Everyday Mechanics

USING THE NEW AC TUBES—TWO ILLUSTRATED ARTICLES

Current Science

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FROM AGENTS

Please ship us another 100 controls. Other 100 came yesterday and the writer sold 9 dozen today.
I. J. Phillips, Sr., Ga.

First I wish to thank you for your prompt service in shipping me the 50 controls, which I received today in good shape. Sold eighteen today and expect to do better tomorrow. Look for more big orders from me in the next few days.
P. F. Metzler, Ala.

Mail immediately 25 controls. Monday, on eighteenth mail 25 more. Demonstration put it over big. The control is a wonder.
J. F. Kellem, Ore.

Send four dozen controls and two demonstration boards. I ordered two dozen but retail sales have already exceeded that number.
P. I. Cutler, Ore.

FROM USERS

The Thermostatic Control you sent me is all you claim. I have sold 14 devices by explaining the principle and merit of same.
Paul Lees, Calif.

We had a test run Saturday and Sunday through level and hilly country, from Washington, D. C., to Martinsburg, W. Va., and back about 208 miles. Made it on 5 gallons of gas. The attachment is a wonder.
Charles F. Rougeau, D. C.

Mr. T. R. Wright told me that he went 32 miles on half gallon of gasoline.
John H. Odgers, Ontario.

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Act at once if you want to get started with a *sure thing*. Make real money with the backing of a big, well-known responsible firm. Don't delay. We want to assign men right *now* to the profitable territories we have left open. Get in with a live proposition that is different. Be successful! Be independent! Make $15.00 a day and large commissions. Mail me coupon quick for free trial, proof, and full details of a big proposition that will surprise you.

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Do not confuse the great Blancke Invention with anything else you've ever heard of. Its principle is entirely scientific—absolutely different. You can easily prove this to your advantage at our risk. All you need to do is mail the coupon at the top of this page. It will cost you nothing and will positively bring you by return mail the biggest surprise and greatest opportunity you've ever known.

Frank Andrews, President

Blancke Auto Devices Co.

154 E. Erie Street Dept. 820-M Chicago, Ill.

"Best Receiver I Ever Built; That World's Record Superhet"

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JANUARY, 1927
Full Data on the Super 8

APRIL, 1927
One Spot Super and Power Compact

MARCH, 1927
Building Ideal Model Super 8

MAY-JUNE, 1927.
Using 9 Tubes on World's Record Super

We will mail any one or all of these back issues at only 30 cents each on receipt of stamps, currency or money order. Write now while they last to

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500 North Dearborn Street

Chicago

Everyday Mechanics

RADIO AGE

Current Science

Established March, 1922

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CONTENTS

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Chats

THE Radio Corporation of America now has friendly representation on the National Radio Commission which regulates broadcasting and allocates wave lengths. R. C. A. has finally assumed control of the chief group of patents under which the bulk of present-day radio sets are manufactured. R. C. A. has even acquired the chairmanships of one of the important committees of the Radio Manufacturers' Association.

None of these things bother us in the least. We had not only anticipated the ascent to the heights but years ago we told our readers what the corporation was determined to do. There is no surprise in the sequel. We expressed doubt as to whether Federal Trade Commission charges of conspiracy against the big five would ever get anywhere. Does any reader know what became of that virtuous blare of trumpets?

It is to be regretted, however, that the R. C. A. should again have thrown the radio trade out of step by announcing the prospective production of a new tube and then proceeding to withhold actual delivery of the tubes far beyond the date originally announced. Result—thousands of radio buyers refusing to buy anything or to build anything until they could be assured that what they intended to buy or to build would not be "obsolete" as soon as installed.

Same old story. You will remember the situation several years ago when we all waited throughout a long summer for the arrival of revolutionary equipment, dealers grumbling, buyers disgusted and trade taking the count. One ray of sunshine pierces the gloom. This tube delay has given the independent makers of tubes a chance to step in. We understand the independents are making hay while the sun shines.

Frederick Smith

Editor of RADIO AGE.

Time to Build

By ARMSTRONG PERRY

THERE was an old fellow, who had started life with nothing and made an honest fortune in real estate, who used to whisper to his intimate friends now and then: "It's time to build!"

He meant that land and building materials were as low as they were likely to go, that increase of population soon would crowd the present housing facilities, and that those who built would profit from their foresight.

If he were alive today, he would be interested in radio and he would advise: "It's time to build."

It *is* time to build. Radio programs now are superlative. Once they were made up of phonograph selections because the fact that voice and music could be transmitted and received through the ether was new and interesting and any sound at all could be used in a demonstration. When the novelty wore off, uncanned music was substituted. Most of it was worse than the phonograph music but it was interesting because we were hearing music made by real people while they were making it. Some good programs had to be broadcast to hold the interest of listeners who could appreciate it, and the number of those who could tell classics from clatter increased. Today the broadcasters are giving us the best there is; cheap stuff is used only to fill in.

Judging from the size of the aerial and the pile of boxes, this set builder in Colorado is going to have a real outfit.

Everybody likes a fight, except those who take the beatings; every championship bout, game and race is broadcast. Everyone likes good music; the air is full of it daily. We are all hero worshippers; every aviator, athlete and politician who makes the front page is given his chance at the microphone. No one can afford to miss today's broadcasts, when a few dollars and a few hours' work enable him to crash the gate at more big events than he could reach without radio even if he owned a flock of automobiles and a fleet of airplanes.

Old and New Styles Good

It is time to build. Apparatus has been developed to the point of high efficiency. The seemingly impossible has been attained—receivers can be attached directly to any electric lamp socket. Older types of receivers, with wet batteries, dry batteries or battery eliminators can be remodelled or merely rejuvenated by overhauling. Every one of them, right down to the crystal detector, gives better results today than it ever did, because of the increased power and quality of the broadcasting stations. There is no limitation of time or money that needs to keep a man from building a new receiver if he wants something better than the old one.

Interference has been reduced, conditions are improving. Broadcasting is under control at last.

Prices Low

Prices of parts never were so low nor the parts so good. Radio business has developed to a point where manufacturers and dealers are making liberal price reductions. Quite different from the hectic days of 1922 and 1923 when customers formed lines reaching out into the street and waited for new shipments of phones and coils to arrive.

The other day a man walked into a chain store. He forgot whatever it was that his wife sent him for and, as usual, found himself hanging over the radio counter. The store advertised: "Nothing over one dollar" and there on the counter was a five-tube radio set whose name was a household word.

He was about to ask for a dozen of those sets and had his twelve dollars in his hand when he overheard

Roy Bates of Plattsburg, New York, uses a copper tank from a wrecked rum runner for an indoor aerial.

You can plug into the house lighting circuit and operate a modern receiver.

a salesman explaining matters to another customer. The set was composed of parts that sold for five cents to one dollar apiece. Altogether they came to forty-five dollars. For the convenience of a customer who wanted to buy them all at once, the store would put them into a cabinet, each in its correct position, and fasten them there with wire and solder. They charged a little more than for wrapping them with paper, twine and gummed strips; the customer could save the difference by assembling the set himself.

He hesitated. Then a bright idea came. He bought the parts, took them home, assembled them. After he tested out the receiver and adjusted it for extra good results, he gave it some touches of individuality that he knew would please a neighbor. He invited the neighbor in to hear it. It caught his fancy and he wanted to buy it. The builder sold it and cleared $20.

The next day he was back at the store for another kit. His first customer sent him his second. The next week he was back after his third outfit. In a month he figured out that if he could keep the neighbors away long enough he could build a set for himself with the money he had made and have enough left to pay him for the time he had spent on all of them.

There is something about a hand-made set with the monogram of the owner on it that gets 'em. The factory-made product may be as good, or better, but it is not exclusive.

Relieves Nerve Strain

It is time to build. Hand work relieves mental strain. Driven all day by executive pressure in the ceaseless grind of business or industry, a man develops a longing to do something in his own way and take his own time about it. He may be a putterer who butchers bakelite and lumber into irregular shapes whose dimensions even geometry could not discover, or he may be a careful artisan whose finished product breathes the spirit of the artist. It makes no difference which he is. Building a radio set in the quiet of the evening in his own home relaxes the nerves, breaks up the monotony of the struggle for existence. It is an unselfish pastime, too, for a radio outfit can provide pleasure for the whole family and friends.

Our eyes have been used too much; the ears should be used more. Radio develops hearing. We learn to distinguish the different instruments in the orchestra and to know the announcers by their voices. It gives us an enlarged channel through which pleasurable sensations reach us from the outside world. We can lay down the fine print that makes us screw up our faces until the wrinkles become permanent. For a few hours at least we can relax, put aside the glasses that wear creases in the bridges of our noses, rest our eyes and let our ears work. It doubles the joy of life.

Or a careful artisan whose work shows the spirit of the artist.

Radio A Time-Saver

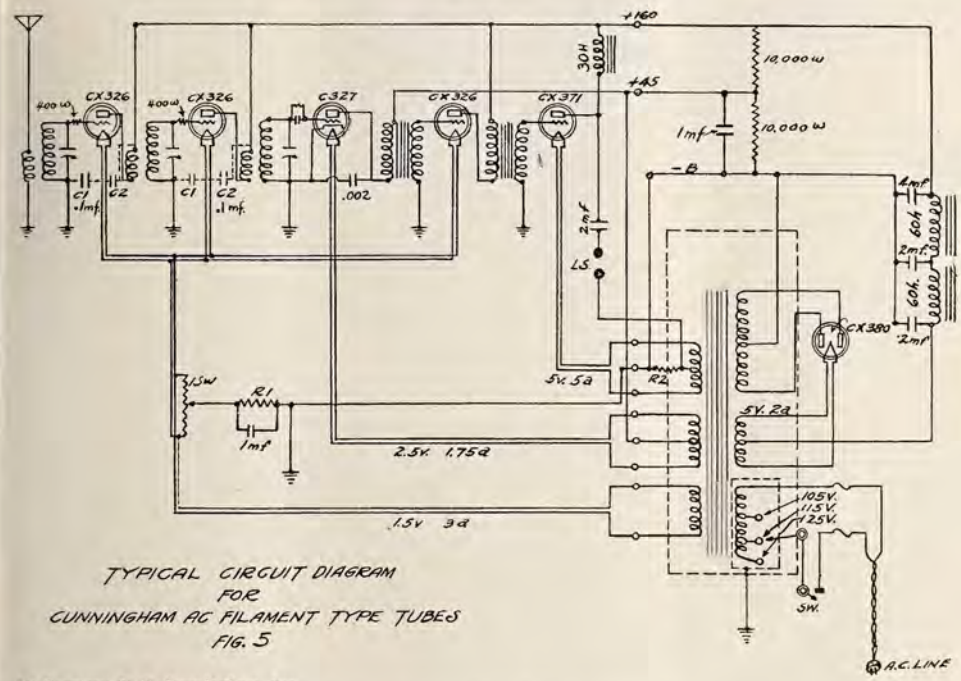
It is time to build. Radio saves time. A man who takes a half hour of our time when he puts his message into print gives it to us in ten minutes, and more interestingly, by radio. When he talks into the microphone he has to condense. It costs one hundred dollars an hour to operate an average broadcasting station and the management counts the seconds. So does the audience. If a speaker wants to hold a radio audience more than ten minutes he has to begin by making a transatlantic flight or knocking out a world's champion.

Time is life. A man must be informed about current events or he is laid on the shelf—modern business has no use for a fellow who does not know what is going on—and if he spends an hour a day gathering information when he could get it by radio in fifty minutes, he is wasting one business week a year. It would be better to use radio and take an extra week's vacation. News, book reviews, talks on the leading plays, technical information, all are on the air regularly. Listening to them directs attention to articles and books

(Continued on page 39)

The set builder may be a putterer who butchers bakelite—

Some Interesting Characteristics of the A. C. Tubes



TYPICAL CIRCUIT DIAGRAM
FOR
CUNNINGHAM AC FILAMENT TYPE TUBES
FIG. 5

By Courtesy E. T. Cunningham, Inc.

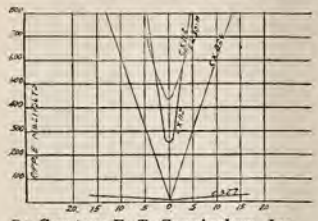
(For further data on A. C. Tubes, see page 16)

THE NEW A. C. tubes seem to be the long sought solution for complete and economical A. C. operation of radio receivers. The new tubes replace the comparatively bulky equipment of the "A" eliminator type only recently developed. Until the cartridge type of rectifier was invented an eliminator was a bulky affair, almost as large as a good sized storage battery, and usually just as wet. Even the latest types of "A" eliminators have a chemical filter condenser in them, with a few exceptions. The only accessory to the new tubes is a small filament-heating transformer, which is very much smaller than the smallest of "A" eliminators.

The announcement of the appearance on the market of the two tubes was made in the July-August issue of this magazine. There are two Cunningham types of A. C. tubes, as already made clear, in that issue; the type CX326, an all purpose amplifier, and the C327, which was designed purposely as a detector, but is also an efficient radio frequency and audio frequency amplifier when used as such.

The CX326 is similar in electrical characteristics to the 301A type. The plate impedance, however, is lower, giving the tube a higher mutual conductance. The filament construction is of the inverted V type, like that of the 301A tube, but is in form of a ribbon and oxide coated. The filament is heavy and takes considerably more current than the 201A tube. The temperature of the filament does not follow with changes in current flowing through it nearly as rapidly as with a light filament and therefore the filament emission to the plate is practically uniform.

In the lighter filament the temperature changes modulate the plate current, as the tube resistance rises and falls with the amount of filament emission, and the A. C. component in the plate circuit is the result. Fig. 1. is a graph showing the amount of A. C. in the plate circuit of various tubes as the center tap to the potentiometer is moved from the exact nodal point. It is very apparent that greater deviations are allowable without inducing noticeable hum in the



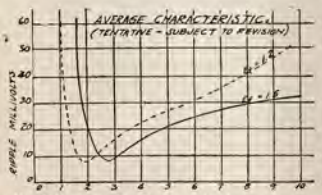
By Courtesy E. T. Cunningham, Inc.

Fig. 1. Percentage of "hum" as potentiometer is unbalanced. Notice that for C327 there is little difference as to the position of the potentiometer.

new tube than in the tubes designed for D. C. filament operation.

There is a balance point between the electromagnetic and electrostatic fields set up by the alternating current and the CX326 is designed so that this point is effective when the tube is used as an amplifier. Fig. 2 illustrates the effect of the plate current on the percentage of hum. It is readily seen that the hum is at a minimum when the plate current is about three milliamperes. This also shows why the tube is not adaptable as a detector, since the plate current would be very much reduced with the grid bias method of detection and the amount of hum correspondingly increased.

When the tube is used as a radio frequency amplifier the results are about the same as those obtained with a 301A tube, since the internal construction of the elements, and therefor the inter-electrode capacity, is the same. The grid plate capacity is about 10 m. m. f. As an audio frequency amplifier the tube is also the same, possibly a little better on the low notes for some transformers.



By Courtesy E. T. Cunningham, Inc.

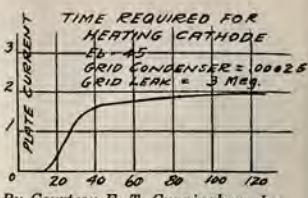
Fig. 2. This curve shows that the least "hum" is present when the tube is taking about three milliamperes plate current with the proper filament voltage of 1.5 volts. The "hum" increases very rapidly as the plate current is decreased below .25 milliamperes. Type CX326 tube.

The use of a bias on the radio stages as well as the audio stages is absolutely essential. The bias is necessary to keep the plate current at a value where the A. C. component is minimized (as has already been observed from the graph of Fig. 2.), and to prevent grid current from flowing. Among other things, this means that the use of a potentiometer for controlling oscillations is impossible. The radio frequency stages may have the grid returns connected to the same potentiometer as the audio stage since the potentiometer adjustment for the r. f. tubes is not as critical as for the audio tube.

With the rather high grid bias required for these tubes (see data list on these pages) the input impedance of the tubes is quit high and the selectivity of tuned circuits across the input is not impaired.

As has already been brought out, the filament voltage must be constant, as well as the plate current, and have a definite value for operation without hum. The plate current should be three milliamperes and the filament 1.05 amperes. This prevents the general practice of controlling oscillations which might occur in the r. f. by means of a rheostat in the filament circuit, or a variable high resistance in the plate current supply.

The internal construction and base of the type C327 tube is quite different from the standard 201A tube The tube, instead of having a regular filament, has a heater filament which requires a current of 1.75 amperes, and an electron emitting cylinder around it. The cylinder is electrically insulated from the filament and connected to the center tap of a potentiometer for the plate current return. The cylinder is oxide coated and when heated by the filament inside, emits electrons to the plate. The potential distribution over the whole surface is uniform and therefore the A. C. fluctuations in the filament have no effect on the plate current. The grid and plate are also in cylindrical form, grid plate capacity is almost half that of the CX326 or 201A tube and should make an excellent r. f. amplifier. The mutual conductance is also slightly higher; the amplification constant the same. All in all, this is the better general purpose tube of the two, and especially so for detection, and r. f. amplification in circuits where the interelectrode capacity is not neutralized or balanced out.



By Courtesy E. T. Cunningham, Inc.

Fig. 3. Time in seconds.

The cylindrical cathode is connected to an extra prong at the base of the tube, making it a five prong base, which naturally requires a special socket. Several sockets to accommodate this tube are already on the market.

Detection by the grid-bias method is not practical with this tube. When this method is used the sensitivity will be only about one-fifth as great as when a regular grid condenser and leak is used. On the graph of Fig. 3. it can be seen that there is a time element in starting the operation of the tube. About a minute is required to bring the heater to full operating temperature, for this reason there

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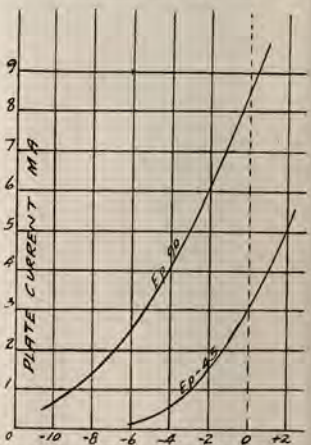


By Courtesy E. T. Cunningham, Inc.

Fig. 4. Plate current grid voltage curve for type C227 tube

Locating Mineral Beds by Radio

EVEN the well known and much honored prospector must now accept the very latest fashion in mineral exploration, for the radio has come into the field with eyes more powerful than all the prospectors combined. New fields will be opened in the mining world, abandoned mines promise to again start operations, while mining property throughout the world will be waiting for the radio to help in locating its underground fortunes. The radiore process, as it is named by the inventors utilizes the well known electrical principle of inducing an electric current through a conductive body and thus creating an electro-magnetic field which extends out at varying lengths. A high frequency sending set with another apparatus designed for receiving and direction finding comprises the complete outfit for the radio prospector of today.

From the broadcasting, set which is set up at any desired location in the field, an alternating electric-current of a very high frequency is sent out into the air, and creates what is called the primary field. If there are any conductive ore bodies within this radius of the broadcasting set some of the electric current will naturally flow through them. As a result of the induced current flowing through the conductive ore deposit an electro-magnetic field will be created called the secondary field. The next problem for the radiore engineer is to locate the axis and depth of the mineral body.

Broadcasting apparatus in the field during operations

To find the axis of the secondary field a receiving set is used with direction-finding loops mounted on the well known surveyor's transit. After the territory has been divided into smaller plots, for convenience in surveying, the radiore receiving set is set up at some point within the primary electro-magnetic field. The operator uses the usual wireless receivers to listen in as he revolves the direction —finding loops in various directions in order to determine the direction to the axis of the secondary field. If there is a conductive ore deposit anywhere under the surface to a depth of 500 feet it can be definitely located by continued observations and plotting of the area. Only ores of the sulphide group such as lead, iron, and copper, and a few ores in their natural state, can be determined with the radiore process so far. However continued experimenting is now being carried on in the mining fields of Arizona and other states of the southwest to further perfect the instruments.

The entire radiore outfit is designed for convenience in carrying about in the field work, while the total weight of every part is nearly 500 pounds. The receiving and sending sets are mounted on tripods which enable quick set-ups and moving in the field. Under normal conditions a crew of four or five men can operate one outfit. In case the terrane is hilly and rocky or covered with dense vegetation additional helpers are added.

Where the ground has been almost inaccessible for the ordinary type of prospecting the radiore process may be used to quickly determine the underground mineral conditions, the radio prospectors may even set up their apparatus hundreds of feet underground, in active mining tunnels and shafts. As an accompanying help to mining the radiore process proves to be the greatest development of the present day. Expensive and futile mining operations will be unnecessary when the ground may be explored without costly drilling.

As yet the character of the ore deposit which may be located cannot be determined with the radiore ap-

(Continued on page 39)

Close-up of broadcasting set which sends out alternating electric current

The "radiore" set in operation in the field. Notice the direction-finding loops

Current Radio Wisdom in Tabloids

Wildest Radio Dreams Not Nonsense

From an interview with Merlin H. Aylesworth, President of the National Broadcasting Company, which appears in the American Magazine for August.

RECENT successful experiments in television, in which persons were seen in the act of telephoning by the ones spoken to, are by no means the end of wonders that may be accomplished by the radio. To the contrary, the wildest dreams for its development are not nonsense, said Merlin H. Aylesworth, president of the National Broadcasting Company in an exclusive interview given to the American Magazine for August.

Radio has shaken off the handicap of taking limitations for granted. In radio and in pretty much everything else, the men who dare to think most boldly, even most absurdly, have been more nearly right than those who have believed that only the little things were possible, said Mr. Aylesworth.

We know for a certainty that big things are just around the corner. We expect that we shall live to see motion pictures flashed onto the walls of our homes. Science may even find a way to break down food into electrons and transmit them to our kitchens by radio and there reassemble them for nourishment. This sounds like the wildest nonsense at the moment but the radio itself seemed like nonsense only a couple of decades ago.

Our hope for radio is that it will make the people of the United States feel that they have "been some place"; that their lives will be richer, their experience wider, their appreciation of life more satisfying because they have been in touch, through this magic, with the wisest, the most talented and the most high-thinking folks of their time.

We are just beginning to find out about it ourselves. But we already know some things that have human interest. We know that there were 5,200,000 radio receiving sets in the country last June, which means, if you assume five listeners to every set, a total radio audience of twenty-six million people. New York State, with 654,000 sets, has the most listeners, and Nevada, with 7,200 sets, and New Mexico, with 7,800, the fewest. The four cities that have the largest number of listeners in proportion to their population are Los Angeles, San Francisco, Chicago, and New York, in the order named.

So far as we can discover, the male and the female audience is about evenly divided. For instance, a recent mail canvass conducted through station WEAF brought 1,943 letters signed by men, 2,190 letters signed by women, and 929 signed by "Mister" and "Misses." Naturally, the daytime audiences will consist almost entirely of women, though it might surprise you to know how many offices of busy executives now have radio sets—a few minutes of orchestra music with the after-luncheon cigar before the afternoon grind begins.

* * *

Against Radio Advertising

From address by United States Senator Arthur Capper of Kansas, broadcast over Station W I B W, Topeka.

IT SEEMS to me that the radio's greatest value is in the direction of furnishing entertainment and practical information to the listeners. For that reason I have regretted to see what appears to be a growing tendency on the part of some of the broadcasters to commercialize their programs—to ultilize the air for the sale of merchandise or to make commercial appeals to comparatively small circles of people.

