June 15, 1925
15 Cents a Copy

RADIO PROGRESS

"Always Abreast of the Times"

In This Issue

YOU WILL UNDERSTAND THIS MAGAZINE --- AND WILL LIKE IT

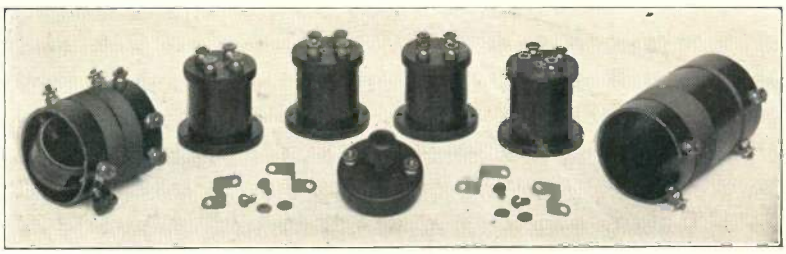
A New England Publication

At Last! At An Unheard of Price!

A SURE FIRE

SUPER-HETERODYNE KIT

A Superadio Product



A Superadio Product

SUPERADIO SUPERHETERODYNE KIT, $15.00

MATCHED TRANSFORMERS—TUNED INPUT

EASY TO BUILD EASY TO OPERATE

UNSURPASSED DISTANCE VOLUME AND SELECTIVITY

WONDERFUL TONE

Kit Consists of:

1 Antenna Coupler
1 Oscillator Coupler
1 Special Variable Condenser
1 Tuned Input Transformer
3 Matched Intermediate Transformers
Hardware for Mounting Couplers

Booklet, With Diagrams and Full Layouts and Information

Manufactured by

DE WITT-LAFRANCE CO., Inc.

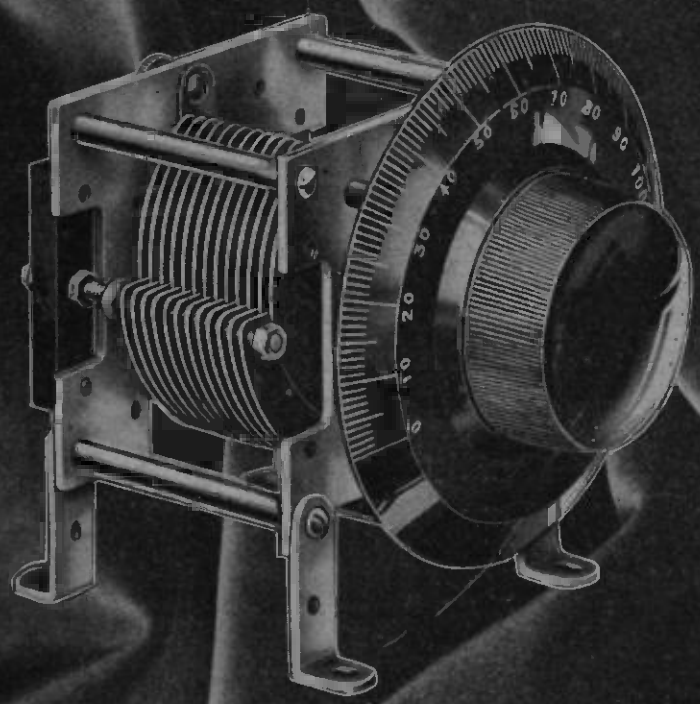
54 Washburn Avenue Cambridge, Mass.

Sales Representatives:

Martin, Hartley and Foss Co. 99 Bedford Street, Boston, Mass.

NATIONAL

VELVET VERNIER CONDENSERS AND DIALS



Made by the NATIONAL COMPANY, INC.
Exclusive Manufacturers of

The NATIONAL
Browning-Drake TRANSFORMER

Write for Bulletin 105 R. E.

NATIONAL COMPANY, INC., 110 Brookline St., Cambridge, Mass.

The Marvelous 5-Tube Radio Frequency Set

RICO-DYNE

An assurance of perfect performance, faithful tone production and $100 radio receiver value, all for

$60.

Mahogany Cabinet

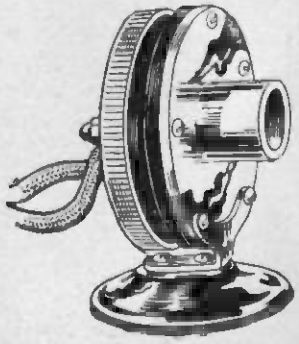
The Set with a Punch

AUTO BALANCED 5-TUBE RADIO FREQUENCY

The combination of "RICO" CELLUWELD Low Loss Coils and Variable Condensers is made mechanically perfect. The Coils are welded firmly to the support of the rotor plates, our own patented principle.

Selective and non-oscillating, the "RICO" "AUTO-BALANCED" TUNED RADIO FREQUENCY SET accomplished by carefully setting the neutralizing angle of the Coils at the factory; remains permanent due to the CELLUWELD process.

The Complete Ricodyne Kit contains everything. The set you can build in 3 hours. Price Complete.....$38.75



ADJUSTABLE

MAKE FULL USE OF YOUR PHONOGRAPH

MELOTONE — "None Better"

Adjustable phonograph unit makes your phonograph a perfect loud-speaker

$7.50

The Melotone Has All the Qualities of the $10 to $12 Units

THE NATION'S FAVORITE HEADSET

RICOPHONES —The Headset of Real Value

There is more quality, real honest-to-goodness quality packed into RICOFONES than you'll find in any headset at twice its price! Compare and see.

$2.95

Manufacturers of the famous "RICO" straight line condensers, at $1.75 each. The "Tropadyne" circuit is supplied free with every tuned "Tropaformer" that we manufacture for all long wave transmission. "Tropaformers" $6.75 each. Dealers—write or wire for wonderful proposition.

RADIO INDUSTRIES CORPORATION,
131 DUANE ST., NEW YORK CITY.

Gentlemen: I am enclosing $..... for the items checked below. Kindly ship at once.

.....RICO-DYNE SET, $60.

.....MELOTONE UNIT, $7.50.

.....RICOFONES, $2.95.

My Dealer is .....

NAME .....

ADDRESS .....

CITY .....

RICO

for all Long Wave Circuits

RICO Products on this Page Will Improve Your Radio 100%

TROPAFORMERS

The sensitivity, selectivity and volume obtained in all types of long-wave circuits depends entirely upon the intermediate frequency transformer. TROPAFORMERS have been specifically designed to meet the new scientific requirements of long-wave circuits. The TROPAFORMER combines transformer and condenser. The condenser is shunted across the secondary winding of the transformer, and by its use the transformer may be tuned to any definite wave length between 3,000 and 9,500 meters. Only in TROPAFORMERS will long-wave circuit users find these advantages, and these advantages are patented for TROPAFORMERS exclusively!

$6.75

Free Hook-up of the Famous Tropadyne Circuit with Each Tropaformer Ordered.

DID YOU EVER BUILD A SET THAT GOT "COAST TO COAST"?

You Can with the RICO-DYNE 5-Tube Auto-Balanced Cellu-Weld Tuned Radio Frequency Kit

$38.75

Complete Knockdown Set as illustrated with full instructions how to build this marvelous set within a few hours.

Greatest Radio Value in History—This is What You Get:

1—Pair Ricofones. 1—Genuine Bakelite Front Panel, completely drilled and engraved. 1—Genuine laminated Bakelite Sub-Panel—with sockets already mounted. All mounting holes properly drilled. 3—Auto Balanced Tuned Radio Frequency Units—perfectly matched and balanced. 3—Beautiful 4-inch Dials. 1—Variable Grid Leak and .00025 M.F. Condenser. 1—4 to 1 Audio Transformer. 1—2 to 1 Audio Transformer. 1—.002 Fixed Mica Condenser. 1—.006 Fixed Mica Condenser. 2—Single Circuit Jacks. 1—Filament Control Switch. 1—30-ohm Rheostat. 1—10-ohm Rheostat.

FOR THOSE WHO WANT TO BUY ONLY THE RICO-DYNE KIT

HERE IS JUST WHAT THEY WANT:

It seems unusual that with the tremendous volume, selectivity and distance-range of the Rico Auto Balanced set, it should be so simple to construct. Yet, nevertheless, this is true. We have letters from fans who tell us that they constructed their Rico set within a few hours. The plans which accompany the Rico Kit are so simple that we believe this is so. Any beginner need only to read English in order to construct the Rico set. This Kit contains 3 Auto Balanced Tuned Radio Frequency Condensers, inductance Units, factory matched, book of instructions and drilling template. You can't go wrong!

$16.50

RICO-DYNE HAS SET NEW RECORDS IN RADIO!

---

for bliss!

SPONGE RUBBER

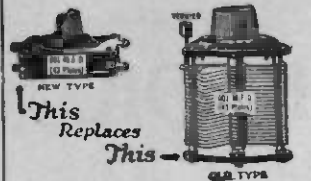
RICO FONEKUSHIONS

You'll know what real ear-phone comfort is when you use RICO FONEKUSHIONS. They are made of soft, pure sponge rubber, and fit any make of headphone. They are like soft, downy pillows for your distance-seeking ears.....

50c

---

for better tuning



RICO STRAIGHT LINE CONDENSERS

In the old days, folks used horses. Now they can get as much power out of one auto as from 40 horses. It was all right, too, a few years ago, for folks to use the old-time condensers, but now, since Rico brought forth the RICO STRAIGHT LINE CONDENSER, which occupies two-thirds less space than the ordinary mesh plate type, everyone modernizes his set with the RICO STRAIGHT LINE CONDENSER.

No. 411—.00025 mfd. $1.75
No. 423—.0005 mfd. 1.75
No. 450—.001 mfd. 1.75

Inclusive with Dials. Without Dials, $1.50.

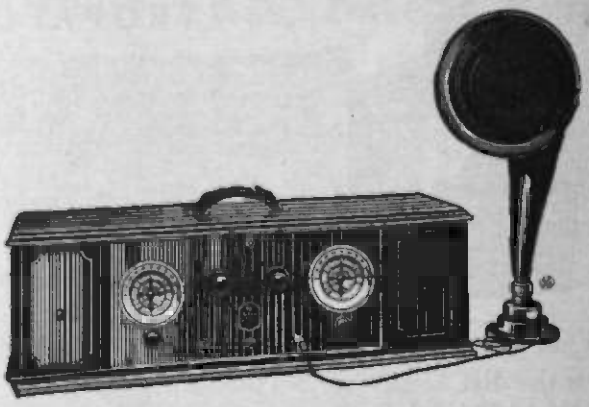
Each of these Rico products means added pleasure and value to your Radio Set.

If Your Dealer Cannot Supply You—Use This Coupon. No Money Down!

RADIO INDUSTRIES CORPORATION
131 Duane Street, New York City

Please send me C. O. D. the following: .....Tropaformers, $6.75 .....Straight Line Condensers, $1.75 .....Ricofones, $2.95 .....Oscillating Coil, $3 .....Fonekushions, 50c .....Melotone Attachment, $7.50.

Name .....Address.....



Which is Better—

A Cheap Set for Cash---or
A GOOD Set ON TERMS ?

The Good Set is Cheapest in the End

Bay State specializes on the better grade sets, like Radiola, DeForest, Adler Royal, Magnavox, and sells on **Convenient Terms.**

Write for information. Address Dept. A,

BAY STATE RADIO CO.

The House of Radio Service

116A Washington Street **Boston, Mass.**

RADIO PROGRESS

HORACE V. S. TAYLOR, EDITOR

Volume 2 Number 7

Contents for

JUNE 15, 1925

RADIO PROGRESS is issued on the 1st and 15th of each month by the Oxford Press at 8 Temple Street, Providence, Rhode Island. John F. O'Hara, Publisher. Yearly subscription in U. S. A., $3.00. Outside U. S. A., $3.50. Single copies, 15 cents. Entered as second-class matter, April 4, 1924, at the Post Office at Providence, R. I., under the Act of March 3, 1879. Address all communications to RADIO PROGRESS, 8 Temple Street (P. O. Box 728), Providence, R. I. Title registered at United States Patent Office.

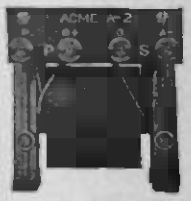
The Two Outstanding Parts In Radio !

Give Low Losses and Amplification Without Distortion to Any Set

QUALITY and distance are what a radio set must give. To insure Quality, amplification without distortion is essential. And to insure Distance, low losses are essential. That is radio in a nutshell.

People in whose sets Acme Transformers are used, are sure of hearing concerts "loud and clear" so a whole roomful of people can enjoy them.

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



Acme A-2 Audio Frequency Amplifying Transformer

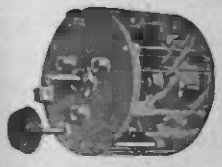
To get the thrill of hearing distant stations loud and clear, your set must have low losses, for it is low losses that give sharp tuning to cut through the locals, and it is low losses that allow the little energy in your antenna to come to the ampifier undiminished. That's what the Acme condenser will do for any set. And it will do it for years, because the ends can't warp, the bearings can't stick and the dust can't get in and drive up the losses several hundred per cent.

The Acme Reflex (trade mark) owes its success and its continued popularity to these two outstanding parts in the radio industry, for low losses and amplification go hand in hand.

Use these two parts in the set you build. Insist on them in the set you buy.

Send 10 cents for 40-page book, "Amplification without Distortion"

WE HAVE prepared a 40-page book called "Amplification without Distortion." It contains 19 valuable wiring diagrams. In clear non-technical language it discusses such subjects as Radio Essentials and Set-building; How to make a loop; Audio frequency amplifying apparatus and circuits; Instructions for constructing and operating Reflex amplifiers; How to operate Reflex receivers; Antenna tuning circuits for Reflex sets; "D" Coil added to Acme four tube reflex; "D" coil tuned R. F. and Reflex diagrams; and several more besides. It will help you build a set or make your present set better. Send us 10 cents with coupon below and we will mail you a copy at once.



Acme Low-Loss Condenser

ACME APPARATUS COMPANY

Transformer and Radio Engineers and Manufacturers

DEPT. (AS), CAMBRIDGE, MASS.

SEND THIS COUPON

ACME APPARATUS COMPANY,
Dept. (AS), Cambridge, Mass.

Gentlemen:—
I am enclosing 10 cents (U. S. stamps or coin) for a copy of your book "Amplification without Distortion."

Name .....

Street .....

City ..... State .....

ACME ~ *for amplification*

These are Worth Waiting For

Our next issue will have a very pretty picture of Gamby, the favorite dancer of Roxy's Gang. The story of her life (more or less) will be told by Vance.

Most loud speakers will have a harsh, rattling noise, if fed too much current, when a local is broadcasting. A style which does not have this defect, and which is unusually clear in speech, is described in the article, **"This Speaker Can't be Overloaded."**

Now the summer is upon us many thunderstorms are passing overhead. Some people are afraid to use their radios because of the fear of lightning. How this can be completely avoided is explained by Wolf in **"The Myth of Summer Lightning."**

Miss Goldman has been writing some very entertaining stories of radio celebrities. A sparkling article, **"A Constellation of Three,"** will delight you in the July 1 issue.

Now is the time to add a couple of tubes of radio frequency amplification to your set to help reduce summer disturbances. Marx explains how to build an amplifier which does not oscillate—**"A Non-Squealing RF Amplifier."**

Arnold's article, **"Broadcasting from a Belfry,"** which tells some of the tricks the broadcasting stations use in order to give life-like reproductions, will appear in the next issue.

In **"What About the Ether?"** Taylor describes the latest experiments on this substance, which is supposed to lie all around us and, in fact, in us. Its relation to relativity is made plain.

RADIO PROGRESS

"ALWAYS ABREAST OF THE TIMES"

Vol. 2, No. 7 JUNE 15, 1925 15c PER COPY, $3.00 PER YEAR

Sending Newspapers by Radio

Music, Pictures, and Now News Items Sent Over Air

By HORACE V. S. TAYLOR

HAVE you ever printed a newspaper? You read them every day, but naturally think of their being printed in a tremendous establishment with presses nine feet high. Did you know that they now could be printed in your own home? This result has come about from developments of the picture sending apparatus which was described in the columns in the January 15, 1925, issue of RADIO PROGRESS. It is now possible to install apparatus to be attached to a regular receiving set which will print a newspaper in black and white right before your face and eyes. At the present time we lack the sending station which will be required to broadcast such newspaper copy, but these will undoubtedly be arranged for in time.

From Hawaii to New York

A sample of the work transmitted is shown in Fig. 1. This shows the top of a column which was sent from Hawaii but printed in New York. Of course, our photographic reproduction is not as good as the original. A whole page may be sent one column after another, or even all seven columns across the page at once.

The method of transmitting such copy is like what was described in the article just referred to. Further refinements have increased the speed and the reliability of this method. In brief, the newspaper which is to be forwarded is photographed on a large film. This is bent around a glass cylinder and is oscillated back and forth. A powerful beam of light from a lamp inside the cylinder sends a pencil of rays through a small spot in the film to a photo electric cell outside. Of course, as the film shifts its position this pencil of light goes through first one spot and then another; and so has its intensity varied by the light and shadow of the film itself.

TERRITORY OF HAW

PHOTOS SENT BY RADIO HERE TO NEW YORK

Radio Corporation and Army Send Pictures Over Land, Sea, Successfully

Greatest Distance Ever Spanned: First Achievement of Its Kind

NEW YORK, May

Fig. 1. One Column of a Newspaper Sent 5,000 Miles Through Air.

The photo-electric cell is a special vacuum tube which sends out more or less current, depending on how much light strikes it. We then have an electric current varying in strength just the way the original film did. This current works a radio sending station just like a microphone.

Fountain Pen Writes Itself

At the receiving end the radio waves are turned into currents by running through a detector and amplifiers just like a broadcast program. Instead of working a loud speaker, however, the output from the last step operates an electro magnet, which pulls a fountain pen against a sheet of paper. This sheet is made to oscillate back and forth, just keeping step with the film at the sending end. The result is a series of dots and dashes, as shown in Fig. 1.

The newspaper illustrated here started at Honolulu, as shown in Fig. 2. The oscillating glass cylinder is seen in the lower left hand corner. Owing to the fact that there is no high powered sending station in that city, the land lines were used to transmit the impulses to Kahuku. There the picture was thrown into the ether from the powerful aerial of the Radio Corporation.

At Marshall, Cal., is the receiving antenna, which hooks up with the Hawaian station, 2372 miles away. Here the signals were received. However, they had not reached the end of their journey. Although there was no operator stationed to receive them, the dots and dashes automatically flowed to the land line connecting Marshall to Bolinas, Cal., where another high power tower transmitting station again put the waves on the air.

