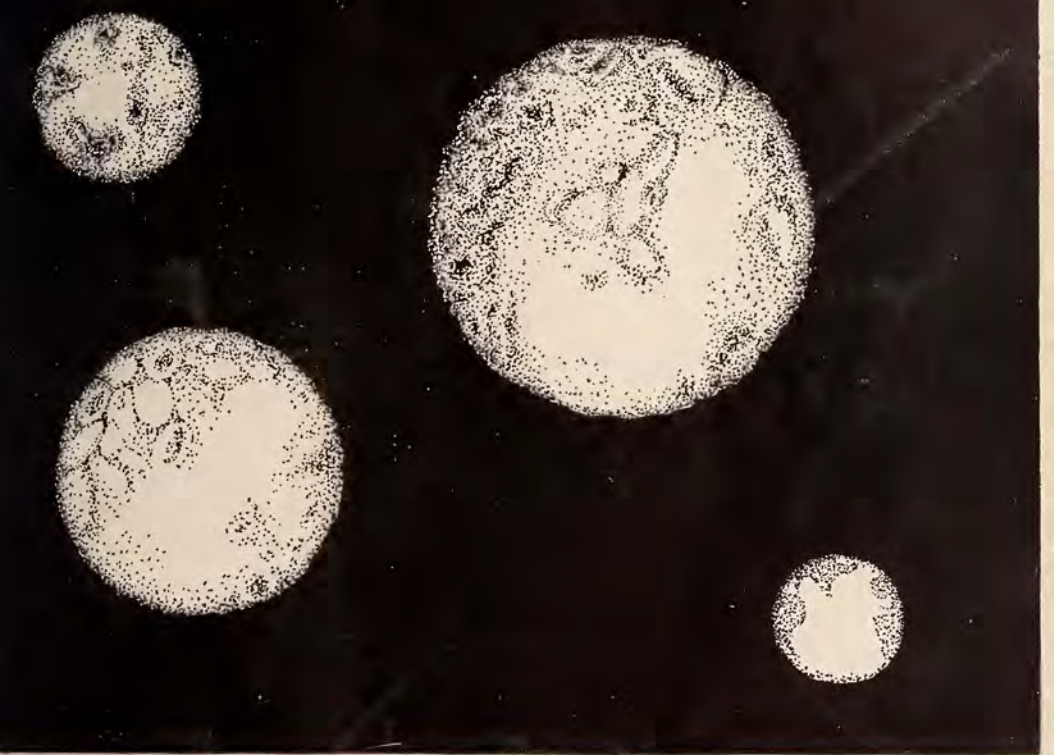
Blueprint Section Every Month

RADIO AGE

The Magazine *of the* Hour



(See story page 18)

February 1927

¶ Building the Hammarlund-Roberts
¶ Keeping Step With Science
¶ Everyday Mechanics

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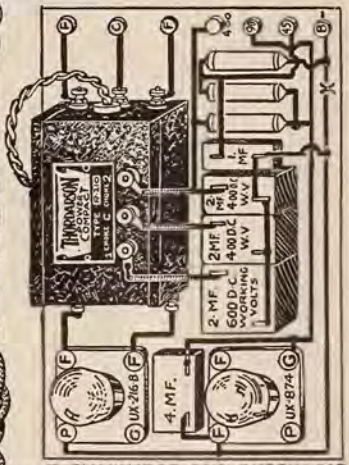

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RADIO AGE

The Magazine of the Hour

Established March, 1922

Volume 6 *February, 1927* *Number 2*

CONTENTS

FOR FEBRUARY ISSUE

Cover Design by A. P. Mehlum

Radio Age is published monthly by RADIO AGE Inc.
Member: Audit Bureau of Circulations.
Publication Office, Mount Morris, Ill.
404 North Wesley Ave.,
Address all communications to RADIO AGE, Inc.
Executive, Editorial and Advertising Offices
500 N. Dearborn Street, Chicago, Ill.

FREDERICK A. SMITH, *Editor*
F. A. HILL, *Associate Editor*
M. B. SMITH, *Business Manager*

Advertising Manager
HARRY A. ACKERBURG
500 N. Dearborn St., Chicago, Ill.

Eastern Representative
HEVEY & DURKEE, 15 West 44th St., New York, N. Y.

Pacific Coast Representative
CONGER & MOODY, Sharon Bldg., San Francisco, Calif.
CONGER & MOODY, Higgins Bldg., Los Angeles, Calif.

Final Advertising forms close on the 20th of the 2nd month preceding date of issue

Vol. 6, No. 2, Issued monthly. Subscription price $2.50 a year. February, 1927. Entered as second-class matter at post office at Mount Morris, Illinois, under the Act of March 3, 1879.

Chats With the Editor

BUILDING activity has been greater than ever before if the volume of correspondence from our readers is any indication of the virility of the parts business and the human urge to accomplish something constructive and yet entertaining. Especially is this true of the eight tube super which was featured in November and January. For March we are preparing another feature in supers—this one to be known as the Ideal World's Record Model. It is made, tested and described by the staff of the RADIO AGE laboratory. Be sure to get your March copy either by subscribing for the magazine or else putting in your order with the newsdealer.

Speaking of supers we have another treat for experimenters with this type of set in a forthcoming series of articles from the pen of D. S. Breitenbach, who is describing the various forms of oscillator tuning, first and second detector detection, intermediate oscillation control and other items dear to the heart of the super experimenter. Watch for these articles in an early issue of this magazine.

Cone speaker enthusiasts will find a construction article of interest on page 11—you'd be surprised to see how easy it is to build a good three-foot cone. And if the wife thinks she is left out of the picture, tell her she may have the pleasure of decorating the face of the cone with an attractive water color design. Or she may even resort to the use of the familiar decalcomanias with which we, as children, adorned our school books.

In the blueprint section of this issue will be found instructions for building the Browning-Drake in power form; that is, using a 171 power tube supplied from a power compact which produces the A, B and C voltages for the 171 and the B voltages for the rest of the receiver.

Frederick Smith

Editor of RADIO AGE.

The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.

Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.

This is the Heavy-Duty Battery in which the new Layerbilt construction provides greater economy

THERE'S an important discovery in radio economy awaiting all users of loud-speaker sets who have been buying the smaller Light-Duty "B" batteries instead of the large Heavy-Duty size required by such sets. Because the Light-Duties cost somewhat less to buy they seem like an economy, but the surprising fact is that the Eveready Layerbilt No. 486 lasts more than twice as long though it does not cost anywhere near twice as much. It is, therefore, much more economical—we believe it to be the most economical "B" battery ever built. Certainly it has proved this by laboratory tests and the service it has given to radio listeners in their own homes during the past eighteen months.

Eveready Layerbilt's remarkable life is due to its unique construction. All other dry cell "B" batteries are assembled of cylindrical cells, with much waste space between them, and many soldered connections bridging the gaps.

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This patented, exclusive battery is built in layers of flat current-producing elements, making automatic connection with each other. Every available inch inside the battery is occupied usefully. You get more battery for your money, and that battery is more efficient.

Remember this about "B" batteries: All loud-speaker sets require Heavy-Duty batteries, and the Eveready Layerbilt has proved time and again to be the longest lasting and most economical Heavy-Duty "B" battery.

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WTAM—*Cleveland*
WWJ—*Detroit*
WGN—*Chicago*
WOC—*Davenport*
WCCO { *Minneapolis* / *St. Paul*
KSD—*St. Louis*
WRC—*Washington*

RADIO EDITORIALS

PRE-EMINENT in many other ways, the Chicago Tribune appears to have taken the lead in the radio broadcasting field. It probably was inevitable that the paper should have set the pace after it awoke from its long indifference to radio. The explanation for the excellent programs regularly offered by the Tribune lies in the fact that it has devoted intelligence and money to the effort—plenty of both.

The Tribune does not copy other newspapers in any of their or its departments. It sets a policy, based on careful consideration of readers' wants and interests, and then adheres to that policy. Therefore, when it began broadcasting it did not fall into step with the unfortunately popular idea that all a radio station needs is a ukelele picker, a whiney tenor weeping for a lost pal o' his, a triple-action saxophone jazz outfit and an announcer who cracked jokes about hip liquor and baby dolls.

The outstanding distinction of WGN is that its programs are sufficiently diversified to appeal to everybody. The radio features may be likened to the various religious beliefs. As the old negro expressed it "They may not touch all 'round, but they all touch somewha'ar."

The Tribune, in short, made a decision which we devoutly wish all other broadcasters had made before they started operations. The newspaper decided that unless it was to put on programs that were better than the other fellow's programs, there was no use in broadcasting at all. A newspaper which spends great sums of money in developing programs of surpassing merit and which does not too obviously intrude upon the listener with advertisements of its own high quality as a newspaper is entitled to the generous support of radio fans everywhere.

* * * * *

SPEAKING of newspapers in the broadcasting fields, it would be positively unfair not to mention the Chicago Daily News. Miss Judith Waller, director of WMAQ, doesn't take a back seat for any man director when it comes to obtaining good features and putting them on with professional skill and spirit. She has won the gratitude of many thousands of listeners by her production of sport-news features and she has a sure sense of what the public wants in musical numbers. The American Bar Association suggests that the over-supply of broadcasting stations be remedied by eliminating the "non-essential" stations. We hope that when the authorities swing their snickersee, if they ever do, they will leave untouched such stations as WGN and WMAQ.

* * * * *

ROBERT Casey, writer extraordinary, is a member of the editorial staff of the Daily News. He is the author of those whimsical and delectable comments on everyday incidents known as the "Vest Pocket Anthology." He is also a radio experimenter and a widely-followed writer on experimental radio. Recently he wrote an article in the News in which he referred to a hook-up which Fred Hill had described in RADIO AGE. Mr. Casey confessed that he at first paid little heed to the rumors heard about the "hokum corners" that the set actually worked. Mr. Casey says he doesn't have much faith in the general run of comment on new circuits. But he tried this one and it worked. If you want to see the set call on Lou Straus at the Newark Electric Co., Chicago, or write us about it.

* * * * *

THE folks are turning more and more to super-hets. In that connection it is pleasant to be able to announce that the next few issues of RADIO AGE will have a generous supply of super-het material. Mr. Hill is working on various developments in this magazine's laboratories at Hinsdale. You will want to follow his descriptions and constructional articles.

* * * * *

THE Radio Manufacturers' Association will hold a show for jobbers and dealers in the new Stevens Hotel, Chicago, the week of June 13. Models for the 1927-1928 season will be on display and we believe the exhibition will do a great deal toward eliminating the seasonal aspect of the radio industry.

* * * * *

THOSE stations which are trying to build up good will by reaching distant listeners would do well to remember that the announcer who assumes that the listener knows it is his station and himself announcing without having been told so between numbers is going to lose more good will than he accumulates. It does make a feller sore to wait for an orchestra to complete a number and then have the announcer glibly go on with another number without giving the station call letters. Why do they do it? Will some announcer please explain? Let's make the logging of distant stations a bit more satisfactory by cutting out the mystery.

* * * * *

ONE of our readers has solved the problem of what is to become of the vast array of miscellaneous radio parts which every experimenter accumulates in his quest for the world-beating circuit and set. In his own neighborhood this reader found a number of crystal fans who did not feel parts for a tube set were within the reach of their purse. Our reader, remembering the thrill he felt when changing over from crystal to tube, and especially when he brought in his first DX station, foraged around in the dusty collection of coils, condensers, sockets and the like until he had found enough material for three one tube receivers. These supplies were turned over to his neighbors who are now enjoying distant reception (compared to their crystal sets). Other readers may find a tip in the foregoing that will give them pleasure and swell the ranks of the experimenters.

RADIO AGE
The Magazine of the Hour

M. B. Smith
Business Manager

A Monthly Publication Devoted to Practical Radio

Frederick A. Smith
Editor

Two Tubes and Regeneration

By ARMSTRONG PERRY

BEFORE advising anyone to build a regenerative receiver, it is only fair to issue a warning that regenerative sets became such a nuisance, soon after broadcasting attracted the general public to radio, that the United States government called conferences in which serious recommendations were made (by manufacturers who were building other types of receivers!) that the manufacture, sale and use of regenerative sets should be prohibited by law. Such a prohibitory law might be enforced more easily than another one that has been quite a live topic of conversation for the past few years, for a government inspector with a radio compass can locate a blooper more easily than an enforcement agent can find a still.

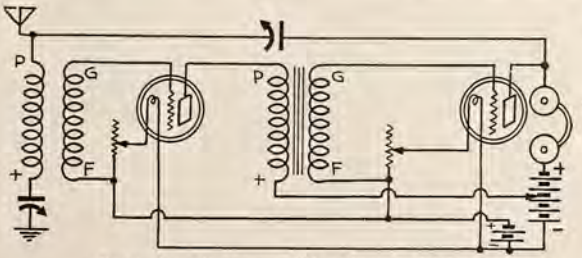
The principle of regeneration is as sound in radio as it is in religion. It must be, for one man is said to have been paid a million dollars for a patent on it and another man spent thousands in proving to the satisfaction of the courts that the fellow who got the million only copied his invention. Superregeneration will amplify energy so tremendously that a receiver using it will pick up a whisper from a man a hundred feet away and throw it back with the volume of a cannon's roar, or make the footsteps of a fly on a bald man's head resound like the ambling of an elephant on a tin roof.

REGENERATION is a method of salvaging some of the radio-frequency energy that passes through a radio tube—which has no useful effect on the side where the phones or loud speaker are—and feeding it back into the grid circuit so that it increases the energy that controls the volume of the sounds we hear. Even a novice, by doing a little experimenting, can learn to use regeneration successfully.

Having made the plunge into the field of multitube set construction, as far as two tubes, the constructor asks himself which tube shall be the detector and which the amplifier. If the first tube, counting from the antenna, is the amplifier, the set will have one stage of radio-frequency amplification. If the first tube is the detector and the second the amplifier, then the amplification will be of the audio-frequency variety.

The builder who wants to pull in the far-away stations will find that radio-frequency amplification will give him the best chance, for the R. F. amplifier increases the weak signals more than the stronger ones. If he wants more volume on stations that can be heard with one tube, then the second tube should be used as an audio-frequency amplifier.

The beginner will have better luck if he tries audio-frequency amplification at first, making the first tube the detector. Radio-frequency amplification is more difficult to handle because the filament and plate, and filament and grid, form small condensers whose capacity, small as it is, has effects that may be hard to overcome. There may be inductive effects that are troublesome also. The tube may howl at the slightest provocation and for no reason that the novice can discover. If radio-frequency amplification is attempted, it should be remembered that a potentiometer, otherwise known as a stabilizer or voltage divider, will be of great assistance in steadying the action of the tube. It should be connected across the



For receiving long waves without tuner or detector

terminals of the "A" battery of the amplifier tube. The device is similar to a rheostat but has terminals at both ends and a sliding contact in the middle which is connected with the lower end of the secondary coil of the first transformer, or to the ground.

There is one advantage in using a radio-frequency amplifier with a regenerative detector, namely, it may stifle the howls of the detector tube before they goad the neighbors to the point of committing justifiable homicide.

The safest recommendation for the average fan who is just striking out into multitube construction is to make the first tube a regenerative detector, with a variocoupler between it and the antenna, use the second tube as an audio-frequency amplifier, and be careful in tuning to keep the tube from howling. Single-circuit regenerative receivers are almost sure to become a nuisance to listeners for blocks around, but with coupled circuits between the antenna and the tube, careful operation usually will prevent any serious disturbance.

As selectivity is important in these days of multiplying broadcasters, it is better to spend a little more money and secure more satisfactory results than are likely to be obtained from the simplest and least expensive outfit. Secure a good variocoupler and two variometers adapted to the wavelengths to be covered. It is almost if not quite impossible to cover the entire broadcasting band efficiently with one receiver, so it is good policy to aim to bring in one station with maximum strength and clarity and then take whatever else comes along for good measure. A station can be selected that has programs you like to hear, and whose wave is near the middle of a waveband that includes other good stations. The receiver that will bring in the one station satisfactorily will probably reach well up and down the scale and miss only those whose wavelengths are at the extremes. There will be enough in any case.

To complete the outfit, secure two tubes, good sockets, an audio-frequency transformer, batteries, rheostat, phones, grid leak and condenser of the correct resistance and capacity values, and jacks for the phone plug.

A loud speaker is not likely to work satisfactorily with so small a set, but a horn to which the phones can be attached may make it possible to hear programs from the near-by stations without wearing the headgear. A crystal detector can be added, so that the local stations can be brought in when the battery is being charged or when the tubes are out of commission for any other reason.

A Simple Circuit

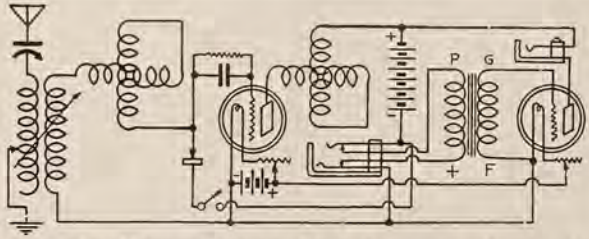
CIRCUIT by circuit, the following two-tube hook-up is easy to understand. See figure 2. The aerial connects with the stationary plates of the variable condenser. The rotor of the condenser connects with the primary coil of the variocoupler. The other end of the primary connects with the ground. That completes the antenna circuit.

Run a wire from the secondary of the variocoupler to a variometer, and another wire from the other terminal of the variometer to the grid leak and condenser, which usually are mounted with common terminals. The other terminal of the grid leak and condenser connects with the grid terminal on the tube socket. The other end of the secondary of the coupler connects with one filament terminal on each of the two tube sockets, the terminals that are not connected with the rheostats. Whether these are positive or negative terminals will depend on whether the positive or negative end of the "A" battery goes to the negative end of the "B" battery. Some tubes require a polarity specified in the directions, and some may be connected either way. The "B" battery connection, however, is always with the positive terminal toward the plate. The above connections complete the grid-filament circuit of the detector.

The plate is connected with the second variometer and the other terminal of the variometer goes to a positive terminal of the "B" battery. Nearly all "B" batteries have several positive terminals, provided with convenient clips, so the voltage may be adjusted easily after the testing begins. The negative terminal of the "B" battery goes to the first jack, whose other terminal connects with the two filaments and the secondary of the variocoupler. This completes the detector plate circuit, which is closed when the phone plug is placed in the jack.

The detector jack is provided with two terminals that should be connected with the two ends of the primary coil of the audio-frequency amplifying transformer. The secondary of the transformer connects with the grid of the amplifier tube on one end and with the filament on the other. The filament terminal used should be the same that connects with the secondary of the variocoupler. The plate of the amplifier tube connects with one terminal of the second jack. The other terminal of the jack goes to the positive terminal of the "B" battery. This completes the wiring for the set, unless a crystal detector is connected between the detector grid lead and phone jack, with a

(Please turn to page 49)



Regenerative detector and first stage of radio frequency amplification, with crystal detector for use when tubes are cut out

Building the Hammarlund-Roberts

PART I

By

LESLIE G. BILES

Front view of the latest design by Hammarlund-Roberts, the construction of which is detailed in this and a succeeding article

HAMMARLUND-ROBERTS' new design known as the "Hi-Q" is an entirely modern radio receiver, non-oscillating and incorporating the latest approved features. The most important of these includes dual tuning, stage shielding, automatic coupling variation, high detection efficiency and a high power output.

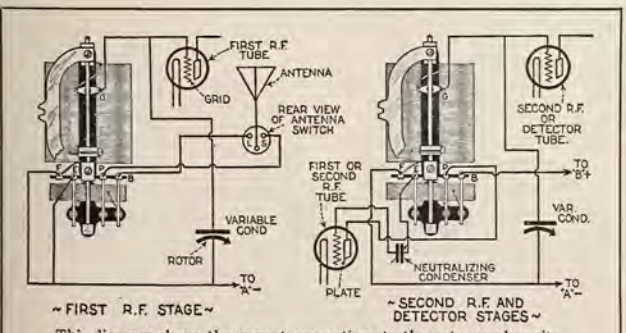
Tried and proven fundamentals have been adherred to; but they are applied in new and different ways that produce greater selectivity, clearer tone, simpler tuning. This design is the united achievement of ten of the leading radio engineers in the country; all concentrating on producing the most advanced and efficient receiver—regardless of cost.

Anyone can build this receiver. All the research, the selection of parts, the exact placing of units, has been worked out in advance. And you have a receiver that will equal an eight-tube set—simplicity of design and operation.

Here is a receiver of five tubes, which employs two highly efficient stages of tuned radio amplification, a non-regenerative detector and two stages of high quality transformer coupled audio amplification, the second stage of which is so arranged the new power tubes may be used.

Tuning has been held down to two major controls. Scientific shielding of the radio frequency units produces a receiver of unusual selectivity, sensitivity, quality and volume.

In theory this receiver is comparatively simple. It combines the sensitivity and selectivity of two stages of radio frequency amplification with the inherent stability and distortionless characteristics of a non-regenerative detector. While it is admitted that a regenerative detector provides a considerable degree of radio frequency amplification it is well known that amplification secured in this manner has many drawbacks. Chief among these is the tendency to cut "side bands," a type of tone distortion which has a very disagreeable effect when passed on to the loud speaker. In order to avoid this and other types of "regenerative" troubles without sacrificing sensitivity, the two radio frequency stages have been designed to insure an extremely high degree of amplification.



This diagram shows the correct connections to the auto couple units

Quality Output

AFTER providing for a high quality audio output from the detector a two stage transformer coupled audio amplifier is used to step up the signals to loud speaker intensity. The transformers used in the audio amplifier have a high primary impedance, insuring faithful reproduction of the lower musical and speech tones. The secondaries are wound by a special helical process which reduces distributed capacity to a minimum

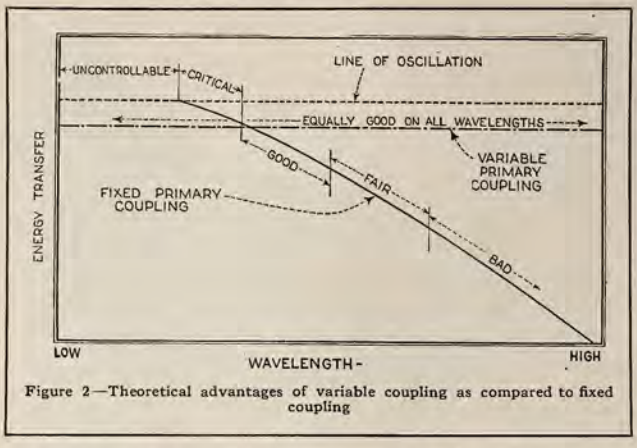


Figure 2—Theoretical advantages of variable coupling as compared to fixed coupling

so that the higher audio frequencies and their harmonics are passed on to the loud speaker without loss. This results in the reproduction of the higher musical tones of such instruments as the violin with full life and brilliance, and aids very materially in removing the dull and muffled effects so commonly associated with loud speaker reproduction.

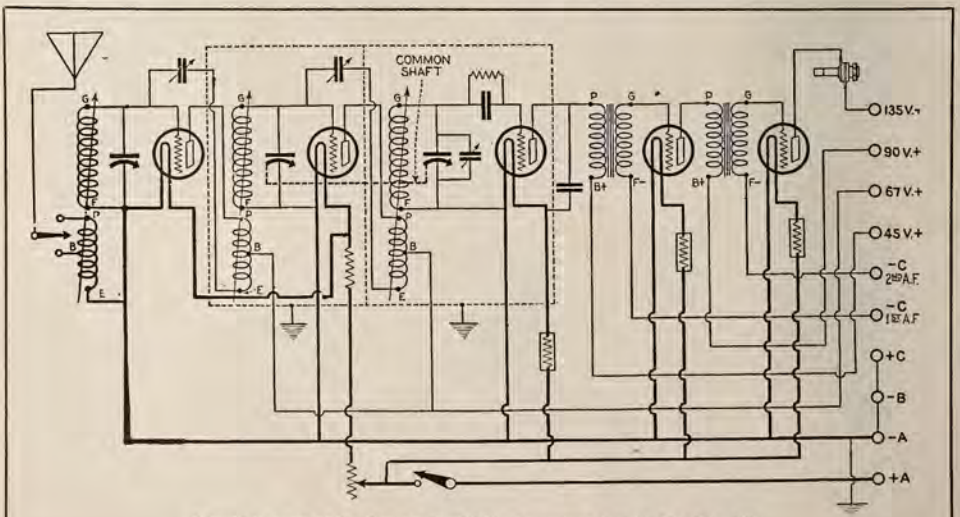
Although the receiver has three radio frequency circuits the tuning controls have been reduced to two by placing the second and third variable condensers on the same shaft. A small compensating condenser in parallel with the third variable condenser has been provided to compensate for the small difference in circuit capacity of the third tuning circuit chiefly due to the detector grid condenser. This compensator needs no adjustment after its setting has once been determined.

A volume control has been provided which is exceptionally smooth and gradual, allowing the operator to adjust for a powerful local or a weak and distant station with equal facility. This volume control is a 10 ohm rheostat regulating the filament brilliancy of the two radio frequency amplifier tubes. To eliminate the possibility of applying more than the rated voltage to the filaments of these tubes, a 2 ohm resistance unit is used in series with the radio frequency tubes and rheostat. The filaments of the remaining tubes are held at their proper operating temperatures by separate automatic resistances.