I do not believe this phase of broadcasting should be encouraged. I believe it was this commercial feature that was to a large extent to blame for the tangle in the wave lengths which the Radio Commission is now engaged in untangling. Commercialism is always followed by a certain selfishness that is rather inclined to brook no interference with its plans. Radio is bigger than that and its future should not be hampered by such small, selfish interests.

Broadcasters should always remember that the interest of the public come first. I am sure that this was what Congress had in mind when the radio law was passed. The Radio Commission named to administer that law must also bear in mind that it's the listener who comes first.

* * *

Favors Advertising

Martin P. Rice, Director of Broadcasting for the General Electric Company, in an address on "Radio Advertising."

BY CONTRIBUTING to the cost of broadcasting, it (advertising) has made possible the rapid development and maintenance of a great public service which makes weather, market and stock reports, music, entertainment, education, religion, and the addresses of statesmen available to everybody, everywhere, without tax, cost or expense.

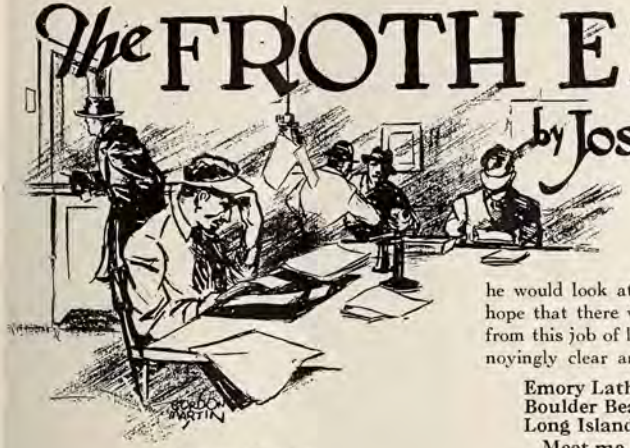
All of these objects may be termed advertising in the broad sense and if you look over the long list of broadcasting stations on the air today you will find very few of them which are not advertising something. The almost universal desire to broadcast today springs from the desire to advertise. It is an age of publicity and advertising.

There is nothing incongruous about it and nothing shocking. Probably everyone who reads a national magazine or buys a newspaper replete with the latest telegraphic reports from all over the world does not stop to consider that his purchase price is only a fraction of the publisher's cost and he may not know that the advertisers make up the difference. There can be no misunderstanding about a commercial broadcast program because the announcer always states frankly the name of the advertiser who sponsors it.

(Continued on page 45)

The FROTH ESTATE

by Joseph Balsamo



The story thus far

Col. Maximilian Minimil sets $10,000,000 aside out of his personally acquired colossal fortune, for the purpose of financing the Fortunatus Gazette for his son Daly. The younger Minimil, while the great project is being organized, has some difficulty in making other people believe he intends to publish a newspaper that is to be free from the smut and hysteria of certain other dailies. He believes a clean journal will win out. Bill Rossom, publisher of the Clarion, is a former movie actor. A horse stepped on his face, and although putting him out of the picture game, so transformed his countenance that he has the appearance of a super-man. People do what Rossom wants because of the compelling power of the Rossom face. Rossom tries to prevent the sale of the first issue of the Gazette. The Minimils win their circulation battle by a ruse and the Gazette is successfully launched.

Daly orders the city editor to discharge one of the girl reporters, giving the reason that she is so good-looking she might distract the attention of the young men from journalistic labors. The girl visits Daly in his office to protest against being dismissed and Daly falls in love with her and tells her so. She leaves Fortunatus that night, explaining in a latter to Daly that she fears he is too hasty in his wooing and she wishes to give him time to consider the future.

XV

MR. EMORY LATHROP, eminent member of the law firm of Lathrop, Lathrop and Moore, shaved himself hastily and laved his face, which extensive adventures on tee and green and fairway had given a hue not dissimilar to the calf binding on his law reports. A robust and yet a distinguished figure of a man, Mr. Lathrop.

"This knocks me out of the club handicap play," sighed Mr. Lathrop, looking out over the green hills of Long Island. "That man Minimil never takes a day off and he apparently doesn't want his legal counsel to swing a driver, either."

Mr. Lathrop's valet laid out linen and a carefully pressed suit. This done he completed packing a Gladstone bag. It was Sunday morning and the Lathrop household was not yet astir. The head of the menage made his way to the breakfast room where Fawcett had eggs and toast and coffee waiting. As Mr. Lathrop sat down to his solitary meal he glanced again through the East windows which revealed hills bathed in hazy sunshine. A perfect day for golf. Mr. Lathrop decided he would look at the telegram again, hoping against hope that there would develop some means of escape from this job of legal work. No, the message was annoyingly clear and explicit:

Emory Lathrop
Boulder Beach
Long Island.

Meet me Keystone hotel, Philadelphia, Sunday morning eleven o'clock important.

Minimil.

Mr. Lathrop gazed at the hateful yellow sheet as if to assure himself that it really meant this particular Sunday, this Sunday of perfect golf weather, this Sunday of the handicap match in which he was to have teed off with Judge Kershaw in the semi-finals of the club's midsummer tournament.

Eminent lawyers are gifted with resourceful minds and Mr. Lathrop was no exception. He found no way of evading this unwelcome Philadelphia journey, but as he studied the telegram he discovered therein an inspiration that made his countenance beam suddenly and glow as radiantly as the golden yolks of the poached eggs that smiled merrily up at him from their twin couches of golden toast.

"Eleven o'clock. Why, that may be early enough to give me a chance to go out to the Philadelphia Country Club for eighteen holes in the afternoon! Meet Traynor and Calkins there, like as not."

Mr. Lathrop was talking to himself but Fawcett, capable old sort, was listening. There was instant action. Fawcett called the country club to say that Mr. Lathrop's car would stop there in about fifteen minutes and Mr. Lathrop wished to pick up golf clubs and clothes on his way to the train.

Col. Maximilian Minimil of Fortunatus was watching alertly for the arrival of Mr. Lathrop and when that quietly attired barrister entered the lobby of the Keystone hotel, followed by two bellboys, bearing hand bags and golf bags, the Colonel stepped forward eagerly to seize his hand. Col. Minimil was clad in a suit of violent plaid, fully as noisy as his greeting. He rushed Mr. Lathrop off to his apartment in a lofty corner of the Keystone and almost pushed the eminent lawyer into a capacious chair by a window.

"It's about Daly," the Colonel said, facing Mr. Lathrop. "Boy's completely goofy over a red-headed

girl reporter. Never saw her but once but just as sure he's going to marry her as if the two families had planned it when he and she were born. She's a smart one. Ran off from Fortunatus to Philadelphia to put up a bluff of making him wait. Gold digger. You know the kind. Daly will either get her back to Fortunatus or follow her here. Up to us to nip the affair in the bud. I'll pay her off and you can take care of the legal end."

"I didn't suspect Daly to be so—so susceptible," ventured Mr. Lathrop.

"Hit him all in a heap," rapped out the Colonel. "Saw her in the reporter's room and fell like a log."

"Um," mused Mr. Lathrop. "How about her? Are you sure she isn't genuinely interested in Daly?"

"Interested your eye," boomed Col. Minimil. "Interested in his bank roll!"

"And yet she ran away from it?" asked the lawyer.

"Just a poker trick, passing for a raise," snorted the Colonel.

"You give her credit for great shrewdness. Either she is full of crafty ways, Colonel, or she instinctively did the right thing about getting away and giving him time to think things over. She's either a dangerous adventuress or——." Mr. Lathrop's voice trailed off into silence and he sat considering the matter.

"Or what?" demanded the Colonel.

"Or she's in love with Daly," calmly reflected Mr. Lathrop, aloud. "In that case, Colonel, we might better go a bit carefully."

"Bunk!" shouted the Colonel, "did you ever know two young folks to fall in love like that anywhere except in one of them confession stories."

"Once," said Mr. Lathrop, a smile flickering at the corners of his mouth. "That was when Mrs. Lathrop and I met. We were married a week later."

"Say Lathrop, are you one of these sentimental lollypops or are you a lawyer?"

"I sometimes think I'm both," laughed Mr. Lathrop.

"Well you are off on the wrong foot in this case. Only one thing to do. Make an appointment with this lady and you'll see how she will play her cards. I know 'em. Look at Adam and Eve or Cleopatra and Napoleon Bonaparte. They're all alike when they want something and they always want something."

"I'll call the young lady up for an appointment," said Mr. Lathrop. "What particular part of the Garden of Eden is she gracing with her presence and what is her name and telephone number?"

Colonel Minimil held up a forefinger as if to impress upon his attorney his client's cleverness. "Had the best detective in the country locate her," he said. "She writes stuff under the name of Amy Templeton Graves but her real name is Amy Templeton and here's the address and telephone number."

Mr. Lathrop looked at the memorandum which the Colonel handed him and almost imperceptibly raised his eyebrows as he read the street address. He got up and walked to a little table on which the telephone stood.

"Miss Templeton? Ah, Mrs. Templeton, may I speak with your daughter please? Will she return soon? Not until dinner. I see. This is Mr. Lathrop. I have just arrived from New York and would like very much to reach Miss Templeton as soon as possible. Could I call her by telephone elsewhere? Too bad, but thank you, Mrs. Templeton, I will call up again at 6. Thank you. Good bye."

"Not home?" asked the Colonel.

"Out for the entire afternoon," replied Mr. Lathrop happily, at the same time seizing a handbag and proceeding to pull forth shirts, golf socks, shirts and shoes. "Come to luncheon with me at the Country Club and we'll talk the thing over while I'm fixing up a game with a couple of near-golfers who gave me a trimming a month ago. Can't turn a wheel until 6 anyhow."

XVI

IF Col. Minimil had not elected to dress himself up like an excursion boat before going to the country club this chapter in the tale of the strange adventures of Minimil and son could not have been written. But the Colonel did so attire himself. He selected a suit of plaid material which was not merely loud. It was cataclysmic. A devastating storm of cobalt blue, burnt orange, and scarlet swept across the background of gray cloth. His hat was a wide-rimmed covering of pearl gray, to match his spats. He carried a stick that had been nothing more than a dried Malacca reed in its native jungle, but which now was a polished rod surmounted by a silver knob, the size of a tennis ball. The stick looked much more like the baton of a circus bandleader than it resembled the cane of a gentleman.

Mr. Lathrop, the conservative New York lawyer, quailed at the sight of the Colonel in his Sunday outfit. But it was not the duty of a lawyer to question the sartorial taste of a client and Mr. Lathrop said nothing and appeared to observe nothing. The elevator boy breathed deeply as the upholstered Colonel entered the lift. Passing through the lobby Mr. Lathrop heard a bell boy ask the cigar counter girl: "Where is the faro game?" Out under the *porte cochere* a taxi driver called out to a crony across the street, "Whatsay about a little game of checkers?" A young gentleman, lolling in the tonneau of a special-bodied touring car, whistled the tune, "Horses, Horses, Horses." Beyond these trifling incidents and several scores of smiles and nods and whispered comments the Colonel's outfit attracted no attention whatever.

At the country club Mr. Lathrop had the good fortune to find Mr. Ned Traynor, an ancient golfing foe, and a match was arranged with gusto and dispatch. Mr. Traynor explained that a young lady was to play with him but that she was a corking good golfer and it would make a tip-top threesome. Mr. Traynor waited while Mr. Lathrop and the Colonel partook of a light luncheon in the grill and then the three walked out on the terrace which overlooked the first tee and the eighteenth green. They stood there a moment chatting

before saying goodbye to the Colonel and trying not to be aware that every eye in or on that part of the golf course was directed at the landscaped elder Minimil.

A girl, idly swinging a driving iron, as she waited near the first tee, looked up casually and saw the Colonel. Her prettily flushed face went white for a moment. Her eyes narrowed and she puckered her fair brow into a scowl of amazement and indignation.

Need we say that the young maiden in such evident stress of spirit was Amy Templeton? It was indeed she and indeed she had been knocked for a row. The Colonel little thought as he went forth to the golf course that he was to so dramatically betray his presence in Philadelphia to the very lady whom, in the presence of legal counsel, he had come to see. Unconscious of the tumult he was causing in the breast of the little red-headed girl reporter from Fortunatus the Colonel shook hands with Mr Traynor, waved *au revoir* to Mr. Lathrop and retired from the terrace.

Miss Amy stilled the beating of her heart and took her errant emotions firmly in hand. Followed, was she? The old Colonel was here to nip her romance in the bud, was he? Miss Amy smiled. It is a well known phenomenon of biology that a red-headed girl will fight for her heart's desire as savagely as a Yunnan tiger battles for his breakfast. No need to try to explain or analyze. An eagle in the air; a serpent on a rock, or near a rock; the way of a maiden with a man. The man of shallow thought assumes that when a lovely woman stoops she is stooping to folly. He does not guess that she may be reaching for a sash weight.

When Mr. Traynor advanced and introduced Mr. Lathrop to Miss Amy, adding that Mr. Lathrop had left the New York bar flat to come to Philadelphia to get a good beating at golf, the girl put two and two together and added them up to a dozen sage conclusions. This lawyer had come to the club with Col. Minimil. He and the Colonel were here to rescue Daly from a titian-haired girl reporter, who was plotting to lure Daly Minimil to the altar and thereby attach herself to the Minimil bankroll, popularly supposed to have a circumference exceeding that of a full-grown water main. Miss Amy was beautiful and yet not dumb.

She greeted Mr. Lathrop with the sweetness that comes to womankind when they are most dangerous. She welcomed him with a warm shake of the hand and a straight look out of eyes that literally swam in loveliness. If Mr. Lathrop, the level-headed legal bearcat, was a trifle groggy under the barrage of feminine charm he was crowded right up against the ropes when he heard Mr. Traynor mention her name:

"Miss Amy Templeton, Ned."

The girl saw and understood. Colonel Minimil and Lawyer Lathrop might be in Philadelphia to look up the past performances and pedigree of the Templetons but at least they had not followed her, like two silly detectives. The lawyer was obviolsly as surprised at meeting Miss Amy as the girl had been at recognizing Col. Minimil in his appearance as King Solomon on the clubhouse terrace. The rest of the sketch would be simple. She knew him and he knew her but he didn't know she knew and she did know that he knew.

XVII

Mr. Lathrop was a golf player. Occasionally he shot under 80, which will explain a lot of things to various of his clients who had wondered why he was so frequently out of town on business during the golfing season. Mr. Lathrop loved a close contest. It irked him that he should meet Miss Amy here under the unfortunate necessity of playing golf with her during the afternoon and asking her why was she a gold digger in the evening. But that latter event could take care of itself. As long as it was afternoon and eighteen holes of good golf stretched out ahead of them, why, he would play golf. He at least would show Miss Templeton that he was able to get both distance and direction and make 'em plunk down, once he was on the green.

Miss Templeton also was a golf player. She never shot under 80 in her life but she had come close to it. She was what is known in the sport page as a money player. The greater the necessity for good shots, the better were her shots. She would now show this lawyer for the Minimil family that she was pretty fair on distance, direction and that her putting touch could turn a five into a par four.

Mr. Traynor never will forget that game of golf. He was out of it from the start. He watched a handsome, accomplished, skilful New York lawyer hook up with a lovely, determined and hard hitting girl. Mr. Lathrop sensed the spirit of conflict in her and his his spirit rose to meet hers. They halved the first hole in four, Miss Amy took the second with a five to Mr. Lathrop's six and the lawyer evened it up on the third when he made a birdie three against Miss Amy's good par four.

"I say," said the bewildered Mr. Traynor as they walked to the fourth tee, "one would think you folks had been waiting for years to settle a golf game instead of having met for the first time today."

"Let us alone, Ned," laughed Mr. Lathrop, "something tells me that a woman is going to almost lick me for the first time in my golfing career."

"You put it conservatively," exclaimed Miss Amy.

They finished the first nine with honors even. They continued on, seesawing, ding-donging, fighting for every break, studying every putt. On the sixteenth the girl hooked her drive into the rough and disaster appeared imminent. She got out with a beautiful niblick and was on in two. Mr. Lathrop's second shot went dead to the pin. Miss Amy looked at the twelve-foot putt that confronted her, took her stance and swung the club in a pendulous, graceful arc, that sent the ball spinning across the velvety turf. The ball rolled lazily toward the cup, straight as a taut string, seemingly controlled by the magic of the young lady's determination, even after it had departed

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Suggestions About Supers

By ARMSTRONG PERRY

THE way to be happy with a superheterodyne radio receiver is to treat it as a sensible man does a new wife: try to control it and, if you can, don't worry because you cannot understand it.

For distance, volume and quality the superheterodyne is as far ahead of other types of receivers as a high-power rifle is ahead of a boy with a snowball. That is, if you have a super that works. However, the snowball, because of its very simplicity, hits many a plug hat that has never been knocked off by more complicated weapons.

It is just as easy to build a super that will work as it is to build one that will not work. These two kinds look almost exactly alike. The main difference is that the ones that work were designed by someone who knew what he was doing and were built by someone who did exactly what the designer told him to do.

The first step toward success is to go to a reliable radio shop and buy a set of blue prints, templates and instructions. A reliable radio shop, from our point of view, is one in which the management always is ready to back up any statement that it makes, by furnishing new parts, by giving free service, or by doing anything else that may be necessary in order to make a set operate as guaranteed. The dealer who sells an outfit with a statement that it will deliver certain results, and who meets complaints with suggestions about spending more money when the set fails to deliver those results, we do not rate as reliable.

The customer who stands next to you at the counter may tell you, while the clerk is wrapping your outfit, of many improvements that you can make by substituting different condensers, coils, tubes, transformers and other parts for those specified by the engineer who designed the outfit. This cuss may tell of no end of supers that he has built, and how he gets Japan on the loud speaker almost every night. Go over to his house any evening to see how he secures his marvelous results and you will find, usually, that he has just taken his set apart because he knows of a hook-up much better than the one he used before, so he cannot give you a demonstration. With an imagination like his you would not need any receiver.

Radio experts do pick up separate parts and construct superheterodyne receivers that give maximum results. That is because they know how to measure inductances, capacities, resistances and voltages, how to plot curves, how to operate tubes at the proper position on their characteristic curves, how to test each piece of apparatus, how to locate the causes of trouble and how to remove them. But the average set builder, working a few hours in the evening and after church on Sunday, has a long course of study and experimentation ahead of him unless he takes plans and instructions worked out by a competent radio engineer and follows them.

Does the super satisfy? See that smile! This is in a steel-frame building surrounded by elevated railways, surface cars and fifty-seven varieties of electrical devices, but it reaches out and brings in the distant stations

It is an easy matter to lay a template on a panel and drill the holes for the apparatus that is to be fastened to it. Anyone who is handy with tools can do that. But it takes a thorough mechanic to lay out the template with the degree of accuracy required to make a super supe.

Knowledge and understanding grow, of course, as the set builder follows the plans. That is why it is ten times more fun to build a set than it is to buy one that is all ready to use. One of the first and most pleasing discoveries is that the superheterodyne receiver consists of four distinct and comparatively simple sections, each of which may be constructed and tested separately. These are: the first detector, the oscillator, the intermediate-frequency amplifier, and the second detector. This does not include the aerial and the condenser used in tuning it, nor the audio-frequency amplifier that some builders may wish to add, but these present no problems that are peculiar to the superheterodyne.

The tremendous amplification of the superheterodyne receiver makes it possible to cover long distances with a loop aerial, and this usually is tuned with a variable condenser. Sometimes the loop is tapped, so that more or less turns may be used.

The aerial picks up energy from the radio waves and delivers it to the first detector. The detector circuits are much the same as those of any other receiver. The energy passes through a grid condenser to the grid. There is a grid leak shunted across this condenser. The filament is connected to the "A" battery in the usual way. The plate output goes to the primary coil of a transformer, the same as in any set with a transformer-coupled amplifier.

The main difference between the wiring diagram of the superheterodyne and those of other receivers is discovered in the grid-filament circuit. The inductance coil in this circuit is placed in inductive relation with coils that connect with the oscil-

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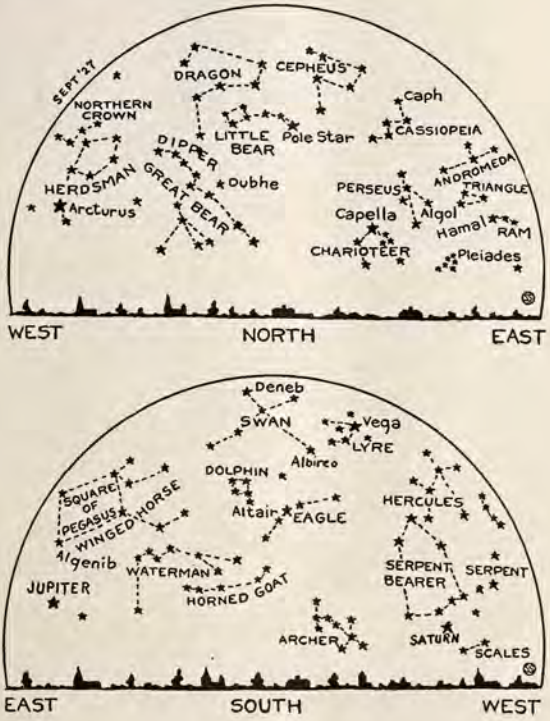
The September Skies

By JAMES STOKLEY
Science Service Staff Writer



WITH the coming of autumn, the skies take on a different aspect from what they had during the summer. Look high overhead this evening. There, up above you, shines Cygnus, the Swan, or the "Northern Cross." Near it are seen the Lyre and the Eagle. To the student of the stars, whether he be professional astronomer, or the merest layman, these groups in this position mean autumn just as clearly as do the falling leaves from the trees.

Let us look at Cygnus. Its long neck points to the southwest, with the brilliant Albireo—beta Cygni, the astronomer calls it—to mark the head. And to the northeast the still brighter Deneb, or alpha Cygni, marks the bird's tail. Then the two stars that form the tips of the transverse of the cross, also mark the wings of the swan.

Just why there should be a swan in the heavens is not certain. In the ancient mythology, there are several stories to account for it. According to one of them it was Orpheus, the marvelous musician. He wooed and won for his bride the beautiful Eurydice, but after that was murdered. Then he was turned into a swan, and put into the heavens near his favorite harp, which is represented by the nearby Lyre. Another story has it that the swan is the one into which Jupiter changed himself in order to deceive Leda, the queen of Sparta.

When seen with a powerful telescope, alpha Cygni, or Deneb, is found to have a companion star. But as the brighter body is of the first magnitude, and the companion of the twelfth, it is difficult to see. Albireo, the star at the southernmost end of the cross, however, is also double, and is one of the most beautiful in the sky. A small telescope, or even a good pair of powerful binoculars, if they are steadily held, shows up the two members of the pair. They are of nearly the same brightness, but of very different colors, as one is distinctly yellowish, and the other blue.

A little to the north and east of the star epsilon Cygni, which is the easternmost star in the transverse of the cross, is a famous star known as 61 Cygni. This is so faint that optical aid is needed to see it well, but faint though it is, it is one of the closest stars in the heavens. It was the first star to have its distance measured.

This was done in 1838 by the great German astronomer Friedrich Wilhelm Bessel, who succeeded where astronomers for centuries had failed. After Copernicus proposed his theory in 1543, that the earth revolves in an orbit around the sun, it took many years for it to gain wide acceptance. One group of opponents of the theory, the fundamentalists of the day, objected to it on theological grounds. But there were others whose objections were more reasonable. They thought that the Copernican ideas did not explain all the observed facts, and so quite properly withheld their acceptance.