Found Their Way to New York

Once more they travelled a tremendous distance until they were picked up 2640 miles farther on by the receiving station at Riverhead, L. I. Again, untouched by human hands, they threaded the land line seventy-six miles to New York. Here their journey was done.

Fig. 3. A Portrait Can be Sent in 20 Minutes—Gov. Gen. Farrington.

The receiving apparatus put down each dot and dash just as it had appeared in the film at Hawaii and presto! the result is shown in our first illustration.

Of course, pictures are sent just as well as newspapers. Fig. 3 shows a portrait of Governor General Farrington, while Fig. 4, shows Mr. W. P. Hawk, of Hawaii. Notice that these cuts are like line engravings rather than half tones. The half tone process, as you probably know, consists in photographing the picture through a fine mesh screen. This method breaks the picture up into a large number of tiny dots. The actual size of the dots determines how black the picture shall be at any spot.

There Are No Grays

Instead of such a series of round dots, the radio pictures are made of a myriad of short dashes which are drawn by the fountain pen. If you have examined our photographs closely, you will see that such is the case. There is no change in the size of these short dashes as happens with the half tone, and that is why there are neither light gray or dark gray parts of the picture. It is either black or white. Of course this is a slight disadvantage with this particular process, but it is not at all serious.

One reason why this limitation occurs is our old friend static. Where the depth of the color varies through wide limits, you can easily see that static and interference from squealing receivers, would cause a great deal of change in the record and so a blurring of the picture would follow. On the other hand, when the half tones are left out entirely, so that only black and white is used, then no change can be made by outside interference unless it is strong enough to stick in a dot where none was intended or to suppress a dot where there was supposed to be one. Such a scheme of sending is much more reliable than half tone processes.

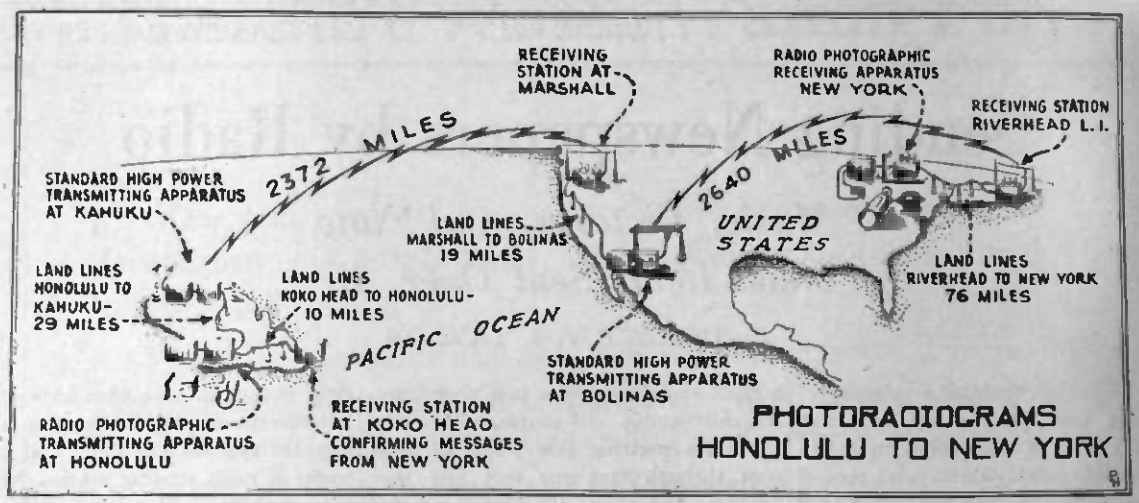


Fig. 2. This Shows Route Taken by Newspaper in Its Travels—Twice by Air and Three Times by Wire

An Improvement in Six Months

As an example of the progress which has been made along these lines, just compare Fig. 5, which shows a portrait of President Coolidge, sent out six months ago. Observe the wavy lines all through the picture. This was caused by a slight irregularity in the motion of the sending apparatus. Notice that this waviness or stippled effect is entirely missing in the new pictures.

In comparing the old style of picture with the new, you may perhaps think that the portrait of President Coolidge is a little more artistic than the recent one. It so happens that the original photograph from which Fig. 5 was made had a more even lighting or tone than the one shown in Fig. 4. This is the fault of the photographer and not the sending apparatus. If the original picture shows one-half of the man's face quite bright and the other half in complete darkness, the radio waves can not change his face but must print what is fed to them.

Twenty Minutes Finished Photo

The pictures which come through best are those which have a fair amount of contrast and which can be reproduced well by this black and white process.

Flat photos with very little light and shadow will not make good, snappy prints. The contrasting negatives can be run through very rapidly. It took only twenty minutes from the time the picture was started in Honolulu, until its being finished in New York.

When this process has been still further simplified, so that it can be built in individual units for home use, just think what a tremendous effect it will have in distributing news. The stock ticker of Wall Street is a wonderful method of distributing stock quotations to all who are interested. Next followed the page printer, by which subscribers to the service may receive items of news right up to the minute. This new method, however, shoots whole pages of newspaper—words and pictures alike—through the air instantaneously.

General J. G. Harbord, of the Radio Corporation, has announced that the experiments along these lines are being conducted continuously and will be kept up all summer.

Fig. 4. This Picture of W. P. Hawk Resembles a Line Cut. Note the Straight Lines.

Fig. 5. This Wavy Line Photo of the President Was Style First Developed.

HERE IS A NEW PROFESSION

The big increase in the number of broadcast stations has created a new vocation which has already attained the dignity of a profession. Each station needs from one to a half dozen program-makers and the requirements of the work are such that a real professional class is being created.

It is estimated that there are now more than 1500 men and women in this class. As its numbers grow, the standard of requirements is being raised. This is a brand new problem to employment experts. They have very little data or experience on which to base recommendations. Until now the owners of broadcast stations have had to pick their program makers and announcers from the radio field. But it is not certain that this practice will be continued much longer.

OMITTING THE STEPS

The Department of Commerce has just announced that favorable consideration will be given to applications from owners of Class B broadcasting stations for permission to use higher power without requiring the increases to be made in steps of 500 watts as has been the practice heretofore, provided the stations are situated outside of congested receiving centers.

In taking this action, the Department is endeavoring to satisfy the demand of broadcast listeners that the use of increased power be permitted in order to overcome the existing static conditions which are making reception difficult.

The usual precautions will be exercised to protect broadcast listeners from excessive interference with reception they are now enjoying.

American Radio Relay League

ABOUT HALF AROUND THE WORLD

All records for radio transmission on high speed (short) waves have been broken in recent daylight tests between England and Australia, according to information received by the headquarters of the American Radio Relay League at Hartford. Two members of the League, E. J. Simmonds of Gerrard's Cross, England, and Charles Maclurcan of Strathfield, Sydney, Australia, working at daybreak, Greenwich (England) time or broad daylight in Australia, succeeded in transmitting three messages and exchanging greetings using only 125 watts of power.

This last fact, coupled with the distance of 10,300 miles, places the tests in the class of world wonders. When you remember that the biggest distance possible from any one part of the world to another is only 12,500 miles, you can see that these two amateur radio telegraphers have almost reached the limit in world communication.

Two Prime Ministers Talk

Maclurcan, whose station call is 2CM, started the conversation, using a wave of 13,300 kc. (22.5 meters.) He transmitted a message from the Australian Prime Minister to Prime Minister Baldwin of England, and then greetings to Dr. W. H. Eccles, President of the Radio Society of Great Britain. Dr. Eccles' reply was transmitted by Simmonds from the British station, and then the early morning conversation was brought to a close, as Simmonds said "to permit a shave before going to business."

This startling conversation began at 5:52 a. m., Greenwich time, and continued until 7:15 a. m., thus finishing the test when it was broad daylight at both stations.

RADIO BEATS DOG TEAM

The practicability of amateur radio telegraphy for those whose homes are in the far-away places is well demonstrated by the station of Ed. Dusang in north central Manitoba, at least 100 miles from the nearest town, railroad or telegraph. The station is situated east of Lake Winnipeg and is a number of miles up the Winnipeg River near the Selkirk Mine, a gold working. The weekly mail is the only link with the outside world and this is brought in by boats in the summer and dog-team in winter.

The station, 9AD, is operated with the usual Hartley circuit with fifty watts of power. The most peculiar feature of the set is that it cannot be heard in Winnipeg, which is the nearest sizeable city. Messages are sent through to Regina, Moose Jaw, and Calgary, in Alberta, with the greatest of ease, and are then relayed back to Winnipeg. This phenomenon is probably due to the fact that the station is near the Selkirk Gold Mine. The big mass of ore disturbs the travel of the waves.

Farthest North for Code

Toronto amateurs are heard quite regularly by this station, which is the farthest north in the central part of the Dominion and it is the hope of Dusang that he will be able to penetrate the eastern country with his set, to establish two way communication.

South America and South Africa have been finally linked up by amateur radio telegraphy. J. S. Streeter, operating Station A4Z from Capetown successfully accomplished two-way communication with Carlos Braggio of Calle Alsino, 412 Buenos Aires, a prominent member of the league in Argentina. This is reported as the first complete transmission of messages between the two continents by amateur radio enthusiasts

ISSY A NUTT—MRS. NUTT SHOWS A BURST OF THOUGHT—By EARLE HARVEY.

Radio in the U. S. Army

This Interesting Article is Illustrated by Official Photographs

By WILLIAM RADOS, Arlington Heights, Mass.

BANG! Bang! Bang! barks the light artillery at the left. Boom! goes the heavy ordnance in front. How does it happen that the gunners are able to direct the aim? Do you see that airplane circling overhead? There is where the signals start which tell the artillery how to fire. If it were not for radio, the long distance guns would be of little use, as they would have to wait for a near approach before releasing their fire.

In the army, radio is used as a necessary means of communication. There are many other ways of sending signals, but radio fills a place which cannot be well taken over by any other method. Radio with U. S. Signal Corps is not a plaything, but merely one of several means of signalling to other stations. It is the most modern way, but the army also uses the most primitive means of signal communication.

Wig-wag and Rockets

Besides radio, the army uses wig-wag flags, telegraph, fireworks, flashes, telephone, buzzerphone, and heat rays. The field which radio occupies, and how it works will now be described.

Radio was used for many years before the war by the army, but when the call to the colors came in 1917, the army did not have an abundance of material. Good radio men are not made over night.

Even such a simple thing as operating a receiver is not any too easy. Just think how many squeals and whistles you hear every night coming from neighborhood sets which are operated by fans who have not learned how to work their own sets. And all this is in the leisure and quiet of one's own home. If instead they were to try to pick up an enemy's wave, while seated in a pool of water, at the dark end of a trench, with shrapnel bursting overhead, just try to imagine how much harder it would be to make the set behave.

Factories cannot do the impossible. So the army was short of radio equipment. Thousands of men were sent to radio schools, the amateurs were put in charge of equipment, and factories were given orders. In a surprising short while, equipment and personnel were satisfactory. Benefiting from the war, the signal corps is in splendid shape to-day.

Men Know Telephone, Too

The men of this corps are trained signal men. They are sent to a school and thoroughly trained in the principles of telephone, radio, and other methods of communication. These men are therefore skilled in every method of communication there is. They can go to the switchboard of a telephone exchange and trace out circuits as in Fig 1. In short, they are skilled in every possible way of sending signals. Any young man who wants to learn a trade, and particularly radio, should see what the signal corps has to offer him.

The army designs and builds all its own radio equipment. Much of it is made at a New Jersey camp. The army officers know better than anyone else what the equipment must undergo to be an army radio set. Would you dare throw your shining five-tube neutrodyne out of the window? Yet an army set must be able to stand that, and much more if it is to be of use. Therefore, an army radio must first of all be rugged. If it can be thrown out of a second-story window with all its tubes in it, and still work when picked up, it will do for the army. Another thing that it demands is *reliability*. The receiver

Fig. 1. Part of Training School. Soldiers Must be Able to Trace Circuits on Telephone as Well as Wireless

must work every time, and must start instantly on manipulation.

No Hair Breadths for Army

There must be no hair-breadth or tiresome fussy adjustments. A soldier in the field has no time to adjust or experiment. This is the reason the army insists on reliability of operation.

Compactness is another feature. In a permanent land station, there is plenty of room. Even on shipboard, there is a fair amount of room, which may be devoted to the signaling equipment. But when a man expects to carry all his equipment in an automobile, and when that is shot out from under him to pick that up and carry it on his back, he does not like to toy with fifty-pound storage batteries or 200-pound generators, nor does he want to walk along with a 75-foot aerial mast stuck in one pocket.

As sets must be small, the transmitter and receiver are put in the same box. A receiver alone is not of much value to the army in the field. Every installation therefore, carries a complete transmitter and receiver together in a case. This case is about the size of a small trunk, and contains everything necessary for the operation of a small radio station. There are legs which can be attached to the sides of the case, thus setting it up as a small table. The cover lets down, forming a shelf on which the operator can write.

Same Tubes Both Ways

Fig. 2 shows the complete equipment out on a table. This is an entire portable set carried by two men. The cases hold everything necessary to put up a station. The box which can be slung over the shoulder, carries a complete transmitter and receiver of the tube type. Three tubes are used for transmitting, and the same three are used for receiving by throwing over a small switch mounted on top of the box. Spare phones, tape, pliers, wire etc., are provided. This particular station can be put in operation in about twenty minutes.

As the reader may have judged for himself by this time, the army demands mobility. A station is useless if it will take three or four hours to put it up. By that time, our company might have been captured, or the enemy could have made good his escape. Therefore, a station must be able to move quickly and be set up quickly. The headquarters stations are mounted in auto trucks. When a truck receives its orders, it must go along the road to its destination. When it arrives, it puts up the antenna and gets in communication with a station

Fig. 2. This is a Combined Sending and Receiving Outfit. Three Bulbs and a Spare Carried.

Fig. 3. This Moving Station May be Towed by Auto, Mule, or Even by a Couple of Privates.

twenty miles back, all in thirty minutes. As it would take several hours for the telephone service to lay wires, it can be seen what an advantage the radio is.

Talking in 20 Minutes

The army gets mobility by making the sets small and compact. They are carried by men, automobiles, mules, or trains. A photograph, Fig 3, shows a small cart or trailer which can be drawn along by an auto truck. In, and on this, is mounted everything needed to insure the success of a radio station. The cart will be drawn by an auto or it may be pulled by a few men. When it gets to its destination, some of the men will put up the antenna, (Fig 4) others will install the counterpoise or ground wires, while the operator opens up the radio case and gets it ready. The whole process usually takes only twenty minutes.

Reliability is assured by using simple regenerative circuits for receiving, and foolproof transmitting circuits. Only as many controls as are absolutely necessary are provided with dials. Although it is a very simple matter to run one of these sets, the operator has the satisfaction of knowing that it is absolutely reliable.

Parked in a Pond

The ruggedness of army sets is well-known. These radios have to go through all kinds of handlings, none of which is very careful. By buying the best materials, and then building everything very rigid, they get apparatus which will stand the gaff. As an example of a government set, I might mention that a good three-tube set may cost about four hundred dollars. If it is dropped in a pond, it will be no worse for the experience, while an ordinary broadcast receiver would be useless.

In return for all the above mentioned advantages, the army sacrifices range or distance. The same equipment that the public uses to hear concerts hundreds of miles away, is employed for distances of no more than thirty miles. The equipment must not send very far, because the enemy could pick it up easier. The receiver need not have a long range, because it may bring in interference originating many miles away.

Three Kinds of Army Stations

The army classes its stations as portable, stationary, and aircraft. The portable sets we have discussed in great detail above. The permanent stations are at the signal corps camps and at the forts. They, of course, need not suffer for lack of room, so they have very large stations. Every fort has a radio station which may send out a voice which can be picked up by the average listener. The wave lengths are similar to those the broadcasting stations use.

The aircraft has only one reliable means of signalling—the radio. The rest of the army would not miss the radio very much in actual combat, as they have many other means of communicating. But the aircraft must depend on

Continued on Page 25

Fig. 4. This Aerial is Set Up and Working, Complete, in 20 Minutes.

Taking Radio South for Summer

Pointers on Kind of Set to Take With You

By R. A. LUNDQUIST, Chief, Electrical Division, Department of Commerce, Washington

WHAT kind of radio set is best in a hot climate? This interesting question may be partly answered by the experience I had while studying electrical conditions in Venezuela, North Colombia, Panama, Costa Rica, Nicaragua, Salvador, Guatemala and Mexico. Conditions are severe in these countries owing to the combination of high temperature and moist air. Here are a few facts which were observed on this trip, which has just been completed.

While there is a steadily growing interest in radio in the Latin-American countries I have just visited, there is as yet no great development.

No One Allowed to Listen

In Venezuela the Governmental restrictions in force make impossible the use even of receiving sets. While permission to exploit radio in that country has been granted to a local group, no definite steps have yet been taken to open up the market, though various plans are under contemplation. However, even though the free use of radio may be permitted in Venezuela, it must be remembered that the population of the country is not great and that only a moderate percentage of the total can be regarded as prospective users of radio equipment.

A few sets are found in Colombia, but in most cases they are owned by Americans or Europeans. Stations in Mexico, Cuba, Porto Rico and the United States are picked up with only moderate success, as static interference is present over a good part of the year.

Jan Weber, the leader of the Lakewood Farm Ensemble, which broadcasts an hour's concert every Sunday evening, starting at ten o'clock, through WJZ.

Sunning Out Static

It may be remarked here that my study of conditions in Colombia indicates that at least part of the so-called static interference met was due to set noises, and to leakage resulting from poor maintenance of electric wires of the distribution lines of light and power companies. Absorbed moisture is undoubtedly the cause of some of the trouble encountered, especially where high plate voltages are used. As proof of this, I was told by an electrical engineer in a Colombian city that a popular priced set owned by him gave quite good results only after he made a practice of sunning it daily in order to keep down the moisture. The humidity is often aggravated by the prevalence of dust in some localities.

In the Central American Republics visited, the most active radio interest was encountered in Costa Rica, Salvador

Continued on Page 19

Talking to MacMillan at 20 Meters

Here Is a Transmitter Which Has No Silent Hours

By VANCE

DO you like a one-sided conversation? You remember the old story of the man with the telephone receiver glued to his ear for ten minutes, without his saying a word. His friends decided that he must be "talking" to his wife.