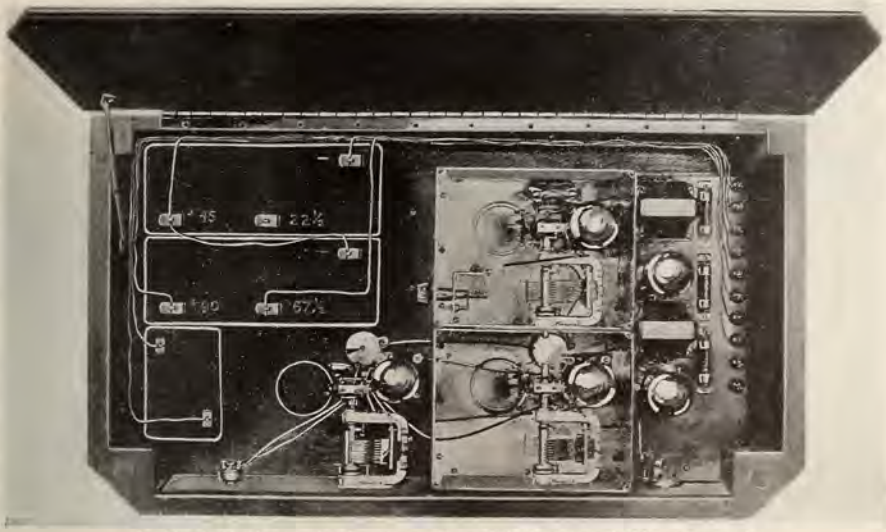
Voltages induced in the antenna ground system are magnified by the action of the first stage of radio frequency amplification and passed on to the second radio frequency stage where their intensity is still further increased.

Since the second radio frequency stage and the detector stage are shielded unwanted signals are weeded out due to the filtering action of the three tuned circuits through which they would have to pass in order to reach the detector tube. This shielding also prevents direct pick-up by the second radio frequency and detector circuits.

The use of stage shielding also eliminates any interaction between circuits, thereby stabilizing the radio frequency amplifier and greatly increasing its over all efficiency.



Circuit diagram of the Hammarlund-Roberts receiver described by Mr. Biles



Looking inside the completed receiver. Tops of the two stage shields are removed

No shield is necessary on the first radio frequency stage although the receiver is designed so that a shield can also be used for this stage if desired.

The output of the second radio frequency stage which is a highly amplified copy of the original signal picked up by the antenna, is then fed to the non-regenerative detector where it is demodulated or converted into audible frequencies. These audio currents, or electric sound waves are then further increased in strength by the two stages of transformer coupled audio frequency amplification and passed on to the loud speaker.

R F Amplifier

TWO stages of radio frequency amplification used in this receiver present some rather new and novel features in the design of the antenna coupling coil and the interstage radio frequency transformers. The design of these coils is based on two fundamental laws of radio engineering that are as old as radio itself. The first of these laws is this: Up to a certain point an increase in the coupling between two coils affords an increase in energy transfer and a decrease in selectivity. The second law is this: The energy transfer between two coils such as the primary and secondary of an ordinary radio frequency transformer increases rapidly as the frequency increases. In other words, the energy transfer is much greater at high frequencies (short wave lengths) than at low frequencies (long wave lengths), and the relative selectivity is less at high frequencies and greater at low frequencies. Conversely, a constant transfer of energy and constant selectivity can be maintained by loosening the coupling as the frequency is increased.

Successful broadcast receivers must be capable of receiving wavelengths from 200 meters (1500 k c) up to 545 meters (550 k c). This represents two extremes in frequency corresponding to a range of about three to one. These requirements together with the two laws stated above make it evident that some means of variable coupling must be provided if we are to obtain equal energy transfer and selec-

(Please turn to page 51)

LIST OF PARTS

- 2 Samson transformers, type HW-43 (3-1 ratio)
- 3 Hammarlund .00035 mfd. midline condensers
- 3 Hammarlund auto-coupled coils (set of 3 coils)
- 1 Hammarlund Jr. condenser, 9 plates, 32 mmfd.
- 2 Mar-co No. 192 Vernier Dials.
- 3 Benjamin No. 9040 sockets (with bases)
- 2 Benjamin No. 9049 sockets (without bases)
- 2 Amperites No. 1A
- 1 Amperite No. 112
- 1 Carter No. M-10-S combined rheostat and filament switch 10 ohm
- 1 Carter No. 1 short jack
- 1 Carter No. 12 Imp aerial switch
- 1 Sangamo .00025 mfd. fixed condenser
- 1 Sangamo .001 mfd. fixed condenser
- 1 pr. Sangamo grid-leak clips
- 1 Durkam metallized resistor, 3 megohms
- 1 Hammarlund-Roberts foundation unit (containing drilled and engraved Westinghouse Bakelite-Micarta panel, drilled Bakelite, Micarta sub-panel, two complete shields, two equalizers, extension shaft, resistance unit, wire, screws, nuts and all special hardware required to complete receiver.

"Noise Doctors" Cure Inductive Static

By GEORGE A. BARCLAY

IT ALWAYS makes you feel better if there is someone you can complain to when things are going wrong. That is especially true if you are a radio fan. So when the Canadian government decided to institute a department for combatting preventable static, it was employing good psychology. When the loud speaker begins to scream like a locomotive and the reception sounds like a load of coal, radio fans in the Dominion simply telephone the nearest government interference station and register their complaint. Soon a corps of trained "noise doctors" are on the case diagnosing the trouble and preparing a remedy.

Canada has taken a step ahead of the United States in trying to improve radio reception for its listeners. The radio branch of the Federal Department of Marine and Fisheries conceived the idea of organizing a body of experts to suppress preventable interference. Government stations were established at Ottawa, Toronto, Vancouver, Montreal and Halifax. C. P. Edwards, a commander in the British navy during the World War, was placed in charge of the service. The stations are equipped with automobiles fitted with special instruments and apparatus. When a complaint is received, the experts start out in their cars to locate the source of the interference and, if possible, to correct it.

"Every population center has a noise level due to preventable causes," Commander Edwards told me. "Every time an electrical switch is opened it creates a static noise. Research by the department disclosed that in one moderately sized town there were sixty-seven sources of preventable noise. Faulty street car wires, telephone wires rubbing against trees, short circuits, power plants out of order, motors of all kinds, and defective switches are the principal offenders.

"The difficulty of locating noises increases with the size of the city. In a small population center it is possible to isolate noises with comparative ease. But in a big city where there are thousands of power plants, interference may be felt by radio listeners as far as ten miles from its source. Whenever a defect in an electrical plant is corrected, a permanent source of radio noise is removed. For instance a transformer may have been slightly out of order for ten years without being detected. When it is fixed there is that much less noise on the air to deal with.

Thermostatic Static

"SOME of the queerest things cause trouble. At a soldiers' hospital in Hamilton, Ont., the patients had a terrible time with static. The authorities called in our 'noise doctors.' Every bed in the hospital was fitted out with electrical footpads equipped with automatic cutouts. When they tuned in on a big city station and the orchestras began to play jazz numbers, the patients would tap their feet in bed in time to the music. This threw the switches off, creating a static that ruined the reception at the hospital until our experts discovered it.

"In another instance our service not only corrected static, but saved some lives as well. In a fairly large city in Eastern Canada there was a street railway company operating a converter which supplied 700 volts of current to its terminal lines. There was a strong inductive interference in the district. Radio fans were complaining constantly. Our experts investigated. They believed the noise was caused by the car line's power plant. They interviewed officials of the company. They examined the machinery. But they could find nothing wrong and engineers at the station laughed at them. Finally they induced the company to shut off power at noon one Sunday. The inductive noise stopped immediately and radio fans got wonderful reception on the afternoon concerts. At four o'clock the plant started again. The noise appeared at once.

"Our 'noise doctors' were not satisfied. They began checking up on the frame of the converter. Then they found something startling. A wire from the armature was touching the frame. It had charged it up to 600 volts. Workmen of the plant knew nothing about it. Yet if one of them had touched the frame it would have meant instant death. The short was corrected and the converter is still operating. It is as safe as can be now but you could not pay a workman to approach it without rubber gloves. All the inductive trouble it caused has ceased.

"Another case was baffling. There was a noise in a Toronto office building. It was spoiling reception for four city blocks around. Our experts tested and tested without success. They visited the place fifteen times and still could not find the cause. The noise was like a phantom. It came and went. Finally the experts isolated the noise down to a dentist grinding teeth in the building. The motor of his drill was defective. It caused enough electrical disturbance to ruin the reception of scores of radio listeners."

Canada is spending $100,000 a year on this special service. Revenue for operation of the work is derived from a license fee of one dollar on every radio receiving set. The Dominion is the only country in the world carrying on an organized campaign of noise prevention.

Radio has had a remarkable

(Please turn to page 47)

Building a 36 Inch Cone at Home

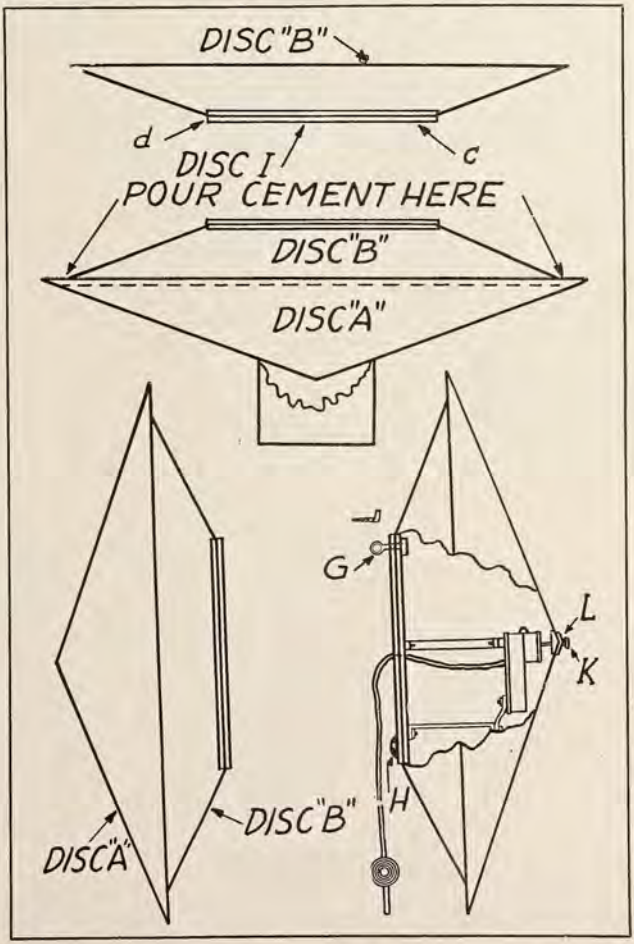
BUILDING a thirty-six inch cone speaker at first blush appeared to our staff to be a very difficult job and one that the average experimenter or handyman would not tackle. But Columbus took a chance. So we figured if that venerable gentleman could discover this country the worst we could do would be to wreck about fifteen dollars worth of parts, and with that alibi in mind we tackled the task. Much to our surprise the matter was comparatively simple, requiring only a little patience and a careful adherence to instructions.

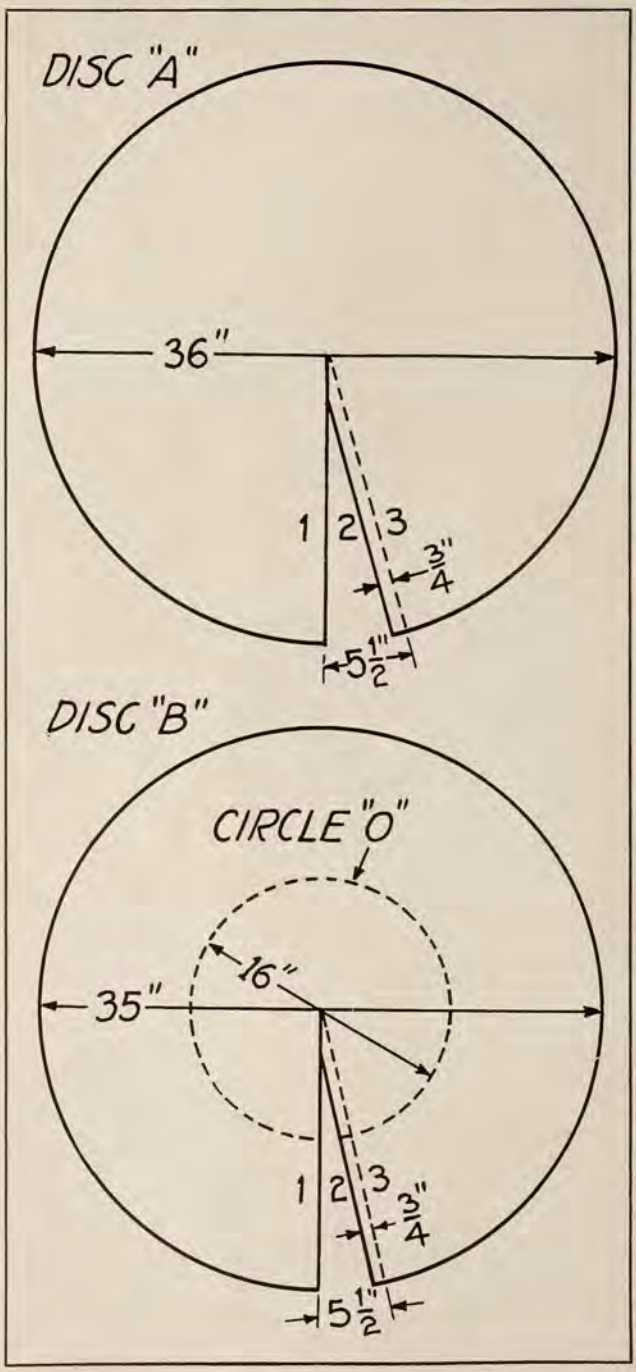
Two diagrams are shown with this article which will give a great deal of the detail necessary. Parts for the construction of such a cone may be secured from a number of manufacturers who supply the integral parts in kit form.

Material for the cone comes in 38 by 38 inch sheets, two being required. This is a special product which leading cone speaker manufacturers are using. One sheet is used for the front of the cone and the other for the back. The upper diagram on page 12 shows the manner of cutting the front cone. To properly scribe the 36 inch circle it is suggested the builder make up a beam compass, consisting of a ruler, or slat about 24 inches in length, with a tack driven through at one end and two small holes drilled 18 and 17½ inches from the tack, the holes being for a pencil to mark the circle. The end of the ruler with the tack in it is placed in the center of the sheet (after you have marked into quarters the 38 by 38 sheet and found its center) a pencil inserted in the hole 18 inches from the tack, and the circle drawn. For the second cone, B, the hole 17½ inches from the tack is used since the diameter of disc B is only 35 inches compared to the first one, disc A.

Consult the top drawing on page 12. Line 1 is now cut from the lower edge of the cone to the exact center. Measure 5½ inches (at the bottom edge) to the dotted line 3. Place a ruler at this point inward to the exact center and draw a dotted line. Be careful not to use too much pressure on the pencil or you will tear the material. Then measure off three-quarters of an inch to the left of the dotted line at the bottom edge and at the center. Here draw a full line which will be the line you cut, line 2. The dotted line, 3, is the three-quarters of an inch lap which the cone will have when its bottom edges are pulled together. A quarter inch hole should be punched out at the exact center.

The back cone, disc B, is made in the same manner except its diameter is 35 inches instead of





36. It also has a 16 inch diameter circle which is later cut out for cementing of the cone to the back rings (these rings come with the parts). In the diagram on page 11, upper, the rings D and C have been cemented on the back disc B. Disc A is placed in a round hatbox, or a smooth rim vessel so it will be self-supporting. Disc B is then placed over the disc A, and a special cement poured at the edges. This cement dries very fast and the builder will have to work quick. This type of cement is furnished with the parts. Let the cones dry overnight to harden the cement thoroughly. The lower left diagram shows the two cones joined, while the lower right sketch shows the mounting of the cone movement to the back rings and the nose piece of the front cone. In cementing the large brass disc on the inside of disc A and the smaller brass disc on the outside of the disc A, it is suggested a small bolt be run through these discs to keep them tight against the inside and outside of the disc A. This will insure a good cement job since the brass discs will not be able to move while the cement is setting.

After all cementing work has been finished and is thoroughly set, insert the cone unit, line it up right and see that threaded nose piece goes through the cone to the driving rod which it engages. Two small set screws are provided, one for the connection to the driving pin which goes into the end of the nosepiece. The other is for a set screw going into the side of the nosepiece to prevent the center screw from turning while the cone is in use.

Results with a speaker of this type are quite surprising provided a good amplifier is used in reception. No cone can make beautiful music out of a poor amplifier so be sure you have a good amplifier and use a power tube in the last audio stage. Low tones are pronounced on a 36 inch cone that might not be observed on a smaller unit. Full building instructions were included with the unit used in building this speaker.

How A Variable Condenser Affects Your Set Tuning

Shape of the Plates Determines Its Characteristics

By KIRK B. MORCROSS

HOWEVER much involved the subject of condensers with variously shaped plates may become, there are two outstanding points for consideration at the outset of a discussion of this subject an understanding of which will form the nucleus of all ideas subsequently considered.

The first of these points reminds us, simply, that the method of allocating broadcasting stations gives them uniform kilocycle separations throughout the band available for broadcasting. An explanation of why this is the ideal method is outside the purport of this article. You must take this statement on faith, if need be. (This question is discussed in an article by this writer in RADIO AGE for December, 1926.)

Having satisfied ourselves as to this first point, we obtain an introduction to the second point by referring to the dials on our receiving sets. The relationship of these dial settings to the frequencies of the various broadcasting stations, a matter of intimate concern to all of us, is most conveniently shown by means of curves plotted with dial settings against frequencies. And this brings us squarely to the second point.

This tells us that for any type of condenser—"type" meaning here the shape of plate employed—a curve may be plotted, frequency values against dial settings, which indicates the relative spacing of stations on the dials. Three curves, each representing a particular type of condenser, are shown in Fig. 1. As indicated, these curves show the tuning characteristics of the "straight line capacity," "straight line wavelength" and "straight line frequency" types of condensers. If your set is equipped with the straight line capacity condenser the frequency to which your circuit is tuned will change rapidly as the condenser is varied near the lower end of its scale then less rapidly on up until at the higher dial settings the frequency change is relatively slow. In other words, since broadcasting stations are (with few exceptions) evenly spaced in kilocycles this condenser spreads them out at the high dial settings and crowds them together at the lower end of the dial. The same is true for the straight line wavelength condenser but to a lesser degree. The "curve" for the straight line frequency condenser is in reality not a curve at all, equal angular rotations of the dial at high or low settings producing equal frequency changes regardless of the dial settings and consequently stations are equally spaced over the dial.

In studying the curves of Figure 1, which, incidentally, deserve preservation for the radio note book, you will avoid confusion by bearing in mind that all three curves are plotted with frequencies along the vertical axis. With the exception of the straight line frequency condenser the names near the curves have nothing to do with the units used in plotting.

It is very difficult in practice to produce a truly straight line frequency characteristic. A shape of plate can be designed mathematically which should give an almost truly straight line, to be sure. But in actual use, owing to distributed capacity in the circuit and particularly to distributed capacity in the coil associated with the condenser, a truly straight line is difficult if not almost impossible to obtain. All of the three curves in Figure 1 are in practice somewhat distorted near their ends, that is, near the maximum and minimum capacities attainable on the condensers. For the discussions in this article, however, these curves and others subsequently considered may be assumed to be as shown.

A simple rule is of assistance

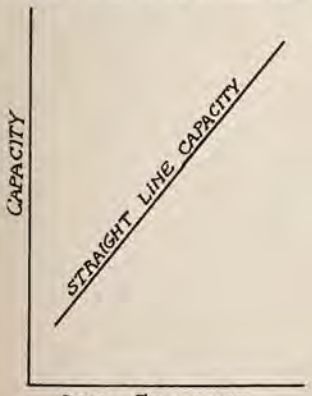


Figure 2

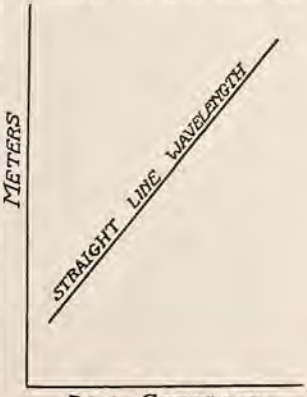


Figure 3

in understanding the definitions of the three types of condensers. The first part of the definition for each of these three condensers refers to the character of "curve" *when* the curve is plotted with units along the vertical axis named in the last part of the definition, it being understood that the units along the other axis are dial settings. The straight line capacity definition is thus illustrated in Figure 2. (The curve for the straight line frequency condenser in Figure 1 illusrates the rule for that type of condenser.) Applying the rule to the straight line wavelength condenser, we suspect this gives a straight line when plotted with *wavelengths* against dial settings as is the case in Figure 3.

ATTENTION may be called here to definitions sometimes used, namely, "straight capacity line," "straight wavelength line" and "straight frequency line." These are perhaps to be preferred because they are more nearly self explanatory. The other definitions have, however, become well established.

Although it is an undisputed fact that for use in a receiving set, a condenser giving an approximately straight line frequency effect is generally to be preferred, it is by no means true that such a condenser is necessarily any more effective at eliminating interference. Let us demonstrate.

Suppose you tune two receiving sets to the same broadcasting station and suppose that these two sets are identical in construction except that one is equipped with straight line capacity condensers while the other has, say, straight line wavelength condensers. Assuming equal resistance in the two types of condensers, in other words equal losses, an equal amount of interference from other broadcasting stations will be noted on each set. The fact that the tuning in of stations at low dial settings on the straight line capacity condenser is accomplished with a small amount of rotation is of course a disadvantage from the mechanical viewpoint but this condition does not determine selectivity. A fine adjustment knob will make it possible to vary the capacity of that condenser quite accurately. It *is* an advantage though to have stations uniformly spaced on the dials, and normally the straight line capacity condenser falls very far short of accomplishing that end. A way of securing this result with a straight line capacity condenser is to equip it with a dial to give slower and slower rotation of the condenser plates when the dial is rotated uniformly in such a direction that the condenser capacity is decreasing.

The straight line capacity condenser has its advantages in the laboratory. For instance when it is used as a standard of capacity it is convenient to have a calibration curve plotted with capacities against settings of the condenser dial which is essentially a straight line. Again, as many experimenters know, who have used oscillators in obtaining numerous frequencies by means of harmonics, the use of straight line capacity condensers in the oscillators is an advantage. To *double* the frequency, one-fourth the dial setting is used.

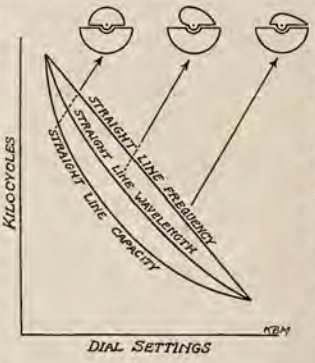


Figure 1

The straight line wavelength condenser would have a good bid for the ideal condenser in a receiving circuit if broadcasting stations were allocated with equal wavelength separations. It is doubtful, however, if such a condition will ever prevail and consequently that type of condenser will always group the stations somewhat more closely as the dial settings are decreased.

ONE sometimes hears the expression "straight line tuning" applied to a condenser. That term may be most correctly assumed to refer to the straight line frequency condenser. It is interesting to note a degree of flexibility inherent in the definition, however, for if broadcasting stations were reallocated with equal wavelength spacings the "straight line tuning" term would fit the straight line wavelength condenser.

The straight line frequency condenser is theoretically the most nearly ideal type for the receiving set although as mentioned previously a truly straight line effect is seldom obtained. Peculiar and interesting difficulties are encountered in the design of the plates of this condenser and, in general, their shape represents a compromise between pure theory and the necessity for a reasonable degree of compactness.

One can not easily conceive of a necessity for designing a condenser giving a characteristic differing from one of the three standard types. A condenser giving a sufficiently straight line characteristics to ensure that there will be no great variations in the spacing of stations over the range of dial settings, and which offers the possibility of slightly greater compactness than the straight line frequency type, is sometimes desirable. As already intimated some so-called "straight line frequency" condensers do just that; a more specific example is found in the Hammarlund "midline" condenser. But no new type of condenser of which we can conceive will give radically different results—at least in the light of present radio knowledge.

In the design of condenser plates, one is not limited to a single means of securing a given characteristic. Sometimes the fixed plates are given a special shape; or again, both sets of plates may be made movable. Still another idea is embodied in the Cardwell straight line frequency condenser which uses rotating plates semi-circular in shape but of increasing thickness from one edge to the other.

Power Six Is Elaboration of *the* Counterphase Six

Popular Circuit Changed to Include New Heavy Duty Tubes

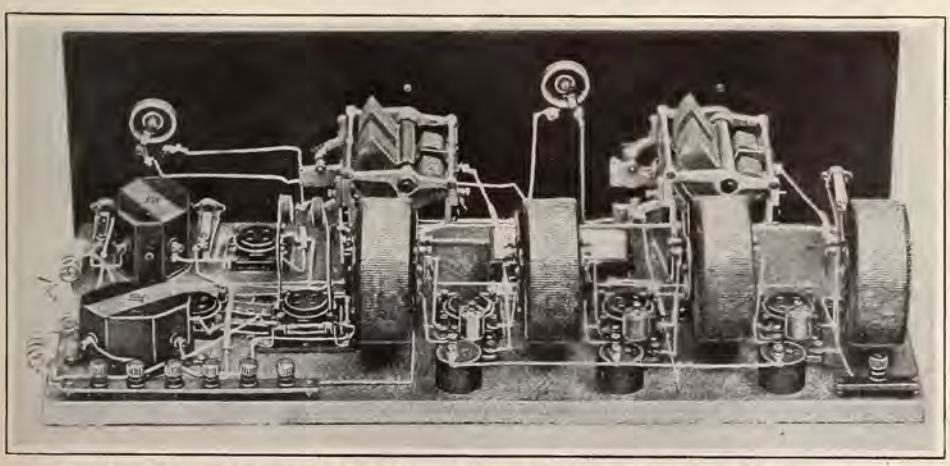
SO THOROUGHLY has the radio public been sold on the question of power amplification through the use of the 112, 171 and 210 types of power tubes that manufacturers today are all including arrangements for operation of a power tube in the last stage.