To this latter group belonged Tycho Brahe, the great Danish astronomer, and the last in the days which preceded the invention of the telescope. Tycho said that if the earth revolved around the sun in so wide an orbit, the stars should have

a yearly displacement. An object on the earth is seen in a different direction from different places, and so Tycho argued that if the earth was in one part of the year many millions of miles away from where it had been six months earlier, or where it would be six months later, the stars should be seen in a slightly different place in the sky. He had the most complete observatory, and the finest instruments that had been made up to his time. He failed to discover any annual change in the star positions. Therefore, he concluded, the earth remained in the same place with respect to the stars.

Tycho died in 1601. The telescope was invented in 1610. But even with this aid, no displacement of the stars by reason of the earth's motion was observed for many years. Finally, however, it became evident why it could not, and the Copernican system, with the sun at the center, and the earth revolving around it, found universal adherence. The reason was simply that the stars were so exceedingly distant, compared with the size of the earth's orbit, that the change in the star's position, or parallax, as it is called, was too small to be measured.

Until 1838, all efforts at measuring parallax were unsuccessful, but then Bessel succeeded. A new epoch in astronomy was inaugurated. One of the difficulties in making parallax measurements is in seasonal changes. If the astronomer measures the position of a star in the sky in January and July, for instance, with accurate instruments, the star will be found to have an apparently different place. But the change isn't all parallax. A large part of it is due to differences in temperature and other atmospheric conditions. It is very difficult to figure just how much of the difference these seasonal changes account for, and so another method is used.

A very simple experiment will illustrate the method. Hold your right index finger a foot in front of your face, and between you and some distant object, like a house. Close your right eye, and look at the house. Your finger will obscure part of the house. Now close your left eye and look at the house with your right eye. Your finger will seem some distance away from the place that it previously covered. Repeat the experiment with your finger at arm's length. Hold your finger so that when you close your right eye the same part of the house is obscured as before. But then when you look at the house with your right eye, your finger will not seem to change its position against the background as much as previously.

Precisely the same procedure is used to measure star distances. A close star takes the place of your finger. A distant one is the substitute for the house in the background. In January the close star might appear near the distant one. In June it seems a bit farther away from the distant one. The farther away from the earth the closer star is, the less is the change, or the parrallax. From this can be figured the actual distance from the earth. When a star is very far away, of course, the chance is so minute that it cannot be detected. Such methods of measurement can only be used on the closer stars.

No star is so close as to have a parallax as large as a second. A second of arc is the apparent diameter of a dime about two and a half miles away. That is, if some one two and a half miles away holds up a dime, facing you, the distance from one side to the other is larger than the change in the position of the nearest star due to the earth's yearly motion. And this despite the fact that the earth revolves around an orbit 186,000,000 miles in diameter! No wonder Tycho Brahe could not detect it!

The parallax of 61 Cygni proves to be about three-tenths of a second. This is equivalent to a distance of 11 light years. A light year is the astronomical yard. Light travels at a speed of 186,000 miles—about seven times the circumference of the earth—in a second. The distance that it will go in a year, about 6,000,000,000,000 miles, is a light year. Alpha centauri, the closest of all the known stars, which can only be seen from southern countries, is about four and a third light years away. Its parallax is about three-fourths of a second.

Venus, the brilliant planet in the west, which has been so conspicuous in the early summer months, has now disappeared from the evening sky. But it will soon reappear in the east before sunrise. It is now getting close to the sun. On September 10, it will be at inferior conjunction, which means that it is between the sun and earth. Then it will move to the west of the sun, so that it will rise before it in the morning. By the end of the month, it will rise two hours before the sun, and will be conspicuous to the person who stays up that late—or rises that early!

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New Crosley Musicone

The Crosley Radio Corporation at their Distributors' Convention, June 8 and 9, announced an addition to their line of loudspeakers—the Tilt-Table Musicone, pictured above.

This DeLuxe Model Speaker is of the tilt table design. Standing three feet high, is finished in a brown mahogany and has at first glance the appearance of a delicate old colonial tilt table. This latest Crosley Musicone possesses certain added characteristics of tonal quality which are highly desirable. Selling at $27.50, it is certain to be a very popular model.

Using the New AC Tubes in a Six-Tube R. F. Receiver

By Frank Freimann

MUCH interest has been aroused by the announcement last month of two new A. C. types, which were to have been on the market July 1. The tubes have at this writing not been available to the public, but information from manufacturers leads us to believe that dealers will have a supply of tubes when this issue of RADIO AGE reaches our readers.

Our laboratory's search for sample tubes with which to experiment, resulted in getting a set of Van Horn tubes, which are similar in characteristics to the type CX-326 Cunningham tubes, and a Cunningham C-327 tube. The Thordarson Electric Co. courteously furnished a filament-heating transformer. This transformer will be on the market when the tubes are available.

It was decided to incorporate the new A. C. tubes in a six-tube single-dial radio frequency set with other new parts that have made their appearance on the market for the new season. A photograph shows the general construction of the receiver, and pictures clearly the parts used therein. The new Remler three gang condenser tunes three Aero Coil radio frequency transformers which are the new development of the Aero Products Co. Thordarson transformers constitute the audio amplifier.

With the application of the A. C. tubes are a few problems not encountered in the ordinary tube set which utilizes either storage batteries or some "eliminating" device. After one is once familiar with the function and characteristics of the tubes, however, these problems disappear and obvious facts are presented. The tubes seem adaptable to any of our present popular receivers when these facts are observed and small deviations made to compensate for the slight difference in characteristics from those of the type 201A tubes. The object—heating the filaments with house lighting current without introducing hum into the loud-speaker—is well accomplished. Very little hum is present even when one listens very carefully for it, and then only a few feet away from the speaker. The hum is not noticeable when a station is tuned in, nor is there any distortion of the music or voice.

The complete data on the characteristics of the Cunningham type CX-326 and C-327 is given in a separate article in this issue.

The Thordarson filament heating transformer has three sets of filament voltage taps at one end, and a cord and plug at the other end. The two top connectors are from the one and one-half volt winding which supplies current to the four "326" tubes, the middle set of terminals are the two and one-half volt winding for the heater element of the C-327 tube.

Rear View af A. C. Operated Receiver Showing Placement of Parts and Associated Wiring. The Set is Wired with Flexible Rubber Covered Wire, Simplifying Wiring and Construction. The 171 Bias Resistor and By-pass Condensor are Hidden from View Behind the Out-put Transformer.

the center terminal is connected to plus forty-volt connection, and the lower set of terminals are for the filament of the CX171 tube in the last stage of audio amplification; the center tap here is for the plate current return. In series with this plate current return lead is a 2500 ohm Carter fixed resistor R_4. The voltage drop due to the plate current flowing through it, is impressed on the grid of the CX171 tube and acts as a bias. The transformer has an electrostatic shield between the primary and secondary windings and is encased in a heavy iron case which acts as a magnetic shield and prevents induction of the 60 cycle current into other parts of the circuit and causing hum. Both of these features are quite essential to operation without noticeable hum.

Since the current supplied to the filaments of the tubes is many times larger than in any of the tubes formerly operated from battery supply, the filament wiring must be given careful study. The leads should be twisted wire to minimize induction, and should be quite heavy, though ordinary rubber covered No. 14 flexible wire was used in this set. The wires carrying alternating current should be as far removed from the coils and grid wires as possible. In this case the tubes are mounted so that the filament terminals are at the back of base board and away from the coils, except for the third r. f. tube which is mounted between the first and third r. f. transformer. A Carter heavy duty rheostat is connected in the 1½ volt filament lead to cut the voltage to 1 volt, to accommodate the use of Van Horn tubes which have a filament terminal voltage of 1 volt. This rheostat can be left out if CX-326 tubes are to be used.

No doubt there will be cries of "wrong wiring diagram" when some of the readers take their first glance at the diagram and see the 45 volt line connected to what looks like the plate current return. But it's all right; the plate current return is to the oxide coated metal cylinder cathode which is electrically insulated from the heater filament and the high voltage through the transformer winding. This unusual connection is probably made to eliminate capacitive coupling between the plate and heater, since they are now both at the same potential.

The grid return wires are all connected through a 1000 ohm resistance to the movable connection on a 20 ohm potentiometer which has its outer terminals across the 1½ volt winding and rheostat. The plate current to all the "326" tubes flows through this resistance and the voltage drop of about 12 volts biases the grids. This is indicated in the diagram as R_3 and is by-passed by a 1 m. f. condenser C_4. The by-pass condensers across both of the bias resistors R_3 and R_4 are quite important, when these are left off a continuous audible oscillation will very likely be the result.

The Remler "right-hand" drum dial is mounted in the exact center of the front panel and the gang condenser is mounted on it, this divides the set in half, the radio frequency stages and detector are on the left side and the audio stages and filament heating transformer on the right. The first tube is a antenna coupling tube and will not add very much to the amplification of the set, but it permits any length of antenna to be used without throwing "off" the tuned stages.

The radio frequency transformers are staggered to afford the greatest spacing between coils and at the same time to allow short leads and of uniform lengths. The first and second transformers are two and one half inches apart, and the second and third transformers are three and a half inches apart, while the space between the first and third transformers is five inches. It is vitally important that the wires running from the condensers to the coils are all about the same length. The wires running to the terminals No. 6 and the condenser terminals should be 4½ inches for transformer T_1 and T_3 (first and third), and 5½ inches for transformer T_2, the transformer mounted at the rear of the board. The terminals No. 5 on transformers T_1 and T_3 could be connected together with a piece of bus-bar wire about seven inches long, and No. 5 of transformer T_2 can be connected with a 3½ inch wire to the exact center of

PRELIMINARY SPECIFICATIONS A. C. FILAMENT TUBES

	TYPE CX-326	TYPE C-327
Filament voltage	1.5 volts	2.5 volts (heater filament)
Filament current	1.05 amperes	1.75 amperes
Plate voltage recommended	90-135 volts	45 volts (as detector 90-135 V as r. f. & a. f. amplifier)
Maximum	180	180 volts
Grid bias at 180 volts	16.5 volts negative	13½ volts negative
at 135 volts	12 volts negative	9 volts negative
at 90 volts	6 volts negative	6 volts negative
Amplification factor	8.2	8.2
Plate impedance at 180 volts	9,400 ohms	9,400 ohms
at 135 volts	10,000 ohms	10,000 ohms
at 90 volts	9,400 ohms	11,300 ohms
Mutual conductance 180 volts	880 micromhos	870 micromhos
135 volts	820 micromhos	820 micromhos
90 volts	875 micromhos	725 micromhos
Plate current 180 volts	3.8 milliamperes	6 milliamperes
135 volts	3.0 milliamperes	5 milliamperes
90 volts	3.7 milliamperes	3 milliamperes
Interlectrode capacity (plate grid)	10.5 m. m. f.	6.0 m. m. f.
Maximum undistorted output at 180 volts	0.160	0.140 watt.
135 volts	0.070	0.055 watt.
90 volts	0.020	0.020 watt
Base—Standard Large "CX"		Special 5 prong type
Mechanical Dimensions:		
Maximum overall length	4 9/16 inches	4 9/16 inches
Maximum diameter	1 5/8 inches	1 5/8 inches

the bus-bar wire, from where a wire leads to the center terminal on the other side of the condensers (the side paralleling the panel). The other two terminals on that side of the condenser are also connected to the center terminal as they are all common and are finally connected to one end of resistor R_3, the other side of which is connected to the center of the potentiometer R_4. The lead that connects to R_3 should be run to the center of the bus wire connecting the three No. 5 terminals together.

The Aero r. f. transformers are furnished in matched units, three in one box. To have the same amount on inductance in each circuit (comprised of a transformer and condenser) the above precautions in keeping all the wires the same length are necessary. The coils should not be handled roughly for the windings are supported only in three places by narrow bakelite strips and can easily be bent out of form. When this happens the set of coils will no longer be matched.

Ordinarily the method of preventing oscillations and maintaining the same sensitivity over the whole wavelength range is that of varying the plate current to the tubes, and therefor the amplification, by means of a variable resistance in the plate current supply lead. This form of oscillation control, or that of varying the filament temperature with a rheostat, is not advocated by the tube manufacturers on claims that noticeable hum is bound to result. In our experience we found neither of these methods very efficient and a quite different scheme was resorted to—that of varying the impedance of the primary of the second transformer. Instead of connecting the plate of the second tube to terminal No. 2 as in the other two transformers, it is connected to terminal No. 3 to increase the impedance of that plate circuit. A .001 m. f. condenser, C_4, is connected in series with the primary winding which helps to some degree in stabilizing the r. f. R_7 is connected directly across the primary and stabilizing condenser from No. 1 terminal on the transformer to "P" on the socket. To further stabilize the r. f. circuits

Front Panel View of Six Tube Single-Control Receiver Employing The New A. C. Tubes.

resistors R_5 and R_6 are connected in series with grids of the second and third tube (second and third stage). The oscillations can be controlled very easily over the whole wavelength range by increasing or decreasing the primary impedance with changes in the value of resistor R_7. There is however one disadvantage in using this circuit for stabilizing; that is, the secondary circuit of transformer T_3 is detuned slightly when the shunt resistor is at a low value, nevertheless there was no effective loss of selectivity noticeable.

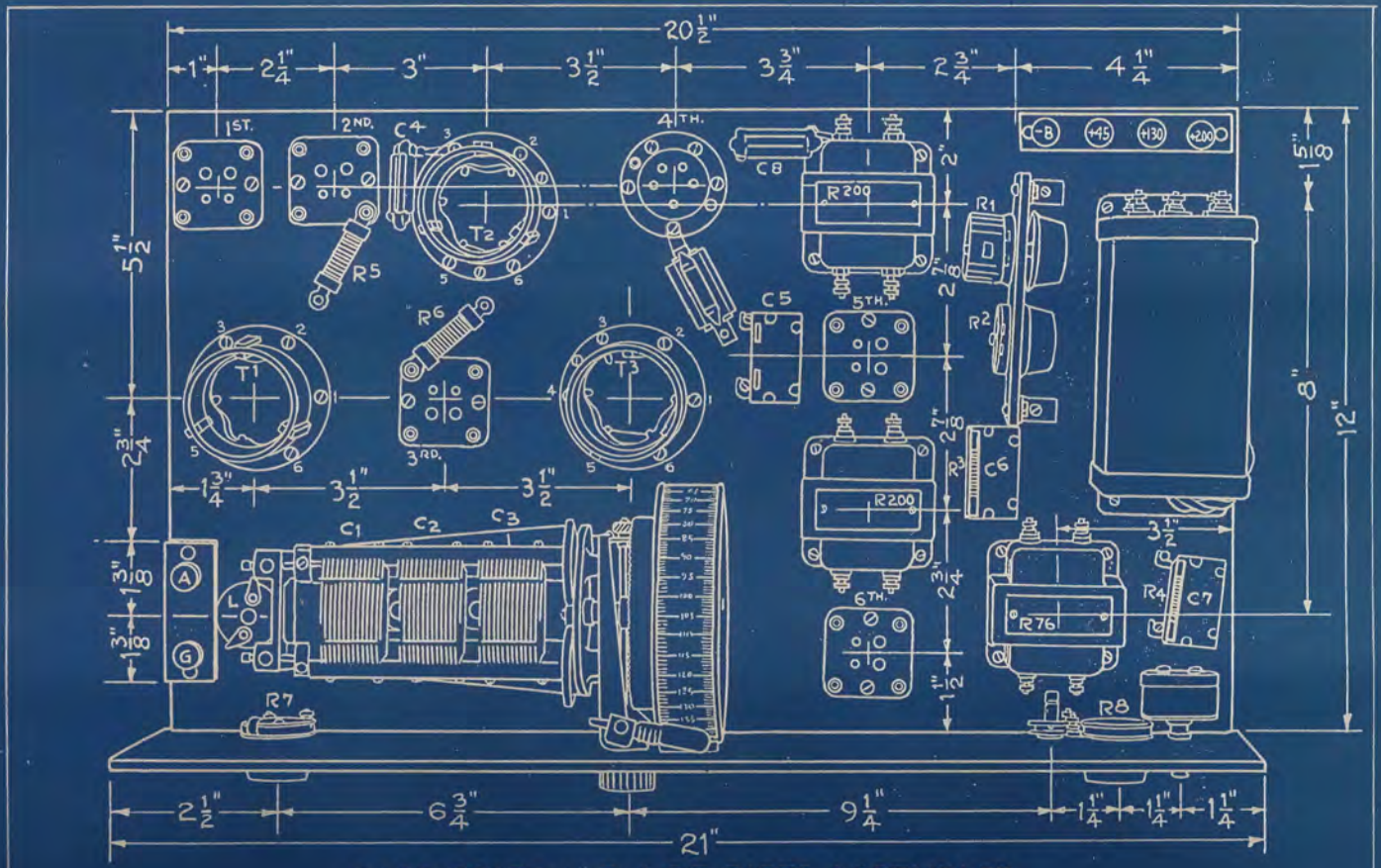
The audio frequency amplifier is very general. The grid bias for the first audio tube is the same as that for the r. f. tubes. All of the transformer cases should be connected together and "grounded" to the center of the potentiometer, this is quite important in preventing a. c. pick-up, and also audio oscillations. A Thordarson R76 out-put transformer is an asset in this receiver, as the current which would otherwise be flowing through the loud-speaker windings might injure the speaker. A 500,000 ohm potentiometer connected across the secondary of the first audio transformer makes a very effective volume control. The two outside terminals are connected directly across the transformer terminals and the grid of the first audio tube is connected to the center of the potentiometer. The wires to the potentiometer should be twisted together into a three conductor cable.

If Van Horn tubes are employed the rheostat should be adjusted for maximum amplification and minimum hum. In any event, however, the rheostat should never be turned full on, as the tubes might be burned out. About one third of the resistance on the rheostat should be in the circuit. Once this adjustment is made it should be left that way. Likewise the potentiometer; it should be to the point where the hum disappears or is at a minimum. The rheostat and potentiometer are mounted on a strip of bakelite two inches wide and four and one half inches long, and spaced three inches apart. Four binding posts are mounted on a strip ¾ inches wide and four inches long, spaced

LISTS OF PARTS

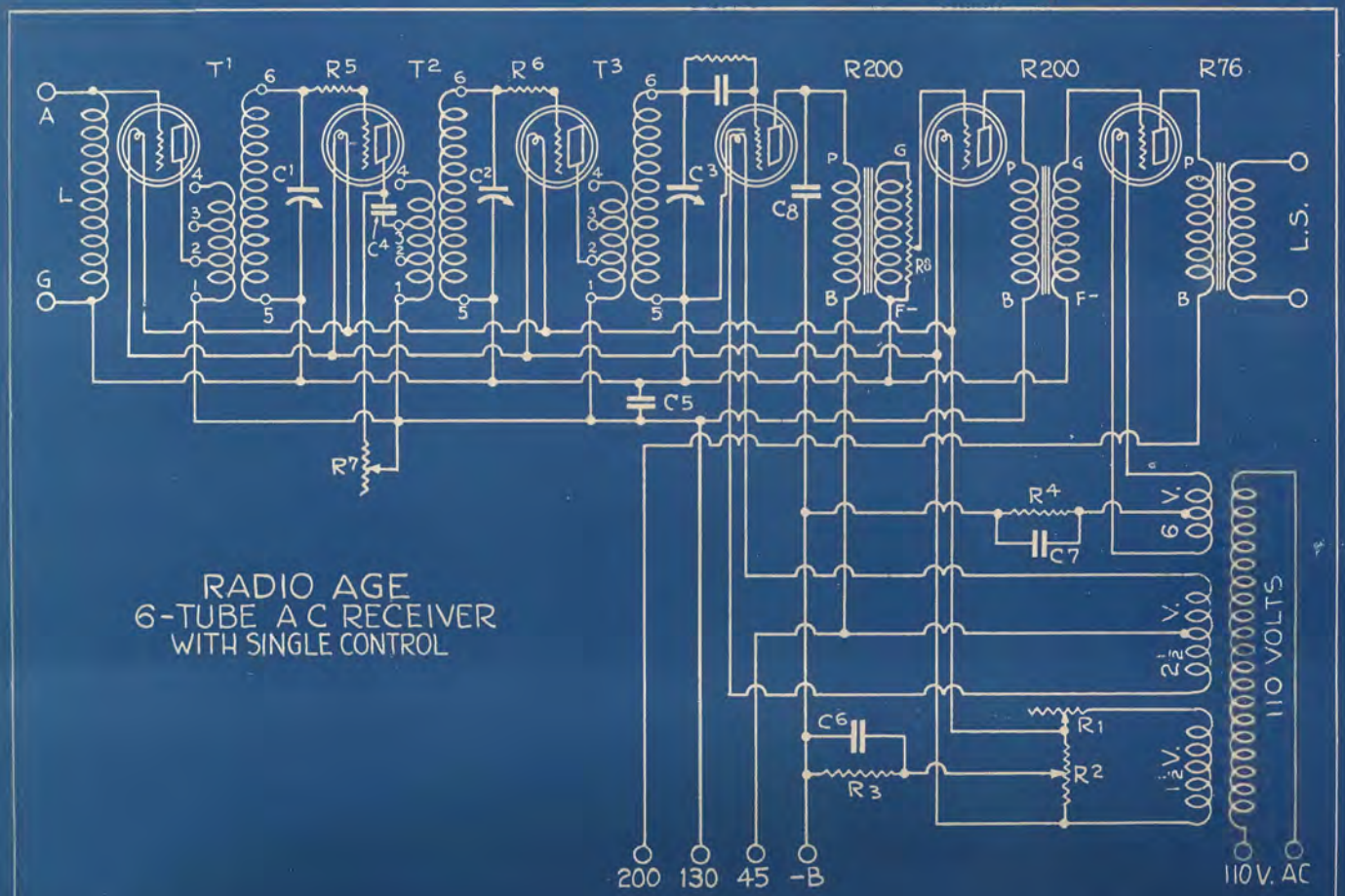
THE following are the parts used in the construction of the RADIO AGE Six Tube R. F. Receiver using the new A. C. tubes. Other parts having the same values may be substituted

1 Panel 7x21x3/16
1 Base Board 20x12x½
5 Frost sockets No. 530
1 Silver-Marshall No. 512—five-prong socket
1 Aero Choke Coil-60 (L)
1 U-123 Aero Universal Tuned R. F. Kit (T1, T2, T3)
2 Thordarson R200 Audio Transformers
1 Thordarson R76 Out-put transformer
1 Thordarson Filament-heating transformer
1 Remler 3-in-line Remler Condenser No. 633 (C1, C2, C3)
1 Remler Drum Dial No. 110
1 Carter Code No. MW-1/5 .2 ohm rheostat (R1)
1 Carter Code No. MP-20 20 ohm potentiometer (R2)
1 Carter 500,000 ohm Hi-pot Code No. 55 (R8)
2 Code No. H-400 resistors (Carter) (R5, R6)
1 Code No. P-2500-40 2500 ohm resistor (Carter) (R 4)
1 Code No. H-1000 1000 ohm resistor (Carter) (R3)
1 X-Hi-ohm (Carter) (R7)
1 Carter Short Jack—open circuit Code No. 1
3 Tobe 1m.f. by-pass condensers (C5, C6, C7)
1 Sangamo .002 condenser (C8)
1 Sangamo .001 condenser (C4)
1 Sangamo grid condenser
1 Cuttler-Hammer filament switch
1 3 meg-ohm grid leak
6 Eby binding posts



BASE BOARD VIEW OF PARTS ASSEMBLED
FOR RADIO AGE AC RECEIVER

RADIO AGE INC.



one inch apart. An extra binding post is shown in the photograph which may be disregarded.

