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Quadrode Superheterodyne (With Blueprints)
Radio Age Short Wave Receiver
1928 "Nine-in-Line"
Aero-Seven
Camfield Super-Ten

November 1927

Complete List of Broadcasting Stations

25¢
All Electric Radio

7 Tubes—Single Control

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Send me full particulars about the RANDOLPH Six and Seven-Tube Electric and Battery Table and Console Sets with details of your 30 Day FREE Trial Offer.

Name
Address

City_.._.State

Mark here □ if interested in Agent's proposition.
If you want to get into the Radio Profession, or if you're in it and want to get ahead—

Read This Announcement!

Here's a message of importance to every man who hopes to better himself along the lines of Radio. Never before has there been a Radio training course that could be made to fit the needs of all—men with a knowledge of Radio and others who wish to better themselves and inexperienced men who wish to start from the beginning. There is one now. I am prepared to help the beginner start in Radio from the very beginning. And I am prepared to help the radio dealer, the experienced Radio operator, the Radio service man, the college engineering student, the graduate engineer, the Radio fan, the "ham," the factory or broadcast man who wants to get a more responsible job.

An old, established system of Radio home-study training has now been developed, improved, tested, and enlarged in scope so that now it not only will help anyone who wants to get into the Radio profession, but more, can be adapted to help almost any man now engaged in Radio (Radio engineers and standing excepted).

If you want to get into Radio, or if you're already in it and want to add to your knowledge and get ahead, let me send you my free 64-page book of information about this new and greater Radio training system.

The Good Jobs Pay $50, $75, up to $200 a Week—Some Pay More

If you're earning a penny less than $50 a week, you're not earning what you should be able to get out of Radio. Thoroughly-trained Radio men—men whose knowledge of Radio is practical and completely mastered out on every point—earn up to $200 and $250 a week. Radio is a new industry with plenty of fine positions unfilled. There are countless opportunities in Radio for a man to earn a splendid salary. But these are not opportunities as far as you are concerned, unless you are fully qualified for them. The only way to qualify is through knowledge—training practical, complete training that fits you to get and to hold a better position in the Radio field.

For the beginner, I have a complete training that will take him from beginning to end. To the Radio dealer I'll give the technical and practical knowledge he has to have. I will teach him and bring up to date the experienced Radio operator's knowledge. I can take the Radio service man who has a pretty good idea of the "how" but very little idea of the "why," and give him the practical and theoretical knowledge he must have before he can hope to climb higher on the Radio ladder. I can take the college engineering student, or the graduate engineer, who wishes to specialize in Radio, and give him what he needs.

What other line offers such an opportunity as Radio? From $7,000,000 a year in 1919 to $300,000,000 a year in 1926; from 1,000 persons engaged in Radio in 1920 to 300,000 in 1926. That's some record. The accomplishment of television and the many other inventions constantly being made promise the same sort of boom for the future.

If you're already in the Radio business, stay in it. But prepare yourself for advancement and more money. If you're not in Radio yet, get in. Men always do their best at work that interests them.

Send Coupon for Free 64-Page Book

My free 64-page book is filled with facts and photos relative to Radio and its opportunities, and tells all about my new and greater system of Radio training. Underscoring my practical methods, you can study at home in your spare minutes, and get a thorough, clear, practical and expert knowledge of Radio in from 12 to 12 months. This will enable you to pass the practical and technical tests for a position as a Radio Service Man or Radio Operator. The knowledge you gain will fit you to earn $50 a week. Your previous knowledge, your ability, and the time you can spare for study, are the only necessities.

This proposition is open to anybody who has a desire to enter this line and make good. If you are not satisfied with his job, his prospects, or his Radio knowledge, this is the opportunity for you. Regardless of how much you know already (or if you don't know the first thing about Radio technically), I'll fit my methods to suit your needs. No particular amount of general education is needed to start—many men I've trained didn't even finish the grade schools.

If you want to enter into any correspondence about your own situation, anything you write will come directly to me and will be held strictly confidential. Send the coupon at the right, or write me a letter today.

Address: J. E. SMITH, President
National Radio Institute
"Oldest and Largest Radio Home-Study School in the World"
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Employment Service to all Graduates
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Dept. O-91, Washington, D. C.

Dear Mr. Smith: Kindly send me your free 64-page book about your new and greater Radio training system. I understand this request places me under no obligation, and to the salesmen will tell me if I am interested. I want to learn more about the Radio business and career and I am willing to pay for the training. I want to know the details of the program and how I can get started.

Name
Address
Town State

Please Mention Radio Age When Writing to Advertisers.
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**BRIEF** articles on further organization of the Radio Protective Association; Court Decision, Favors A. R. R. L.; Survey of Radio Dealers' Stock made by Government.

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**Final Advertising forms close on the 10th of the 2nd month preceding date of issue**


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**Chats**

Following our announcement in the October issue we are publishing this month the description of a superheterodyne circuit which presents absolutely new features. But aside from the unique phases of the receiver it has qualities which will be sure to make it popular. Mr. Freimann's article on this Quadrode Superheterodyne tells of the superior performance of the set when carefully tested in our laboratory and makes it clear, also, that here is an outfit that, despite its simplicity of construction and operation, measures up to the best results obtained by the more complicated superheterodynes. Set builders who have hesitated to tackle superheterodyne construction but who have wished to do so, will find this simplified super a dish to their taste.

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Interest in set building and in kits is maintained at a mark that scarcely would have been predicted a year ago. It appears that the anticipated falling off in "how-to-make" radio has not developed. On the other hand there are general signs of increased interest.

One sure register of technical radio interest is to be found in our correspondence from fans. They are more enlightened as to what they want than they were two or three years ago but they are just as enthusiastic. It had been a rather commonly heard prediction that interest in technical radio would slump off sharply after the first glow of enthusiasm, just as interest in automotive engineering and interest in talking machine mechanics died away. But it is now apparent that there will remain indefinitely a large number of fans who will not be satisfied unless they can make their own.

---

Frederick Smith

Editor of RADIO AGE.
Radio is better with Battery Power

NOT because they are new in themselves, but because they make possible modern perfection of radio reception, batteries are the modern source of radio power.

Today's radio sets were produced not merely to make something new, but to give you new enjoyment. That they will do. New pleasures await you; more especially if you use Battery Power. Never were receivers so sensitive, loud-speakers so faithful; never has the need been so imperative for pure DC, Direct Current, that batteries provide. You must operate your set with current that is smooth, uniform, steady. Only such current is noiseless, free from disturbing sounds and false tonal effects. And only from batteries can such current be had.

So batteries are needful if you would bring to your home the best that radio has to offer. Choose the Eveready Layerbilt "B" Battery No. 486, modern in construction, developed exclusively by Eveready to bring new life and vigor to an old principle—actually the best and longest-lasting Eveready Battery ever built. It gives you Battery Power for such a long time that you will find the cost and effort of infrequent replacement small indeed beside the modern perfection of reception that Battery Power makes possible.

NATIONAL CARBON CO., INC.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—9 P. M., Eastern Standard Time

WEAF—New York WOC—Des Moines
WJAR—Providence WCCO—St. Paul
WFEN—Boston WGBS—[ ]
WFL—Philadelphia WQXI—Atlanta
WGR—Buffalo WBG—Kansas City
WCAE—Pittsburgh WRC—Washington
WSAI—Cincinnati WGY—Schenectady
WTAN—Cleveland WHAS—Louisville
WJR—Detroit WBZ—Boston
WGN—Chicago WSN—Nashville
WMG—Memphis

Pacific Coast Stations—9 P. M., Pacific Standard Time
KPO—San Francisco KFLN—Los Angeles
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Radio Batteries
—they last longer

The air is full of things you shouldn't miss
SIXTEEN REMLER REASONS WHY!

1. Readily changeable, white cardboard indicator strips. Supplied for clock-wise or counter-clock-wise reading.
2. Large, easily read figures.
3. Space provided for call letters.
4. Round hole for escutcheon plate; no special tools necessary.
5. Station Settings spread over 15 inches of space.
6. Heavy brass bracket supports condenser; rigid construction.
8. Vernier control; Special shaft cannot bind in bushing.
9. Vernier control; Special shaft cannot bind in bushing.
10. Right or left hand control.

REMLER Drum Dial

1. 360° rotation of shaft and reduction drive give vernier control.
2. Proper placing of insulating material minimizes resistance to radio frequency currents.
3. Complete insulation of plates from dial and dial shaft and provision for grounding dial and shaft give absolute freedom from body capacity effects.
4. Plates carefully aligned by hand and soldered rigidly in position at three points.
6. Shape of plates permits attainment of very low minimum capacity and wide tuning range.

REMLER Twin-Rotor Condenser


REMLER
DIVISION OF
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260 FIRST ST., SAN FRANCISCO
CHICAGO NEW YORK
EASTERN WAREHOUSE, ELKHART, INDIANA

NINE YEARS OF RADIO EXPERIENCE
The Radio Age Short Wave Receiver

This instrument was designed and built in the laboratory of the Radio Age testing station, 9BRE

There is as much room below 100 meters as there is above, and in fact, a lot more. To the average person this territory is so much wilderness infested by wild Hams and kindred parasites. In other words, a refugee for those who don’t dare go anywhere else. Maybe so. Then, why is it that the mightiest radio interests in the world are fighting for a slice of this useless ether for their individual employment? The answer is simple; the short waves are the most valuable of all the channels. Phenomenal distances are covered with ease, it takes only hundredth as much power to bridge a gap as on 300 meters, tuning is so sharp there is practically no interference.

Here may be found powerful transatlantic stations which keep a twenty-four hour schedule, amateurs in all parts of the world, KDKA and twenty other short wave phone broadcasters, as well as numerous foreign phone stations, the Navy and private interests.

It should not be understood that the short wave receiver belongs merely to the amateur who can read code. Broadcast listeners who have not the slightest knowledge of dots and dashes have new and wonderful fields of entertainment opened to them by the short wave set. Not only may the broadcast listener enjoy delightful programs on the low waves (not possible to get on ordinary receivers) but they can bring in these programs from a distance in the daylight hours and under adverse weather conditions that would possibly prevent reception on the higher waves.

Just recently the Puget Sound tug boats were equipped with short wave radiophones. Any one is free to listen who so desires. The broadcasters run some excellent programs, and there is no jamming and interference as on the higher channels. World history has been made on short waves. When Byrd flew over the North Pole he informed the world of the fact on short waves, and again while he crossed the Atlantic. The only clew to the fate of several flyers was received on short waves. Most all airplanes that have radio use short waves. Numerous expeditions in the remotest corners of the world keep in touch with the home office on short waves. The famous Catalina
Channel swim was scooped on short waves before other mediums could function. All this is free to him who has a short wave receiver.

The only requisite is a knowledge of the code. This is easy to master. Conscientious endeavor will familiarize one to such an extent the funny buzzes cease to be static and become letters spelling words, connected together into sentences. It is a great thrill to hear a mess of dots and dashes slowly evolve into a serious statement that an expedition has just discovered something new, or a great catastrophe has befallen someone. Those of us who heard the Dallas Spirit fall know this only too well. The results are worth the effort.

Before any signals may be heard a receiver must be built, so let us roll up our sleeves and get busy. The parts selected are those which have proved their worth time and again. They are all standard and may be obtained on the open market. We chose them carefully, picking those which performed best in the combination of the finished receiver.

Now that all the parts contained in the list are on hand we will lay out our panel and baseboard. This should always be done before a single hole is drilled. Quite often it will be found that a certain instrument must be moved a fraction of an inch to make room for another. If it is already mounted this cannot be done without leaving unsightly holes. The only correct way to lay out a panel is by using a square and a pair of dividers. It is slow and often tedious, but the results are accurate. We have already done this, and the readers may avail themselves of our efforts by obtaining the drilling templates supplied by the service department of this publication at a cost of twenty-five cents. Paste this template to the panel and with a centerpunch and hammer make an indentation for every hole. Care must be used, both to make sure the impression is in the correct spot, and also that a light enough blow is struck not to crack the panel. The correct size drill is indicated, as well as countersunk holes.

Rubber is used for panel and baseboard because it is the best dielectric obtainable in workable form, and it is far easier to handle than other insulating materials.

The instruments to be mounted on the panel are the two tuning condensers, the rheostat and cord tip jacks. Next we will fasten the two brackets to the panel, and in turn subpanel to them. The chassis is now complete, ready for the instruments to be mounted.