Bremer-Tully's popular circuit known as the Counterphase Six (described by Ray G. Piety on page 23 of the May, 1926, issue of RADIO AGE) has been altered in a few circuit respects and provision made for the use of a UX112 or UX171 in the last stage. (For the UX210 the filament supply would be AC and furnished by a step-down transformer.)

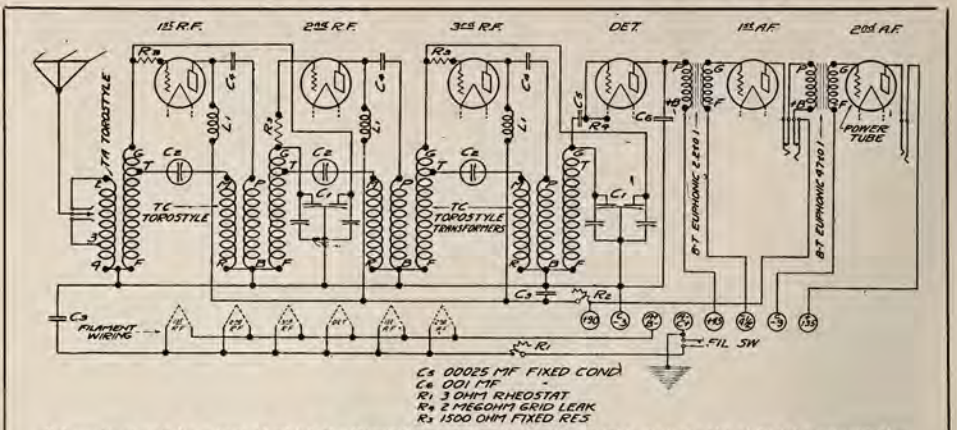
Pictorially and diagrammatically we are showing in this article the "Power Six" which consists of three stages of tuned radio frequency amplification, non-regenerative detector, and two stages of audio amplification. Filament control is by a master rheostat.

Experimenters will note, on close inspection of the circuit diagram on page 16, one departure from the Counterphase Six in the addition of three 1500 ohm fixed resistances, one placed in each of the three radio frequency grids to allow the sensitivity of the tuning to be maintained at an equal value over the entire broadcast band. Another point of difference is the use of a single unit 500,000 ohm variable resistance instead of the dual type used previously. Antenna coupling has been changed from the tapped coil in the previous design to the inductive form in the present receiver with a switch permitting change from short to long antenna. Jacks have been inserted in the first and second stages of audio to allow the listener to cut the volume at will. Neutralizing condenser design has been changed to a simpler and better form. Individual radio frequency chokes are placed in each of the three RF plate leads. It is not recommended that this set be shielded since that job alone is an exceedingly tough proposition unless the reader has had considerable experience. In the new coils some of the connections have been made inside the forms whereas in the older type these connections were made by the builder himself. The 1500 ohm fixed grid resistances together with the 500,000 ohm variable resistor in the 90 volt lead of the set serve to maintain the amplification of the receiver practically constant over its range. The variable resistor is simply a volume control. Grid biasing is used on both the radio frequency and audio grids. This sums up the alterations made in the later model, changes being made to bring the set to its highest efficiency.

On page 15 is shown a rear



Rear view of the completed receiver. Either binding posts or a plug connection may be used by the constructor



Schematic circuit by means of which the Power Six may be wired. The novice may use the pictorial representation on the opposite page for the same purpose

view of the completed receiver. Circuit diagram, and the front panel view are shown on page 16 while the pictorial representation of the set (for use by those unable to read a schematic diagram) is printed on page 17, where also the list of parts used in making up this set may be found.

Connections Simple

OSCILLATION control in the Power Six is the well known system used by Bremer-Tully and called the "Counterphase." Wiring of the set may be done with No. 14 tinned, round bus wire. All sockets used are the cushion type while the detector socket has a snubber attachment which will eliminate microphonic action in that tube. The biasing battery should preferably be placed inside of the cabinet. In the circuit diagram on page 16 it will be seen that all connections to the filaments are very simple ones. Only one rheostat is used and this is in the negative filament lead where the filament switch is also located.

Assuming that all wiring has been finished, go over the work again to make sure that no wrong connections have been made. Then put in tubes, connect loud speaker and turn on batteries, previously having adjusted all the mikro-mike condensers to about half way down. Tune in a station of moderate volume to exact resonance, this being done with the condenser dial and the trimmer. Adjust the volume control to greatest volume without oscillation. This means greatest volume secured without a whistle or beat note secured when the condenser dial is rotated back and forth across the incoming signal. Disconnect either the positive or negative filament connection to socket of tube number three. The signal will still be heard. Turn adjustment screw of mikro-mike number twenty (see pictorial representation for all numbered parts) carefully until a point is found where the signal diminishes in volume or disappears entirely. Now rotate right hand dial for loudest signal, also rotating trimmer condenser to exact resonance. Again adjust mikro-mike to the setting which gives weakest signals or at which signal disappears. If signal remains weak or disappears over a setting of several turns of the mikro-mike screw, adjust to the middle of this weak or silent band. This will be the proper setting for mikro-mike number twenty. Replace the filament connection to tube number three and retune the set carefully using the trimmers. Remove filament connection of tube number two and determine setting of mikro-mike number nineteen exactly the same as before. Retune both dials carefully before making final adjustment of mikro-mike. Signal may become weak or disappear altogether over a band of one or more turns of the mikro-mike. The proper setting is half way between the settings where volume starts to increase. Replace filament connection to tube number two and retune the signal carefully. Remove either positive or negative filament connection on tube number one and adjust mikro-mike number eighteen exactly the same as the previous ones, first finding approximate setting, then retuning carefully as before to find the final setting.

Front panel view of the Power Six

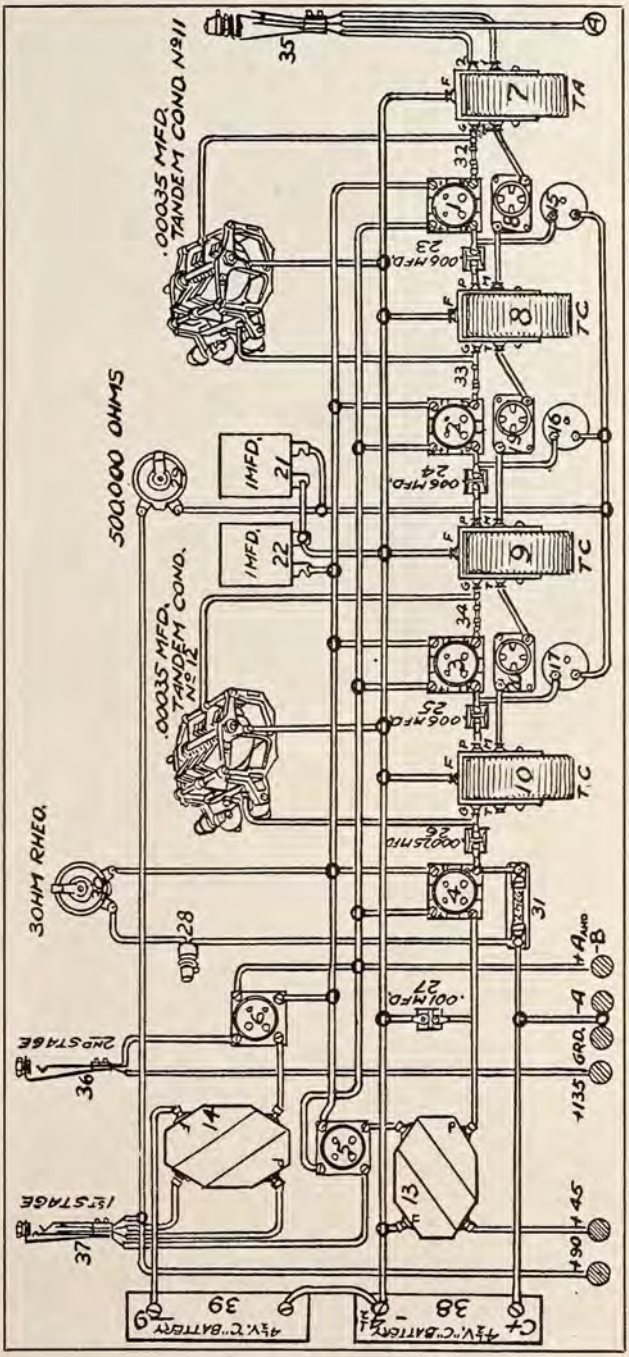
On this stage the reduced volume band is very small and the mikro-mike should be rotated very carefully. As soon as position of reduced volume is found retune carefully for loudest signal and rotate mikro-mike carefully to setting where signal becomes weakest or disappears. Then replace filament connection on tube number one. If careful wiring has been made slight oscillation may be secured in the vicinity of 350 meters, when volume control is full on, this being desirable for greatest sensitivity.

Both the left and right hand dials on the panel will run fairly close together as far as settings are concerned. In the Bremer-Tully dials both the numerical values of the condenser degrees and the approximate wavelengths are shown.

Parts necessary in the makeup of this receiver are given in the following list:

LIST OF PARTS

- 1 B-T type TA torostyle transformer
- 3 B-T type TC torostyle transformers
- 2 B-T type LD17 tandem condensers
- 3 B-T mikro-mike condensers
- 1 Carter 500,000 ohm variable resistance
- 3 B-T radio frequency chokes
- 3 Carter 1500 ohm fixed resistances
- 1 B-T 2 to 1 audio transformer
- 1 B-T 4 to 1 audio transformer
- 2 B-T tuning controls
- 5 B-T type UXA sockets
- 1 B-T type UXD socket
- 1 Carter double circuit jack No. 104
- 1 Carter single circuit jack No. 101
- 1 Carter filament switch
- 1 Carter 3 ohm rheostat
- 1 Carter SPDT jack switch
- 9 X-L Pushposts
- 2 Eveready 4½ volt C batteries
- 1 Sangamo .001 mfd condenser
- 1 Sangamo .00025 mfd condenser
- 3 Sangamo .006 mfd condensers
- 2 Dubilier 1 mfd condensers
- 1 Durham 2 megohm grid leak
- 1 Formica 7 by 24 panel
- 1 Wood baseboard 9¾ by 23½



Keeping Step with SCIENCE

How the Lonely Astronomer Is Fed

Wide World Photo

An Airplane Dropping Supplies by Means of a Parachute to the Staff of Mount Blanc Observatory Perched High on the Side of the Highest Pinnacle of the Swiss Alps. Someone Is Then Dispatched on the Perilous Task of Rescuing It, Where Ever It May Alight

Four Faint Comets Are Now Visiting Us

THE earth is now experiencing the unusual astronomical event of the presence of four comets near enough to be visible at the same time. Were these celestial visitors large enough to be seen by the naked eye the assemblage undoubtedly would cause apprehension among the considerable part of the population which still regards a comet as presaging disaster, a superstition inherited from the days of belief in witchcraft and black magic. Fortunately for the peace of mind of the more credulous, the four comets now in our neighborhood are far too faint to be seen by the eye alone or even in the smaller telescopes usually available to amateurs. Even the great observatories, provided with large telescopes and with sensitive photographic plates, are having difficulty in detecting the movements of our four visitors, so faint are these bodies.

All four of the present comets are believed to have visited us before. Finley's comet, the most familiar of the four, was here in 1886, 1893, 1906, and 1919. The comet named Giacobini-Zinner, the names referring, as usual, to persons associated with the discovery, visited the neighborhood of the earth in 1900 and in 1913. Neujmin's comet was here only once previously, in 1916. The fourth of the ones now visible, that named for Professor Comas-Sola, of the Barcelona Observatory, is suspected of being identical with a comet first seen in 1890, named Spitaler's comet and never seen again.

As far as is known the presence of comets in our heavens does not have any effect upon radio reception, although of course this is a subject upon which there is little data.

Elsewhere in this issue the case of sun spots affecting reception by causing fading, is discussed and may prove of interest to readers.

Land Indicated By Tides

SCIENTIFIC predictions, made from studies of the tides, which led the arctic expeditions of the Norge, of Commander Byrd and others to seek a supposed continent in the polar regions, now turn out to be wrong, even from the tidal data. Such is the report of Mr. H. U. Sverdrup, just published by the Washington Academy of Sciences. As the daily waves which produce the tides move around the earth under the influence of the gravitational attraction of the moon, they are stopped and deflected by the continents. If scientists knew as much as they now do about tides but were ignorant of the existence of the American continent, it would be possible to detect the presence of this land mass from the tidal data alone.

What Neptune Does to Propellers

Wide World Photo

Three of Uncle Sam's gobs inspect the barnacled port propeller on a destroyer in dry dock at San Diego, Calif., before setting to work to cleanse the screw.

Slow Movies of a Cat's Fall

EVERYONE knows when a cat falls it will turn over in the air and land on its feet, usually without injury. Recent scientific studies of the reflexes tell how this useful accomplishment is brought about. An English physiologist, Dr. F. M. R. Walshe, took slow-motion motion pictures of the fall. These show the cat's head is the first part of its body to take on the new and safer posture. The head twists with reference to the body, so the head is right-side-up. Righting of the head has been traced to a nervous reflex originating in the three small liquid-filled semi-circular tubes in the inner part of the cat's ear. These same tubes serve as "levels" for the human

body, warning us whenever our head is tilted. A nervous impulse from these three tubes notifies the cat's head it is upside down. The neck muscles instantly twist it around. Another set of nervous reflexes begun by the tension of the neck muscles start the body muscles into motion, so the whole body of the cat is righted and lands right-side-up. These nervous reflexes are involuntary, unconscious and practically instantaneous.

Melted Rock Crystal Urged for Telescopes

NEW material for the construction of large astronomical telescopes was suggested by Dr. E. R. Berry, of the Lynn, Mass., works of the General Electric Company in a recent address to the New York Electrical Society, the oldest electrical society in America. This material is clear fused quartz, a substance which Dr. Berry and his associates first succeeded, a year or two ago, in producing in quantity and at reasonable cost. Fused quartz is rock crystal, like that found in many rocks, melted at an enormously high temperature and with the bubbles removed from it by the alternate application, while it is still very hot, of vacuum and of pressures up to thousands of pounds per square inch. The fused quartz is not suggested for telescope lenses, although small lenses have been made of it. What Dr. Berry urges is the use of fused quartz for the great mirror-blocks used in the largest of modern telescopes. These instruments collect and concentrate the light by large concave mirrors, not by lenses. The glass now used for these mirror-blocks expands when slightly heated and contracts when cooled. The body heat of a person standing near one side of a glass-block mirror may heat the glass sufficiently to distort the image formed in the telescope. Fused quartz expands and contracts only very slightly when heated and cooled. Mirror telescopes made from quartz blocks would be easier to build and could be used with fewer precautions.

World Wide Photo

The giant naval dirigible "Los Angeles" leaving the naval air station at Lakehurst, N. J., for its recent flight to Philadelphia in honor of the American Legion. Photo shows the land crew walking the ship out for the take-off

Use Mica Particles for Insulators

MICA particles which heretofore could not be used, are now utilized as an insulating material for the production of radio high-frequency insulators. The new insulation is a composition of ground mica and lead borate.

Mica previously presented a difficult problem because of the enormous amount of waste. Obtained in India and Canada in large sheets, there was considerable waste at the mines, it being estimated that only about five per cent of the material taken from the mine could be used. In manufacturing, there were still further wastes of small pieces of mica, but some years ago it was found that these mica flakes, mixed with a binding material and compressed under heat, made very good insulation. Such sheets of prepared mica are used by the General Electric Company in manufacturing processes.

The new material has better insulating properties than has porcelain, and several applications for it have been developed by engineers of the General Electric Company. The substance, light gray in color and with a metallic ring, is being used in the manufacture of bases for radio transmitter tubes, for aerial insulators in high frequency work, and for numerous similar applications.

Chief among its characteristics are that metal parts may be inserted or combined with Mycalex during the process of moulding; and, although a hard and stone-like product, it can be subjected to ordinary machining methods.

Everyday Mechanics

Accurate Sun Dial

Wide World Photos.

Father Terray, of Assumption College, Worcester, Mass., who has just perfected a unique sun dial which gives extremely accurate readings of minutes of the day as well as hours

Radio Starts Lights

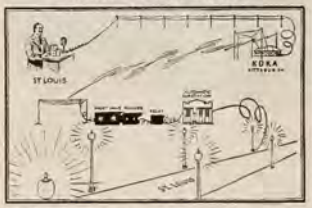


Diagram of the radio-starting of St. Louis' new $8,000,000 lighting project, which was inaugurated December 16. The voice of Mayor Victor J. Miller, picked up by a microphone produced a low-frequency wave from Station KDKA which set in motion the train of automatic operations which illuminated the streets of St. Louis.

No Trouble For This Car

Wide World Photo

A new innovation in the automobile line is this "Wheel-Cum-Track" combination of automobile and tractor, exhibited at the recent tank demonstration at Camberley, England. The body is that of an ordinary touring car, and the change from to wheels to rack can be made by engine power in less than a minute.

Microphonic Air-Gap

SOON after the invention, by Emile Berliner, of the loose contact transmitter, or microphone, scientists tried to explain its delicate action. That air was a factor in microphonic action was indirectly proved by Berlinger and his assistant W. L. Richards in 1879 when they put a Blake transmitter contact into a tight chamber and pumped the air out. Regularly the normal electric resistance of the contact was reduced on exhaustion and as regularly restored when again admitting air into the chamber.

Recently it occurred to Mr. Berliner to consult Roy M. Allen of Bloomfield, N. J., formerly the President of the New York Microscopic Society and who is very skillful in the making of photomicrographs. Mr. Berliner furnished Mr. Allen with a mounted telegraph key the contacts of which consisted of elongated, conical iron pins, which could be adjusted by a small relay spring. They were fashioned so as to permit the close approach of a high power microscope that had a photographic attachment. The mounted key could be readily adjusted so that it would by microphonic action transmit the the ticking of a watch and the whirring of its wheels. Mr. Allen's problem consisted in photographing the contact while listening to the ticking of the watch which was transmitted by the delicately adjusted key where an air-gap was supposed to exist; this air-gap Mr. Allen was trying to enlarge and photograph.

The invention of the microphone started with a telegraph key improperly manipulated by Mr. Berliner and it is mentioned in his patent document of April 14, 1877 describing the microphone. The details appear in Frederic William Wile's biography of Mr. Berliner recently published.

We shall be glad to have the comments of our readers on this feature, and the one on science which we are running each month. Are you interested in the pictures? Does the type of news matter give you any needed imformation? Let us hear from you. —Editor.

Head First Toward the Ground

Wide World Photo

Corporal Archie Atherton, Marine Corps parachute jumper, leaving a bombing plane head first with a parachute strapped to his back. As yet the parachute has not opened but Archie has lived through several hundred experiences like this and he knows that it will, sooner or later. He hopes it won't be much later. Taken over the city of San Diego, Calif., recently

Test Tank Duplicates Altitude Conditions

Wide World Photo.

Some of the sensations of an airplane ascent 30,000 feet in the air can now be experienced without leaving the ground. Thomas Templeman, aeronautical instrument expert at the Bureau of Standards, is shown inside of the steel cell, the interior of which is designed to duplicate conditions in the upper atmosphere. The changes of atmospheric conditions can be regulated by the "pilot" and the cylinder is also used to test instruments used in altitude flights

Engine Tug-of-War

Wide World Photos.

Storage locomotive plays tug-o-war with steam locomotive in the Chicago & Northwestern R. R. yards, at Chicago. Demonstration proves the storage battery locomotive far superior in many different types of duties. The storage battery locomotive is 17,000 pounds lighter than the steam locomotive

President and Engineer

Wide World Photo.

The famous Toonerville Trolley of the cartoons has a rival in the 5-mile railroad in the Ozarks of Southwest Missouri, said to be the shortest railroad line in the country. Dave Dingler, of Cassville Mo., is the president of the "Cassville and Exeter Railroad Company" and also is the line's only engineer. Mr. Dingler says he owes his success to having risen from the ranks. He is part owner of the road with J. C. Ault who is auditor and secretary. Mrs. Dingler is vice-president, while Mrs. Ault is treasurer. In all, there are eight employees of the road. Photo shows Mr. Dingler in the conventional overall attire, standing beside the locomotive of his line

What kind of pictures would you like to see in this section? We are always glad to please our readers if we know their desires. Moral:-Write us your wishes.
—Editor.

Studying Mars

Some forms of animal and plant life probably exist on Mars, is the conclusion of Dr. W. W. Campbell, president of the University of California and a director of Lick Observatory shown at the telescope. He is regarded as one of the world's foremost astronomers. Dr. Campbell bases his conclusions on the fact that studies of the ruby planet, now but 42,000,000 miles distant, show that there are indications of vegetation there. The fact that the surface of Mars takes on a dark hue in spring and a lighter color in the fall, comparable to seasonal changes on earth, indicates to Dr. Campbell that there is a strong possibility of plant and animal life there. Two factors necessary for the existence of life, he explains, are the presence of water vapor and oxygen.

Almost conclusive evidence of the presence of these two vapors is seen in the findings of Dr. W. H. Wright of Licks observatory, who has made many investigations of the Martian atmosphere.

Words--Without Music

By

DOROTHY BRISTER STAFFORD

Graham McNamee, champion long distance talker of the world, who to the satisfaction of millions answered the question "How big is Alexander, pa, that people call him great?"

IF YOU get as much of a "kick" as we do out of this fascinating new advertising known as "whisper copy," you've surely seen the two distinguished gentlemen—immaculate in evening clothes—who apparently are present at every fashionable gathering, discussing one of their fellow-guests behind his back; (in this case not the instance where they are expressing pity for the poor chap for his social ostracism because no kind friend has had the courage to tell him to brush the dandruff off his coat collar or gargle his throat,) but the one where approval beams from their expressions and they are saying.

"By George, that chap Jones is certainly interesting. He is never at a loss for something to say and I can't see where he gets time to pick up so much general information. He has no more time to read than we have yet he can talk better than any of us."

And if, intrigued by the possibility that you, too, may become a social knockout, or learn how to talk back to the boss in conference, you read on, you'll find that Information Harry has climbed to this lofty pinnacle where he is the envy of all his associates by zealous study of some little book that contains the best thoughts of the greatest minds, and all the general information that a poor boy trying to get along needs in his business.

We are sure our *corpsbruder* of the Corona won't mind much if we steal his carefully prepared thunder and trot out our own particular hobby as an answer, instead of his little book. For everybody knows that the best informed people we come in contact with these days, whether it be at a social gathering or in the business world—those who are right up to the minute with knowledge and information on all subjects of current interest, politics, news and sports, are those far-seeing souls who own radio sets and listen to what comes over them. That we are all subconsciously absorbing a wide knowledge of music and cultural subjects on the side is an old story. What we are talking about in this lesson is the tremendous news and informative value of radio. If Burke, who named the press the Fourth Estate, were living today he would surely nominate Radio as the Fifth, and as its information is so often in the present tense, it can truly be regarded as the most important of all.

A man said the other day that he would just as soon think of getting along without a radio set as a telephone.

"The entertainment and music appeal to the family," he said. "To me it is as necessary as the newspaper. I use the market reports in my business and of course I get them long before they are printed. And as baseball and football are my hobbies, I wouldn't think of missing the radio accounts of the important games."

And since it seems that so much of moment in the way of epoch-making events has transpired in the past few months in this phase of broadcasting, it might not be amiss at this period of the year to review some of it.

Hearing the Series

HANDLING of the World's Series the past fall will be marked with a white milestone in the progress of broadcasting. For although in previous seasons, we of the outlying districts have had the excellent Associated Press accounts of the games broadcast by our local stations, this year was the first time in history, when, by reason of the network of hook-ups, millions of baseball fans in practically every state in the union heard not only the detailed accounts of the games at the instant they were transpiring, but of the roar of the crowds witnessing the struggle, in several instances the crack of the bat, and with the aid of the vivid word pictures of Graham McNamee, were able to follow the game with as breathless interest as those actually witnessing the contest. And while personally we felt that we had never heard a more dramatic or colorful description of anything either by McNamee or any other radio speaker than the account of these games, it is significant that the New York Times considered this announcing so important and epochal, that in the sacred first column of its first page it printed the verbatim radio account of the first game, and continued at length to five full columns, relegating its own important sport writers' accounts to the sporting section. This policy was followed daily throughout the series. It seems to us that this was not only a high compliment to the ability of the announcer, and the National Broadcasting Company, as we must now learn to call the WEAF-ers, but establishes radio as something entirely legitimate and standard, and places broadcasting not only alongside the newspaper as a distinguished public servant, but a little bit ahead of it. We wonder if the baseball public would ever again be satisfied with a telegraphic account of the games. The best a ticker can do is the past tense, "It was a strike." But listen to Mac,

"Alex-an-der pitching. Two balls, two strikes! His arm comes up—here it comes!" A mighty howl from the crowd. "It's a strike! Struck him out!" The listener doesn't have to be told that *it was* a strike. He hears it, it *is* a strike.

And there comes the thought that the newspapers and the expert writers thereon are going to regard radio as a bit more of a menace to their profession. Of course the dyed-in-the-wool baseball bug who delights in post

Clyde R. Randall, announcer at WSMB, deserves honorable mention for yeoman's service at the time of the Florida hurricane

mortems still wants to read everything he can find printed about the game, but the average person who has listened to the striking description of every play, and for who the event was history when the last man went out, is he likely to dash out and buy a paper? We think not. We know there were mighty few sport extras sold around our neighborhood after any of the games.

