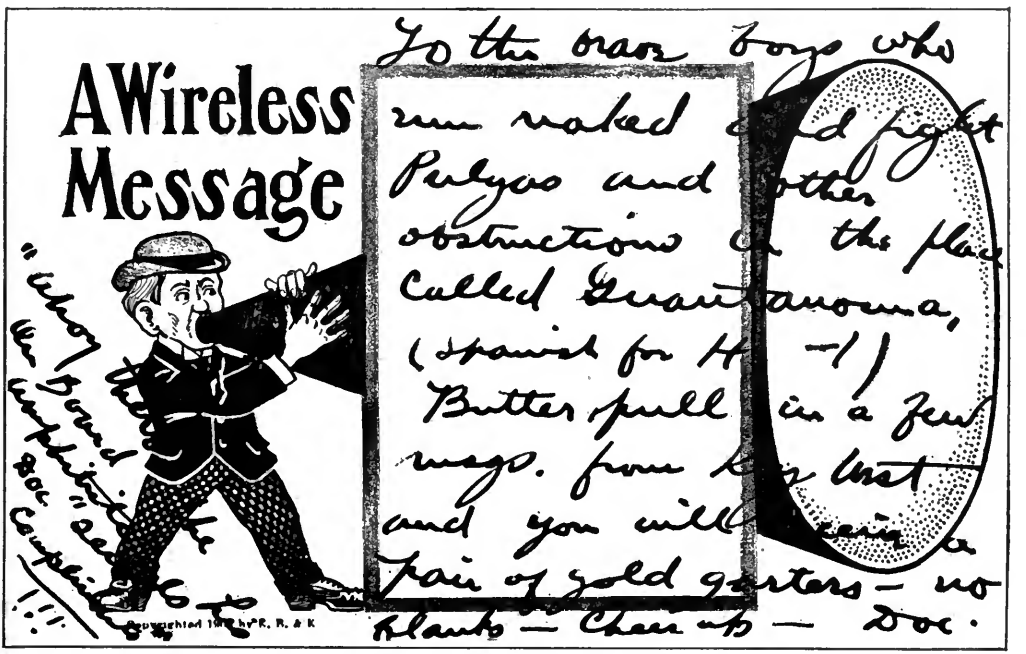
enabled me to form an idea of the difficulties I would have in a country whose language I didn't know and where buying facilities were very inadequate. My stay there was during the celebration of the first Cuban Independence Day, which resembled our own Fourth of July. The city was full of natives from all over the island, and when the train left Havana that evening I was mixed in with the most motley lot of passengers I ever met. I was the only white man.

A great quantity of wire, instruments, etc. had been shipped to me at Havana from New York. Having been forewarned of the advisability of not checking this material as baggage or shipping it via express on account of the unreliability and slowness of these methods, I decided to take it all in the car with me. As a result, my seat in the so-called, "sleeper," resembled a baggage car.

EN ROUTE TO GUANTANAMO

THE train dragged along slowly all night and seemed to stop at every sugar plantation. In the morning we stopped thirty minutes at a town for breakfast which was served in a large room adjoining the depot. The passengers swarmed in there like a lot of cattle. There were no chairs, just long benches to sit on. Everybody grabbed, and so did I. They all talked Spanish, and they all talked at once. I was the only American in the crowd. The only Spanish I knew was "agua" but as they did not have any water, this one-word proficiency in the language was useless. Everybody was drinking wine, so I drank it, too, the while I sat in amaze as I watched the others empty glass after glass until they were stopped only by the call that the train was ready to move on.

At each station I hoped that some one would come aboard who could speak English. But all that I heard from the new passengers as well as the old, was Spanish. During the stop for lunch I was sitting rather disconsolate by myself when I noticed a dapper young Cuban army officer, who had, apparently, been to Havana for the recent celebration. He appeared very popular with the entire crowd. Just before leaving the station to board the



"DOC" DE FOREST TO MR. BUTLER——

The postal card was mailed in St. Louis on June 14, 1905. He writes: "To the brave boys who run naked and fight pulgas and other obstructions in the place called Guantanamo (Spanish for h—l) Better pull in a few msgs. [messages] from Key West and you will receive a pair of gold garters—no blanks—cheer up—Doc." And along the side: "'Ahoy there on board the *Amphitrite*—Doc sends his compliments'" The pulgas are small insects, almost invisible. They swarmed about the station in clouds, and their bite, while not poisonous, was very annoying. Since these insects chose to hover under clothing, the radio pioneers at Guantanamo often took the easiest way and removed most of theirs, hence Dr. De Forest's remark about the "boys who run naked"

train he came over to me and said, in perfect English, "Hello, John. Are you going to Santiago?" Every stranger in Cuba in those days was called, "John."

When I replied in the affirmative, the dashing young officer told me that he, also, was going there. From that moment the aspect of the trip was changed. I had found a companion, and a delightful one he proved to be!

About three o'clock the train stopped at what appeared to be a railway terminal. I stepped out to the platform for a little exercise while engines were being changed. After about ten minutes everything was in readiness, yet the train did not move. Fifteen, twenty, thirty minutes passed, and still we stood there. I noticed a little crowd by the baggage car so I strolled up to investigate the trouble. Imagine my surprise to find the entire crew circled around a large coil of wire which had been taken from my seat while I was away. All were talking excitedly and casting suspicious glances at me. I couldn't understand the situation. I hurried back to the "sleeper" to seek the assistance of my English-speaking Cuban friend. He came forward with me and asked what the trouble was. They explained that it was against the rules of the company to carry such kind of "baggage" in the sleeping car unless the express charges on it were paid. I had visions of a hold-up which would either mean most of my money for carrying charges or the confiscation of my tools and material. So I asked my interpreter to inquire the amount of the charges. The excited gestures and the combined talking of the crew increased my fears and I expected the worst. Imagine my surprise, however, when I was told I would have to pay the railroad company thirteen cents in American money to release the wire so that the train could proceed with my baggage in the sleeper. Upon payment of this sum I had to wait for several receipts and then the train again started on its journey.

We arrived at Santiago about nine o'clock that evening after a twenty six hour drag. It was dark and the town was lighted with old fashioned kerosene street lamps. Through the officer I engaged several Cuban boys to assist me to the dock with my luggage as there were no conveyances about. From here I boarded a small steamer enroute to Boqueron, located on the interior shores of the Bay of Guantanamo.

The boat steamed out of the bay and past old Morro Castle over the spot where, a few years before, Hobson had sunk the *Merrimac*. We skirted the southern shore of the island and could see, as we passed by, the dim outlines of some of the hulls of the Spanish fleet which Admiral Sampson beached during the Spanish war.

THE SCENE OF ACTION

EARLY the next morning we arrived at the little group of huts which was called Boqueron. This hamlet port was the nearest point to the site of the contemplated government wireless station, which in Spanish was called telegrafo sin hilo.

It will be remembered that it was only a few years previous to this time that the Spanish-American war occurred which resulted in the freedom of the Cuban people. The United States Government had only very recently completed the arrangements of the formal turning over of the island to its natives, and it was the jollification at Havana which I saw only a few days before which had been held in honor of the event. In this transaction it was agreed that the United States should retain a small spot in Cuba as a naval base and coaling station. The site selected was the Bay of Guantanamo and its surrounding land consisting approximately of thirty-six square miles. About half of this was land and half water. The entrance from the sea was through a narrow inlet with high hills on either side extending along the coast. It was an ideal land-locked harbor, and big enough to accommodate all the navies of the world at once.

The sight of the harbor was inspiring, and the sight of Boqueron was depressing in proportion. The principal building was at the dock. A few native huts, a store and a saloon, housed the entire population of, perhaps, twenty-five people. The loungers around the dock were a tough looking lot, mostly negroes or half-breed Spaniards, just the kind you see in blood and thunder plays. I learned later that a few of them were fugitives from justice, and two were wanted in the United States for murder.

As I needed assistance to get overland to my destination I engaged a Jamaican negro, George Morehead, who spoke English, to go as my guide. We strapped the luggage across the backs of two horses and started afoot on the hike through the jungle to the government "lines" beyond which was the continuance of the jungle to the point where the wireless station was to be built. Government surveyors were the only white men who had pre-

ceded me through this wilderness, and the marks of their hatchets as they hewed the trail through the underbrush, were the only signs that any one had ever been there before. The land on this entire reservation, and for miles beyond, was in its virgin state. All was a dense undergrowth and jungle, interspersed with low, arid, sand flats: a paradise for mosquitoes, snakes, horned toads, scorpions, tarantulas, wild cats, and all other kinds of tropical creatures, flying and crawling.

I found George an intelligent fellow, entertaining and thoroughly trustworthy. This in itself was a godsend, as one would hardly expect to find anything like honor in surroundings such as these. As we journeyed he asked me if I had a pistol and I told him I had. He advised me to carry it always in my belt whether or not I ever had occasion to use it, as the many bad Negroes down there behaved only when they knew that the white man had a gun. I later found this advice valuable.

ONE THRILL OF MANY

ONE of my first thrills happened on this pathfinder trip. As we emerged from the jungle trail onto a wide level stretch of sand flats, I noticed that far ahead of us the earth looked bluish white, while beneath us it was hard packed salty sand. Nearing the blue patch I noticed this "land" moving. Slowly the bluish white part was separating in the middle with a wide swath and making a path showing the earth underneath. The negro, noticing my amazement, smiled and told me that this was a large army of land crabs scampering away to avoid us. They were there by the millions—ugly, worthless, destructive creatures with glaring, protruding eyes and wicked claws, some of them as big as human hands. In their cowardly nature they scurried and scampered away from us. But had we fallen helpless by the wayside they would immediately have returned to devour us.

A short time previous to my arrival the U. S. monitor, *Amphitrite*, had anchored in the harbor with officers and men to break ground for the construction of the new Naval Station. This ship was the Naval headquarters of the entire reservation and its commanding officer was the acting Commandant of the Navy Yard. Three Navy electricians from the ship were assigned ashore with me. They were: John Watts, Chief Electrician, of New York, Roscoe Kent of St. Paul, and V. Ford Greaves of Minneapolis.

First we lived in a tent and got our food

A TYPICAL NATIVE HUT

supplies from the ship. The initial general work to be done was the clearing of the dense growth of mango bushes which grew profusely along the shores around the station site. This made sport for the mosquitoes. Next a small dock was made so as to land supplies for the engine house and other necessary material. Finally, the engine house was completed to the extent that we could move in there until our regular living quarters were finished. Mosquitoes by the millions abounded and they made life miserable for us both day and night until we were able to obtain the necessary fine mesh netting to protect our tent and house.

It was not uncommon to be awakened in the night by the sound of a wildcat outside, for the animal was attracted there by the smell of food. Once we failed to close the flap of our tent and were awakened in the middle of the night by a suspicious but familiar sound inside. We switched a flashlight in the direction of the sound. Instantly a huge cat sprang completely across three of our cots to the tent opening and escaped with our next day's quota of meat.

Any one who has ever witnessed a southern sky can understand our enjoyment in watching the southern constellations which are so different from those at home. Huge fireflies as big as bumblebees emitting a bright green light filled the air at night. Small deer were plentiful and once we shot a fine specimen from our door. In the nearby inlets were the beautiful pink plumed flamingo birds so free from the haunts of man as not to fear our approach. In the waters all about us were gold fish, star fish, sea urchins, cow fish, and scores of other tropical wonder fish, besides many of the edible variety.

But enjoyment of the scenery had to take

second place to work. Heavy concrete abutments were constructed for the huge towers. These were in triangle formation three hundred feet apart. The towers were made of eight inch timbers, about three feet square at the base and tapering to one foot square at the top. They were two hundred and eight feet high. Suspended from the cross cables at the top was a big fan antenna from each of the three sides of the triangle. Heavy, seven-strand phosphor bronze wire was used and each triangle consisted of about 15,000 feet of wire or a total of 45,000 feet for the entire cage. This immense amount of wire weighed over a third of a ton, or the equivalent to the amount used to-day by radio fans in building five hundred sets of antennas. The huge cage resembled a giant gold fish globe two hundred feet high, and months afterwards, when the station was in operation, the mesh of wires would emit a bluish brush discharge at night which was beautiful beyond description and always proved of unending awe to the natives who would stand off from afar and gaze in open mouthed wonder.

QUARTERS

THE main building consisted of six rooms, which included living quarters. About 100 feet distant was the engine house which contained a 50-horsepower gasoline driven dynamo that furnished the electrical power. The station was rated at 20 kilowatts. One room contained the operating instruments, another the huge condenser trays, the spark gap and helix. So many wires from the antenna came into the one point of the bottom apex that it was necessary to build a gibbet to hold them on account of their weight before running them into the station.

It so happened that the site of the station was selected by Navy officials who instead of first considering its location from the point of its adaptability for perfect wireless work, selected it because that particular space was down on the blue print as the place, just as every other building planned for the reservation. As a result, a worse location could not have been chosen, The little peninsula upon which the station stood was wholly of coral formation, entirely dead as far as moisture or good ground facilities were concerned. This condition gave us no end of trouble in getting the station to function properly.

The days were hot and dry and the insects bothered us so much that work progressed slowly in the erection of the buildings and the installation of the apparatus. Many times it was necessary to tie a towel around one's face, neck, and head, leaving only opening enough to see and breathe, wearing overalls and shirts saturated in kerosene was another method used to ward off the pestering insects.

Hard luck seemed to follow every move. High winds often blew down our antenna, and the station was struck by lightning three times. Once we experienced a slight earthquake shock, but aside from frightening us it did no damage.

An outcast Frenchman by name of Émile was our cook. He spoke broken English, poor Spanish, and never ceased telling us of his acquaintance with Sarah Bernhardt. He was a chef by courtesy only, but was the best we could procure in that godforsaken land. Another interesting member of our family was Marianna Binega, a Cuban Negro, black as the ace of spades, but loyal to the last degree. He was a general roustabout; but did everything in his power for us. He watched over our health and comfort always, once saving me from the bite of a scorpion by quickly cautioning me not to put my arm in the sleeve of a coat which had been hanging for some time in the closet without being worn. Excitedly he told me in Spanish (which by this time I had begun to grasp) to shake the garment. Sure enough, out from the sleeve dropped the wicked insect which Marianna quickly surrounded with an oiled wick, then lighted it so that the scorpion would commit suicide—which it did—thus giving me, as Marianna had designed—another souvenir, which I still possess. To Marianna, I was, "Mistah Fraang." Kent was "Mistah Kee." Watts was "Mistah Gwaa" and Greaves was "Mistah Greavo." He was as faithful as Friday to us.