It will be noted that the coil jacks are removed from the supporting strip furnished by the manufacturer and placed directly in the subpanel. This shortens the leads considerably, makes a neater set and allows all the connections to be made on the under side.

The grid condenser and leak are mounted on the under side of the subpanel, placing them in a position where the leads will be shortest. Mounting screws are furnished with the condenser, as well as clips to contain the gridleaf.

Surface mounting sockets are used, for as many leads are above the subpanel as below and it is just as easy to have the leads going down as it is to have them coming up.

In wiring, about five lengths of square

(Continued on page 36)
Radio Age for November, 1927

Temples of panel and baseboard of the Radio Age Short Wave Receiver.
The design of the Aero-Seven receiver is one of distinction in the radio field. It claims several new features as follows: A special feature eliminating the objectionable detuning of the first stage of radio frequency amplification by the antenna, a common defect in many so-called single dial sets; the use of Aero Universal Coils, which are tapped in such a way as to allow the use of the new high-mu tubes for radio frequency amplifiers, with a considerable gain in both the sensitivity and the selectivity of the receiver; the use of these tubes in a perfectly balanced resistance coupled amplifier to produce exceptional tone quality and volume; and the embodiment of a special foundation unit consisting of drilled and decorated panels, with mounting brackets so that the construction of the receiver is simplified to an assembly operation. A front view of the completed receiver, Figure 1, shows the workmanlike appearance of the receiver that may be constructed by the home builder. Many of the present-day single control receivers have the first radio frequency transformer tuned by one of the units of the gang condenser. In spite of any care in matching of the coils and condensers there is no provision made against the detuning of the first stage by antennas of different electrical characteristics. This effect is not noted in the succeeding stages as the other transformers each operate out of the plate circuits of similar tubes and hence similar impedances. A very simple means has been resorted to in the design of the Aero-Seven in order to eliminate this defect. As will be seen in the circuit diagram, Figure 2, the antenna is connected across the 1,000-ohm resistor in the grid circuit of the first radio frequency tube, thereby allowing the first R. F. transformer to operate out of the impedance of a tube in similar manner to the rest of the transformers in the receiver. The size of this resistor has been carefully chosen so as to permit the voltages set up in the antenna to be effectively transferred to the grid of the first amplifier tube. As will be seen from the circuit diagram, the remainder of the radio frequency features are the tried and tested standards of the past, with the exception of the employment of high-mu tubes as radio frequency amplifiers. This feature is made possible by the design of the Aero Universal Coil. This coil is an arrangement of an exceptionally efficient, secondary construction that has been on the market for several years, with a primary arrangement so as to get the most effective coupling coefficient to the secondary and tapped so as to produce primary impedances of widely varying values on the different taps. The highest of these values is secured by the use of tap No. 1 as the plate and the No. 4 tap as the battery connection, as shown in the circuit diagram. When employed in this connection the impedance is of such a value as to perform very effectively with the high-mu tubes now on the market, such as the UX240 and the CX340. At the plate potential used (90 volts), these tubes on the average show a figure of merit, as generally accepted in engineering work, of 1.6 times the figure of merit for the usual 201A type of construction. This figure of merit may be realized in the design of a practical receiver either in selectivity or in amplification, or partially in both. In the design of the Aero Universal coil the primary impedance was so proportioned as to conform to the latter possibility. The result is an extremely sensitive receiver of extreme selectivity. An innovation in the matching of the radio frequency stages has been employed by matching the Aero coils in kits of three at two widely separated frequencies in the broadcast band. It has been found after considerable investigation of the subject that if two or more coils match at one wavelength that they will not necessarily match at another wavelength at the other end of the broadcast band. In order to prevent the receiver from falling out of tune at one end of the dial and in at other points of the dials, the Aero coils are matched at the factory to 250 meters and also at 500 meters. It has been found that by matching the coils in this manner that they will be sure of maintaining the same inductance over the whole broadcast band. The Amaco gang condenser used to tune these coils is one of exceptional accuracy and is provided with small compensating capacities to adjust for small differences in the wiring and tube capacities of the various stages. This adjustment will be described later. Preliminary to constructing the AERO-SEVEN, a word about the Aero Norskip No. 60 choke coil used in the set. It has
The remainder of the wiring to the potentiometer and rheostat may now be completed and the receiver is ready to set up.

(Continued on page 28)
THE HFL Nine-in-Line Super-Heterodyne certainly needs no introduction to radio fans since in the past two years it has been one of the leading receivers. This receiver delighted thousands of radio DX fans in its remarkable ability to extract stations in remote and distant corners of the United States—and even foreign stations—through the conglomeration of powerful local broadcasters in congested areas such as represented here in Chicago. No doubt many who built the set last year feel that it couldn’t be improved upon.

There are refinements in the 1928 receiver which will attract the man who has already built the set and the new prospect for a receiver capable of getting distance under the present conditions and still preserve the fine qualities of music and speech as they are presented from the broadcasting stations. The outstanding refinements are the new audio transformers which have the characteristic of reproducing all the notes with uniform intensity so that an orchestra, for instance, will sound like the orchestra playing in the ballroom of a large hotel and not like an orchestra playing the same melody yet distinctively different from the original. That is, the low notes, mediocre notes and high notes are relatively the same as they burst forth from the loud speaker. The new Remler drum dials are here incorporated giving the set a snappy finished appearance and making the tuning easier.

The simplicity of assembling and wiring the set, which has been in the past one of the outstanding features, is well retained. All the leads are extremely short and direct which also adds to the electrical efficiency of the receiver. As can be readily observed from the name Nine-in-Line, nine tubes are used in the receiver. A first detector, four intermediate stages of amplification (using three iron core untuned transformers and two sharply peaked transformers), one oscillator, one second detector and the conventional two stages of audio frequency.

The receiver built in the laboratory of the RADIO AGE a few weeks previous to the writing of this article produced very gratifying results. The first night it was tried, a Sunday night, stations from coast to coast were easily tuned in. KFI, the west coast criterion, was brought in with ample volume to fill a room with music. It being Sunday night there were, of course, not quite as many local stations on the air as on an ordinary week day night. The tone quality is very good. The set tunes smoothly without breaking into annoying oscillations and was as a whole very easy to operate. A very
smooth volume control is provided to afford signals that can be heard a block away or in just a whisper.

Assembling and wiring the set was an interesting operation. All the parts coordinated perfectly. There is available on the market a front and sub-panel already drilled for the parts to be mounted thereto. As the parts are taken out of the boxes they are screwed down to the sub-panel in the proper places as indicated in Figure 2. Soldering lugs should be inserted on all the machine screws holding the transformers to the panel and also on all the filament terminals of the tube sockets, for electrical connections. Most of the lugs from the plate grid terminal of the transformers should be soldered directly to the tube sockets making practically no leads. Solid bus bar wire can be conveniently used in wiring up the set and the lugs bent so that the wires will be straight or at an angle. This gives the set a very neat and commercial appearance. Spring washers beneath all nuts are a great advantage as they prevent the nuts from loosening and making a poor electrical connection.

Assembling the new drum dial and condenser is probably a novel experience but as the fittings are quite obvious there is no difficulty. On the right hand dial, however, slight changes may have to be made so that the condenser will be mounted the opposite way from the left hand condenser. This is simply a changing of the position of the shaft and putting on another gear provided for that purpose with

(Continued on page 32)
The Campfield Super-Selective Ten

Radio is, and as it is most progressing, and we have before us today the Campfield Super-Selective Ten, which combines a Tuned Radio Frequency circuit and the Super-Heterodyne.

This remarkable receiver functions best when used with an aerial and ground. It is well known that even the most diminutive of aerials picks up more current than a loop. The only reason aerials and supers were not used together long ago was that the super refused to differentiate between stations. It could not handle all the power collected by the antenna.

By consulting the diagram one will readily see how this trick is possible. Three stages of radio frequency amplification are placed ahead of the detector, one untuned, the others governed by a three gang condenser.

The untuned stage acts as a ballast, stabilizing the circuit and greatly retarding unwanted oscillation. This receiver positively will not squeal nor howl when being tuned.

Tuning is extremely sharp, due to the employment of a new device on the market, a 10 Kilocycle Band Pass Filter. This device prevents stray waves from visiting the second detector. Only the frequency to which the first detector is tuned is allowed to pass. This is quite desirable for use in metropolitan districts for it enables one to tune right through the high powered ether paralyzer next door and drag in the favorite back in the old home town.

The Campfield Super-Selective Ten is the first receiver to make use of a filter circuit of this sort, and by the way it works it will not be long till there are plenty of others.

Tone quality is perfect. Sharply peaked intermediates are avoided and the filter allows a sufficient breadth of channel to let the overtones and musical side bands pass undisturbed. This means that the full musical scale is faithfully reproduced, from the deepest growl to the highest squeak.

Now that we have made an appeal both to the man who hates QRM and the lover of fine music we will also include the midnight prowler who is satisfied with nothing short of Manila or Cape Town. This receiver is sensitive, very much so. There are three stages of radio frequency amplification ahead of the first detector. No matter how many tubes after this first detector, signals are heard no farther than it is able to detect. There is a minimum point of audibility, below which no sound is heard. With the additional radio frequency tubes ahead, this point of audibility may be considerably lowered giving phenomenal range. D. X. is a matter of selection of tubes, batteries, aerial and ground, coupled with patience and skill on the part of the operator. Many new trans-Atlantic records will be made this winter with the Campfield Super-Selective Ten.

There are only two tuning controls, because most of us have but two hands. That is all that is needed anyway for they do the work to perfection.

The three T. R. F. condensers must be
LIST OF PARTS

1 251 Camfield .00025 mfd. Variable Condenser
2 351 Camfield .00035 mfd. Variable Condenser
3 10 inch Camfield Steel Shaft
4 Pair Camfield Condenser Support Brackets
1 Camfield Kit of 3 Camfield Type 44 Duoformers
1 620 Camfield Oscillator Coupler
1 10KC Rusco Band Pass Filter
2 95KC Rusco Transformers
1 Carter .001 mfd. Fixed Condenser
1—IR400 Carter 400 ohm Potentiometer
1—MW2000 Carter 2000 ohm Potentiometer
2 105 Carter .5 mfd. By-Pass Condensers
2 Carter .0025 mfd. Grid Condensers with Clips
2 Lynch 2 Meg ohm Grid Leaks
2 330 Tyrman Audio Transformers
1 Tyrman Double Vernier Drum Dial
1 10 Carter Battery Switch
1 6 Carter Jack Switch
1 Carter 750 ohm Resistances
1 Carter Tip Jacks
10 9044 Benjamin Sockets
3 Karas Sub-Panel Brackets
2 Engraved Eby Binding Posts
1 PM Jones Multiplug
2 4A Amperites
1 3A Amperites
1 Celeron 7" x 30" x 3/16" Drilled and Engraved Front Panel
1 Celeron 10" x 29" x 3/16" Drilled Sub-Panel
40 Feet Acme Celatsite Wire

Graphic chart of the Camfield Super-Selective Ten

synchronized down to a hairs breadth, or the set wont work. This sounds formidable, but it is simple. Tune in a station and then disengage the set screw for two of the condensers and adjust till in resonance with the third. An hour is plenty of time for this.

One advantage in building this receiver is that it may be constructed in two sections if desired. One will notice by consulting the diagram that the receiver may be either a six tube T. R. F. or a ten tube super, at the throw of a switch. The switch connects the first detector tube directly to the audio amplifier in one position, and when thrown to the other, lights the super tubes and connects the oscillator, intermediates and second detector. A more desirable arrangement than this cannot be found.

The super has been considered the most satisfactory circuit for use under conditions formerly prevailing. But broadcasters have increased power and crowded together till the overlapping of harmonics has become a serious matter. In fact it is so bad in certain localities the beat note of one station may be used as a heterodyne for another, making it possible to remove the oscillator tube from the socket and still have perfect reception, if such circumstances may be called perfect.

A super designed to function on an intermediate frequency of 50 kilocycles or thereabouts will pick up the local stations regardless of the oscillator dial setting if there happens to be another station on the air in the neighborhood having a frequency either 50 kilocycles above or below the one intended to be heard. Needless to say, results are far from gratifying.

In the Super Ten this condition is entirely eliminated as intermediate frequency transformers, peaked at 95 kilocycles, are used. There are no stations in the United States that are exactly 95 kilocycles apart. This frequency coupled with the three stages of T. R. F. spells freedom from harmonic interference.