And as we watched the tense faces about the loud speakers and heard the comments of the listeners, we thought of the unique experience of this man whose voice was becoming familiar to millions all over the land. Surely no such privilege has been enjoyed by any other speaker since the beginning of time. And while naturally in such a heterogeneous mass of individuals as is represented by the radio audience there are as many opinions as there are types of minds, to us it seems that Mr. McNamee's technique is just about what it should be. A crowd of rabid baseball fans doesn't want to hear the dignified McNamee of the Atwater-Kent concerts, and we wonder what the disgruntled listener who wired him that he talked too much expected him to do while the pitcher is stalling for time or the umpire is settling an argument. This same listener would be the first to howl if he had to listen to the hum of the wire between plays, and we note in the New York Times' accounts all the extraneous chatter was included. And how many of the self-appointed critics could keep up a running fire of comment for two hours and a half, give an accurate description of the game and equal Graham McNamee's batting average?

Colorful Announcing

THIS inevitable criticism of the announcer's method brings to mind some of the funny comments we heard regarding Major Andrew White's able delineation of the Dempsey Waterloo down in Philadelphia. Here again was a first time on any stage performance. Never before had the fifteen millions—which seems to be the popular current quotation on the size of the radio audience—been given the opportunity to listen to the description of a championship prizefight direct from the ringside—the clang of the gong, the conversation of the vast multitude soaking in the downpouring rain and the thud of the gloves. Some of the psychological effects of bringing a slugging contest into the sacred precincts of the home were humorous to say the least. For instance the white-haired grandmother, (a real grandmother, this time with her soft silk gown trailing about her and her glasses slightly askew in her excitement,) who rushed into the hall and informed the tenants in the next apartment, whom as she explained afterwards she didn't know "from Adam's hat-band," that Jack's nose was a complete wreck and one of his eyes was closed! Possibly there were some God-fearing souls in the radio audience who shut off the set and didn't listen, but we don't know any of

them. It is interesting to conjure up a vision of the listeners far away on lonely farms, in prim little villages, the type who have had no contact with anything in the world of sport, let alone a thing as revolutionary as a prize-fight, drinking in the vivid account of that battle. And the crowning event to many of them as it was to the eleven-year old whose father allowed him to stay up for the finish was the opportunity of boasting to less fortunate ones. "And I heard Gene Tunney speak himself." A night or two later the small boy was able to say, "And I heard Gertrude Ederle," though personally the only thought we were able to carry away from Miss Ederle's discourse was that Channel swimmers seem to exist entirely on chicken.

But to return to Major White and the fisticuffs. One of the most absurd criticisms we heard was from a man who said:

"I couldn't understand that announcer. He sounded like he was excited." Well, my word! and a couple of sentences! Who wouldn't be excited? We know the air in our living-room was fairly electric, and we couldn't see the contest. When psychologists tell us how extremely difficult it is for the average human being to give an accurate description of even an unimportant happening, and how in criminal trials three supposedly reliable persons will give three totally different versions of the same event, doesn't it seem a little remarkable that a man can think so quickly and put his thoughts into intelligible words in the fraction of time it took the agile Tunney to sidestep one of Dempsey's lunges? It requires a little more than a quick eye and a gift for gab. A pretty agile mind, working on all six seems to be the chief requisite for reporting a championship ring battle, and anyone who listened to Major White knows that he possesses it.

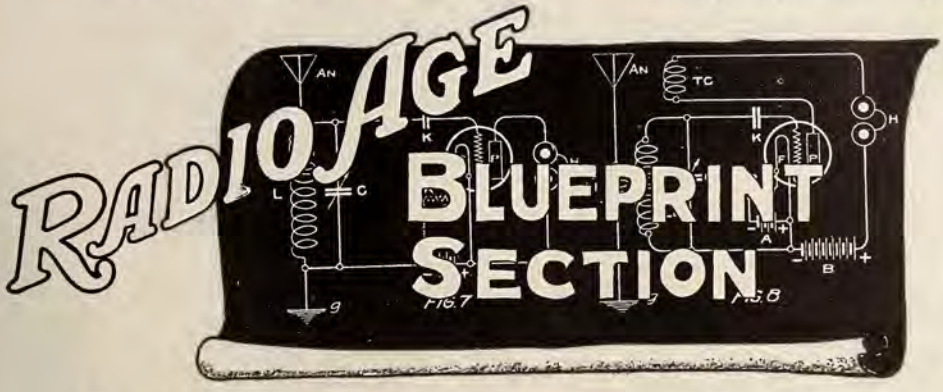
Back of the Scenes

ONE doubts if a dozen of the listeners to this great broadcast even gave a thought to the tremendous mechanical and technical work involved in its success. The radio audience has had so many marvelous things done for it that it accepts everything as a matter of course, and the attitude of some of our blasé friends of the dial-twisting fraternity leads us to believe that if we were back in 1917, and some enterprising station corraled the rights to broadcast from the western front, the listeners wouldn't bat an eyelash, but someone would probably complain that the machine guns were too close to the microphone. But whether the listeners were impressed or not, the broadcasting of the fight was quite an achievement. Held up until the eleventh hour because of the difficulty of finding an advertiser willing to pay the exorbitant fee Mr. Rickard demanded for the privilege, it was only on the Monday preceding the fight that the contract was closed with Mr. Smith which made the broadcast possible, and all the mechanical difficulties had to be solved in three days. And there were many. In addition to the WJZ hook-up, there was the complicated WEAF chain, to say nothing of dozens of independent stations clamoring to get in on the big event. But under the direction of Carl Dreher, chief engineer of the R. C. A. stations all the technical complications were met and overcome, and the fight went on the air, and into thousands of living-rooms, where the unique spectacle of father, mother and the children all listening to the account of two huge men pummelling each other to the accompaniment of considerable spilt gore probably gave the reformers much food for thought.

And then this past fall there was that event, decidedly impromptu in nature, that for the time being represented to thousands of people the most impor-

(Continued on page 55)

Andrew J. White, who with McNamee, as alternate, announced the Dempsey-Tunney fight recently



Building Browning-Drake Power Receiver

Quality Reproduction Assured With Compact

By J. E. COOMBES

RADIO'S public today, whether it be the experimenter or the listener, has become quite fastidious in its taste for quality in all forms of reproduction. With the improvements made in the nature of the programs broadcast last year, the radio set has become almost a vital necessity in the home of the music lover as well as the individual who keeps track of news developments via the air. The receiving set described in this article is designed so that its reproductive powers will be readily appreciated by the severest music critic. Considerable care has been used in selecting the proper apparatus so the finest musical performance will be obtained without sacrificing the other elements for successful reception. From the standpoint of simplicity of construction the Browning-Drake design was used, since this arrangement is deserving of, rather than in need of, publicity. For over two years this design has remained unchanged and has gained popularity constantly because of its ease of construction, comparatively low cost and efficiency of operation in service.

One stage of neutralized radio frequency amplification is used with a regenerative detector, thus getting all of the energy possible out of a small number of tubes. As for selectivity and distance getting ability the receiver is quite commendable, but it is primarily for its freedom from distortion in the radio frequency and detector circuits that it has been selected for use as a self contained power operated receiver. The only deviation from the standard Browning-Drake construction practice is the introduction of an optional antenna inductance for greater selectivity. This inductance consists of from two to four turns of insulated wire wound on the outside of the antenna coupler at the filament end. One end of the extra coil is attached to the common ground-filament connection while the other is brought out to an additional antenna binding post. This reduces the coupling from the antenna to the secondary of the first coupler and sharpens up the tuning considerably. This was done for work in Chicago where the average experimenter and listener is beset with two dozen or more broadcasting stations. In sections removed from metropolitan districts there will not be the necessity for the added antenna coupling since interference there will not be anywhere near as bad as in the city. If it is desired the added antenna coil may be left on and the degree of selectivity governed by changing from one binding post to another as conditions warrant such a change.

Reason for Power

POWER amplification requires but little introduction to the radio public for no single feature of the improvement of the methods of reception has earned more publicity from radio magazines and journals than this comparatively recent development. The reason for power amplification is not difficult to find. Bass notes require a considerable expenditure of energy if they are to be amplified faithfully. When we reason back and realize how much more mechanical energy it takes to sound the pedal diapason of the organ than the note of the violin it is not hard to appreciate the fact a correspondingly

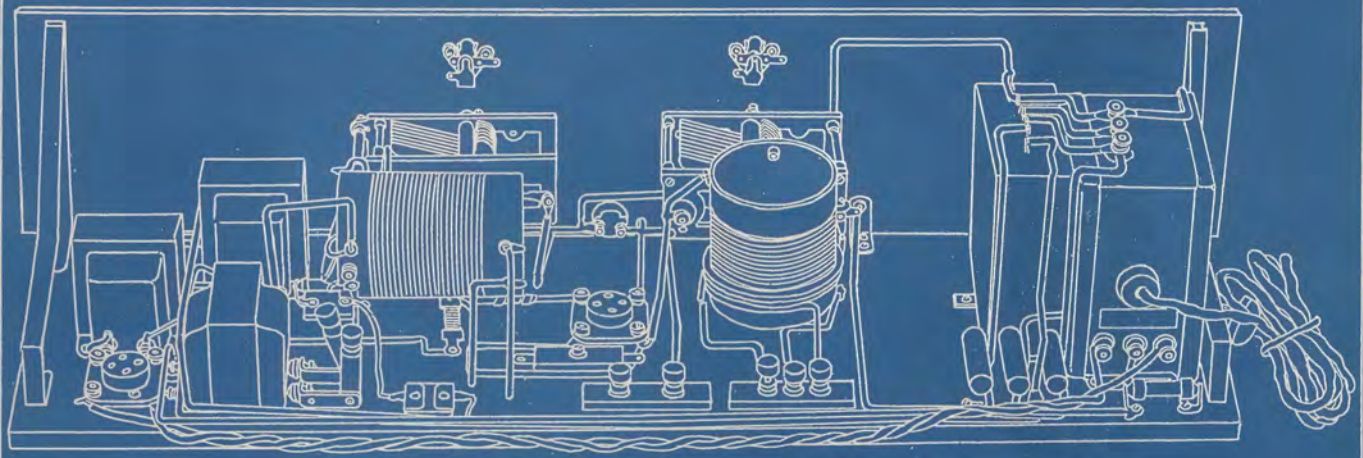


FIG. 1 REAR VIEW BROWNING-DRAKE
POWER OPERATED RECEIVER

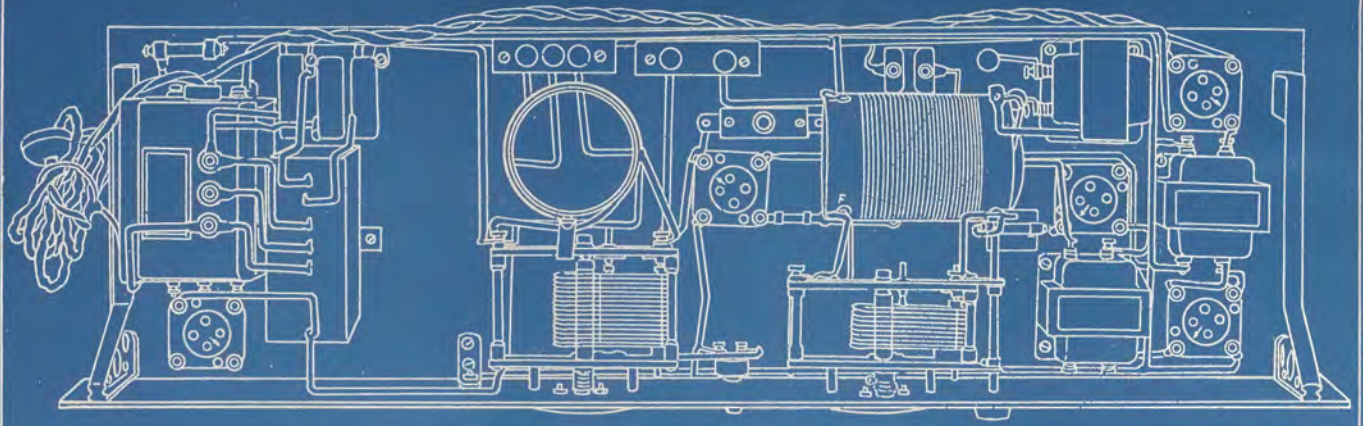


FIG. 2 TOP VIEW BROWNING-DRAKE
POWER OPERATED RECEIVER

greater amount of electrical energy must be spent for the full reproduction of these deeper tones. Consequently a radio tube with a capacity just sufficient to amplify comfortably the music of the violin cannot be expected to do justice to the tones of the heavier bass instruments.

It is significant that the power tube UX171 used in the last stage of this receiver has an undistorted power output approximately forty times greater than that of the ordinary amplifying tube. This power tube gives full sway to the bass notes which have heretofore been squeezed through the audio channels of the receiver with diminished and strained quality and volume.

Choose with Care

MUCH care has been taken in selecting the apparatus for the audio frequency end of the power operated Browning-Drake set. Upon the construction of the audio amplifier depends the success or failure of the receiver as a musical instrument. Thordarsons R200 audio transformers were chosen as giving the smoothest amplification obtainable. These transformers will handle all notes from 30 cycles up past the upper range of the human ear.

The use of the power compact (R171) makes it possible to build a very compact power supply and B eliminator into the set itself. This power compact contains the major portion of the complete unit. Within its compound filled case are to be found the power supply transformer, two filter chokes of 30 henries inductance with a current carrying capacity of 80 milliamperes; two buffer condensers of .1 mfd. each (to go across the Raytheon elements) and a filament supply for the 5 volt power tube. This power supply unit is designed to supply complete A, B and C power for the power stage, and in addition, the plate supply for the rest of the receiver. With the power supply unit constructed in accord with the diagrams shown in the blueprint section of this article there is not the slightest trace of a hum in the loudspeaker. The 60 cycle pulsations in the house lighting current have been carefully filtered out, leaving a smooth direct current flow to the plate of the tubes.

One of the features of the power compact used in constructing this set, is the perfectly balanced filament winding. The mid-tap is taken from the exact electrical center. This center position is not obtained by tapping a continuous winding, but is taken from the common lead of two individual perfectly balanced coils, wound side by side. The C bias for the power tube grid is brought to the center tap through a 2000 ohm resistor which gives about 50 volts grid bias. It is only with a perfectly balanced grid return that the AC hum may be completely obliterated. As will be observed, the power supply unit is placed at the radio frequency end of the receiver. This is done because the tuning circuit is less apt to pick up the 60 cycle hum of the light circuit than is the audio amplifier.

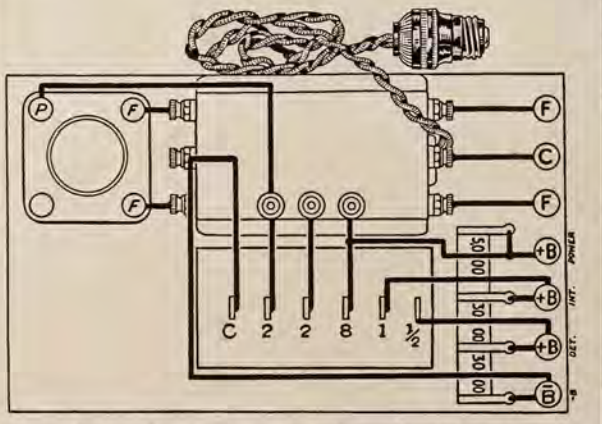
In looking at the schematic circuit, Figure 4, the 2000 ohm resistor is shown, at one end, common with the negative B and the negative A, and common with all the grid returns of the set. Since the power tube filaments are lighted from raw AC and since that circuit is not a part of the regular filament circuit, the C bias connection will be at zero potential to the balance of the receiver, *but will be 50 volts negative to the power tube grid.*

Another feature is the absence of variable controls. The voltages delivered to the set by the

LIST OF PARTS

These parts were used in the model shown here. Other parts of equal merit will serve.

1 Bakelite panel, 7"x30"x3/16"
1 Wood baseboard, 9"x29"
2 Panel brackets
1 National Browning Drake kit, consisting of coils, variable condensers, and vernier dials.
1 X-L Neutralizing condenser
1 Carter resistor, 2 ohms RU2
1 Carter resistor, 50 ohms RU50
1 Sangamo grid condenser, .00025 mfg.
1 Durham grid leak, 2 Megohm
2 Thordarson R-200 amplifying transformers
1 Thordarson speaker coupling transformer
1 Thordarson power compact R-171
1 Raytheon rectifying tube, type BH
5 Benjamin spring base tube sockets
1 Dubilier condenser block, Raytheon type
1 5000 ohm resistor, 40 MA capacity
2 3000 ohm resistor, 40 MA capacity
1 2000 ohm resistor, 40 MA capacity
1 Carter A battery switch



Separate diagram of the power compact. This may be made up as a separate unit if desired and used for all receivers

power device are automatically controlled by means of fixed resistances. The first three fixed resistances in series divide the voltage in proper values for the receiver. Two hundred and fifty volts are delivered to the plate of the power tube. The 5,000 ohm resistor cuts this down to 90 volts for the first audio tube. The two 3,000 ohm resistors divide this last voltage in half and deliver 45 volts to the plate of the detector tube and 50 volts to the radio frequency tube. These resistances should be capable of carrying a current of 40 milliamperes.

The importance of having these voltages predetermined will be appreciated when we realize the average voltmeter in possession of the home constructor is of a comparatively low resistance. These low resistance voltmeters, while they give a fairly accurate reading of voltages from batteries, are not suggested for reading the voltages supplied by power devices. The voltage output of the power supply devices varies with the amount of current consumed in the output device. When these voltmeters are used a comparatively heavy current is caused to flow through the low resistance windings of the instrument, increasing the total current consumption and causing a considerable drop in voltage.

For loud speaker coupling the transformer method has been chosen since under this arrangement the speaker windings do not carry the direct current voltage, but rather handle only the alternating current pulses from the plate of the power tube. The speaker coupling transformer R76 is inserted in the plate circuit of the power tube and its output delivered through a secondary winding to the loud speaker.

In the blueprints, Figure 1 shows a rear view of the receiver. The wiring for the filament of the power stage is twisted as shown and leads from the power tube filament terminals on the compact along the baseboard and over to the last audio tube. The compact itself is shown with the accompanying condenser bank beside it so that all leads may be made as short as possible. The location of the socket for the Raytheon tube is shown in Figure 2 at the left end of the panel. Since the newer type Raytheon tubes have the long prongs on the tube, the standard UX base socket may be used in the receiver. The fixed resistances are shown in Figure 1 at the right of the baseboard. These plans merely show the location of the parts, which however should be wired according to the schematic circuit, Figure 4. Flexible, rubber covered wire should be used for hooking up the set, although bus bar wire may be used providing spaghetti is used on all sections where there is any possibility of short circuiting.

Filament control for the 199 tube used as the radio frequency tube is through a fixed fifty ohm resistance. Filaments of the detector and the first audio are handled in parallel through a fixed two ohm resistance. With these resistance values the filaments secure their allotted current rating and manual control is obviated. The bypass condenser shown across the primary of the first audio transformer may be either a .001 or a .002 mfd. fixed condenser. Grid return of the first audio transformer is to the negative filament, there being no C battery used in this position. Biasing of the power tube grid is automatic through the 2,000 ohm fixed resistor in series with the center tap of the filament winding of the power compact. In Figure 4 the parts which are included in the power compact itself are shown within the dotted lines. The filament switch is placed in the negative lead.

For neutralization purposes the small neutralizing condenser shown in Figure 2, is located between the first socket and the front panel, being connected between the grid of the radio frequency tube and the neutralizing tap on the detector inductance. This should be adjusted with a wooden or bakelite rod and should be manipulated so that with the set in a non-regenerative condition (tickler backed away from oscillation point) the first dial may be rotated back and forth across a station's signal without the first tube going into oscillation and squealing. A little practice with the neutralization adjustment will determine the best position. The neutralization should be made on a signal about the mid position in the broadcasting channels.

Rear view of the completed Browning-Drake power operated receiver, parts for which are shown in list on the opposite page

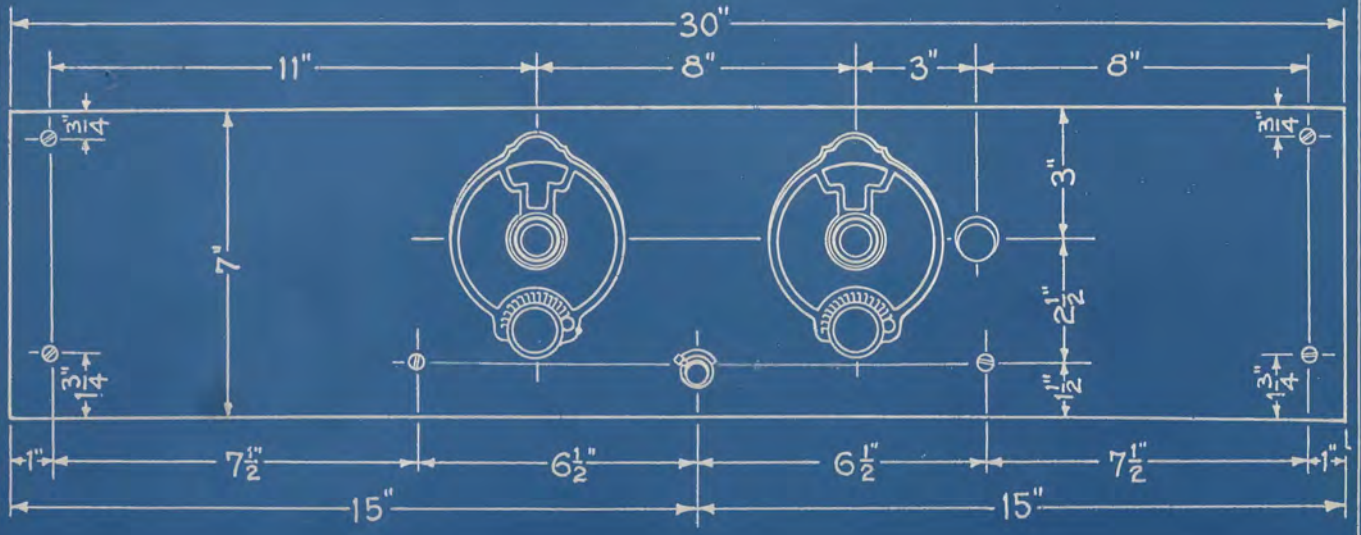


FIG. 3 FRONT VIEW BROWNING-DRAKE
POWER OPERATED RECEIVER

RADIO AGE INC.

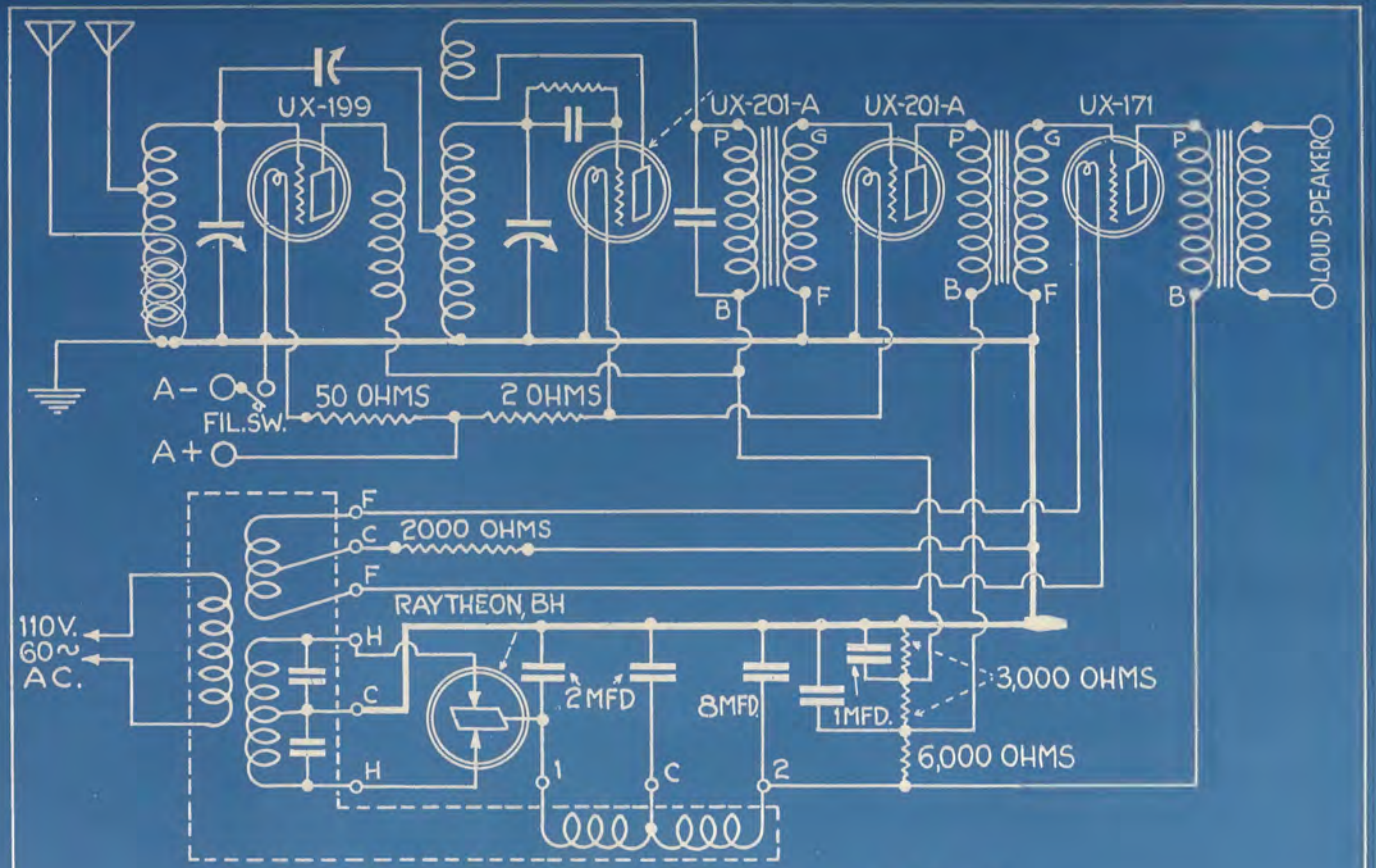


FIG. 4 SCHEMATIC CIRCUIT BROWNING-DRAKE
POWER OPERATED RECEIVER

RADIO AGE INC.