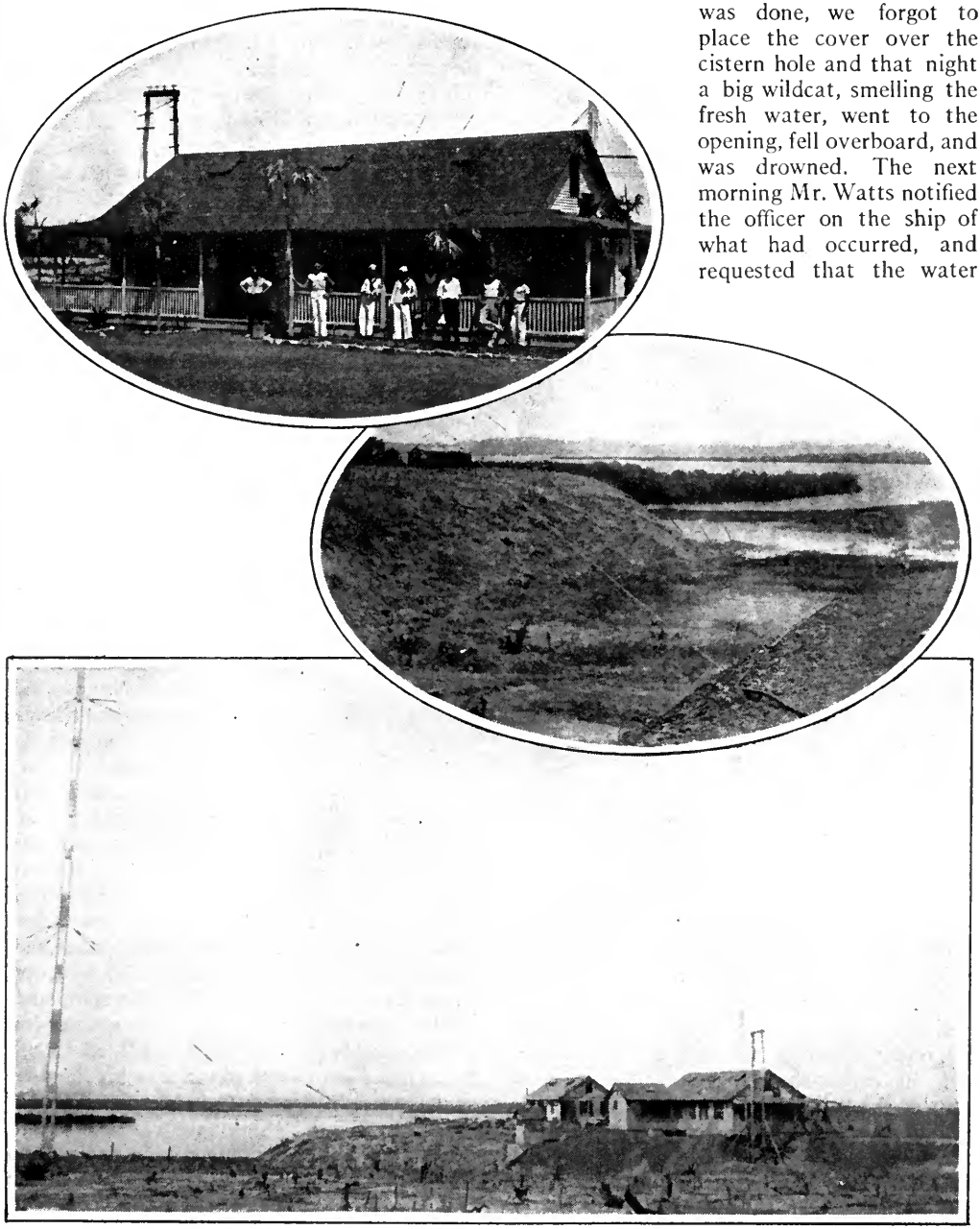
GOVERNMENT INSPECTION

FOR some reason, unknown to me, a so-called government inspector was sent there for the purpose of watching me and my work. I will not mention his name here, but Marianna called him "Mistah Sinka-Walla" and that name stuck with him till he left after I did. He stayed on the job religiously for eleven long months, every day, Sunday included, from 8 A. M. till 5 P. M. He watched me constantly and said nothing. Never a word of encouragement or suggestion, but whenever anything went wrong he was always there with his familiar, "I thought so."

As we had no fresh water supply on account of the dead ground formation, we made a cement cistern to hold our drinking water.

To obtain this water it was necessary for the Government tug to steam up the Guantanamo River to where the supply was fresh, there fill its tanks, and then run down to our dock and fill the cistern. Usually it required half a day to do this and of course was of some expense to the Government, so naturally we tried to be as saving with the water as possible.

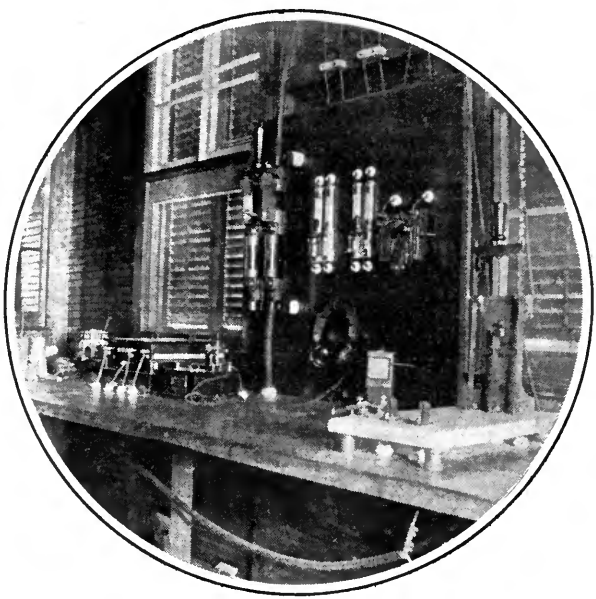
One day after this filling was done, we forgot to place the cover over the cistern hole and that night a big wildcat, smelling the fresh water, went to the opening, fell overboard, and was drowned. The next morning Mr. Watts notified the officer on the ship of what had occurred, and requested that the water



IN AND AROUND THE WIRELESS STATION

Which was installed by Mr. Butler, working for Dr. De Forest's American Wireless Telegraph Company at Guantanamo, Cuba, for the United States Navy. The lower photograph shows the station house and the masts. The oval next above it shows the view of the Cuban landscape, on which the operators could feast their eyes. The top oval is taken outside the operating shack and shows a part of the staff then attached to the station

be pumped out and the cistern refilled with fresh water. A prompt, curt refusal was the result. Such an order coming from their superior officer had to be obeyed, of course. I then sent a similar request and received the answer that the matter had been taken care of through Mr. Watts. Here, then, was the first time it was necessary for me to use the special letter I had from the Secretary of the Navy which requested all officials where I operated to assist me in every possible way. Without further argument I cabled Washington. Within a few hours an answer came and we got what we asked for. A short time afterwards a case of yellow fever broke out in the laboring camps near by and my three Navy companions were ordered to vacate the station and come aboard ship until the disease subsided. This inhuman action left me helpless and alone at the station with an imminent danger near. I again sought recourse from the Navy department with instant and satisfactory results.



THE OPERATING ROOM AT GUANTANAMO

The huge contrivance on the right is the antenna switch; next is the power-control panel. An electrolytic detector and slide tuning coil receiver completed the installation

In reviewing my old diary I find under date of Tuesday, November 14th, 1905, that I employed a Negro by name of Joe Francis to repair a parted main antenna cable which spanned the space of 300 feet between two masts. To repair this was not only a difficult task but an extremely dangerous one because most of the splicing work had to be done 200 feet above the ground. No one but Francis could be found who was daredevil enough to risk it. He was a notorious bad man and had a price on his head for a murder alleged to have been committed in the United States. I dickered with him to do the job for $40.00 and he accepted.

However, after he had nearly finished the work, and while sitting up there swaying between heaven and earth, he called down and declined to proceed unless I doubled the amount of pay. This I flatly refused to do and he still maintained his strike until I drew my pistol and threatened to shoot him down from his perch unless he completed the job as he had contracted to do. To this threat he promptly replied: "I guess you'd do that all right, Mistah Frank. I'll finish the job." I kept him covered while he continued the work because he continually looked down at me to see if I still meant business. He afterwards told others he was going to get me for that trick.

One night about nine o'clock, a few days later, one of the station boys and myself were returning with fruit from "the halfway house," a tent shack, not far away where native fruits and vegetables could be bought.

The night was starlit and the journey was three miles over a zigzag path through the jungle. We had to walk single file. Some of the spots on the way were so dense with overhanging moss and tropical foliage as to entirely cut out the view of the sky. There were comparatively few snakes here, but there were plenty of horned toads, tarantulas, land crabs, mosquitoes, and wildcats, so we always carried a pistol. At a spot, such as this, one third of the way home we met Joe Francis, the Negro. He spoke coolly and slunk by us like a panther, looking over his shoulder as he passed. Fortunately I was ahead of my partner and I think this was what saved me. We were suspicious of his designs, so the instant he left our view we turned off the trail and penetrated the jungle, deciding to attempt to feel our way home through the unchartered underbrush. This, in itself was dangerous, but we thought it the lesser of the two evils. Scarcely had we left the path and fallen to the ground than we heard Francis retracing his steps stealthily. Not having

a compass with us we selected, before moving, a group of stars which we figured was above the wireless station. Then, instead of starting directly for the station we doubled back further toward the way we had come and planned on a wide circle around so as to enter the station from the other side, thus avoiding that trail entirely. We encountered bogs, marshes and everything imaginable, but after several hours of maneuvering we reached home safely and without further adventure.

About a week later, Castro Frerrar, a Spanish surveyor with whom I was well acquainted, was stabbed and killed on this lonely trail a short distance from the wireless station. No one ever knew who did the deed or for what purpose. He was about the same size as I and might easily have been mistaken for me. The singular coincidence was that Joe Francis left a few days later and was never seen or heard of afterward.

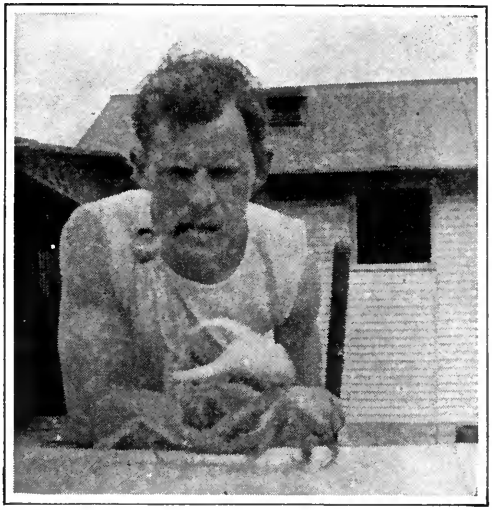
TESTING THE STATION

FINALLY after many months the station was completed and the long series of tests began. Static was terrific. It was a continual rumble. Our principal tuning device was a two-coil slider which to-day would not be considered worth anything by a nine-year-old school boy with a crystal set. Realizing the immense importance of developing the receiving end of wireless, Dr. De Forest left Key West and went back to New York to study out this problem.

I firmly believe it was our gruelling experience with these southern stations that turned the doctor's attention so strongly toward this subject that he never gave it up until he later perfected the heart of radio—his three-element audion bulb, without which present day broadcasting and receiving would be impossible.

His immediate work, however, after going north was to perfect a tuning device which would handle static better. This led to his invention of the pancake tuner which consisted of fine insulated wire wound spirally on glass with variable adjustments. This we found more efficient than anything used previously and it became one of the principal elements in the success of these installations.

In reviewing the many letters which passed between Dr. De Forest and me during these trying days it is gratifying and interesting to note his keen appreciation of our difficult work—his determination to succeed, and his constant belief in ultimate success. Too much credit cannot be given to Dr. De Forest for what he has contributed toward the development of wireless and radio. His dominant persistence, patience and ability were as prominent two score years ago as they are to-day. Had this developement been left in the hands of a less determined or less capable man than he, it would probably not be in the advanced stage it is to-day. I firmly believe this, because during the twenty years I have watched the progress of radio I have seen many experimenters who started with great expectations but soon fell by the wayside, not strong enough at heart or in ability to stand the test of constant disappointments.



A LAND CRAB

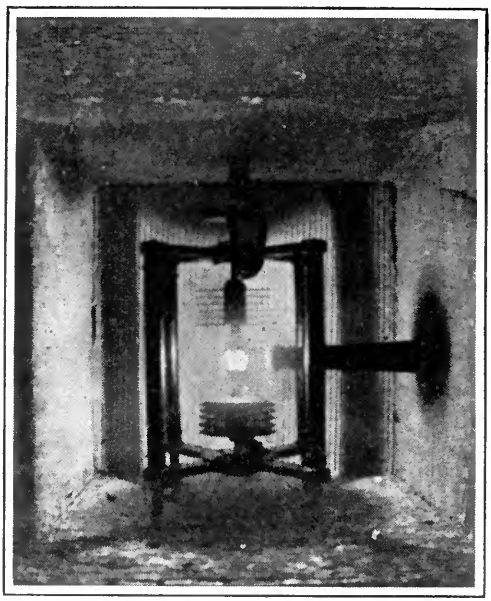
Which was caught in the act of carrying away a pair of overalls belonging to one of the workmen at the station. His claws are about the size of a man's hand. These bluish white molluscs crawling across the bare wooden floor of the porch at night sounded like people walking across the creaking spaces

Here are a few excerpts from some of the De Forest letters:

July 28th, 1905: Your very interesting letter concerning the lightning storm received. It was a very graphic account of a frightful experience. I appreciate your devotion to the cause in taking the risk you did and am glad so little damage to our apparatus occurred.

August 9th, 1905: You certainly are the star martyr to the wireless cause at present and have our fullest sympathies—if those will do you any appreciable good. None of us are too happy or enjoying flowery beds of ease. It is a tough problem and I can't tell what "ist los," but will keep on trying new stunts until it is solved. "Never say die," and "You can't stop a Yank," are the two cardinal mottoes of the wireless bunch, you know.

October 4th, 1905: "I am enclosing plan for



THE SPARK-GAP AT GUANTANAMO
The electrodes were encased in an asbestos-lined muffler box. The spark jumped a one-inch gap, shunted by four large condensers

connecting up the six condensers. The tinfoil has been shipped from the lab. You can put this on with paraffin, as we generally do now, *building up the whole thing under oil.* (Imagine working for days with arms immersed in kerosene.)

November 8th, 1905: Glad to get your long letter of 30th, and regret it is so full of hard luck tales. Sincerely hope your big transformer (weighing a ton) won't blow up again and believe that the new ground plate will remedy your troubles. You show splendid grit as you always do in facing these difficulties.

November 20th, 1905: Your yellow feverish, earth quakish letter came to hand this morning. I am sorry your troubles are holding up so well, but do not get discouraged as we have ours here, and you have not succeeded in cornering the trouble market by any means.

December 26, 1905. I want to thank you most heartily for the very kind letter of Christmas greetings you wrote me. There is no one in our employ who has shown himself more loyal and determined in his efforts to hasten success of the system than yourself, and you may be sure that I appreciate it fully.

Then, in reviewing my diary of that year, the following few terse sentences graphically portray the unbroken schedule of daily mishaps we encountered:

June 5th, 1905: Big 50 H. P. motor generator blew up, damaging armature.

June 7th. Commenced taking off tin roof on building and substituting it with asbestos.

June 12th. Commenced repairing damaged trays in condensers.