The filter used in this receiver has been designed to pass a band of frequencies 10 kilocycles wide between 90 and 100 kilocycles. All frequencies lying within this range are amplified equally by the intermediate stages. The filter is designed to cut off very sharply on both sides of this band, and the circuit, therefore, has excellent selectivity.

It must be remembered that the frequency of a broadcasting station at any given wavelength is not absolutely constant. It is modulated by the frequency of the voice or music being transmitted and therefore varies within 5 kilocycles of the rated frequency, either above or below. If a circuit is not designed to give practically uniform amplification over a band of frequencies 5 kilocycles above or below that of the incoming wave, some of the voice or music frequencies will not be

(Continued on page 28)
The Quadrode—A New Super-Heterodyne

By Frank Freimann

We are bringing to our readers a new super-heterodyne which we know will be met with enthusiasm. We have long been wondering why the Quadrode Vacuum Tube (four electrode) was not adapted to the many possibilities which this interesting tube affords. A month ago we started working towards a super-heterodyne of a highly efficient nature which would be simple enough to attract the man who, because of its complicated character, has been afraid to build a super-heterodyne. We planned a super-heterodyne simple enough in construction to be built by one who has had little or even no experience with radio receivers and yet a super-heterodyne as generally efficient as the most complicated of receivers we know today. And here the Quadrode Vacuum tube immediately presented itself as the solution for a simple mixer circuit.

Fortunately we already have on the market a highly efficient intermediate frequency amplifier which we immediately decided to use in our new receiver, due to its simplicity and high amplifying ability. The amplifier was described in the October issue of RADIO AGE and is already familiar to the radio experimenter as the S-M 440 Jewelers Time Signal receiver, manufactured by Silver-Marshall, Inc. This instrument itself reduces the complications of the super-heterodyne many fold. Instead of having a series of transformers to wire up into an intermediate amplifier—complications which entail dozens of connections, not to mention the worries as to whether or not the transformers are matched—the S-M 440 amplifier merely has eight connections to be made to the associated parts of the receiver.

The one tube mixer, the S-M catacomb, and a simple two-stage audio amplifier constitute the unique Quadrode Super-heterodyne shown in the photograph, Figure 1.

The special tube which serves the dual purpose of detector and oscillator more efficiently than the conventional two-tube circuit, needs perhaps some description as very little publicity has been given this very excellent tube in this country. In foreign countries its merits are more fully recognized and the tube is more commonly in use, whereas here in America there has been no such device developed and made available until this late date.

The Voltron Quadrode we are here employing is the development of the K & H Electrical Corporation, and consists of a very substantial filament, two grids, one on each side of the filament, and a common plate. The characteristics of each side of the tube is practically identical, that is, the inter-electrode impedance and capacity is the same. Double grid tubes that have previously made their debut on the market are the type having one grid within the other. A tube of this kind has two decidedly different characteristics, one equivalent to a High Mu (high amplification and very high plate resistance) and the other a Low Mu; therefore the tube does not lend itself to all purposes. The Voltron Quadrode looks externally exactly like any other tube of the more common type except for the base, which has five points instead of four, so spaced that the tube can be plugged into a socket designed for a five prong type of tube.

The connections on the socket can be followed according to the way the tube is marked except the cathode connection (the extra connection) which is the additional grid. The plate resistance of the tube is about 20,000 ohms.

The Quadrode Super-heterodyne is not only simple in construction but easy in tuning as well, since there are no regeneration controls and since there is no possibility for the detector circuit to oscillate; yet regeneration is always present in the detector circuit, thus increasing the sensitivity and selectivity of the set. The two dials run together over the whole wave length range with a deviation of less than five points. This makes the set particularly easy to tune because one knows that the dials are in resonance as long as the numbers on the dials correspond.

The set can be used on either an inside loop aerial or a short outside aerial. Most of the experiments were conducted with a wire connected through a small condenser to the house lighting system as an antenna. In this manner KFI was received with enough volume for good loud
Power Amplification With Tone

The Jewelers Time Signal Amplifier

The Silver-Marshall 440 Jewelers Time Signal Amplifier is a three stage R.F. amplifier and detector completely wired and sealed in a copper and brass catacomb and tuned exactly to 112 K. C., the 2677 meter wavelength of the U. S. Naval Observatory Station at Arlington (NAA).

Each of the four circuits of the amplifier is sectionally shielded. The selectivity is so great that interference from other wavelengths is impossible. The amplification is tremendous—higher than that of any 3-stage long wave amplifier that can be constructed from standard parts today. Thousands have been sold, for it's the best long wave amplifier ever developed. The 440 simplifies construction and eliminates all guesswork. Price $35.00.

New S-M Transformers

Two new S-M audio transformers are now available and chosen for the Quadrode Receiver. Type 240, 3:1 ratio audio provides practically the same characteristics as the famous S-M 220, the largest selling high grade audio transformer, except for slightly less accentuation of notes below 80 to 100 cycles. Type 241 output protects speaker windings and boosts low note reproduction. Used together, a pair of 240's and a 241, provide an ideal audio amplifier in small space, at low cost, and with low power consumption—and they provide the 5000 cycle cut-off so necessary under present broadcast conditions to keep heterodyne squeals and noise at a minimum. Due to their small size, these transformers will fit in almost any of the older receivers, and once installed, will work wonders in tone quality improvement. Size 3 7-16 inches high, 2 1-4 inches wide, 2 5-8 inches deep, weight 2 lbs. 4 oz. each. Price, 240 audio, $6.00; 241 output $5.00.

S-M audio transformers hold the record again this season—for the largest sales in their class—and again for specification for more circuits than any other type.

Do you know that no matter what kind of a set you have, by adding an S-M Unipac you can eliminate all B and C batteries and add power amplification that will give you tone quality obtainable by no other method—not even with the most expensive of the new sets?

The 660-210 push-pull Unipac is a light socket-push-pull 210 power amplifier stage (and receiver B supply) far superior to any other power pack you can buy. It will give from five to fifteen or more times the power you can get from any other 210 power pack—in fact, it is the finest amplifier ever offered. It is priced at $83.25 for the kit.

Then there's the new 660-171A Unipac, a similar model for 112 or 171 tubes that will far outperform ordinary 210 packs, and it also supplies A.C. power for any receiver at all using A. C. tubes. It is priced at $66.00.

The 660-240 Unipac, a two stage amplifier and B supply for any set at all, is the choice of L. M. Cockaday for his LC-28 set, and of Glen Browning for the new two tube Browning-Drake. It is priced at $81.25 for the kit, and uses one 210 amplifier, one 226 A. C. amplifier, two 216B or 281 rectifiers and one 874 ballast tube.

SILVER-MARSHALL, INC.
850 West Jackson Blvd. Chicago, Ill.

If you want all data on the Unipac, the new transformers, and other new S-M developments just drop the coupon below with 10c to cover mailing in an envelope, and we'll send it all to you.

Silver-Marshall, Inc.
850A West Jackson Blvd., Chicago
Please send me all data on the Unipac, new transformers, etc. Enclosed is 10c to cover postage.

Name
Address
speaker operation. The set was equally sensitive when using a loop for the pick-up. Due to the high amplification of the intermediate frequency amplifier a large antenna was found unnecessary. Ten kilocycle separation between stations is very practical. Only when too close to a possible interference is a separation of more than ten to twenty kilocycles necessary to bring in distant stations. Due to the splendid characteristics of the new S-M 240 audio frequency transformers which are employed in this receiver, very little windup is necessary of the radioondes. The music and voice is realized. There is no drummy sound to the music even when stations from a great distance are received. All in all the quality is beautiful.

The highest grade materials available on the market are used in the make-up of this receiver, yet the set can be built for about $90.00 which is within reach of many builders who have found the more expensive super-heterodynes restricted because of the cost in building. This set is unusually compact. With the propped sets, a height of twenty-six inches and longer, the Quadrode Super-heterodyne is a delightful contrast, being only twenty-one inches long, seven inches high and ten inches deep. Nevertheless the parts are not so crowded as to hamper greatest efficiency in operation. This set indeed has a portable feature.

Seven tubes are used, one Voltron double grid tube, five Voltron 201A tubes and one Voltron 171 power tube. The Quadrode in the mixer circuit, four 201A's in the S-M circuit, 1 201A in the first stage of audio—and the power tube, of course, in the last stage. A Yaxley cable plug and connector for the batteries is used making the connecting and disconnecting of the set a matter of seconds.

The schematic wiring diagram is shown in the blue-print, Figure 2. The mixer circuit of a Quadrode tube, the antenna coupler U99 and its tuning condenser C1. This is the in-pit circuit to the tube. Four binding posts are used so that either a wire antenna or loop can be used. If the antenna is used, the ground is connected to G post, and the antenna to A post while the other two binding posts are connected together by a piece of wire completing the circuit from the secondary of the coil to the grid condenser. When a loop is used, the terminals are connected to the two outside binding posts B and L. In the connection between the shorted binding posts is removed thus connecting the loop directly across the tuning condenser C1. If the wire between the upper two posts is not removed, the secondary of the coil will be connected across the loop and interfere with its operation. U100 is the oscillator coupler and C2 its tuning condenser. As can be observed, the plate of the tube is common to both the in-pit circuit (detector circuit), the oscillator circuit, and the first intermediate transformer. In other words, there are three frequencies in this one circuit, the frequency of the station which is desired, the frequency to which the oscillator is tuned, and the beat frequency which is the difference in frequency between the station frequency and the oscillator frequency. The beat frequency is that to which the intermediate frequency amplifier is tuned, namely 112 kilocycles. The pickup coil is entirely eliminated. It is apparent that there is no need for the pick-up coil since all three frequencies are already in the plate circuit of the mixer tube.

To illustrate this we will suppose that WMAQ is desired and condenser C1 is tuned so that the secondary circuit of the antenna coupler will be in resonance with 670 kilocycles (448 meters) than the oscillator condenser C2 must be tuned to 568 kilocycles. These two frequencies combined net a frequency difference of 112 kilocycles which will be amplified to a very large value by the intermediate frequency amplifier, then rectified by the second detector which is incorporated in the S-M 440, and then amplified to any desired volume by the two audio frequency stages. The oscillator condenser is always tuned to a frequency lower by 112 kilocycles than that of the desired broadcasting station frequency. The 0.01 mfd condenser in series with the oscillator tuning condenser straightens the tuning characteristics of this circuit so that the dial readings on the in-pit, or antenna, and oscillator circuit will always be alike. Only on stations lower than 350 meters is it possible to use the "upper setting" or the frequency higher by 112 kilocycles than that of the station frequency, thus preventing repeating of the low wave stations on the upper part of the dial to a marked degree.

The S-M Jewelers Time Signal receiver designed to receive the time signals from NAA on 112 kilocycles works at an ideal frequency for a super-heterodyne amplifier because the two oscillator settings are so wide apart (224 kilocycles). When the oscillator is set to the lower setting and the local station should be 224 kilocycles lower, the possibility of interference is very much reduced because of the great percentage of difference in frequency from that of the station which is desired. If the intermediate amplifier was tuned to half that frequency or about 55 kilocycles, the percentage of interference would be twice as great. Thus the advantage of working on a high intermediate frequency is readily apparent. Each stage of the S-M 440 amplifier is carefully shielded so that no energy is fed from one stage back to another due to coupling between stages and this makes a much higher gain per stage possible than with the usual transformers mounted in a row. Accurately tuned air-core transformers are in each stage. These transformers are all identical so that each stage is tuned to the same frequency making a perfect frequency band pass about ten kilocycles wide.

Amplification and oscillation in the S-M 440 is controlled with a 200 ohm potentiometer which is connected across the filament terminals of the mixer tube. The terminal to the right, number 3, should be connected to the negative lead, and the left hand terminal number 1, should be connected to the positive lead. When the knob of the potentiometer is turned to the right, the grid of the tubes become less positive in potential and the amplification is increased. When the knob is turned to the left, the potential on the grid is more positive and the amplification is increased. When the knob turned to maximum—the extreme right—no positive potential will be impressed on the grids of the intermediate frequency tubes and oscillation in the amplifier will likely result. The maximum amplification is at the point just below which the tubes start going into oscillation. As the amplification is increased by making the grids less positive, the selectivity is also slightly increased, and as the amplification is decreased due to an increased positive potential on the grids, the selectivity of the amplifier diminishes. This is a very desirable characteristic since the quality on local stations will be better when the intermediate amplifier is a little broader. As the amplification is increased to receive distant stations, the selectivity of the amplifier automatically increases, which is very advantageous in cutting through the locals.