There have been various receivers described in the radio publications, which will pick up the high speed vibrations of 15,000 kilocycles per second (twenty meters). If you use such a receiver you will be able to listen in to get the MacMillan expedition to the North Pole when they send at this high frequency. Very likely some of your friends also are building such a receiving set. However, it is a lot more fun if you can talk back and forth to them instead of having to wait for MacMillan before being able to use your receiver.

Doesn't Have to be Quiet

Here is a sending set which will put out waves at this high speed. It will work even when using a 201-A tube for sending, although, of course, the range will be small. Don't forget, however, that to do any sending at all, you must have a government license. Such a license does not cost anything, but to get it you must be able to read code at a moderate rate of speed. One great advantage of such a high frequency sending outfit is that you are not obliged to observe the "quiet" hours.

If you have ever done any transmitting you will know that up until late in the evening no amateur is allowed to send out code at around the ordinary wave speeds of 1,500 kc. (200 meters). This is so that broadcast listeners, who want to pick up ordinary entertainment, will not be interfered with by code even though their receiving sets may not be very sharply tuned. However, for such high vibrations as we are here considering no sound will be caused in a broadcast receiving set even though the latter may have very poor selectivity. That is why the government does not require silent hours with such a sender. This is, of course, a great advantage when you wish to talk to your friends during the earlier part of the evening.

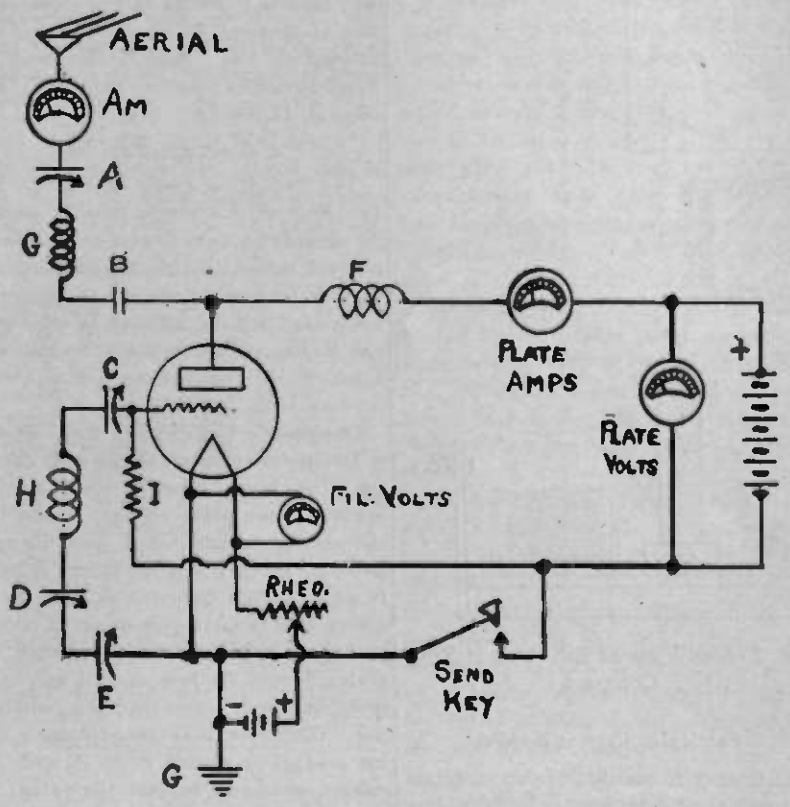


Fig. 1. This Sending Station Hook-up Reaches 15,000 K.C. (20 Meters). Only One Tube is Required

Eddy Currents as Square

Sending at such a high vibration speed will require precautions not needed with ordinary waves. Eddy current losses increase as the *square* of the frequency. A 20-meter wave with its 15,000 kilocycles per second has a frequency just ten times as great as a two hundred meter vibration at 1,500 kc. Since the frequency is ten times and the losses go as the square, that shows that we shall waste 10 x 10 or 100 times as much energy in eddy currents as we did with the slower wave.

When you drop a tennis ball on the ground it compresses the rubber at the instant it lands. Then the ball springs out again to its original shape, owing to the elasticity of the rubber and the air inside the ball. But the force which it gives out is not quite as great as that which was absorbed in compressing the

rubber, and for that reason the ball does not rise quite as high on the rebound as its first position. This effect of giving out less energy than it absorbs is called "hysteresis." The same thing occurs in a diclectric or piece of insulation, and it has the same effect as in the rubber ball. Each time a voltage is impressed on it, it absorbs a small charge of electricity which is given out again when the current reverses. But the energy given out always lacks a small part of the amount which was put in it.

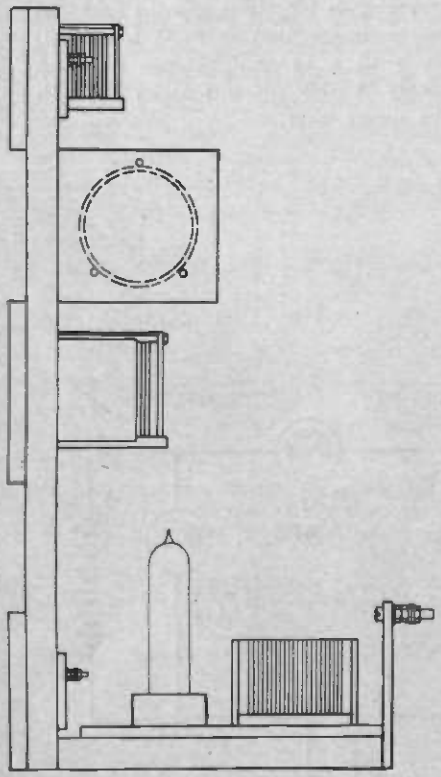


Fig. 2. Side View of Set. This is Very Compact.

Particular Care is Needed

It is easy to see that if you compress a tennis ball and lose a little energy ten times, you will waste a lot more than if you do it only once. In this way the losses in the insulation increase with the frequency of vibration. Since the losses both in conductors from eddy currents and in insulators from hysteresis are greatly magnified by this big increase in the speed of vibration, it stands to reason that you will need particular care in assembling this set to use only the best low loss parts.

In building the frame work and cabinet to hold the parts, it is well to treat the wood with parafin. A hard wood should be used which has been well seasoned. After the pieces are cut to size dry them out slowly in an oven for several hours. The temperature of the oven should be around 220 or 240 Fahrenheit, if you have a thermometer. The temperature should not run much higher than this point or else the wood may be damaged. A lower degree of heat will do no harm, but will necessitate considerable longer time to drive out all moisture.

After the drying treatment, the wood should be immediately plunged into a bath of boiling parafin. When the wood has taken up all that it will hold, which will usually be inside half or three quarters of an hour, it may be removed and allowed to cool. Such a treatment reduces hysterses losses to practically zero even at 15,000 kc.

A One-Tube Hook-up

The hook-up is shown in Fig. 1. Notice that only a single tube is needed. As already explained, this may even be a 201-A tube with 120 volts on the plate. If your correspondents are in the same town that will be all that is necessary, but if you wish to reach out some distance it will be well to get a 5-watt sending tube.

Condensers A, C, D, and E, have each a maximum value of .00025 mfd. capacity. They must be well insulated so they can stand the plate voltage. Unit C is the grid condenser and if desirable may be made non-adjustable. D and E being in series reduce the effective capacity to about half, but if you prefer a single condenser with half the number of plates, it will do just as well and with probably lower losses than the combination. Condenser B is non-adjustable and has a capacity of .001 mfd. A mica insulated unit will be just the thing.

Sizes of the Coils

The two coils, G and H, consist of five turns each of edgewise wound high frequency cable. The kind consisting of a great many small enameled fine wires is best. The coils themselves are about six inches in diameter and are supported on glass rods, as shown in Fig. 2. The five turn coils are right for 15,000 kc. (20 meters), while twelve turns should be used on each coil when sending at 7,500 kc. (40 meters). A single layer of choke, one inch in diameter, and four inches long, is shown at F. This is to be wound full of No. 24 dcc. wire.

I and J are resistances. The grid leak I should be about 10,000 ohms. The rheostat J will have a resistance depending upon what style of tube set used. The 201-A tube requires six ohms, while a power tube will need a two-ohm rheostat.

Four meters are shown, although of course this number may be reduced if you desire. The most important one is the ammeter in the aerial line. This must be AC instrument reading about one ampere at full scale. It is needed in making the adjustment for the greatest output. The other three meters are all direct current instruments. The voltmeter labelled "filament volts" is used to keep a constant pressure and so prolong the life of the tube. The plate voltmeter and plate ammeter are convenient in making sure that the "B" battery is working correctly. These meters are all plainly seen in Fig. 3.

Tracing Out the Waves

The way the hook-up works is this: The filament is lighted from the "A" battery and adjusted by rheostat J until the pressures, as shown on the voltmeter, is equal to the rating of the tube. Plate current is fed from the "B" battery through the choke coil F to the plate. The negative side of the "B" returns to the filament only when the sending key is depressed. This establishes current through the plate. The grid is connected to the secondary coil H through grid condenser C and tuning condensers D and E.

The set is made to oscillate through the feedback action of primary coil G and secondary H. Notice that G is in the output or plate circuit through condenser B. The oscillations from the output are fed back to the secondary H, where they are impressed on the input or grid circuit. Choke coil F is needed to prevent the high frequency oscillations from being short circuited back through coil G.

Making Dots and Dashes

Notice that the sending key must make the circuit before current from the "B" battery can flow back to the fila-

ment. When this key is up, it interrupts the circuit, and so no plate energy can pass. It is only with this key down that the set can oscillate. By working this key up and down, the aerial oscillations are started and stopped, and in this way the dot and dash code message is put on the air.

In operating this set coils G and H are spaced about a foot apart. The closer they are together the stronger is the feedback action and so also the oscillation, but the same time, unfortunately, the broader is the resulting tuning. Condensers A and D are set to about the same value, which must be a low one for this high speed wave. Condenser E is then varied while watching the aerial ammeter. This will read a maximum at the right setting of A. The grid condenser C may be varied to secure stable operations. After that it need never be changed. To adjust the wave speed condensers A and B may be changed up and down the low values of capacity, of course, giving the high speed of vibration or short wave lengths. Once these have been set to give the right wave they may be logged and brought back to the same place again at any future time.

This is such a simple sending set that it is easily built and is quite portable. This, together with the absence of quiet hours, as already explained, makes it a good one for a broadcast listener to build if he is anxious to break into the wireless telegraph game.

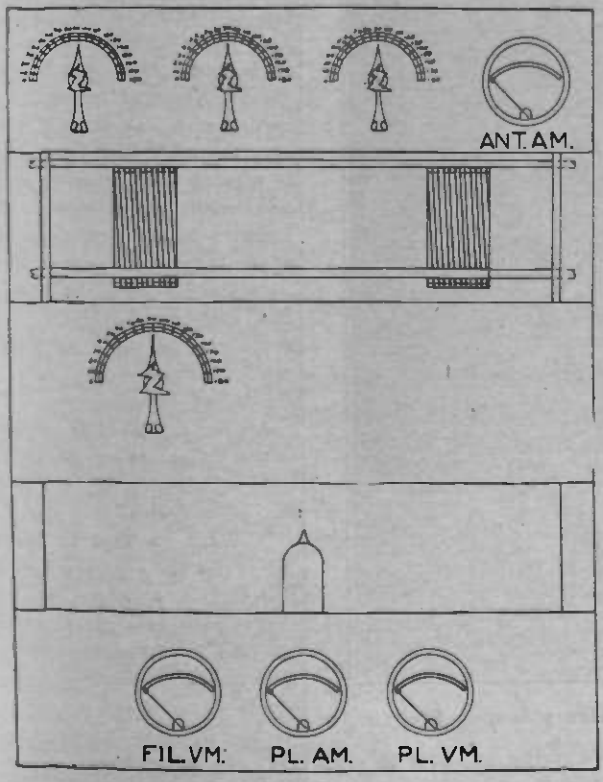


Fig. 3. Front View. One-quarter Way Down Are the Coils, Supported on Three Glass Rods.

TAKING RADIO SOUTH

Continued from Page 16

and Guatemala. In those countries radio sets and parts were displayed by a few dealers and there is talk of local broadcasting being initiated in Costa Rica and in Salvador. In considering the situation here, it must be borne in mind that the number of people who have the necessary purchasing power to enable them to buy radio sets is necessarily limited.

Ranches Relish Radio

Of all the countries visited, Mexico has, of course, made the greatest progress to date. There is an active sale of radio parts and sets in the larger centers; in Mexico City there appear to be almost as many radio stores as there are in an American city of equal size. Of course, a great many crystal sets have been sold. Outside of the larger cities, there are a considerable number of multitube sets at mines and ranches, and apparently these are readily picking up American stations with little difficulty, though static is more or less prevalent.

Considering the situation as a whole, American manufacturers are getting the bulk of the business. The only foreign sets or parts seen to any extent were German and these were very few in number compared to the American products offered.

Giving U. S. a Black Eye

Naturally, sets using three or more tubes are necessary for proper reception in most of this Latin American territory, and in offering such radios for sale, manufacturers should be careful not to be over-optimistic as to the results obtainable. One or two American radio houses have given our people a bad name by advertising radio sets with "guaranteed" reception of distant stations, not substantiated by results. It is all right to say what a set has done in the United States but it is another thing to say what it can do somewhere else, especially in sections that are subject to such static interference and local screening as are these Latin American regions.

Another point that should be emphasized is that American radio manufacturers should pay more attention to the insulation of sets going into hot countries. It must be remembered that distant stations in the United States are picked up usually in the winter time when homes are heated and insulation is kept dry without any attention on the part of the operator.

Boiled in Paraffine

Strange to say, in the tropics they do not use stoves for heating, and a small amount of moisture absorbed by the insulation of a set remains and lowers its efficiency very considerably. There was complaint in one or two cases, that the terminals of American sets were so close together that there was considerable leakage of current between battery terminals under operating conditions. The moral of these results

Continued on Page 22

How to be Happy and Broadcast

Life of a Studio Director at Station KYW, Chicago

By WILSON WETHERBEE, Director of KYW

IT isn't the fashion any more for the young chap in his teens to long to be a movie hero. Instead, he now casts his eyes longingly on the broadcasting studio in the hope of becoming a studio director. But this is not always as easy a job as it looks.

"Sen" Kaney Plays the Uke and Piccolo—Has a Snappy Style.

The daily life of a radio announcer is steady by jerks, as capricious as a stock ticker and filled with more moments of anxiety than there are parasites in Paris. The announcer is, professionally at least, a gentleman without moods other than those dictated by the program material to which he must give voice while he is on duty.

Jump from 15th Story

Of course, in the majority of instances, what he has to say is pretty well prepared for him, but broadcasting studios, regardless of how well regulated, have their wild moments. It is during these instants that the announcer, who probably wishes he could leap from the fifteenth story, must remain calm and unruffled. Just as a finished actor has stage presence, the trained radio announcer has microphone presence—or at least he should have.

Westinghouse Station KYW at Chicago has many announcers. Among these men who tell you what will take place next is Logan ("Steve") Trumbull, chief announcer, Sen Kaney, Eddie Borroff, Edwin Harper and Fred Hill. All of these men are thoroughly trained in the fundamentals of good announcing. They have handled radio "jobs" of all kinds and descriptions from a smoothly running classical concert to the broadcasting of a play directly from the stage of a theatre. Each of them knows how to present a program to the public, but occasionally an attack of the well known "heebie jeebies" (apologies to Spark Plug) will saunter along and ruin an otherwise perfectly good disposition. The listening world, of course, knows nothing about this. As I have said, the radio announcer is a man without moods, at least moods which his audience can detect. The trained announcer is the Pollyanna of the air, a person as fully in command of his emotions as the ancient and illustrious stoics.

Want to Talk to Motorman

Now, in the ordinary course of broadcasting, the programs are prepared by the booking manager and given over to the studio manager for presentation. Artists are expected to confer with the studio manager and if there are changes to be made the manager in turn conveys the information to the announcer. Efforts are made constantly to impress this system in the minds of artists. Occasionally, however, there are entertain-

ers who feel they should confer directly with the announcer, and failing to reach him, many feel slighted, just as they do because they can't talk to the motorman of a street car. Probably they have already given the information to the studio manager who has taken it at once to the announcer. Also, it is probable that they have been told they must not talk to the announcer.

Possibly the studio manager is called outside for a moment. Some radio entertainers seem to believe that opportunity knocks only once if at all, and as soon as the studio manager has disappeared they head for the microphone. Customarily, they choose a moment when the announcer is talking over the air. This, of course, is no obstacle in their paths. The chances are that Aunt Sophia in Maine is listening and the artist desires this valuable bit of information released by the announcer. The entertainer leans over the announcers desk and imparts the "dope" to him. The microphone is open, of course, with the result that it is not necessary for the announcer to tell the story later, for it has already gone out, announced by no less person than the artist himself and blended probably with the words uttered by the man at the microphone. The announcer's favorite color at that moment is a deep red, but he merely closes the microphone and in his sweetest tones asks, "Did you wish to speak to me?"

Most of KYW's announcers can do some kind of a stunt in an orchestra, as can the station's studio managers and other members of its personnel. There are times, of course, in the life of every station when persons booked to appear on a program fail to arrive. The show must go on, for continuity of service is the byword of all radio men from directors to announcers. I shall never forget the first time KYW was without a program. Eight o'clock arrived and there was not an artist in the studio. Sen Kaney (Fig. 1) was at the microphone and Harold Fall, assistant director of the station, then serving in the capacity of manager of the Edison studio, was also on duty. Sen opened the microphone, made his opening announcement and then told the world something to the effect that the studio was as free from artists as a battleship is from wings. He added that the listeners would have to lend an ear while he crooned a few tunes on the ukelele.

Next he dragged the unwilling Mr. Fall (Fig. 2) to the microphone and made him sing while he (Kaney) played the piano accompaniment. In about ten minutes Morgan E. Eastman, musical director of KYW sauntered in. He was prevailed upon to give a few readings. Later, the now famous "Herbie" Mintz came up the studio to see Fall. He too, was pressed into service. The four men whose names are now well known to radio fans gave an hour's program which brought more than 100 telegrams, scores of letters and no end of telephone calls to the station. Kaney confessed that he was stricken with an attack of radio "stage-fright," but he knew some kind of a program had to be released and so he went ahead. The success with which the program met, resulted later in the afternoon frolics, which KYW releases on Tuesday and Thursday afternoons of each week. This program which Kaney, Fall, Eastman and Mintz produced was the first spontaneous bit of broadcasting done, and although it cost probably ten years of Kaney's life, (notice how old and worn he looks in our photograph,) it resulted in the development of a new kind of radio entertainment.