Pick-ups and Hook-ups by our Readers

THE material appearing under the title "Pickups and Hookups by Our Readers" in RADIO AGE, is contributed by our readers. It is a department wherein our readers exchange views on various circuits and the construction and operation thereof. Many times our readers disagree on technical points, and it should be understood that RADIO AGE is not responsible for the views presented herein by contributors, but publishes the letters and drawings merely as a means of permitting the fans to know what the other fellow is doing and thinking.

ONE of our readers, W. D. Devore, an electrical contractor, writes very interestingly concerning power transmission by radio. Because his letter holds a novel viewpoint we are printing it for the benefit of our readers.

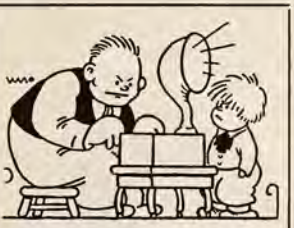
"In reading your September issue I noticed an article by Armstrong Perry in which he severely criticizes the idea of power transmission by radio.

"As the transmission of sound by radio has reached a very good stage of development and as we are about exhausted with speculations in that direction we only naturally turn our thoughts and direct our experiments towards that which will open up new and larger spheres of activity.

"Foremost of these newer ideas is the transmission of power with no interconnecting means. Whether or not the term radio should be used to express this form of transmission is open to discussion, but we will use this term to convey the idea.

"Many engineers claim this means of power transmission is wholly without foundation and dismiss the thought as absolutely impossible. For example, one engineer calls to mind the statement that a very small amount of energy, three trillionths to be exact, is the amount of the original broadcast power picked up by a receiving set. We will grant this statement without argument. We can readily understand what an inconceivably great power would be required to transmit enough power to light a small lamp only a short distance from the transmitter. But before we dismiss the idea as wholly impractical let us consider a few different angles of the situation.

"Radio as we are familiar with it today consists of but one thing, the transmission of sound waves, nothing more and nothing less. How well this has been accomplished you can answer for yourself. Does it then seem fair and reasonable to think that to transmit power it would be necessary to send out a stronger sound wave and convert this sound wave into a heat wave or a light wave? Certainly not. If you turn on your radio and wish to receive a good concert it is necessary that some broadcasting station be transmitting a concert. You would not think for a moment of using your lamp socket for a telephone or trying to heat your home and illuminate your parlor with the telephone. But that is the idea those persons surely must have when they come out and say point blank and say that power transmission by radio is an absurd idea.



"Pop is that some one whistling on the radio?"

"No dear that is little Tommy Jones next door operating one of those sets that 'even a child can run'."

"How is the feat going to be performed? We do not know, neither did we know, just a few years ago, how the radio telephone was to be made practical. These same men who today so quickly condemn power transmission were among those who said that practical radio telephony was only visionary. Some of you old timers go back with me just for a moment. Do you remember how we used to try to modulate a direct current arc circuit, how the microphones would fuse almost as soon as the power was turned on, how we some times used a dozen or more of them in series (and paralleled) to withstand the high current? And then, the one wonder working invention that made all our dreams come true. The three electrode tube. The wonderful little lamp that could be used as a detector, an amplifier or as a generator of undamped oscillations. This alone made radio telephony practical and some day some little device is going to make power transmission possible.

"Do not misunderstand me. When we receive power, power must be transmitted. When we receive heat, heat must be transmitted. We cannot expect to convert a sound wave at radio frequencies and get any use from it in the form of heat or light. Some day a station will broadcast a heat wave which will be picked up and amplified in the same manner as our present sound waves.

"In the preceding paragraphs I have named three possible kinds of transmission, power, heat and light. We need not consider the power and light problems because they will only involve unnecessary arguments.

Whenever we can transmit heat at a radio frequency we have conquered the entire radio universe because with the transmission of heat will come power and with heat will come light and from light we will get vision. So if you are told your receiver only picks up three trillionths of the broadcasters power do not become down hearted because some day if you can pick up three trillionths of heat. Broadcasters power you will not only will be able to heat and light your home but you will be able to see important events as you now hear them.

"In conclusion I might add these statements for the benefit of those who will criticize this article and thus rob them of some of their arguments. Sound wave transmission as we know it today is of course transmitted by electricity but the sound wave must be changed in character so that it will blend with the carrier wave. In short the simple term for this is modulation. This is accomplished by a simple microphone which of course must have its attendant speech amplifiers in order to modulate the powerful oscillator. With some such an idea we may hope to change the form of a heat wave so as to cause it to blend into a carrier and be amplified. Such an accomplishment is not only possible but very probable, so before we condemn the idea lets give it a chance and maybe someone will come forth with a device that will render our present system as obsolete as the ancient coherer."

A SURVEY of the United States by the Department of Commerce shows the following proportion of listeners:

New England 8.025 percent; Middle Atlantic states 18.998 percent; East North Central states 27.068 percent; West North Central states 19.242 percent; South Atlantic states 5.730 percent; East South Central 3.489 percent; West South Central 8.046 percent; Mountain states 2.876 percent and the Pacific states 6.526 percent.

WE HAVE had quite a few laughs in our existence, but this letter from A. Rufus Applegarth, Jr., of 86 South Long Beach Ave., Freeport, N. Y., gives us quite a chuckle, although we will admit it is serious business for our correspondent. He says: "I built one of your circuits called the 'ultra-audion' described in the August, 1925, issue. I have had wonderful results from the set, but my neighbors are loading their shotguns." We can readily appreciate what his neighbors think, but the cure is simple: go over to one stage of neutralized RF; something like the circuit shown on page 21, January, 1926. This set is a great distance getter and if properly constructed will not radiate. Tell the neighbors you are building one of this type of sets and watch them trade their shot guns for bouquets. We are sending a DT button on account of the excellent log which Rufus has furnished this department. We'll bet the neighbors didn't get as good a log!

February Evening Skies

Mars and Jupiter Only Planets Seen This Month

By JAMES STOKLEY

(Science Service)

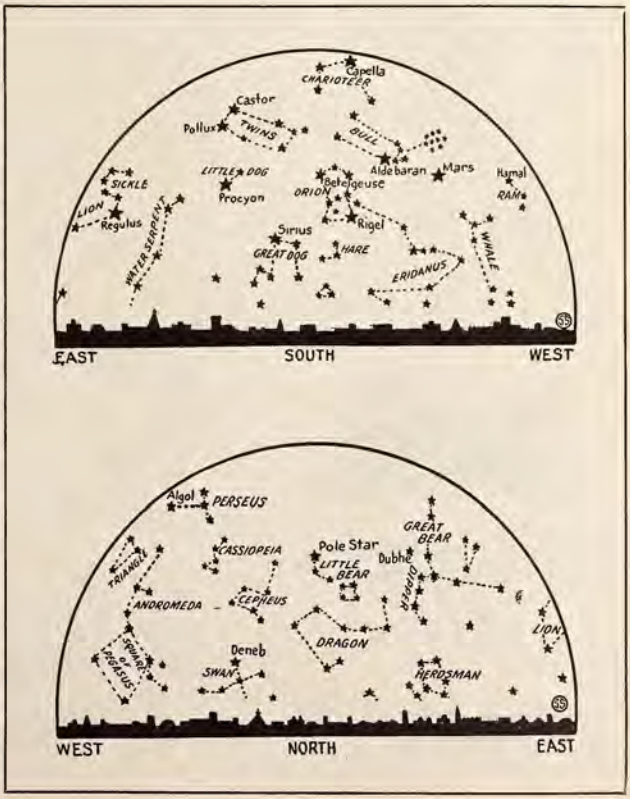
THIS month sees an end of the evening display of one of the plants of the autumn sky, for Jupiter has passed close to the sun. On the first of March it will be in opposition, which means that Jupiter and the sun will be in the same straight line from the earth. But Mars is still with us, shining with its ruddy glow in the southwest, just to the south of the Pleiades, the famous loose cluster of stars in Taurus, the Bull.

On February 25, Mercury, a planet which few people have ever seen, will be in a position where it will be visible low in the western sky at dusk, ready to be picked up by a keen eye. As it revolves around the sun in a year of 88 days, it is sometimes seen to the west of the sun, and sometimes to the east, when it is said to be in either western or eastern elongation. On the 25th, it will be in eastern elongation, which means that the sun sets a little while before Mercury. It is only a third as far away from the sun as the earth, so that it is never seen more than 28 degrees from our orb of day—a distance about the same as that between Betelgeuse and Sirius, two of the bright stars now in the southern sky. Its orbit is not circular, but elliptical, and as a result it seldom reaches the maximum elongation on the average getting only about 23 degrees away from the sun. Twilight lasts until the sun is about 18 degrees below the horizon, so Mercury can never be seen for very long after complete darkness has arrived. This month the opposition is not as great as the average, being only 18 degrees, so that it can be seen at best only as a bright star in the evening twilight.

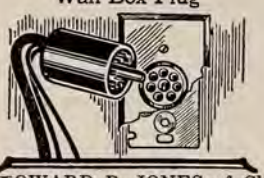
But the February evening sky makes up in stellar attractions for what it lacks in the planets. The winter sky is now in all its glory, for at no other time of the year can as many first magnitude stars be seen at once. In the whole sky there are twenty stars brighter than one and a half in the astronomical scale of magnitudes. Five of these are in the southern hemisphere and are never visible above our horizon. This leaves fifteen which we can see, and of these, eight are now in the sky at once, six of them forming a hexagon with another at the center.

Almost directly overhead is the yellowish-white Capella, astronomically alpha Aurigae, as it is the brightest star in the constellation of Auriga, the Charioteer. This is so bright that it is very easy to identify, for only Sirius, of the stars we can now see, exceeds it in brilliance. To the southwest of Capella is the orange-red star, Aldebaran, or alpha Tauri, the brightest star in the constellation of Taurus, the bull, and which was represented on the ancient star maps as the bull's eye, glaring at the nearby warrior, Orion, South, and a little east of Aldebaran, is a representative of Orion itself, in the form of Rigel, or beta Orionis, for it is the second brightest star in Orion. Rigel has the distinction of being one of the most brilliant

(Please turn to page 38)



Wall Box Plug



HOWARD B. JONES of Chicago, manufacturer of the Jones Multi-Plug line for battery connections, announces a new type W. B. (Wall Box) Multi-Plug, consisting of the standard seven contact socket mounted on a switch box cover and the regular plug and cable.

By installing this socket in the baseboard of the room, the batteries with their messy wires and unsightly appearance can be removed from the living room entirely and placed in basement or adjoining closet.

A connection from the batteries or power supply unit can then be made in the same manner as the ordinary floor lamp.

Hope to Solve Mystery of Dengue Fever

SIXTY-FOUR soldiers who voluntarily submitted themselves to the bites of infected misquitoes have enabled officers of the U. S. Army Medical Department Research Board at Manila to clear up the previously unsolved problems of dengue fever.

Lt. Col. J. F. Siler told the American Association for the Advancement of Science meeting at Philadelphia that medical science is now in a position to wage war on dengue with the same assurance of success that has attended the campaigns prosecuted against yellow fever.

Dengue, or break-bone fever, is a common disease of the tropics and is one of the chief causes of sickness in the U. S. army in the Philippines. Five years ago an epidemic swept through the southern states from Texas to Georgia, attacking about 2,000,000 people.

The research board investigating the disease found, said Lt. Col. Siler, that it was transmitted by the same mosquito and in exactly the same way that yellow fever is carried from person to person.

$12.50

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Nothing else to buy. Replaces "B" Batteries. Operates direct from Electric Light Socket on 110-120 volt A. C. Lighting Circuit. Delivers up to 100 volts.

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New High Voltage Model
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Not only the most reasonable-

but proved by 40,000 users to be also the most convenient, unfailing and satisfactory "B" Eliminator

They Want YOU to Know

Montreal, Canada
I am pleased to state that the Ferbend "B" Eliminator purchased from you is a wonder and is giving results far beyond my expectations. The tone and volume would satisfy the most critical. James Stroud, Electrical Engineer.

Youngstown, Ohio
Your Eliminator is the best buy I have made in a long time. It has already more than paid for itself in saving on "B" batteries. K. L. Welch.

Springville, N.Y.
Having had perfect results with the seven Eliminators recently purchased you may send me six more by express at once. Leonard J. Cooper.

Burbank, Calif.
I am more than pleased with your Eliminator. I am getting several Eastern stations through about 16 locals using the Eliminator. Jean Bernard.

St. Petersburg, Fla.
I used your Eliminator all last winter, and it was as good, if not better than several I tried of much higher price. I am more than satisfied. Ben M. Pratt.

Trenton, N. J.
I have used your Eliminator for several months and unhesitatingly recommend it. It has added 25 per cent to the volume of my set and always has full voltage. J. M. Starger

New Orleans, La.
The "B" Eliminator which I purchased from you some three or four months ago has given entire satisfaction and I am well pleased with its performance. C. J. Murphy

Wilmington, N. C.
I am well pleased with the Eliminator I purchased some time ago. It is all you claim and more. It brings in signals louder and clearer than any set of dry batteries I ever used. T. E. Lyon.

Amsterdam, N. Y.
I have compared your Eliminator with other makes and it cannot be beat. My reception has easily increased 50 per cent. It gives me much better results than I was ever able to get with dry batteries. William Davis.

Wheeling, W. Va.
The Eliminator purchased some time ago is giving remarkable results. William A. Raper, Jr.

Des Moines, Ia.
Your Eliminator is fine. Rev. F. A. Case.

Louisville, Ky
Your Eliminator is all you claim it to be. Am very much pleased with it. Alonze G. Smith.

Ott City, La.
Your Eliminator has given me good service for over a year. George May.

St. Louis, Mo.
After giving your "B" Eliminator a thorough trial wish to state that I am thoroughly satisfied. It's performance is perfect—absolutely no hum whatever. Frank Kolar.

Mattapan, Mass.
I have used your Eliminator for six months and am satisfied with it in every way. It has increased the volume of my 9-tube Neutrodyne fully 50 per cent and there is absolutely no hum from the 60-cycle line. John W. Parnell, Jr.

Second Successful Year

New High Voltage Model

for extremely large sets, or sets using power tubes, now perfected. Delivers up to 180 volts. One control adjusts voltages on all taps.

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FERBEND "B" ELIMINATOR

Approved and passed by the rigid Laboratory Tests of the two foremost Radio Laboratories in America —Radio News and Popular Radio

February Evening Skies

(Continued from page 35)

of known stars, referring to its intrinsic brightness. In general the brightest stars are very close, but Rigel is at the respectable distance of 540 light years, one light year being the distance that a beam of light will travel in twelve months, going at the rate of 186,000 miles a second, or about 6,000,000,000,000 miles.

Compared to Rigel, Sirius, to the southeast of it, and the next star in the hexagon, is next door to us, for we see it tonight by light that left it in 1918, instead of in 1387, which was the year that the light reaching us from Rigel left on its long journey. Sirius is the brightest of all the stars we see in the sky, partly, of course, because it is so close. Alpha centauri, the nearest known star, is at a little less than half the distance of Sirius, but it is one of the southern stars not visible from northern latitudes. Sirius, however, appears brighter than alpha centauri. It is the "dog star," as it is in the constellation Canis Major, the great dog.

The great dog is one of the two that accompanied the mighty hunter Orion, the other one being represented by the next star in the hexagon, yellow-white Procyon, northeast of Sirius. This is in the constellation Canis Minor, the lesser dog, and is also very close, for it is only 10 light years distant. They look close together in the sky, and in fact they are but a relatively short distance apart—about four and a third light years, closer to each other than either of them are to the earth.

Completing our hexagon, we come to the orange colored Pollux, northwest of Procyon and southeast of Capella. Pollux is one of the two stars that form the twins, Gemini, the other member of the pair being the fainter Castor, just above Pollux. The ancients considered the Twins propitious to navigators, and the Romans swore by them, as they were two of their most popular gods. The remains of the temples to Castor and Pollux at Rome, and at Girgenti, are among the most famous of the Roman ruins. The Roman oath by them

must have been very popular, for it has survived to the present day, in the slightly modified "by jiminy."

Finally, in the center of the hexagon is the famous Betelgeuse, or Alpha Orionis, the brightest star in Orion. This star is in the warrior's right shoulder, according to the old star maps, and in his upraised right hand he holds the club with which he is about to smite the giant bull Taurus.

The constellation Leo, the lion, now rising in the eastern evening sky, contains the eighth first magnitude star now visible. This is Regulus, or alpha Leonis, at the end of the handle of the "sickle," probably the most famous group of stars next to the Dipper and Orion. The blade of the sickle forms the lion's head.

Female Fish Fuses Mate to Body

ONE of the most curious living creatures ever discovered by science has been described by Dr. C. Tate Regan, of Copenhagen. This astonishing creature is named Ceratias and lives in the depths of the Atlantic Ocean, a mile or more below the surface. There are two sexes, male and female, but the male Ceratias is unable to live alone. He passes his life attached to the body of the female. The female fish is much larger than the male, being some three or four feet long while the male equals only as many inches. Dr. Regan thinks it probable the baby males attach themselves to the similarly immature females soon after the young fish emerge from the eggs. The male then loses his mouth and head parts.

X-Ray Overdoses Hurtful to Plants

X-RAYS can have harmful effects on plants as easily as they can on animals, and the result of an apparently mild dose given to a plant in its youth may show up in distortions and freak growths much later, when maturity has been reached according to a series of experiments with X-ray on plants, conducted here by Edna Louise Johnson of the University of Colorado.

Miss Johnson used sunflowers for her material, raying them while they were young seedlings and even unplanted seeds. Then she let them grow up and watched for results. Most of the plants developed doubled, or "fasciated" stems, a phenomenon occasionally observed in nature, caused by injury to the growing tip. The doubling tendency extended to leaves and flowers as well, for many leaves had two blades and some of the flower heads appeared in distorted and unnatural shapes.

The effects of the X-rays were evident internally as well as externally. The stem was made coarser and woodier, its water-conducting vessels were dislocated from their usual positions, and abnormal amounts of corky material appeared in the skin. Measurements of physiological effects showed that the rate of life-processes in general was depressed. (Science Service).

American Anticipated British "Dark Vision"

SEEING in the dark by means of the "televisor," the reported invention of John L. Baird in Great Britain, was anticipated, at least so far as its fundamental principles are concerned, by an American physicist, Prof. R. W. Wood of the Johns Hopkins University. There is nothing new or mysterious about the rays which the British inventor employs; they have been known for many years and are of the same character as ordinary light rays, but due to their lower vibration rate do not stimulate the human eye and therefore remain invisible.

Gasoline of Future May Be Pink But Plentiful

MOTORISTS of the future will be able to match the color of their cars when filling the tank, and they will not have to worry about the gasoline supply for some time to come, according to Dr. Gustav Egloff who has investigated the possibilities of getting motor fuels from various sources.

"The potential future gasoline supply will last for hundreds of years," Dr. Egloff said, "and it will come from 'cracking' a wide variety of materials such as petroleum, coal tars, shale oil and wood tars. The old fashioned gasoline was simply evaporated off of the crude oil and had no anti-knock properties. The modern 'cracking process' is a way by which heavy oils are chemically broken down into lighter ones suitable for motor fuels. 'Cracked' gasoline has valuable anti-knock properties, and the gasoline of the future will be a mixture of the two. Motor fuels will yield double the mileage and have anti-knock properties.

But the cracking process has not only created new styles in the quality of gasolines, Dr. Egloff explained, but has also introduced a new variety of colors. Although there are still many specifications that require gasoline to be water-white, the automotive cylinder that transforms "gas" into miles has no preference for any particular shade or tint. In fact color means nothing to the motor. It does, however, mean something to the distiller, for he often tries to doctor up his gasoline to get rid of all trace of color and as a result loses some of the anti-knock properties.

"It is a happy sign to motor over the country and see not only yellow, but pink, red, blue and green as well as water-white gasoline in the visible bowls," Dr. Egloff said. "The motor is no stickler for style. It will operate as well with the yellow as with the water-white, blue, pink, or even red, gasoline. Perhaps some day the motorist will suit the color of the gasoline to that of his car."

Bacteriophage Cures Carbuncles and Boils

WILL bacteriophage, mysterious sub-microscopic subject of endless scientific controversy that has been called the disease of bacteria, become a cure for one of the oldest and most common of mankind's afflictions painfully famous ever since the days of Job?

Utilized in the past by its discoverer d'Herelle to help cure dysentery, a group of French medical workers have found that anti-staphylococcus bacteriophage is a successful agent for clearing up a whole class of infections of the sort responsible for boils, abscesses and carbuncles.

The bacteriophage was first tried out on animals.

Inventor Plans High Power Cathode Ray Tube

SUPER-POWER cathode ray tubes which will take much higher voltages than the tube which he demonstrated recently at the Franklin Institute, in Philadelphia, and which has attracted considerable scientific attention, are now planned by Dr. W. D. Coolidge, assistant director of the General Electric Company's research laboratory.

Briefly, the method which he proposes to use is to "cascade" two or more tubes, the rays from one being fed into another, which speeds them up still further and increases their range. The cathode rays are rapidly moving electrons, small particles of electricity, moving with speeds of a hundred thousand or more miles a second. These electrons start from a small electric light filament from which they come at speeds of merely a few miles a second. With a voltage of 350,000 they are speeded up within the tube, so that they leave it with a velocity of 150,000 miles a second. By building larger tubes, it will be possible to increase the voltage to a certain limit, but when too much power is applied to a single tube the cathode itself is bombarded by positive rays, which move in opposite directions to the cathode or negative rays. This introduces troublesome effects.

By arranging two or more tubes together so that the nickel window at the end of the tube, from which the rays ordinarily emerge into the open air, acts as the cathode of the next tube, they are already moving at great speed when they leave the first tube and when the same voltage is applied to the second tube they are still further accelerated. The window between the two tubes may be made thick enough so that it passes the cathode rays going in one direction, but stops the positive rays going the opposite way, as they are less penetrating. Another advantage of the multiple tube over a single very large one is that it is much easier, to supply, for instance four tubes with 250,000 volts each than one tube with a million volts. (Science Service.)

Non-Magnetic Ship May Again Cruise Ocean

WILL the most unique craft in the world put to sea again after resting at its moorings for five years?

Proposed cruises for the Carnegie, the non-magnetic ship of the Carnegie Institution of Washington, were recently announced by Captain J. P. Ault.

The Carnegie is a two mast hermaphrodite brig in the construction of which iron has been reduced to a minimum.

SHIELDED TUBE

Above is shown the new Strongson self shielded copper plated tube recently marketed by the Moulded Products Corporation. A section of the copper coating is shown laid back. This tube was designed for use in radio sets where tube coupling effects are bothersome. The shielding is connected to the negative terminal of the socket so the tube's coating remains at ground potential.

Plane Excels Insects In Wing Support

THAT man excels some of Nature's creatures in keeping himself aloft in the air by the use of wings is the flattering result of recent tests carried out in France by M. P. Portier and Mille. de Rorthays. Modern airplanes support weights of from two to four pounds on each square foot of their wing surfaces; some of them even more. For comparison with these figures the French experimenters measured the wing areas of twenty-three kinds of insects and determined the weights supported by these wing areas. The record holder among the insects proved to be a variety of carpenter bee, whose wings supported a weight of a little over six-tenths of a pound per square foot, less than half as much as the poorest modern airplane. Many of the butterflies and other insects with large wings made much poorer showings, being able to support only a twentieth of a pound or even less for each square foot of wing surface. The actual wings are much less than a square foot in area, the figures being calculated to that ratio in order to compare them with the figures for airplane wings.

Please Mention Radio Age When Writing to Advertisers.

"Death Whisper" Waves Are Produced By Crystals

EFFECTS of the new "death whisper" investigated by Prof. R. W. Wood of the Jones Hopkins University and A. L. Loomis, in the latter's private laboratory at Tuxedo Park, N. Y., were described at Philadelphia before the meeting of the American Association for the Advancement of Science by Dr. Frank Thone of Science Service, Washington, D. C.

The "death whisper," Dr. Thone stated, is simply a nickname for vibrations similar to those of ordinary sound, but produced so rapidly that the human ear cannot hear them, just as the human eye cannot see ultra-violet light or X-rays. They are generated by means of electrically excited quartz crystals in a bath of oil. When a vessel of water containing a small fish or tadpole or other aquatic animal, or some kinds of water plants, is set on top of the vibrating crystal the waves are shot through the glass into the water, and there they kill the animal or plant, and frequently break down its structure so completely that it simply disappears.

While the waves cannot leave the liquid, Dr. Thone explained, they will pass through solids and will penetrate human flesh and bone, causing no pain at high intensities, but giving rise to no sensation but a feeling of warmth at low ones. At the lower intensities, however, they are still destructive to the red cells of the blood, and a mouse was once kept exposed to them until it had a bad case of artificial anemia without showing the least sign of discomfort.

The discovery of the possible uses of these inaudible sound waves was made by Prof. Wood during the War, as a result of a chance observation in the laboratory of Prof. P. Langevin at the great naval arsenal at Toulon, where the French scientist was experimenting with them in an endeavor to perfect an apparatus for the detection of submarines. (Science Service.)