The set is ready for a test after all the connections are checked and re-checked. On turning on the light current to the transformer and B eliminator, if one is used, there will be a very loud hum bursting out of the speaker. After the set "hums" for about a half minute (until the detector tube heater is white hot) the hum will suddenly subside, and then with adjustment of the potentiometer will disappear. The drum dial is then revolved until a station is heard on the upper part of the drum. But before tuning in your station loosen all of the adjustment screws of the alignment condensers which are between each set of plates. Screw down the adjustment screw nearest to the drum dial until the signal is the loudest; if the station gets weaker loosen the screw to the point where it will be loudest again. Now make the same adjustment on the middle alignment condenser. In approaching the point of maximum signal strength the set may break into oscillation. In that case set the stabilizing resistance to a point where the set will stop oscillating. The next alignment condenser is then adjusted, and in the same manner. After this adjustment turn the drum dial back and forth across the station, that is, so the station will be tuned in and out, and at the same time go over the condensers again until the loudest signal is heard, or until oscillations occur. It is a good idea to adjust the stabilizer to a position right below the point where oscillations start, and then make the alignment adjustments until oscillations start, then back off the stabilizer to stop the oscillations, and again make your condenser adjustments until oscillations occur, finally the further adjustment on the condensers will not induce oscillations (whistles), unless the stabilizer is turned up. The circuits will now be tuned to resonance at the high wave-lengths. If the coils are properly matched and the gang condenser is accurate the alignment should hold for the lower wave-lengths. A slight re-adjustment will soon determine this. If re-adjustment is necessary to get the loudest signal it means that either the coils are not matched or the gang condenser is "off." During all these adjustments a small antenna of about twenty feet should be used.

The total current consumed in the plate circuits is about fifty milliamperes. The average B battery eliminator will handle the set, though the voltage to the plate of the 171 tube will be less than 200 volts. It will be about 150. The bias regulation however, will be automatic, and adjust itself to any plate voltage. A B battery eliminator having about a 80 milliampere capacity is advantageous, and in a set where more than six tubes are used is absolutely necessary.

October Supers

Get the October Radio Age for illustrated articles on three of the latest super-het circuits. An important number.

Everyday Mechanics

Radio Beacons to Aid Air Mail Flyers

By S. R. Winters

AT COLLEGE PARK, Maryland, where six years ago the Air-Mail Service of the United States Post Office Department was inaugurated, there has just been dedicated the first aircraft radio beacon for the promotion of civil aviation. There, at this landing field, the first airplane laden with postal matter departed from the now time-worn hangars for New York City; today, this same spot marks the genesis of radio aids to air navigation.

The dedication of the College Park aircraft radio beacon station—the

This is Captain Maurice Graham, Western Air Express Pilot, flying the air mail between Los Angeles and Salt Lake, who in thirteen months from April 17, 1926, to May 17, 1927, has flown 125,000 miles, a world's record for any similar period of time. During that time, Graham has never been forced down for trouble or weather, has never defaulted a trip for any cause, and has never failed to start on scheduled time regardless of weather conditions. This is said to be a record unparalleled in the history of flying. He is to be nominated for the Clifford B. Harmon trophy given each year to the most meritorious feat for the advancement of aviation.

forerunner of 40 similar installations along the 8,234 miles of civil airways across the continent—was without formal exercises. The event, none the less impressive, was attended by Dr. George K. Burgess, Director of the Bureau of Standards; Dr. J. H. Dellinger, Chief of the Radio Laboratory, and the technical staff responsible for the erection of the station. Appropriately signalizing the completion of this safety aid to flying, Dr. Burgess congratulated Haraden Pratt, actively in charge of the work, while the latter was winging his way far above the field in the test airplane. Using a radio telephone, located in a wooden shack on the outskirts of the College Park aviation field, the Director of the Bureau of Standards, in communicating with the airplane in flight, said: "Mr. Pratt, I hear you very plainly. I am interested in what you are doing out here and am pleased to note that you have such a complete setup. Now, I must be going back to the Bureau to do some work. Goodbye."

Previously, Dr. Burgess had inspected the directive beacon for guiding aircraft in a zone of safety; he had donned a helmet and climbed aboard the radio-equipped flying craft; and then posed with Dr. Dellinger and the eight members of his technical staff for a photograph. The Director of the Bureau of Standards listened attentively to Dr. Dellinger as the latter related how the ignition system of this airplane had been shielded to minimize interference with radio communication; how a satisfactory receiving set, with but one control, had been installed on this craft; and how, by means of a visual indicator, aviators may be directed in a zone of safety by slender beams of radio when consulting a device on the instrument board of the airplane.

In the sense of being the genesis of radio aids to civilian aeronautics, the beacon station at College Park bears an analogy to the relation betwen the "Zero Milestone," in Washington, D. C., to the public highway system. The latter is the starting point in reckoning the mileage of the network of highways: This beacon station not only marks the starting point in developing radio aids to air navigation but the results of experiments now in progress will serve as a chart for erecting more than 40 other radio beacons along airways across the United States—for directing aircraft carrying passengers, postal matter, and express.

The directive beacons in transmitting a double-beam radio wave will set up a well-defined path or zone of safety for the airplane in flight. Established at intervals of

The "Wireless Airplane" has arrived! Dr. George K. Burgess, Director of the Bureau of Standards, and Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau and other members of the laboratory staff, are seen examining the airplane at College Park, Maryland, which is guided exclusively by radio waves. The course of safety is automatically indicated by vari-colored lights flashed on the instrument board of the airplane.

200 miles along the airways, in their functioning they are somewhat like marine radio beacons or lighthouses for mariners, in that aviators are thus offered a guiding hand when enveloped in fog or obscured in darkness. This beacon transmits two directed radio beams, continuously sending on each a characteristic signal. The airplane, equipped with an ordinary radio receiving set, if traveling at equal distances from the lines set up by these radio beams will receive signals of equal intensity; off the well-defined path, there is an inequality of signals and the pilot corrects his course until the signals are again equalized.

The marker beacons, established at 25-mile intervals along the 8,234 miles of airways, will serve as mileposts to aviators, indicating the distance already traveled and how many more miles must be traversed before reaching their destination. These marker beacons do not overlap the function of the directive beacon since the former do not define the course of flight. Instead, these very low-power radio transmitting stations will flash a charactertstic signal and upon being intercepted by the aviator he is automatically informed of his location. Extremely simple transmitting sets have been designed for this purpose and these mileposts along the air highways instead of conflicting with the function of the directive beacon will materially supplement its effectiveness.

Radio-telephone stations, located at 200-mile intervals along the more than 8,000 miles of civil airways, will serve as mediums for imparting weather forecasts, information about landing fields, and other navigational facts, to aircraft in flight. For this purpose, radio telephony is necessary since aviators are not usually trained in the technique of the Morse International telegraph code and are not, therefore, qualified telegraph operators. The use of the radio telephone on aircraft necessitates the adoption of specially armored cable for the engine ignition systems. Once the engines have been shielded to eliminate interference, conversations between pilots in flight and persons at ground radio stations may be effected at distances of 100 miles or more. Officials of the Bureau of Standards recently conducted experiments which form the basis of this estimate.

Radio installation in aircraft, mail-carrying transport, showing transmitter, reel and control box

The aircraft radio beacon station at College Park, Maryland, is at once the original and model of all future radio aids to air navigation. There, under the direction of Dr. J. H. Dellinger, Chief of the Radio Laboratory of the Bureau of Standards, the first radio beacon was erected under authority of the United States Department of Commerce for the development of civilian aeronautics. A similar installation is being made by the Bureau at Bellefonte, Pennsylvania, and both of these beacon stations will be available for radio service to commercial air lines after July 1. The other four aircraft radio beacon stations available now or soon are: The station of the Army Air Corps at McCook Field, Dayton, Ohio; two stations of the Ford Motor Company, located respectively at Dearborn, Michigan, and Chicago; and a station installed by the General Electric Company at Hadley Field, New Brunswick, New Jersey. The commercial lines which these radio aids will serve are, respectively, the Pitcairn Company, operating the New York to Atlanta route, and the National Air Transport, Inc., operating the New York to Chicago route; and the Ford Motor Company, operating out of Detroit.

The model station at College Park includes a wooden tower, 70 feet high, painted a deep shade of yellow, with a flag at its apex. This towering latticework is the main supporting structure for two triangular loop antennas, from which double-beam radio waves are emitted for guiding aircraft. A radio room, 10x 14 feet in dimension, containing the vacuum-tube transmitting set, the goniometer, and other necessary radio equipment, is located directly un-

der this tower. The tower is approximately 10 feet in circumference at its base; gradually narrowing down to a peak at its apex. It extends over the top of the radio room so that there will not be an unbalanced electrical effect in the operation of the radio equipment in conjunction with the triangular loop-antenna.

Extending from the apex of this tower are four wires, running to four points of the compass, to distances of 150 feet. At the termini, the wires are connected to pulleys, which in turn are staked to posts by means of 200-pound weights. These antenna wires, forming a single-turn triangular loop, are run back to the radio room, the wires being supported 8 feet above the ground by three posts set in concrete. These so-called base wires are insulated from the posts by use of large glass insulators. The 200-pound weights at the termini of the base wires serve the purpose of slackening or tightening the antenna.

The wires leading from the top of the tower appear, at first glance, to be guy wires but in reality they constitute the antenna system—the somewhat odd arrangement of two enormous loops crossed at right angles. It is a giant loop antenna when compared with our usual conception of loops; 1,256 feet of wire being utilized in constructing the two single-turn triangular loops. The College Park aircraft radio beacon station was constructed by Haraden Pratt, Francis W. Dunmore, and Carl B. Hempel of the Radio Laboratory of the Bureau of Standards. The radio aids to air navigation are being developed and perfected under the direction of Dr. J. H. Dellinger, Chief of the Radio Laboratory, who is leaving Washington soon for a three months' study of aids to air navigation in European countries. The Aeronautics Branch of the Department of Commerce is vested with the work of establishing radio beacon stations, a step of far-reaching significance.

A double-beam radio beacon for aircraft

Showing ignition shielding installed on Liberty motor as means of suppressing noises in radio reception on aircraft

Preliminary to determining the equisignal zone of a directive radio beacon, the Bureau of Standards made ground tests with radio equipment installed on a motor truck. Fortunately, the equisignal line corresponded with the test road, thus facilitating the ease of making observations. At points 13, 21, 34, 38, and 51 miles distant from the transmitting station observations were made on crossroads running perpendicular to the equisignal line. The width of the zone at these points was found to be as follows: at 13 miles 360 feet, at 21 miles 400 feet, at 34 miles 400 feet, at 38 miles 450 feet, at 51 miles 500 feet. In measuring the width of the zone at these points the following method was used:

The signals were tuned in and the radio amplifier adjusted until the strength of the signals was of medium intensity. The motor truck was then driven back and forth on a line at right angles to the equisignal line until the middle point was found; that is, where the intensities of the signals were equal. Then the truck was slowly driven north until the inequality of the signals became noticeable, this point being taken as one limit of the zone. The truck was then driven due south past the middle point of the zone until the inequality of the signals again became noticeable. This point was taken as the other limit of the zone, the distance between the two limits as determined was taken as the width of the zone.

The equisignal zone thus determined was found to extend due west, not exceeding 500 feet in width at any point up to 50 miles from the transmitting station. "As the distance from the transmitting station increased," reports the Bureau of Standards, "the sharpness of the zone decreased, which necessitated closer observation to determine the exact width of the zone. It is interesting to note that observations could not be made close to overhead wires of any kind or in the lee of a high hill or wooded section. It was found that wires running parallel to and in the immediate vicinity of the equisignal zone have the effect of blending the two signals, distorting the position of the zone, and in many cases doubling the strength of both signals."

In an airplane test using a 200-foot trailing wire antenna the results were markedly different, owing to the directional characteristics of the trailing wire. This test showed that signals were stronger when the airplane was flying away from the transmitting station than when flying toward it. This effect resulted in an apparent shifting of the equisignal

(Continued on page 48)

"B" Batteries encased in a parachute sack as they looked after their 25,000 foot drop from an army balloon. They were still good for further use

Batteries Drop 25,000 Feet Still Working O. K.

Just how durable is a radio dry battery? Captain Hawthorne C. Gray of the U. S. Army Air Corps, satisfied himself on this point recently when he broke all previous world altitude records for free balloon flights in reaching a height of 42,470 feet at Scott Field Air Depot, Belleville, Ill.

At a height of approximately 25,000 feet, the radio "B" batteries and dry cells, with which his balloon was equipped, were hurled overboard in a specially made parachute; were recovered uninjured and returned by parcel post to Captain Gray without packing, in the condition shown in these photographs.

Captain Gray, in a letter to National Carbon Company, makers of the Eveready Batteries so ignominiously treated, writes:

"The same set of batteries was used in my altitude flight of March 9th and is still in condition to be used again. The "B" batteries tested 21 volts each, and "A" batteries tested 23 amps."

Diagram Shows Plane Features

This diagram gives some of the new details of the construction of Commander Noel Davis' plane "Pathfinder" in which he will attempt the 3,600 mile non-stop flight from New York to Paris this summer for the $25,000 Orteig prize. Some of its unusual features are—the huge 900 gallon tas tank in the fuselage, smaller gas tanks in the wings of the plane, which are of unusual thickness, shock absorbers on landing gear, deflated life preserver raft stored in the fuselage and a special designed instrument which shows whether the ship is on even keel. The "Pathfinder," now in process of construction at the Keystone Aircraft Factory, Bristol, Pa., is to have three Wright whirlwind engines developing over 200 H. P. each. The plan also has a short-wave broadcasting set. The large gas tank is divided into partitions to prevent the splashing which might disturb the equilibrium of the ship.

Edward Manley, radio operator of Putnam-Baffin Island Expedition, testing out his transmitting apparatus.

Radio Nearest Pole

When the schooner "Morrissey," in charge of Captain "Bob" Bartlett, Peary's skipper of his North Pole days, comes abreast of West Baffin Island with the members of the Putnam-Baffin Island Expedition aboard, it will mark the nearest that radio has ever been taken to the Magnetic Pole.

The Putnam-Baffin Island Expedition, headed by George Palmer Putnam, left New York on June 11 for West Baffin Island, a region unvisited by white men since its discovery by Luke Fox in 1631. Radio scientists are especially interested in the outcome of radio experiments so near the actual center of the earth's magnetic force. Radio operations and experimental work will be in charge of Edward Manley, of Marietta, Ohio. The Morrissey's radio equipment, as shown here, includes a generator-powered transmitter (shown at extreme left of picture), a battery-powered transmitter with the UX 852 tube (shown at top of wooden shelf), two especially built radio receivers, one short wave, one long wave, and a portable battery transmitter. Equipment includes 37 dry batteries, which can be used for portable purposes.

The battery-powered transmitter shown above, in addition to the UX 852 tube, which will be used for the first time in Northern waters, has four radio frequency chokes. The circuit is shown as a tuned plate and tuned grid circuit, for use on 33 and 20 meters. Twenty "B" batteries supply 900 volts as power.

Electric Arc Decomposes Water

What will 6,000 volts of direct current, at the rate of 5 to 6 amperes, do to a stream of water? Here's the answer. The heavy current decomposes the water into its constituents, hydrogen and oxygen, and reburns the hydrogen to form more water.

In addition, slight impurities in the water are burned, the flame being colored reddish-purple by potassium salts, golden yellow by sodium, and green by copper.

The photograph was taken in the East Pittsburgh works, U. S. A. of the Westinghouse Electric and Manufacturing Company, where the machine was under test as a generator of plate current for radio work. One side of the circuit was the water pipe, from which a piece of heavy copper wire dipped into a porcelain insulator. As the water flowed into the bowl-like top of the insulator and spilled over the sides, the current arced through the water and returned to the generator through a wire entering the lower portion of the insulator.

The arc varied in length from three to five inches, and expended 25 kilowatts power—enough to light 600 ordinary 40-watt house lamps.

Film Feeding Device

Edward Amet, Los Angeles inventor, exhibits a model of a new film feeding device which can take from 1 to 25,000 pictures per second. This invention, he believes, is the only bona fide fast film feed in existence, aside from the secret methods used by the Government in aerial photography

Current Science

Astronomer Plans $12,000,000 Telescope

By JAMES STOKLEY
Science Service Staff Writer

THE astronomer is never satisfied.

Recently Dr. Edwin Hubble, of the Mt. Wilson Observatory, estimated that he had observed nebulae in the sky so far distant that their light takes 140,000,000 years to reach us. As light travels 186,000 miles in a single second, these distant objects are something like 840 million million million miles away.

And yet the human eye desires to see still farther, and better.

To do this three things are necessary, in the opinion of Dr. Hubble. His views are shared by other astronomers.

First of all, astronomers need better photographic plates.

Then they need more big telescopes in the southern hemisphere.

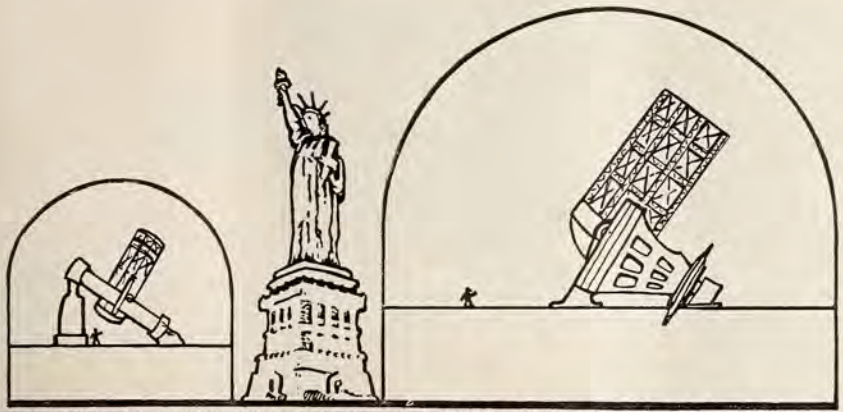
Lastly, they need one or more super-giant telescopes. Such an instrument has already been planned by Francis G. Pease, builder of the great 100-inch reflecting telescope at Mt. Wilson—the one with which Dr. Hubble worked.

The need of the big telescopes in the southern hemisphere arises from the shape of the globe on which we live. Unless a telescope is precisely on the equator, there is a piece of the sky that it can never observe. If the telescope is in the northern hemisphere, like those in the United States, there is a large circular area, centered at the South Pole of the heavens, which never rises above the horizon at all. And a still larger circle of stars never rises high enough to be really satisfactorily observed.

One hundred-inch reflecting telescope of the Mt. Wilson Observatory in California, now the largest in the world

The equator is not the ideal location for a telescope, however. While on this imaginary line it is theoretically possible to see every star in the heavens at some time or other, those around both poles never rise very high. The best way to do is to have two telescopes. One should be well to the north of the equator, the other well to the south.

For many years several American observatories have had branches in southern countries. The Lick Ob-



servatory, of the University of California, has one in Chile. Here are observed stars that are invisible in California. The observatory of Harvard University has had a branch since 1889 in Peru. Now they are moving to South Africa, where conditions are better.

Largest Southern Telescope

At this branch will be not only the instruments from Peru, but also some new ones. Chief of these will be a great reflecting telescope with a mirror five feet in diameter. This will be the largest telescope in the southern hemisphere. It is already being constructed in a plant in Pittsburgh. This is the same plant that made the six-foot mirror for the big telescope at Victoria, B. C., the largest outside of the United States.

Like all reflecting telescopes, this great instrument will have a mirror which takes the place of the convex lens in the telescope of most familiar type. The mirror is dish-shaped, and faces the stars. It is at the bottom of the telescope. The light of the star is reflected back from it, and a smaller mirror at the top of the telescope reflects the light to the side. Here it can enter the eye of the astronomer or fall on the sensitive photographic plate.

The Harvard astronomers will have company, even though they are so far away from home. Within the last two years the University of Michigan and Yale University have established branch observatories in South Africa, but at both of these stations are refracting telescopes, not reflectors.

There are other reflecting telescopes in the southern hemisphere, though not as large as the new Harvard one. Nearly a century ago, the great English astronomer Sir John Herschel, took his great 4-foot telescope, at that time one of the largest that had been built, to the Cape of Good Hope. He was the first astronomer to use a large instrument in southern latitudes. From his researches arose the British Royal Observatory at the Cape.

Australia also has a big reflector. This is a more modern instrument than Sir John's, for it was built in 1870. Its mirror is also four feet in diameter. This year it has been overhauled for use in observing Pons-Winnecke comet.

$12,000,000 Telescope Planned

But all these instruments fade into insignificance before a telescope that has been planned by F. G. Pease, designer and constructor of the 100-inch Mt. Wilson telescope. According to Mr. Pease, the principal item necessary for the construction of this monster research instrument is the cost. Twelve million dollars, he estimates, would provide it. A large amount, of course, but only about a third the cost of a modern battleship! And how much more good would the telescope do for the world than the battleship, for it would increase man's knowledge of the universe about him!

There are mechanical difficulties to be solved before such an instrument could be made, it is true. However, Mr. Pease probably knows more about such matters than any man living. This is what he says:

"The question has often been asked 'How large a telescope can be built today?' My reply would be that anything up to a hundred feet in aperture can be built provided one wants to pay for it."

One of the problems to be solved is the material of which to make the mirror. Present telescope mirrors are mostly made of glass. On this is coated a layer of silver to reflect the light, much as in the ordinary looking glass. The chief difference is that the telescope mirror is silvered on the front instead of the back. Hold a coin to your looking glass and you will see the reason. In the glass you see two coins, one bright, reflected from the silver on back, and one faint, reflected from the glass surface. In astronomy such a double image would be a serious defect. So the silver is coated on the front, and

Great nebula in Orion, photographed with the 100-inch telescope. Such objects as these would be shown in far greater detail with a still larger telescope, such as Mr. Pease has planned

is renewed occasionally.

However, in the large size contemplated there might be some defects of a block of glass as huge as would be required. Glass transmits heat slowly. When the temperature goes down, the great mirror would cool on its surface sooner than inside. The result would be that the outside would contract a little and the mirror would be slightly twisted until it reached the same temperature throughout. Though very minute, the twisting would be enough to be serious in accurate observing. So it may be that some metallic alloy, which transmits heat quickly to its interior, will prove better than glass.

Faster Photographic Plates

But astronomy doesn't want merely bigger telescopes. Even more welcome to the world of star-gazers would be better and faster photographic plates. Most astronomical observations today are made with the aid of photography. If you visit the modern astronomer at an observatory, you are not likely to find him peering through a telescope. Instead, you will probably find him looking through a microscope at a photographic negative made with the telescope.

In a single night at a big observatory enough photographs might be made to keep the astronomers busy for a month. The plate has one great advantage over the eye because it doesn't get tired. If you look through a telescope, you see as much in the first second as you will see if you look steadily for an hour. Of course, if there is a lot of fine detail, it may take time to give it careful scrutiny. But long gazing doesn't make details visible which were at first invisible. In fact, the eye gets tired, and really sees less after prolonged looking than at first.