Fig. 2. Shorty Fall, the Assistant Director, is the Original Football Announcer.

Announcing End of the World

All in all, the life of a radio announ-

cer, is an excellent training school for the development of the poise and control required by lion tamers and steeple jacks. It is entirely within the realm of possibility that an announcer upon receiving a bit of press copy to the effect that the world was coming to an end in ten minutes, would calmly open the microphone and tell the world about it.

Wilson Wetherbee—the Author of This Story. He Looked Sad When We Insisted on His Portrait.

while in the back of his mind he'd be wondering if he would be assigned to announce that long expected event, and it did not occur as stated whether he would have to supply something else just as good on the spur of the moment.

The minstrels of the air recently splurged into prominence at Westinghouse Station KYW, when Harold A. "Shorty" Fall, assistant director of the station and A. W. "Sen" Kaney, one of the station's pioneer announcers, started this stunt.

Trying Out New Stunts

In radio's repertoire will be found practically all types of entertainment. Music and song have predominated with the most wonderful applause possible by listeners-in. Within a comparatively short time after radio's advent, plays were broadcast from the stage, football games and other sports were put on the ether directly from the field, and so on—while with the passing of time, other things are tried out.

Thus, radioland is being introduced to another feature—the minstrels are now on the ether. The idea was brought up by "Scoop" Wetherbee, (Fig. 3) director of KYW, at one of the meetings, and as the scheme seemed ripe with possibilities of becoming popular with the fans. Shorty and Sen started the wheels rolling about two months ago, in an outburst of ancient jokes and witticisms, resulting in an influx of telephone calls and letters acknowledging the fun that was being handed out. Thereafter, each Thursday evening, at 11:00 p. m., or shortly thereafter, KYW, from the Hearst Square studio of the Chicago Evening American, has broadcast Shorty's and Sen's minstrel show, always coming out with a fusilade of jokes that would tickle all listeners, and polishing the act with a few timely songs.

TAKING RADIO SOUTH

Continued from Page 19

is this: Insulation on your set has to be moisture proof. Any wood which comes in contact with wires or connections should be first boiled in paraffine. Fibre insulation is not at all satisfactory. Hard rubber is excellent and so is bakelite if it is a good grade. Even with the best insulation, however, there is apt to be a slight film of moisture which collects on the surface. That is why the creepage distance between wires and current carrying parts should be made fairly large. Do not bring your "B" battery positive leads closer than an inch or two as measured along any surface. A separation even wider than this will do no harm.

Getting back to conditions in the tropics, it was found that American broadcasting stations are picked up throughout all these republics and programs are much enjoyed as a rule, though there was some complaint regarding the selection of music. On the other hand, in several cases radio fans who had selective long range sets and were able to choose between American stations, commented favorably on this point, saying that they were surprised to note the quality of music received from small towns where the programs were given by local talent. This was especially true of the Middle Western States which are apparently in some sections picked up more readily than are those in the East or far West.

Using Both Ears for Receiving

Experiments Show Why Even Best Loud Speakers Don't Sound Real

By OLIVER D. ARNOLD

DO you remember the story of the wonderful artist of ancient Greece? He painted a picture of a curtain, which was so realistic that all those who saw it asked him to pull aside the curtain and let them see the picture. But no one could accuse any loud speaker of being so true to nature that it was mistaken for the original tone.

Just why is it that this is the cause? Of course, with the cheap horns, there is considerable distortion of the sound waves as they come out from the throat. Sometimes it is the fault of the diaphragm and often it is the shape of the horn itself, which is wrong. But after years of experimenting many of the more progressive companies have eliminated these troubles. If you take a phonograph record of the sound waves as they emerge from the speaker and compare them with a similar record which has been taken of the original air vibrations, they will be found practically to coincide.

Whistle from All Directions

In such a case the big reason why a band does not sound natural is that the whole vibration comes from a single point, instead of spread out over an entire stage. As a result of this, our ears have no sense of direction as regards the various pieces. This sense of direction has only recently been understood. When we look at a certain object we can tell its direction, because our eyes must point exactly at the thing we see. When it comes to hearing, however, the case is quite different. When a whistle blows a mile away we can face in any direction and hear it equally well.

And yet any person with normal hearing is able to tell right away that the sound of the whistle came from (say) the east. He may not know within a point or two of the compass, just where it started, but he can at least get a pretty general idea of which way the sound came from. This has recently been investigated and it is discovered that it is the difference in action between the two ears which is mostly responsible for this sense of sound direction.

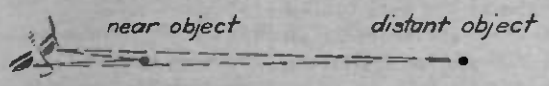


Fig. 1. How We Are Able to See Th at a Thing is Near to Us.

Try This Yourself

The idea is very much like that which governs the use of our two eyes. When you look at any nearby object you can estimate fairly closely how far it is away,—that is, if you use both eyes. To show how necessary it is that we employ both try this experiment. Get a friend to hold a pencil in his hand with the point straight up in the air. Then close one eye and extending your forefinger, try to bring it straight down on the point of his pencil. You will find that you cannot hit the point once in three times. When you open the other eye you will find, you can touch it every time.

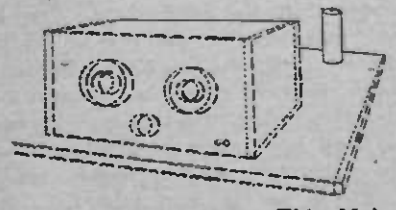


Fig. 2. A Picture Like This Makes Near Objects Stand Out.

This is called the "stereoscopic" effect. It is explained in Fig. 1. When both eyes look at a *distant* object they point in the same direction along practically parallel lines. On the other hand, when looking at something nearby they turn in at quite an angle. To notice how strong this effect is, get a friend to watch his own hand as he moves it up close to his nose. You will see his eyeballs turn in very strongly as his hand gets closer and closer to his face. Through untold centuries our brains have been able to interpret this pointing of our eye balls in terms of distance.

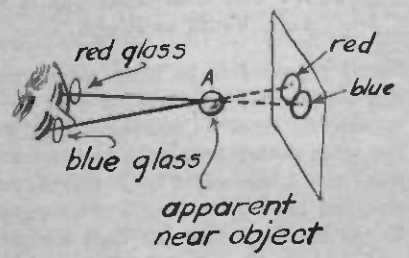


Fig. 3. Principle on Which Fig. 2 Works.

Guessing the Airplane

Of course, the objects have to be reasonably close to get this result. It persists up to 100 feet or so. Beyond that distance the line of sight of the two eyes is so nearly parallel that we cannot make use of it. Just estimate the distance to an airplane when it is flying far overhead and get someone else to make a similar guess. As likely as not the figures will vary as much as two to one (and both be way off).

This stereoscopic effect is made use of in pictures which are printed to make nearby objects stand out in their true perspective. Indeed, movie films have recently been exhibited with the same construction. When viewing such a movie, on seeing a baseball thrown towards the camera it becomes so realistic that the whole audience gasp and

many will instinctively dodge in their seats.

Printed in Red and Blue

Such a picture is shown in Fig. 2. This represents a radio set resting on the front of a table with a dry cell at the rear. As actually printed, this should be shown in colors. The dotted line is printed in red while the broken

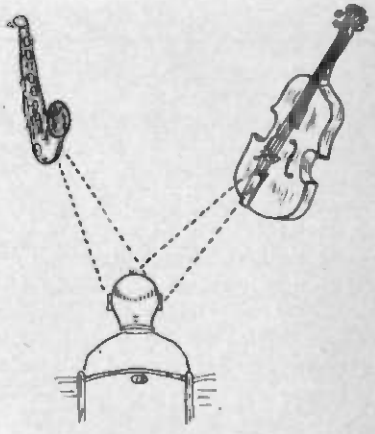


Fig. 4. We Can Hear That Sax is at Left, Violin at Right.

line is supposed to be blue. Where red and blue overlap they make a dark color resembling black. Understand that we are using dotted lines only to illustrate what the colors would be if this magazine had been printed on a color press. In the actual picture the lines are not broken, but are full and of the proper tint. Looking closely at Fig. 2 you will see that the dotted and broken lines at the front of the set are spaced some distance apart. At the back of the set the lines are much closer together, and in the dry cell which stands some distance to the rear, the dotted and broken lines overlap so that they appear to be continuous.

To view such a picture the observer is given a pair of colored glasses. One of the lenses is red and the other one blue, corresponding to the colors of the picture. When looked at through a *red* glass a red line on white does not show since both return a red color to the eye. But when observed through the blue glass, altho the white background appears blue, the red line (since it has no blue rays in it) and does not reflect light at all—in other words it looks black. The red lines, then, show up in the blue glass and the blue lines in the red glass. Where both come together and overlap (as in the dry cell) the lines look black in both red and blue lenses.

The Lines Stand Out

When these glasses are worn and Fig. 2 is observed, the effect on the eyes will be as shown in Fig. 3. The red line on the sheet of paper looks just like the *background* by the left eye looking through the red glass. The blue line, however, is seen by the left eye at B. Similarly the right eye notices the red line at R. The observer is looking at both lines at the same time and the eyes turn in slightly and merge the image together as received by the brain. Since the two eyes turn in toward the point A immediately the brain thinks that the eyes are looking at a nearby object instead of back at the sheet of paper. If points R and B had been separated still farther apart you can easily see that point A would have appeared much nearer the eyes than it now does.

When these glasses are used to look at Fig. 2 the front of the radio set (since red and blue are far apart) will appear to stand right out from the paper, while the dry cell in the rear will seem to be in the distance since the eyes were nearly parallel when they looked at it. It is a similar principle which has been found to obtain in locating the direction of sound.

This is Wrong Explanation

Fig. 4 shows a man in the audience listening to an orchestra. Only the saxophone and violin are shown but the other instruments fill in between them. The sound from the sax strikes both ears and the same is true of the violin. Yet the listener, even with his eyes shut, is able to tell that the saxaphone lies at the left and the strings at the right. How does he know? It used to be thought that it was because the nearer ear picked up the noise a little bit louder than the farther one. This is not true, however, as can be easily shown. Just stick a little absorbent cotton in your right ear. If this explanation were correct then since the left ear now hears everything louder than the right, then all the sounds would appear to you to come from the left. You will find that this is not the case and therefore such an explanation is not true.

Professor F. M. Doolittle, of Yale University, has been experimenting along these lines for some time. In an article in the "Electrical World" for April 25, 1925, he publishes the main reason for this directional action for sounds. Of course, you know that noises do not travel instantaneously. It takes about five seconds for sound to travel a mile. Your left ear is nearer the saxaphone than your right and as a result the

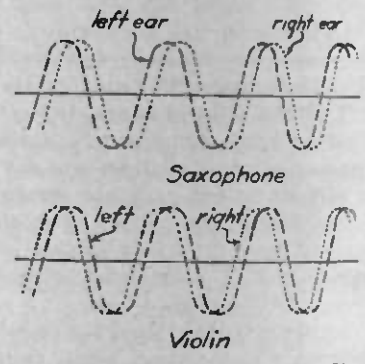


Fig. 5. A Difference in Tuning Gives Us Direction.

tones strike it an instant ahead of time. Of course, the difference in the timing is very slight, indeed, only a small fraction of a second, but it is enough for your hearing mechanism to tell that the sound came from the left.

One Ear Hears Before Mate

Fig. 5, makes this plainer. Suppose both instruments are sounding the same note, which may be middle C. Then the vibration per second of each will be identical—256 cycles per second. The wave as heard by the left hand ear is shown as a dotted line, while the right ear is noted by the broken line. When listening to the saxophone notice that the vibration as heard starts an instant sooner at the left than at the right, and keeps up this advantage all along. That is how we know that this instrument is on its side of the hall. The violin, on the other hand, gives the start to the right ear and so reveals its location.

With the Doolittle system of radio broadcasting this effect is sent out on the air in the following manner:

Instead of a single unit *two* microphones are used which are placed a short distance apart. Each has its own separate sending set as shown in Fig. 6. They both are connected, however, to the same aerial. Our diagram shows them in parallel although series connection is just as satisfactory. The two

senders are adjusted for different frequencies or wave lengths so that they can both be running at the same time without interfering with each other.

How Two Waves Compare

The waves they send out in their audio frequency characteristics resemble those already described in Fig. 5. The music which is played by an instrument direct-

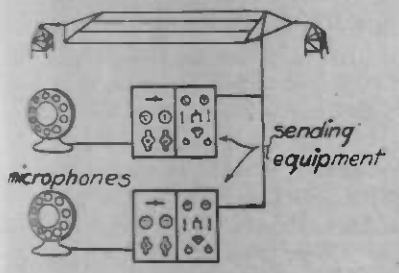


Fig. 6. Both Mikes Use Same Sending Aerial.

ly in front of the two microphones (and so spaced the *same* distance from each one) will have waves which coincide, one lying right on top of the other. Instruments to the left will have one wave slightly ahead of the other, while transmitting waves. As heard in the phones each half is connected to its respective set. In this way we hear in our left ear just what was picked by the left hand microphone in the studio and similarly with the right.

You Will Hear Big Difference

It is surprising what a big difference such a method of receiving works in the appreciation of the music. If you have even seen a stereoscopic picture (as just described) you will realize what a wonderful difference there is between it and an ordinary photograph. And the same thing applies to the change from ordinary broadcasting to this binaural (two-ear) system.

You get an idea of depth and space rather than just a flat reproduction. Of course, there is the disadvantage that two wave speeds (wave lengths) are needed for such sending. At the present time the ether is already overcrowded so the chances of changing to require two different waves is slim. Later on it is probable that the number of broadcasting stations will be sharply curtailed. Then there is a chance that

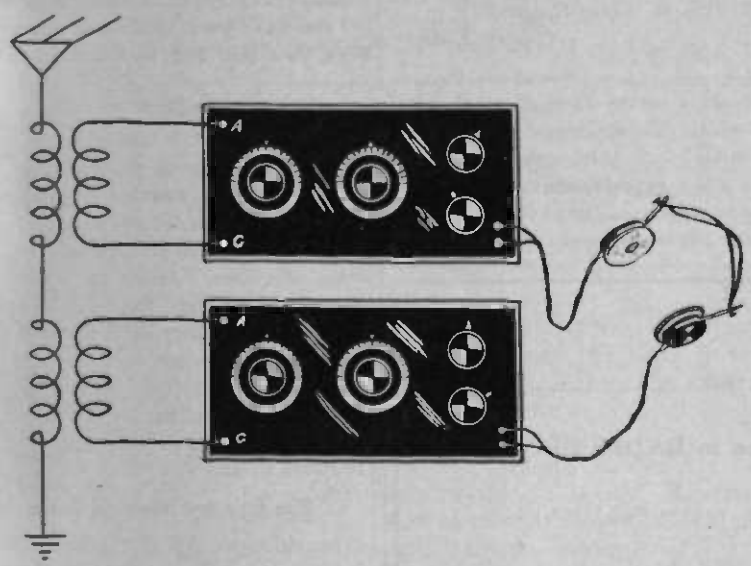


Fig. 7. Two Sets Are Used, One to Feed Each Ear Phone.

with those at the right, the order will be reversed.

In order to pick up such a double or "binaural" wave the hook-up shown in Fig. 7 is needed. Two similar sets, which may be of any standard make are used. One is tuned to one frequency and the other to the other of the two this development can be put in operation. There is the further trouble that the receiving set has to be made in duplicate. Our diagram, Fig. 7, shows two entirely separate receivers. Naturally this would not be required in a commercial instrument, since cabinet, panel, "A" and "B" batteries, rheostats and the like could be made common to both sets with corresponding saving.

Fooling Your Two Ears

An interesting fact about this kind of reception is the following: If the phones are reversed so that the mike on the left makes music for the right hand head phone and vica versa, then the saxophone, which really was on the left of the stage, appears to be on the right, and the same kind of change takes place with the violin. This shows that there is a real directional effect and not that it is just guess work in these results.

This whole scheme is worth knowing about not so much from the practical value which it is likely to attain in the very near future, as from the great amount of light it sheds on the way our ears work. It has generally been thought in the past that the phase or difference in the timing of two waves had nothing to do with the impression made on our brains. Indeed it is true that if a flute is accompanied by a piano, both having the same number of vibrations per second, that it makes no difference in our enjoyment of the music whether the waves from the flute happen to start when the vibration from the piano is at a maximum or at the zero point. But it is evident that our brains are able to appreciate more in the way of sound than we had thought since they are able to catch and interpret the infinitesimal part of the second required for sound to go the distance from one ear to the other.

RADIO IN U. S. ARMY

Continued from Page 15

this, because it is the only means the airship has. When an airplane is over enemy lines, it can instantly report back to army headquarters by the radio telephone. This is the greatest use of the radio telephone in the army, as it is so quick. In the field, however, it is not as accurate as wireless telegraph, and it is easy for the enemy to overhear the conversation.

Wired Wireless Perfected Here

The U. S. Signal Corps has a large laboratory at Washington, where they are constantly experimenting with new methods of radio communication. Re-

Continued on Page 26

Fone Fun For Fans

The Right Answer

"Should wives be paid wages?" asked a writer in a recent article in a magazine.

"Certainly!" says a married man of our acquiantance. "What do you think I send my wife out to work for?"

—Judge.

Feminine Honesty

First Co-ed: "The cheek of that conductor. He glared at me as if I hadn't paid my fare."

Second Co-ed: "And what did you do?"

First Co-ed: "I glared right back as if I had."—Yale Record.

Invaluable Assistance

Teacher: "Why do you always add up wrong?"

Scholar: "I don't know."

Teacher: "Does any one help you?"

Scholar: "Yes, my father."

Teacher: "What is he?"

Scholar: "A waiter."

—Vikingen, Oslo.

Both Right

As a ship was leaving the harbor of Athens a woman passenger approached the captain and pointing to the distant hills, asked: "What is that white stuff on the hills, captain?"

"That is snow, madam," answered the captain.

"Is it really?" remarked the lady. "I thought so, but a gentleman just told me it was Greece."—Exchange.

Conditions Perfect

Tramp: "Pardon me. sir, but have you seen a policeman round here?"

Polite Pedestrian: "No, I am sorry."

Tramp: "Thank you. Now will you kindly hand over your watch and purse?"—Buffalo Bison.

"Is your Packard friend coming tonight, Rose Marie?"

"No."

"Dodge Brothers?"

"No, this is Willys-Knight."

—Crosley Radio.