By-pass condensers C5 and C6 are quite essential, especially when the set is operated on a "B" battery eliminator. One condenser is connected from terminal B, where the 45 volt lead terminates from the detectors, to the amplifier case, and the other condenser is connected from N on the S-M 440 amplifier to the case. The copper housing is already connected to the negative A terminal inside the amplifier. The second detector in the amplifier is biased by 4½ volts negative. This is used in preference to a grid condenser and leak because with this method a larger out-put from the intermediate frequency stages can be handled without distortion of the music. The out-put of the detector is connected to the two stage audio amplifier.

The new S-M 240 audio transformers which are in no small way responsible for the fine quality obtainable from this
receiver are worthy of some comment here. These transformers have just been placed on the market and we find them especially fine for the use with a super-heterodyne, or any other extremely selective receiver, due to the characteristic of amplifying the very high notes which are to some degree reduced when passing through a very sharply tuned radio frequency amplifier. The higher notes are restored to normal proportions after they are amplified by these two audio stages. The transformers are mounted almost directly against one another without any bad effect due to coupling between transformers.

The grid return of the first audio stage is connected to the negative A battery instead of using a C battery since this tube is not handling any large volume of power. A one volt bias is impressed on the grid by virtue of the voltage drop across the 3A Amperite. The grid of the power tube is connected to minus 45 volts for C bias since this tube handles much more power.

The 200,000 ohm potentiometer is connected across the secondary of the first audio transformer to serve as a volume control. This, incidentally has a stabilizing effect on the audio amplifier. The left hand terminal of the potentiometer, number 3, is connected to the filament terminal of the secondary, the right hand terminal, number 1, is connected to the grid terminal of the secondary while the grid of the tube is connected to the middle terminal of the potentiometer. In this way the volume is increased as the knob of the potentiometer is turned towards the right and decreased as it is turned to the left. The current voltage of all audio transformers is reduced to five volts by the two Amperites 5A and 3A. The four tubes in the S-M 440 amplifier and the double grid tube are governed by the 5A Amperite and the two audio tubes are governed by the 3A Amperite. Filmament rheostats were found unnecessary.

Figure 3 in the blue-print section shows the dimensions for drilling the front and sub-panels. The panels should be first accurately laid out, marked with the center punch and then drilled with a drill so that the holes will line up perfectly. The condensers and two potentiometers, battery switch and dials should be mounted on the front panel first. The 200 ohm Frost potentiometer to the left side, and the 200,000 ohm Frost potentiometer to the right side. The sockets, coils and fixed condensers, cord tip jacks, binding posts and battery plug receptacle should be mounted on the sub-panel before the audio transformers and the S-M 440 amplifier is mounted. The U96 Auto antenna coupler is mounted on the right side and the U100 Aero oscillator coupler is mounted on the left side. The U96 coil should be mounted so that the terminals 3 and 4 face the panel to permit the antenna and ground wires to go through the hole provided for this purpose in the sub-panel. This will line up the other holes for wires automatically. The U100 coil should be mounted so that the terminals 1 and 2 (plate coil) face the front panel and the hole through which the wires are to pass. The parts already mounted should be wired first with leads coming up through the proper holes for the S-M 440 and the two audio transformers before the latter parts are mounted. This leaves more room to work. The long wires underneath the panel may be cabled or run directly from one hole to another. In the accompanying diagrams the wires were run parallel to make a neat appearance. Soldering lugs are not necessary except on the variable condensers. Tinned No. 20 cotton covered wire is used by the telephone company for cabling, makes the wiring job very easy. This wire can be obtained in radio stores and in a variety of colors. The ends of the wires should be skinned and the wires twisted around the screwed terminals then screwed down tightly. Small spring washers beneath all screws will insure permanent connections. Soldering lugs of the type referred to this type of connections. The filament circuits and B and C battery wires leading from the Yaxley battery connector should be wired first leaving the terminals free on the panel to be connected to the S-M 440 amplifier and to the audio transformers. Be sure to wire up the 200 ohm potentiometer so that the right hand side is the negative terminal, making the volume increase as the dial is turned to the right as has already been explained. If the output terminals are reversed, the action will be backwards.

The mixer circuit should be wired next. The binding post closest to the front panel should be connected through the hole made for that purpose to terminals 4 and 5 on the U96 coil and from there to the right hand side of the potentiometer (positive terminal); also terminal 5 should connect to frame of condenser. The wire from the second binding post should be run up through the same hole and connected to No. 3 terminal. The third binding post can be connected directly to No. 6 terminal from the bottom of the panel through provided hole.

It is immaterial as to which grid is used for the input circuit of the oscillator circuit. The grid condenser should be mounted to one grid terminal by bending over one end of lug on the condenser and screwing same onto F grid terminal. The wire from the fourth binding post should be brought up through the hole beneath the grid condenser and connected to the stator plates of the left hand condenser and from there to the top terminal of the grid leak. The .001 series condenser can be connected directly to the stationary plate of the oscillator tuning condenser so that it can be vertically adjusted and the wire can be connected from the bottom of the fixed condenser to No. 6 terminal of U100 coil and from there through the hole in the panel and underneath the panel to the other grid terminal of the mixer tube. The S terminal of the condenser (rotary plate) is connected to No. 5 terminal and from there to the negative terminal of one of the tube sockets. A wire from No. 1 terminal of U100 is run through the hole provided near this terminal along the bottom of the panel and up through the hole near the plate terminal of the mixer tube to P.

A wire is run underneath the panel from No. 2 terminal of the oscillator coil to the edge of the panel. It is brought up through the hole provided for the P connection in the S-M 440 amplifier. The .00025 is connected from No. 1 terminal to negative filament. The center tap of the 200 ohm potentiometer is connected (through the hole directly beneath the terminals) to the N terminal to the telephone system and also connects one end of the ½ mfd by-pass condenser. A lead is connected from the blue terminal of the battery connector (No. 4) through the large hole near the receptacle along the bottom of the panel to terminal B on right side of S-M 440 amplifier. The wire should come up through the same

(Continued on page 20)
FIG. 3 QUADRODE SUPERHETERODYNE

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hole as P wire. To this terminal is also connected one end of the other ½ mfd by-pass condenser. The other ends of the two by-pass condensers are connected together and to a screw in one corner of the amplifier which holds the metal box to the sub panel. A wire is run in the same manner from the 90 terminal of the amplifier to the grey terminal (plus 90) of the battery connection. Two short wires should also be soldered to these two battery and connection terminals, the other ends of which are to be later connected to the audio transformers. The 90 volt wire is brought up on the amplifier end through the same holes as the N wire. From the 4½ terminal of the Yaxley connection (brown) run the wire along the bottom of the panel and up through hole on the out-put side (right side) of S-M 440 and connect to 4½ volt C terminal.

A wire is connected from the green terminal of the battery connector to terminal No. 4 on the second audio transformer. A wire is run from the yellow terminal to one of the loud speaker cord tip jacks, the wire from the other jack to the plate of the last tube. The wires terminating at the transformer soldering lugs are clearly shown in the diagram of figure 2 and can be easily followed without detailed description here as to how they should be run.

The terminal on the right side of the 200,000 ohm Frost potentiometer should be connected to the negative A battery lead which terminates at the Amperites near the front of the panel. On the left side of the potentiometer (looking at the potentiometer from the front of the set) a wire should be run to No. 3 terminal on the first audio transformer. A wire from the center terminal of the potentiometer should run directly across the top of the panel to the first tube socket and connect to the grid terminal. The first audio tube and audio transformer is towards the back of the sub panel. The filament wiring is quite obvious.

As can be judged from the photographs, the finished set looks very neat and business like. When mounted in an attractive cabinet of either a console or table model type, it will hold it's own with the handsomest of receivers and in performance do even more. Any good B battery eliminator will work well. An A eliminator appliance can also be used if preferred to the conventional storage battery. The results obtainable from the Quadrode Super-heterodyne are well worth the effort and money spent in building it. We are sure this receiver will delight thousands of radio fans who undertake to build it.

Accurate blue-print and templates for the Quadrode Super-heterodyne are available through the RADIO AGE office at the price of 25 cents per blue print.

Tuning Up

"Pardon me a moment, please," said the dentist to the victim, "but before beginning this work I must have my drill."

"Good gracious, man!" exclaimed the patient, "can't you pull a tooth without a rehearsal?"

**VOLTRON TUBES**

*The “Heart” of the Quadrode*

The double grid Voltron is the only tube of its kind on the market. With two grids and a common plate the single Voltron replaces what would ordinarily be the first detector and oscillator. The merits of this principle are proven—it marks a most startling advance in tubes and opens possibilities in receiver design never before realized. It makes seven tubes do the work of eight—it makes for increased efficiency in any super circuit.

Voltron tubes are known for their uniformity of manufacture for the absence of the ordinary tube noise—for their handling capacity and for their clarity of tone. Voltrons in any set will make a good set better.

**Complete Quadrode Kits**

A complete tube set exactly as specified for the Quadrode is neatly packed in kit form and may be purchased from your dealer. The tubes included in the Quadrode kit are—

1 Voltron Quadrode tube .................................. $ 4.50
1 Voltron 171 power amplifier ................................ 4.50

5 Voltron super-sensitive 201A amplifiers $1.25 ........ 6.25

$15.25

Voltron tubes are available in all standard types, Oxide filament, 210 super power amplifiers, 216B high power rectifier. Voltron A. C. tubes, types 22 and 72 are guaranteed to give you results that are superior to the battery tubes that you are now using in your set.

Although Voltron tubes are better—standard prices prevail.

**K and H ELECTRICAL CORPORATION**

68 Springfield Ave., Newark, N. J.
These are the AERO Universal Coils

Two Wonderful Inductances

No. 100 AERO Universal Coil (Code U-100) - Price $4.00
AERO Universal Antenna Coupler (Code U-96) - Price $4.00

That Make Possible the Fine Performance of the QUADRODE Superheterodyne Receiver

Described Elsewhere in This Issue

Of course you'll want to build the Quadrode Superheterodyne Receiver featured in this issue of Radio Age. It's a mighty good set—powerful, selective, and possessing wonderful tone qualities.

The AERO Universal Coils used in this circuit are responsible, to a great extent, for the splendid efficiency and fine performance of this receiver. These super-sensitive inductance units are twice-matched, and are adaptable to 201-A, 199, 112, and the new 240 and A. C. tubes.

Patented construction features eliminate losses to the greatest possible degree. You'll find these coils the finest inductances thus far produced.

When ordering parts for the Quadrode Superheterodyne from your dealer, order these AERO Universal Coils by code number.

No. 100 AERO Universal Coil (Code U-100) - Price $4.00
AERO Universal Antenna Coupler (Code U-96) - Price $4.00

Other AERO Kits Employing Supersensitive AERO Universal Coils

AERO Universal Tuned Radio Frequency Kit

Especially designed for the Improved Aero-Dyne 6. Kit consists of 4 twice-matched units. Adaptable to 201-A, 199, 112, and the new 240 and A. C. Tubes. Tuning range below 200 to above 550 meters. This kit will make any circuit better in selectivity, low and range. Will eliminate losses and give the greatest receiving efficiency. Code No. U-16 (for .0005 Cond.) ... $15.00
Code No. U-163 (for .00035 Cond.) ... 15.00

Important Notice

-A New Service

We have arranged to furnish the home set builder with complete Foundation Units for the Improved Aero-Dyne 6, the Aero 7, and for the Chicago Daily News 4-Tube Receiver and the Aero Transmitter. Set drilled and engraved on Westinghouse Micarta. Detailed blueprints and wiring diagram for each circuit included in foundation units free. Write for information and prices.

You should be able to get any of the above Aero Coils and parts from your dealer. If he should be out of stock order direct from the factory.

AERO PRODUCTS, Inc.
Dept. 106
1772 Wilson Ave., Chicago, Ill.
Radio's Newest Receiver

The Quadrode Super

Complete Parts List

<table>
<thead>
<tr>
<th>Part Description</th>
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<tr>
<td>1—Aero Antenna coupler U96</td>
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<td>1—Aero Universal Oscillator coil U100</td>
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<td>2—Camfield 0.0005 S. L. F. condensers</td>
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<td>2—Kurz-Kasch Vernier dials</td>
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<td>1—S-M 440 amplifier</td>
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<td>2—S-M 240 audio transformers</td>
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<td>1—Yaxley on-off switch</td>
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<td>4—X-L binding posts (antenna, ground and 2 loops)</td>
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<td>1—3A Amperite</td>
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<td>1—Carter .00025 condenser with clips</td>
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$92.39

Accessories

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<td>1—Voltron Quadrode tube</td>
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<tr>
<td>1—Voltron 171 power amplifier</td>
<td>$4.50</td>
</tr>
<tr>
<td>5—Voltron super-sensitive 201A amplifiers at $1.25</td>
<td>$6.25</td>
</tr>
</tbody>
</table>

$15.25

Substantial discounts to professional set builders and the trade.