The photographic plate is untiring. If a star of a certain brightness can be photographed in five minutes, one half as bright can be photographed in ten minutes, or one a quarter as bright in twenty. Some nebulae are so faint that even in the great Mt. Wilson telescope they can not be seen with the eye. But when a photograph of one is made with a long exposure, it is revealed in all its glory. Sometimes exposures as long as twenty or thirty hours are made, on several nights. All night long the plate is exposed, and then covered at the approach of dawn. Then the next night it is again uncovered, and it is kept pointed at the object for all of that night. In this way things are seen in the sky that without photography would have remained ever beyond our ken.

But photographic plates are not perfect. Some are more sensitive to light than others. The fast plates that the newspaper photographers use in their cameras record a scene even in poor light in a fraction of a second. The "wet plates" that the photoengraver used in making the illustrations for this article require long exposures with brilliant arc lights.

Fast Plates Show "Grain"

It might then seem that the astronomer should merely use the same kind of plates as the newspaper camera man. However, as soon as you begin to magnify the picture on one of these plates, the "grain" appears. It is like looking at a halftone reproduction of the photograph of Mr. Pease on this page. As soon as you look at it through a magnifying glass, the dots that make up the picture become so evident that the picture is no longer recognizable. In the plate, the grain is irregular, unlike the uniform rows of dots, but it is no less troublesome.

The plate of the photoengraver does not suffer from this defect. Even

(Continued on page 37)

Francis G. Pease, builder of the 100-inch telescope, who has planned one three times as large, to cost an estimated total $12,000,000

Amateur Radio

Improved Radiophone Modulation Circuit

By CHARLES F. FELSTEAD, 6CU

If the modulation transformer circuit shown in the accompanying diagram is used by the transmitting amateur, not only are switches and jack eliminated in the radiophone transmitter, but the wiring is made much less complicated. In the usual modulation circuit, a jack is connected to the modulation transformer primary and the *D* battery, and plugs are connected to the microphone, and buzzer and key. If a push button is put in series with the microphone

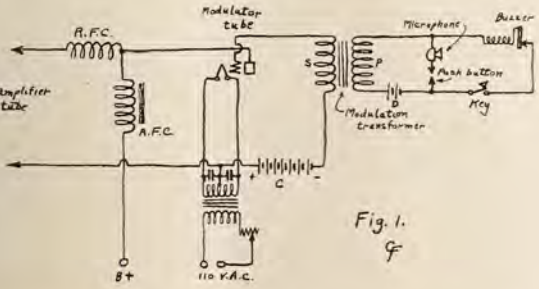


Fig. 1.

as shown, the operation of the set will be more simple; and the cost of the jack and plugs will be saved. Some manufactured microphone assemblies have push buttons built into the handles; so, when a microphone of that type is used, no extra push button is necessary. Otherwise, with the ordinary microphone, a small push button will have to be connected in series with it. When neither key nor push button is closed, no current flows from the *D* battery. When the operator wishes to use voice, he presses the push button; and to use buzzer-modulated C. W., he operates the telegraph key.

Works All Continents

Colonel Clair Foster, radio amateur, of Carmel, California, has just set a record for his fellow members of that exclusive amateur club known as WAC—"worked all continents" —to shoot at.

Colonel Foster on June 10, communicated from California with an amateur station in South Africa, working with only a standard broadcast listener's receiving tube as a transmitter and with B battery power. It has just become known that on the same day Foster successfully worked with Shanghai, China.

By establishing communications with South Africa and China, Colonel Foster has now worked all of the continents, in each case accomplishing communication by means of the ordinary receiving tube and B batteries. The conversation in Africa was carried on with fo1SR, J. M. Davidson, Salisbury, Rhodesia, and in China with ac8HB, P. O. Box 266, Shanghai.

Regarding his record-making talks with these two continents, Mr. Foster says: "This makes all continents worked with my little transmitter, with the same identical 201A tube and Eveready batteries."

All the foreign stations were worked on 38.2 meters, or near it, except eg5HS, in England, on 20.2 meters.

Mr. Foster's accomplishment is believed to set a record for long distance communication with low power. In the California to Africa conversation, a distance of 14,000 miles was traversed.

Amateurs Elect Kerrigan

Vincent Kerrigan, head of the Inspection and Test Department of the Bremer-Tully Mfg. Company at Chicago has been elected President of the Chicago Nines Club. Other officers elected at the semi-annual business meeting, July 5, are Clifford Agazim, Vice-President, George Schmidt, Secretary, and Elmer Enke, Treasurer.

As many will remember, the Chicago Nines Club was organized in December, 1925, by a number of active Chicago amateurs. The first meeting, held at station 9VJ owned by Elmer Enke had nine charter members. At the present time the club has thirty members, the limit set by its constitution. The members are all licensed amateurs and many of them are employed in the engineering and laboratory departments of Chicago radio manufacturers.

The Club is operating its own station 9CN, operating on 21 and 42 meters with 250 watts.

Crosley Extends Programs

Announcement is made today by the National Broadcasting Company that Powel Crosley, Jr., president of The Crosley Radio Corporation of Cincinnati, has purchased the programs of the Blue Chain for broadcast through the Crosley station, WLW.

The Blue Chain programs will be brought to Cincinnati after the first week in September. They will go on from 8:00 o'clock to 10:00 o'clock on Wednesday and Friday nights with the possibility of the addition of Collier's hour from 9:30 to 10:30 on Sunday nights. The New York broadcasts through WLW will include such entertainment features as the Maxwell Coffee hour, Don Amaizo, and others already popular. Besides these, the station will broadcast such national events as have been the Presidential messages, the receptions in Washington and New York for Lindbergh, the Eucharistic Congress, and the Dempsey-Tunney fight.

With the purchase of the Blue Chain programs by WLW, Cincinnati takes its place as one of the greatest radio centers in the world. Three big chains may now be heard there without interference, in addition to the excellent programs furnished by the Cincinnati stations.

New Wisconsin Station

Wisconsin has a new radio station—WTMJ, The Milwaukee Journal. Upon completion of the new station, The Journal, following the suggestion of the Federal Radio commission, will discontinue broadcasting over WHAD, which it has operated jointly with Marquette University since 1923. Marquette will retain the license of WHAD and operate as the station of an educational institution.

Journal officials also announce the purchase of WKAF. WTMJ will replace the old call letters.

THE FROTH ESTATE

(Continued From Page 11)

from the impact of the clubhead. It touched the very rim of the cup and trembled there—and failed to drop. One would have said that Mr. Lathrop's hands trembled a bit as he perfunctorily sank the easy putt which gave him the hole and put him one up.

Miss Amy laughed and in her cheerful congratulation of the hated enemy there was not the least evidence of repressed dismay.

"What a great sport that girl is!" said Mr. Lathrop to himself. "I wish Col. Minimil was in hell."

"I'll lick him if I have to break an arm," said Miss Amy. "If I can't choose Col. Minimil's tailor I at least can spoil his lawyer's afternoon."

"Never saw anything like it," said Mr. Traynor. "Neither of them know I am here."

Miss Amy won the seventeenth hole by smashing a long drive straight for the green, lifting a spoon shot to the edge and chipping dead to the pin. She had made par and Mr. Lathrop was one over.

Thus they walked to the eighteenth tee all even. The lawyer, watching the girl as she teed up for what was likely to be the deciding shot of the game, inwardly prayed that she would get a good drive. He hoped she would win. But he was determined she should not. It wouldn't be fair to her to let down an ounce. What a hard-shooting, genuine jewel she was!

Miss Amy having teed up the ball, stood and silently contemplated it for a moment. She was conjuring up a fancy that the little pellet was Col. Minimil and she was going to sock him. It was her star drive of the afternoon. Two hundred yards down the fairway and well on the way to another par.

Mr. Lathrop, on the other hand, addressed his ball with a secret wish that it were the seat of a pair of tremendously plaid trousers. He also made a magnificent drive. The girl was on with her second. A long putt would give her a birdie. His second rolled into a trap at the edge of the green. He would need two to get down, barring a miracle of luck. Mr. Lathrop walked up to his ball and prepared for the last desperate chance to halve the hole and avert defeat. He lifted it to within two inches of the cup, a marvelous shot out of the sand and over a mat of rough that bordered the trap.

Miss Amy met his eye as he stepped to the side of the green. She smiled her appreciation of his fine skill. Mr. Traynor, twenty yards off the green, carelessly chipped up, and realizing that he was of only nominal consequence in this strange threesome he asked permission to hole out and make way for the final effort of the two embattled ones.

That left the field to Miss Amy. Once again she studied the slopes of the undulating green. She surveyed every inch of the ten feet that separated her ball from the cup and victory. She settled herself for the stroke and from the instant the clubhead touched the ball it was apparent the lawyer from New York had lost a contest. As the ball clinked into the cup Mr. Lathrop strode over to shake Miss Amy's hand. "Immense," he said, "Great! It is an honor to have been whipped by you."

She and Mr. Lathrop were comparing cards as they walked up to the clubhouse, Mr. Traynor preceding them. She stopped a moment and as the big brief and lawsuit man from New York paused with her she asked him in a very calm little voice and with the ghost of a smile at the corners of a really serious mouth:

"Mr. Lathrop, you will admit, won't you, that even a woman sometimes plays the game?"

The legal gentleman laughed an uneasy acquiescence. What more did she mean than what she had merely said?

"How," asked the tortured Mr. Lathrop of himself, "am I ever going to tell this girl I am Col. Minimil's lawyer?"

The New A C Tube

(Continued from page 6)

will be a loud hum on turning on the set. The hum disappears in about 30 seconds and the set starts functioning properly.

Fig. 4 shows the grid voltage plate current curves for the C327 tube, for 45 and for 90 volts. When the tube is operated at about 50 volts the same grid bias may be applied to it as for the amplifier tubes. The grid return is connected with the cathode cylinder and to the bias resistor. The grid return to the center of the potentiometer is not at all critical.

Mechanically the construction of both tubes is more rugged than that of any of the earlier tubes. The detector tube seems more free from mechanical vibrations which are transmitted to the loud-speaker than in the case of the tube with a light filament. The filament voltage, by the way, is not as critical as the type 326 tube. In any case variation in line voltage will not effect the tubes sufficiently to make any difference in their characteristics, either the 326 or 327.

The circuit diagram, Fig. 5, is typical for a five tube receiver using house lighting current for power supply to filaments and plates of the tubes. This circuit shows a single transformer for both high and low voltage, although a separate transformer may be used for filament and for plate current supply, in fact, it is the recommendation of transformer manufacturers to have it so, for flexible operation. The by-pass condensers C1 and C2 are not necessary, though they may prove of advantage in reducing interstage coupling in some cases. The radio frequency transformers and variable condensers may be of any type or manufacture. A 171 type tube is recommended for the last stage.

The grid return is to bias resistor R2 which should have a value of about 2500 ohms for correct voltage drop to be impressed on the grid of the CX171. R1 is the bias resistor for the three CX326 tubes. Since the three tubes draw about nine milliamperes (at 135v.) the value of this resistor should be 1300 ohms. (.009 amperes X 1300 ohms equals 11.7 volts), the voltage drop will increase for larger plate voltage automatically. In figuring the bias resistor R1 the plate current for the CX326 tubes only should be considered, as the plate current return for the CX371 and C327 is not through this resistor. The bias resistor for two CX326 tubes would be 2000 ohms (.003 X 2000 is 12 volts drop), similarly the proper bias resistance for one tube would be 4000 ohms, for four tubes 1000 ohms, and for five and six tubes, 800 and 700 ohms respectively. The voltage drop across the bias resistance is not effective on the plate of the tube and should be substracted from the total plate voltage. The voltage drop across the bias resistors can be measured with a high resistance voltmeter used for measuring voltages supplied from "B" eliminators.

There is no volume control shown in this diagram, but a variable resistance of about 10,000 ohms may be connected across the primary of one of the r. f. transformers, or a potentiometer connected across (500,000 ohms) the secondary of the first audio transformer with the grid connected to the sliding arm instead of directly to the transformer.

The "B" eliminator is connected as usual, but only two voltage taps are shown here, the 45 and 160 volt taps. The eliminator should be in a metal case if it is to be installed in the same case with the receiver, and should be "grounded".

EDITOR'S NOTE—Other articles on the use of A. C. tubes in various types of receivers will be published in early issues of RADIO AGE. The A. C. tube in Super construction will be an early and interesting feature.

Radio World's Fair

The Radio World's Fair of 1927 will be held at the Madison Square Garden, New York, September 19 to 24 and G. Clayton Irwin, Jr., general manager, declares it will be the finest exhibition thus far presented in the radio field in this country. The New York and Chicago shows are thoroughly national in character and they are not only interesting to the public but provide a stimulus for the trade that could not be achieved in any other way.

Several important radio events will take place in New York during the week of the show. The fourth annual radio industries banquet will be held in the Hotel Astor on the evening of September 21. Major Herbert H. Frost, chairman of the speakers' committee, visited President Coolidge at Rapid City, S. D., recently and invited the chief executive to be the speaker of the evening. The President's reply will be received at an early date. The proceedings will be broadcast. It is expected that seventy stations will be connected in the chain that will give the country an opportunity to hear the music and speeches. More than three hundred entertainers will participate in the program.

Realizing the public interest in the broadcast of this event the committee has decided to designate the day of the banquet as "National Radio Day." Broadcasting will begin from the banquet hall at 9 p. m., New York time. Broadcasters are to be requested to make their programs for Wednesday, September 21, "National Radio Day Programs," stirring interest in the occasion by the character of their broadcast and, as last year, presenting a program that will lead up to the beginning of the banquet program at 9 o'clock, Eastern time.

The National Association of Broadcasters will hold its fifth annual convention during the week of September 19 at the Hotel Astor. Officers will be elected on the morning of the 21st.

The Garden display will include scores of improved radio products for the 1927-1928 fan.

Suggestions About Supers

(Continued from page 12)

lator tube. This oscillator tube takes energy from the batteries and produces an oscillating current. The frequentcy of the oscillations may be varied by a tuning condenser and the frequency always is different from that of the wave that is being received through the aerial.

For example, if the set is tuned to receive a 100-meter station, the incoming waves have a frequency of 3,000,000 per second. The oscillator may be tuned to produce 3,100,000 waves or oscillations per second. These oscillations will combine with those received from the transmitting station and, by heterodyne action, a frequency of 100,000 is passed along to the first amplifying tube. The reason that only 100,000 oscillations per second reach the amplifier is that 100,000 times per second the oscillations from the two sources of power, the transmitting station and the oscillator tube of the receiver, get in step and help each other, while the rest of the time they buck each other and prevent each other from going on. The rectifying action of the detector tube is necessary here, in order to produce this beat frequency of 100,000 per second, but this first detector does not reduce the frequency enough to produce sound waves in a phone.

It is this reduction of high frequencies to lower frequencies that gives the superheterodyne receiver its distinctive character and its high amplifying power. High-frequency current always is more difficult to control than low-frequency current. Inductance coils, resistances and almost every part of a set through which high-frequency current passes shows effects different from those produced by low-frequency current. Energy may be transferred from one part of a circuit to other parts or to other circuits where it is not wanted and where it makes trouble. The more the high-frequency current is amplified, the more troublesome it becomes.

The superheterodyne receiver rids itself of these troublesome high frequencies right at the first tube, with the help of the oscillator. After that it amplifies the low-frequency current to any desired extent and finally passes it through the second detector, which reduces it to audible frequencies. When the frequencies are low enough to produce sound, they can be passed along to an audio-frequency amplifier, or directly into the phones or loud speaker. The changes of frequency have no more effect upon the words or music that are being received than the number of

After it is thoroughly tested, it can be mounted on good panels and placed in a neat portable case with built-in loop and loud speaker

times a ball is thrown or batted has on the shape of the ball, unless distortion occurs by reason of faulty design or operation of the circuits.

The third section of the superheterodyne is the intermediate-frequency amplifier. This may contain from one to three tubes, or more. The circuits are typical amplifier circuits. The plate output of the first detector tube goes to the primary coil of the first transformer. It produces a current of higher voltage in the secondary coil of this transformer, by induction, and this goes to the grid of the first amplifier tube. The plate output of this tube goes to the primary coil of the next amplifying transformer, and from the secondary coil of this transformer a current of still higher voltage goes to the grid of the next tube, and so on.

Both the primary and secondary coils of the first transformer, which receives the output of the detector tube, are shunted by condensers. The transformers that receive the output of the amplifier tubes have no such condensers.

The primary coils of the transformers that receive the output of the amplifying tubes connect with the positive terminal of the "B" battery, at the end of the coils opposite the plate connection. They connect also with a coil in the plate circuit of the oscillator tube. The secondary coils of the first two of these amplifying transformers are connected back to the secondary coil of the transformer between the first detector and the first amplifier tube. The secondary coil of the third amplifying transformer connects with the grid leak and condenser of the second detector tube, on one end. The other end of this coil connects with the plate of the second detector tube, through a condenser. Also it connects with the filaments of all tubes except the oscillator, on the positive side.

The fourth section of the receiver is the second detector. This tube receives the amplified radio-frequency current from the last amplifier and reduces it to audible frequencies. The current passes into the phones or loud speaker, or into an audio-frequency transformer if one is added, through

A superheterodyne receiver in the experimental stage. It is a good idea to make panels of dry wood, mount the parts and try out the set. This may prevent mistakes that would be costly with more expensive materials

the plate circuit. The return wire from the phones, speaker or amplifier goes to the negative terminal of the "B" battery. Also it connects with the primary coil of the transformer that is next to the first detector tube, and with the positive terminal of the filament of the first detector tube. There is another wire from the plate of the second detector tube to a condenser and a wire from the other side of the condenser to the positive terminal of the "A" battery.

The negative terminals of the filaments of all the tubes connect with a rheostat that governs the supply of current from the "A" battery. As is usual in radio-frequency amplification, the "A" battery is shunted by a potentiometer, which steadies the action of the tubes. The sliding contact in the middle of this potentiometer leads to the secondary coils of three of the transformers: the one next to the first detector and those in the first and second stages of amplification. There is a by-pass condenser between the slider and the potentiometer and the wire leading from the positive terminal of the "A" battery to the filaments.

The oscillator circuit is the only one that looks exceptional to a man who has studied the diagrams of other types of receivers. The grid and plate are connected by a variable condenser. The wires from the grid and plate each go to a coil. These two coils are separated by a condenser. The positive terminal of the filament, which connects of course with the "A" battery, connects also with the coil in the grid lead and with the condenser that separates this coil from the coil in the plate lead.

If an outside antenna is used with a superheterodyne receiver it should be designed to work with the receiver. Usually, fifty feet is long enough. The longer the antenna the more it broadens the tuning and decreases selectivity. For the super, the antenna does not need to be as high as for less powerful sets.

Ordinary types of audi-frequency amplifiers can be used to increase the volume of the super. They are connected to the second detector in the usual way. It is not necessary to tear down the super and build the audio-frequency amplifier into it. The amplifier can be built as a separate unit and connected.

Shielding is important in the superheterodyne. Usually it is provided for in the kit and instructions.

Amateurs who want to bring in code signals from stations that transmit continuous waves add a second tube to the oscillator of the super.

Parts for a superheterodyne receiver cost well over a hundred dollars. The work of assembling these requires a considerable amount of time. It is folly, therefore, to try to save a few dollars by buying poor parts. The condensers should be of exactly the capacities specified. There are many small fixed condensers that are satisfactory for some purposes but that do not have the exact capacity indicated on the labels.

H. A. Snow, formerly with the United States Bureau of Standards, found in his experiments that the amplification factor in a superheterodyne receiver using four tubes ahead of the second detector was 3500. A receiver using uncompensated untuned radio-frequency amplification with three tubes has an amplification factor of about 600. This explains why a super often brings in stations all the way across the continent, even in the worst radio weather of summer. It is not always easy to build and adjust one so that it works perfectly, but the results that it will deliver make it worth all the effort.

WLW's Artists' Bureau

Formation of an Artists' Bureau, announced by Powel Crosley, Jr., president of the Crosley Radio Corporation, Cincinnati, Ohio, who operate the well-known broadcasting station WLW, is said to mark the beginning of a new epoch in broadcasting studio management. In the opening of this Bureau, which provides a booking service for the station's outstanding individual artists and organizations, a step has been taken in the direction of a closer relationship between the artists and the studio, and toward a more complete service to the public in making available for outside appearance the most successful of its performers.

Artists and organizations who have affiliated themselves with the Bureau are: the Heermann trio; William J. Kopp, orchestra director; Lydia Cleary Dozier, soprano; Marjory Garrigus Smith, pianist; the Lyric Male Quartet; the Crosley "Pups"; Johanna Grosse, organist; the Crosley Cossacks; and Melville Ray, tenor.

How To Make An Outdoor Gym

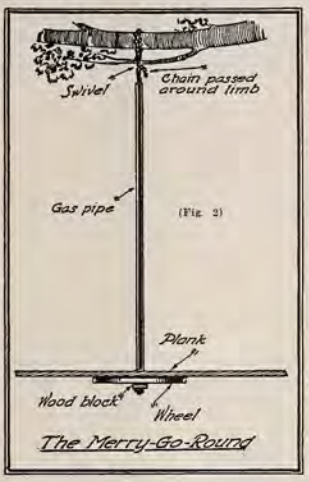
BY ALL means make an outdoor gym this fall if you have even a small plot of vacant ground, such as back of the house. It will give you pleasure, not only in the building of it, but particularly after it has been made. More than this you can invite your friends and thus make your own home the most popular place in the neighborhood. Here are a few plans and suggestions you can use.

Some boys find that it pays to enlist the aid and enthusiasm of other boys right from the start. Then the work of construction is lessened and all of the boys have a mutual interest. You can form a committee consisting of your friends and have each agree to do an equal part. Anyone who joins the agreement will vote as do the others in special problems which come up.

If possible, choose a place where there are a few trees. These not only give shade but will help to support some of the apparatus. If you wish you can set a timber in a crotch formed by a large limb and support the other end with a post of suitable height. The horizontal beam can be from eight to twelve feet long. The ends must be securely wired or nailed in place. A block under the outer end will prevent the nails from pulling out.

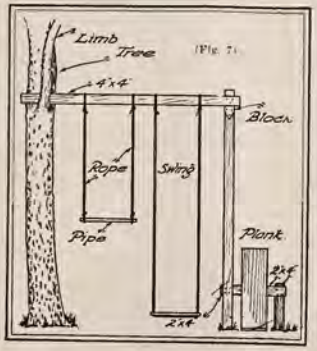
From this beam you can hang a swing, and also a piece of gas pipe for doing "stunts." There may also be room enough for a single rope and an old auto tire. If you wish you can run a short piece out from the right end, one end nailed to the tall post, the other supported by a short stake. This, then forms a suitable support for a teeter-totter and requires only a plank to complete it. Cleats nailed to the under side of the plank at the middle, will prevent it from working out of balance. Even though the post is set snugly in the ground, braces of either wire or wood should be set each side, anchored near the top and set in the ground to prevent side-play.

Figure 2 shows an interesting

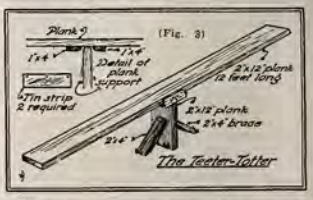


merry-go-round that is really different. Fasten a short piece of chain to a limb and attach a swivel to it, preferably with a ring. Attach a longer chain to this and run it through a gas pipe. Fit a large iron wheel with a plank on top onto the lower end of the pipe, setting it fast with a set screw. The lower end of the chain is kept from slipping up the pipe by tying or otherwise securing it to a block of wood or piece of iron.