RADIO IN U. S. ARMY

Continued from Page 25

cently, they perfected a means of sending radio waves over wires so that there will be no interference from other stations. This is the famous wired wireless, which Major-General Squier was responsible for. Although the results of the army experiments cannot always be made public on account of military reasons, the experimenting as a whole is beneficial to radio.

Another use of the radio in the army, is the picking up of reports, time signals, press, and weather bureau data. These services are all broadcast by specified stations which operate on reliable schedules. Although the receiving stations are few, they are important because the artillery and aircraft wish to know the weather, and the men like to hear the news from home. In time of peace, at posts outside of the States, the main use is to get the press reports for home news.

The Quickest Way to Learn

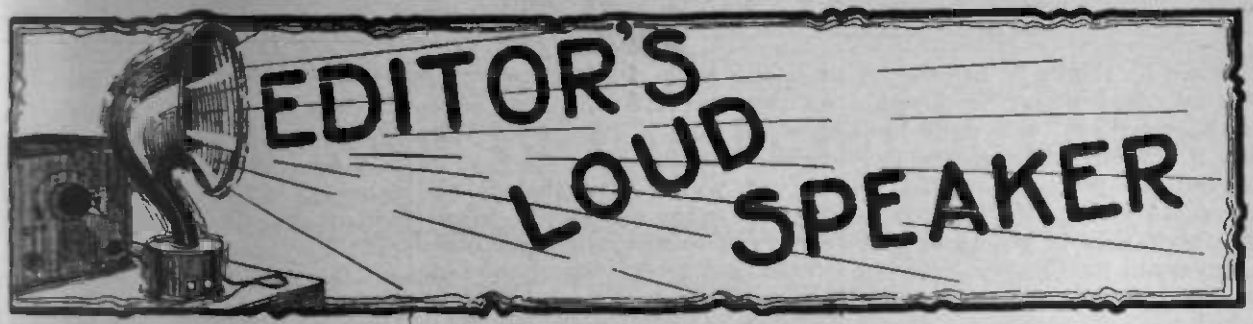
Thus it is seen that the army has a vast radio machine which is on the job continually and always ready. Anyone who joins the signal corps to learn radio, will learn far more than he could otherwise acquire and can be of service to the country if necessary.

Acknowledgments: The photographs are loaned through the courtesy of Lieutenant J. M. Heath, U. S. Signal Corps.

BROADCASTING PIRATES AND COWBOYS

On Saturday afternoon, June 14, the Yale-Princeton baseball game was broadcast from Princeton, N. J., through WJZ. In addition to the baseball game, the entire Alumni Reunion Celebration was described at length to the listening audience. This provided a most interesting event, for it is the custom at Princeton for all the alumni of the university to gather on the campus prior to the baseball game, each class being rigged out in some sort of freak garb.

One class was dressed as sailors, another as pirates, another as cowboys and so forth, and then, just as the game was about to start, a parade was formed with the college band at its head, and the staid old "Grads" became boys again in a grand old "Peerade" across the field. All this atmosphere and local color was described to the listening audience by the announcer, together with the exciting moments of the baseball game which followed next. Undoubtedly among the radio audience that afternoon there were large numbers of the alumni of "Old Nassau" who either through age, illness or business were unable to join "the boys" in a trip back to the Alma Mater.



SHOCKING THE FILAMENT

A filament costs about $2.00 to $3.00, and the rest of the tube is thrown in free. This is a good way of looking at your vacuum tubes, because it is always the filament which gives out first and so makes you buy a new one. The grid and plate do not deteriorate and will stand any amount of use.

That is why it is a good thing to be very careful of your filaments and not treat them roughly. Caveman stuff is not at all popular here. You see a great many different directions in the radio press as to the best way of prolonging the life of this delicate part. Of course the best way to do if you have a voltmeter (which can be bought for $1.00) is to make sure that the rheostat is never turned up to a point where the tube gets more than its rated voltage.

Recently one of the magazines carried the warning never to turn off the "A" battery current with a switch, but be sure to reduce it slowly by means of the rheostat, so that it was no longer very strong when the current was finally cut off. However, this is all wrong. It is not any advantage to the tube at all to cut off the "A" battery in any such way.

All the current through the filament does is to keep its heat up. When it reaches the right temperature, it shoots off myriads of little negative particles of electricity or electrons, and these carry the plate current through the phones and "B" battery. However, notice that it is the *temperature* alone which shoots the electrons. The current through the filament has nothing to do with it. If you could heat the wire to the same degree with a gas flame it would work just as well. Of course. this is not practical, since it must work in a vacuum.

We are now in a position to see the effect of sudden switching. If you have ever done any soldering with an electric iron you will know that after turning on the current, a minute or so must elapse before you can make the solder flow. On the other hand, when you switch off the electricity the iron still stays hot for long enough to finish a job. Here again it is the temperature only which does the business, and not the current flowing through the winding inside.

If you use a gas-heated iron instead of one run by electricity, the same effect is to be observed. That is, there is quite a time lag between the heat applied and the temperature of the metal. The same thing also occurs in a vacuum tube filament. Of course, here the effect is not nearly so great—it is only a half second or so after turning on the rheostat or switch until the tube is up to full brillancy. When the switch is turned off the metal cools again in a half second or so.

However, this is like a year or two to the electrons. Remember that electricity flows 186,000 miles per second—enough to run around the equator seven times in the tick of a clock. Then figure out how long it will take for electrons to jump from the filament through the grid to the plate, a distance of a half an inch.

In the half second it takes for the filament to cool down after turning off the "A" battery current there is a procession of electrons streaming through the tube long enough to form a parade several times around the earth. From this you can see how ridiculous it is to assume that you are doing a thing very rapidly when it comes to dealing with these small bodies.

From this you can draw the conclusion, which has been found true in practice, that a switch to control the "A" battery is a very convenient piece of equipment and has no bad effect at all on the operation of the tube.

HOW TO SIGN OFF

There seem to be various ways for a studio director to sign off. It used to be "This is Station XYZ, New York, signing off at ten o'clock." Now, however, there are various changes which have developed as radio has grown.

In the first place, why is it that a station signs off, anyway? The only reason is so that the listener will know who has been talking to him. Unlike the colored mammy, who, when she received an anonymous proposal over the phone, said, "Yes, who is it?", we feel that we want to know who is at the other end of the air.

The nearby stations are all fairly familiar to the confirmed broadcast listener, so when he hears the call letters of any station within a few hundred miles, he knows what city it is, and so the latter for him is unnecessary in the call. When he is out for distant stations, however, and he hears a faint one from way across the Continent he wants to be sure that he got the letters correctly. It is so easy to mistake a "B" for a "P" or an "A" for a "K."

When he thinks he has the letters he can look up the location in the call book, and if he finds that it corresponds with the city, he can be pretty sure that he heard correctly. If the two do not check, then he knows he must listen again for the call letters to make sure where they are coming from.

Keith McLeod, the Musical Director of Twin Stations WJZ-WJY. McLeod is a Westerner, coming from Denver, Colo., and is to-day one of the most widely known pianists in the radio world, and is responsible for a large portion of the musical programs broadcast by the Twin Stations.

That is why there is a lot of complaint among radio fans about the habit of some of the stations in omitting the name of the city. Every five or ten minutes they give the letters, but no location. The DX hounds, way across the country from them, can not be sure that they got them straight, and they certainly can not persuade their friends who are listening with them what a wonderful set they really have. This omission in such a case seems like carelessness.

Even worse than that is the habit of some of the big broadcasters of substituting some other words instead of the city. One big station for instance signs the location, "New England." This seems rather egotistical on the part of the director. Furthermore since in the call book the location is not given that way, it is impossible for a Westerner to verify the call. Recently another class "B" station has started to give his address as "USA" following his call letters. The announcer must think that he is being picked up by Africa and Australia right along and that they are glad to know what country he is in.

A few complaints from the audience addressed to the studios will make the directors realize that they are giving their call letters as a help to their listeners and not to please themselves. When they appreciate this, they will call in a manner which makes the station easy to locate.

BREEZE AND BILLOWS BROADCAST

A specially constructed microphone housed under the furthermost point of the Steel Pier, Atlantic City, directly over the surf of the Atlantic Ocean, will daily fill the air with the sounds of the mighty waves as they crash against the shore. Tune your receivers to WIP, Philadelphia, at 3:00 p. m. and 8:45 p. m., and listen to the cooling sounds of Atlantic City's world-famed surf. A good radio receiver, a cooling drink and the sound of Atlantic City's surf will drop the temperature of any thermometer.

GLOBE TROTTERS HAVING FINE TIME

The party of radio fans that set sail from New York a short time ago on the radio tour of the world, are having most interesting times in the various ports visited. This tour is being conducted every Tuesday evening through Station WJZ at ten o'clock, and consists of a descriptive talk of the port to be visited and its environs with a setting of music characteristic of the country.

PRIZE FOR SNAPPY NAME

A comparatively new feature, the Landay Musical Hour, broadcast by WJZ every Monday evening at 8:30, brings to the radio audience musical talent of rare ability. There is also the possibility of winning a first class radio set if you are clever enough to suggest a suitable name for the period of broadcasting. There will be five sets given away, representing $1,000.00, and the judges will be three prominent men of the musical world and two of similar position in the realm of advertising. The name must be short and yet give the full information regarding the nature of the period and its sponsors.

Hard Rubber vs. Cardboard in Radio

What to Use for Spools in Winding Your Own Coils

By W. STUART STANDIFORD, Youngstown, Ohio

DO you wind your own coils? There is some advantage in doing this as you get just what you want, and besides it is fun to make your own couplers and variometers. The directions always tell how many turns and what size of wire to use, but the spool or tube on which the wire is wound is usually left to your imagination.

In making up the radio set, the question occurs to many amateur builders as to whether to use cardboard or rubber tubes as a foundation for the windings. They naturally desire to keep the expense of their receivers down to the lowest possible cost. While cardboard may be used for such work, it is not nearly as effective from a wearing or insulation standpoint as hard rubber. The reason is that the broadcast current is of such a high frequency that nothing but a material having a high insulation strength ought to be used. Dependable insulation is a vital factor in radio construction work because it has a direct bearing upon the sensitivity and clearness of both transmitting and receiving.

Why Cardboard is Wrong

Hard rubber has great dielectric resistance to the voltages and frequencies used in broadcasting reception, and this gives greater clearness to the signals, than is the case when the instruments are made out of cardboard. On this account, the very best factory made radiophone sets have their variometers and vario-couplers made out of phenol compounds like bakelite or else hard rubber, as their manufacturers desire their product to give the best possible results in regard to working efficiency. The great trouble with cardboard exists in the fact that it is not only a fragile substance, but also has a tendency toward moisture absorption, thus causing an electrical leakage between the various instruments.

The latter quality makes it necessary to protect it against moisture in the air by a coating of paraffine wax or shellac varnish, which in turn attracts and holds dust. Hard rubber is an excellent material for making radio set parts, but on account of its being very difficult to cut and bend in its natural state, and also from a lack of knowledge in handling it, the amateurs have confined themselves largely to wood or cardboard.

Accounts for Poor Tuning

Many amateurs prefer wooden variometers and vario-couplers for their tuning instruments, but wooden rotors, etc., have their drawbacks, as there is apt to be some moisture in the pores of the wood, which is due to rapid drying, sufficient time not having been allowed to drive out all moisture from the pores. This is the reason why some variometers are poor in tuning qualities as contrasted with others constructed of the same substance.

Another trouble that is sometimes met in the cheaper wooden and paste board tubes is the coloring matter. Most of these are black. This shade is made either with lamp black or with aniline dyes. Lamp black is a cheap method of coloring, but it has the great disadvantage that it is a form of pure carbon and so is a fairly good conductor. As such it forms a partial short circuit for the coil which is wound over it.

Even though the wire on top of it is insulated, the lamphlack still prevents sharp tuning. You see it lies all the way round the tube like a single turn of wire closed on itself. In this way it forms a single turn secondary and as it will absorb a fairly large amount of energy, the only safe coloring material is one which is absolutely non-conducting, like the dyes. They may be employed without any fear of increasing the losses and reducing the selectivity.

Avoiding the Lampblack

Some of the tubes bought in 10c stores have the above defects. Hard rubber, on the other hand, is free from such qualities as it does not absorb moisture and contains no lamp black. After some experimenting, the writer has found a very easy and effective way to cut and bend hard sheet rubber, up to ¼ inch thick, by using the following methods.

Buy a sufficient quantity of smooth sheet rubber of the desired thickness from any reliable electrical supply or radio dealer. Then lay it on a level surface and mark an outline with a scriber or other sharp instrument on the place to be cut. Always allow your sheet to be larger than necessary so as to leave enough material for the finishing operations. Hard rubber can be cut with a hack saw, but the latter process is slow and tedious as compared with the method of working by means of heat, as used by the writer.

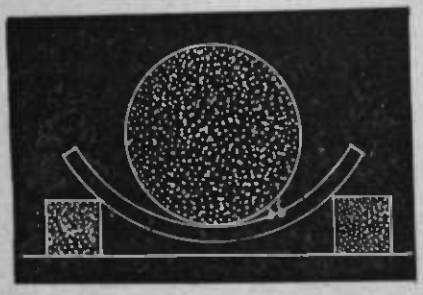


Fig. 1. How to Bend Hard Rubber Into a Perfect Cylinder

Cutting it with Scissors

Plunge your marked sheet into very hot water (boiling is not too hot), until it gets soft like leather; then remove quickly from the water and while it still retains the heat, quickly cut on the mark with scissors or tinsmiths snips, depending upon the rubber's thickness as to which one should be used. It will be found that as it becomes cooler, it will take more force to do the cutting. If any more trimming is to be done and the rubber is too cold to cut easily, place

it in hot water again for a few moments, and continue your work.

If you wish to have it flat for a panel, put a plate of glass on a newspaper laid on your work-table, dip the rubber into hot water again and place on the glass, then lay another sheet of glass over it, putting weights on its top to keep it perfectly flat until it is cold and hard. It will then be found to be straight even though the cutting throws it out of shape to a certain extent.

Making a Cylinder

It is very easy to bend hard sheet rubber into cylinders of different diameters for making variometers, etc., by the aid of heat. The first thing needed is a wooden mandrel of the desired diameter which can be turned up on a lathe, or a rolling pin may be borrowed from the "kitchen mechanic," but care should be taken to get her consent as she is apt to use it on your head if you take it surreptitiously. Having obtained it, measure the outside surface with the family's tape measure and cut your material to the right length. This will, of course, be three and 1/7 times the diameter of the wooden mandrel. The exact diameter does not matter much in a radio coil, as you will notice, as some authors call for 2½, some for 3 and some 4-inch tubes. From this you can see an exact figure is not required.

Heat the rubber in hot water, place two wooden blocks on a smooth surface, spacing them at such a distance apart so as to be even with the edges of the rubber that requires bending. Put the hot sheet into position on blocks and quickly press the mandrel down on its center; gradually curling it into cylindrical form to fit the mandrel, Fig. 1.

Phonograph Records Will Do

In using thick plates of rubber, reheating them several times may be necessary in order to get it into the form of a cylinder, as this material loses its heat rapidly once it is out of the water. Old phonograph discs can also be bent into cylindrical shapes and make excellent parts for radio apparatus.

There will be a joint where the two edges of the cylinder meet. To make a smooth surface having no joint showing, fill the crack with automobile rubber cement, letting it extend up to form a ridge; when it is hard and dry, file or sandpaper the cement down level, Fig. 2. It may be necessary to repeat this several times, depending upon the thickness of the cement, so as not to have any joint showing. There is a rubber composition putty on the market sold in automobile supply stores for repairing cuts in tires, which proves to be excellent for joining the edges together, as it is a very thick substance. It is best to tie your work tightly together with a string until either the cement or putty has set.

Polishing the Panel Edges

Polishing the edges of the hard rubber, which has been cut to form, is a poser for amateur set builders as they do not know how to get the edges of their panels and coils to present as smooth a surface as its sides. Therefore it is the usual practice among most radio novices to smooth the edges with a file and let it go at that. This rather mars the appearance of the instruments. By

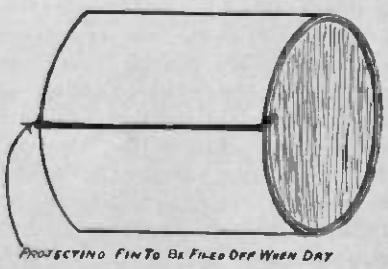


Fig. 2. The Crack Between Edges is Filled and Later Smoothed Flush.

the following process almost any novice can obtain a fine polish on a panel's edges that is equal to any on the manufactured article.

At the outset, it should be stated that in doing polishing work on the sides or the edges of radio instruments or panels, no *emery* paper or cloth should be used for smoothing purposes. The reason is that all emery is apt to contain a certain amount of iron. If particles of the dust from emery should become embedded into the cement at the joints, it would interfere with the clearness of a signal's reception.

Sandpaper, Not Emery Cloth

Sandpaper is the only material suitable to use for radio work. For those not familiar with the nature of sandpaper, a brief description will be of interest to the radio fan. It is a heavy paper coated with glass, ground to varying degrees of coarseness, designated by numbers which start with 000, the finest, next comes 00, then 0, ½, 1, 1½, 2—ending with 3, which is the coarsest. As its surface is composed of glass, any dust which may adhere to a panel or variometer surface will not have any effect on the working of a set.

These abrasives are made into sheets 8½ x 10½ inches and are sold in hardware stores at about 3c per sheet. Sandpapers are extensively used by all woodworkers, so there will be no trouble encountered in buying it even in the smaller towns. The use of this product will enable any person to make a fine smooth finish on radio panel edges, when oil and powdered pumice stone are used with it to put the final polish on them.

Don't Hold Paper in Hand

For our purpose we shall use number 00-grade (fine) tacked tightly on a square, wooden block; this will give us three working surfaces, which is the most economical way to use it, as when one side wears out, all you have to do is to turn the block over on another side; this also saves time. Don't hold a sheet of this abrasive in your hand and expect to do level work on flat surfaces, as the pressure on your hand will be uneven, thus making depressions which will show in your finished work. Clamp the rubber in a vise between two thin boards from an orange box, which can be obtained from any grocery store for the asking.