A full line of standard parts and accessories carried. Headquarters for Silver-Marshall Unipacs, Shielded Sixes, Reservoir B, Temple Drum Speakers, Setco A Eliminator, etc.

From us you can get all parts for the new Quadrode Super-radio's latest development—which is described in detail in this issue of Radio Age. Each and every part is most carefully inspected and checked—no substitutions anywhere—each and every item exactly as specified by the designer. It goes without saying that you want to own the Quadrode Super, the first receiving set which makes use of the new double grid tube—seven tubes doing the work of eight and in a more efficient manner.

Orders can be filled on the complete list of parts, complete tube kits and all accessories. All carry the guarantee of Setbuilders Supply Company. Or if you need but an individual part your order will be taken care of in the same prompt, efficient manner.

Our stock and adequate shipping facilities enable us to make immediate shipment either on complete kits or on individual units. Send your order to us or ask us to send you our complete literature.

The Improved Laboratory Super

The sensation of the shows, the set that everyone is talking about. The super in the three to five hundred dollar price class, with tone incomparable, that will bring in distance just as if every night was "silent night." The Improved Laboratory Super will bring in distant stations with loud speaker volume that are barely audible with other receivers. Its selectivity allows the separation of distant stations within ten kilocycles of powerful locals—not occasionally but regularly. No matter where you live the Improved Laboratory Super is the finest set you can build or buy. This set has been endorsed and approved by Radio Broadcast, Citizens Radio Call Book, Radio Review, Popular Radio—in fact, by every prominent authority. Complete parts, including walnut metal panel and pierced steel sub-base, complete $89.45. Send for literature.

SETBUILDERS SUPPLY COMPANY
516 South Peoria Street
Chicago, III.
Camfield Super-Selective "10"

Camfield has again come to the front with a 10-tube super-selective circuit of exceptional merit, possessing many features never before incorporated in a radio receiving set. It is a simplified receiver, having two easily operated drum-dial controls. Another feature is that it may be operated as a six-tube radio frequency set, or as a ten-tube super-selective receiver by the simple turn of a switch on the front panel.

Again the famous Rusco Band Pass Filter in the intermediate frequency amplifier comes to the fore as one of the most remarkable things in radio. This Filter is designed to pass a band of frequencies 10 kilocycles wide. The amplification over this band is uniform and the cutoff on either side is extremely sharp. The result is perfect selectivity between waves bands of only 10-kilocycle separation in the frequency. The uniform amplification over the band maintains perfect tone quality. The selectivity of this device is so perfect that it permits the use of radio frequency amplification ahead of the super and the operation of the set on an antenna, making it one of the most sensitive receivers ever developed. This makes possible the simultaneous increasing of both sensitivity and selectivity to a degree hitherto unknown.

This new circuit embodies all the latest improvements—simplified control by means of two Tyrman Drum Dials, Tyrman Audio Transformers, Camfield Condensers, Rusco Band Pass Filters and especially selected parts to make a perfectly balanced receiver of the highest quality yet available at a very modest price. It is easy to construct and simple to operate and will outperform any radio set you have ever used.

“A Tribute to a Leader”

Camfield Equalume Condensers are the unanimous choice of discriminating manufacturers, jobbers, dealers and builders. There is proof of this in the fact that they are being officially specified in the following circuits for the 1927-28 season:

Camfield Super-Selective 9 and 10.

The Tyrman Ten.
Madison Moore Super.
Madison Moore AC Operated Radio.

Frequency Circuit.

Citizens Super 8.
Camfield Duofomer 7.

On actual demonstration the Camfield Super-Selective 9 will out-perform any other receiver. Its exclusive features mean real service and satisfaction to the man who builds his own. Do not pass up this wonderful opportunity. Set builders in all parts of the country who have built the Camfield Super-Selective 9 are enthusiastic.

We stand back of this circuit and are ready to help you in every way. If you have any special questions regarding this circuit we will welcome a personal call or a letter from you. Either will receive our immediate attention.

Write for free booklet, “Whenever You Require Quality” or get complete parts from your jobber or dealer.

CAMFIELD RADIO MANUFACTURING CO.
35 E. Wacker Drive, Dept. RA, Chicago, U. S. A.
Shielded Grid Tube Announced

THE Radio Corporation of America has finally announced the coming of the shielded grid tube developed some time ago by Doctor A. W. Hull of the General Electric Company. Although the tube was developed almost two years ago, there has been much secrecy about it and it has been kept off the market until now, for some unknown reason. We have been hearing rumors of this wonderful Aladdin's Lamp for some time, and here and there appeared unofficial information regarding same, in various publications, some of them proclaiming this wonder of wonders as "revolutionary." It is true that much can be expected from this really remarkable invention which was originally discovered several years ago by the German scientist, Doctor Schottky. However, the tube was never developed to its full scope until a few years ago by Dr. Hull.

According to an article by Dr. Hull which appeared some time ago in the PHYSICAL REVIEW, the effect of inter-electrode capacities within the tube are practically entirely eliminated by virtue of the additional grid, or mesh, which shields the usual grid from the plate—or plate from the grid if you so prefer to put it. The parasite and bugbear of the radio frequency amplifier, mainly oscillation, which limit the amplification to a low value and cause squealing and some howls with which we are familiar. Where now the amplification for tube (at broadcast frequency) is from 6 to 16 per stage, and the latter only in cases of well shielded and balanced circuits, the new tube affords an amplification from 20 to 35 per stage, depending upon the efficiency of the tuned plate circuit. With the detrimental capacity removed the tube becomes a true one-way repeater with all the complications of balancing out capacities removed. Doctor Hull in his article has found unlimited and undreamed of amplification available with properly shielded stages.

He states that stage after stage of amplification can be effectively added until the amplification is so great that the minute tube noises or "short effect" saturate the last tube. In his experiments with five tubes an amplification of about 2,000,000 was attained. Just imagine, with three stages of amplification at a gain of 30 per stage the total amplification is 18,000, where with the best balanced and shielded three-stage amplifier the gain is less than 3,500; the ordinary three-stage neutralode or unamplified amplifier yields a gain from 1,000 to 1,500. In a super-heterodyne intermediate amplifier, tuned to about 50 kilocycles, an amplification of 75 per stage is quite feasible, Dr. Hull says.

At broadcast frequencies the same number of tuned circuits will still be necessary, that is, three or four to get the selectivity required to cut through local stations in the receiving set. With this sort of grid, tubes in the radio frequency amplifier will not be decreased but the sensitivity will increase many fold with absolute freedom from oscillation. If no great amount of amplification is desired, however, a number of tuned circuits may be used in parallel and fewer tubes used in the amplifier. The super-heterodyne should still reign supreme because of the greater possibility in selectivity and the greater gain per stage.

The new tube will most certainly be food for the experimenter, and of the most delicious variety. The Radio Corporation announces that the tube will be on the market at the end of the present year. The new Radiotron will be known as UX-222. It has a filament, a plate and two grids, in place of the usual three elements employed in our present tube. The second grid is responsible for its high amplification and freedom from oscillation. It is intended primarily for radio frequency amplification (without neutralization or stabilizing resistance) in circuits especially designed for it.

Radiotron UX-222 may also be used as a "space charge grid" tube in audio frequency circuits. It is also useful in other experimental circuits, where a double grid, four element tube can be used.

Quoting Mr. Bucher, assistant vice president of the Radio Corporation of America: "It should be realized, however, that this tube will not bring about any revolutionary developments in the radio industry, nor will it render obsolete the type of sets now in use or being sold. It must be remembered that all of these tubes give greater radio frequency amplification per tube than former type, nevertheless, a certain number of tuned circuits must be used under present day broadcasting conditions to obtain adequate selectivity; therefore, all things considered, the new Radiotron will not necessarily reduce the number of tubes required in a given broadcast receiver."

The new Radiotron has a standard four-prong UX base and differs in external appearance from the ordinary tube by the addition by a small metal cap at the top of the glass housing in the interconnection to the controlled grid, or shield. The filament terminal voltage for this tube is 3.3 volts and the filament current consumption is .132 amperes. A filament resistor makes it usable with a six-volt stored battery. The recommended plate voltage is 135 volts. The shielding grid is connected to the 60-volt tap of the B battery. Instead of transformer coupling direct coupling through a condenser and tuned plate circuit, is used between tubes.

Switching Tubes

In times gone by, the efficiency of a multi-tube receiver could often be greatly increased by switching the tubes around. Some tubes functioned better as R. F. amplifiers while others gave better results as detectors or A. F. amplifiers. By trying all tubes in each tube for each different function in a receiver the most efficient arrangement was readily found. Improved manufacturing methods have now made such switching of tubes unnecessary.

Announce New System

An announcement is made by the DeForest Radio Company, Jersey City, N. J., of the development and perfection of a "fundamentally new system of radio reception." This new system is the conception of and the result of long research by Dr. George A. Somersalo, well known Finnish physicist and former Research Director of the DeForest Company. In an interview, an official of the DeForest Co. stated:

"It is frequently claimed that all fundamental patents relating to radio receiving are owned or controlled by a group of large interests. That this contention is without foundation has been fully demonstrated by the advent of Dr. Somersalo's system."

The Somersalo system, which is controlled by Arthur D. Lord, Receiver-in-Equity of the DeForest Radio Company, provides a fundamentally new method of obtaining radio frequency amplification without infringing any existing patents.

For those who are technically inclined, it may be stated that the Somersalo system, selectivity is obtained by the use of a special form of high frequency tuning filter placed in the antenna circuit ahead of the first tube. The rest of the circuit is tuned, the only variable or adjustable apparatus or values being the rheostats if such method of controlling the filament supply be used.

"Many attempts have been made to construct an efficient and at the same time a selective filter system. These earlier attempts failed because efficiency had been sacrificed at the expense of selectivity. A proper solution seemed impossible until Somersalo made his discovery, making use of a peculiar arrangement of coils in the filter system, which in itself is quite simple. In his system, the signal passes through a group of tubeless filters without any voltage reduction whatever, and is later amplified by tubes.

"An extremely important feature is that the need of neutralization is practically eliminated. It is, of course, necessary to plug in the proper type of grid coupling tube by one of the various well-known methods, not to prevent squealing, however, since there is hardly a tendency towards squealing, but in order to sharpen the tuning if such be necessary. With regard to the other tubes, nothing is needed to suppress oscillations, as there is no oscillation present. This is a very important point of design which eliminates one of the greatest difficulties in set construction."

Automatic Safeguard

Where a rheostat is used to control the filament current to a group of radio-frequency tubes, and thus to function as a volume control, it is a good plan to use an automatic filament control unit in series with the rheostat. The automatic control unit should be the same as would be used if the rheostat were not in the circuit. The rheostat is turned up all the way the tubes will be burning only at their normal temperature and the filaments cannot be overloaded by careless operation of the rheostat.
The Aero-Seven Receiver, which is being featured in the prominent radio magazines and newspapers, is a new tried and tested tuned R. F. circuit, incorporating the most modern radio improvements at a popular price. It is a distinct innovation in a tuned R. F. receiver, utilizing three stages of R. F. and three stages of audio amplification. The coils are wound right around the famous improved Aero Universal Coils, with improved Amsco S. L. tuning 3-gang condenser. S. L. single-control drum dial and the tried and tested parts of other famous manufacturers. Such names as Carter, X-L, Westinghouse, Aero, Amsco and Silver-Marshall assure you of a circuit that is in the final word in perfection.

Distinct features are: the new Hi-Mu tube at input and in R. F. stages, potentiometer control, higher amplification, 10-kilowatt selectivity and true single control. The Aero-Seven has a broadcast range from below 200 meters to over 550 meters (1500-500 kc) and requires no shielding as with the small Aero coils, direct pick-up is negligible and coupling between coils is the very minimum. The coils are twice-matched at both high and low frequencies of the broadcast band, thus eliminating many difficulties in dual dial control and overcoming the principle causes of discrepancies.