In use this merry-go-round not only revolves very freely, but there is an up-and-down motion, too, which is quite exciting. The swivel prevents twisting the chain in two and it can be used indefinitely. Wire the



plank to the wheel. As a rule the plank should be at least three feet from the ground. The pipe lends stiffness which is desirable.



For a separate teeter-totter, the type shown in figure 3 will serve well. The support is a piece of plank of the same width as that used for the teeter-totter, sunk in the ground at least three feet and braced well on each side. The plank should be at least twelve feet long and two inches thick. Cleats are nailed cross-ways of the plank at the center on the underside. Notice that the edges of the cleats are rounded off as well as the upper edge of the plank support. This permits easy operation. The two heavy sheet iron pieces on each side of the plank prevents it from moving out of place.

These and many other pieces of apparatus can be made from scrap materials.

September Skies

(Continued from page 14)

But Saturn, the ringed planet, is still with us in the evening sky, in the constellation of the Scorpion, while Jupiter is now visible throughout the night. It is in the constellation of the Fishes.

One astronomical event that is not always so welcome, is the coming of autumn. This occurs on the evening of September 23, at 8:17 p. m. At that moment the sun will be directly over a point on the earth's equator and will enter the sign of Libra, the scales. This is the autumnal equinox, and days and nights will be of equal length. But this will be attended by no earthly happenings connected with or caused by it. The old idea of the "equinoctial storm" has been completely overthrown by science, though of course, like so many old superstitions, many people still believe in it.—*Copyright 1927, by Science Service, Inc.*

$12,000,000 Telescope

(Continued from page 28)

with the most powerful microscope, no one has ever seen the grain of a wet plate of this kind. But the astronomer cannot use it, because it would take such long exposures.

What a boon it would be for him if he had a plate as fast as the news plate and as grainless as the wet plate! Perhaps this is an ideal impossible of attainment, but photographic research laboratories are working on the problem. Even a plate twice as fast as those used at present and with no coarser grain would mean that every existing photographic telescope would immediately have its light-gathering power doubled. So perhaps the next great advance in astronomy will originate in the chemical laboratory of a photographic plate factory!

This was the idea expressed by Dr Hubble. In his estimation, the needs of astronomers at present are threefold. First of all, is needed better and faster plates. And then, comes more large telescopes in the southern hemisphere. Last of all comes the great telescopes surpassing in size the present instruments.

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	E. Pittsburgh, Pa.	315
KDLR	Radio Electric Co.	Devils Lake, N. D.	206
KDYL	Intermountain Bdcstg Corp.	Salt Lake City, Utah	258
KELW	Earl L. White	Burbank, Calif.	229
KEX	Western Broadcasting Company	Portland, Ore.	222
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	309
KFAD	Electrical Equipment Co.	Phoenix, Ariz.	273
KFAU	Independent School Dist.	Boise, Idaho	285
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. Z. Azbill	San Diego, Calif.	248
KFBK	Sacramento Bee	Sacramento, Calif.	535
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	Bishop N. S. Thomas	Laramie, Wyo.	428
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	244
KFCR	Santa Barbara Broadcasting Co.	Santa Barbara, Calif.	211
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	375
KFDX	First Baptist Church	Shreveport, La.	236
KFDY	South Dakota State College	Brookings, S. D.	394
KFDZ	Harry O. Iverson	Minneapolis, Minn.	216
KFEC	Meier & Frank	Portland, Ore.	214
KFEL	Eugene P. O'Fallon, Inc.	Denver, Colo.	248
KFEQ	Scroggin & Co.	St. Joseph, Neb.	206
KFEY	Bunker Hill & Sullivan	Kellogg, Idaho	233
KFGQ	Boone Biblical College	Boone, Iowa	210
KFH	Hotel Lassen	Wichita, Kans.	246
KFHA	Western State College of Colo.	Gunnison, Colo.	254
KFHL	Penn. College	Oskaloosa, Iowa	212
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	468
KFIF	Benson Polytechnic Institute	Portland, Ore.	214
KFIO	North Central High School	Spokane, Wash.	246
KFIQ	First Methodist Church	Yakima, Wash.	208
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Commonwealth Reporter	Fond du Lac, Wis.	268
KFJB	Marshall Electric Co.	Marshalltown, Iowa	248
KFJF	National Radio Mfg. Co.	Oklahoma City, Okla.	272
KFJI	E. E. Marsh	Astoria, Ore.	250
KFJM	University of North Dakota	Grand Forks, N. D.	331
KFJR	Ashley C. Dixon & Son	Portland, Ore.	283
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	240
KFJZ	W. E. Branch	Ft. Worth, Tex.	250
KFKA	Colo. State Teachers College	Greeley, Colo.	400
KFKB	J. R. Brinkley	Milford, Kan.	242
KFKU	The University of Kansas	Lawrence, Kans.	254
KFKZ	State Teachers College	Kirksville, Mo.	225
KFLR	University of New Mexico	Albuquerque, N. M.	416
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelist Church	Rockford, Ill.	268
KFLX	George Roy Clough	Galveston, Texas	270
KFMR	Morningside College	Sioux City, Iowa	441
KFMX	Carlton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Iowa	270
KFOA	Rhodes Department Store	Seattle, Wash.	447
KFOB	KFOB, Inc.	Burlingame, Calif.	225
KFON	Nicholas & Warriner, Inc.	Long Beach, Calif.	242
KFOR	Tire & Electric Co.	David City, Neb.	217
KFOX	Tech. High School	Omaha, Nebr.	258
KFOY	Beacon Radio Service	St. Paul, Minn.	285
KFPL	C. C. Baxter	Dublin, Texas	275
KFPM	The New Furniture Co.	Greenville, Texas	231
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Cal.	232
KFPW	St. Johns M. E. Church	Carterville, Mo.	263
KFPY	Symons Investment Co.	Spokane, Wash.	246
KFQA	The Principia	St. Louis, Mo.	322
KFQB	Lone Star Bdcast Co.	Fort Worth, Texas	261
KFQD	Anchorage Radio Club	Anchorage, Alaska	345
KFQU	W. E. Riker	Holy City, Calif.	250
KFQW	C. F. Knierim	Seattle, Wash.	217
KFQZ	Taft Products Co.	Hollywood, Calif.	232
KFRC	Don Lee, Inc.	San Francisco, Calif.	254
KFRU	Stephens College	Columbia, Mo.	250
KFSD	Airfan Radip Corp.	San Diego, Calif.	441
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFTL	C. C. Baxter	Dublin, Tex.	252
KFUL	Thomas Groggan & Bros.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	236
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver, Colo.	227
KFUR	Peery Bldg. Co., Inc.	Ogden, Utah	225
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	500
KFVD	Chas. & W. J. McWhinnie	Venice, Calif.	208
KFVE	Benson Broadcasting Corp.	St. Louis, Mo.	234
KFVG	First M. E. Church	Independence, Kans.	225
KFVI	KFVI Broadcasting Co.	Houston, Texas	238
KFVN	Carl E. Bagley	Fairmont, Minn.	229
KFVS	Cape Girardeau Battery Sta.	Cape Girardeau, Mo.	224
KFWB	Warner Bros. Pictures	Hollywood, Calif.	261
KFWC	L. E. Wall	San Bernardino, Calif.	222
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Eureka, Calif.	254
KFWI	Radio Entertainments, Inc.	San Francisco, Calif.	268
KFWM	Oakland Educational Society	Oakland, Calif.	236
KFWO	Lawrence Mott	Avalon, Calif.	218
KFWV	KFWV Studios	Portland, Ore.	229
KFXB	Bertram C. Heller	Los Angeles, Calif.	353
KFXF	Colorado Radio Corp.	Denver, Colo.	283
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	Mt. States Radio Dis., Inc.	(Portable) Colorado	216
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	224
KFXY	Harry M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	238
KFYR	Koskins-Meyer, Inc.	Bismarck, N. D.	240
KGA	Northwest Radio Service Co.	Spokane, Wash.	261
KGAR	Tucson Citizen	Tucson, Ariz.	234
KGBS	A. C. Dailey	Seattle, Wash.	203
KGBU	Alaska Radio Co.	Ketchikan, Alaska	229
KGBX	Foster Hall Tire Co.	St. Joseph, Mo.	288
KGBY	Dunning & Taddikon	Shelby, Nebr.	203
KGBZ	George R. Miller	York, Nebr.	213
KGCA	C. W. Greenley	Decorah, Iowa	248
KGCB	Wallace Radio Institute	Oklahoma, Okla.	216
KGCG	Moore Motor Co.	Newark, Ark.	224
KGCH	Wayne Hospital	Wayne, Nebr.	294
KGCI	Liberty Radio Sales	San Antonio, Texas	220
KGCL	Louis Wasmer	Seattle, Wash.	231
KGGN	Concordia Bdcstg. Co.	Concordia, Kans.	208
KGCR	Cutler's Broadcasting Service	Brookings, S. D.	208
KGCU	Mandan Radio Assn.	Mandan, N. D.	208
KGCX	First State Bank	Vida, Mont.	225
KGDA	Home Auto Co.	Dell Rapids, S. D.	234
KGDE	Jaren Drug Co.	Barrett, Minn.	205
KGDJ	R. Rathert	Cresco, Iowa	203
KGDM	V. G. Koping	Stockton, Calif.	217
KGDP	Boy Scouts of America	Pueblo, Colo.	224
KGDR	Radio Engineers	San Antonio, Tex.	203
KGDX	William Erwin Antony	Shreveport, La.	213
KGDY	J. Albert Loesch	Oldham, S. D.	207
KGDW	Frank J. Rist	Humboldt, Nebr.	207
KGEF	Trinity Methodist Church	Los Angeles, Calif.	263
KGEH	Eugene Broadcast Station	Eugene, Ore.	201
KGEK	Beehler Elect. Equipment Co.	Yuma, Colo.	263
KGEN	E. R. Irey & F. M. Bowles	El Centro, Calif.	225
KGEO	Raymond D. Chamberlain	Grand Island, Nebr.	205
KGEQ	Fred W. Herrmann	Minneapolis, Minn.	203
KGER	C. Merwin Dobyns	Long Beach, Calif.	216
KGES	Central Radio Electric Co.	Central City, Nebr.	205
KGEU	L. W. Clement	Lower Lake, Calif.	227
KGEW	City of Fort Morgan	Fort Morgan, Colo.	219
KGEY	J. W. Dietz	Denver, Colo.	201
KGEZ	Flathead Broadcasting Ass'n	Kalispell, Mont.	205
KGFB	A. G. Dunkel	Iowa City, Iowa	224
KGFF	Earl E. Hampshire	Alva, Okla.	205
KGFG	Full Gospel Church	Oklahoma City, Okla.	216
KGFH	Frederick Robinson	La Crescenta, Calif.	224
KGFI	M. L. Eaves	Fort Stockton, Texas	220
KGFJ	Ben S. McGlashan	Los Angeles, Calif.	208
KGFK	Kittson County Enterprise	Hallock, Minn.	224
KGFL	Trinidad Broadcasting Co.	Trinidad, Colo.	222
KGFM	Geo. W. Johnson	Yuba City, Calif.	211
KGFN	Haraldson & Thingstad	Aneta, North Dakota	200

Time To Build

(Continued from page 4)

that should be read and saves unnecessary reading.

Most men are interested in science, but it is almost impossible to grasp scientific conceptions without having some scientific experience. The fact that so few men maintain chemical laboratories, astronomical observatories, botanical gardens or zoological collections indicates that most forms of scientific research are beyond the reach of the multitude. Radio, one of the newest sciences, is basically as old as any; it is the only one that is wide open to rich and poor, sound and crippled, educated and unschooled.

It is impossible to build a radio set without opening the mind to new worlds of thought. It is impossible not to wonder how a smelly liquid, poured into a container with leaden plates, will cause a current of electricity to flow through wires and make a fibre of metal become luminous. A set builder cannot escape the thrill that comes when a slight adjustment causes an inert tangle of wires and metal plates to come to life and open the door for him into the midst of a frenzied multitude yelling because a horsehide-covered sphere, rebounding from a willow stick, has flown over a fence and escaped from the scene of its recent activities.

A set builder who studies radio cannot but be awed by the mystery of the electron, which he can control in some of its wanderings although he cannot see it. According to science it is the very basis of our physical being, the things from which all other things, animate and inanimate, are formed.

Radio An Obligation

It is time to build. Domestic duty requires that our homes shall not remain below the general level, that our loved ones shall have every opportunity that others enjoy. One home in five has radio—the rest should have it.

Civic duty demands that we do our best to follow the trend of politics and the devious ways of politicians. Public works worth a million dollars cost us two millions, or possibly five, by the time they are paid for. The money comes directly out of our pockets, it is taken from those who are dependent upon us. War plunges us into debts from which there is no escape; our last war with Mexico, which was fought nearly a century ago, is not paid for yet but there are those who want to start another one.

We cannot read all the political propaganda, yet it is necessary to know two sides all the time or run the risk of becoming the tools of predatory groups whose real leaders have not the nerve to face an honest man and answer a straight question. Radio helps, because character is revealed in a voice even when lying words are carefully studied and artfully spoken. We can listen, and then get behind the real leader who knows the situation and is ready to help us fight our battles.

It is time to build. What is the use of living in the greatest age in history and not being a part of it?

Radio Aids Miners

(Continued from page 7)

paratus. After the required locations and measurements are made test drilling is done to obtain definite information of the ore deposit.

For thousands of years the great underground mineral mysteries have been held as silent secrets of nature until here and there a prospector or mining company locates some trace of the great fortunes yet unknown. Millions of dollars have been expended in searching for mineral deposits which might be located in northern Alaska or in Southern Africa, but no better method other than the faithful pick and shovel or diamond drilling has been used. But today a new method of prospecting and exploration has entered the mining world with the development of the radiore process which has electrical eyes more powerful than any human's eyes. Nature's mineral secrets will be revealed where least expected. The future will see even a greater development of radio as the most valuable tool in the mining world.

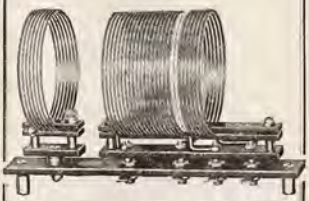
KGFP	Mitchell Broadcast Co	Mitchell, South Dakota	212
KGO	General Electric Co	Oakland, Calif.	384
KGRC	Gene Roth & Co	San Antonio, Texas	220
KGRS	Gish Radio Service	Amarillo, Tex.	244
KGTT	Glad Tidings Tabernacle, Inc	San Francisco, Cal.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii	270
KGW	Oregonian Publishing Co	Portland, Ore.	491
KGY	St. Martins College	Lacey, Wash.	244
KHJ	Times-Mirror Co	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Spokane, Wash.	370
KICK	Atlantic Automobile Co	Anita, Iowa	461
KJBS	J. Brunton & Sons Co	San Francisco, Calif.	220
KJR	Northwest Radio Service Co	Seattle, Wash.	348
KKP	City of Seattle, Harbor Dept	Seattle, Wash.	265
KLDS	Reorganized Ch. of Jesus Christ,	Independence, Mo.	238
KLIT	Lewis Irvine Thompson	Portland, Ore.	207
KLS	Warner Brothers	Oakland, Calif.	246
KLX	Tribune Publishing Co	Oakland, Calif.	508
KLZ	Reynolds Radio Co	Denver, Colo.	268
KMA	May Seed & Nursery	Shenandoah, Iowa	270
KMED	W. J. Virgin	Medford, Ore.	268
KMIC	J. R. Fouch	Inglewood, Calif.	224
KMJ	Fresno Bee	Fresno, Calif.	366
KMMJ	M. M. Johnson Co	Clay Center, Nebr.	379
KMO	Love Electric Co	Tacoma, Wash.	254
KMOX	Voice of St. Louis	St. Louis, Mo.	300
KMTR	Radio Corp	Hollywood, Calif.	526
KNRC	C. B. Juneau	Santa Monica, Calif.	375
KNX	Los Angeles Express	Los Angeles, Calif.	337
KOA	General Electric Co	Denver, Colo.	326
KOAC	Oregon Agriculture College	Corvallis, Oreg.	326
KOB	N. Mex. College of Agric	State College, N. Mex.	394
KOCH	Oamaha Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Mona Motor Oil Co	Council Bluffs, Iowa	278
KOIN	KOIN, Inc	Portland, Ore.	319
KOLO	Gerald K. Hunter	Durango, Colo.	200
KOMO	Fisher's Blend Station, Inc	Seattle, Wash.	307
KOWW	Frank A. Moore	Walla, Walla Wash.	300
KPCB	Pacific Coast Biscuit Co	Seattle, Wash.	231
KPJM	Wilburn Radio Service	Prescott, Ariz.	214
KPNP	Central Radio Co	Muscatine, Iowa	211
KPO	Hale Bros., Inc	San Francisco, Calif.	422
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Printing Co	Houston, Texas	294
KPSN	Star-News	Pasadena, Calif.	316
KQW	First Baptist Church	San Jose, Calif.	297
KQV	Doubleday-Hill Electric Co	Pittsburgh, Pa.	270
KRAC	Caddo Radio Club	Shreveport, La.	220
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KRLD	Dallas Rado Laboratories	Dallas, Tex.	461
KRLO	Freeman Lang & A. B. Scott	Los Angeles, Calif.	216
KROX	N. D. Brown	Seattle, Wash.	211
KRSC	Radio Sales Corp	Seattle, Wash.	211
KSAC	Kansas State Agricultural College	Manhattan, Kans.	333
KSBA	W. G. Patterson	Shreveport, La.	268
KSD	Pulitzer Publishing Co	St. Louis, Mo.	545
KSCJ	The Journal	Sioux City, Iowa	244
KSEI	Broadcasting Association	Pocatello, Idaho	333
KSL	Radio Service Corp	Salt Lake City, Utah	303
KSMR	Santa Maria Valley Railroad	Santa Maria, Calif.	273
KSO	Berry Seed Co	Clarinda, Iowa	227
KSOO	Sioux Falls Bdcst. Ass'n	Sioux Falls, S. D.	210
KTAB	Associated Broadcasters	Oakland, Calif.	280
KTAP	Robert B. Bridge	San Antonio, Texas	229
KTBI	Bible Institute	Los Angeles, Calif.	283
KTBR	M. E. Brown	Portland, Ore.	283
KTCL	Amer. Radio Tel. Co	Seattle, Wash.	278
KTHS	New Arlington Hotel	Hot Springs, Ark.	384
KTNT	N. Baker	Muscatine, Iowa	256
KTUE	Uhalt Electric	Houston, Texas	213
KTW	First Presbyterian Church	Seattle, Wash.	394
KUJ	Puget Sound Broadcasting Co	Seattle, Wash.	200
KUOA	University of Arkansas	Fayetteville, Ark.	297
KUOM	University of Montana	Missoula, Mont.	375
KUSD	University of South Dakota	Vermillion, S. D.	484
KUT	University of Texas	Austin, Texas	232
KVI	Puget Sound Broadcasting Co	Tacoma, Wash.	234
KVOO	Southwestern Sales Corp	Bristow, Okla.	349
KVOS	L. Kessler	Seattle, Wash.	210
KWBS	Schaeffer Mfg. Co	Portland, Ore.	201
KWCR	H. F. Parr	Cedar Rapids, Iowa	384
KWG	Portable Wireless Telegraph Co	Stockton, Calif.	345
KWKC	Wilson Duncan Studios	Kansas City, Mo.	222
KWLC	Luther College	Decorah, Iowa	249
KWSC	State College of Washington	Pullman, Wash.	394
KWTC	J. W. Hancock	Santa Ana, Calif.	353
KWUC	Western Union College	Le Mars, Iowa	244
KWWG	Chamber of Commerce	Brownsville, Texas	278
KXL	KXL Broadcasters	Portland, Ore.	220
KYA	Pacific Broadcasting Corp	San Francisco, Calif.	309
KYW	Westinghouse Electric & Mfg. Co	Chicago, Ill.	526
KZM	Preston D. Allen	Oakland, Calif.	246
WAAD	Ohio Mechanical Institute	Cincinnati, Ohio	268
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	359
WAAM	Isaiah R. Nelson	Newark, N. J.	349
WAAT	F. V. Bremer	Jersey City, N. J.	246
WAAW	Omaha Grain Exchange	Omaha, Nebr.	375
WABC	Atlantic Broadcasting Corp	New York, N. Y.	326
WABF	Markle Broadcasting Corp	Pringleboro, Pa.	205
WABI	1st Universalist Church	Bangor, Me.	389
WABO	Hickson, Electric Co., Inc	Rochester, N. Y.	232
WABQ	Keystone Broadcasting Co	Philadelphia, Pa.	261
WABR	Scott High School	Toledo, Ohio	281
WABW	College of Wooster	Wooster, Ohio	248
WABY	John Magaldi, Jr	Philadelphia, Pa.	248
WABZ	Colis Place Baptist Church	New Orleans, La.	248
WADC	Allen Theater	Akron, Ohio	297
WAFD	Albert P. Parfet	Detroit, Mich.	219
WAGM	R. L. Miller	Royal Oak, Mich.	225
WAGS	Willow Garage, Inc	Sommerville, Mass.	216
WAIT	A. H. Waite & Co	Taunton, Mass.	214
WAIU	American Insurance Union	Columbus, Ohio	283
WALK	Albert A. Walker	Bathayres, Pa.	204
WAMD	Raddison Radio Corp	Minneapolis, Minn.	225
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	326
WARS	Amateur Radio Specialty Co	Brooklyn, N. Y.	227
WASH	Baxter Laundry Co	Grand Rapids, Mich.	256
WATT	Edison Elec. Illum	Boston, Mass.	201
WBAA	Purdee University	W. Lafayette, Ind.	273
WBAK	Pennsylvania State Police	Harrisburg, Pa.	300
WBAL	Consolidated Gas & Power Co	Baltimore, Md.	285
WBAO	James Milliken University	Decatur, Ill.	268
WBAP	Ft. Worth Star Telegram	Ft. Worth, Texas	500
WBAW	Waldrum Drug Co	Nashville, Tenn.	248
WBAX	John H. Stenger, Jr	Wilkes-Barre, Pa.	250
WBBG	Brooklyn Bdcstg. Corp	Brooklyn, N. Y.	227
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	248
WBBM	Atlass Investment	Chicago, Ill.	389
WBBP	Petoskey High School	Petoskey, Mich.	240
WBBR	People's Pulpit Assoc	Rossville, N. Y.	256
WBBW	Ruffner Junior High School	Norfolk, Va.	236
WBBY	Washington, Light Inf	Charleston, S. C.	500
WBBZ	C. L. Carrell	Chicago, Ill.	204
WBCN	Great Lakes Broadcasting Co	Chicago, Ill.	288
WBES	Bliss Electrical School	Takoma Park, Md.	297
WBET	Boston Transcript Co	Boston, Mass.	265
WBKN	Arthur Faske	Brooklyn, N. Y.	268
WBMH	Braun's Music House	Detroit, Mich.	211
WBMS	G. J. Schowerer	North Bergen, N. J.	268
WBNY	Baruschrome Corp	New York, N. Y.	236
WBOQ	Atlantic Bdcst. Corp	Richmond Hill, N. Y.	326
WBRC	Birmingham Broadcasting Co	Birmingham, Ala.	244
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	250
WBRL	Booth Radio Laboratories	Tilton, N. H.	232
WBRS	Universal Radio Mfg. Co	Brooklyn, N. Y.	211
WBSO	Babson's Statistical Org	Wellesley Hills, Mass.	384
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	258
WBZ	Westinghouse Elect. & Mfg. Co	Springfield, Mass.	333
WBZA	Westinghouse Elect. & Mfg. Co	Boston, Mass.	333
WCAC	Connecticut Agricultural College	Mansfield, Conn.	275
WCAD	St. Lawrence University	Canton, N. Y.	366
WCAE	Pittsburgh Press	Pittsburgh, Pa.	517
WCAH	C. A. Entrekin	Columbus, Ohio	535
WCAJ	Nebraska Wesleyan University	University Pl., Nebr.	379
WCAL	St. Olaf College	Northfield, Minn.	236
WCAM	City of Camden	Camden, N. J.	224
WCAO	Monumental Radio Inc	Baltimore, Md.	384
WCAT	School of Mines	Rapid City, S. D.	248
WCAU	Universal Broadcasting Co	Philadelphia, Pa.	278

Frank D. Pearne

Readers of Radio Age, and all radio constructors who have been following the development of radio since the early days of broadcasting will learn with poignant regret of the passing of Frank D. Pearne in June. Mr. Pearne was found lifeless at the wheel of his car in a garage near his home in Chicago. Mr. Pearne had been suffering from heart trouble and had been planning a long rest. His funeral was directed by Masonic brothers and was an impressive ceremony, attended by a large number of personal and professional friends who admired and loved Mr. Pearne for his sturdy character, his unfailing kindness and his important contributions to the art of radio transmission and reception.