Then run the sandpaper block lightly along the edge of rubber until it is fairly smooth. Wipe off all dust and give the edges a coat of shellac varnish and let it dry. This fills up all pores. The varnish should dry in about two to three hours. Buy at a paint store some FF grade powered pumice stone, a small bottle of boiled linseed oil and also a rubbing felt. Dip the latter into the oil, thence into pumice stone which will now adhere to the felt. Rub your varnished surface lightly along its length. After doing so, remove the surplus oil and pumice stone with a soft, clean cloth. Put on another coat of shellac and let it dry. Soak another piece of felt in oil free from pumice stone; rub briskly and a fine polish will result. Those who prefer a dull finish on both edges and sides of a panel, variometer or vario-coupler made out of hard sheet rubber, can obtain it by rubbing the surfaces with the pumice and a small portion of oil.

The Romance of Chemistry in Radio

Without it We Should not Pick Our Music from the Air

By DR. CHARLES B. HURD, Assistant Professor of Chemistry, Union College

DO YOU think of a chemist mostly in terms of poison gases, from which thousands of men have died? Or of delicate tints and colors, skillfully applied, from which thousands of dresses are dyed?

As a matter of fact, the chemist has invaded almost every art and science with his magic touch and radio is no exception. Just how shall we define this study? Chemistry is the science of materials and their composition. The chemist is interested in finding out on the one hand, what simple substances are contained in ordinary materials, and on the other, in making additional complex substances out of these simple ones.

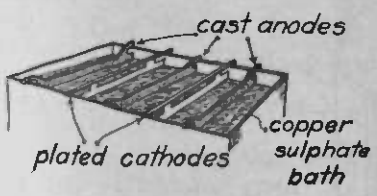


Fig. 1. One of the Most Important Chemical Processes.

90 Things Make Whole World

By the first process, called analysis, he has shown that there are only about ninety simple substances, called elements, and that ordinary things are made up of some of them, taken in certain proportions. By the second or building up process, called synthesis, many thousands of new compounds have been prepared. It is obvious that the application of such knowledge must have been and is of the greatest of importance to industry and human life in general. We shall try at this time to point out a very few ways in which the science of chemistry has been of importance in radio development.

Of the eighty-eight elements isolated so far, some are very common and others are quite rare. Carbon, iron and copper are examples of the commoner elements. The metal copper is of such importance in the electrical industry as to be indispensable. Copper, for instance, as prepared from the ore by the chemical process called smelting, contains impurities which seriously injure its electrical properties. So, in order to obtain the purest copper, such as is used in all radio sets and nearly all electrical machinery, the impure metal must be further refined.

Baths for Making Copper

The impure metal, which may contain several per cent. of iron, lead, sulphur, and other common elements, is cast into heavy plates, called anodes. These are hung in a big tank, or vat, as shown in Fig. 1. These are all connected to the plus pole of a plating generator. The negative pole is hooked up to the cathodes, which are thin plates of pure copper, and which are hung between the anodes. A few volts pressure is given by the generator across from anode to cathode. This causes a large direct current of thousands of amperes to flow, which is divided up equally among the various pairs.

These metal plates are all dipping in a bath of copper sulphate, or blue stone, dissolved in water. In such an electrolyte the copper metal flows with the current from the plus anode to the minus cathode, and so is deposited on the latter and gradually eaten away from the former. The peculiar thing about this action is that while the pure copper is plated out on the cathode the impurities all drop to the bottom of the cell and make a kind of mud, which is removed every now and then.

After a while the cast anodes will be found to have been eaten entirely away and new ones are then hung in their places. On the other hand, the cathodes are built up into slabs of copper which is 99.95% pure.

This Is Built Into Your Set

It is this product which is used on the coils on your radio set, on the magnets of your loudspeaker or telephone, in the bus wire connecting the instruments, and in many other places in your equipment.

Some of the chemical elements are uncommon and are or have been scientific curiosities. However the chemist has painstakingly studied these elements,

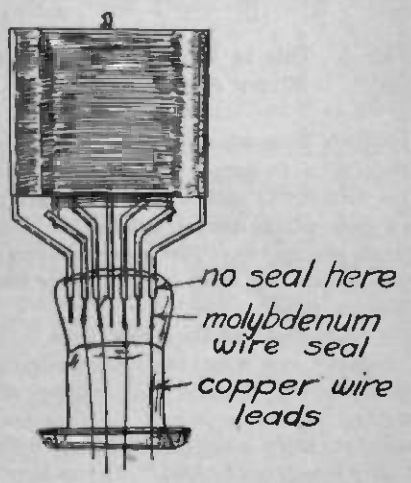


Fig. 2. It is the Seal Which Keeps Up the Vacuum.

and their properties are well known. It has usually been only a matter of time before uses for them have been discovered. Tungsten was found to be a rather rare metal, very hard and brittle, with a high melting point. Then it was discovered that by suitably working the tungsten, it could be made into wire, from which filaments for incandescent lamps were made. Many types of vacuum tubes use tugsten filaments, as the UV-200 for instance.

As many of you know, a vacuum tube works because the hot filament gives off

electrons, those small unit charges of electricity so important in all electrical processes. Some metals, such as thorium, give off these electrons much more readily than tungsten does. Hence, if thorium is present on the surface of the

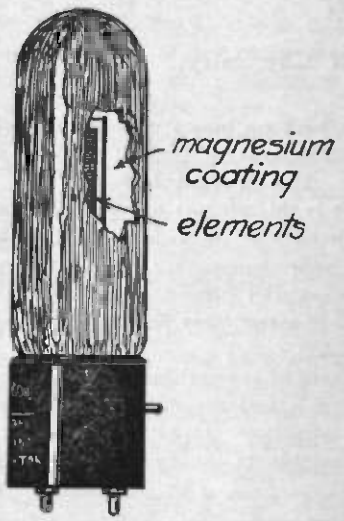


Fig. 3. This is What Gives Tube a Silvery Appearance.

tungsten filament as in thoriated tungsten, it is no longer necessary to heat the filament to such a high temperature to give off the proper number of electrons per second. The lower temperature results in a much longer life for the vacuum tube.

How to Liven Up a Sick Tube

Some of you, who burn your filaments too brightly, destroy the coating of thorium on the surface of the tungsten filament, after which the tube becomes poorly sensitive or "dead." If you have, in addition, been working the tube for a long time at too high a temperature, the thorium may have been all driven out of the tungsten. If such is the case, the tube is ruined. But if you have only driven away the thorium from the surface, you can, by burning the tube very brightly for a very short time, with the "B" battery disconnected, cause some of the thorium still remaining in the interior to come out on the surface of the tungsten. Your radio service man will show you just how to do this. The tube will then work efficiently once more.

Some other elements show this ability to give off electrons easily, such as the rare alkali metal caesium. A similar, but commoner alkali metal, sodium, is used in one type of vacuum tube. Are you at all familiar with this element sodium? When combined in equal parts with the poison gas, chlorine, it forms sodium chloride, which is better known as ordinary table salt.

Sealing Wires Into Glass

As the manufacture of vacuum tubes was developed, demands were made for metals of unusual properties, for grids, plates and other metal parts. In some tubes the metal nickel could be used, but other tubes, requiring metal of different properties, developed a use for the rather uncommon metal molybdenum. This metal is commonly used in vacuum tubes. Fig. 2 illustrates its use. Notice that the wires, which run from the base of the vacuum tube up to the seal, are copper. However, copper cannot be run through the glass of the seal itself, as glass and copper have a different rate of expanding and contracting when heated and cooled. If copper were to be used it would very shortly crack the glass and the air leaking through it would soon destroy the vacuum. Molybdenum, however, happens to have about the same expansion as glass.

There is another reason for using this metal. It is "wet" by molten glass just the way glass is wet by water. Many other metals which would work all right from the temperature standpoint, do not form a tight seal with glass, since they do not flow together with this wetting action.

Magnesium a Go-Getter

In order to remove the gases from the so called "hard tubes" like UV201-A UV199, and WD11, efficient vacuum pumps are used. Yet the finishing touches are put on the vacuum by vaporizing metallic magnesium within the bulb (Fig. 3.) This is equivalent to boiling the metal and allowing it to condense on the walls of the bulb. It had long been known that magnesium, which is called a "getter," cleans up the gases. The metallic magnesium which has condensed on the wall of the tube gives a shiny, mirror-like surface as all of you know. Yet in the short time necessary for the magnesium to reach the walls of the bulb the metal has combined chemically with and removed the gases, giving a high vacuum.

From this you will see that the coating which is left on the tubes has no use at all. It has done its work and is now on a vacation for the rest of its life. Naturally in going to the cooler surface it has not distributed itself evenly. When moisture collects on the outside of a cool pitcher on a hot day, you know that the drops of dew are not equally thick at all spots. But since the action is all over long before the tube

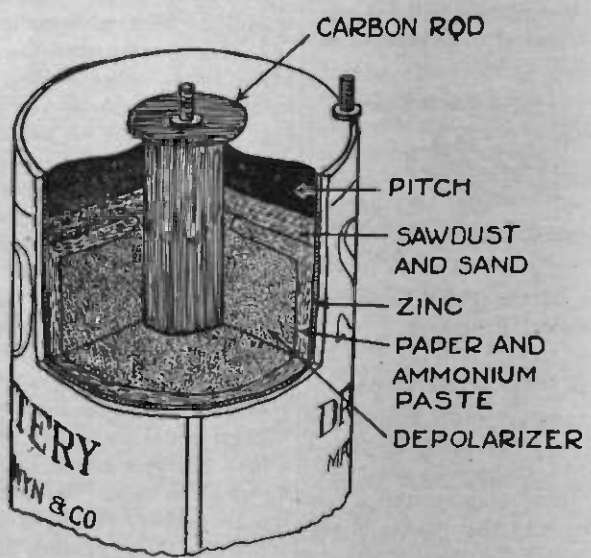


Fig. 4. What You Find if You Cut Open a Dry Cell.

It's INSULINE, the Best there is

Ready Drilled and Engraved Panels for 11 Standard Circuits Now in Stock

These drilled and engraved panels for standard circuits are made of genuine Insuline and manufactured to the same high standard as required by prominent set manufacturers. The factory made "Look" adds to the appearance of any home made set.

	Fada 5 Tube Neutrodyne, 7"x26" x3/16"	Fada 5 Tube Neutrodyne, 7"x24" x3/16"	Ambassador 3 Tube, 7"x18" x3/16"	Ambassador 4 Tube R. F. 7"x21" x3/16"	Cockaday Super-Het. Reflex 7"x24" x3/16"	Freshman Masterpiece, 5 Tube 7"x18" x3/16"	Rasla Reflex 3 Tube 7"x18" x3/16"	Browning Drake 7"x28" x3/16"	B. T. Nameless 7"x24" x3/16"	Roberts Knockout 4 Tube 7"x21" x3/16"
Black	$5.00	$4.80	$3.50	$4.00	$5.00	$3.50	$3.50	$5.50	$4.50	$4.50
Mahogany	6.00	5.70	4.00	4.50	6.00	4.00	4.00	6.50	5.50	5.50
Frieze Finish	6.00	5.70	4.00	4.50	6.00	4.00	4.00	6.50	5.50	5.50

Our Plant is Equipped to Handle Special Work on Cutting, Drilling and Engraving to Specification

INSULINE DIALS

4" Diameter

Beautiful Design

Special

75c Each

INSULINE LOW LOSS SOCKETS

Side Wipe Contacts

Special

75c Each

INSULINE SUB PANEL

Specially made for the 5-tube T. R. F. and can be used with any hook-up requiring a five-tube base layout. 7x17x3/16 hard rubber mounted with genuine nickel plated sockets and strong phosphored bronze contact springs securely eyeleted to base. Will improve the inside appearance of any set.

Special

$4.00 Each

HOW TO ORDER. Tear out this sheet and check the items wanted, together with how many of each, fill in the coupon and mail the page together with your check or money order to cover the cost of same. We pay the postage.

Radio Panel & Parts Corp.

Insulating Co. of America

59 WARREN STREET NEW YORK CITY

Enclosed is my money order for $.....

Please ship items checked to:

NAME ADDRESS

CITY STATE

STANDARD SIZE PLAIN RADIO PANELS

INSULINE Frieze Finish

Size	Thickness	List Price
7"x10"	3/16" each	$1.10
7"x12"	3/16" each	1.30
7"x14"	3/16" each	1.50
7"x18"	3/16" each	1.90
7"x21"	3/16" each	2.20
7"x24"	3/16" each	2.50
7"x26"	3/16" each	2.80
7"x28"	3/16" each	3.30
7"x30"	3/16" each	3.50
7"x36"	3/16" each	4.30

INSULINE Mahogany

Size	Thickness	List Price
7"x10"	3/16" each	$1.20
7"x12"	3/16" each	1.60
7"x14"	3/16" each	1.80
7"x18"	3/16" each	2.40
7"x21"	3/16" each	2.80
7"x24"	3/16" each	3.20
7"x26"	3/16" each	3.50
7"x28"	3/16" each	4.00
7"x30"	3/16" each	4.50
7"x36"	3/16" each	5.00

INSULINE Black Panels

Size	Thickness	List Price
7"x10"	3/16" each	$.95
7"x12"	3/16" each	1.20
7"x14"	3/16" each	1.40
7"x18"	3/16" each	1.70
7"x21"	3/16" each	2.00
7"x24"	3/16" each	2.30
7"x26"	3/16" each	2.50
7"x28"	3/16" each	2.90
7"x30"	3/16" each	3.30
7"x36"	3/16" each	4.00

reaches your hands, it makes no difference how thick the mirror layer may be. This shows the fallacy of those fans who look for particularly light or particularly dark colored tubes as detectors.

Most of you are using batteries of various kinds as "A", "B" or "C" units. Have you realized that in each battery a chemical reaction is running, furnishing electrical power for tubes, loudspeaker or phones? Let us spend a minute or two in studying this problem. Batteries are, in general, of two kinds: primary and storage types. In the primary battery, such as the dry cell, certain chemicals are consumed during the life of the unit.

What is Inside a Cell

The cell consists essentially of a zinc cylinder, which acts as a containing can, a carbon rod in the center, and a solution of ammonium chloride (sal ammoniac) which is absorbed in a paste of blotting paper and water. The carbon rod is surrounded by a layer of material called a depolarizer. When out of use, the chemical reaction goes on very slowly. But as soon as current is drawn from the cell, the zinc dissolves in the ammonium chloride solution. As the materials become used up, the battery gets weak and after a while holes appear in the zinc. Inasmuch as the zinc chloride which oozes out is corrosive (it is often used as a soldering flux for ordinary soldering,) an old battery should not be allowed to stand on the furniture or rugs. The "B" battery and "A" battery are essentially the same, except for size, number of cells and current available.

In the storage cell, electrical energy put into the battery during the charge, causes a certain chemical reaction to take place. In the lead battery, sulphuric acid is set free during the charge, and since the acid is heavier than water, the density of the solution increases. By using a hydrometer (Fig. 5) the progress of the reaction is observed until it is completed. The battery is then said to be charged. It is now capable of giving out electrical energy at the expense of its stored up chemical energy. But, while a discharged dry cell is thrown away, the storage battery may be charged again and again.

Each Has a Hand

Let us emphasize the importance, in the development of these ideas, of the co-operation between chemist, physicist, electrical engineer and radio engineer. To the chemist must go the credit for the discovery and preparation of elements and compounds. It is he who supplies the materials, such as tungsten, thorium, molybdenum, magnesium and many others. The physicist and physical chemist have been mainly responsible for the discovery of properties of substances which have been utilized by

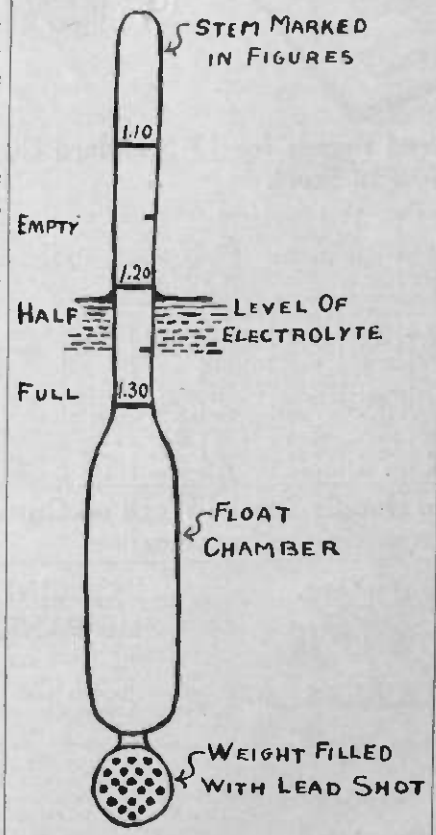


Fig. 5. A Hydrometer Measures the Chemical Action of Storage Battery.

the electrical engineer in investigational work and in the design and production of electrical machinery. The radio engineer has been able to avail himself of all the data of the others and to add development work of his own.

In this short talk we have been able to discuss only a few instances where chemistry has been of some assistance to electrical engineering, particularly in the development of radio. We have not mentioned the use of alloys, glass, rubber and many other materials. We have not had time to describe the discovery and manufacture of that wonderful synthetic resin, bakelite, which is of such great use, especially as an insulator. But if I have been able to point out to you a few ways in which the science of chemistry and its discoveries have been instrumental in aiding you in receiving entertainment from the air, I shall feel satisfied.

WHEN YOU CABLE EUROPE

Perhaps in this last year you have sent or received a cablegram from across the water. Did it go above or underneath the ocean? Either way is now possible, and the traffic above the waves is increasing much faster than that below.

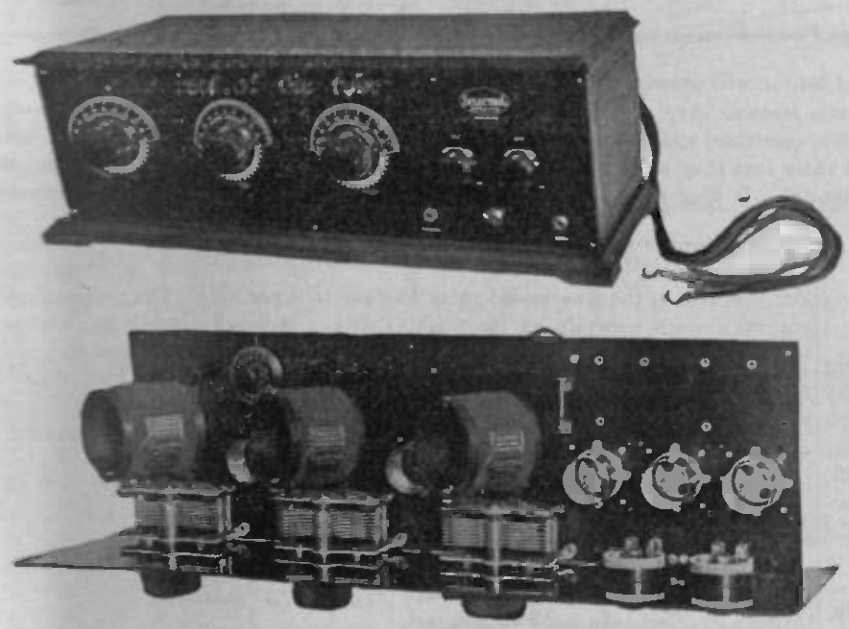
Invisible radio circuits link the United States with Great Britain, France, Germany, Norway, Sweden, Italy, Poland, and Argentina. About 20 to 30 per cent of the total number of telegraph messages exchanged daily between the United States and Europe flow through these radio channels, the remaining 70 to 80 per cent being handled by the seventeen cables on the floor of the Atlantic Ocean. An important asset possessed by radio is its ability to transmit messages at high speeds. It has been found practicable to send and receive more than 100 words per minute, such speeds being attained in ordinary operation. It would take only 12 minutes to send a whole page of this magazine.