June 14th. Lined condenser trays with portland cement.

June 26th. Killed an 8-foot Moha snake in back yard. This was the cause of so many of our chickens disappearing.

July 10th. Constructed plate glass condensers for motor and circuit breakers.

July 13th. Terrific storm 2:30 A. M. Lightning struck station bursting an entire room full of condensers—just finished after two weeks of hard work—throwing oil and plate glass all over the room and into the walls.

July 14th. Repaired damaged antenna wires.

July 26th. Changed all d. c. wiring throughout station 36 inches away from a. c. from engine house to station.

August 14th. Rained this evening during exceedingly bright moon which caused unusual phenomena of two bright rainbows at night.

August 21st. Small cyclone struck us.

August 31st. Lightning struck the station at 4:15 P. M. blowing up one set of condensers.

September 5th. No fresh water. Had to drink salt water all day.

Sept. 24th. Another entire span of 15,000 feet antenna wire blew down.

Sept. 27th. Touched off station again and blower motor blew up.

October 8th. Herd of horses from workmen's camp broke corral in night and demolished the guy wires on the entire aerial spans twisting wires badly.

October 15th. Earthquake at 4:43 P. M. while eating supper.

October 17th. Finished new ground to-day.

October 19th. Rewound blower armature.

November 7th. Secretary of Navy Taft visited us to-day.

November 17th. Heard Key West and Pensacola first time.

December 10th. Key West heard us first time. Blew up blower motor.

December 15th. Big two-ton transformer blew up.

I had almost begun to think I was waging a hopeless battle against nature as week after week a fresh burst of some new and unforeseen trouble presented itself.

MORE TROUBLE

ABOVE the door of our station we tacked a motto: "Abandon hope, all ye who enter here, for verily this *is* hell." It was there for months and was a grim way we had of joking with ourselves.

It was not until the following March that we finally overcame all our troubles and succeeded in establishing communication with

our distant stations to the entire satisfaction of the Navy Department.

When the end finally came, when my work was finished, I was more than overjoyed to get away from that place of trials, but I was sorrowful to leave my three faithful navy companions, Watts, Kent, and Greaves, likewise faithful Marianna, who so loyally stood by me through, perhaps, the most crucial period that any group of early wireless workers ever experienced.

In the meantime, Dr. De Forest had sailed for Europe and shortly after my arrival in New York I received the following letter from him, which I highly prize, because of the wonderful sentiment and appreciation it discloses.

London, E. C.
April 20th, 1906

Mr. Frank E. Butler,
New York City.

MY DEAR FRANK:

Upon the occasion of the final acceptance by the U. S. Navy of the five large stations, of which you have been in charge, I wish to extend to you on behalf of myself and of the American De Forest Wireless Telegraph Co., congratulations, hearty and sincere, and to felicitate you upon your safe return to God's country.

Too often it is the case that while the faults and blunders of men receive prompt and severe criticism, the merits of their work, the fidelity of their services pass unacknowledged, even if fully appreciated by their employers. I trust that this may never be the policy of our company.

All of the officials of this corporation have watched with intense pride the heroic efforts you have made, the great patience through long months of discouragement and difficulties which have necessarily preceded this success. I can deeply appreciate the nature of your labors, your trials, the hardships you have undergone, for it has been my good fortune to have been with you at your post and shared in, while directing, your work.

This work, these experiments, these long-drawn-out tests, carried on in the face of unforeseen and manifold difficulties have, I believe, not only achieved the wireless success intended, but have been the means of developing character, a determination to bear and achieve like good soldiers; have ripened a friendship and a loyalty to one another and to a worthy cause, which constitutes in life elements of even greater value than commercial success.

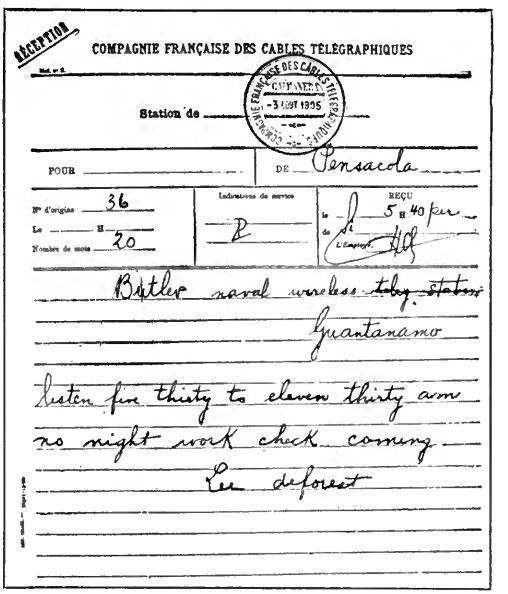
We do not, we cannot forget the obstacles you have had to face and which you have bravely overcome.

For tedious months away from home and friends, in climates scorching and unhealthy, deprived of all usual comforts of life, tormented night and day by insect pests, distressed but not baffled by static unkown to any other wireless workers, delayed month after month by breakdowns of Navy apparatus, continually called upon to make repairs, often without proper tools, facing skeptical criticism, surrounded by hostility, open or concealed on the part of officials from whom we had every reason to expect coöperation and interest,—yet, you have stuck to your posts, have triumphed over one difficulty after another, have forced new secrets from Nature, and having by your tenacity, patience and skill accomplished your ends, you have won at last an acknowledgment of the success of the system from the entire Navy Department, and set a new standard in the art of Wireless Telegraphy.

In view of your services in this unexampled undertaking we wish to express, although in inadequate words, some portion of praise you so well deserve, and to express our confidence that this navy work is but the beginning of greater things we are yet to accomplish together in wireless.

Very sincerely yours,
LEE DE FOREST.
Vice Pres. and Scientific Director.

All the desperate trials of the Cuban experience seemed wiped out by this letter. For were they not worth it, those trials, when one was working for Dr. Lee De Forest?


RÉCEPTION

COMPAGNIE FRANÇAISE DES CABLES TÉLÉGRAPHIQUES

Station de

POUR

DE Pensacola

N° d'origine 36
Le H
Nombre de mots 20

Indications de service
R

REÇU
le 5 H 40 par
de
L'Employé

Butler naval wireless tby station
Guantanamo
listen five thirty to eleven thirty am
no night work check coming
Lee deforest

ONE OF DR. DE FOREST'S CABLEGRAMS

To Mr. Butler and his associates in Cuba. It was filed in Pensacola, Florida on August 3, 1905 and reads: "Butler Naval Wireless Station Guantanamo listen five thirty to eleven thirty A. M. no night work check coming Lee De Forest". Many messages of this sort had to be exchanged before the new Naval station in Cuba could be put in order

The Factors Governing Radio Receiving

Why Daytime Reception Is Less Than That at Night—Why Signals Fade—How Selective Should a Receiver Be?

WHAT MAKES THE WHEELS GO 'ROUND: XI

By WALTER VAN B. ROBERTS

THIS installment of Mr. Roberts's series of explanatory technical articles answers some of the questions most often asked by the broadcast listener. Many attempts have been made to explain the phenomenon of fading in radio, and still, although radio is more than twenty-five years old, we know but little definitely about it. Here the best-known facts have been gathered together, and every reader whose set has come to mean more to him than a box containing tubes and wires will be interested to read what an authority has written on the subject of radio reception. The next and last article in this series will appear soon. It deals with the operation and use of the various accessories of the radio receiver.—THE EDITOR.

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

(1) The amount of interference.

(2) The inverse distance effect. As the radio waves spread out in all directions from the transmittng station their strength naturally decreases. At twice the distance their amplitude is halved, at four times the distance it is only one quarter, 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. The result of this is that, independently of the inverse distance effect, every so many miles the strength is reduced by a certain fraction of what it was at the beginning of those miles.

Thus if the amplitude is cut down by attenuation to one half of its original value at the end of the first hundred miles, it would be only one fourth after two hundred miles, one eighth after three hundred miles, one sixteenth after four hundred, etc. This is the same sort of thing as the compound interest law, and mounts up very rapidly. 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 more power than is available in the whole world—in fact more power than the sun gives out. Yet by the insertion of a dozen or so amplifiers or relay stations along the line, the attenuation law is prevented from "getting well under way" and a ridiculously small power is enough for transcontinental telephony.

In daytime, the attenuation of radio waves (which is possibly due to the air being rendered slightly conducting by sunlight) seems to be fairly constant and reliable. At night, however, it may be anything between the daytime value and nothing at all. On especially good nights in winter when there is practically no attenuation, stations can be heard at great distances because the spreading out effect is all that is at work to weaken the signals. Thus, for example, a station that can be heard fifty miles in daytime could be equally well

heard, on one of these good nights, a thousand miles away by simply adding a stage of radio-frequency amplification which would amplify the received signal twenty times before supplying it to the detector.

The mere absence of attenuation is probably enough to account for the numerous cases of the simplest sort of receiving equipment sometimes hearing stations thousands of miles away, while the presence of the daytime attenuation accounts for these same sets failing to get equally powerful stations only a hundred miles or so away in daytime.

82. FADING

IN THE close vicinity of a transmitting station the inverse distance effect is the main factor in weakening the signals. Hence near-by stations come in about as well by day as by night. Above a few hundred miles the attenuation is the chief factor, but there is also another type of variation of signal strength called "fading." Every broadcast listener has noticed this, but many of them think it is due to improper tuning of their receivers. The phenomenon is as follows: suppose a distant station has been tuned-in and we are sitting listening to a speech. Suddenly we realize that the voice is rapidly becoming fainter and in the course of a few seconds it may drop out of hearing entirely. If now we do not touch the receiving set but wait a few seconds or perhaps half a minute, the voice will probably reappear and rapidly regain its original volume. If this happens often, it makes the reception very unsatisfactory. There is no proved explanation of it. Variations in the attenuation constant due to ionization of the air by "storms" of electrons shot out from the sun or interference effects due to some of the waves going from transmitter to receiver via a different path are two of a number of possible causes. The phenomena are so irregular that no law has been discovered governing them.

83. IDEAL SELECTIVITY AND SENSITIVITY OF A RECEIVING SET

THE ideal radio receiver will be as selective as is possible; that is, it will receive a channel of frequencies about 10,000 cycles wide (or only 5000 cycles in the case of single side band transmission) equally well, but will not receive other frequencies at all. In this manner, the door is shut to all interfering wavelengths except those lying in the channel that we must receive. This is all that selectivity can do to reduce interference. (It is assumed that a loop or the most "directional" possible antenna is used to further reduce interference by responding less to interference coming, on the average, from all directions than to the signal which comes from the most favorable direction). The ideal receiver will not need to be any more sensitive than enough to bring in interfering noises with more than tolerable loudness under conditions of *least* interference. When interference is worse, the sensitivity should be cut down to keep these noises from becoming objectionably loud. In summer time the interfering radio waves manufactured by nature are the worst, and rarely stop.

84. MORE POWER NEEDED AT THE TRANSMITTER

AS THIS ideal in radio receivers is not attainable at the present time, there is only one way left to reduce interference with the present wavelengths and improve the distance over which satisfactory broadcasting is possible. That is to have the transmitting stations put out more power and still more power. If every broadcasting station put ten kilowatts into the ether for every one that they are radiating now, interference between stations would *not* increase and the "static" and other noises would be drowned out and the signal would be so powerful that receiving sets could be less sensitive and thus save much more money than would be required to increase the power of the transmitting station. However, just as in the case of land wire telephony we will probably never be able to put enough power into the ether to give good transmission across the continent in spite of bad interference with the daytime attenuation at work. We will more likely send the voice across country by land line to be shot out by radio from numerous broadcast stations so located that everybody will be somewhere near one of them. This system has the advantage that if something that is to be transmitted is of interest to only certain sections of the country, it can be broadcast only from stations in those sections, and thus not cause unnecessary interference in other sections.

"NOW, I HAVE FOUND. . ."

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

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

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

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

AN ECONOMICAL B.C.L. ANTENNA MAST

MANY and varied have been the articles concerning the kind of apparatus to be used by the radio experimenter, while the descriptions of good auxiliary apparatus have been few. The writer believes that there is a definite need for the description of a mast especially suitable for the broadcast listener.

In designing this mast, the location and needs of the listener have been kept in mind. Simplicity of construction, neat appearance, stability, and ease of erection have been the prime considerations. Due to the number of good well distributed broadcast plants and the increase in sensitivity of the present-day receivers, great height is not required in a mast. Besides, many listeners live in the cities, near the big stations, and where apartments are the dwellings of the majority, so that there is a corresponding lack of room and facilities for the erection of any very high mast.

The mast described below is easy to make, easy to erect, mechanically strong, neat appearing (thus eliminating the objection of many property owners), and best of all it is inexpensive.

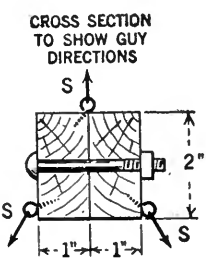


FIG. 2

MATERIALS AND ESTIMATED COST:

Two pcs. 2″ x 1″ clear surface pine, 16 to 24 ft. long	$1.00
One pc 1″ x 1″ clear surface pine, 5 ft. long	.20
Eight $\frac{3}{16}$″ diam. ordinary stove bolts, $2\frac{1}{4}$″ long	.20
Twelve large screw eyes	.20
Pint can outside white paint	.75
Guy wire (length to be calculated)	.50
TOTAL	$2.85

In addition, several screws or nails, usually found in the home work box, and a pair of blocks or stakes will be required.

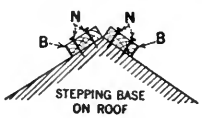


FIG. 3

This total is only approximate and will probably vary for different localities.

ASSEMBLY

CONSTRUCTIONAL work is much easier and very much facilitated if two old boxes are set up to hold the mast pieces while working.

Place the two mast pieces side by side, flat side (the 2″ face) up. Then, starting a few inches from the end, mark drilling points every two feet, stopping at point C, which is five feet from the proposed lower end of the mast. The number of these drilling points will vary as some can get 24-ft. pieces, while others can only get 16-ft. pieces. Drill these holes so they will just take the $\frac{3}{16}$″ bolts snugly. Bolt the two mast pieces together, tighten nuts, and place the mast so the two one-inch faces are now up (bolts parallel to ground). See Fig. 7.

Now cut a one-foot length from the 1″ x 1″ and slip it in at a point a few inches from end of the unbolted portion of the mast (H in diagram). Fasten this in permanently with screws. Cut three more sections (J, K, L) and insert in the same way. Be sure to cut the

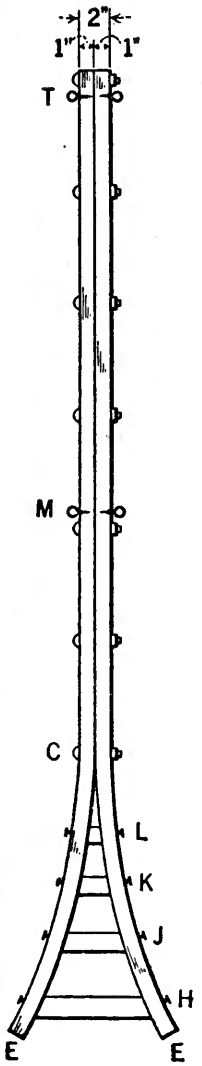


FIG. 1

ends of these at a slight angle so they will fit snugly into the slight curve in the wood. A mitre box is very useful if available. Ends E, E are to be sawed off at the proper angle to rest on roof or ground, Insert eyes at top (T) and at midpoint (M), so that two guys will pull backward and one forward (see sketch). Note that the forward eye is not to be put in the crack, but screwed in at an angle. The mast is now ready for painting, which is easily done on the double box rest mentioned previously. Apply *two* coats (one is insufficient and will wear off quickly), giving each a full twenty-four hours to dry, and applying the first thinly. See Figs. 2-5 and 6.