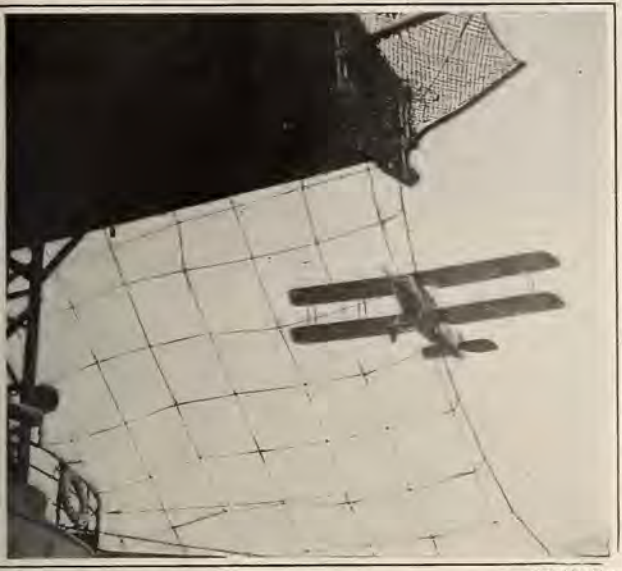
Beam Radio System Finds Sunspots

OPERATION of the beam radio system between England and Canada has supplied new evidence of the effect of sunspots on radio. The beam system consists of radio transmitters which send virtually all of their emitted energy in one direction, toward the country which it is intended to reach, instead of spreading it broadcast in all directions. The radio energy forms a beam between the two stations, like the beam of a searchlight. On several occasions this winter what are called "magnetic storms," when the earth's magnetism is greatly disturbed, have accompanied weakening of the radio beams. It has long been known that these magnetic storms are related to sunspots, probably being caused by streams of electric particles shot out with enormous speeds from the great solar storms which we recognize as the spots. In a recent letter to the London scientific journal, *Nature*, Captain T. L. Eckersley, Chief Engineer of the British Broadcasting Company, suggests these same electric particles are responsible for weakening the radio beams.

Windmills For Making Electricity

EXTENSION of radio to farms may have the unexpected result of assisting the use by man of one of the world's greatest idle sources of cheap power, the power of the wind. Modern radio receivers require considerable amounts of electricity, more than can be supplied conveniently or cheaply from chemical batteries. In cities and towns the radio fans make use of the ordinary current supply. Where no electric current is available, as on isolated farms, radio is under a severe handicap. Wind power, like that which was once much used in windmills for pumping water, has often been sugested to charge storage batteries for such isolated radio receivers but development has been retarded by the lack of suitable windmills and dynamos and by uncertainties about the amount of wind available. During the past two years successful wind-driven electric plants large enough for radio use or even for house lighting have been constructed in France and England. In the United States the engineers of the University of Nebraska have made similar tests. The uncertainty about the wind has now been studied by Harry G. Carter of the United States Weather Bureau station at Lincoln, Nebraska, where the university is located. A wind velocity of at least ten miles an hour is necessary for charging storage batteries and Mr. Carter finds that this velocity is available for at least five hours a day on three-fourths of the days of a year.

Landing on Deck of the "Langley"



World Wide Photo

One of the naval airplanes about to land on the U. S. S. Langley, airplane carrier, near San Diego, Calif. Note the shielding wire screen to prevent plane from landing on lower deck. On the landing gear of the plane will be observed part of the secret apparatus used by the American navy to permit the planes to come to a full stop within the length of the deck

Helium Is Found In Ontario

WIDENING of the field of production of helium gas to include the Canadian province of Ontario has been recently announced. The Ontario government claims a deposit of helium gas has been discovered at Inglewood, about 40 miles from Ontario. Three wells have been taken over by the government and are being worked. Commercial development of helium gas on a large scale is expected to result in time. The discovery was made during the war but was kept a secret until recently when the wells were taken over by the government. (Science Service.)

Correct List of Broadcast Stations

KDKA	Westinghouse Electric & Mfg. Co.	E. Pittsburgh, Pa.	309
KDLR	Radio Electric Co.	Devils Lake, N. D.	231
KDYL	Intermountain Bdcstg Corp.	Salt Lake City, Utah	246
KFAB	Nebraska Buick Auto Co.	Lincoln, Neb.	341
KFAD	Electrical Equipment Co.	Phoenix, Ariz.	273
KFAF	A. E. Fowler	San Jose, Calif.	217
KFAU	Independent School Dist.	Boise, Idaho	280
KFBB	F. A. Buttrey & Co.	Havre, Mont.	275
KFBC	W. Z. Azbill	San Diego, Cal.	380
KFBK	Kimball-Upson Co.	Sacramento, Calif.	535
KFBL	Leese Bros.	Everett, Wash.	224
KFBS	School District No. One	Trinidad, Colo.	238
KFBU	Bishop N. S. Thomas	Laramie, Wyo.	375
KFCB	Nielson Radio Supply Co.	Phoenix, Ariz.	238
KFCR	Santa Barbara Broadcasting Co.	Santa Barbara, Calif.	413
KFDD	St. Michael Cathedral	Boise, Idaho	275
KFDM	Magnolia Petroleum Co.	Beaumont, Texas	316
KFDX	First Baptist Church	Shreveport, La.	236
KFDY	South Dakota State College	Brookings, S. D.	300
KFDZ	Harry O. Iverson	Minneapolis, Minn.	231
KFEC	Meier & Frank	Portland, Ore.	252
KFEL	Eugene P. O'Fallon, Inc.	Denver, Colo.	254
KFEQ	Scroggin & Co.	Oak, Neb.	268
KFEY	Bunker Hill & Sullivan	Kellogg, Idaho	233
KFFP	First Baptist Church	Moberly, Mo.	242
KFH	Hotel Lassen	Wichita, Kans.	268
KFHA	Western State College of Colo.	Gunnison, Colo.	252
KFHL	Penn College	Oskaloosa, Iowa	240
KFI	E. C. Anthony, Inc.	Los Angeles, Calif.	467
KFIF	Benson Polytechnic Institute	Portland, Ore.	248
KFIO	North Central High School	Spokane, Wash.	272
KFIQ	First Methodist Church	Yakima, Wash.	256
KFIU	Alaska Electric Light & Power Co.	Juneau, Alaska	226
KFIZ	Commonwealth Reporter	Fond du Lac, Wis.	273
KFJB	Marshall Electric Co.	Marshalltown, Iowa	248
KFJF	National Radio Mfg. Co.	Oklahoma City, Okla.	261
KFJI	E. E. Marsh	Astoria, Ore.	246
KFJM	University of North Dakota	Grand Forks, N. D.	278
KFJR	Ashley C. Dixon & Son	Portland, Ore.	263
KFJY	Tunwall Radio Co.	Fort Dodge, Iowa	246
KFJZ	W. E. Branch	Ft. Worth, Tex.	254
KFKA	Colo. State Teachers College	Greeley, Colo.	273
KFKB	J. R. Brinkley	Milford, Kan.	431
KFKU	The University of Kansas	Lawrence, Kans.	275
KFKX	Westinghouse Elec. & Mfg. Co.	Hastings, Neb.	288
KFKZ	State Teachers College	Kirksville, Mo.	225
KFLR	University of New Mexico	Albuquerque, N. M.	254
KFLU	San Benito Radio Club	San Benito, Texas	236
KFLV	Swedish Evangelist Church	Rockford, Ill.	229
KFLX	George Roy Clough	Galveston, Texas	240
KFMR	Morningside College	Sioux City, Iowa	261
KFMX	Carlton College	Northfield, Minn.	337
KFNF	Henry Field Seed Co.	Shenandoah, Ia.	461
KFOA	Rhodes Department Store	Seattle, Wash.	454
KFOB	KFOB, Inc.	Burlingame, Calif.	225
KFON	Nichols & Warriner, Inc.	Long Beach, Calif.	233
KFOO	Latter Day Saints' Union	Salt Lake City, Utah	236
KFOR	Tire & Electric Co.	David City, Neb.	226
KFOT	College Hill Radio Club	Wichita, Kans.	231
KFOX	Tech. High School	Omaha, Nebr.	248
KFOY	Beacon Radio Service	St. Paul, Minn.	252
KFPL	C. C. Baxter	Dublin, Texas	252
KFPM	The New Furniture Co.	Greenville, Texas	242
KFPR	Los Angeles County Forestry Dept.	Los Angeles, Cal.	231
KFPW	St. Johns M. E. Church	Carterville, Mo.	258
KFPY	Symons Investment Co.	Spokane, Wash.	273
KFQA	The Principia	St. Louis, Mo.	261
KFQB	Lone Star Bdcast Co.	Fort Worth, Texas	508
KFQD	Anchorage Radio Club	Anchorage, Alaska	300
KFQP	G. S. Carson, Jr.	Iowa City, Ia.	224
KFQU	W. E. Riker	Holy City, Calif.	231
KFQW	C. F. Knierim	Seattle, Wash.	216
KFQX	Alfred M. Hubbard	Seattle, Wash.	210
KFQZ	Taft Products Co.	Hollywood, Calif.	226
KFRB	Hall Bros.	Beeville, Texas	248
KFRC	Don Lee, Inc.	San Francisco, Calif.	268
KFRU	Stephens College	Columbia, Mo.	500
KFSD	Airfan Radio Corp.	San Diego, Calif.	246
KFSG	Echo Park Evan. Assn.	Los Angeles, Calif.	275
KFUL	Thomas Groggan & Bros.	Galveston, Texas	258
KFUM	W. D. Corley	Colorado Springs, Colo.	240
KFUO	Concordia Seminary	St. Louis, Mo.	545
KFUP	Fitzsimmons General Hospital	Denver, Colo.	234
KFUR	Peery Bldg. Co., Inc.	Ogden, Utah	224
KFUS	Louis L. Sherman	Oakland, Calif.	256
KFUT	University of Utah	Salt Lake City, Utah	263
KFVD	Chas. & W. J. McWhinnie	Venice, Calif.	208
KFVE	Benson Broadcasting Corp.	St. Louis, Mo.	240
KFVG	First M. E. Church	Independence, Kans.	236
KFVI	Headquarters Troop, 56th Cavalry	Houston, Texas	240
KFVN	Carl E. Bagley	Fairmont, Minn.	227
KFVR	Olinger Corporation	Denver, Colo.	244
KFVS	Cape Girardeau Battery Sta.,	Cape Girardeau, Mo.	224
KFVY	Radio Supply Co.	Albuquerque, N. M.	250
KFWB	Warner Bros. Pictures	Hollywood, Calif.	252
KFWG	L. E. Wall	San Bernardino, Calif.	291
KFWF	St. Louis Truth Center	St. Louis, Mo.	214
KFWH	F. Wellington Morse, Jr.	Eureka, Calif.	254
KFWI	Radio Entertainments, Inc.	San Francisco, Calif.	250
KFWM	Oakland Educational Society	Oakland, Calif.	326
KFWO	Lawrence Mott	Avalon, Calif.	211
KFWU	Louisiana College	Pineville, La.	238
KFWV	KFWV Studios	Portland, Ore.	213
KFXB	Bertram C. Heller	Big Bear Lake, Calif.	203
KFXD	Service Radio Co.	Logan, Utah	205
KFXF	Pike's Peak Broadcasting Co.	Denver, Colo.	430
KFXH	Bledsoe Radio Company	El Paso, Texas	242
KFXJ	R. G. Howell	near Edgewater, Colo.	216
KFXR	Classen Film Finishing Co.	Oklahoma City, Okla.	214
KFXY	Harry M. Costigan	Flagstaff, Ariz.	205
KFYF	Carl's Radio Den	Oxnard, Calif.	214
KFYJ	Houston Chronicle Pub. Co. (Portable)	Houston, Tex.	238
KFYO	Buchanan-Vaughan Co.	Texarkana, Tex.	210
KFYR	Hoskins-Meyer, Inc.	Bismarck, N. Dak.	248
KGAR	Tucson Citizen	Tucson, Ariz.	244
KGBS	A. C. Dailey	Seattle, Wash.	227
KGBU	Alaska Radio Co.	Ketchikan, Alaska	229
KGBX	Foster Hall Tire Co.	St. Joseph, Mo.	348
KGBY	Albert C. Dunning	Shelby, Nebr.	203
KGBZ	Federal Livestock Remedy Co.	York, Nebr.	333
KGCA	C. W. Greenley	Decorah, Iowa	280
KGCB	Wallace Radio Institute	Oklahoma, Okla.	331
KGCG	Moore Motor Co.	Newark, Ark.	240
KGCH	Wayne Hospital	Wayne, Nebr.	434
KGCI	S. M. Rhodes	San Antonio, Texas	240
KGCL	Louis Wasmer	Seattle, Washington	238
KGCN	Alva E. Smith	Concordia, Kansas	210
KGCR	Cutler's Broadcasting Service	Brookings, S. D.	252
KGCU	Mandan Radio Ass'n	Mandan, N. D.	285
KGCX	First State Bank	Vida, Mont.	240
KGDA	Home Auto Co.	Dell Rapids, S. D.	254
KGDE	Jaren Drug Co.	Barrett, Minn.	232
KGDI	Northwest Radio Service Co.	Seattle, Wash.	416
KGDJ	R. Rathert	Cresco, Iowa	203
KGDM	V. G. Coping	Stockton, Calif.	217
KGDO	C. H. & Henry Garrett	Dallas, Tex.	285
KGDP	Boy Scouts of America	Pueblo, Colo.	261
KGDR	Radio Engineers	San Antonio, Tex.	240
KGDX	William Erwin Antony	Shreveport, La.	291
KGDY	J. Albert Loesch	Oldham, S. Dak.	210
KGDZ	Norwegian College	Decorah, Iowa	431
KGDW	Frank J. Rist	Humboldt, Nebr.	242
KGEF	Trinity Methodist Church	Los Angeles, Calif.	517
KGO	General Electric Co.	Oakland, Calif.	361
KGRS	Gish Radio Service	Amarillo, Tex.	234
KGTT	Glad Tidings Tabernacle, Inc.	San Francisco, Cal.	207
KGU	Marion A. Mulrony	Honolulu, Hawaii	270
KGW	Oregonian Publishing Co.	Portland, Ore.	492
KGY	St. Martins College	Lacey, Wash.	278
KHJ	Times-Mirror Co.	Los Angeles, Calif.	405
KHQ	Louis Wasmer	Spokane, Wash.	395
KICK	Atlantic Automobile Co.	Anita, Ia.	273
KJBS	J. Brunton & Sons Co.	San Francisco, Calif.	234
KJR	Northwest Radio Service Co.	Seattle, Wash.	384

"Noise Doctors" Cure Inductive Static

(Continued from page 10)

growth in Canada. The Dominion's radio bill exceeds $10,000,000 a year. Canada is buying radio equipment from the United States at the rate of $5,000,000 annually. Production of radio apparatus in Canada, including receiving sets, parts and batteries, reached a total of $5,548,659 in the year ending March 31, 1926.

More radio sets were sold to farmers in Western Canada this year than to any other class. Radio has developed into an important factor in land settlement. It has banished the traditional isolation of the farm. Radio keeps the new settler in constant communication with the outside world, gives him information on the latest phases of agriculture, keeps him in touch with market prices and furnishes his family with music and entertainment. Radio, automobiles, rural telephones, good roads and other modern conveniences give the prairie farmer all the comforts of the city dweller.

There are 134,699 radio receiving sets in operation in Canada, late government statistics show. There are 543 radio transmitting stations. Of these, 67 are radiophone broadcasting stations and 356 are amateur and experimental stations, 67 are used to conduct regular telegraphic communication between points in the Dominion or with stations abroad, while the remaining 46 are operated to provide facilities for communication with an "aid to navigation" service to ships.

KKP	City of Seattle, Harbor Dept.	Seattle, Wash.	360
KLDS	Reorganized Church of Jesus Christ, Independence, Mo.		441
KLS	Warner Brothers	Oakland, Calif.	250
KLX	Tribune Publishing Co.	Oakland, Calif.	508
KLZ	Reynolds Radio Co.	Denver, Colo.	265
KMA	May Seed & Nursery	Shenandoah, Iowa	461
KMED	W. J. Virgin, Medford, Ore.		250
KMJ	Fresno Bee	Fresno, Calif.	234
KMMJ	M. M. Johnson Co.	Clay Center, Nebr.	229
KMO	Love Electric Co.	Tacoma, Wash.	250
KMOX	Voice of St. Louis	St. Louis, Mo.	280
KMTR	Echophone Mfg. Co.	Los Angeles, Calif.	372
KNRC	C. B. Juneau	Santa Monica, Calif.	238
KNX	Los Angeles Express	Los Angeles, Calif.	337
KOA	General Electric Co.	Denver, Colo.	322
KOAC	Oregon Agriculture College	Corvallis, Oreg.	280
KOB	N. Mex. College of Agric.	State College, M. Nex.	349
KOCH	Omaha Central High School	Omaha, Neb.	258
KOCW	Oklahoma College for Women	Chickasha, Okla.	252
KOIL	Mona Motor Oil Co.	Council Bluffs, Iowa	306
KOIN	KOIN, Inc.	Portland, Ore.	319
KOMO	Birt F. Fisher	Seattle, Wash.	306
KOWW	Frank A. Moore	Walla Walla, Wash.	285
KPJM	Wilburn Radio Service	Prescott, Ariz.	215
KPO	Hale Bros., Inc.	San Francisco, Calif.	428
KPPC	Pasadena Presbyterian Church	Pasadena, Calif.	229
KPRC	Houston Printing Co.	Houston, Texas	297
KPSN	Star-News	Pasadena, Calif.	316
KQW	First Baptist Church	San Jose, Calif.	333
KQV	Doubleday-Hill Electric Co.	Pittsburgh, Pa.	275
KRAC	Caddo Radio Club	Shreveport, La.	220
KRE	Berkeley Daily Gazette	Berkeley, Calif.	256
KRLD	Dallas Radio Laboratories	Dallas, Tex.	357
KROW	Oregon Broadcast Co.	Portland, Ore.	231
KRSC	Radio Sales Corp.	Seattle, Wash.	500
KSAC	Kansas State Agricultural College	Manhattan, Kans.	341
KSD	Pulitzer Publishing Co.	St. Louis, Mo.	545
KSEI	Broadcasting Association	Pocatello, Idaho	261
KSL	Radio Service Corp.	Salt Lake City, Utah	300
KSMR	Santa Maria Valley Railroad	Santa Maria, Calif.	283
KSO	Berry Seed Co.	Clarinda, Iowa	405
KSOO	Sioux Falls Bdcst. Ass'n.	Sioux Falls, S. D.	360
KTAB	Associated Broadcasters	Oakland, Calif.	303
KTAP	Robert B. Bridge	San Antonio, Texas	263
KTBI	Bible Institute	Los Angeles, Calif.	294
KTBR	M. E. Brown	Portland, Ore.	263
KTHS	New Arlington Hotel	Hot Springs, Ark.	375
KTNT	N. Baker	Muscatine, Iowa.	333
KTUE	Uhalt Electric	Houston, Texas	263
KTW	First Presbyterian Church	Seattle, Wash.	454
KUOA	University of Arkansas	Fayetteville, Ark.	300
KUOM	University of Montana	Missoula, Mont.	244
KUJ	Puget Sound Broadcasting Co.	Seattle, Wash.	352
KUSD	University of South Dakota	Vermillion, S. D.	278
KUT	University of Texas	Austin, Texas	231
KVI	Puget Sound Broadcasting Co.	Tacoma, Wash.	342
KVOO	Southwestern Sales Corp.	Bristow, Okla.	375
KVOS	L. L. Jackson	Seattle, Wash.	333
KWCR	H. F. Parr	Cedar Rapids, Iowa	296
KWG	Portable Wireless Telegraph Co.	Stockton, Calif.	248
KWKC	Wilson Duncan Studios	Kansas City, Mo.	236
KSBA	W. G. Patterson	Shreveport, La.	261
KWSC	State College of Washington	Pullman, Wash.	349
KWTC	J. W. Hancock	Santa Ana, Calif.	261
KWUC	Western Union College	Le Mars, Iowa	252
KWWG	City of Brownsville	Brownsville, Texas	278
KXL	KXL Broadcasters	Portland, Ore.	400
KXRO	Brott Laboratories	Seattle, Wash.	240
KYA	Pacific Broadcasting Corp.	San Francisco, Calif.	400
KYW	Westinghouse Electric & Mfg. Co.	Chicago, Ill.	535
KZM	Preston D. Allen	Oakland, Calif.	240
WAAD	Ohio Mechanical Institute	Cincinnati, Ohio	258
WAAF	Chicago Daily Drovers Journal	Chicago, Ill.	278
WAAM	Isaiah R. Nelson	Newark, N. J.	263
WAAT	F. V. Bremer	Jersey City, N. J.	235
WAAW	Omaha Grain Exchange	Omaha, Nebr.	384
WABB	Harrisburg Radio Co.	Harrisburg, Pa.	204
WWNC	Chamber of Commerce	Asheville, N. C.	254
WABF	Markle Broadcasting Corp.	Pringleboro, Pa.	411
WABI	1st Universalist Church	Bangor, Me.	240
WABO	Hickson Electric Co., Inc.	Rochester, N. Y.	278
WABR	Scott High School	Toledo, Ohio	263
WABW	College of Wooster	Wooster, Ohio	207
WABX	Henry B. Joy	Mt. Clemens, Mich.	246
WABY	John Magaldi, Jr.	Philadelphia, Pa.	242
WABZ	Colis Place Baptist Church	New Orleans, La.	275
WADC	Allen T. Simmons	Akron, Ohio	258
WAFD	Albert P. Parfet	Port Huron, Mich.	275
WAGN	R. L. Miller	Royal Oak, Mich.	275
WAGS	Willow Garage, Inc.	Sommerville, Mass.	250
WABG	Atlantic Broadcasting Corp.	New York, N. Y.	316
WAIT	A. H. Waite & Co	Taunton, Mass.	229
WAIU	American Insurance Union	Columbus, Ohio	294
WAMD	Raddison Radio Corp.	Minneapolis, Minn.	244
WAOK	A. H. Andreasen	Ozone Park, N. Y.	248
WAPI	Alabama Polytechnic Institute	Auburn, Ala.	461
WARC	American Radio & Research	Medford, Mass.	261
WARS	Amateur Radio Specialty Co.	Brooklyn, N. Y.	295
WASH	Baxter Laundry Co.	Grand Rapids, Mich.	256
WATT	Edison Elec. Illum. (Portable)	Boston, Mass.	244
WBAA	Purdue University	W. Lafayette, Ind.	273
WBAC	James Milliken University	Decatur, Ill.	270
WBAK	Pennsylvania State Police	Harrisburg, Pa.	275
WBAL	Consolidated Gas & Power Co.	Baltimore, Md.	246
WBAP	Carter Publication, Inc.	Ft. Worth, Tex.	476
WBAW	Braid Elec. Co. & Waldrum Drug Co.	Nashville, Tenn.	236
WBAX	John H. Stenger, Jr.	Wilkes-Barre, Pa.	256
WBBC	P. J. Testan	Brooklyn, N. Y.	250
WBBL	Grace Covenant Presbyterian Church	Richmond, Va.	229
WBBM	Atlass Investment	Chicago, Ill.	226
WBBP	Petoskey High School	Petoskey, Mich.	238
WBBR	People's Pulpit Assoc.	Rossville, N. Y.	416
WBBW	Ruffner Junior High School	Norfolk, Va.	222
WBBY	Washington Light Inf.	Charleston, S. C.	268
WBBZ	C. L. Carrell	(Portable), Chicago, Ill.	216
WBCN	Foster & MacDonnell	Chicago, Ill.	266
WBES	Bliss Electrical School	Takoma Park, Md.	222
WBET	Boston Transcript Co.	Boston, Mass.	384
WBKN	Arthur Faske	Brooklyn, New York	291
WBMC	Malbrook Co.	Woodside, N. Y.	294
WBMS	G. J. Schowerer	North Bergen, N. J.	224
WBNY	Baruschrome Corp.	New York, N. Y.	322
WBOQ	A. H. Grebe & Co., Inc.	Richmond Hill, N. Y.	236
WBRC	Birmingham Broadcasting Co.	Birmingham, Ala.	248
WBRE	Baltimore Radio Exchange	Wilkes-Barre, Pa.	231
WBRL	Booth Radio Laboratories	Tilton, N. H.	365
WBRS	Universal Radio Mfg. Co.	Brooklyn, N. Y.	394
WBSO	Babson's Statistical Org.	Wellesley Hills, Mass.	242
WBT	Charlotte Chamber of Commerce	Charlotte, N. C.	275
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.	263
WCAE	Kaufman & Baer Co.	Pittsburgh, Pa.	461
WCAJ	Nebraska Wesleyan University	University Pl., Nebr.	254
WCAL	St. Olaf College	Northfield, Minn.	337
WCAM	City of Camden	Camden, N. J	337
WCAO	Monumental Radio Inc.	Baltimore, Md.	275
WCAR	Southern Radio Corp.	San Antonio, Texas	263
WCAT	School of Mines	Rapid City, S. Dak.	240
WCAU	Universal Broadcasting Co.	Philadelphia, Pa.	278
WCAX	University of Vermont	Burlington, Vt.	250
WCAZ	Carthage College	Carthage, Ill.	246
WCBA	Charles W. Heimbach	Allentown, Pa.	254
WCBD	Wilbur Glenn Voliva	Zion, Ill.	345
WCBE	Uhalt Radio Co.	New Orleans, La.	263
WCBH	University of Mississippi	Oxford, Miss.	242
WCBM	Hotel Chateau	Baltimore, Md.	229
WCBR	C. H. Messter	Providence, R. I.	234
WCBS	H. L. Dewing, Portable	Boston, Mass.	242
WCCO	Washburn-Crosby Co.	Anoka, Minn.	416
WCFL	Chicago Fed. of Labor	Chicago, Ill.	492
WCFT	Knights of Pythias Home	Tullahoma, Tenn.	252
WCGU	C. G. Under	Lakewood, N. J.	351
WCLO	C. E. Whitmore	Camp Lake, Wis.	231
WCLS	WCLS Inc.	Joliet, Ill.	214

Two Tubes and Regeneration

(Continued from page 6)

switch for cutting it in and out. These connections should be made between the grid leak and condenser and the grid circuit variometer, and on the side of the jack opposite the "B" battery.