The adjustable compensators on the Amsco condensers facilitate the equalization of circuits, solving the major problem of tandem tuning. The extremely sharp selectivity of the Aero-Seven circuit is due to the low resistance of the coils. The high voltage gain per stage, due to the extremely low loss construction, assures extreme distant reception and greatest volume and sensitivity is assured through the high efficiency of the coil windings.

Get the Facts—MAIL NOW—

AERO PRODUCTS, INC.
1768 Wilson Ave., Dept. 711
Chicago, Ill.


New and Unique Hookup

3 Stages of Radio Frequency
3 Stages of Audio Amplification

The Aero-Seven has a new and unique hook-up that incorporates three stages of R. F. and three stages of Audio. There are two stages of tuned radio frequency and a special coupling stage, the secondary function of which is to prevent antenna depolarization, thereby circuit efficiency is increased to a remarkable extent. The combination of the three stages of R. F. and Audio, together with the unique coupling produces an interesting circuit. In the audio stages, the usual parallel tuned circuit is used, one 201A tube and one CX340 tube in the input stage. The CX340 is a single stage tube, which variations contribute to its selectivity, perfect quality, and brilliance volume. The combination of all the various parts, the match of the Aero Universal Coils, together with the Amsco compensated 3-gang condenser, with true single control and potentiometer control, greatly simplifies operation and tuning, while adding efficiency to the circuit.

First Use of New CX340 Tubes—140/10 Better

Utilizing the new CX340 Cunningham tubes in place of the usual 201A, gives the Aero-Seven the distinction of being the first circuit built in the frequency method. CX340 tubes are used instead of the usual 201A tubes, having a 15-1 volt filament and 25 amperes; plate, 160 volts maximum. In this receiver 90 volts is used constantly on the plate for the R. F. circuit, something seldom attempted but effectively worked out here. It is a Hi-Mu tube, having both high amplification factor (150-200) and is used both as a detector and as a radio and audio amplifier. The Aero-Seven is specially designed to operate with this new and better CX340 tube and the results secured will be a pleasing revelation to you. It is surprising what tubes and volume is secured with a minimum use of current.

Resistance Coupled Audio Amplification

Resistance coupled audio amplification in the Aero-Seven attains a quality of reproduction unattainable elsewhere. It is a feature not commonly achieved by Aero-7's 10-kilowatt selectivity.

10 Kilowatt Selectivity—Now a Real Fact

Ten kilowatt selectivity is OPTIMUM Selectivity. It means a receiver that tunes sharply enough to eliminate interference and yet does not tune so sharply as to cause distortion. It is the ideal tuning characteristic. "Optimum tuning," says the engineer, who needs a perfect radio with anything but the best! Why put up with anything but 10-kilowatt selectivity, as represented in the Aero-Seven circuit?

Due to the low-loss construction of the coils and condensers in the Aero-Seven and the direct selectivity introduced into the circuit itself, you get selectivity to sharpness that you cannot get on two-stages at one time under present broadcast conditions, at the same time providing adequate frequency response to prevent high 'out of order' distortions.

Imagine what this means in perfect radio reception. Selectivity, the ability to tune in clearly, sharply, without fear of distortion in getting the station you want whenever you want—it's that something every radio fan has been after. It is an actuality in the Aero-Seven—a feature that is necessarily in an up-to-date circuit—a feature that you get in the Aero-Seven when you build it.

New, Modern, Proved Features in Aero-Seven


Using New 340 Tubes

Battery, Electrical or A C Operation

Unique Features

The Aero-Seven tube receiver assures you of the very latest in radio circuitry. It has such features as a 10-kilowatt selectivity—extreme low resistance and a volume at your command that can be raised to music-level proportion or lowered to silencer whisper. The particular circuit applies amplification for a most remarkable tone. It gives you a receiver that is in a class all its own—a real companion to a complete turn down to a whisper when you want to. It is an actuality in the Aero-Seven—particularly in an up-to-date circuit—a feature that you get in the Aero-Seven when you build it.

An Opportunity for Set Builders

The set builder will find the Aero-Seven, a most profitable receiver to build. It is an extremely simple circuit—efficient, high grade and having a record of exceptional performance. It could hardly be duplicated in a factory-built set at double the cost. You can make his money handling this set for your friends and get a real "kick" out of it yourself. Complete parts, drilled and engraved panels and foundation units are being distributed through the jobbing trade and are available at leading radio stores everywhere. If your retailer cannot supply you, order direct from your dealer's name and we will see that you are supplied promptly.

Complete assembly and operating instructions with complete data is furnished, which makes it both practical and easy to build this circuit perfectly. Build yours early—get the jump on the other fellow. Get the facts. Mail the coupon and the stamps for this valuable booklet. Send today—NOW!
The Aero-Sevew
(Continued from page 9)
The antenna and ground are connected to the two posts at the left of the set and battery connections in the manner marked at the right. It will be noted from the circuit diagram that the —A BAT post is used as well for the —B and +C. The + AMP B BAT post should be supplied from a 180-volt battery for the amplifier and power stages, while the C battery on the power stage will be 35 to 40 volts. The Amsco resistors should be unpacked and inserted in the clips of the Resistocouplers in the order shown in the circuit diagram form, left to right while facing the front panel.

The tubes necessary for the operation of the receiver are as follows: Five UX-240 or CX-340, which are placed in the radio frequency sockets, the detector and the first stage of audio frequency; one UX-201A or CX-301A, for use in the second audio stage; and a UX-171 or CX-371, for use in the last or power stage. Where extra good quality is desired, the second stage should employ a 112 tube rather than the 201A, particularly when receiving loud signals from a nearby station.

In lining up the radio frequency stages, a screw driver should be made from a sliver of wood or bakelite to use on the condenser adjustment. These midget capacities should be screwed all the way out as a preliminary and a station tuned in, preferably on the lower waves. After tuning to maximum volume the dial reading should be decreased ever so slightly. If the signal is a weak one it will disappear by this procedure, while if a strong one it will only be diminished in volume. After this has been done the small condensers are adjusted with the wooden screw driver until the volume is at maximum. In the course of doing this it may be noted that as a perfect adjustment is approached the receiver may oscillate. In this case the potentiometer should be retarded as much as necessary to prevent this and then proceed with the adjustment for maximum volume.

With this adjustment made the receiver is in perfect operating condition over the entire wave band.

Ray: Why do they have most all radio broadcasting stations on top of tall buildings?
Bray: So nobody can throw bricks at the performers.

Independent Directors
Announcement of the permanent board of directors to manage the affairs of the Radio Protective Association—the anti-trust organization of the independent manufacturers—was made after a meeting of the membership at the Palmer House, Chicago, during the Chicago Radio Show. As a result of the growth in the membership, the board was increased from five to eleven members, particularly to give representation to the new members of the association in the East. The new board of directors follows: Harry G. Sparks, Sparks-Whittington Company, Jackson, Mich.
Fred S. Armstrong, Vesta Battery Corporation, Chicago.
H. R. Rose, Shamrock Manufacturing Co., Newark, N. J.
H. Chirelstein, Sonatron Tube Co., New York, N. Y.
L. Mandel, Metro Electric Co., Chicago.
J. Wiechers, Western Coil & Electrical Co., Racine, Wis.
Arthur D. Lord, DeForest Radio Co., Jersey City, N. J.
Alexander Weiss, Marti Electric Co., West Orange, N. J.
Ernest Kauer, C. E. Manufacturing Co., Providence, R. I.
Mr. Armstrong remains treasurer of the association and Oswald F. Schuette, executive secretary in charge of the headquarters at 134 South LaSalle Street, Chicago.

As the decisive step in the battle of the Radio Protective Association against the radio trust, it was decided that the association is to undertake the defense of any dealer or jobber of a member who may be sued for patent infringement by the Radio Corporation of America, or its constituent companies—the America Telephone & Telegraph Company, the General Electric Company and the Westinghouse Company.

Sixty-six representatives of independent manufacturers at the Chicago Radio Show attended the meeting. At a meeting held at the Hotchkiss Hotel, the preceding week, fifty-two were present. The association is only two months old, and its members point to its directorate as proof that as an organization it will have to be reckoned with in shaping the future of the radio industry.

Camfield Super
Selective Ten
(Continued from page 13)
properly amplified and distortion will result.

Building this receiver is a simple task. All parts are laid out with mathematical accuracy in such a fashion that a single centerline passed through a dozen holes. By carefully consulting the diagrams and layouts one cannot go wrong in the assembling.

The wiring is nearly all on the under side of the sub-panel out of sight and out of harms way. Such small parts as are liable to be in the way and may readily be placed in concealed locations are also put here. All connections are soldered and carefully wiped with a rag saturated with alcohol.

The large hole in the panel for the drum dial requires a bit of painstaking work. It may be either cut out on a drill press with an expansion bit, if one is available, or it may be drilled around the circumference and the plug pushed out. Be careful in doing this, or the panel may break in two. Time spent in careful workmanship is never wasted.

To obtain the best of results good tubes must be used. For the radio, intermediate oscillator and first audio, 201-A tubes are used, the two detectors are 200-A, and the last audio a 112. A total of 135 volts plate current is needed, furnished either by B Batteries or an eliminator. If an A Eliminator is used it must be one that delivers parallel feed, for series feed is useless in a super-heterodyne. Though not included in the original plans, an output filter is most desirable for obtaining the highest quality of reproduction.

Test Your Tubes
It is a good plan to have the tubes in a receiver tested after every three or four hundred hours of service. If a receiver is in use an average of three hours per day for instance, it will be worth while to have a service man test the tubes about once every four months, and to replace any that are found to be wearing out. This is particularly important where the receiver makes use of rheostats for the adjustment of the tube filament supply because if a single tube starts to wear out there will be a tendency to make up the decreasing volume by turning the other tubes up higher and the usual result is that several tubes are prematurely worn out, whereas replacement of the one poor tube would have saved the others.

And what do you want for Christmas, little boy?
Youngster—Nothing but a three-step polyphase heterodyne regenerative unit and a reflex inductive oscillatory tube for my radio.
Now a World Chain

International rebroadcasting, heretofore a one-way service from the United States to other countries east, south and west, is now a two way service.

On successive mornings, Oct. 27 and 28, WGY, the General Electric Company station at Schenectady, N. Y., picked up and rebroadcast station 2FC of Sydney, Australia, 9970 miles away. Music carried on the late evening program of the Australian station became breakfast hour music for WGY's audience. The signals started off in the spring-time and reached Schenectady in the fall, but in spite of the difference in season, WGY's audience heard the music from 7:50 to 8:30 a.m. Thursday, which Sydney listeners were getting between 10:50 and 11:30 Thursday night.

In May of this year WGY broadcast a series of early morning programs for Australian and New Zealand listeners. These programs were carried on two short wave stations 2XAF and 2XAD. Martin P. Rice, manager of broadcasting for the General Electric Company addressed the faraway listeners over the air from the greetings of the United States. Five Australian stations picked up the short wave signals and rebroadcast them. Reports indicated that the rebroadcast signal was exceptionally clear and fortunately free from static and fading.

The success of this broadcasting delighted the Australians but left their technical man dissatisfied. The picture couldn't be complete until the courtesy could be returned. A few weeks ago the chief engineer of Amalgamated Wireless Ltd. of Sydney notified the management of WGY that test programs would be transmitted by 2FC on 28.5 meters and they asked the Schenectady engineers to rebroadcast if possible. Dates for test programs were Oct. 25, 27, and 28. Signals on the first morning were unsatisfactory, but Oct. 27, voice and music were coming through so well that WGY went on the air with the rebroadcast entertainment for forty minutes. There was some static and the fading surge was present at all times, but the signal, when present, was never inaudible. Just before the sign-off at 11:30 p.m. Sydney time, a male quartet sang: "The more we are together, the merrier we'll be," and in that song forecast what may ultimately prove the highest mission of radio, the promotion of international understanding.

In transmitting 2FC, WGY has established an American record in rebroadcasting. Two years ago a station of the British Broadcasting Company was picked up in the United States and rebroadcast by WJZ and WGY, but this is as far as rebroadcasting of foreign stations has gone in this country. The signals of the European and other foreign stations were not strong enough for rebroadcasting purposes. Now, however, there is a trend toward the broadcasting wires in other countries. Station PCCJJ of Eindhoven, Holland, is using a short wave station that has reached out well and AGA, a German station working on 14 meters, has been heard occasionally in the United States.

(Continued on page 35)
Transformers

Two additions to last year’s Radio Sensation
The Amazing Achievement in Audio Amplification

Designed to fulfill the exacting requirements of set builders who demand

EFFICIENCY
SENSITIVITY
PRECISION AND
HIGH QUALITY
BEAUTY

The new C-16 and C-26 and C-25 Transformers will work in any circuit and will improve any radio set.