GUYS

IN THE small diagram, P represents perpendicular pole height, and B the distance from base to point at which you will anchor the guy, of length L. Square P, square B, add these together and take the square root. The result is the guy length L. Three are needed at the top and three more that are attached at M. Be sure that P for the latter is measured from base up. Add at least a foot to each of the guy lengths to allow for twist when securing to pole and at the base. See Fig. 7.

STEPPING THE MAST

IF THE mast is to be on the roof, a stepping base should be built. This consists of two blocks of wood nailed to roof as an inverted V at point of rest (see sketch.) The mast is stepped against this in raising so that one man can raise it alone, as he would a long ladder. Tying in a couple of guys in advance assists materially. Block and tackle attached to a near-by tree or building may be used if available. This is shown in Fig. 3.

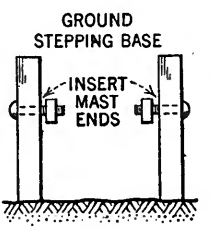


FIG. 4

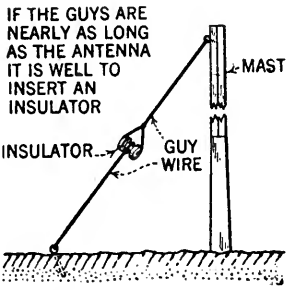


FIG. 5

If the mast is to be raised from the ground, two stakes may be driven in and ends of mast bolted to these as swivel points in raising. See Fig. 4.

ANTENNA

THIS mast will easily support an antenna of several wires with their spreaders. However, for most reception, one wire is sufficient. Furthermore, attaching a single wire to the mast permanently is highly recommended, as trouble due to broken pulley ropes is thus entirely avoided.—CARLOS S. MUNDT, San Francisco, Calif.

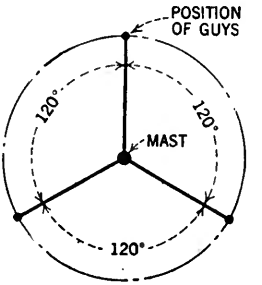


FIG. 6

A HANDY RADIO B BATTERY WHICH USES FLASHLIGHT CELLS

THE block type B battery is not always the best investment according to the opinion of some radio users because when one or two cells go dead the entire block has to be thrown away and its usefulness is gone. If separate cells are utilized however, only the "dead" ones need be discarded. New ones may be inserted in their places and the battery will be as good as ever for considerable continued use. Assembling these, in the ordinary case, is more or less troublesome however when the various connections have to be soldered together. Consequently, the idea described here will be found of great advantage and by its

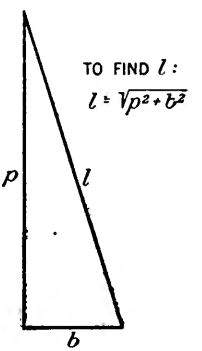


FIG. 7

use dead cells may be instantly removed and fresh ones inserted.

This article describes a 22½-volt outfit using flat flashlight cells of standard size with an e.m.f. of 3.8 volts each. Batteries of higher voltages may be computed from these measurements.

The constructional details are shown in Fig. 8.

Make a box of thin wood whose inside measurements are 4⅞ inches long, 3 inches high and 2½ inches wide. Shellac the inside to keep out moisture. Remove any projecting nails or metal that might cause a short circuit between two or more neighboring cells.

Next make five contact strips of sheet brass as shown in the little detail sketch. These must be at least ¾ inches wide and long enough to bend over and clinch on each side of the wood. Place the six cells in the box and note where their tabs come along the edge. Mark the spots and then remove the cells and fit three contact strips along one side in proper relation and two on the other side of box. Replace the cells, being careful to alternate the relation of the various tabs. The short or positive tab of one cell must be on the same side as the negative or long tab of its neighbor and so on. Thus the strips will connect, electrically negative to positive all through the six cells and build up the resultant voltage to about 22½. As will be noted, the tabs originally bend inward but should be sprung out sufficiently to bear well against the contact strips when the cells are in position in the box.

To prevent the cells from rising from the box due to the springiness of the tabs, it will be necessary to make a top strip of thin wood which must be fastened across the box lengthways. This holds the cells down and makes contacts sure.

A spring clip on each B battery wire enables one to tap in anywhere and secure any plate voltage desired. Such a battery will be found very handy and a considerable money saver.

To insure a positive contact at all times it is well to brighten the contact strips by rubbing with fine sandpaper.—L. B. Robbins, Harwich, Mass.

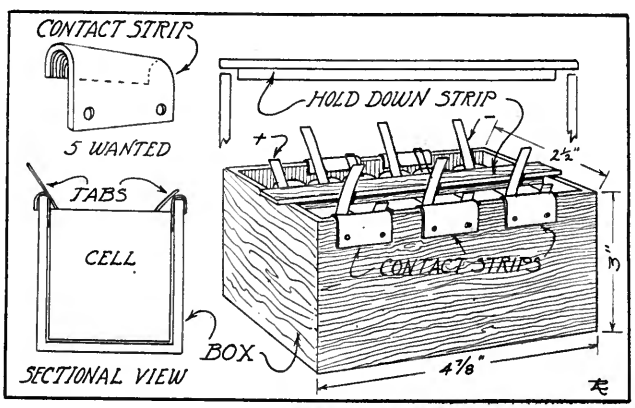


FIG. 8

UN-BLOOPING BLOOPERS

LIVES there a man with soul so dead that he *wishes* to annoy the neighbors by running a blooper?

If so, the neighbors would be justified in making his body match his soul, and the whole town would rejoice, and the minister should refuse to bury him.

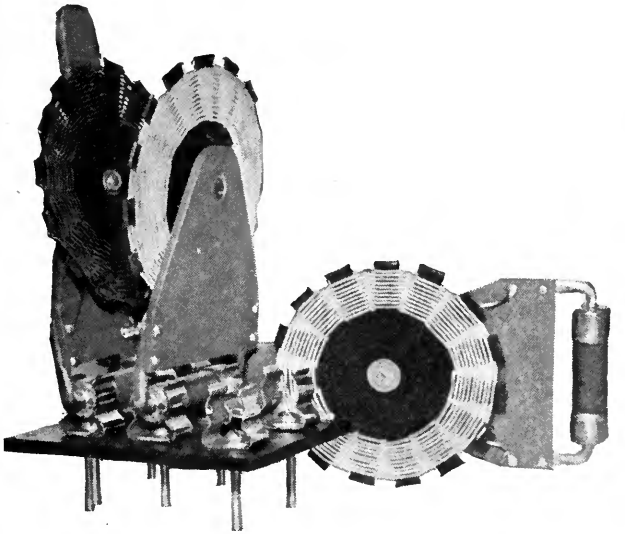
If you own a blooper and wish to avoid such a well deserved fate, and also wish to avoid the expense of a new panel and cabinet you can change it to a Roberts set, (which does not radiate), by mounting three of the spider web coils on the outside of the old cabinet. These are the coils NP, S2, and T, and unless you have a very good set with as many as three tubes it will also give you better reception.

This is not a fashionable arrangement as radio fashions go, but it works quite as well as with the knob-controlled coils, the only requirement being that there must be room in the old cabinet for two .0005-mfd. variable condensers with about four inches clearance between them.

The coil mounting consists of three cartridge fuses two inches long and six fuse clips to hold them. The clips are fastened to the bakelite shown in sketch by $\frac{8}{32}$ brass machine screws 1¼ inches long which project into the cabinet for the connections.

The fuse cartridges are drilled out for a $\frac{3}{16}$ inch hole at the ends and the fuses and filling shaken out. Three pieces of ⅛ inch fibre are cut out as shown in Fig. 9 for the coil controls. These pieces and also the fuse cartridges should be boiled in paraffin for ten minutes to prevent them from absorbing moisture.

The brass rod should be softened by heating to a dull red and cooling in water, cut into pieces 1⅝ inches long, bent in a vise with a hammer, ½ inch from one end to shape a right angle. The other end should be flattened slightly to fit against the fibre and to drill easier. No. 14



HOME MADE
A simple and very efficient mounting for the Roberts circuit

brass escutcheon pins are used for rivets in the No. 44 holes to fasten the bent rods to the fibre, with heads on the fibre side.

The construction of the coil forms has already been described in RADIO BROADCAST.

The leads of the coils are soldered to the rivet heads or rods. The tickler coil is on the right, coil S2 in the middle clips and coil NP at the left. The third terminal from the coil NP is soldered to a $\frac{6}{32}$ screw in the No. 27 hole in the fibre. Two inches of pig tail wire are soldered to the other end of this screw, a piece of shoestring is slipped over the pig tail for insulation and the free end connects to a small binding post in the hole X.

The coils A and S1 should be mounted on top of the left hand condenser in a horizontal position, using a bracket made of a strip of stiff brass bent at right angles. The three-coil mounting is located on the right hand end of the cabinet with the centers of the coils at the same height from the base board as the average height of A and S1. This may necessitate lowering the left hand condenser, but it is very important to prevent magnetic feedback. Only the right hand condenser which tunes S2 need have a vernier.

The small neutralizing condenser shown in the photograph is very easy to make, the plates being insulated from each other by a piece of thin celluloid or mica. The screw head is soldered to the movable plate and is turned by a piece of hacksaw blade tied in the split end of a stick which allows adjustment from a distance, as this condenser is easily effected by body capacity. For this reason it should be placed at the back of the cabinet, high enough to adjust easily. A screw driver with a wooden handle will also serve to vary the capacity by inserting the blade in the screw head. Once this adjustment is made, for the tube used, it does not have to be altered. —HARDING GOW, East Sound, Wash.

NOTES ON THE ROBERTS CIRCUIT

IN BUILDING a receiver employing the Roberts circuit I have come across the following points which may be of help and interest to others who build a receiver of this type.

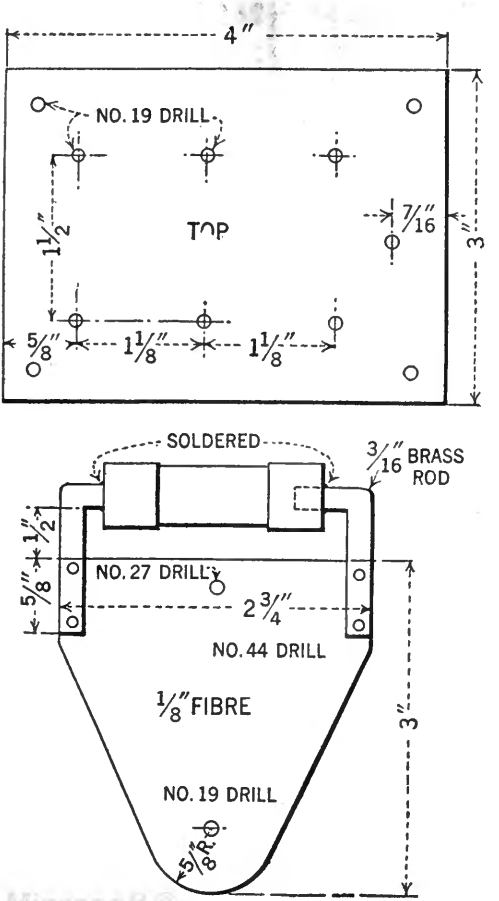
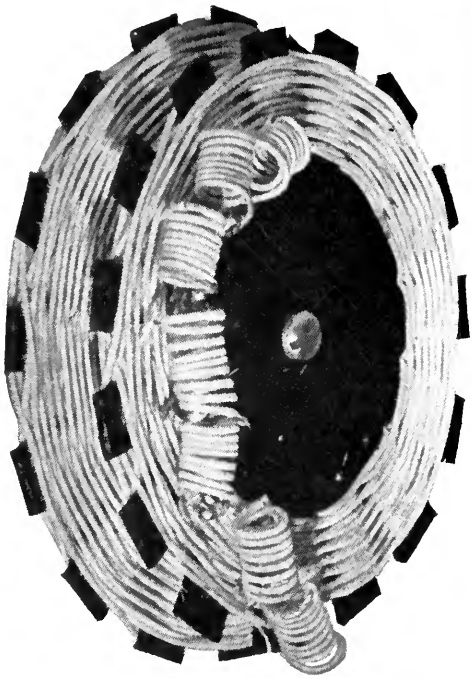


FIG. 9

If the components of the circuit are so arranged that the capacity of the first tube is more than neutralized due to capacity between parts of the circuit, it is impossible to balance



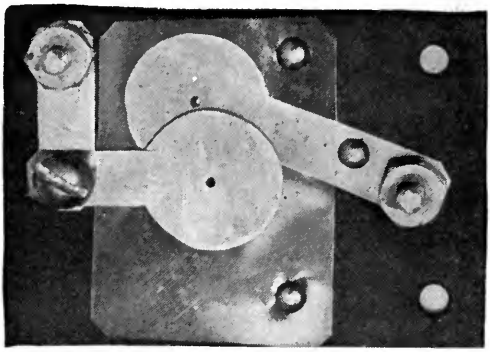
THE ANTENNA COUPLER

By means of a bolt and nuts the coupling between primary and secondary may be varied

the first tube capacity in the usual way. In order to avoid this condition, it is necessary to minimize any capacity between the grid circuits of the two tubes by the following precautions:

1. Mount the two variable condensers so that there is at least a 2-inch clearance between them.
2. Do not mount the audio transformer near the grid circuit of the detector tube.

If it seems impossible to neutralize the tube capacity in the usual way, the neutralizing condenser may be connected as shown in Fig. 10, and a balance obtained by adjustment in the usual manner. To arrange the neutralizing condenser for this connection, solder a



A GOOD NEUTRALIZING CONDENSER

For the Roberts circuit which can be made in the home laboratory

piece of wire, preferably braided, to the neutralizing condenser sleeve and connect this to the grid. Connect the two electrodes of the condenser as in Fig. 10. One to the end of the balancing winding and one to the plate of the tube.

Moving the sleeve towards A balances out the tube capacity as usual. Moving the sleeve towards B increases the capacity between grid and plate of the tube so that if, due to stray capacity as explained above, the tube capacity is neutralized, a balance can be obtained.

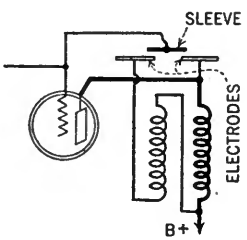


FIG. 10

I have found that a vernier is unnecessary for tuning the circuit of the first tube, but the tuning of the detector tube circuit requires that a vernier be used.