As there are three circuits to be tuned, the receiver is more difficult to operate than the single-control receivers that have gained such popularity during the past year. On the other hand, it is probable that some efficiency is sacrificed in any design that concentrates all controls in one knob and dial, and also probable that separate control of the tuning circuits gives the operator a chance to obtain more volume and distance with fewer tubes.

There are many other hook-ups employing two tubes and regeneration. Most of them can be constructed with the same parts suggested here, or with small additional expense.

A two-tube set can be made without either a detector or a tuning circuit. The man who wants to be a radio operator and see the world will be interested in this because such a set will bring in the long-wave commercial and government stations. These stations either use automatic transmitters that send so fast that there is no use trying to copy them without an automatic recording receiver, or else they send so slowly and with such perfect swing and rhythm that they give the beginner an ideal chance to practice receiving code.

In such a set, the antenna connects with the primary of an amplifying transformer capable of handling radio frequencies. See figure 1. The other terminal of the primary coil connects with a variable condenser of .001 microfarads capacity. The rotor of the condenser connects with the ground. One end of the secondary coil joins the grid of the first tube and the other end connects with the filament rheostat. The plate connects with the primary of another transformer, whose secondary is connected with the grid and filament of the second tube just as the secondary of the first transformer is connected with the first tube.

The battery connections are as usual: "B" positive to phones and plate of the second tube and to the primary of the second transformer; "B" negative to the filament terminal not connected with the rheostat, and to the positive or negative terminal of the "A" battery, whichever may be farthest from the rheostat. To secure the regenerative effect and maximum signal strength, a .001 condenser is connected between the positive terminal of the "B" battery and the antenna.

WCMA	Culver Military Academy	Culver, Ind	258
WCOA	City of Pensacola	Pensacola, Fla.	252
WCOM	172nd Field Artillery	Manchester, N. H.	252
WCRW	Clinton R. White	Chicago, Ill.	416
WCSH	Henry R. Rines	Portland, Maine	500
WCSO	Wittenberg College	Springfield, Ohio	248
WCWK	Chester W. Keen	Fort Wayne, Ind.	234
WCWS	Chas. W. Selene (Portable)	Bridgeport, Conn.	232
WCX	Detroit Free Press	Pontiac, Mich.	517
WDAD	Dad's Auto Accessories, Inc.	Nashville, Tenn.	226
WDAE	Tampa Daily Times	Tampa, Fla.	273
WDAF	Kansas City Star	Kansas City, Mo.	366
WDAG	J. Laurence Martin	Amarillo, Texas	263
WDAH	Trinity Methodist Church	El Paso, Texas	268
WDAY	Radio Equipment Corp.	Fargo, N. Dak.	261
WDBE	Gilham Electric Co., Inc.	Atlanta, Ga.	270
WDBJ	Richardson Wayland Elec. Corp.	Roanoke, Va.	229
WDBK	M. F. Broz	Cleveland, Ohio	227
WDBO	Rollins College	Winter Park, Fla.	240
WDBZ	Kingston Radio Club	Kingston, N. Y.	233
WDEL	Wilmington Elec. Specialty Co.	Wilmington, Del.	266
WDGY	Dr. George W. Young	Minneapolis, Minn.	263
WDOD	Chattanooga Radio Co., Inc.	Chattanooga, Tenn.	256
WDRC	Doolittle Radio Corp.	New Haven, Conn.	268
WDWF	Dutee Wilcox Flint, Inc.	Cranston, R. I.	441
WDWM	Radio Industries Broadcast Co.	Newark, N. J.	280
WDXL	DXL Radio Corp.	Detroit, Mich.	297
WDZ	J. L. Bush	Tuscola, Ill.	278
WEAF	National Broadcasting Co.	New York, N. Y.	491
WEAI	Cornell University	Ithaca, N. Y.	254
WEAM	Bor. of N. Plainfield	North Plainfield, N. J.	261
WEAN	The Shepard Co.	Providence, R. I.	367
WEAO	Ohio State University	Columbus, Ohio	294
WEAR	Willard Storage Battery Co.	Cleveland, Ohio	389
WEAU	Davidson Bros. Co.	Sioux City, Iowa	275
WEBC	Walter Cecil Bridges	Superior, Wis.	242
WEBH	Edgewater Beach Hotel	Chicago, Ill.	370
WEBJ	Third Avenue Railway Co.	New York, N. Y.	273
WEBL	R. C. A. Show (Portable)	New York, N. Y.	226
WEBQ	Tate Radio Corp.	Harrisburg, Ill.	226
WEBR	H. H. Howell	Buffalo, N. Y.	244
WEBW	Beloit College	Beloit, Wis.	268
WEDC	E. Denemark Station	Chicago, Ill.	250
WEEI	The Edison Elec. Illuminating Co.	Boston, Mass.	349
WEHS	Oliver G. Fordham	Evanston, Ill.	203
WEKD	Foulkrod Radio Engineering Co.	Philadelphia, Pa.	250
WEMC	Emanuel Missionary College	Berrien Springs, Mich.	316
WENR	All-American Radio Corp.	Chicago, Ill.	266
WEPS	R. G. Matheson	Gloucester, Mass.	295
WEW	St. Louis University	St. Louis, Mo.	360
WFAA	Dallas News & Dallas Journal	Dallas, Tex.	476
WFAM	Times Publishing Co.	St. Cloud, Minn.	273
WFAV	University of Nebraska	Lincoln, Neb.	270
WFBC	First Baptist Church	Knoxville, Tenn.	255
WFBE	Garfield Place Hotel Co.	Cincinnati, Ohio	232
WFBG	The Wm. F. Gable Co.	Altoona, Pa.	278
WFBJ	St. John's University	Collegeville, Minn.	236
WFBL	The Onondaga Co.	Syracuse, N. Y.	252
WFBM	Merchants Heat & Light Co.	Indianapolis, Ind.	268
WFBR	Fifth Infantry National Guard	Baltimore, Md.	254
WFBZ	Knox College	Galesburg, Ill.	254
WFCI	Frank Crook, Inc.	Pawtucket, R. I.	258
WFDF	F. D. Fallain	Flint, Mich.	234
WFI	Strawbridge and Clothier	Philadelphia, Pa.	394
WFKB	Vesta Battery Corp.	Chicago, Ill.	217
WFRL	Flatbush Radio Labs.	Brooklyn, N. Y.	330
WGAL	Lancaster Elec. Supply & Const. Co.	Lancaster, Pa.	248
WGBB	H. H. Carman	Freeport, N. Y.	244
WGBC	First Baptist Church	Memphis, Tenn.	278
WGBF	Fink Furniture Co.	Evansville, Ind.	236
WGBL	Scranton Broadcasters, Inc.	Scranton, Pa.	240
WGBR	G. S. Ives	Marshfield, Wis.	229
WGBS	Gimbel Brothers	Astoria, L. I., N. Y.	316
WGBU	Florida Cities Finance Co.	Fulford By-The-Sea, Fla.	278
WGBX	University of Maine	Orono, Me.	234
WGCP	May Radio Broadcast Corp.	Newark, N. J.	252
WGES	Oak Leaves Broadcasting Corp.	Chicago, Ill.	316
WGHB	Fort Harrison Hotel	Clearwater, Fla.	266
WGHP	G. H. Phelps	Detroit, Mich.	270
WGM	Verne and Elton Spencer	Jeanette, Pa.	269
WGMU	A. H. Grebe & Co. (Portable)	New York	236
WGN	The Tribune	Chicago, Ill.	303
WGR	Federal T. and T. Co.	Buffalo, N. Y.	319
WGST	Georgia School of Technology	Atlanta, Ga.	270
WGWB	Radiocast Corporation	Milwaukee, Wis.	384
WGY	General Elec. Co.	Schenectady, N. Y.	379
WHA	University of Wisconsin	Madison, Wis.	535
WHAD	Marquette University	Milwaukee, Wis.	275
WHAM	Eastman School of Music	Rochester, N. Y.	278
WHAP	W. H. Taylor Finance Corp.	New York, N. Y.	431
WHAR	F. D. Cooks Sons	Atlantic City, N. J.	275
WHAS	Courier-Journal & Louisville Times	Louisville, Ky.	400
WHAZ	Rensselaer Polytechnic Institute	Troy, N. Y.	379
WHB	Sweeney School Co.	Kansas City, Mo.	366
WHBA	C. C. Shaffer	Oil City, Pa.	250
WHBC	Rev. E. P. Graham	Canton, Ohio	254
WHBD	Chamber of Commerce	Bellefontaine, Ohio	222
WHBF	Beardsley Specialty Company	Rock Island, Ill.	222
WHBL	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBM	C. L. Carrell (Portable)	Chicago, Ill.	216
WHBN	First Ave. Methodist Church	St. Petersburg, Fla.	238
WHBP	Johnstown Automobile Co.	Johnstown, Pa.	256
WHBQ	St. John's M. E. Church South	Memphis, Tenn.	233
WHBU	Riviera Theatre & Bing's Clothing	Anderson, Ind.	219
WHBW	D. R. Kienzle	Philadelphia, Pa.	216
WHBY	St. Norbert's College	West de Pere, Wis.	250
WHDI	W. H. Dunwoody Institute	Minneapolis, Minn.	278
WHEC	Hickson Electric Co., Inc.	Rochester, N. Y.	258
WHFC	Triangle Broadcasters	Chicago, Ill.	258
WHK	The Radio Air Service Corp.	Cleveland, Ohio	273
WHN	George Schubel	New York, N. Y.	361
WHO	Banker's Life Co.	Des Moines, Ia.	526
WHOG	Huntington Bdcstrs. Assn.	Huntington, Ind.	242
WHT	Radiophone Broadcasting Corp.	Deerfield, Ill.	238
WIAD	Howard R. Miller	Philadelphia, Pa.	250
WIAS	Home Electric Co.	Burlington, Iowa	254
WIBA	Capital Times-Strand Theatre	Madison, Wis.	236
WIBG	St. Paul's Protestant E. Church	Elkins Park, Pa.	222
WIBI	Frederick B. Zittell, Jr.	Flushing, L. I., N. Y.	219
WIBJ	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBM	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBO	Nelson Brothers	Chicago, Ill.	226
WIBR	Thurman A. Owings	Weirton, W. Va.	246
WIBS	T. F. Hunter	Elizabeth, N. J.	203
WIBU	The Electric Farm	Poynette, Wis.	222
WIBW	C. L. Carrell (Portable)	Chicago, Ill.	216
WIBX	WIBX, Inc.	Utica, N. Y.	234
WIBZ	A. D. Trum	Montgomery, Ala.	231
WICC	Bridgeport Bdcst. Stations	Bridgeport, Conn.	285
WIL	Benson Radio Co.	St. Louis, Mo.	258
WIOD	Earl G. Fisher Co.	Miami, Fla.	248
WIP	Gimbel Bros.	Philadelphia, Pa.	508
WJAD	Jackson's Radio Eng. Laboratories	Waco, Texas.	353
WJHO	W. J. Thomas Radio Co.	Ferndale, Mich.	407
WJAG	Norfolk Daily News	Norfolk, Neb.	270
WJAK	Kokomo Tribune	Kokomo, Ind.	254
WJAM	D. M. Perham	Cedar Rapids, Iowa	268
WJAR	The Outlet Co.	Providence, R. I.	484
WJAS	Pittsburgh Radio Supply House	Pittsburgh, Pa.	275
WJAX	City of Jacksonville	Jacksonville, Fla.	337
WJAZ	American Bdcast Corp.	Mt. Prospect, Ill.	329
WJBA	D. H. Lentz, Jr.	Joliet, Ill.	207
WJBB	Financial Journal	St. Petersburg, Fla.	254
WJBC	Hummer Furniture Co.	LaSalle, Ill.	234
WJBI	Robert S. Johnson	Red Bank, N. J.	219
WJBK	E. F. Goodwin	Ypsilanti, Mich.	233
WJBL	Wm. Gushard Dry Goods Co.	Decatur, Ill.	270
WJBO	Valdemar Jensen	New Orleans, La.	268
WJBR	Omro Drug Stores	Omro, Wis.	227
WJBT	John S. Boyd	Chicago, Ill.	468
WJBU	Bucknell University	Lewisburg, Pa.	211
WJBV	Union Course Laboratories	Woodhaven, N. Y.	288
WJBW	C. Carlson, Jr.	New Orleans, La.	270
WJBY	Electric Construction Co.	Gadsden, Ala.	260
WJBZ	Roland G. Palmer	Chicago Heights, Ill.	420
WJJD	Supreme Lodge, L. O. of Moose	Mooseheart, Ill.	370
WJR	Jewett Radio & Phonograph Co.	Pontiac, Mich.	517

Building the Hammarlund-Roberts

(Continued from page 9)

tivity throughout the broadcast spectrum. Since the trend in modern broadcast receivers is toward simplicity of tuning, the addition of variable coupling controls was not advisable. Therefore, the engineer-designers of the Hammarlund-Roberts developed a radio frequency transformer in which the coupling between the primary and secondary coils is automatically varied by the rotation of its associated tuning condenser. This variation in coupling is smooth and continuous and is accomplished by means of a cam on the variable condenser shaft. At the setting of zero on the condenser dial (which tunes the transformer to a wavelength slightly below 200 meters) the coupling between primary and secondary is minimum. As the tuning dial is advanced toward 100 the coupling increases gradually until it reaches maximum when the condenser dial reads 100, at which time the circuit is tuned to a wavelength of about 560 meters. The antenna coupler is designed to make use of this same efficient principle, and in addition, the antenna coil itself is tapped and a switch provided in order to afford a further coupling variation to suit different length antennas and to provide extremely loose coupling in very congested areas.

This automatic variable coupling feature made it possible to use a comparatively large number of turns in the primaries of the radio frequency transformers. This large primary allows great energy transfer and consequent loud signals on the longer wavelengths where the coupling between primary and secondary is closest.

HOWEVER, this large primary and close coupling would be totally unsuitable at the shorter wavelengths. This difficulty is overcome by automatically loosening the coupling as the receiver is tuned to the shorter wavelengths, thereby maintaining a high degree of selectivity without sacrificing signal strength. This is due to the fact that the same amount of energy transfer can be obtained with looser coupling at short wavelengths than at long wavelengths. Thus the Hi-Q receiver provides great signal strength and a high degree of selectivity throughout. (See diagram on page 8.)

In most so-called "self-balanced" circuits elimination of the tendency to oscillate has been attained at the sacrifice of efficiency. A method often used is to design the coils in such a way that the losses in the coils introduce enough resistance to prevent oscillation. This method is of course detrimental to efficiency. Some others make use of very low plate voltages in the radio frequency stages, thus reducing the tendency to oscillate, but again with a consequent lowering of efficiency.

In order to permit the use of more efficient stage coupling coils, equalization of disturbing potentials has been incorporated in this circuit, thereby allowing a higher degree of amplification with consequent louder signals and greater distance getting ability, without the usual troubles caused by self-oscillation.

Both radio frequency stages are equalized utilizing the familiar Hammarlund-Roberts equalizing system.

(The second portion of this article will appear in the March issue of RADIO AGE.)

WJUG	U. B. Ross	New York, N. Y.	517
WJY	Radio Corp. of America	New York, N. Y.	405
WJZ	Radio Corp. of America	Bound Brook, N. J.	454
WKAF	WKAF Broadcasting Co.	Milwaukee, Wis.	261
WKAQ	Radio Corp. of Porto Rico	San Jaun, P. R.	341
WKAR	Michigan State College	East Lansing, Mich.	286
WKAV	Laconia Radio Club	Laconia, N. H.	422
WKBA	Arrow Battery Co.	Chicago, Ill.	210
WKBB	Sanders Bros.	Joliet, Ill.	283
WKBC	H. L. Ansley	Birmingham, Ala.	225
WKBE	K. & D. Electric Co.	Webster, Mass.	270
WKBF	N. D. Watson	Indianapolis, Ind.	244
WKBG	C. L. Carrell (Portable)	Chicago, Ill.	216
WKBH	Callaway Music Co.	LaCrosse, Wis.	250
WKBI	F. L. Schoenwolf	Chicago, Ill.	220
WKBJ	Gospel Tabernacle Inc.	St. Petersburg, Fla.	282
WKBL	Monrona Radio Mfg. Co.	Monroe, Mich.	250
WKBM	J. W. Jones	Newburgh, N. Y.	285
WKBO	Camith Corporation	Jersey City, N. J.	304
WKBP	Enquirer and News	Battle Creek, Mich.	265
WKBQ	Starlight Amusement Park	New York, N. Y.	285
WKBR	C. J. Heiser	Auburn, N. Y.	225
WKBS	P. M. Nelson	Galesburg, Ill.	361
WKBT	First Baptist Church	New Orleans, La.	252
WKBU	H. K. Armstrong (Portable)	Newcastle, Pa.	238
WKBV	Knox Battery and Electric Co.	Brookville, Ind.	236
WKBW	Churchill Evang. Ass'n	Buffalo, N. Y.	362
WKBY	Fernwood Wuick (portable)	Danville, Pa.	220
WKBZ	K. L. Ashbacker	Ludington, Mich.	256
WKDR	Edward A. Dato	Kenosha, Wis.	428
WKJC	Kirk Johnson & Co.	Lancaster, Pa.	258
WKRC	Kodel Radio Corp.	Cincinnati, Ohio	422
WKY	Hull and Richards	Oklahoma City, Okla.	275
WLAC	Life & Casualty Ins. Co.	Nashville, Tenn.	226
WLAL	First Christian Church	Tulsa, Okla.	250
WLAP	Wm. V. Jordan	Louisville, Ky.	275
WLB	University of Minnesota	Minneapolis, Minn.	278
WLBA	Philadelphia School of Wireless Tel.	Philadelphia, Pa.	236
WLBC	D. A. Burton	Muncie, Ind.	224
WLBE	J. H. Fruitman	Brooklyn, N. Y.	231
WLBF	E. L. Dillard	Kansas City, Mo.	211
WLBG	R. A. Gamble	Petersburg, Va.	332
WLBH	Joseph J. Lombardi	Farmingdale, N. Y.	230
WLBI	Aloysius Yare	East Wenona, Ill.	297
WLBJ	Henry Grossman	Cleveland, Ohio	300
WLBL	Wisconsin Dept. of Markets	Stevens Point, Wis.	278
WLBN	William Evert Hiler (Portable)	Chicago, Ill.	225
WLBO	Frederick A. Tribbe, Jr.	Galesburg, Ill.	243
WLPP	Robert A. Fox	Ashland, Ohio	220
WLBQ	E. Dale Trout	Atwood, Ill.	23
WLBR	Alford Radio Company	Belvidere, Ill.	335
WLCI	Lutheran Association	Ithaca, N. Y.	266
WLIB	Liberty Weekly, Inc.	Elgin, Ill.	303
WLIT	Lit Bros.	Philadelphia, Pa.	394
WLS	Sears Roebuck & Co.	Crete, Ill.	345
WLSL	Lincoln Studios	Cranston, R. I.	441
WLTS	Lane Technical High School	Chicago, Ill.	258
WLW	Crosley Radio Corp.	Harrison, Ohio	422
WLWL	Paulist Fathers	New York, N. Y.	384
WLBT	Harold Wendell	Crown Point, Ind.	230
WLBU	Matthew B. Greiner	Canastota, N. Y.	220
WLBV	John F. Weimer & D. A. Snick	Mansfield, Ohio	231
WLBW	Petroleum Telephone Co.	Oil City, Pa.	321
WLBX	John N. Brahy	Long Island City, N. Y.	231
WLBY	Aimone Electric	Iron Mountain, Mich.	250
WLBZ	Thompson L. Guernsey	Dover-Foxcroft, Maine	299
WMBA	LeRoy Joseph Beebe (Portable)	Newport, R. I.	250
WMAC	C. B. Meredith	Casenovia, N. Y.	275
WMAF	Round Hills Radio Corp.	Dartmouth, Mass.	441
WMAK	Norton Laboratories	Lockport, N. Y.	266
WMAL	M. A. Leese	Washington, D. C.	294
WMAN	Haskett Radio Station	Columbus, Ohio	278
WMAQ	Chicago Daily News	Chicago, Ill.	447
WMAY	Kingshighway Presbyterian Church	St. Louis, Mo.	248
WMAZ	Mercer University	Macon, Ga.	261
WMBB	American Bond & Mortgage Co.	Chicago, Ill.	250
WMBC	Michigan Broadcasting Co., Inc.	Detroit, Mich.	256
WMBF	Fleetwood Hotel Corp.	Miami Beach, Fla.	384
WMBI	Moody Bible Institute	Chicago, Ill.	288
WMBS	Mack's Battery Co.	Harrisburg, Pa.	360
WMC	Commercial Pub. Co.	Memphis, Tenn.	500
WMCA	Greely Sq. Hotel Co.	Hoboken, N. J.	341
WMHA	Young Men's Hebrew Ass'n	New York, N. Y.	230
WMPC	First Methodist Church	Lapeer, Mich.	222
WMRJ	Peter J. Prinz	Jamaica, N. Y.	227
WMSG	Madison Sq. Gard. Bdcast. Corp.	New York, N. Y.	302
WMVN	Edward J. Malone, Jr.	Newark, N. J.	476
WNAB	Shepard Stores	Boston, Mass.	280
WNAC	Shepard Stores	Boston, Mass.	430
WNAD	University of Oklahoma	Norman, Okla.	254
WNAL	Omaha Central High School	Omaha, Nebr.	258
WNAT	Lenning Brothers Co.	Philadelphia, Pa.	250
WNAX	Dakota Radio Apparatus Co.	Yankton, S. Dak.	244
WNBH	New Bedford Hotel	New Bedford, Mass.	248
WNJ	Herman Lubinsky	Newark, N. J.	350
WNOX	Peoples Tel. & Tel. Co.	Knoxville, Tenn.	268
WNRC	W. B. Nelson	Greensboro, N. C.	224
WNYC	Dept. of Plants & Structures	New York, N. Y.	526
WOAI	Southern Equipment Co.	San Antonio, Texas	394
WOAN	J. D. Vaughn	Lawrenceburg, Tenn.	356
WOAX	Franklyn J. Wolff	Trenton, N. J.	240
WOBB	Longacre Eng. & Const. Co.	Chicago, Ill.	555
WOCB	Orlando Broadcasting Co.	Orlando, Fla.	294
WOC	Palmer School of Chiropractic	Davenport, Iowa	484
WOGL	A. D. Newton	Jamestown, N. Y.	275
WODA	O'Dea Temple of Music	Paterson, N. J.	391
WOI	Iowa State College	Ames, Iowa	270
WOK	Neutrowound Radio Mfg. Co.	Homewood, Ill.	217
WOKO	Harold E. Smith	Peekskill, N. Y.	232
WOKT	Titus-Ets Corporation	Rochester, N. Y.	340
WOMT	Mikado Theater	Manitowoc, Wis.	254
WOO	John Wanamaker	Philadelphia, Pa.	508
WOOD	Grand Rapids Radio Co.	Fernwood, Mich.	242
WOQ	Unity School	Kansas City, Mo.	278
WOR	L. Bamberger and Co.	Newark, N. J.	405
WORD	People's Pulpit Assn.	Batavia, Ill.	275
WOS	State Market Bureau	Jefferson City, Mo.	441
WOW	Woodman of the World	Omaha, Nebr.	526
WOWO	Main Auto Supply Co.	Fort Wayne, Ind.	227
WPAB	Radio Corp. of Virginia	Norfolk, Va.	319
WPAK	N. D. Ag. College	Agricultural College, N. D.	275
WPAP	(See WQAO)	Cliffside, N. J.	361
WPCC	North Shore Cong. Church	Chicago, Ill.	258
WPCH	Concourse Radio Corp.	New York, N. Y.	273
WPDQ	H. L. Turner	Buffalo, N. Y.	205
WPEP	Maurice Mayer	Waukegan, Ill.	213
WPG	The Municipality of Atlantic City	Atlantic City, N. J.	300
WPRC	Wilson Printing & Radio Co.	Harrisburg, Pa.	216
WPSC	Pennsylvania State College	State College, Pa.	261
WQAA	Horace A. Beale, Jr.	Parkersburg, Pa.	220
WQAE	Moore Radio News Station	Springfield, Vt.	246
WQAM	Electrical Equipment Co.	Miami, Fla.	285
WQAN	Scranton Times	Scranton, Pa.	250
WQAO	Calvary Baptist Church	Cliffside, N. J.	361
WQJ	Calument Rainbo Broadcasting Co.	Chicago, Ill.	444
WRAF	The Radio Club (Inc.)	LaPorte, Ind.	227
WRAH	S. N. Read	Providence, R. I.	235
WRAK	Economy Light Co.	Escanaba, Mich.	256
WRAM	Lombard College	Galesburg, Ill.	244
WRAV	Antioch College	Yellow Springs, Ohio	263
WRAW	Avenue Radio & Electric Shop	Reading, Pa.	238
WRAX	Beracah Church, Inc.	Philadelphia, Pa.	268
WRBC	Immanuel Lutheran Church	Valparaiso, Ind.	278
WRC	Radio Corp. of America	Washington, D. C.	468
WRCO	Wayne Radio Co.	Raleigh, N. C.	252
WREC	Wooten's Radio Shop	Coldwater, Miss.	254
WREO	Reo Motor Car Co.	Lansing, Mich.	285
WRES	H. L. Sawyer	Woloaston, Mass.	300
WRHF	Wash. Radio Hospital Fund	Washington, D. C.	256
WRHM	Rosedale Hospital, Inc.	Minneapolis, Minn.	252
WRK	Doron Bros.	Hamilton, Ohio	270
WRM	University of Illinois	Urbana, Ill.	273
WRMU	A. H. Grebe & Co., Inc.	Motor Yacht "MU-1"	236
WRNY	Experimenter Publishing Co.	Coyetsville, N. Y.	374
WRR	City of Dallas	Dallas, Tex.	246
WRRS	Racine Radio Corp.	Racine, Wis.	360
WRSC	The Radio Shop	Chelsea, Mass.	270
WRST	Radiotel Mfg. Co., Inc.	Bay Shore, N. Y.	216

Improving and Adapting the Resistance Coupled Amplifier to the "B" Eliminator

By WILLIAM H. FINE

THOSE who have experimented with resistance coupled amplifiers are fully aware of the usual difficulty encountered in determining the most efficient values to use in both the plate and grid circuits. While it is generally recognized that resistance coupled audio amplification preserves the original purity of the incoming wave to a more pronounced degree than any other present known method, still, the final output remains more or less distorted, due primarily to the fact that ordinary fixed resistors cannot be made to take care of that small fractional part of resistance which would undoubtedly afford greater clarity and more perfect fidelity of reproduction.