H. F. L. Units Give Wonderful Clear Reception

Engineers acclaim H. F. L. C-16 and C-26 a marvellously efficient Audio Transformer. It carries signals at highest volume and lowest amplitude without blasting or developing harmonics. Operates with all power tubes as well as standard tubes. H. F. L. C-25 Output Transformer handles the voltage output of power amplifying tubes, at the same time matches the impedance of the average speaker to tubes. Protects loud speaker unit without reducing plate voltage.

Mechanical features of these two transformers are: A coil designed and treated to exclude moisture and withstand heavy electrical surges without breaking down—complete magnetic shielding to avoid interstage coupling—terminals brought out so as to insures short leads.

Endorsed by America’s Leading Engineers—Guaranteed by the Manufacturers

Prices

Set Builders—Dealers
If your jobber cannot supply you with H. F. L. Transformers, write us for name of nearest jobber.

Radio Dealer’s Stocks

According to a survey of radio dealers’ stocks just completed by the Electrical Equipment Division of the Department of Commerce, the first of its kind ever officially undertaken returns from 7,842 dealers out of a total of 31,485 indicate that there was an average of 9 receiving sets and loud speakers per reporting dealer on October 1, 1927. “B” and “C” battery’s stocks showed an average of 31 per reporting dealer, in units of 45 volts, and 7 storage batteries for “A” power, whereas eliminators averaged 5 per dealer. Receiving set tubes, not A, C, averaged 63 per dealer, whereas A, C, ones averaged 4. The survey showed that other types of tubes for rectifying purposes averaged 5 per dealer.

A total of 936 jobbers were centralized of which 236 replied. The number of receiving sets per reporting jobber was 373, loud speakers 383, “B” and “C” batteries 1220—45 volt units, Storage batteries 105, eliminators 254, tubes other than A, C, ones 3,140, A, C, tubes 97, and rectifying tubes 171, all per jobber.

Herewith is a table showing combined dealers and jobbers stocks, actually reported:

(1) Receiving Sets No. on Hand
(a) Radio Receiving Sets without accessories, for operation ........................................................ 153,817
(b) Radio Receiving Sets wired for A. C. operation not including power supply......................... 9,498

(2) Loud Speakers
(a) Loud Speakers only ................................................... 153,001
(b) Loud Speakers with associated power amplifier .......................................................... 5,018

(3) Batteries
(a) Dry "B" and "C" Batteries in terms of 45 volt units .......................................................... 534,721
(b) Storage Batteries not associated with trickle chargers .................................................... 77,143

(4) Socket Power Units
(a) "A" Socket Power Units using storage battery ................................................................. 15,560
(b) "A" Socket Power Units not using storage battery .......................................................... 7,503
(c) "B" Socket Power Units with or without "C" ................................................................. 51,979
(d) "A" and "B" Socket Power combined units with or without "C" ........................................... 26,237

(5) Vacuum Tubes (Receiving)
(a) Tubes designed for operation from 6 volts D. C. .................................................. 1,008,278
(b) Tubes designed for operation from 4 volts D. C. .................................................. 230,053
(c) AC Tubes (either heater or filament type) ........................................................................... 52,147

(6) Rectifying Tubes or Units
(a) High voltage tubes or other rectifying units for "B" power supply .................................... 58,070
(b) Low voltage tubes or other rectifying units for "A" power supply ................................... 18,546

Details by states will be available later.

SUPERS IN DECEMBER
Read the December issue of Radio Age for another extensive group of how-to-make articles on the latest supers.

H. F. L. Facts

H. F. L. Units have been used, approved and most highly endorsed by Radio News, Citizens’ Call Book, Radio Review, Radio Age, Radio Engineering, Radio Mechanics, Chicago Evening Post, the Daily News and others. Thousands of engineers and fans, who have turned to H. F. L. Units for better reception, hail them as the finest transformers known to Radio—excelled for Power, Selectivity and Purity of Tone.

Perfectly matched, skillfully designed, carefully made, rigidly tested—in a word, H. F. L. transformers are technically correct to the minutest detail.

All H. F. L. transformers are designed for baseboard mounting or invisible subpanel wiring—each unit is enclosed and sealed in a genuine bakelite molding.

H. F. L. Units are easily connected into the assembly, simplify set construction, and make a beautifully finished job.

H. F. L. C-16 and C-26 Audio Transformers and C-25 output Transformer —New companions of a Great Unit, will work in any circuit and improve any radio set.

HIGH FREQUENCY LABORATORIES
133-U NORTH WELLS STREET
CHICAGO, ILL.

Please Mention Radio Age When Writing to Advertisers.
Best Hookups—Thirty Cents Each!
We have laid aside a limited number of back issues of RADIO AGE for your use. Below are listed the best hookups and diagrams to be found in them. Select the ones you want and enclose 30 cents in stamps for each one desired.

March, 1926
- Improving the Browning-Drake.
- Rheostatless Tubes in a Set.
- How to Make a Wavemeter—Blueprint.

May, 1926
- Short Wave Transmitter—Blueprint.
- Simplifying Battery Charging.
- Protecting Your Inventions.

June, 1926
- Simple Crystal Set.
- Golden Rule Receiver—Blueprints.

August, 1926
- Receiver, Transmitter and Wavemeter.
- Beginners 200 mile Crystal Set.
- Changing to Single Control.

September, 1926
- How to Make a Grid Meter Driver.
- Short Wave Wavemeter.
- Power Amplifier for Quality (Blueprint)

October, 1926
- Crystal Control Low Power Transmitter (Blueprint).
- Raytheon Design for A B C Elimination
- What Type Loud Speaker to Use.
- Nine Tube Super Brings Back Faith.

November, 1926
- Blueprints of the Henry-Lyford.
- Worlds Record Super With Large Tubes.
- How to Use a Power Tube in Your Set.

December, 1926
- Starting Radio with Crystal Set.
- Six Tube Shielded Receiver.
- Types of Rectifiers Discussed.

January, 1927
- Full Data on Worlds Record Set.
- Dual TC Receiver.
- Clough Super Design.

February, 1927
- Building the Hammarlund-Roberts.
- Making a 36 Inch Cone Speaker.
- Browning Drake Power Operated.

March, 1927
- Ideal Model Worlds Record Super.
- Building the Hammarlund-Roberts.
- Ridding Supers of Repeat Points.
- Loop and Four Tubes.

April, 1927
- Inexpensive B. Eliminator.
- One Spot Superhet.

May-June, 1927
- Complete Trouble Shooter for Supers.
- Nine Tubes for Worlds Record Super.

July-August, 1927
- Building Vacuum Tube Voltmeter
- Low Power Crystal Control Transmitter.

September, 1927
- New A. C. Tubes in a Six-Tube R. F. Receiver
  (blue prints.)

October, 1927
- The Thompson Super-Seven.
- The 1926 Infradyne.
- New World's Record Super-Ten.

Radio Age, Inc., 500-510 N. Dearborn St., Chicago
1928 Nine-in-Line Super Heterodyne

(Continued from page 11)

The oscillator tube is the seventh tube to the right. The oscillator coupler L430 is between the two variable condensers and the choke coil H425 is mounted between the two audio transformers. The following tube is the first detector.

The first two transformers are of the iron core type H210 designed for the purpose of amplifying only while the third and fifth transformer are of the air core type tuned to about 37 kilocycles. The third, fourth, fifth and sixth tubes in the diagram are the intermediate frequency amplifier tubes. The seventh tube is the second detector. The combination of the iron core and air core transformers yield a comparatively high amplification and allow a frequency band to pass of not more than 10 kilocycles. The eighth and ninth tube are the audio frequency amplifier tubes and C16 transformers are the associated audio frequency transformers. C25 is the out-put transformer which prevents the plate current in the last tube from flowing into the loud speaker and possibly injuring the winding. A 4½ to six volt bias is impressed on the four intermediate stages second detector and first audio frequency amplification stage, while a bias of 4½ volts additional is put on the last tube if it is of the 112 type of tubes with a 135 plate voltage, making the total bias on the last tube about 9 volts. However, if the 171 type of tube is used in the last stage, 180 volts of plate voltage, a 45 volt C battery should be used connecting the positive side of the B battery directly to the negative A battery. This is recommended in preference to the 112 type. The center tap of the loop is

Sub-Panel templet for 1928 "Nine-in-Line".
connected to the filament terminal of the first detector tube. No grid condenser and leak is used in the first detector circuit. The oscillator grid return is connected to the positive filament. An Amperite R4 is provided to maintain the filament of the last two tubes at 5 volts.

Twenty-two and ½ volts of B battery are used on the oscillator and first detector, 67 volts on the second detector and 90 volts on the intermediate stage. The 112 tube is used, 135 volts can be applied to the first stage audio tube as well as the last stage. However, if 180 volts are used for the 171 type of tube this should be impressed on the last tube only and 90 volts or 135 volts on the first audio tube.

Some of the by-pass condensers in this set are of more importance than they may appear at a glance at the circuit diagram. The .0005 mfd fixed condenser connecting from the plate terminal of the detector tube to the minus filament terminal, for instance, is quite necessary. This condenser changes the impedance in the plate circuit of the first detector tube so that the detector tube will not oscillate uncontrollably. Leaving this condenser off is sure to cause whistles and instability on the lower part of the wave length band. The .0405 midget condenser is the feed-back condenser to control regeneration in the loop circuit. This device provides greater sensitivity and at the same time will help to sharpen up loop tuning because of the regeneration present. This condenser is mounted on the sub-panel since it requires adjustment only once at about the center of the wave length.

The .002 condenser across the primary of the first audio transformer provides a low impedance path for the radio frequency component in that circuit. One mfd condenser is connected from the B battery terminal, 90 volt, to the negative filament terminal to prevent radio frequency passing through the B battery. The 6 ohm rheostat which has the switch mounted to it is marked “FILAMENT” in the center of the panel, and controls the filament current to the four amplifying tubes. The amplification of the intermediate stages is regulated by increasing or decreasing the current going through the tube with the variations produced by the rheostat when it is turned one way or the other. The other 6 ohm rheostat “Sensitivity” on the right hand side of the panel, controls the two detector and oscillator tubes. The 200/300 ohm Hi-Voltage rheostat controls the volume control and is connected directly across the secondary of the first audio transformer. This is marked “VOLUME” on the extreme left hand side of the panel. The in-out resistance is the first audio tube, is increased or decreased with this resistor and the out-put from the speaker accordingly regulated. When resistance is at the maximum the out-put is greatest and when resistance is at minimum the out-put is very low. The filament voltage is automatically switched on when the rheostat “Volume” is turned from minimum towards maximum. The theoretical function of this super is practically identical with any super-heternodyne of this type in use and today is common knowledge to most radio fans.

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SUPER S IN DECEMBER

Read the December issue of Radio Age for another extensive group of how-to-make articles on the lat-est supers.

Please Mention Radio Age When Writing to Advertisers.
so we will not discuss it here.

The photograph (Figure 1) is a very clear picture of the set as it looks when complete. The three cord tip jacks on the right are for the loop while the three jacks on the left are for the C battery; the two in the center of the panel to the right are for the loud speaker. The cable plug receptacle is visible beneath the panel to the left. This makes it a simple matter to connect or disconnect the receiver from the battery and loop. The knob to the right is the midget condenser control for regeneration. All the wiring is beneath the sub-panel, only the wires connecting the dial lamps are visible.