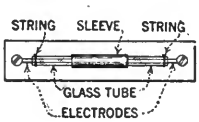


FIG. 11

Some means should be employed to prevent the neutralizing condenser sleeve from coming in contact with the condenser electrodes. A piece of string tied tightly around the glass tube at each end as in Fig. 11 will prevent the sleeve from touching the electrodes while adjustments are being made. —

JOHN B. CLOTHIER, JR., Landsowne, Pa.

Improving the Storage Battery for Radio

By JAMES M. SKINNER

WE HAVE heard and read much concerning the recent developments in various systems of current production from the regular lamp socket as a means of doing away with batteries of all kinds for radio work. This work, as editorials and articles we have published heretofore certainly indicate, is in our minds both valuable and interesting—work which we have gone a long way off the beaten path to encourage. In the light of present-day enterprise an advance in any branch of industrial activity usually results in a necessity for rearrangement of existing methods which the more recent development is designed to improve or replace, rather than total abolition of older methods. The most efficient method of radio receiver operation, obviously, is the method which will produce the best results at the lowest cost. The estimate of cost should include purchase price and upkeep and in these days of luxury it would seem reasonable to include convenience as part of the service the device must render.

All of these much mooted questions have, to a certain degree at any rate, been glossed over by most radio editors while the manufacturers of storage batteries and current tap devices have to a marked degree been gnawing at each other's throats.

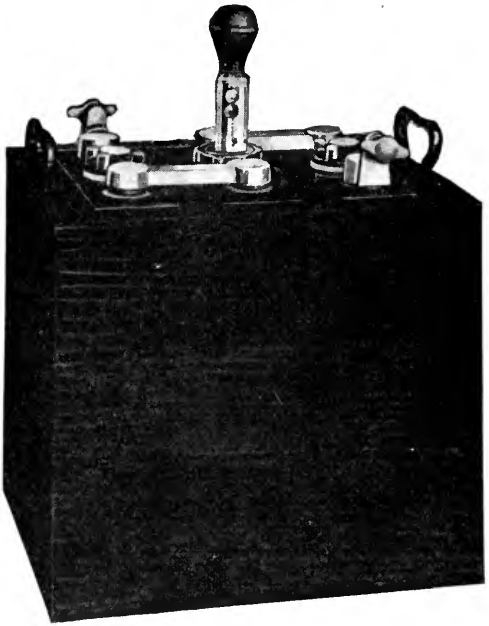
We are convinced that there is room in the field for all three systems of plate and filament supply and feel that the publication of articles like this one will let our readers know that the makers of our old friends, the dry and storage batteries, have not been entirely asleep. They have made radical improvements in their products which have made the storage battery a clean enough device to grace our living rooms and have developed a system of charging which is almost automatic. Batteries are still very important elements in radio, and it is very likely that they always will be.—THE EDITOR

THERE was a time when the radio enthusiast went to his favorite radio shop and bought merely a storage battery for his set. Now he is more critical, for he knows that the storage battery has been carefully and excellently adapted to the uses of radio by progressive manufacturers. When the vacuum tube first came into use and storage batteries were required to light their filaments, the only battery which could be had was the heavy and unwieldy and certainly unbeautiful battery then used for ignition purposes. The acid leaked through the vents in the sticky top of the cell and the wood case was itself often acid soaked. Then, the storage battery had to be carefully disposed indeed, for few carpets and rugs were proof against its acid invasions.

Now the storage battery has been modified and altered so that it is really suited for radio. It is essentially the same old storage battery and it works on the same tried and true chemical principles as before the battery got all dressed up for its radio uses.

With the new models of storage batteries recently brought out by several manufacturers, it is unnecessary to have any technical knowledge about the workings of storage batteries. It is entirely unnecessary to worry about such deep technical mysteries as current rates, overcharging, and reverse charging.

Many of these batteries are now manufactured with glass cases so that the complete condition of the cell can be seen at all times. Some contain a charge and discharge indicator, in the form of two colored indicator balls. These are so designed that they indicate the condition of the cells at all times. When both of these indicators are floating, the battery is charged. When one sinks and the other floats, the battery is partially discharged and when both sink, the battery is nearly discharged. During the charging process, this action is reversed. First one ball floats when the battery is more than half charged. Later, the other floats, which indicates that the recharging of the battery has been completed.



THE OLD TYPE

Of battery to which the name "radio" was applied by makers of auto lighting batteries when the demand for radio batteries came upon them. Though a perfectly good battery for other purposes, it does not fill the bill for radio as a comparison with the other illustrations will disclose

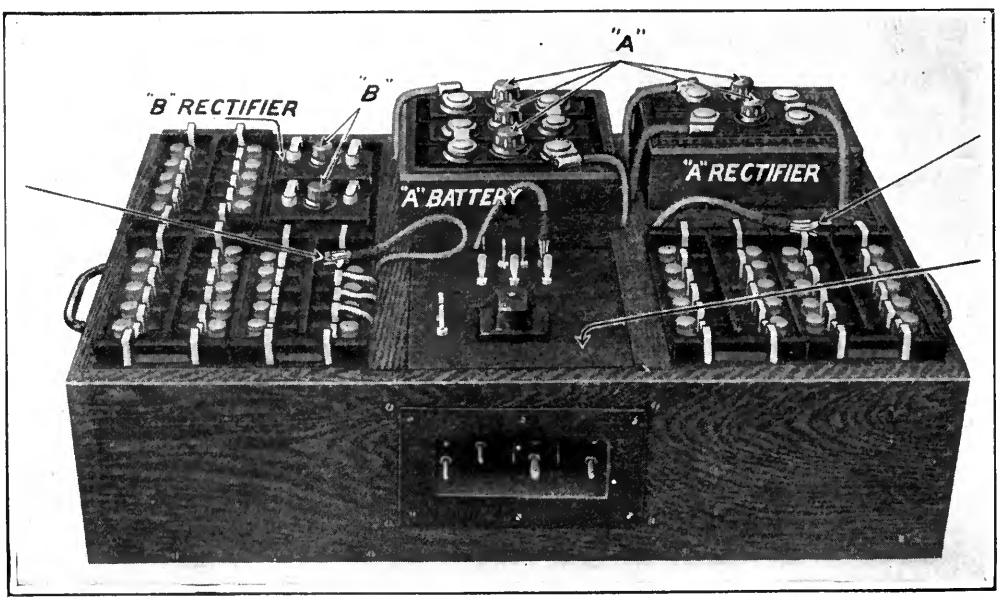
KEEPING THE ACID IN ITS PLACE

MODERN radio storage batteries are designed so that almost no spray escapes from the battery. Everybody knows that a mere trace of acid turns blue litmus paper red. One manufacturer claims that his storage battery for radio use stays so dry and free from acid on top that a piece of blue litmus paper placed over the vent cap will not turn red.

Of course, this all implies that the unit shall be properly charged, but here again, the radio user, no matter how inexperienced, has nothing to worry about. Chargers can now be purchased with a current rate so low that even if the battery remain on charge long after it is fully charged, no harm can result. The battery therefore cannot overheat.

CHARGING THE BATTERY

FOR small A batteries of about 15 to 18 ampere-hour capacity, such as would be used to supply the filaments of peanut tubes, a $\frac{1}{2}$-ampere charger is sufficient. For a 30 to 50 ampere-hour A battery supplying standard 6-volt tubes, a one-ampere charger is satisfactory. A batteries whose capacity is from 80 to 100 ampere-hours, use a one- or two-ampere charger. For storage A batteries of size larger than this, a two- or five-ampere

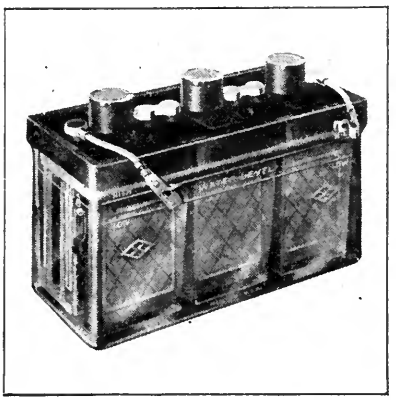


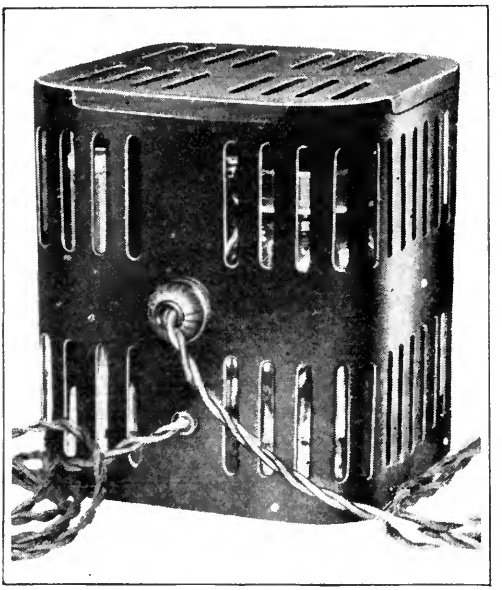
ALL IN ONE

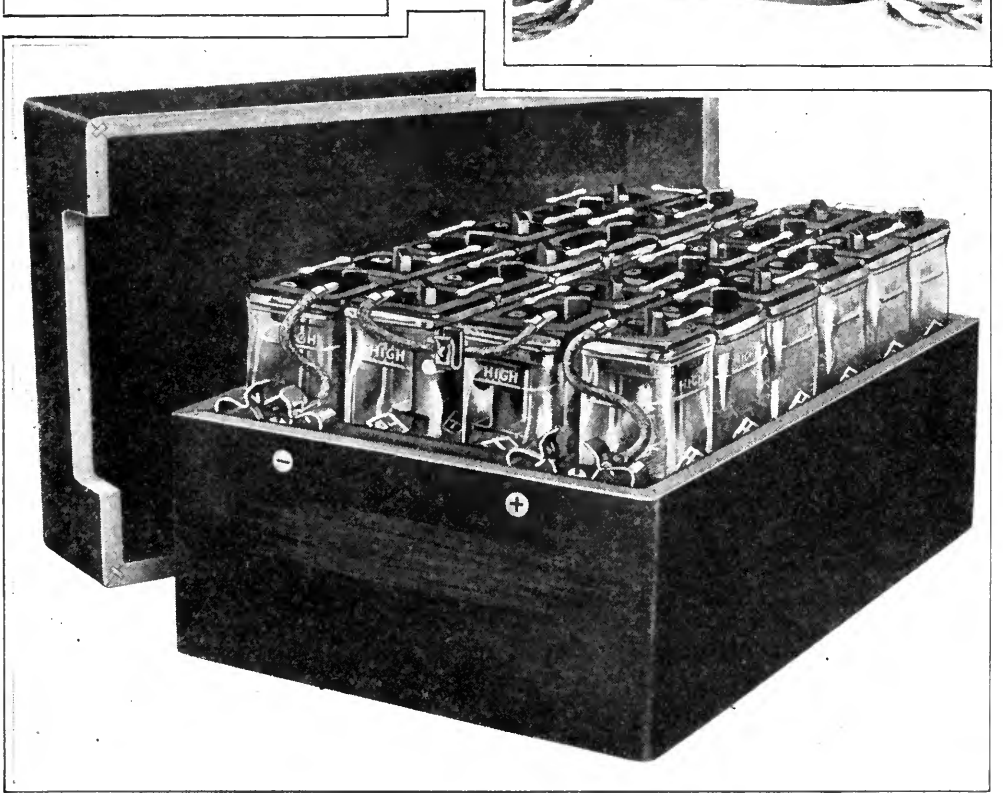
Storage A, storage B batteries with plugs for varying the voltage at will. The A charger and B charger and switching device make it possible to use batteries with this unit and operate it directly from an alternating current light socket

charger will charge gently enough to insure against acid spray or overheating.

Since radio storage batteries have been so refined there is no reason why they cannot be charged as well as discharged in the same room in which the radio receiver is located. It is almost a waste of energy to carry one of the newer batteries to a service station for recharging when it is possible to perform that operation in the home at a minimum of expense. Separate chargers can be purchased







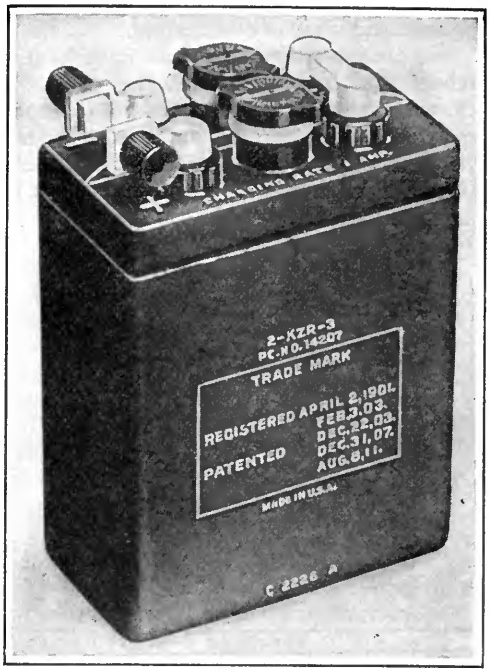
ANOTHER COMPLETE UNIT

Comprising storage A and B batteries with chemical low-rate charger and convenient switching arrangement for charging and operating. Here the manufacturer has made an effort to keep pace with the demands made upon him by discriminating purchasers. A radio supply system of this type is clean, easy to operate, and quite satisfactory

and wired so that when the battery is run down from continued use, a switch may be thrown and the battery charged. If the purchaser wishes, he may buy a complete storage battery and charging unit combined.

The glass case of most of the present radio storage batteries allows the user to see at all times the proper height of the electrolyte and a constant check can be kept on its condition. Because of the avoidance of overheating during the charging process and proper design of the vent caps in the top, the water in the solution evaporates quite slowly and refilling is necessary only at very infrequent intervals.

When a low-rate charger is used, the battery must obviously be charged at more frequent intervals than if the charging rate is high, say five amperes. With the charging unit connected so that charging and discharging is merely a matter of throwing a switch from one side to the other, frequent charging at a low rate is no especial hardship. Also, it actually costs less for current to charge slowly and easily at a low rate than fast and furiously at a high rate. When one overheats a battery by leaving it too long with a charger too big for it, one has to pay for the current which generates this utterly useless and harmful heat.



A SMALL STORAGE BATTERY

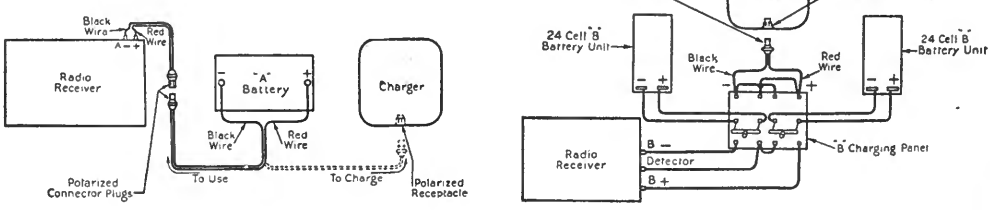
Made with a rubber case and a view to portability. Such a battery may well be used with the smaller tubes, requiring 3 volts for filament operation. It is rugged, clean, and not too expensive

PLACING AND USE OF THE BATTERY

GLASS cased storage cells can very easily and neatly be placed inside radio cabinets, and some of the late models of complete cabinet receivers contain glass cased storage cells which are used for continuous service with no annoyance from spilled acid.