By the use of two transmitting stations, a message of 5,000 words, for instance, can be divided into two parts and thus transmitted in one-half the time required by a single station. It is reasonable to expect that these speeds will increase quite a bit with the development of the radio art until the time in the near future when we shall flash radiograms across the oceans at speeds as high as 1,000 words per minute. And of course, the practical significance of high speed is lower rates.

Medical service to ships at sea, radio entertainment, ship-to-shore communication, flashing photographs and drawings through space, trans-oceanic communication—surely, the wonders of radio never cease.

Selectrol Super-Five

ENGLAND, SCOTLAND, SPAIN HEARD ON LOUD SPEAKER



HERALDING
THE
Wonder Set
THE
WHOLE
WORLD
HAS BEEN
LONG
AND
ANXIOUSLY
AWAITING

It is impossible to even begin to describe the many unusual and novel features embodied in this wonderful new receiver

SPECIAL INTRODUCTORY OFFER

Selectrol SUPER-FIVE

INCLUDING

Five Radiotron 201A Tubes—Tower's Scientific Phones
Highest Grade Storage Battery—B Batteries, 90 Volts
Leader Loud Speaker Equipped with Novel Tone Control
Beautiful Mahogany Radio Table with Leatherette Top and Battery Shelf

Complete Outfit—Ready to Operate $128

INSTALLED IN YOUR HOME

Ask Your Local Dealer to Demonstrate This Set for You, or Write Direct to Us and We Will Make Arrangements for a Demonstration.

STANDARD RADIO CO.

3 TREMONT ROW, DEPT. S. BOSTON, MASS.

DEALERS—Write for our Attractive Proposition

Rx DR RADIO PRESCRIBES.

NOTE: In this section the Technical Editor will answer questions of general interest on any radio matter. Any of our readers may ask not more than two questions, and if the subjects are of importance to most radio fans they will be answered free of charge in the magazine. If they are of special interest to the questioner alone, or if a personal answer is desired, a charge of fifty cents will be made for each answer. This will entitle the questioner to a personal answer by letter. However, if the question requires considerable experimental work, higher rates will be charged.

Question. What is the best solution for a lead and aluminum rectifier?

Answer. Borax is sometimes used for this purpose, but it is not as good as some other salts. The best one, which has been in use for at least ten years, is a saturated solution of ammonium phosphate. This may be procured from most any drug store. The chemically pure salts should be used. This chemical has the advantage over borax that it rectifies more completely, i. e., cuts down the amount of current which flows in the opposite direction, and so tends to discharge the battery. The saturated solution may be made up by allowing the salt to stand in the water overnight. The excess, which rests on the bottom, does no harm, although it may be removed if you care to do so.

Question. Can the set described on page 19 of the April 15 issue of RADIO PROGRESS be used without an operator's license?

Answer. Unfortunately you need a government operator's license to do any kind of sending with the set described. You can see the reason very readily. If *any* one were allowed to transmit, the squeals and howls and interference which are now so annoying would be multiplied perhaps one hundred fold.

You must realize, however, that there is no fee required to obtain such a license and the only requisite is a working knowledge of the code. Without such knowledge it would be no use for you to operate a sending set anyway. For that reason the government rules do not work much hardship on the would-be senders.

Question. What kind of a test should be run on a lightning arrester?

Answer. There are two which are usually tried. The first is to make sure that there is no contact at all between the aerial and ground terminal, as any such conductivity would allow part of the radio waves from the aerial to leak through your set. To make such a test, a "B" battery in series with milliammeter is a good scheme. It is well to include a pair of phones in series so that if a leak *should* exist the big current would not burn out the meter. A high grade volt meter will do as an indicator instead of a milliammeter, but the ordinary cheap "B" battery tester is not very satisfactory for this service.

If you find that the circuit is open, as it should be, that is usually all that is done by the user. According to the Underwriter's ruling, however, when 500 volts are applied from aerial to ground terminals the arrester must break down and short circuit the electricity, thus allowing the current to leak harmlessly to earth. Such a test is always made by the Underwriters' inspector when approving an arrester, but it is hardly practical for use outside a laboratory.

Question. What is the capacity of a storage "B" battery?

Answer. The pressure of a storage "B" battery is usually 24 or 48 volts, depending on whether twelve or twenty-four cells are used. The capacity of the battery is usually rated in milliampere hours which means the number of milliamperes multiplied by the number of hours the battery will supply them. An ordinary size will contain 2,500 MAH which is the equivelant of 2½ ampere hours. (Milli means 1/1000). The large size usually will have an output of 4500 MAH. This compares with about 1500 MAH for the average run of dry cell "B" batteries.

Question. Is it a good thing to use a "C" battery on a detector tube?

Answer. Either a grid leak and condenser or else a "C" battery may be used, but not both together. These two methods accomplish much the same results—distorting the output compared with the input, so that the former is not a copy of the latter, (as in an amplifier) but is reduced from radio to audio frequency.

The more efficient of these two ways is the grid condenser and leak. The music is also slightly clearer with this scheme of connection. Add to this, the fact that the "C" battery is more expensive and has to be renewed periodically, while a condenser and leak last forever, and you will see why the "C" battery is no longer used on the detector.

On the other hand, an amplifier is improved in quality and also the efficiency of the "B" battery is much greater when using a "C" battery. For these reasons, it is always a good thing to add this unit to any amplifier set which operates with more than 45 volts of "B" battery.

The Heart of Your Radio Set

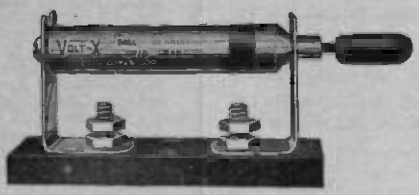
A Grid Leak is essential on every set. There are few sets made which wouldn't be improved by the use of a Variable Grid Leak.

Even the set makers admit that.

But those makers say—"Show us a good Variable Grid Leak,"—because they know that most of the variables on the market have been a failure.

Right now -- we're showing them

Buy It



Volt-X Ball-Bearing
Variable Grid Leak

Try It

If you are not satisfied, return it and get your money back

This GRID LEAK is made by an organization which has been handling delicate electrical instruments for years. We know what it means to build accurately and substantially. We KNOW that this GRID LEAK is as nearly perfect as human hands and precise machinery can make it —we're glad to have you try it with the knowledge that if it doesn't do what we claim for it, your money will be refunded.

Clip the coupon, and send it in with $1.00—a grid leak will be mailed at once.

BURTON & ROGERS MFG. CO.

755 Boylston St. Boston, Mass.

Please send me one of your VOLT-X VARIABLE GRID LEAKS.

I enclose $1.00 with the understanding that this merchandise is guaranteed to give satisfaction, or may be returned.

NAME. . . . . .

ADDRESS. . . . . .

UNITED STATES BROADCASTING STATIONS ARRANGED ALPHABETICALLY BY CALL LETTERS

Abbreviations: W.L., wave length in meters; K.C., frequencies in kilocycles; W.P., wattpower of station.

	K.C.	W.L.	W.P.
KDKA—Westinghouse Elec. & Mfg. Co., E. Pittsburg, Pa.	970-	309-	1000
KDPM—Westinghouse Elec. & Mfg. Co., Cleveland, O.	1200-	250-	500
KDYL—Newhouse Hotel, Salt Lake City, Utah	900-	333-	500
KDZB—Frank E. Siefert, Bakersfield, Cal.	1430-	210-	500
KFAB—Nebraska Buick Auto Co., Lincoln, Neb.	1250-	240-	200
KFAD—McArthur Bros. Mercantile Co., Phoenix, Ariz.	1100-	273-	100
KFAE—State College of Washington	860-	349-	500
KFAF—Western Radio Corp., Denver, Colo.	1080-	278-	500
KFAJ—University of Colorado, Boulder, Colo.	1150-	261-	100
KFAU—Boise High School, Boise, Idaho	1090-	275-	500
KFBK—Kimball Upson Co., Sacramento, Cal.	1210-	248-	100
KFCF—Frank A. Moore, Walla Walla, Wash.	1170-	256-	100
KFDM—Magnolia Petroleum Co., Beaumont, Tex.	950-	316-	500
KFDX—First Baptist Church, Shreveport, La.	1200-	250-	100
KFDY—S. Dak. Ste. Col. Ag. & Mech. Arts, Br'kngs., S. Dak.	1100-	273-	100
KFEQ—Scroggin & Co. Bank, Oak, Nebr.	1120-	268-	100
KFFV—Graceland College, Lamoni, Iowa	1200-	250-	100
KFGC—Louisiana State Univ., Baton Rouge, La.	1120-	268-	100
KFGD—Oklahoma College for Women, Chickasha, Okla.	1190-	252-	200
KFGH—Leland Stanford Junior Univ., Stanford Univ., Cal.	1110-	270-	500
KFI—Earl C. Anthony, Los Angeles, Cal.	640-	469-	2000
KFIF—Benson Polytechnic Institute, Portland, Ore.	1210-	248-	100
KFIQ—First Methodist Church, Yakima, Wash.	1170-	256-	100
KFIZ—Daily Com'lth & Seifert Rad. Corp., Fondulac, Wis.	1100-	273-	100
KFJF—National Radio Mfg. Co., Oklahoma, Okla.	1150-	261-	225
KFJM—University of No. Dak., Grand Forks, No. Dak.	1080-	278-	100
KFKB—Brinkley-Jones Hosp. Assoc., Milford, Kans.	1100-	273-	500
KFKQ—Conway Radio Laboratories, Conway, Ark.	1200-	250-	100
KFKU—University of Kansas, Lawrence, Kas.	1090-	275-	100
KFKX—Westinghouse Elec. & Mfg. Co., Hastings, Neb.	1040-	288-	2000
KFLR—University of New Mexico, Albuquerque, N. Mex.	1180-	254-	100
KFLV—Swedish Evangalical Mission Church, Rockford, Ill.	1310-	229-	100
KFLZ—Atlantic Automobile Co., Atlantic, Iowa,	1100-	273-	100
KFMQ—University of Arkansas, Fayetteville, Ark.	1000-	300-	500
KFMR—Morningside College, Sioux City, Iowa	1150-	261-	100
KFMT—George W. Young, Minneapolis, Minn.	1140-	263-	100
KFMX—Carleton College, Northfield, Minn.	890-	337-	750
KFNF—Henry Field Seed Co., Shenandoah, Iowa.	1130-	266-	500
KFOA—Rhodes Dept. Store, Seattle, Wash.	660-	454-	500
KFOC—First Christian Church, Whittier, Cal.	1270-	236-	100
KFON—Echophone Radio Shop, Long Beach, Cal.	1290-	233-	100
KFOO—Latter Day Saints Univ., Salt Lake City, Utah.	1150-	261-	250
KFOX—Technical High School, Omaha, Nebr.	1210-	248-	100
KFPG—Oliver S. Garretson, Los Angeles, Cal.	1260-	238-	100
KFPR—Los Angeles County Forestry, Los Angeles, Cal.	1300-	231-	500
KFPY—Symons Investment Co., Spokane, Wash.	1130-	266-	100
KFQA—The Principa, St. Louis, Mo.	1150-	261	100
KFQB—Searchlight Publishing Co., Fort Worth, Texas.	1180-	254-	150
KFQC—Kidd Brothers Radio Shop, Taft, Cal.	1300-	231-	100
KFQU—W. E. Riker, Holy City, Calif.	1350-	222-	100
KFQZ—Taft Radio Co., Hollywood, Calif.	1330-	226-	250
KFRB—Hall Bros., Beeville, Texas	1210-	248-	250
KFRU—Etherical Radio Co., Bristow, Okla.	760-	395-	500
KFRW—United Churches of Olympia, Olympia, Wash.	1360-	220-	100
KFSG—Echo Park Evangelistic Asso., Los Angeles, Calif.	1090-	275-	500
KFUM—W. D. Corley, Colorado Springs, Colo.	1240-	242-	100
KFUO—Concordia Seminary, St. Louis, Mo.	550-	545-	500
KFUT—University of Utah, Salt Lake City, Utah.	1150-	261-	100
KFVE—Film Corporation of America, St. Louis Mo.	1250-	240-	500
KFVJ—First Baptist Church, San Jose, Cal.	1330-	226-	500
KFVK—Sacramento Chamber of Com., Sacramento, Cal.	1210-	248-	500
KFWA—Browning Bros. Co., Ogden, Utah	1150-	261-	500
KFWB—Warner Bros. Pictures, Inc., Hollywood, Cal.	1190-	252-	500
KFWD—Arkansas Light & Power Co., Arkadelphia, Ark.	1130-	266-	500
KFWF—St. Louis Truth Center, St. Louis, Mo.	1400-	214-	250
*KFWH—F. Wellington Morse, Jr., Chico, Cal.	1180-	254-	100
KGO—General Electric Co., Oakland, Cal.	830-	361-	2000
KGU—Marion A. Mulrony, Honolulu, Hawaii	1110-	270-	500
KGW—Portland Morning Oregonian, Portland, Ore.	610-	491-	500
KHJ—Times-Mirror Co., Los Angeles, Cal.	740-	405-	500
KHQ—Excelsior Motorcycle & Bicycle Co., Seattle, Wash.	1100-	273-	100
KJR—Northwest Radio Service Co., Seattle, Wash.	780-	384-	1000
KJS—Bible Institute of Los Angeles, Los Angeles, Cal.	1020-	294-	750
KLDS—Reorg.ChurchofJesusChristofLatterDaySts., Ind.,Mo.	1120-	268-	250
KLS—Warner Bros. Radio Supplies Co., Oakland, Calif.	1240-	242-	250
KLX—Tribune Publishing Co., Oakland, Calif.	590-	509-	500
KLZ—Reynolds Radio Co., Denver, Colo.	1130-	266-	250
KMO—Love Electric Co., Tacoma, Wash.	1200-	250-	100
KNX—Los Angeles Express, Los Angeles, Cal.	890-	337-	500
KOA—General Electric Co., Denver, Colo.	930-	322-	2000
KOB—New Mexico Col. of Agriculture, State Col., N. Mex.	860-	349-	750
KOP—Detroit Police Dept., Detroit, Mich.	1080-	278-	500
KPO—Hale Bros., San Francisco, Cal.	700-	428-	500
KPRC—Houston Printing Co., Houston, Texas.	1010-	297-	500
KQV—Doubleday-Hill Electric Co., Pittsburg, Pa.	1090-	275-	500
KSAC—Kansas State Agric. College,	880-	341-	500
KSD—Post-Dispatch, St. Louis, Mo.	550-	545-	750
KSL—The Radio Service Corp., Salt Lake City, Utah.	1000-	300-	1000
*KTCL—American Radio Tel. Co., Inc., Seattle, Wash.	980-	310-	1000
KTHS—New Arlington Hotel Co., Hot Springs, Ark.	800-	375-	500
KTW—First Presbyterian Church, Seattle, Wash.	660-	454-	750
KUO—Examiner Printing Co., San Francisco, Cal.	1220-	246-	150
KUOM—State Univ. of Montana, Missoula, Mont.	1230-	244-	500
*KWKC—Wilson Duncan Studios, Kansas City, Mo.	1270-	236-	100
KYW—Westinghouse Elec. & Mfg. Co., Chicago, Ill.	560-	535-	1500
KZKZ—Electrical Supply Co., Manila, P. I.	1110-	270-	100
KZM—Preston D. Allen, Oakland, Cal.	1240-	242-	100
KZRQ—Far Eastern Radio, Manila, P. I.	1350-	222-	500
WAAB—Valdemar Jensen, New Orleans, La.	1120-	268-	100
WAAC—Tulane University, New Orleans, La.	1090-	275-	100
WAAF—Chicago Daily Drovers Journal, Chicago, Ill.	1080-	278-	200
WAAM—I. R. Nelson Co., Newark, N. J.	1140-	263-	250
WAAW—Omaha Grain Exchange, Omaha, Neb.	1080-	278-	500
WABA—Lake Forest University, Lake Forest, Ill.	1320-	227-	200
WABI—Bangor Hydro-Electric Co., Bangor, Me.	1250-	240-	100
WABL—Connecticut Agric. College, Storrs, Conn.	1090-	275-	100
WABN—Ott Radio (Inc.) La Crosse, Wis.	1230-	244-	500
WABO—Lake Avenue Baptist Church, Rochester, N. Y.	1080-	278-	100
WABX—Henry B. Joy, Mount Clemens, Mich.	1220-	246-	500
WADC—Allen Theatre, Akron, O.	1160-	258-	100
WAFD—Albert B. Parfet Co., Port Huron, Mich.	1170-	256-	250
WAHG—A. H. Grebe Co., Richmond Hill, N. Y.	950-	316-	500
WAMD—Hubbard & Co., Minneapolis, Minn.	1230-	244-	100
WARC—Am. Rad. & Research Corp., Medf'd H'lside, Mass.	1150-	261-	100
WBAA—Purdue University, West Lafayette, Ind.	1100-	273-	250
WBAK—Pennsylvania State Police, Harrisburg, Pa.	1199-	202-	500
WBAO—James Millikin University, Decatur, Ill.	1090-	275-	100
WBAP—Wortham-Carter Publishing Co., Fort Worth, Tex.	630-	476-	1000
WBAY—Erner & Hopkins Co., Columbus, Ohio.	1020-	293-	500
WBBG—Irving Vermilya, Mattapoisett, Mass.	1210-	248-	250
WBBL—Grace Covenant Church, Richmond, Va.	1310-	229-	100
WBBM—Atlas Investment Co., Chicago, Ill.	1330-	226-	200
WBBP—Petoskey High School, Petoskey, Mich.	1260-	238-	100
WBBR—People's Pulpit Assoc., Rossville, N. Y.	1100-	273-	500
WBES—Bliss Electrical School, Takoma Park, Md.	1350-	222-	100
WCBN—Foster & McDonnell, Chicago, Ill.	1130-	266-	500
WBOQ—A. H. Grebe Co., Richmond Hill, N. Y.	1270-	236-	100
WBS—D. W. May, Newark, N. J.	1190-	252-	200
WBT—Southern Radio Corp., Charlotte, N. C.	1090-	275-	250
WBZ—Westinghouse Elec. & Mfg. Co., Springfield, Mass.	900-	331-	2000
WCAD—St. Lawrence University, Canton, N. Y.	1140-	263-	250
WCAE—Kaufmann & Baer Co., Pittsburg, Pa.	650-	461-	500
WCAG—Clyde R. Randall, New Orleans, La.	1130-	226-	200
WCAH—Entrekin Electric Co., Columbus, O.	1130-	266-	200
WCAJ—Nebraska Wesleyan University, Univ. Place, Nebr.	1180-	275-	100
WCAL—St. Olaf College, Northfield, Minn.	890-	337-	500
WCAO—Kranz-Smith, Baltimore, Md.	1090-	275-	100
WCAP—Cheaspeake & Potomac Tel. Co., Wash., D. C.	640-	469-	500
WCAR—Southern Radio Corp. of Texas, San Antonio, Tex.	1140-	263-	100
WCAU—Durham & Co., Philadelphia, Pa.	1080-	278-	500
WCAX—University of Vermont, Burlington, Vt.	1200-	250-	100
WCAY—Milwaukee Civic Br'dcstng Assoc., Milwaukee, Wis.	1130-	266-	250
WCBC—University of Michigan, Ann Arbor, Mich.	1310-	229-	200
WCBD—Wilbur G. Voliva, Zion, Ill.	870-	345-	1500
WCBI—Nicoll, Duncan & Rush, Bemis, Tenn.	1250-	240-	150
WCCO—Washburn Crosby Co., Minneapolis, Minn.	720-	416-	1500
WCEE—Charles E. Erbstein, Elgin, Ill.	1090-	275-	500
WCK—Stix, Baer & Fuller Dry Goods Co., St. Louis, Mo.	1100-	273-	100
WCM—Texas Markets & Warehouse Dept., Austin, Tex.	1120-	268-	250
WCN—Foster & McDonnell, Chicago, Ill.	1130-	266-	500
WCTS—C. T. Sherer Co., Worcester, Mass.	1120-	268-	100
WCUW—Clark University, Worcester, Mass.	1260-	238-	250
WCX—Detroit Free Press, Detroit, Mich.	580-	517-	500