Simultaneously with the inauguration of popular broadcasting in 1922 Mr. Pearne became a friend of those who wanted to know how to build sets. He had been instructor in electricity at Lane Technical High School for more than ten years at that time and was already familiar with the practice and theory of radio. His forte was the helping of beginners. Thousands of readers of Radio Age in 1922 and 1923 depended upon Mr. Pearne to help them over the rough spots. His articles and drawings appeared in Radio Age regularly and he was technical editor of this magazine, as well as technical editor of the Chicago Herald and Examiner.

The editor of Radio Age has probably a better knowledge of the unselfish work performed by Mr. Pearne in behalf of radio beginners than has any other person, except probably Mrs. Pearne. She many times had to protect Mr. Pearne from the hundreds of persons who called his residence by telephone by day and night, threatening to deprive him of needed rest and of time for his high school work. No letter was too insignificant for this friend of radio. He answered all queries personally, giving the same time and careful thought to the reply to the small boy who was experimenting with crystal sets as he gave to the



WGAX	University of Vermont	Burlington, Vt.	254
WCAZ	Carthage College	Carthage, Ill.	341
WCBA	Queen City Radio Station	Allentown, Pa.	222
WCBD	Wilbur Glenn Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	227
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Hotel Chateau	Baltimore, Md.	384
WCBR	C. H. Messter	Providence, R. I.	201
WCBS	H. L. Lewing	Springfield, Ill.	210
WCCO	Washburn-Crosby Co.	Anoka, Minn.	405
WCFL	Chicago Fed. of Labor	Chicago, Ill.	484
WCGU	C. G. Under	Lakewood, N. J.	211
WCLO	C. E. Whitmore	Camp Lake, Wis.	227
WCLS	WCLS, Inc.	Joliet, Ill.	216
WCMA	Culver Military Academy	Culver, Ind.	258
WCOA	City of Pensacola	Pensacola, Fla.	250
WCOC	Crystal Oil Co.	Columbus, Miss.	231
WCOM	172nd Field Artillery	Manchester, N. H.	238
WCOT	Jacob Conn	Olneyville, R. I.	225
WCRW	Clinton R. White	Chicago, Ill.	224
WCSH	Congress Square Hotel Co.	Portland, Maine	361
WCSO	Wittenberg College	Springfield, Ohio	256
WCWK	Chester W. Keen	Fort Wayne, Ind.	229
WCWS	Bridgeport Bdcst. Sta.	Bridgeport, Conn.	214
WCX	Detroit Free Press	Pontiac, Mich.	441
WDAD	Dad's Auto Accessories, Inc.	Nashville, Tenn.	225
WDAE	Tampa Daily Times	Tampa, Fla.	268
WDAF	Kansas City Star	Kansas City, Mo.	370
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	234
WDAY	Radio Equipment Corp.	Fargo, N. D.	361
WDBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	231
WDBK	Bdcst Co.	Cleveland, Ohio	227
WDBO	Orlando Broadcasting Co.	Orlando, Fla.	288
WDBZ	Boy Scouts of America	Kingston, N. Y.	216
WDEL	Wilmington Elec. Specialty Co.	Wilmington, Del.	265
WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	246
WDRC	Doolittle Radio Corp.	New Haven, Conn.	275
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	375
WDWM	Radio Industries Broadcast Co.	Newark, N. J.	361
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	National Broadcasting Co.	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	484
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	240
WEAN	The Shepard Co.	Providence, R. I.	319
WEAO	Ohio State University	Columbus, Ohio	283
WEAR	Willard Storage Battery Co.	Cleveland, Ohio	400
WEBC	Head-of-the-Lakes Radio Station	Superior, Wis.	242
WEBE	Roy W. Waller	Cambridge, Ohio	248
WEBH	Edgewater Beach Hotel	Chicago, Ill.	366
WEBJ	Third Avenue Railway Co.	New York, N. Y.	256
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	225
WEBR	H. H. Howell	Buffalo, N. Y.	242
WEBW	Beloit College	Beloit, Wis.	259
WEDC	E. Denemark Station	Chicago, Ill.	242
WEEI	The Edison Elec. Illuminating Co.	Boston, Mass.	448
WEHS	A. T. Becker	Evanston, Ill.	216
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	238
WENR	Great Lakes Broadcasting Co.	Chicago, Ill.	288
WEPS	Matheson Radio Co., Inc.	Gloucester, Mass.	297
WEW	St. Louis University	St. Louis, Mo.	353
WFAA	Dallas News & Dallas Journal	Dallas, Texas	500
WFAM	Times Publishing Co.	St. Cloud, Minn.	252
WFBC	First Baptist Church	Knoxville, Tenn.	234
WFBE	Garfield Place Hotel Co.	Cincinnati, Ohio	246
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	280
WFBJ	St. John's University	Collegeville, Minn.	273
WFBL	The Onondaga Co.	Syracuse, N. Y.	259
WFBM	Indianapolis Power & Light Co.	Indianapolis, Ind.	225
WFBR	Fifth Infantry National Guard	Baltimore, Md.	225
WFBZ	Knox College	Galesburg, Ill.	248
WFCI	Frank Crook, Inc.	Pawtucket, R. I.	225
WFDF	F. D. Fallain	Flint, Mich.	349
WFHH	Chamber of Commerce	Clearwater, Fla.	366
WFI	Strawbridge and Clothier	Philadelphia, Pa.	405
WFIW	The Acme Mills, Inc.	Hopkinsville, Ky.	280
WFKB	Vesta Battery Corp.	Chicago, Ill.	224
WFLA	Boca Raton Radio Corp.	Boca Raton, Fla.	213
WFRL	Flatbush Radio Labs.	Brooklyn, N. Y.	219
WGAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	252
WGBB	H. H. Carman	Freeport, N. Y.	246
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBI	Scranton Broadcasters, Inc.	Scranton, Pa.	231
WGBS	Gimbel Brothers	Astoria, L. I., N. Y.	349
WGCP	Lanter Piano Co.	Newark, N. J.	280
WGES	Oak Leaves Broadcasting Corp.	Chicago, Ill.	242
WGHP	G. H. Phelps	Detroit, Mich.	319
WGL	International Broadcasting Corp.	Secaucus, N. Y.	294
WGM	Verne and Elton Spencer	Jeanette, Pa.	208
WGMU	Atlantic Bdcst. Co.	New York, N. Y.	201
WGN	The Tribune	Chicago, Ill.	306
WGR	Federal T. and T. Co.	Buffalo ,N. Y.	303
WGST	Georgia School of Technology	Atlanta, Ga.	270
WGWB	Radiocast Corporation	Milwaukee, Wis.	219
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	319
WHAD	Marquette University	Milwaukee, Wis.	294
WHAM	Stromberg-Carlson Tel. Mfg. Co.	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	New York, N. Y.	236
WHAR	F. D. Cooks Sons	Atlantic City, N. J.	273
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	461
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	337
WHBA	C. C. Shaffer	Oil City, Pa.	261
WHBC	Rev. E. P. Graham	Canton, Ohio	236
WHBD	Chamber of Commerce	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBL	James H. Slusser	Chicago, Ill.	204
WHBM	C. L. Carrell	Chicago, Ill.	201
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	297
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	229
WHBQ	WHBQ, Inc.	Memphis, Tenn.	232
WHBU	Bings Clothing—Riviera Theater	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	220
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Institute	Minneapolis, Minn.	246
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	232
WHFG	Triangle Broadcasters	Chicago, Ill.	216
WHK	The Radio Air Service Corp.	Cleveland, Ohio	265
WHN	Loew's State Broadcasting Station	New York, N. Y.	395
WHO	Banker's Life Co.	Des Moines, Ia.	535
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	416
WIAD	Howard R. Miller	Philadelphia, Pa.	220
WIAS	Home Electric Co.	Burlington, Iowa	476
WIBA	Capital Times-Strand Theatre	Madison, Wis.	240
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	441
WIBI	Frederick B. Zittell, Jr.	Flushing, L. I., N. Y.	268
WIBJ	C. L. Carrell	Chicago, Ill.	201
WIBM	C. L. Carrell	Chicago, Ill.	201
WIBO	WIBO Broadcasters, Inc.	Chicago, Ill.	416
WIBS	N. J. National Guard	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	217
WIBW	C. L. Carrell	Chicago, Ill.	204
WIBX	WIBX, Inc.	Utica, N. Y.	238
WIBZ	A. D. Trum	Montgomery, Ala.	231
WICC	Bridgeport Bdcst. Station	Bridgeport, Conn.	214
WIL	Benson Radio Co.	St. Louis, Mo.	258
WIOD	Earl G. Fisher Co.	Miami, Fla.	248
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAD	Hotel Raleigh	Waco, Texas.	448
WJAG	Norfolk Daily News	Norfolk, Neb.	286
WJAK	Kokomo Tribune	Kokomo, Ind	234
WJAM	D. M. Perham	Cedar Rapids, Iowa	384
WJAR	The Outlet Co.	Providence, R. I.	484
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	270
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAY	Cleveland Broadcasting Corp.	Cleveland, O.	227
WJAZ	American Bdcast. Corp.	Mt. Prospect, Ill.	263
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	322
WJBB	Financial Journal	St. Petersburg, Fla.	345
WJBC	Hummer Furniture Co.	LaSalle, Ill.	227
WJBI	Robert S. Johnson	Red Bank, N. J.	256
WJBK	E. F. Goodwin	Ypsilanti, Mich.	220
WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	213
WJBO	Valdemar Jensen	New Orleans, La.	263
WJBR	Gensch and Stearns	Omro, Wis.	227
WJBT	John S. Boyd	Chicago, Ill.	389
WJBU	Bucknell University	Lewisburg, Pa.	214

advanced student of radio who was working on super hets.

Radio Age takes this opportunity gladly to say for the thousands of radio fans who knew and loved him that he has left a record of service that will stand as an enduring monument to remind us of a man who was big enough to give the best he had to his fellows with little thought to immediate rewards. Frank D. Pearne was a kindly neighbor, a patient instructor, a loyal friend. His passing is a great loss to radio.

Brazil a Growing Market

Brazil is a good market for radio receiving sets, according to a trade bulletin issued by the Electrical Equipment Division of the Department of Commerce. There are many crystal receivers of local manufacture in use, the report states but the demand for the larger types of tube sets is growing rapidly because of the general desire of the listeners to pick up Buenos Aires broadcasting stations. In many parts of Brazil it is necessary to use a large receiver in order to hear the nearest station satisfactorily. Practically all complete receiving sets and parts now imported into Brazil are of American origin.

The development of the demand for radio receiving sets during the last few years, though impeded a great deal in the beginning by Government regulations, has of late been rapid, the report reveals. Radio enthusiasts have formed societies in Rio de Janeiro, Sao Paulo and fourteen other cities, thus stimulating interest.

—"Now I know what becomes of little boys who can't remember their A B C's."
—"What's that?"
—"They grow up and become radio announcers and forget their call letters."

WJBW	C. Carlson, Jr.	New Orleans, La.	238
WJBY	Electric Construction Co.	Gadsden, Ala.	234
WJBZ	Roland G. Palmer	Chicago Heights, Ill.	208
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	266
WJPW	J. P. Wilson	Ashtabula, Ohio	208
WJR	Station WJR, Inc.	Pontiac, Mich.	441
WJZ	Radio Corp. of America	Bound Brook, N. J.	454
WKAQ	Radio Corp. of Porto Rico	San Juan, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	285
WKAV	Laconia Radio Club	Laconia, N. H.	224
WKBB	Sanders Bros.	Joliet, Ill.	216
WKBC	H. L. Ansley	Birmingham, Ala.	219
WKBE	K. & D. Electric Co.	Webster, Mass.	229
WKBF	N. D. Watson	Indianapolis, Ind.	252
WKBG	C. L. Carrell	Chicago, Ill.	201
WKBH	Callaway Music Co.	LaCrosse, Wis.	220
WKBI	F. L. Schoenwolf	Chicago, Ill.	322
WKBL	Monrona Radio Mfg. Co.	Monroe, Mich.	205
WKBM	J. W. Jones	Newburgh, N. Y.	208
WKBN	Radio Electric Service Co.	Youngstown, Ohio	214
WKBO	Camith Corporation	Jersey City, N. J.	219
WKBP	Enquirer and News	Battle Creek, Mich.	213
WKBQ	Starlight Amusement Park	New York, N. Y.	219
WKBS	P. M. Nelson	Galesburg, Ill.	217
WKBT	First Baptist Church	New Orleans, La.	252
WKBU	H. K. Armstrong	Newcastle, Pa.	204
WKBV	Knox Battery and Electric Co.	Brookville, Ind.	217
WKBW	Churchill Evang. Ass'n.	Buffalo, N. Y.	217
WKBZ	K. L. Ashbacker	Ludington, Mich.	200
WKDR	Edward A. Dato	Kenosha, Wis.	322
WKJC	Kirk Johnson & Co.	Lancaster, Pa.	252
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	333
WKY	WKY Radio Co.	Oklahoma City, Okla.	288
WLAC	Life & Casualty Ins. Co.	Nashville, Tenn.	226
WLAP	Virginia Avenue Baptist Church	Louisville, Ky.	268
WLB	University of Minnesota	Minneapolis, Minn.	246
WLBC	D. A. Burton	Muncie, Ind.	210
WLBF	E. L. Dillard	Kansas City, Mo.	211
WLBG	R. A. Gamble	Petersburg, Va.	214
WLBH	Joseph J. Lombardi	Farmingdale, N. Y.	232
WLBI	Legion Broadcasters, Inc.	East Wenona, Ill.	238
WLBL	Wisconsin Dept. of Markets	Stevens Point, Wis.	319
WLBM	Browning Drake Corp.	Boston, Mass.	231
WLBN	William Evert Hiler	Chicago, Ill.	204
WLBO	Frederick A. Tribbe, Jr.	Galesburg, Ill.	217
WLBP	R. A. Fox	Ashland, Ohio	203
WLBQ	E. Dale Trout	Atwood, Ill.	203
WLBR	Alford Radio Company	Belvidere, Ill.	322
WLBT	Harold Wendell	Crown Point, Ind.	322
WLBV	John F. Weimer & D. A. Snick	Mansfield, Ohio	207
WLBW	Petroleum Telephone Co.	Oil City, Pa.	294
WLBX	John N. Brahy	Long Island City, N. Y.	204
WLBY	Aimone Elec.	Iron Mountain, Mich.	210
WLBZ	Thompson L. Guernsey	Dover-Foxcroft, Maine	208
WLCI	Lutheran Association	Ithaca, N. Y.	248
WLIB	Liberty Weekly, Inc.	Elgin, Ill.	306
WLIT	Lit Bros.	Philadelphia, Pa.	405
WLS	Sears Roebuck & Co.	Crete, Ill.	345
WLTS	Lane Technical High School	Chicago, Ill.	484
WLW	Crosley Radio Corp.	Harrison, Ohio	428
WLWL	Paulist Fathers	New York, N. Y.	370
WMAC	C. B. Meredith	Casenovia, N. Y.	225
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	428
WMAK	Norton Laboratories	Lockport, N. Y.	545
WMAL	M. A. Leese	Washington, D. C.	303
WMAN	First Baptist Church	Columbus, Ohio	234
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Macon Junior Chamber of Commerce	Macon, Ga.	270
WMBA	LeRoy Joseph Beebe	Newport, R. I.	204
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	252
WMBC	Michigan Broadcasting Co., Inc.	Detroit, Mich.	244
WMBD	Peoria Heights Radio Lab.	Peoria Heights, Ill.	205
WMBE	Dr. C. S. Stevens	St. Paul, Minn.	208
WMBF	Fleetwood Hotel Corp.	Miami Beach, Fla.	384
WMBG	Havens & Martin	Richmond, Va.	207
WMBH	Edwin Dudley Aber	Chicago, Ill.	204
WMBI	Moody Bible Institute	Chicago, Ill.	263
WMBJ	Wm. Roy McShaffrey	Monessen, Pa.	232
WMBL	Bonford Radio Studios	Lakeland, Fla.	229
WMBM	Seventh Day Adventist Church	Memphis, Tenn.	210
WMBO	Radio Service Laboratories	Auburn, N. Y.	220
WMBQ	Paul J. Gollhofer	Brooklyn, N. Y.	204
WMBR	Premier Electric Co.	Tampa, Fla.	252
WMBS	Mack's Battery Co.	Harrisburg, Pa.	234
WMBU	Paul J. Miller	Pittsburgh, Pa.	217
WMBW	Youngstown Bdcstg. Co., Inc.	Youngstown, O.	214
WMBY	Robert A. Isaacs	Bloomington, Ill.	200
WMC	Commercial Pub. Co.	Memphis, Tenn.	517
WMCA	Greely Sq. Hotel Co.	Hoboken, N. J.	370
WMPC	First Methodist Church	Lapeer, Mich.	234
WMRJ	Peter J. Prinz	Jamaica, N. Y.	207
WMSG	Madison Sq. Gard. Bdcast. Corp.	New York, N. Y.	236
WNAC	Shepard Stores	Boston, Mass.	353
WNAD	University of Oklahoma	Norman, Okla.	240
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Brothers Co.	Philadelphia, Pa.	283
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	303
WNBA	M. T. Rafferty	Forest Park, Ill.	208
WNBF	Howitt-Wood Radio Co.	Endicott, N. Y.	207
WNBH	New Bedford Hotel	New Bedford, Mass.	261
WNBJ	Lonsdale Baptist Church	Knoxville, Tenn.	207
WNBL	Gray, Trimble & Smith Electric Co.	Bloomington, Ill.	200
WNBO	John Brownlee Spriggs	Washington, Pa.	211
WNBR	Popular Radio Shop	Memphis, Tenn.	229
WNBQ	Gordon P. Brown	Rochester, N. Y.	203
WNJ	Herman Lubinsky	Newark, N. J.	280
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	265
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plans & Structures	New York, N. Y.	535
WOAI	Southern Equipment Co.	San Antonio, Texas	303
WOAN	J. D. Vaughn	Lawrenceburg, Tenn.	286
WOAX	Franklin J. Wolff	Trenton, N. J.	240
WOC	Palmer School of Chiropractic	Davenport, Iowa	353
WOCL	A. D. Newton	Jamestown, N. Y.	224
WODA	O'Dea Temple of Music	Paterson, N. J.	294
WOI	Iowa State College	Ames, Iowa	265
WOK	Chicago Beach Hotel	Homewood, Ill.	252
WOKO	Harold E. Smith	Peekskill, N. Y.	216
WOKT	Titus-Ets Corporation	Rochester, N. Y.	210
WOMT	Mikado Theater	Manitowoc, Wis.	222
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Walter B. Stiles, Inc.	Fernwood, Mich.	261
WOQ	Unity School	Kansas City, Mo.	337
WOR	L. Bamberger and Co.	Newark, N. J.	422
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	469
WOW	Woodman of the World	Omaha, Nebr.	508
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	229
WPAP	(See WQAO)	Cliffside, N. J.	395
WPCC	North Shore Cong. Church	Chicago, Ill.	224
WPCH	People's Broadcasting Corp.	New York, N. Y.	309
WPEP	Maurice Mayer	Waukegan, Ill.	216
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	273
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	210
WPSC	Pennsylvania State College	State College, Pa.	300
WPSW	Philadelphia School of Wireless Tel.	Philadelphia, Pa.	203
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	216
WQAM	Electrical Equipment Co.	Miami, Fla.	322
WQAN	Scranton Times	Scranton, Pa.	261
WQAO	Calvary Baptist Church	Cliffside, N. J.	395
WQJ	Calument Rainbo Broadcasting Co.	Chicago, Ill.	448
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	208
WRAH	S. N. Read	Providence, R. I.	200
WRAK	Economy Light Co.	Escanaba, Mich.	283
WRAM	Lombard College	Galesburg, Ill.	248
WRAV	Antioch College	Yellow Springs, Ohio	341
WRAW	Avenue Radio & Electric Shop	Reading, Pa.	238
WRAX	Beracah Church, Inc.	Philadelphia, Pa.	283
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	238
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wayne Radio Co.	Raleigh, N. C.	217
WREC	WREC, Inc.	Whitehaven, Tenn.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	231
WRES	H. L. Sawyer	Woloaston, Mass.	217
WRHF	Wash. Radio Hospital Fund	Washington, D. C.	319
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	205
WRM	University of Illinois	Urbana, Ill.	273
WRMU	Atlantic Bdcasting Co.	New York, N. Y.	201

Radio Tabloids

(Continued from page 8)

It is difficult to refer to the results of broadcast advertising without mentioning specific cases which might be undesirable, but ample evidence of its efficacy is available. The manufacturer of a tooth paste, whose product sold side by side with that of competitors, put on a radio "hour." He could not fail to notice that in districts covered by the broadcasting his sales increased many fold, while in other districts they remained about the same. Similar results have been had in radio receiving sets

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Chinese Radio

Admiral W. H. G. Bullard, in an address before the National Electrical Manufacturers' Association.

RADIO both for broadcasting or communication plays a very small part in the Republic of China. The Chinese Government maintains a few small powered costal stations for communication with ships at sea. The importation into China of any form of radio apparatus is prohibited by decree of Chinese Government, as such apparatus is classified as munition of war, although for those who have the proper influence, the ban may be lifted. An attempt to bring in radio apparatus is not an offense and if one is caught doing so, there is no penalty nor is the apparatus confiscated; it is simply not allowed to enter, and if one is caught in one port it is usually the practice to try another port.

Broadcasting as practiced in the United States is practically unknown. There is one small station in the International Settlement in Shanghai and the owner simply has to pay the police to keep away from it to allow him to continue. Recently, a change is coming over responsible officials, particularly in the Northern sections, notably in Manchuria, where the so called ruling War Lord has been convinced by one of his aids—a returned United States student—that radio broadcastng might fulfill a long felt want. In consequence, an American doing business in China has given a contract to erect a broadcast station in Mukden which is about ready to operate.