Storage batteries have the advantage of maintaining a quite constant, even voltage. This variation is not more than ten per cent. from the start to finish of a discharge, and less than five per cent. if the battery is kept pretty well charged at all times with frequent boosting with a low rate charger. In the A battery circuit of a receiver, uniform voltage minimizes the danger of shortening the life of tubes at first by overheating filaments, and against weak signals through underheating of the tube filaments later on. Uniform filament voltage also makes the filament rheostat settings on a receiver the same for any one station from one day to the next.

Steady voltage of the B battery circuit is even more desirable than in the A circuit.



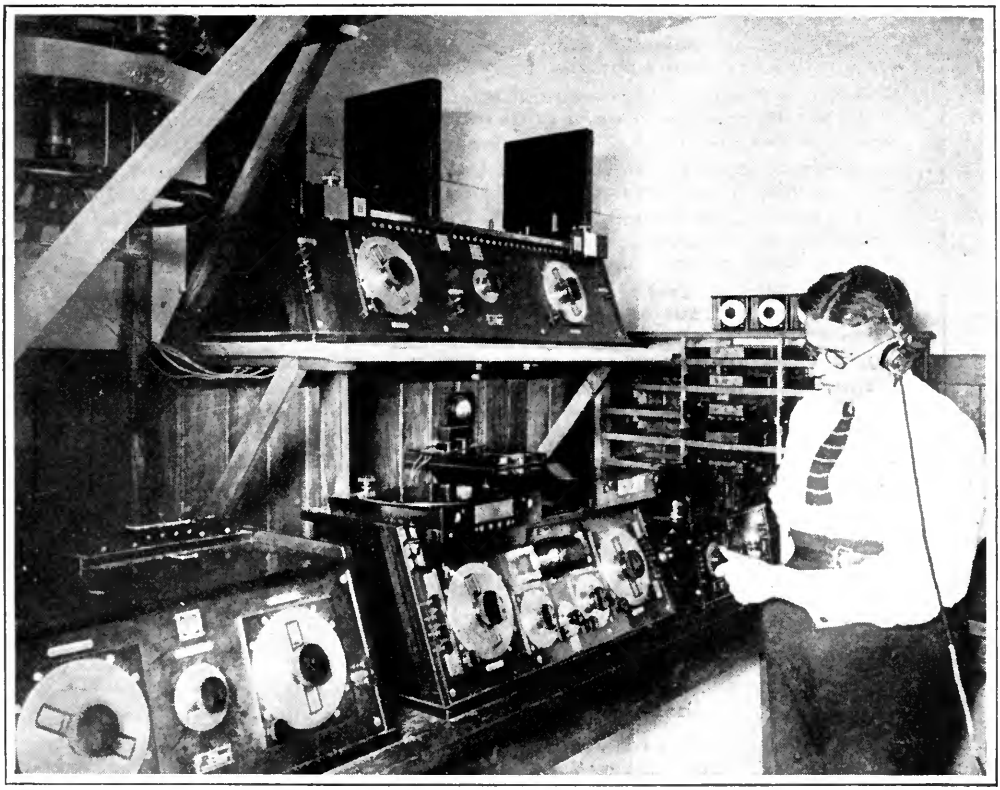
SWITCHING CONNECTIONS

For charging storage batteries used with radio receivers. The diagram on the left shows a convenient method for charging a radio A battery and the complete one on the right shows a method very generally used for B battery charging

Storage B batteries give steady, uniform voltage which is desirable.

Storage batteries are not overly expensive. A high grade A battery and charger (the filament supply for peanut tubes) including plugs and sockets for permanent switching connection costs about $18. A larger size for standard 6-volt tubes can be bought for a little more than $30, which also includes a charger and switches. A 96-volt B battery costs about $27.50 to $40.00, according to its size and finish. Most A battery chargers are designed to charge B batteries as well, or they can be so adapted.

To charge a 96-volt B battery of 3000 milliampere-hours capacity costs about ten cents. The expense of keeping an A battery charged is very slight. And a properly built storage battery will last for years with practically no outlay for repairs.



RECEIVING TRANSATLANTIC COMMERCIAL RADIO TRAFFIC

In the station at Nauen, near Berlin, Germany. Nauen, POZ, is the single most powerful station in that country and transmits commercial traffic directly to many countries. The handle of a large receiving loop is in the upper left corner

QUESTIONS AND ANSWERS

WHEN YOU WRITE THE GRID . . .

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

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

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

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

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

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

QUERIES ANSWERED

WHAT IS BODY-CAPACITY AND HOW MAY IT BE ELIMINATED?

L. C. M.—Berkeley, Calif.

WHAT KIND OF AN ANTENNA DO YOU SUGGEST FOR ORDINARY RECEIVING PURPOSES?

F. E. C.—Kansas City, Mo.

MAY I HAVE A CIRCUIT DIAGRAM FOR ADDING A STAGE OF RADIO-FREQUENCY AMPLIFICATION TO THE ROBERTS CIRCUIT?

J. H. M.—Washington, D. C.

MY RECEIVER WILL NOT TUNE TO THE LOWER WAVELENGTHS. HOW MAY I REMEDY THIS CONDITION?

I. N.—Madison, Wisc.

BODY-CAPACITY EFFECTS

HOW many people there are who have to be told that when there is trouble in a receiver it may usually be traced to some definite source!

The effects of body-capacity are no exception to the rule.

Generally speaking, body-capacity may be termed that effect which when the hand of the operator is brought near the tuning dial or other parts of the tuning circuit, causes the receiver to become detuned from the signal being received. It may be further placed as an electrostatic effect altering the inductance-capacity value of the tuning circuit.

Some receivers employ metal shielding fastened

WHERE MAY A BY-PASS CONDENSER BE ADDED TO ADVANTAGE IN AN AUDIO-FREQUENCY AMPLIFIER CIRCUIT?

S. P.—Nashville, Tenn.

WILL YOU EXPLAIN, IN DETAIL, THE APPLICATION OF FORMULAS GOVERNING THE CALCULATION OF RESISTANCE AND CAPACITY?

W. K.—Portland, Oregon.

MY HOME IS EQUIPPED WITH 110 VOLTS DIRECT CURRENT. HOW MAY I CHARGE MY STORAGE BATTERY WITH IT?

R. R. T.—New York City.

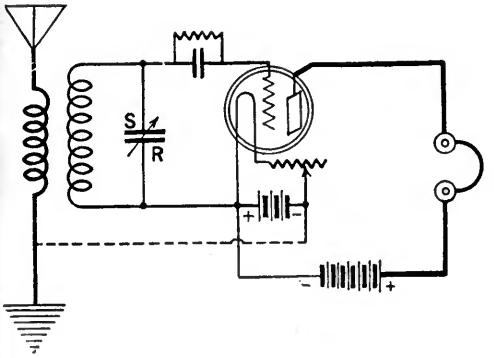


FIG. 1

on the panels behind the tuning dials as a remedy for this condition. That is only a remedy.

To put the receiver into proper operating condition it would be well to follow a logical trouble-shooting plan. One should look to see if the stationary plates of the condenser are not tightly connected to the grid of the tube, and to see that the negative side of the filament is properly connected to ground. Grid and plate leads should be so arranged that they do not run parallel and close together.

The placement of the parts constituting the tuner circuit also adds to the possibilities of body-capacity effects and may be forestalled by a painstaking preliminary set-up and test of the circuit.

In all circuits it is advantageous to bunch the filament and B battery supply wires so that the grid and plate terminal leads may be as short and direct as possible.

In Fig 1 are incorporated the ideas as outlined here.

ANTENNAS

MANY times this department is asked about the advisability of erecting antennas of questionable design and makeup. The uni- and vari-directional types, multi-strand, and the new braid-ribbon arrangements all come in for their amount of querying.

The ordinary receiving conditions, which, in the

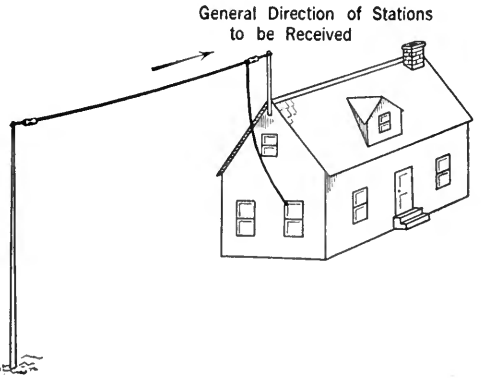
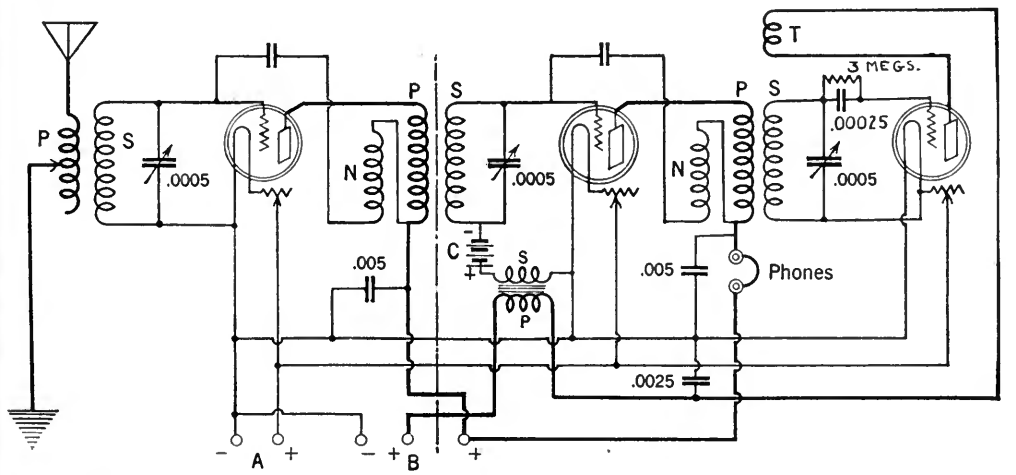


FIG. 2

end, interest the majority of broadcast listeners, require simply a single strand of antenna wire erected in as straight a line as possible.

It has been argued pro and con as to the special merits of the placement of the lead-in tap-off but we advise bringing the lead-in from the end of the antenna which generally points in the direction of the stations to be received. See Fig. 2.



ADDITIONAL STAGE OF R.F. (NEUTRALIZED) AMPLIFICATION

TWO TUBE ROBERTS KNOCKOUT CIRCUIT

FIG. 3

A STAGE OF RADIO FREQUENCY FOR THE ROBERTS RECEIVER

FOR those who wish to add a stage of neutralized radio-frequency amplification to the Roberts circuit we show the circuit in Fig. 3. From this circuit it will be seen that the antenna coupler which was previously connected before the tube No. 2 is now placed before tube No. 1. It then becomes necessary for us to provide the radio-frequency coupler between the first and second tubes. Like the other radio-frequency coupler it has a double wound primary constituting the plate coil and the neutralizing coil which is connected back through the condenser to the grid of the tube. The necessary parts for this addition are, the r. f. coupler (as explained), the neutralizing condenser, a socket, a rheostat, and a .005 mfd. fixed condenser.

TUNING TO THE LOWER WAVELENGTHS

WHERE, the condition exists in a receiver, that makes tuning at the lower wavelengths difficult or even impossible it is well to incorporate the improvement as outlined in Fig. 4.

By making a tap-off on the tuner coil and bringing

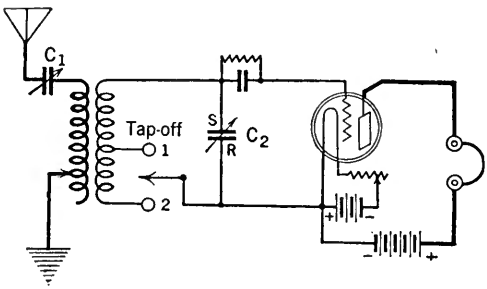


FIG. 4

the lead to a switch point it is possible to cut in or out, by means of the switch arm, a section of the entire inductance.

Naturally enough, when the switch arm is placed on tap No. 1 the lower section of the coil is cut out

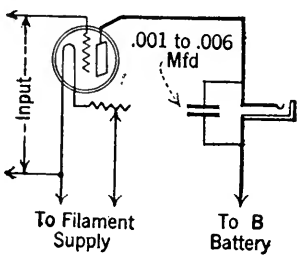


FIG. 5

of the circuit and the condenser C2 shunt only that part of the inductance between switch point No. 1 and the grid of the tube. The wavelength range of the receiver at this setting will be shifted down. That is to say at minimum capacity the wavelength will be lower than if the whole coil were in the circuit. Similarly when the condenser is at a maximum capacity value the wavelength setting is lower than when the switch is on point No. 2.

It will also be noted that with the switch on point No. 1, the positions of stations transmitting on the comparatively low wavelengths will be spread out over the tuning dial which facilitates their reception.

The insertion of the variable capacity C1 offers a means for sharply tuning the antenna circuit to the incoming signal. However, its use is not absolutely necessary and may be required only where the antenna is exceptionally long.

A BY-PASS CONDENSER FOR THE LOUD SPEAKER

TO OBTAIN that fullness of tone so much desired of all loud speakers, it has been observed that a fixed condenser shunted across the output terminals of an audio-frequency amplifier will often do the trick.

The circuit showing the position of the condenser

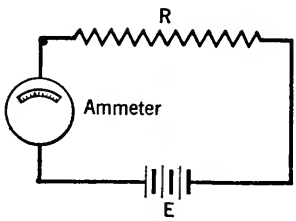


FIG. 6

is depicted in Fig. 5. The value of the condenser (better determined by test) usually varies between .001 and .006 mfd. In some instances that side of the by-pass condenser connected to the B battery is better situated on the negative than on the positive terminal of this battery.

RESISTANCE AND CAPACITY FORMULAS

NOW to digress and to go from the practical to the theoretical.

The computation of resistance, capacitance, and inductance values is of interest and importance to the experimenter who proceeds not along on hunches but on carefully laid plans.

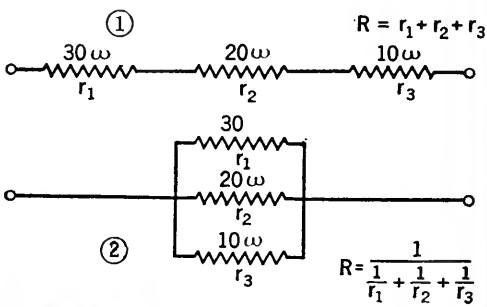


FIG. 7

MAGNAVOX

Reg. U.S. Pat. Off.