Another annoying and really serious problem which has but recently been brought forcibly to the attention of resistance coupled enthusiasts, is the continuous "putting" or "motor-boating" as it is more commonly termed, which manifests itself to varying degrees of intensity when "B" eliminators are connected to this type of amplifier.

These plopping sounds, which generally rise to such intensity as to drown out the incoming signals, are caused by low frequency audio oscillations.

The information given in this article is the result of extensive laboratory experiments and not only solves the "motor-boating" problem but sets forth the use of variable resistances in a manner which tends to lift resistance coupled amplification up to a still higher plane of excellence.

In the plate circuit R-1, is a fixed resistor with a value of .75 megohms; R-2, .5 megohms and R-3 .5 megohms.

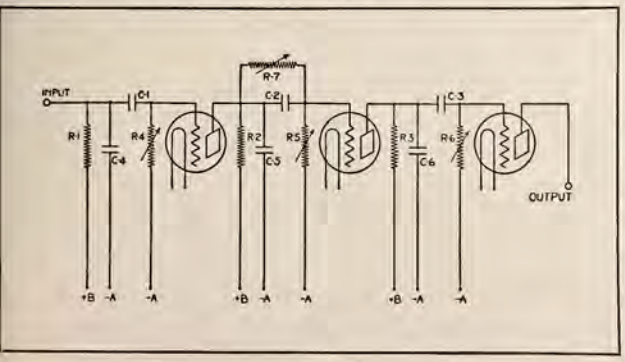
In the grid circuit, R-4 is a resistance variable up to 500,000 ohms; R-5, a resistance variable up to 250,000 ohms and R-6, a resistance variable up to 100,000 ohms. If a power tube is used in the last stage a resistance variable up to 500,000 ohms was found to give maximum results.

It might not be amiss at this time to impress upon the reader the fact that the resistance in the grid circuit of the last tube is the one that actually governs the final tone quality of the receiver and therefore, only by employing a highly dependable make of variable resistor can the proper value be determined which will assure both clear reception.

The isolating condensers, C-1, C-2, and C-3, have a capacity of at least 1 Mfd. Condensers C-4, C-5 and C-6 are of the small by-pass type and are low in capacity, about .00025 Mfd. These by-pass condensers keep the radio frequency currents out of the resistors in the plate circuits and were found absolutely necessary for best results. It was found better practice to connect these by-pass condensers to minus A as they will then by-pass the batteries as well as the resistors themselves.

To eliminate all semblance of the aforementioned "putting" or "motor boating," it was found advisable to shunt a variable resistance across the isolating condensers C-2, coupling the first and second stages. This resistance is shown in the illustration as R-7 and should be variable up to approximately 5,000,000 ohms.

Last but not least, when building a resistance coupled amplifier, as well as any other piece of radio apparatus, it is well to bear in mind the fact that the final results of your labors depend entirely upon your own workmanship and the quality of the parts used. This is particularly true in the selection of the isolating condensers, and the resistances, especially the variable types. Metalized fixed resistors are recommended for the plate circuits because their values do not readily change. Centralab variable resistances were selected by the writer for use in his set.



WRVA	Larus & Brother Co., Inc.	Richmond, Va.	256
WSAI	United States Playing Card Co.	Cincinnati, Ohio	326
WSAJ	Grove City College	Grove City, Pa.	229
WSAN	Allentown Call Publishing Co. Inc.	Allentown, Pa.	229
WSAR	Daughy & Welch Electrical Co.	Fall River, Mass.	322
WSAV	Clifford W. Vick	Houston, Tex.	248
WSAX	Zenith Radio Corp. (Portable)	Chicago, Ill.	268
WSAZ	Chase Electric Shop	Pomeroy, Ohio	244
WSB	Atlanta Journal	Atlanta, Ga.	428
WSBC	World Battery Co.	Chicago, Ill.	288
WSBF	Stix Baer & Fuller	St. Louis, Mo.	273
WSBT	South Bend Tribune	South Bend, Ind.	316
WSDA	Seventh Day Adventist Church	New York, N. Y.	261
WSKC	World's Star Knitting Co.	Bay City, Mich.	263
WSM	Nashville Life & Accident Ins. Co.	Nashville, Tenn.	283
WSMB	Saenger Amuse. Co. & Maison B. Co.	New Orleans, La.	319
WSMH	Shattuck Music House	Owosso, Mich.	240
WSMK	S. M. K. Radio Corp.	Dayton, Ohio	275
WSOE	School of Engineering	Milwaukee, Wis.	246
WSRO	Harry W. Fahrlander	Hamilton, Ohio	252
WSSH	Tremont Temple Bap. Church	Boston, Mass.	261
WSUI	State University of Iowa	Iowa City, Iowa	484
WSVS	Seneca Vocational School	Buffalo, N. Y.	219
WSWS	Richmond Harris & Co.	Batavia, Ill.	275
WSYR	Clive B. Meredith	Syracuse, N. Y.	353
WTAB	Fall River Herald-News	Fall River, Mass.	266
WTAD	Ill. Stock Medicine Corp.	Quincy, Ill.	236
WTAG	Worcester Telegram	Worcester, Mass.	545
WTAL	Toledo Broadcasting Co.	Toledo, Ohio	252
WTAM	Willard Storage Battery Co.	Cleveland, Ohio	389
WTAQ	C. S. Van Gordon	Eau Claire, Wis.	254
WTAR	Reliance Electric Co.	Norfolk, Va.	261
WTAW	Agricultural & Mech. Col. of Texas	College Sta., Texas	270
WTAX	Williams Hardware Co.	Streator, Ill.	231
WTAZ	Thomas J. McGuire	Lambertville, N. J.	261
WTIC	Travelers Insurance Co.	Hartford, Conn.	476
WTRC	20th Dist. Republican Club	New York, N. Y.	240
WTRL	Technical Radio Laboratory	Midland Park, N. J.	280
WWAE	Electric Park	Plainfield, Ill.	384
WWJ	Evening News Assn. (Detroit News)	Detroit, Mich.	353
WWL	Loyola University	New Orleans, La.	275
WWPR	Detroit Police Dept.	Detroit, Mich.	300
WWVA	John C. Stroebel, Jr.	Wheeling, W. Va.	349
WWRL	Woodside Radio Labs.	Woodside, N. Y.	258

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
CFCT	Victoria City Temple	Victoria, B. C.	329
CFCU	The Jack Elliott (Ltd.)	Hamilton, Ont.	341
CFHC	Henry Birks & Sons	Calgary, Alta.	434
CFKC	Thorold Radio Supply	Thorold, Ont.	248
CFQC	The Electric Shop (Ltd.)	Saskatoon, Sask.	329
CFRC	Queens University	Kingston, Ont.	450
CFXC	Westminster Trust Co.	Westminster, B. C.	291
CFYC	Commercial Radio (Ltd.)	Vancouver, B. C.	411
CHBC	The Calgary Albertan	Calgary, Alta.	434
CHCM	Riley & McCormack (Ltd.)	Calgary, Alta.	434
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.	511
CJCL	A. Couture	Montreal, Que.	279
CJGC	London Free Press	London, Ont.	329
CKAC	La Presse	Montreal, Que.	411
CKCD	Vancouver Daily Province	Vancouver, B. C.	397
CKCK	Leader Pub. Co.	Regina, Sask.	476
CKCL	Dominion Battery Co.	Toronto	357
CKCO	Ottawa Radio Association	Ottawa, Ont.	434
CKCX	Int'l Bible Students Ass'n.	Toronto	291
CKFC	First Congregational Church	Vancouver, B. C.	411
CKLC	Wilkinson Electric Co. (Ltd.)	Calgary, Alta.	434
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.	435
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.	384

Republic of Mexico

CYB	Mexico City	380	CYL	Mexico City	400	CZE	Mexico City	350

Republic of Cuba

PWX	Cuban Telephone Co.	Havana 400	5DW	R. S. Calderon	Matanzas 200	6KW	F. H. Jones	Tuinucu 272
2BY	F. W. Borton	Havana 260	6VY	Jose Ganduxe	Cienfuegos 260	7SR	S. Rionda	Central Elia 350
20K	M. G. Velez	Havana 360						
20L	Oscar Collado	Havana 257	6JK	F. H. Jones	Tuinucu 340	8BY	A. Ravelo	Santiago de Cuba 250

Great Britain

2LO	London	365	5XX	Daventry	1600	2ZY	Manchester	378
5IT	Birmingham	479	2RN	Dublin	390	5NO	Newcastle	404
5WA	Cardiff	353				5SC	Glasgow	422
2BE	Belfast	440	6BN	Bournemouth	386	2BD	Aberdeen	495

France

Lyons		550	Paris (Eiffel Tower)		2,650	Paris		1,780	Paris		458

Short Wave Phone Broadcasting

		K.C.	Meters			K.C.	Meters
2XK	Schenectady, N. Y.*	4600	65.16	KDKA	Pittsburgh, Pa.*	5100	58.79
KDKA	Pittsburgh, Pa.*	4760	63.00	2XAF	Schenectady, N. Y.*	9143	32.79

*Crystal Control

Words—Without Music

(Continued from page 24)

tant broadcast of the year, but so quickly did the news fade from the front pages of the subsidized newspapers that to many it is now scarcely a memory. We refer to the valuable service rendered by WSMB, New Orleans, at the time of the Florida disaster, and while we haven't heard of anyone else going out of the way to pass out any eulogies to the southern station, from personal observation of what this service meant to thousands of frantic people in the north, it seems to us if there is any Nobel prize for the outstanding service rendered by a broadcasting station during the past year it should go to New Orleans.

Every hour through the Sunday and Monday night following the hurricane, WSMB was on the air, at first merely repeating messages from distracted friends in the north, then as the fury of the wind abated, sending out the cheering word that New Orleans, Pensacola and Mobile were safe; and finally as they established communication with Florida, broadcasting the first authentic news from the stricken region. It was a thrilling experience even to those not vitally interested, and we stayed with them through a goodly portion of Monday night, feeling that we were participating in one of the most extraordinary of our radio experiences.

And we had the feeling that, if New Orleans had been preparing for such a contingency, they couldn't have found a man more happily adapted to the work than Clyde R. Randall, whose voice was already known to thousands of listeners. His calm, reassuring tones—somewhat weary toward morning—came over with faithful regularity, and must have carried comfort and optimism to many apprehensive listeners. The fact that the only Florida station any of us could pull in that night was calmly talking about the New York Radio Show, as though cataclysmic occurrences were of no moment, rendered WSMB's service more commendable.

Thus, it is, with outstanding events such as the foregoing, that RADIO—two or three short years ago regarded as the rather annoying toy of the boy next door—has come through the year 1926, not only as the greatest entertainment feature of all times, but as a dignified public utility; safeguarding our homes with warning of storms, aiding in the capturing of criminals, searching for lost persons, and giving us first-hand information of all notable events in the day's news—truly as important a factor in our daily life as that other great public servant—the newspaper.

No Congressional Cure for Radio Tangle

AT THE time of printing this issue, no congressional action has been taken to unscramble the congested condition of the air, although many plans have been advanced by various interests.

Latest reports from Washington show the Senate and House conferees have been unable to come to a definite agreement on pending legislation.

The recent Senate resolution providing for a waiver of rights of the broadcasters against the government, has apparently not stopped the stream of new licenses, over fifty changes being made in our present broadcast list in the form of additions to the broadcasting ranks.

Readers who are concerned with at least a semblance of order in the air (instead of the nightly chorus of heterodyne squeals caused by a multiplicity of broadcasters each picking their own channel) should write their senator or congressman and demand action that will make their pastime a pleasure instead of a nightmare.

An interim report on radio legislation by the Air Committee of the American Bar Association has recently been published, its chief feature being the suggestion that excess stations be deleted from the list and just compensation to their owners made from a tax levied upon the remaining station owners.

Chester W. Cuthel, of New York, chairman of the air committee advances the opinion the problem will be worked out only by a slow and expensive litigation even if no legislation is forthcoming. The reason advanced for the suggestions in the committee's report is that by their adoption will follow greater justification for full regulation of broadcasting.

KC	Meters	STATIONS	DIALS 1	DIALS 2	DIALS 3	KC	Meters	STATIONS	DIALS 1	DIALS 2	DIALS 3

CLASSIFIED ADVERTISEMENTS

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

The classified advertising rates are but five cents per word for a single insertion. Liberal discounts are allowed on three, six and twelve-time insertions, making rate of 4 1-2, 4 and 3 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 the March issue must be sent in by January 25.

AGENTS WANTED

AGENTS: Make $8 to $15. Daily. White Rose Polish. Send 50c for full size sample and particulars. WHITE ROSE DISTRIBUTORS, Box 2551, Memphis, Tenn.

WANTED, AN ACTIVE MAN TO TAKE ORDERS for Hardy fruit trees, berry bushes, evergreens, flowering shrubs and roses. Liberal commission. Free replacement. Sales instruction and outfit free. Sherman Nursery Company, attention Mr. Smith, Charles City, Iowa.

MAN in each town to plate auto parts, reflectors, bath fixtures, silver mirrors, refinish beds, chandeliers by new method; $10 daily; no capital or experience required; outfits furnished; write today. Gunmetal Company, Avenue J, Decatur, Illinois.

AUTOMOBILE ACCESSORIES

FREE CIRCULAR—INSTANT COLD WEATHER starting for Ford, Chevrolet and Star owners—P. O. Box 1523-E, Denver, Colorado.

BOOKS AND MAGAZINES

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., 324 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 stamp 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.

BUSINESS OPPORTUNITIES

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

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 90 days. For particulars address National Development Company, Empire Building, Block 135, Pittsburgh, Pennsylvania.

CODE

DO YOU WANT TO MEMORIZE THE WIRELESS TELEGRAPH CODE? THE CORYDON SNYDER CODE METHOD IS EASIEST, QUICKEST. PATENTED. Send 10c coin for complete method to Corydon Snyder, 1243 Rosemont Avenue, Chicago, Illinois.

COLLECTIONS

Three Collection Letters That Actually Collect: Product, 23 years' experience, $1.75. Address J. A. Hillsman, Lynchburg, Virginia.

DOGS

BEAUTIFUL REGISTERED BULL PUPS $15. Bulldogs, 501 Rockwood, Dallas, Texas.

MISCELLANEOUS

FOR SALE: WATCHMAKER'S LATHE at a bargain. R. Jaegermann, 5815 Easton Ave., St. Louis, Missouri.

HELP WANTED

SET BUILDERS: We furnish jobs for you. (No fee) competent men needed today in every community to build LC-27 and Hammarlund-Roberts Sets. Big money for you if you can qualify. Register NOW, giving particulars, experience, references. Allen-Rogers, Inc., 118 E. 28th Street, New York, N. Y.

PERSONAL

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

RHEUMATISM, NEURITIS—WHY SUFFER? Guaranteed complete treatment mailed, postpaid $1.50. Persons Pronounced Incurable should try. This Remedy gets you results or money refunded. Square dealing. Write PROF. GUHA, BOX R-166, HUNTINGTON, IND.

RADIO

Build the Quadraformer Super VI. A real five tube set. Genuine Essential Kit, $17.50 including instructions. Booklet 2c. Literature on request. R. P. Tomamichel, 2244 Seminary Avenue, Chicago, Illinois.

TROUBLE-SHOOTING. Do you know the key to the knowledge of any electrical circuit? You can find correct answer in a booklet written by nationally known authorities on Radio and Electricity. Ask your radio dealer for "Practical Guide for Every Radio Builder and Owner" or Send 10c today to Universal Test Equipment Co., 2939 N. Oakley Ave., Chicago, Ill. Sold at all news stands in the city of Chicago.

Buyers Service for Readers of Radio Age. I will buy for you standard radio merchandise if you cannot obtain same in your locality. Remit list price of article wanted, and if same are not obtainable by me I will make refund. R. P. Tomamichel, 2244 Seminary Ave., Chicago, Illinois.

Guaranteed tubes, 199 and 201A types $1.00 each. $7.50 units to make a loud speaker of your Phonograph only $2.49. $4.00 list head phones going at $1.69. This is real value. A standard make 3 tube set with long range and lots of volume for $8.95, (less accessories), while they last. $12.00 loud speakers with genuine Bakelite Bell at $6.95. Write for our prices before you buy your radio parts. Outlet Sales, 112 Calvert Ave., Detroit, Michigan.

RADIO TROUBLES OVER. Hoff's trouble finder locates, explains Remedy, 103 radio ailments. Particulars free. Smith, 516 Main, St. John, N. B.

IVORY RADIO PANEL beats them all. Write for FREE Sample. Ivorylite Radio Panel Co., 3222 Ave. F, Fort Worth, Texas.

A new circuit just out, something different. Send 2 cent stamp for information how to build your own set. Web Radio Company, Box 849, 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 196 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 stamp 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. .007" for radio frequency transformers, 50c cubic inch, postage extra. At least ½ cash with order—balance C. O. D. Geo. Schulz, Calumet, Michigan.

99.7% Pure aluminum for Rectifiers, B Eliminators, Trickle chargers and transmitters ½" round, ¾x1" rectangular 5c inch, ½"x¾ 4c inch, ⅜" round lead elements 3½" long 15c, 7 for $1.00 all with brass terminals, prepaid to 3 zone. No order less than $1.00. Geo. Schulz, Calumet, Michigan.

PURE ALUMINUM and lead rectifier elements, holes drilled, with brass screws and nuts per pair 1-16", 1"x4", 13c; 1x6, 15c, 1½x6, 17c, 1½x6, 19c, single elements half price. Sheet aluminum 1-16", $1.00, 1-8" $1.90. Lead $1.00 square foot all prepaid. Geo. Schulz, Calumet, Michigan.

CONDENSERS. 800 VOLT FILTER. .1 mfd 45c, .25 51c, .5 60c, 1. 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. $3.60. ELIMINATOR BLOCKS, 2, 2, and 8 $5.70, 2, 2, 8 and 1 $6.15, 2, 2, 8, 1 and 1 $6.60, 1 and 1 in series 90c. Many other capacities. Acme transformers and chokes. THE RADIO CLUB, INC., La Porte, Ind.

3 element Rectifier jars for B eliminators, B battery chargers and transmitters. 1 jar takes the place of 2 ordinary jars. ½"x3½" 99.7% pure aluminum, rubber covers binding posts 3" inside diameter $1.00 each, 4 for $3.00, prepaid to 5th zone, ½ cash with order balance C. O. D. Satisfaction or money back, George Schulz, Calumet, Mich.

RADIO PANEL ENGRAVING: Single panels, quantity work and special engraving of any description. Highest standards of workmanship. We have served prominent Radio Age experimenters and broadcast engineers for several years. A. L. WOODY, Room 704, 19 South Wells St., Chicago.

VICTOREEN No. 170 superheterodyne transformers $4.50 postpaid. Chelton 13 plate midget condensers $1.05 postpaid. L. W. Crosby, 19 Railroad Avenue, Swampscott, Mass.

Tubes, all kinds, including latest power tubes at cut prices and special discount, send 2c cent stamp for prices and particulars. Web Radio Company, Box 849, Chicago Ill., Dept. TE.

Eliminator parts 50H choke $2.00, 30H choke $1.75, 20H choke $1.00. Write for list of parts including condensers and transformers. Postage prepaid. Radio Parts Sales Company, Box 24, Orange, N. J.

EUROPEAN broadcast on two tubes. Simple and cheap to construct. Blue prints 50c. Triangle Drafting Service, 5124 Sheridan Road, Chicago, Illinois.

Save up to 50% on Nationally Advertised Radio parts. Send for our new price list of Radio Kits, "B" eliminators, Radio Receivers and Parts. NATIONAL RADIO-PRINT CO., Room 404, 200 Broadway, New York.

Radio Panel Lamp. Rests on top cabinet. Lights dials. Uses battery current. Complete with bulb $1.25, postpaid. Satisfactory or money back. Robert Stevenson, Lancaster, Ohio.

SAVE MONEY on radio sets and parts. List free. All merchandise guaranteed. GEMRAD COMPANY, 631 E. Okmulgee, Muskogee, Okla.

SALESMEN WANTED

Make $100 WEEKLY in spare time. Sell what the public wants—long distance radio receiving sets. Two sales weekly pays $100 profit. No big investment, no canvassing. Sharpe of Colorado made $955 in one month. Representatives wanted at once. This plan is sweeping the country—write today before your county is gone. OZARKA, INC., 431 N. LaSalle Ave., T, Chicago.

WANTED TO BUY

Full value paid for old GOLD jewelry, silver or platinum. Packages returned if our offer not satisfactory. Elaine Specialty Company, 3121 Avenue G, Fort Worth, Texas.

Radio Age Classified Ads Bring Results

Please mention Radio Age when writing to advertisers

CROSLEY 1927 RADIOS

Each set giving the utmost in radio enjoyment at its price. All prices slightly higher West of the Rocky Mountains. All prices are without accessories.

The 5-50—$50

Enthusiastic owners report amazing performance—a drum delivering stations loud, clear and sharp; each an almost imperceptible turn of the drum apart. Write station letters on drum, return to them at will. Single drum Station selector, Acuminators, power tube adaptability and all metal chassis that shields the units from each other. Beautifully finished. Mahogany cabinet, rose gold trimmings.

The 5-75 Console—$75

This set includes ideas for radio reception perfection not found in any other radio. Marvelous exclusive Crosley "Crescendon" and "Acuminators" increase volume on distant stations and bring in programs entirely missed and passed by on ordinary one-dial control radios. Console model stands 40 inches high. The Crosley Musicone is skillfully built into the cabinet in a manner which is both an artistic and an acoustical triumph. Ample space for batteries and accessories.

"6 Tube RFL-90" Console, $90

Introducing the double drum station selector! Crosley's winning non-oscillating perfectly balanced tuned radio set. Includes Musicone skillfully built into exquisite console mahogany cabinet of two-tone finish to match finest surroundings. Room for batteries and all accessories; 40 inches high; 30½ inches wide.

THE CROSLEY MUSICONE. The secret of the popularity of this biggest selling loud speaker on the market lies in its actuating unit. This and NOT the cone shape is the reason for its perfect reproduction of all audible sound. BEWARE of imitations. There is only one genuine Musicone. It is built solely by Crosley under mass production methods which makes its unmatchable value possible.

CROSLEY

BETTER ··· COSTS LESS

RADIO

"~as long as I can pick up 27 programs in 30 minutes beside our 3 locals interference won't bother me

I sat down the other night with this Crosley set. One control. Beginning at one end of the broadcasting wave band, I tuned in 27 stations, loud and clear, just like the Cincinnati stations, three of which were going full blast. I listened to each program; identified it; didn't hear any others in the background, and passed on to the next,—all with one finger. It was between 7:00 and 7:30 P. M. Central Standard Time.

The air was certainly full. Some of the stations were less than a dial marking apart. It is amazing how the jiggers they call "acuminators" helped on such fine separation.

Even using a hundred foot aerial the local stations were easy to go through. One of them only a few blocks from my home.

Some radio, I call it! $50.00 seems too little. I'd like to see some two hundred dollar sets do as well!"

Write Dept. 63 for Catalog

The Crosley Radio Corporation

Powell Crosley, Jr., Pres.
CINCINNATI, OHIO

Crosley sets are licensed under Armstrong U. S. Patent No. 1,113,149, or under patent applications of Radio Frequency Laboratories, Inc., and other patents issued and pending.

Single Drum Control $50.

Prices slightly higher West of the Rocky Mountains.

The above scale reading shows how stations picked up by Mr. X— appeared on the Crosley graphic drum station selector.

Name on request.

CROSLEY 1927 FEATURES

Many exclusive—others found only in highest priced radios.

THE "CRESCENDON"

When, on ordinary radios, ears must strain to catch a station miles away, a turn of the Crescendon on Crosley radios instantly swells reception to room filling volume. An exclusive Crosley feature.

ALL-METAL SHIELDED CHASSIS

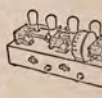
This truly great radio achievement, found in several Crosley sets, furnishes a substantial frame for mounting elements, produces excellent alignment of condensers, shields the units from each other, prevents interstage, improves the stability of the circuit, increases selectivity and saves costs by standardizing this phase of manufacture.

THE SINGLE-DRUM STATION SELECTOR

Nothing in radio equals the joy or the convenience of single drum control. Crosley single drum control enables you to find the stations sought without log book or "tuning."

"THE ACUMINATORS"

Crosley Acuminators permit tuning in—loud and clear—weak stations passed over and entirely missed by ordinary single dial radios. In tuning high powered and local stations they are not used. They are an exclusive Crosley feature.



POWER TUBES

Power tube adaptability marks the Crosley "5-50", "5-75" and "RFL" sets. This feature typifies Crosley provision for best radio reception at moderate cost.