WRNY	Experimenter Publishing Co.	Coytesville, N. Y.	309
WRR	City of Dallas	Dallas, Tex.	353
WRRS	F. G. Leavenworth	Racine, Wis.	322
WRSC	The Radio Shop	Chelsea, Mass.	205
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	211
WRVA	Larus & Brother Co., Inc.	Richmond, Va.	254
WSAI	United States Playing Card Co.	Cincinnati, Ohio	361
WSAJ	Grove City College	Grove City, Pa.	224
WSAN	Allentown Call Publishing Co. Inc.	Allentown, Pa.	222
WSAR	Daughy & Welch Electrical Co.	Fall River, Mass.	252
WSAX	Zenith Radio Corp.	Chicago, Ill.	204
WSAZ	Chase Electric Shop	Huntington, W. Va.	242
WSB	Atlanta Journal	Atlanta, Ga.	476
WSBC	World Battery Co.	Chicago, Ill.	232
WSBF	Broadcasters	St. Louis, Mo.	441
WSBT	South Bend Tribune	South Bend, Ind.	238
WSDA	City Temple	New York, N. Y.	227
WSEA	Virginia Beach Broadcasting Co.	Virginia Beach, Va.	219
WSIX	638 Tire & Vulc. Co.	Springfield, Tenn.	213
WSKC	World's Star Knitting Co.	Bay City, Mich.	492
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	341
WSMB	Saenger Amuse. Co.	New Orleans, La.	322
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	297
WSOE	School of Engineering	Milwaukee, Wis.	270
WSOM	Union Course Laboratories	Woodhaven, N. Y.	246
WSRO	Harry W. Fahrlander	Hamilton, Ohio	384
WSSH	Tremont Temple Bap. Church	Boston, Mass.	250
WSUI	State University of Iowa	Iowa City, Iowa	422
WSVS	Seneca Vocational School	Buffalo, N. Y.	205
WSYR	Clive B. Meredith	Syracuse, N. Y.	225
WTAD	Ill. Stock Medicine Corp.	Quincy, Ill.	236
WTAG	Worcester Telegram	Worcester, Mass.	517
WTAL	Toledo Broadcasting Co.	Toledo, Ohio	280
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	400
WTAQ	Gillette Rubber Co.	Eau Claire, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	275
WTAS	Richmond Harris & Co.	Batavia, Ill.	275
WTAW	A. & M. Coll. of Texas	College Sta., Texas	309
WTAX	Williams Hardware Co.	Streator, Ill.	322
WTAZ	Thomas J. McGuire	Lambertville, N. J.	220
WTHO	W. J. Thomas Radio Co.	Ferndale, Mich.	219
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WTRL	Technical Radio Laboratory	Midland Park, N. J.	207
WWAE	L. J. Crowley	Chicago, Ill.	232
WWJ	Evening News Assn.	Detroit, Mich.	375
WWL	Loyola University	New Orleans, La.	275
WWNC	Chamber of Commerce	Asheville, N. C.	297
WWRL	Woodside Radio Laboratories	Woodside, N. Y.	268
WWVA	John C. Strobel, Jr.	Wheeling, W. Va.	389

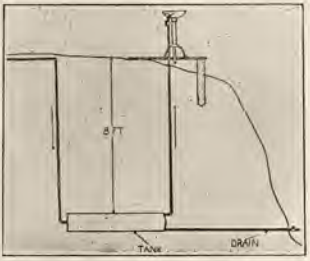
Dominion of Canada

CFAC	Calgary Herald	Calgary, Alta.	434
CFCA	Toronto Star Pub. & Prtg. Co.	Toronto, Ont.	356
CFCF	Marconi Wireless Teleg. Co., (Ltd.)	Ca. Mont., Que.	411
CFCH	Abitibi Power & Paper Co. (Ltd.)	Iroquois Falls, Ont.	500
CFCK	Radio Supply Co.	Edmonton, Alta.	517
CFCN	W. W. Grant (Ltd.)	Calgary, Alta.	434
CFCR	Laurentide Air Service	Sudbury, Ont.	410
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	268
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHCS	The Hamilton Spectator	Hamilton, Ont.	341
CHIC	Northern Electric Co.	Toronto, Ont.	357
CHNC	Toronto Radio Research Society	Toronto, Ont.	357
CHUC	International Bible Ass'n.	Saskatoon, Sask.	329
CHXC	R. Booth, Jr.	Ottawa, Ont.	434
CHYC	Northern Electric Co.	Montreal, Que.	411
CJCA	Edmonton Journal	Edmonton, Alta.	517
CJGC	London Free Press	London, Ont.	329
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	411
CKCK	Leader Pub. Co.	Regina, Sask.	312
CKCL	Dominion Battery Co.	Toronto	360
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	Int'l Bible Students Ass'n.	Toronto	291
CKFC	First Congregational Church	Vancouver, B. C.	411
CKNC	Canadian National Carbon Co.	Toronto, Ont.	357
CKOC	Wentworth Radio Supply Co.	Hamilton, Ont.	341
CKY	Manitoba Tel. System	Winnipeg, Man.	384
CNRA	Canadian National Railways	Moncton, N. B.	322
CNRC	Canadian National Railways	Calgary, Alta.	435
CNRE	Canadian National Railways	Edmonton, Alta.	517
CNRM	Canadian National Railways	Montreal, Que.	411
CNRO	Canadian National Railways	Ottawa, Ont.	434
CNRQ	Canadian National Railways	Quebec, Que.	341
CNRR	Canadian National Railways	Regina, Sask.	312
CNRS	Canadian National Railways	Saskatoon, Sask.	329
CNRT	Canadian National Railways	Toronto, Ont.	357
CNRV	Canadian National Railways	Vancouver, B. C.	291
CNRW	Canadian National Railways	Winnipeg, Man.	405

Home-Made Cooler

Cool water for the home, summer cottage, or golf course may be provided by the installation of a simple cooling system. This arrangement consists essentially of an ordinary galvanized iron hot-water tank buried in a horizontal position at least eight feet below the surface of the ground and connected to a drinking fountain or faucet placed at the surface.

The tank should be placed so that one end will be slightly lower than the other. The inlet pipe is connected to the higher end. To the lower end, at the bottom, is attached a drain pipe which is used to remove water from the tank during cold weather or when the system is cleaned. The outlet pipe to the fountain or faucet runs from the upper side of the lower end. To facilitate draining, the tank should be placed near an embankment, or near a cellar into which the drain pipe is run.



Several coolers of this type have been installed at the Fairlawn golf course near Akron, Ohio. Water from the surface sprinkling system often reaches a temperature near the boiling point, but after being passed through the tank it emerges from the fountain at about fifty degrees Fahrenheit.

The most satisfactory size of tank is a 40-gallon one. Where the consumption of water is great, a larger size should be used. It has been found that cooler water will be produced if the tank is buried in clay soil, rather than in sand.

See Page 1 for facts about back issues of this magazine covering famous World's Record Super.

Radio Aids Air Mail

(Continued from page 24)

zone in the direction of flight—when flying across the equisignal zone. The shift was greatest when the airplane was flown at right angles to the equisignal line. When flying to or from the transmitting coil the shift was not noticed.

The apparent displacement of the equisignal zone in the direction of flight was more marked the greater the altitude of flight. Twenty miles from the radio beacon station this shift at an altitude of 1,000 feet was found to be one mile; that is, an airplane flying in one direction across the equisignal zone found this zone displaced from its true position one mile in the direction of flight; an airplane flying in the opposite direction found the equisignal zone displaced one mile in the new direction of flight. At 2,000 feet this zone displacement appeared to be 2 miles, and at 3,000 feet it appeared to be 4 miles. At all altitudes, however, with the airplane in a stall so that the trailing antenna hung vertically or when the airplane was flying toward or away from the beacon station there was no zone displacement, the zone being located in the position determined by ground tests.

"The result of these tests," indicated the Bureau of Standards, "in which a light antenna weight and a 200-foot trailing wire were used, showed that the apparent shift in the equisignal zone was due entirely to the type of receiving antenna used and its inclination to the vertical. By using a short trailing wire with a much heavier weight the antenna hung in a nearly vertical position, thus eliminating the zone displacement effect to a large extent. Such an antenna is best suited for this type of reception, as any ambiguities arising from an apparent shift in the equisignal zone when the airplane is turned are practically overcome. The use of a coil antenna in place of a trailing wire is equally effective in this respect, but cannot be worked over as great a distance."

Of the future of this far-reaching system of guiding aircraft by slender beams of directed radio, Dr. Dellinger states:

"In carrying out its newly assigned responsibilities to provide aids to air navigation on the civil airways, the Department of Commerce has concluded that radio aids are indispensable. As the first step in establishing these radio aids the Bureau of Standards has been assigned certain research work and is setting up model installations.

"It has been established that the airways must be provided with a system of radio telephone transmitting stations and directive beacons at certain intervals. At smaller intervals between the directive beacon, probably every 25 miles, are to be located the marker beacons. It is not yet certain whether the beacons will operate by means of an audible or a visual signal on the airplane, and the determination of this is one of the principal objects of the investigations now in progress.

CLASSIFIED ADVERTISEMENTS

If you have anything to buy or sell, don't overlook RADIO AGE'S classified advertisements.

The classified advertising rates are but four cents per word for a single insertion. Liberal discounts are allowed on six and twelve-time insertions, making rate of 3 and 2 cents a word per insertion respectively. Unless placed through an accredited advertising agency, cash should accompany all orders. Name and address must be included at foregoing rates. Minimum contract charge $1.00.

All Classified ads for October issue must be sent in by Aug. 25.

AGENTS

RADIO AGENTS—Make Big Money—Easy! selling Marvelous New Sets and Accessories. Buy from factory at lowest prices. Get New Catalog with thousands of nationally advertised bargains. FREE Call Book. Write today. American Auto and Radio Co., Dept. 138, American Radio Bldg., Kansas City, Mo.

Sell Radio Sets on time $10.00 down buys 5 tube set. Agents get my special prices. Bargain Speakers; order now. T. King, 609 Oneida St., Syracuse, N. Y.

AIRPLANES

SEND FOR free illustrations and plans of our wonderful two-place, companion type, small, high lift wing monoplane, and information on how to build this ship, and be sure it will fly; also propeller literature. Crawford Airplane Manufactory, 2225 American Avenue, Long Beach, California.

BOOKS AND MAGAZINES

Judge Lindsey's "companionate marriage" hoax exposed! Rich debate! Flays other "doctrines". Expanent 15c. Orlando, Fla. Consigned: Newsdealers, Agents.

FREE—Two big New Magazines and information worth hundreds of dollars to you. Enclose 2c stamp. Salesmanager, Box 74-R, Beaver Dam, Wisconsin.

What could be better than magazine subscriptions for gifts. Send stamp for our special list of subscription bargains. Midland Products, Dept. R. A., 524 Courtland Ave., Park Ridge, Illinois.

Twentieth Century Book of Receipts, Formulas and processes, an 807 cloth bound book containing 10,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Sent prepaid upon receipt of $4.00. Send dime for our 48 page catalog of latest and best practical, scientific mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Ill.

BOYS

Boys get a three foot model aeroplane free. No selling. Write for particulars. Aero Shop, 3050 Hurlbut Ave., Detroit, Michigan.

RADIO SET FREE, form magazine clubs among friends. Club list free. Spencerian Agencies, Los Angeles, Brentwood Heights, California.

BUSINESS OPPORTUNITIES

PECAN-Orange-Fig Groves "On the Gulf". Monthly payments. Guaranteed euro. Big, quick returns. Suburban Orchards, Dept. R, Biloxi, Mississippi.

MAKE RADIO PANEL LAMPS. Inventor can supply necessary parts. Easily assembled. Rests on top of radio cabinet. Lights dials. Information free. Sample Lamp $1.25. Postpaid. Robert Stevenson, Lancaster, Ohio.

LAND FREE if planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant five acres, which should pay $1,500 profit annually. Reliable Companies will cultivate and market your bananas for 1/3. Bananas ripen every day and you get your check every 30 days. For particulars address Jantho Plantation Co., Empire Building, Block 765, Pittsburgh, Pa.

FOR SALE—Patent on fountain mop and duster. I have party offered to take five hundred dozen per month. Lester Deak, McMinnville, Tennessee.

DOGS

BEAUTIFUL REGISTERED BULL PUPS $15. Bulldogs. 801 Rockwood, Dallas, Texas.

ELECTRICAL

ELECTRIC FUN! Seventy stunts, 110 volts, $1. Circuiting, Campbell, Calif.

FORMULAS

20c—Any Formula, 20c. "Hawkins," 2158 Lasanimas, Colorado Springs, Colorado.

MISCELLANEOUS

NEUTRODYNE AND HETERODYNE ARE GOOD AS FAR AS THEY GO. THE BEST ONE TUBE SET FOR PYORRHEA IS ZI-O-DINE (tooth-paste). SATISFACTION GUARANTEED. FIFTY CENT TUBES BY MAIL. IODINE PRODUCTS COMPANY, LAUREL, MISS.

"MUSIC Composed" to words, Bauer Bros., (formerly of Sousa's Band). Oshkosh, Wis.

GILLETTE STYLE Razor with 10 Blades 60c Prepaid. Loud Speaker $3.89. Speaker Unit $1.10 prepaid. Transformer 25c. Mole Station A, New Haven, Conn.

PANEL ENGRAVING

SINGLE PANEL and medium quantity engraving of highest quality. Also panel drilling, motor cutouts and machine engraving on small parts. Careful attention to single panels and special work. Write for price-list. A. L. Woody, 19 S. Wells Street, Chicago.

PERSONAL

LONELY HEARTS: Exchange letters; make interesting new friends in our jolly club. Particulars free. Eva Moore, Box 908, Jacksonville, Florida.

RADIO

EXTRA HEAVY Antenna wire 7 No. 18 $1.50 100 feet. 17 No. 22 braided 3/8" wide $2.00 100 feet all prepaid. George Senulz, Calumet, Michigan.

MR. H. SADZECK, 1636 Addison St., Chicago, Ill., writes us as follows: "I bought one of your Radio Trouble-Shooters. Just the thing I have been looking for, Dandy. Please send me catalog or literature of other parts you carry. Thanking you for this favor, I am (Signed) H. Sadzeck." It will pay you to investigate at Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, Ill.

Radio Books—Construction of a modern Super Heterodyne Type Receiver including Testing and Operation $1.00; Henley's 222 Radio Circuit Designs, 267 pages, $1.00; The ABC of Vacuum Tubes used in Radio Reception 132 pages, 75 cents; Henley's Workable Radio Receivers 198 pages $1.00; Experimental Wireless Stations 392 pages $2.00; Wireless Telegraphy and Telephony Simply Explained 154 pages $1.00. Sent prepaid on receipt of price. Send dime for our 48 page catalog of latest and best practical, scientific, mechanical and industrial books. Midland Products Co., Dept. RA, 524 Courtland Ave., Park Ridge, Illinois.

SILICON Transformer Steel cut to order .014", 10 lbs. 25 cents, 5 lbs. 30 cents, less than 5 lbs. 35 cents per lb., 4 cubic inches to the lb. postage extra. At least ½ cash with order—balance C. O. D. Geo. Schulz, Calumet, Michigan.

PURE ALUMINUM and lead rectifier elements, holes drilled, with brass screws and nuts per pair 1-16", 1"x4", 13c, 1x5, 15c, 1½x5, 17c, 1½x8, 19c, single elements half price. Sheet aluminum 1-16", $1.00, 1-8" $1.50. Lead $1.00 square foot all prepaid. Geo. Schulz, Calumet, Michigan.

CONDENSERS, 800 VOLT FILTER, .1 mfd 45c, .25 6ic, .3 69c, .5 75c, 2. $1.20, 3. $1.80, 4. $2.40, 1500 VOLT FILTER, .1 51c, .25 60c, .5 75c, 1. $1.05, 2. $1.95, 3. $2.70, 4. $3.80. ELIMINATOR BLOCKS, 2, 2, and 8 $5.78, 2, 2, 8 and 1 $6.16, 2, 2, 8, 1 and 1 $6.80, .1 and .1 in series 90c. Many other eqpatities. Acme transformers and chokes. THE RADIO CLUB, INC., La Porte, Ind.

IVORY RADID PANEL beats them all. Write for FREE Sample. Ivorylite Radio Panel Co., 3330 Ave. G Fort Worth, Texas.

Complete kit for S-M 7 tube Super including every part —Panel, dials, etc. Guarantee new and perfect. First $41.50. P. E. Chapman, 841 Preston, Philadelphia, Pa.

AMAZING RADIO OFFER. 3 new S-M 7 tube Super Hets engraved panels—Sub-base completely wired. Beautiful folding loop FREE. The choice of experts—Coast to Coast on loop. Without cabinet $52.50 each. The Radio Hospital, 841 N. Preston, Philadelphia, Pa.

Iron core chokes 20H-25 MA $1.00. 30H-60MA $2.25. 30H-85 MA $2.75. 30H-125 MA $3.75. 30H-85 MA $2.75. 50H-125 MA $5.75. Write for list or let us quote on your requirements. Radio Parts Sales Co., Orange, N. J.

10% off all standard radio apparatus laboratory tested radiotron UV 201A's at only $1.70. Postage prepaid. Petsto Radio Laboratories, Wauwatosa, Wisconsin.

METERS—CONDENSERS—"B" eliminator parts. Power transformers $2.00 up. High grade chokes $2.25 up. Write for lists of specials. We can quote prices on any material you require. Radio Parts Sales Co. Orange, N. J.

CHOKES 10H,—50, or 30 Henry 125 M. A. $5.75. 30H, 50H; 65 M. A. $2.75, 420V and 6V transformer $4.00. 550V $3.50. 280V—$2.00. 5-1 Ratio Audio Transformers 10 for $5.00. Write for lists. Radio Parts Sales Co., Orange, New Jersey.

RUBBER STAMPS

RUBBER STAMPS and supplies. 20c per line. Cushion mounted. Catalog for stamp. Newman & Son, Auburn, Nebraska.

RUBBER STAMPS! Name, Address, two lines 25c. Three Lines 35c. C. Brush Company, Auburn, Nebraska.

SALESMEN WANTED

75 MILES ON 1 GALLON—New Moisture Gas Saver. All Cars. 1 Free. CRITCHLOW, A2-91, Wheaton, Ill.

STAMMERING

STAMMERING quickly and cheaply cured in your own home. Free book of facts with proof of cures. Write, Mohr, 34 Fernhill Avenue, Buffalo, New York.

TYPEWRITERS

TYPEWRITERS, all standard makes, $10 up. Fully Guaranteed. Free Trial. Write for COMPLETE illustrated lists. Northwestern Typewriter Exchange, 121 N Franciseo Ave., Chicago.

WANTED TO BUY

Full value paid for old GOLD jewelry, silver or platinum. Packages returned if our offer not satisfactory. Elaine Specialty Company, 3330 Ave. G, Fort Worth, Texas.

Radio Age Classified Ads Bring Results

"....You're *there* with a Crosley"

These approved cabinets have been selected by Powel Crosley, Jr., as ideal consoles, acoustically and mechanically, for the installation of the Crosley "BANDBOX." Genuine Musicones built in. Crosley dealers secure them from their jobbers through

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Recent court decisions which clarified the radio patent situation have paved the way for still greater Crosley triumphs.

Now—completely available to Crosley—and amplifying Crosley supremacy in fullest measure, are the enormous resources, great discoveries and ideas embodied in patents of

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4—The General Electric Co.
5—The American Telephone & Telegraph Co.
6—The Hazeltine Corporation.
7—The Latour Corporation
under which Crosley is now licensed to manufacture.

Here are the seven big things which represent radio's greatest advancement, brought together by Crosley and combined with the experience, mass production method and leadership of the Crosley organization. No wonder a waiting radio world pronounces the "Bandbox" at the unprecedented price of $55, Crosley's paramount achievement.

The Bandbox is Shielded

Radio coils are surrounded by magnetic fields similar in every respect to the magnetic field around the earth that moves the needle of a compass but around radio coils these fields make nuisances of themselves by feeding back on each other. Heretofore it has been customary to make inefficient coils with inefficient fields to prevent such feeding back. The Crosley Bandbox incorporates copper shields around each coil to prevent such feeding back. The coils consequently can be made and are very much more efficient. The amplification of the receiver is, therefore, much higher—the sensitivity is greatly increased. Condensers are also completely shielded from each other in separate metal compartments. Hitherto, only high priced sets have enjoyed this super radio advantage.

There is No Oscillation

The Bandbox employs completely balanced or neutralized radio frequency stages to prevent oscillation, instead of the common form of looser method. More costly, to be sure, but extremely necessary in achieving such results as are obtained by this marvel of radio reception.

For Sharpness—The Acuminators

"Bandbox" acuminators enable "fishers" for distant stations to bring them in loud and clear. As powerful telescopes magnify distant scenes, acuminators increase the volume of far-away signals so they seem like local programs.

Volume Control

This is another big "Bandbox" feature which permits full brass band power for those who want their dance notes strong and loud. For others, it cuts volume down to a soft and gentle murmur, without distortion.

Illuminated Dial

A Master Station Selector has an illuminated dial for easy reading in shadowy corners. A single knob permits full tuning for ordinary reception of local, nearby and super-powered stations.

Installation Simplified

A woven cable, containing vari-colored rubber covered leads makes installation and hook-up easy for the veriest novice. No waiting for the radio service man, should the batteries be changed.

Easily Adapted to Consoles

Simply remove screws in escutcheon and in base of set. Lift off metal case. Chassis now stands ready for installation in console cabinet. Opening in console cabinet permits control shafts to protrude. Escutcheon screws in place and—Presto! the console radio is complete.

For A C Operation

a special Bandbox is available at $65, wired specially for use with the Crosley Power Converter at $60. This special Bandbox utilizes the new R.C.A. AC tubes which have made the operation of radio receivers direct from house current so simple, efficient and dependable. The first three tubes employed in the AC model are UX 226. These go into the radio frequency sockets. The detector tube is UY 227, with indirectly heated emitter. Another UX 226 is used in the first audio stage. Raw A C current heats the filament of all UX 226 tubes. Power tube UX 171 is in the last audio socket. This makes the "dog houses" rumble sonorously and the bass drums deeply boom.

Improved Musicones

Although Musicones improve the reception of any radio set, they are perfect additions in finish, beauty and reproductive effectiveness for Crosley Radios. A new model built in the form of a Colonial Tip-Table with brown mahogany finish, stands 3 feet high. Price $27.50.

16-Inch Super Musicone
(As pictured with Bandbox)
$12.75

12-Inch Ultra Musicone
$9.75

The Power Converter

The power converter which smooths the alternating current is a marvel of engineering ingenuity. Only half the size of an ordinary "A" storage battery, it supplies the required A, B and C currents, without hum. Finished in brown frosted crystalline.

There are models for 25 and 60 cycle current. A snap switch shuts down the set and power coverter completely.

Price of Power Converter—$60

You owe it to yourself to see the "Bandbox" and listen to its remarkable performance. If you cannot easily locate the nearest Crosley dealer, his name and address will be supplied on request. Write Dept. 63.

CROSLEY RADIO

Crosley Radio is licensed only for Radio Amateur, Experimental and Broadcast Reception.

Crosley recommends the use of five power tube, or Cunningham equivalents prices, with each Bandbox. While Radiotrons and one UX171 which are furnished at standard tube gives superior performance for 135-volt "B" batteries. from UX-171 is 180-volt tube, it

201-A Radiotrons and one UX171 which are furnished at standard tube from UX-171 is 180-volt tube, it gives "B" batteries.

THE CROSLEY RADIO CORPORATION

Powel Crosley, Jr., *Pres.*, Cincinnati, O.

Prices slightly higher west of the Rocky Mountains.

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