The name to look for when buying radio equipment.

TRF-5

ONE hand on ONE dial for *Tuning in!*

Magnavox Receiving Sets

TRF-5 (as illustrated) encased in carved mahogany cabinet; price includes M4 Reproducer . . $125.00

TRF-50 in carved mahogany period cabinet with dust-proof doors and built-in Magnavox Reproducer $150.00

Semi-dynamic Reproducer

M4—the most efficient unit ever designed to operate without external battery, $25.00

Electro-dynamic Reproducer

The original radio reproducer, famous throughout the world. With Volume Control.

R3, $35.00
R2, $50.00

EVEN though the Magnavox single dial Station Selector has displaced the "old style" complicated tuning arrangements, this remarkable feature *alone* would not have merited the praise which every owner gives his Magnavox Set.

It is by its sheer *musical quality,* in addition to its unusual simplicity, that the Magnavox 5-tube tuned radio frequency circuit retains the user's lasting admiration.

As pioneers in the design and manufacture of radio reproducers, Magnavox engineers were thoroughly equipped to master the problem of beautiful tone.

If you already own a receiving set, a Magnavox Reproducer will wonderfully enhance its daily usefulness for family and friends.

Ask the nearest Registered Magnavox Dealer to demonstrate Magnavox Radio equipment

THE MAGNAVOX COMPANY, Oakland, Calif.

New York: 350 W. 31st St. *Chicago:* 162 N. State St.

Canadian Distributors: Perkins Electric Limited, Toronto, Montreal, Winnipeg

★ MAGNAVOX Radio

3R

★ Tested and approved by RADIO BROADCAST ★

At a later time we will discuss the computation of inductance. Just now, let us consider the factors of resistance and capacity.

In computing the resistance of a coil of wire such as a rheostat it is necessary to make use of Ohm's Law which is expressed symbolically $R=\frac{E}{I}$ or, as written, the resistance in a circuit equals volts divided by amperes.

By transposing, it is possible to obtain a formula

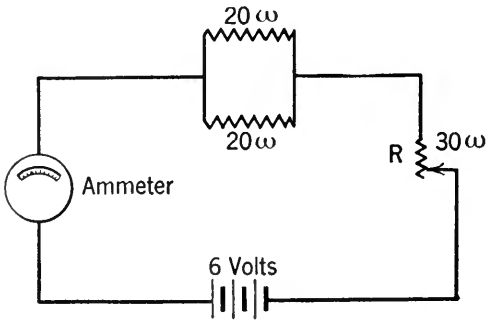


FIG. 8

for finding the other two values, namely E and I, as follows:

$E=I \times R$

$I=\frac{E}{R}$

Now in Fig. 6 we have a circuit containing the resistance R and the battery supplying the voltage, E. The ammeter will register the amperage of the circuit. Assuming that the battery delivers 6 volts and the resistance has a value of 30 ohms, then, substituting these values in Ohm's Law the formula would read $I=\frac{6}{30}$ or .2 amperes.

To determine the resistance of the filament of a tube the same law may be employed. For instance, in the UV-201-A the filament voltage as stated by the manufacturers is 5 volts and the amperage at which its best operation is obtained is .25 amperes. Then substituting values in the formula $R=\frac{E}{I}$, $R=\frac{5}{.25}$ or $R=20$. Therefore the resistance of a UV-201-A filament is 20 ohms.

Where several resistances are used in a circuit, their total resistance may be obtained by the application of other formulas depending upon the particular type of hook-up.

When resistances are connected in series (1, Fig. 7) the total resistance value equals the sum of all. The formula is expressed $R=r_1+r_2+r_3$.

For resistances in parallel another calculation is necessary. Here is the formula: $R=\frac{1}{\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}}$

Substituting the values as shown in 2 Fig. 7, $R=\frac{1}{\frac{1}{30}+\frac{1}{20}+\frac{1}{10}}=\frac{1}{11}$ or 5.4 ohms.

When the current in a circuit must pass through several resistances in series the amperage is less than if only one of the units were used.

However, from the formulas it may be seen that this is not true when the resistances are connected in parallel. The reason here is evident. Due to the units being in parallel three paths are afforded to the flow of current. The same effect would be obtained by the use of a larger wire, the resistance of which is lower than smaller sizes.

In Fig. 8 we have the combination of resistances in series-parallel. The two 20-ohm resistances are in parallel while the resistance R of 30 ohms is is series in the entire circuit. To find the amperage of the entire circuit first compute the total resistance of the two parallel resistances (10 ohms), Then $10+30=40$ ohms total resistance of the circuit. Therefore $I=\frac{6}{40}$ or .15 amperes.

This will indicate that when all the resistance (if it be variable in the form of a rheostat) is included in the circuit .15 amperes of current will flow through. By reducing the value of resistance the amperage will vary to a maximum of .6 amperes.

To calculate the resistance of a rheostat necessary to control a tube circuit the following formula will prove helpful: $R=(\frac{E}{I})$—rf

where R—resistance of rheostat
E—voltage of battery
I—current rating of tube
rf—resistance of the filament

Interpreted, this formula would be expressed thus: to obtain the value of resistance of the required rheostat divide the voltage of the battery by the current rating of the tube. From this quotient substract the resistance of the filament.

By an inspection of the formulas and circuits as outlined in Fig. 9 it will be seen that they are similar to those for resistance computations with the exception that they apply to the opposite condition. That is to say, the total capacity of con-

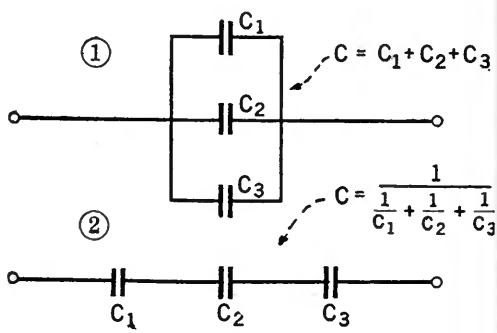


FIG. 9

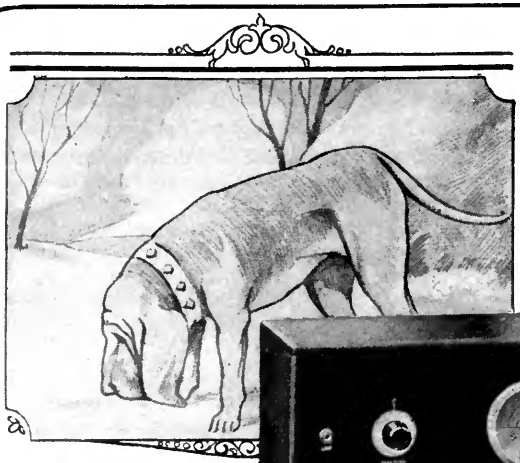
densers in parallel as in 1, Fig. 9 is equal to the sum of all, while the total value of resistances in parallel is equal to the sum of the reciprocals.

As an example: 3 condensers, each of .002 mfd, in parallel would equal .006 mfd. Three condensers of .006 mfd. in series would equal .002 mfd.

CHARGING STORAGE BATTERIES WITH 110 VOLTS D. C.

HERE again the knowledge of Ohm's Law plus another formula, that of power equation, will prove of aid.

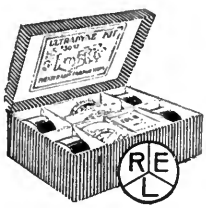
The power expended in a circuit performing a



The bloodhound, remarkable for the acuteness of its smell, can pick up a scent and follow a trail when all else fails.

Sensitivity

-never before thought possible!



THE ULTRADYNE KIT

Consists of 1 Low Loss Tuning Coil, 1 Special Low Loss Coupler, 1 Type "A" Ultraformer, 3 Type "B" Ultraformers, 4 Matched Fixed Condensers.

To protect the public, Mr. Lacault's personal monogram seal (R. E. L.) is placed on all genuine Ultraformers. All Ultraformers are guaranteed as long as this seal remains unbroken..... **$30.00**

How to Build and Operate the ULTRADYNE

32-page illustrated book giving the latest authentic information on drilling, wiring, assembling and tuning the Model L-2 Ultradyne Receiver **50c**

With the extreme acuteness of the bloodhound's scent, the Model L-2 Ultradyne detects the faintest broadcast signals—signals that are "dead" to other receivers—regenerates and makes them audible on the loud speaker.

It's here, where the development of other super-radio receivers has halted, the Ultradyne forges ahead.

The unusual sensitivity of the Model L-2 Ultradyne is due to the successful application of regeneration, to the famous Modulation System of radio reception, recently perfected by R. E. Lacault, E.E., A.M.I.R.E., Chief Engineer of this Company and formerly Radio Research Engineer with the French Signal Corps Research Laboratories.

It's this development, an exclusive feature of the Model L-2 Ultradyne, that makes it possible to receive greater distance on the loud speaker.

Everything that the Model L-2 Ultradyne means in actual results and genuine satisfaction you will appreciate the first evening you operate it.

Write for free descriptive folder

★ ULTRADYNE

MODEL L-2

PHENIX RADIO CORPORATION

5-7 Beekman Street New York

★ Tested and approved by RADIO BROADCAST ★

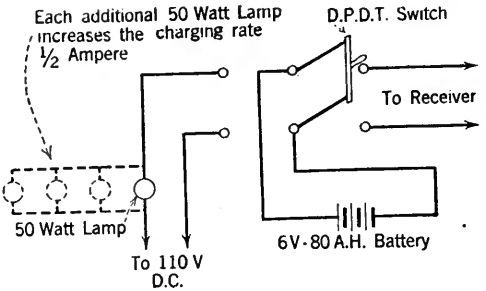


FIG. 10

certain work is equal to the voltage supplied multiplied by the amperage flowing through. This is expressed: power equals voltage times amperage. The designation of power in electrical and radio terms is watts. Symbolically the formula is expressed $W = E \times I$.

Now for the battery charging.

A storage battery must be recharged at a definite amperage rate. Usually the manufacturers of batteries designate this charging rate on the name-plate fastened on the battery.

Generally it does not exceed 8 amperes. Theoretically it is necessary to put back into the battery just as many "amperes of current" as were taken out by the discharge.

The capacity of a battery is rated in ampere hours. Explained, this means that an 80-ampere hour battery may be discharged at 4 amperes for 20 hours, 2 amperes for 40 hours or 8 amperes for 10 hours.

Therefore in recharging it is necessary to charge the battery for a certain period of time the length of which depends upon the amperage rate of charge. For instance, a fully discharged 80 ampere-hour battery must be recharged for 80 hours at 1 ampere; 40 hours at 2 amperes; 20 hours at 4 amperes and so on.

Ordinarily a battery is not completely discharged and only requires a short time charge or as is correctly termed, a trickle charge.

Fig. 10 shows a circuit for charging a storage battery at a trickle-charge rate.

To increase the rate of charge it is necessary to parallel additional 50 watt lamps to that shown. The addition of each lamp increases the charging rate one half an ampere.

Other charging rates with various sized lamps may be computed from the power formula as previously explained.

This power formula is given as an aid in determining the resistance values of various sized lamps. It may be transposed as follows: $I = \frac{W}{E}$, and $E = \frac{W}{I}$

Given the wattage of the lamp and the voltage of the line it is a simple matter by substituting values, to calculate the value of amperage.

Then, knowing the amperage and voltage, the resistance of the lamp filament may be computed. Therefore knowing the resistance and the voltage in the charging circuit it is a matter of calculation to determine the value of the current in amperes flowing through the charging circuit.

As an example, using a 75 watt lamp in a 110 volt charging circuit: $I = \frac{W}{E}$ or $I = \frac{75}{110}$ or .68 amperes.

Then $R = \frac{E}{I}$ or $R = \frac{110}{.68}$ or 162 ohms (approximately)

Therefore $I = \frac{E}{R}$ or $I = \frac{110}{162}$ or .68 amperes. The amperage of the charging circuit is equal to the computed amperage value of the lamp derived from the power formula.

This computation was carried through to its logical conclusion as a proof and also as an indication that the last calculation is unnecessary, the charging rate being determined by the current rating of the tube where only one is used.

HOW TO FIND TROUBLE

AS AN aid in determining and locating defects and trouble in any type of receiver the following list of trouble-shooting pointers will be found helpful.

Many of the tests to determine the causes of trouble require only a pair of phones and a battery, C, B, or A.

Continuity of circuits, short circuits, open circuits and leakages may be located by arranging a test circuit merely consisting of a pair of phones to which has been added a battery inserted in series with one side of the phone lead. The other lead and the remaining terminal of the battery are connected to pointer leads so that they may be touched to the terminals of units to be tested.

Trouble-shooting may be divided into several classes

1—Battery circuits

A—If the tubes light to full brilliancy the filament battery is O. K. This may further be determined by the use of a hydrometer.

B—B batteries may be tested for full life by noting the volume of the click when a pair of phones are momentarily touched to each of the output terminals of each block. This test is not recommended, but is merely suggested if a voltmeter is not available to register the voltage of the battery.

2—Tuning circuits

A—The antenna circuit of the coupler coil may be tested with the phone battery tester for continuity of the circuit.

B—Inspect antenna and ground connections.

C—Have antenna and ground leads insulated from other objects.

D—Secondary of coupler may be given circuit continuity test.

E—Condenser shunting the secondary should have the rotor connected to the filament and the stator should connect to the grid of the tube.

3—Audio-Frequency units

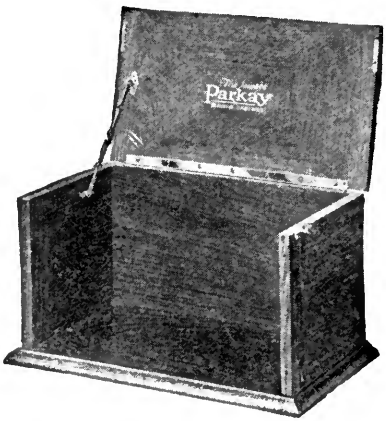
A—Try reversing the primary leads. Also the secondary leads.

B—Give each winding continuity test. Here the primary will click louder than the secondary.

C—Try grounding the metal cores to eliminate squealing.

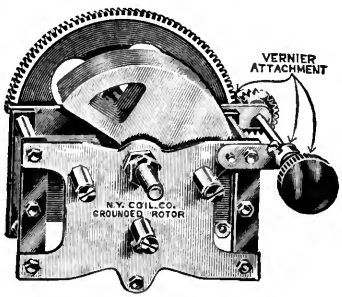
D—Make use of by-pass condensers to round out the tone quality. They should be placed across the primaries or across the phone output.

New Equipment



A CABINET

Of neat design and sturdy construction is presented in this Jewett Parkay cabinet. It is a well finished article which should please even the most particular. Made by The Jewett Radio & Phonograph Co., 5672 Twelfth St., Detroit, Mich.



N. Y. COIL CO. CONDENSER

A condenser with cone type bearings insuring smooth action and long service. The grounded rotor eliminates hand capacity. "Straight line" capacity is obtained by cutting away a portion of the rotary plates. Made by the New York Coil Co., 338 Pearl St., New York City

THE BRADLEYLEAK

This instrument combines a smooth action variable grid leak with a grid condenser in a compact and efficient manner. It is possible to mount this unit on a base board, subbase, or panel without difficulty. Made by the Allen-Bradley Co., 278 Greenfield Ave., Milwaukee, Wis.