Biltmore Master Reflex

We wish to announce our

Model V1 Master Reflex Receiver

which we are about to place on the market.

It has taken more than a year of constant improvement on one of the most popular reflex circuits which has ever been designed to develop this receiver.

And we have been well repaid for our efforts. We have completed this six tube machine, a set extreme in sensitiveness and excellent in selectivity.

But most important of all, the receiver is perfect in tone! We will compare it with any standard receiver, and guarantee that it wins the opinion of all who hear, that it has the finest tone of any receiver manufactured.

If your dealer is not yet supplied, we shall gladly fill your order direct, and if you are within a reasonable distance of Boston, we shall be pleased to have the receiver installed and demonstrated in your own home, and to your own satisfaction.

MODEL V1 $115

DEALERS ARE REQUESTED TO WRITE

Please mention RADIO PROGRESS

THE BILTMORE RADIO COMPANY

BOSTON 30 MASS.

	K.C.	W.L.	W.P.
WDAE—Tampa Daily News, Tampa, Fla.	1100	273	250
WDAG—J. Laurence Martin, Amarillo, Tex.	1140	263	100
WDBE—Gilham-Schoen Electric Co., Atlanta, Ga.	1080	278	100
WDBK—M. F. Broz Radio Store, Cleveland, O.	1320	227	100
WDBR—Tremont Temple Baptist Church, Boston, Mass.	1150	261	100
WDBY—North Shore Congregational Church, Chicago, Ill.	1160	258	500
WDWF—Dutee W. Flint, Cranston, R. I.	680	441	500
WDZ—James L. Bush, Tuscola, Ill.	1080	278	100
WEAA—Frank D. Fallain, Flint, Mich.	1280	234	100
WEAF—American Tel. & Tel. Co., New York, N. Y.	610	492	2500
WEAH—Wichita Board of Trade, Wichita, Kas.	1120	268	100
WEAI—Cornell University, Ithaca, N. Y.	1180	254	500
WEAJ—University of So. Dakota, Vermilion, So. Dak.	1080	278	100
WEAM—Borough of North Plainfield, No. Plainfield, N. J.	1150	261	250
WEAN—Shepard Co., Providence, R. I.	1110	270	250
WEAO—Ohio State University, Columbus, Ohio.	1020	294	500
WEAR—Goodyear Tire & Rubber Co., Cleveland, Ohio.	770	389	1000
WEAU—Davidson Bros. Co., Sioux City, Iowa.	1090	275	100
WEAY—Iris Theater, Houston, Tex.	1110	270	500
WEBH—Edgewater Beach Hotel Co., Chicago, Ill.	810	370	1000
WEBJ—Third Avenue Railway Co., New York, N. Y.	1100	273	500
WEBL—Radio Corp. of America, United States (portable).	1330	226	100
WEBM—Radio Corp. of America, United States (portable).	1330	226	100
WEBW—Beloit College, Beloit, Wis.	1120	268	500
WEEI—Edison Electric Illuminating Co., Boston, Mass.	630	476	500
WEMC—Emmanuel Missionary Col., Berrien Springs, Mich.	1050	286	500
WEW—St. Louis University, St. Louis, Mo.	1210	248	100
WFAA—Dallas News & Dallas Journal, Dallas, Tex.	630	476	500
WFAV—University of Nebraska, Lincoln, Neb.	1090	275	500
WFBB—Eureka College, Eureka, Ill.	1250	240	100
WFBG—William F. Gable Co., Altoona, Pa.	1080	278	100
WFBH—Concourse Radio Corp., New York, N. Y.	1100	273	500
WFBI—Galvin Radio Supply Co.	1270	236	100
WFBK—Dartmouth College, Hanover, N. H.	1170	256	100
WFBL—Onondoga Hotel, Syracuse, N. Y.	1190	252	100
WFBM—Merchant Heat & Light Co., Indianapolis, Ind.	1120	268	250
WFBR—Fifth Infantry Maryland N. G., Baltimore, Md.	1180	254	100
WFBY—U. S. Army 5th Corps Area, Ft. Benj. Har'sn, Ind.	1160	258	100
WFI—Strawbridge & Clothier, Philadelphia, Pa.	760	395	500
WFKB—Francis K. Bridgman, Chicago, Ill.	1380	217	100
WGAQ—W. G. Paterson, Shreveport, La.	1110	273	250
WGAZ—South Bend Tribune, South Bend, Ind.	1090	275	250
WGBA—Jones Electric & Radio Mfg. Co., Baltimore, Md.	1180	254	100
WGBB—Harry H. Carman, Freeport, N. Y.	1240	244	100
WGBS—Gimbel Bros., New York.	950	316	500
WGES—Coyne Electrical School, Oak Park, Ill.	1200	250	500
WGN—The Tribune, Chicago, Ill.	810	370	1000
WGR—Federal Telephone Mfg. Corp., Buffalo, N. Y.	940	319	750
WGS—Georgia School of Technology, Atlanta, Ga.	1110	270	500
WGY—General Electric Co., Schenectady, N. Y.	790	380	2000
WHA—University of Wisconsin, Madison, Wis.	560	535	750
WHAD—Marquette University, Milwaukee, Wis.	1000	275	500
WHAG—University of Cincinnati, Cincinnati, O.	1290	233	100
WHAM—University of Rochester, Rochester, N. Y.	1080	278	100
WHAP—William H. Taylor Finance Corp., Brooklyn, N. Y.	1250	250	100
*WHAR—Seaside Hotel, Atlantic City, N. J.	1090	275	500
WHAS—Courier Journal & Louisville Times.	750	400	500
WHAV—Wilmington Electric Specity Co., Wilmington, Del.	1130	266	100
WHAZ—Rensselaer Polytechnic Institute, Troy, N. Y.	790	380	500
WHB—Sweeney School Co., Kansas City, Mo.	820	366	500
WHBF—Beardsley Specialty Co., Rock Island, Ill.	1350	222	100
WHBH—Culver Military Academy, Culver, Ind.	1350	222	100
WHBW—D. R. Kienzle, Philadelphia, Pa.	1390	216	100
WHDI—Wm. Hood Dunwoody I. Inst., Minneapls, Minn.	1080	278	500
WHEC—Hickson Electric Co., Inc., Rochester, N. Y.	1160	258	100
WHK—Radiovox Co., Cleveland, O.	1100	273	250
WHN—George Schubel, New York, N. Y.	830	361	500
WHO—Bankers Life Co., Des Moines, Iowa.	570	526	500
WHT—Radiophone Broadcasting Corporation, Deerfield, Ill.	1260	238	1500
WIAD—Howard R. Miller, Philadelphia, Pa.	1200	250	100
WIAK—Journal-Stockman Co., Omaha, Nebr.	1080	278	250
WIAS—Home Electric Co., Burlington, Iowa.	1180	254	100
WIBA—The Capital Times Studio, Madison, Wisc.	1270	236	100
WIBC—L. M. Tate Post No 39, V. F. W. St Petersburg, Fla.	1350	222	100
WIBF—S. P. Miller Activities, Wheatland, Wisc.	1300	231	500
WIBK—University of the City of Toledo, Toledo, O.	1460	205	100
*WIBL—McDonald Radio Co., Joliet, Ill. (Portable).	1390	215	250
WIL—St. Louis Star, Benson Radio Co., St. Louis, Mo.	1100	273	250
WIP—Gimbel Bros., Philadelphia, Pa.	590	508	500
WJAD—Jackson's Radio Eng. Laboratories, Waco, Texas.	850	353	500
WJAG—Norfolk Daily News, Norfolk, Nebr.	1110	270	250
WJAR—The Outlet Co., Providence, R. I.	980	306	500
WJAS—Pittsburgh Radio Supply House, Pittsburgh, Pa.	1090	275	500
WJAZ—Zenith Radio Corp., Chicago, Ill. (portable).	1120	268	100
WJBC—Hummer Furniture Co., La Salle, Ill.	1280	234	100
WJBD—Ashland Broadcasting Committee, Ashland, Wisc.	1290	233	100
WJBI—H. H. Couch, Joliet, Ill.	1400	214	100
WJJ—Supreme Lodge L. O. Moose, Mooseheart, Ill.	990	303	500
WJY—Radio Corporation of America, New York, N. Y.	740	405	1000
WJZ—Radio Corporation of America, New York, N. Y.	660	454	1000
WKAQ—Radio Corporation of Porto Rico, San Juan, P. R.	880	341	500
WKAR—Michigan Agric. Col., E. Lansing, Mich.	1050	286	750
WKRC—Kodel Radio Corp., Cincinnati, O.	710	422	1000
WKY—WKY Radio Shop, Oklahoma, Okla.	1090	275	100
WLAL—First Christian Church, Tulsa, Okla.	1200	250	150
WLBL—Wisconsin Dept. of Markets, Stevens Point, Wis.	1080	278	500
WLIT—Lit Bros., Philadelphia, Pa.	760	395	500
WLS—Sears, Roebuck Co., Chicago, Ill.	870	345	500
WLW—Crosley Radio Corp., Harrison, O.	710	422	5000
WLW—Crosley Radio Corporation, Harrison, O.	710	422	500
WMAC—Clive B. Meredith, Cazenovia, N. Y.	1090	275	100
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833	360	500
WMAF—Round Hills Radio Corp., Dartmouth, Mass.	833	360	100
WMAK—Norton Laboratories, Lockport, N. Y.	1130	466	500
WMAQ—Chicago Daily News, Chicago, Ill.	670	448	500
WMAY—Kingshighway Presbyterian Church, St. Louis, Mo.	1210	248	100
WMAZ—Mercer University, Macon, Ga.	1150	261	100
WMBB—Trianon Ball Room, Chicago, Ill.	1200	250	500
WMBF—Fleetwood Hotel, Miami Beach, Fla.	780	384	500
WMC—Commercial Appeal, Memphis, Tenn.	600	500	500
WMCA—Greeley Square Hotel Co., New York N. Y.	880	341	500
WNAB—Shepard Stores, Boston, Mass.	1200	250	100
WNAC—Shepard Stores, Boston, Mass.	1070	280	500
WNAD—University of Oklahoma, Norman, Okla.	1180	254	150
WNAP—Wittenberg College, Springfield, Ohio.	1210	248	100
WNAT—Lennig Bros. Co., Philadelphia, Pa.	1200	250	100
WNAV—People's Tel. & Tel. Co., Knoxville, Tenn.	1290	233	500
WNAX—Dakota Radio Apparatus Co., Yankton, S. Dak.	1230	244	100
WNJ—Radio Shop of Newark, Newark, N. J.	1290	233	100
WNYC—City of New York, New York, N. Y.	570	526	1000
WOAI—Southern Equipment Co., San Antonio, Texas.	760	395	1000
WOAN—James D. Vaughn, Lawrenceburg, Tenn.	1060	283	500
WOAW—Woodmen of the World, Omaha, Nebr.	570	526	1000
WOC—Palmer School of Chiropractic, Davenport, Iowa.	620	484	2000
WOI—Iowa State College, Ames, Iowa.	1110	270	500
WOO—John Wanamaker, Philadelphia, Pa.	590	508	500
WOQ—Unity School of Christianity, Kansas City, Mo.	1080	278	500
WOR—L. Bamberger & Co., Newark, N. J.	740	405	500
WORD—People's Pulpit Association, Batavia, Ill.	1090	275	2000
WOS—Missouri State Marketing Bureau, Jefferson City, Mo.	680	441	500
WOWL—Owl Battery Co., New Orleans, La.	1110	270	100
WPAJ—Doolittle Radio Corporation, New Haven, Conn.	1120	268	100
WPG—Municipality of Atlantic City, Atlantic City, N. J.	1000	300	500
WPSC—Pennsylvania State College, State College, Pa.	1150	261	500
WQAA—Horace A. Beale, Jr., Parkesburg, Pa.	1360	220	500
WQAC—Gish Radio Service, Amarillo, Tex.	1280	234	100
WQAM—Electrical Equipment Co., Miami, Fla.	1120	268	100
WQAN—Scranton Times, Scranton, Pa.	1200	250	100
WQAO—Calvary Baptist Church, New York, N. Y.	833	360	100
WQAS—Prince-Walter Co., Lowell, Mass.	1190	252	100
WQJ—Calumet Rainbow Broadcasting Co., Chicago, Ill.	670	448	500
WRAA—Rice Institute, Houston, Tex.	1170	256	100
WRAF—The Radio Club, Laporte, Ind.	1340	224	100
WRAK—Economy Light Co., Escanaba, Mich.	1170	256	100
WRAM—Lombard College, Galesburg, Ill.	1230	244	100
WRAV—Antioch College, Yellow Springs, Ohio.	1140	263	100
WRAX—Flexon's Garage, Gloucester City, N. J.	1120	268	100
WRBC—Immanuel Lutheran Church, Valparaiso, Ind.	1080	278	500
WRC—Radio Corporation of America, Washington, D. C.	640	469	1000
WREO—Reo Motor Car Co., Lansing, Mich.	1050	286	500
WRK—Doron Bros. Electrical Co., Hamilton, O.	1110	270	100
WRM—University of Illinois, Urbana, Ill.	1100	273	500
WRR—Dallas Police & Fire Dept., Dallas, Tex.	1150	261	350
WRW—Tarrytown Radio Research Laboratories.	1100	273	500
WSAB—S. E. Missouri State Tech's Col., Cape Gir'du Mo.	1090	275	100
WSAC—Clemson Agric. Col., Clemson College, S. C.	890	337	500
WSAD—J. A. Foster Co., Providence, R. I.	1170	256	100
WSAG—Gospel Tabernacle, St. Petersburg, Fla.	1130	266	500
WSAI—United States Playing Card Co., Mason, O.	920	326	500
WSAJ—Grove City College, Grove City, Pa.	1310	229	250
WSAP—The City Temple, New York, N. Y.	1140	263	250
WSAR—Doughty & Welch Electric Co., Fall River, Mass.	1180	254	100
WSAV—Clifford W. Vick Radio Const. Co., Houston, Tex.	833	360	100
WSB—Atlanta Journal, Atlanta, Ga.	700	428	500
WSMB—Saenger A'm't Co., & Maison Blanche N. O. La.	940	319	500
WSMK—S. M. K. Radio Corp., Dayton, Ohio.	1090	275	500
WSOE—School of Engi'ring of Milwaukee, Milwaukee, Wis.	1220	246	100
WSRO—Radio Co., Hamilton, Ohio.	620	483	100
WSUI—State University of Iowa, Iowa City, Iowa.	620	484	500
WSY—Alabama Polytechnic Institute, Auburn, Ala.	1200	250	500
WTAB—Fall River Daily Herald Pub. Co., Fall R'vr, Mass.	1130	266	100
WTAC—Penn. Traffic Co., Johnstown, Pa.	1430	210	100
WTAM—Willard Storage Battery Co., Cleveland, O.	770	389	1500
WTAQ—S. H. Van Gorden & Son, Osseo, Wis.	1180	254	200
WTAR—Reliance Electric Co., Norfolk, Va.	1150	261	100
WTAS—Charles E. Erbstein, Elgin, Ill.	990	302	1000
WTAT—Edison Illum'ting Co., Boston, Mass., (portable)	1230	302	100
WTAW—Agric. & Mech. Col. of Texas, Col. Station, Tex.	1110	270	250
WTHS—Flint Senior High School, Flint, Mich.	1370	219	250
WTIC—Travelers Insurance Co., Hartford, Conn.	860	349	500
WWAD—Wright & Wright, Philadelphia, Pa.	1200	250	100
WWAE—Lawrence J. Crowley, Joliet, Ill.	1240	242	500
WWAO—Michigan College of Mines, Houghton, Mich.	1140	263	250
WWI—Ford Motor Co., Dearborn, Mich.	1130	266	500
WWJ—Detroit News, Detroit, Mich.	850	353	500
WWL—Loyala University, New Orleans, La.	1090	275	100

*Additions and corrections