JONES MULTI-PLUG AND CABLE

A neat and efficient means of connecting batteries to the receiver. All leads are contained in a cable furnished with a keyed bracket which facilitates making connection or disconnection to the receiver by one operation. The design of the bracket makes it impossible to connect the leads wrong after once having the wires connected to the set. Made by Howard B. Jones, 614 South Canal St., Chicago, Ill.

TITAN B BATTERY

Here we have a 48-volt storage B battery designed to give long and satisfactory service. It is possible to tap off for any desired voltage. The cells are contained in heavy glass jars and as a unit have a capacity of about 6000 milliampere hours. Made by the General Lead Battery Co., Chapel St. and Lister Ave., Newark, N. J.

BESTONE RECEIVER

A five-tube receiver of interesting design which is encased in a cabinet with built-in loud speaker and battery compartment. This compactness should be an attractive feature. Made by Henry Hyman & Co., Inc., 476 Broadway, New York City

A Special Offer!

An opportunity for radio fans to save money in buying Celoron Panels and Vulcawood Cabinets

WE are making this special introductory offer to make new friends for our products and for the dealers who sell them.

Celoron is the standard insulating material among leading radio manufacturers and it is the choice of nearly a million radio fans. But there are many fans who never have had an opportunity to see and use this popular insulating material and others have never heard of the new Vulcawood Cabinet.

For a limited time, we offer you the privilege of buying these standard, well-known parts direct from our factory—at special introductory prices. Orders will be accepted subject to the conditions outlined below.

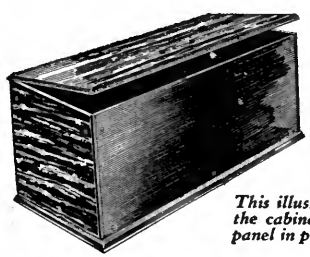
This offer expires on April 30, 1925.

Your money back if not satisfied

If your dealer does not stock and carry these parts, you may select a cabinet, and the panel to fit it, at the special introductory prices quoted.

In return for this privilege we ask you to send us your dealer's name and the names of three of your friends who are radio fans.

We shall refund your money without a whimper if you are not entirely satisfied with the goods when received.



This illustration shows the cabinet—with the panel in place.

NEW VULCAWOOD CABINET

the only bakelite cabinet made

This new bakelite cabinet insulates your entire set and it is grained and colored to match beautiful hand rubbed manogany.

Vulcawood Cabinet Prices

Sizes	*List Prices*	*Special Prices*
(1) 7 x 7 x 10	$ 7.95	$4.50
(2) 7 x 7 x 12	8.10	4.50
(3) 7 x 7 x 14	8.10	4.50
(4) 7 x 7 x 18	9.40	4.50
(5) 7 x 7 x 21	10.40	6.50
(6) 7 x 7 x 24	10 40	6.50
(7) 7 x 7 x 26	10.55	6.50
(8) 7 x 7 x 30	11.15	6.50

DIAMOND STATE FIBRE COMPANY

Bridgeport, Pa., and Chicago, Ill.

Branches in Principal Cities Toronto, Canada—London, England

CELORON RADIO PANELS

universally endorsed by radio experts

Celoron will help you get better results from your radio hook-up. It will give your instruments thorough, leak-proof insulation.

A Celoron Panel will not soften with heat or deteriorate with age as do rubber and composition panels. It retains its beauty and its insulating properties indefinitely.

Celoron Panel Prices

Sizes	*List Prices*	*Special Prices*
(1) 7 x 10 x $\frac{1}{8}$	$1.09	$1.00
(2) 7 x 12 x $\frac{1}{8}$	1.31	1.00
(3) 7 x 14 x $\frac{1}{8}$	1.53	1.00
(4) 7 x 18 x $\frac{3}{16}$	2.95	1.00
(5) 7 x 21 x $\frac{3}{16}$	3.45	2.00
(6) 7 x 24 x $\frac{3}{16}$	3.94	2.00
(7) 7 x 26 x $\frac{3}{16}$	4.25	2.00
(8) 7 x 30 x $\frac{3}{16}$	4.92	2.00

If your dealer does not carry Celoron, order by mail

In ordering please follow these simple directions:

1. Indicate on the coupon the size of the panel and the size of the cabinet you want.
2. Print in your name and address carefully.
3. Clip out the coupon and attach it to a plain sheet of white paper.
4. Mark on the white sheet the name and address of your dealer and the names and addresses of three friends who are radio fans.
5. Attach your check or money order to the white sheet.
6. Mail all papers to the Diamond State Fibre Co., Bridgeport, Penn.

DIAMOND STATE FIBRE COMPANY,
Dept. 103
Bridgeport, Pennsylvania

Please send me prepaid the following items:

Celoron Panel Size No. . . . . Price $.....
Vulcawood Cabinet (without panel)
Size No. . . . . Price $.....
Check attached $..... Total $.....

Name.....

Street.....

City.....State.....

★ Tested and approved by RADIO BROADCAST ★

Among Our Authors

D. C. WILKERSON

FOR a number of years Dan C. Wilkerson has been closely associated with the Army Air Service in Washington and has done considerable technical work with radio and airplanes. He is a resident of Washington and a quite frequent writer of radio articles.

PHIL FAY built his first radio set in 1911 and has never since, like a lot of us, recovered from the first infusion of the radio virus. He writes considerably for the newspapers on various radio subjects, but RADIO BROADCAST is the first magazine to have an article under his name. Mr. Fay is responsible for the design of many of the essential little accessories for radio receivers which are familiar to every fan.

PHIL FAY

H. D. KELLOGG is a native Philadelphian and a graduate of Yale in the class of 1923. Although he won the prize of $500 offered by this magazine for what the judges decided was the best answer to the problem of who is to pay for broadcasting, he is not actively occupied in radio. Mr. Kellogg says, however, "I have followed with great interest the development of radio communication, particularly the outstanding developments of the last few years which have come with the advent of broadcasting." He feels that there is a growing difficulty which broadcast station directors are facing in securing good talent to appear at stations without payment for their services.

CARL DREHER, in addition to being the excellent radio man that he is, writes articles which insinuate themselves into such august covers as are found on Henry Goddard Leach's *Forum* and the expressive Mr. Henry L. Mencken's *American Mercury*. Mr. Dreher was a visitor at the offices the other day and outlined some of the plans he has for "As the Broadcaster Sees It." If he manages to put in print the ideas he has, life will certainly be more interesting for both the broadcaster and those who like to know what broadcasters are doing.

W. R. BRADFORD contributes one of his excellent radio cartoons and an article about his attack on the Roberts Knock-out receiver to the magazine this month. His method of attack is strangely more like an electrician's than a cartoonist's, but perhaps this is just another anomaly. The accompanying photograph is one of himself taken by himself—which certainly makes it a one-man affair.

W. R. BRADFORD
Self-photographed as his grandmother

Montiero, Forest Hills
J. E. MILLEN

J. E. MILLEN is a senior at Stevens Institute of Technology at Hoboken but he finds some spare time occasionally to write about radio and experiment with it.

ALTHOUGH at present an enthusiastic Chicagoan, McMurdo Silver was born in Geneva, New York. Now Geneva is otherwise famous for two things: it contains Hobart College and is not far from Cornell University at Ithaca. They also make cutlery there, if we remember the geographies correctly. Mr. Silver is designing, manufacturing, and selling radio equipment.

EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.
(Eastern Standard Time)

For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations

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

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

Satisfaction Reliability Economy

You need three things in radio "B" Batteries—satisfaction, reliability and economy. You get them all in Eveready "B" Batteries. Satisfaction, because they produce all the current needed by your tubes, giving you the maximum results of which your set is capable. Reliability, because you can depend on them to work at full power. Economy, because they long maintain their strength, and because they are low in price.

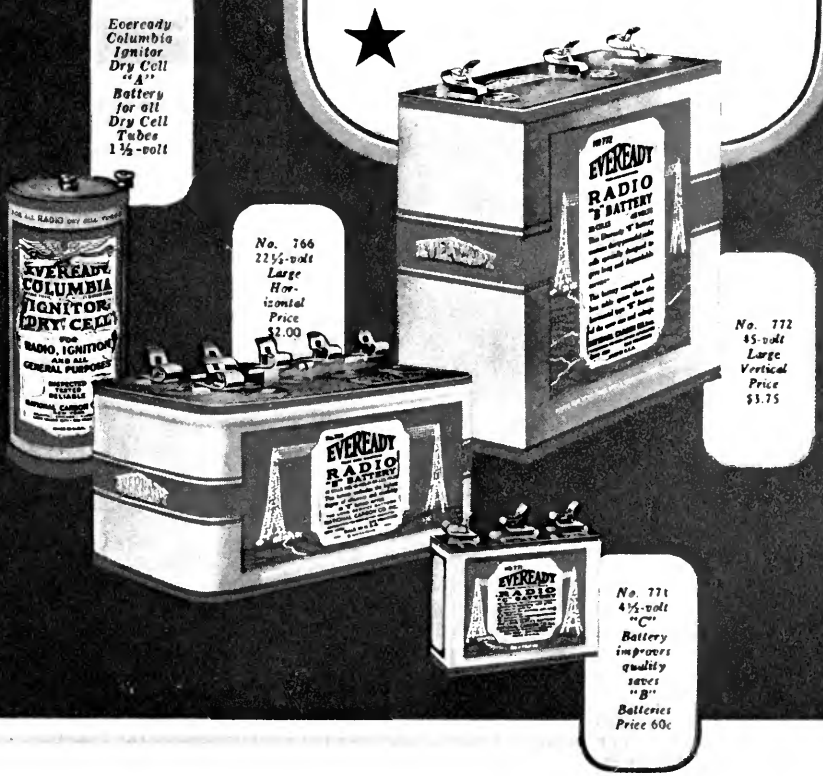
Advances in the art of battery manufacture make Evereadys last longer than ever. You actually get much longer service for your money.

There is an Eveready Radio Battery for every radio use.

Buy Eveready Batteries.

Manufactured and guaranteed by

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



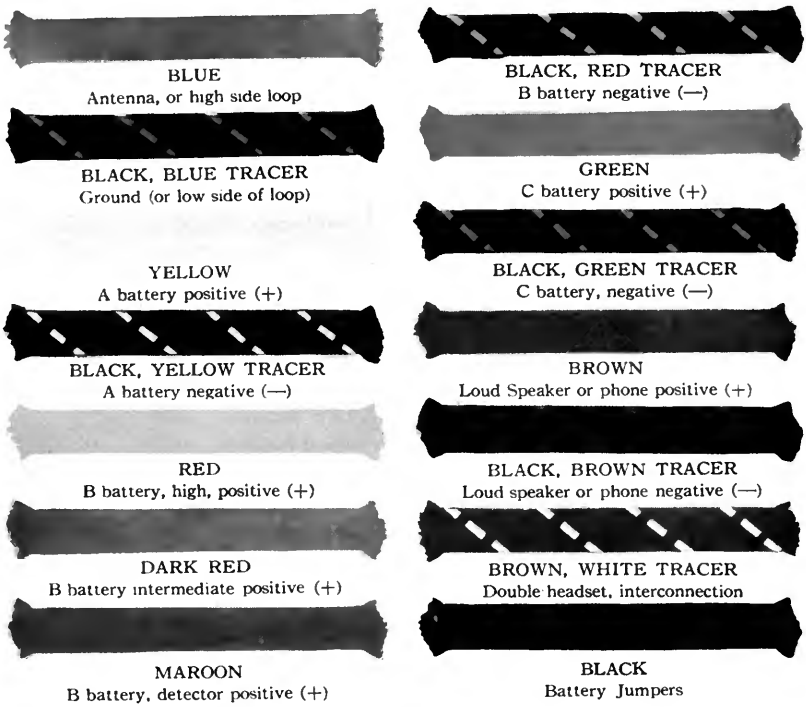
★ Tested and approved by RADIO BROADCAST ★

Standard Color Designations for Cords Used for Outside Connections in Radio Receivers

As Adopted by

The Associated Manufacturers of Electrical Supplies

SIMPLE CORD COLOR COMBINATIONS



BLUE
Antenna, or high side loop

BLACK, BLUE TRACER
Ground (or low side of loop)

YELLOW
A battery positive (+)

BLACK, YELLOW TRACER
A battery negative (—)

RED
B battery, high, positive (+)

DARK RED
B battery intermediate positive (+)

MAROON
B battery, detector positive (+)

BLACK, RED TRACER
B battery negative (—)

GREEN
C battery positive (+)

BLACK, GREEN TRACER
C battery, negative (—)

BROWN
Loud Speaker or phone positive (+)

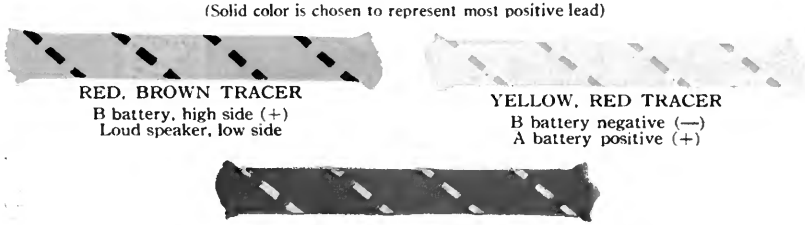
BLACK, BROWN TRACER
Loud speaker or phone negative (—)

BROWN, WHITE TRACER
Double headset, interconnection

BLACK
Battery Jumpers

COLOR DESIGNATIONS OF CONDUCTORS COMMON TO MORE THAN ONE CIRCUIT

(Solid color is chosen to represent most positive lead)



RED, BROWN TRACER
B battery, high side (+)
Loud speaker, low side

YELLOW, RED TRACER
B battery negative (—)
A battery positive (+)

GREEN, YELLOW TRACER
A battery negative (—)
C battery positive (+)

RADIO BROADCAST presents for the first time in any magazine the colors to be used in dyeing the braid used in the cord. Solid colors are to be used to designate the high or positive side of a circuit. Tracer colors are to be used to designate the low or negative side. The shade designations, in parentheses, are the same as those specified in the Standard Color Card of America, 6th edition, published by the Textile Color Card Association of the United States, Inc., 50 West 42nd Street, New York.

The general scheme is:

- BLUE FOR THE ANTENNA CIRCUIT (Bluebird S-6065)
- RED FOR B BATTERY (Geranium S-2035)
- MAROON FOR B BATTERY (Magenta S-7285)
- YELLOW FOR FILAMENT CIRCUIT (Orange S-3005)
- GREEN FOR C BATTERY (Emerald S-5005)
- BROWN FOR TELEPHONE CIRCUIT (Gold Brown S-3285)

In using these designations, always be guided by the point to which the flexible cord is attached, not where it leads to. For instance, a cord connecting the positive side of the B battery to the high side of the loud speaker jack should be marked red.