In tuning the set, rotate both dials at the same time so that the numbers will be almost alike. In tuning for distant stations, the sensitivity control should be turned almost completely to the right or maximum and left that way until later on. The center knob or "FILAMENT" control should be turned to the right until the set oscillates which is indicated by whistles or other noises. Slowly rotate the oscillator dial and follow the wave-length dial so that both dials are in resonance which can be noticed by the hissing noise. When the dials are out of resonance, the hiss disappears. Once the set is logged it will remain so permanently. Until the log is complete, the tuning should be done very slowly as otherwise stations will be passed over unnoticed. After a distant station is tuned in, adjustment should be made on the midget condenser, which until now should have been so

<table>
<thead>
<tr>
<th>List of Parts for 1928 &quot;Nine-in-Line&quot;</th>
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<td>2—H. F. L. Transformers No. H215</td>
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<tr>
<td>2—H. F. L. Transformers No. C16</td>
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<td>2—Relmier .0005 mfd. Variable Condensers</td>
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<td>2—Carter 1 mfd. By-pass Condensers</td>
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<td>1—Carter .0005 mfd. Fixed Condenser</td>
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<tr>
<td>1—Carter 6 ohm Rheostat with Switch</td>
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<td>8—Carter Cord tip jacks</td>
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<td>1—Celeron 6&quot;x24&quot;x3/16&quot;Drilled</td>
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<tr>
<td>1—Sub-Panel</td>
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<tr>
<td>5—6 Amperite</td>
</tr>
<tr>
<td>30—Feet Acme Celeste Wire</td>
</tr>
<tr>
<td>1—Package Kester Radio Solder</td>
</tr>
<tr>
<td>Miscellaneous Lugs, Screws, Nuts, etc.</td>
</tr>
</tbody>
</table>

Panel Templet of 1928 "Nine-In-Line".

set that the plates are completely out of mesh. This condenser should be adjusted preferably on a station around 300 meters. If oscillations occur in the detector when the dials are retuned, the midget condenser should be again adjusted to the point where oscillation ceases and the signals are at their maximum intensity. After this the SENSITIVITY control can be adjusted for best results and then left that way. Any given station can be tuned in at two positions on the oscillator dial amounting to a frequency difference equivalent to the B frequency which is in this case about 37 kilocycles. That is, the two positions at which a station can be tuned in are twice 37 or 74 kilocycles. Some times a given station will come in better at the upper setting than the lower setting or visa versa, due to interference on either one or the other of the settings. Several hours of experimenting will soon lead to skillful handling of the dials.

Chicago Radio Fan Hears
Australia in Midsummer

Chicago, Ill.—"It can't be done—but here it is," says Virgil C. Zeis, of 106 S. Thatcher Avenue, Riverforest, Illinois, as he produces his verification of reception from The Westralian Farmers Limited, relating to the reception of Radiophone 6WF, located at Perth, Australia. The reception was accomplished in the wee small hours of the morning on June 25th, proving that the early bird with a good set gets the long distance stations.

Mr. Zeis uses a superheterodyne in his radio prowling around the globe, in which he has included a number of his own ideas. He has built the circuit around the World's Record Super transformers more generally known as Selectone R-410 and R-400, which are manufactured by the Scott Transformer Company.

In a recent letter to Mr. E. H. Scott, the designer of the Selectone radio transformers, he says:

"Dear Mr. Scott:

"I feel sure that you will be interested to know that the receiver I am using, which employs your transformers, is performing wonderfully. I have just received verification of reception of 6WF at Perth, Australia, on the morning of June 25th, 1927. This station came in with sufficient volume to be heard all over the downhillers of a big house.

"He climaxes his letter with the modest mention, "I have also received Station JOCK at Japan, and am present waiting for verification of this reception."
Now a World Chain  
(Continued from page 29)

WGY is known throughout the world as a result of rebroadcasts of its short wave stations. Perth, Australia, over 11,000 miles away, and Schenectady stations and rebroadcast. Last winter a half hour from WGY was a program feature of the British Broadcasting Company every Tuesday night for several weeks. Stations in South America, Germany, Spain and France have all carried WGY’s programs. So well known is the reliability of 2XAF and 2XAD’s signals that cables are generally received when sporting events of international interest are planned. On the eve of the Dempsey-Tunney and Dempsey-Tennant fights, 2XAF was asked to broadcast these features. Men in the service, Army or Navy, have already written WGY from distant posts, requesting that the Army-Navy football game be carried on short waves. Three polar expeditions reported receiving the Dempsey-Tunney fight story via 2XAF.

Engineers of WGY are hopeful that the management of 2FC may be interested in carrying a special program for the United States at an hour when more listeners will find it convenient to be at their radio sets. This would mean that Australia must start its program about 6:00 a.m.

Linked Broadcasting

One chance of relief from the present overcrowded situation of the radio broadcasting stations in the United States was indicated by O. H. Caldwell, Member of the Federal Radio Commission for the Eastern District, at a meeting of the New York Section of the American Institute of Electrical Engineers in October. The plan is to have a number of the broadcasting stations use the same radio wave for the same program. There is a growing tendency for broadcasting stations to operate in “chains,” a number of stations being connected by long-distance telephone wire so that all broadcast simultaneously a program coming from the same studio. On one recent occasion as many as 87 stations, in all parts of the country were thus linked together. Such linked stations now use different wavelengths, so that the ether over the United States is apt to be clogged with the self-same program material.

One wavelength would be enough, for then anyone who wanted that program could tune in on that wavelength and receive any one of the stations in the chain broadcasting it. The chief difficulty in arranging this is the technical one of keeping all of the stations exactly on the same wavelength. A very tiny variation would spoil the result, as the stations would then interfere with each other. The problem is not unlike that of an orchestra leader, who must see to it that all the musicians under his baton are playing in exactly the same key. Mr. Caldwell believes, however, that this technical difficulty will soon be solved.

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Enesco Ad. No. 309-O. V. 1927

Please Mention Radio Age When Writing to Advertisers.
Short Wave Receiver
(Continued from page 6)

bus are needed. There is no advantage in square bus other than it is rigid and stays where it is put. Often the capacity of these wires has a material effect on signals. If flexible wire is used, a slight jar will be sufficient to completely throw the circuit out of resonance, degrading the calibration.

Use nothing else but rosin core solder and flux. A bad connection is a greater cause of trouble than a bad aerial. It is possible to remove one coil from the socket and place another in in less than three seconds, giving an almost instantaneous shifting of wave bands.

A single primary coil is used which will easily fit any existing aerials. This is mounted on a pivot so it may be rotated to vary the coupling. The primary circuit is not critical, but many operators find that by using a primary condenser they are able to increase the volume of signals and add to the sensitivity of the set. The aerial is used for both the broadcast and short wave receivers, then the condenser has to be employed. Any old one you happen to have on hand will be good enough.

In order to regenerate the radio frequency current must be fed from the plate into the feedback coil. By consulting the diagram one will see that there is a choice of two channels, the other one through the amplifying transformer. This latter course is most undesirable so prevent it from occurring entirely the condenser choke must be used. This choke must be small and compact. It successfully retards all tendency of wide frequency current to pass but allows the B potential to reach the plate without loss. If code signals are especially desired a high ratio transformer must be used. One of six to one ratio will give greatest volume and plenty of distortion. This is advisable for it is often necessary to distort a signal to make it stand clear of a background of static or other interference. If music and voice is wanted most then a regular broadcast transformer is desirable. On 90 volts a 4½ volt bias is used. It is not advisable to use a higher plate voltage than this. As this receiver is designed primarily for headphone use one of amplification is included. Loudspeaker reception on short waves has been as a rule a bit unsatisfactory for signals are so sharp it is quite hard to tune in.

In connecting the batteries to the receiver plug it is wise to lock the set properly. If possible, cabinets are not much good for they interfere with the receiver. It sounds rather queer to the uninitiated, but a set of this nature will tune in a full fifteen meters lower on the largest coil when out of a cabinet than when in it. Opening the lid of the cabinet changes the tuning five meters. If the receiver must be housed, place it within a grounded metal case. Now to get back to the batteries. On short waves every piece of wire in the circuit acts as a miniature aerial. If the battery leads amble all over the room they are liable to set up some interference. An eliminator is no good, for the hum cannot be ironed out on wavelengths longer than forty meters.

The operations of this set is similar to the old style regenerative receiver, only a lot sharper. Once tuned it is fairly easy, the regenerative condenser being far from critical. If the tuning is disturbed when this condenser is swung it is a sign that the receiver is not functioning properly. Also while on the subject, no signals should be heard when the aerial and counter-}

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terpose are disconnected unless set is inductively coupled to them in the same way. Signals with the aerial off are positive proof that the set has too much wire in it. On twenty meters every Ford with in 200 feet will be distinctly audible, and at times are quite objectionable. No other car save certain trucks have any effect. From what the laboratory this receiver picked up signals from the Philippines, Syria and Czechoslovakia, not to mention numerous stations in America. Since that time we have logged every continent but Africa and expansion of signals to other parts of the world have been conducted by telegraphic, that is, code.
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Correct List of Broadcast Stations

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KELW  Earl L. White, Burbank, Calif. 229
KEX  Western Broadcasting Company, Portland, Ore. 222
KFAF  Nebraska Buick Auto Co., Lincoln, Neb. 309
KFAI  Electrical Equipment Co., Phoenix, Ariz. 273
KFBB  Independent School Dist., Boise, Idaho 227
KFAB  F. A. Engstrom Co., Havre, Mont. 275
KFBK  W. Z. Azbill, San Diego, Calif. 248
KFBK  Sacramento Bee, Sacramento, Calif. 535
KFLB  Leese Bros., Everett, Wash. 224
KJBS  School District No. 1, Trinidad, Colo. 238
KFBU  Radio Thomas, San Antonio, Texas 247
KFCB  Nelson Radio Supply Co., Phoenix, Ariz. 244
KFCR  Santa Barbara Broadcasting Co., Santa Barbara, Calif. 211
KFKD  Magnolia Petroleum Co., Beaumont, Texas 375
KFDX  First Baptist Church, Shreveport, La. 236
KFDY  South Dakota State College, Brookings, S. Dak. 394
KFDZ  Harry O. Iverson, Minneapolis, Minn. 216
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KHEL  Eugene P. O'Fallon, Inc., Denver, Colo. 248
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KFGO  North Central High School, Spokane, Wash. 246
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KFLR  Ashley C. Dixon College, Portland, Ore. 208
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KFKU  The University of Kansas, Lawrence, Kans. 254
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KFLX  George Roy Clough, Galveston, Tex. 270
KFMN  Morningside College, Sioux City, Iowa 441
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KFNF  Henry Field Seed Co., Shenandoah, Iowa 270
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KFOY  Beacon Radio Service, St. Paul, Minn. 285
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KFPN  The New Furniture Co., Greenville, Texas 321
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The Melody Ship

And now comes the unexpected—A loud speaker that is really pleasing to look at. Perhaps it may be considered rash to speak of the loud speaker as a thing of beauty, but the Melody Ship is an object that combines the great advantage of a utility with its handsome design.

The Melody Ship is a new loud speaker. To all appearances it is a beautiful ship model handsomely decorated, sails of an intricately net work of rigging, rope ladders, and rigging that seem to wander aimlessly amongst the sails and masts.

On close observation one will notice that the decorated main sail is the diaphragm of a loud speaker. Behind the diaphragm one will see a loud speaker unit fastened to the main mast. Two slender wires running from the unit is the only indication that the ship is anything but an excellent replica of a historic vessel. The evolution of the loud speaker has been from the horn type to the cone type, the most advanced change in loud speakers. The cone type because of its large diaphragm and peculiar construction of the reproducing unit has a wider tonal range than the horn type. Following the development of the cone speaker much attention has been given to combining beauty with tone quality.

With this idea in mind which provides a loud speaker which would be beautiful both to the eye and ear, J. E. Sanders, an engineer of the Miniature Ship Models, Inc., of Philadelphia, has developed such a practical instrument after many months of experimentation. The reproducer which he called the Melody Ship is both unique in its design and beautiful in appearance. He has reproduced a number of the most historical ships of many centuries ago and incorporated with them the melody sail. The ship is made entirely of wood which is a distinct aid to toning quality and eliminates counter vibrations which cause distortion. Every ship is a material aid in catching the vibration of the speaker and enriching the tone quality.

The development of the Melody Ship was not merely an accident. Many months of diligent labor and experimenting were spent before Mr. Sanders arrived at the present degree of perfection. Many difficulties had to be overcome in shaping the diaphragm to conform to the shape of the ship's sail. Even the seemingly insignificant joining together of the seam in the diaphragm presented almost insurmountable obstacles. It was found that the different tone qualities resulted from the manner in which the melody sail was placed on the ship.

When Mr. Sanders developed the Melody Ship he did so with the idea of using it solely for his own use but the novelty of the idea met with such instantaneous approval that he incorporated it with the ship models that he was manufacturing in the knock down form.

It is a very simple matter to build one of these radio loud speaker ship models in a few hours. The building of ship models has become so simplified that small boys and even small girls are building them in all parts of the world. The knock down system of building by which the
Paralysis of Tubes

Vacuum tubes, in use today, for the most part, have so-called thoriated tungsten filaments, the accuracy of which, even at this late date, is not fully appreciated by the average listener.

The electronic emission of the thoriated tungsten filament, according to S. Ruttenberg, Chief Engineer of the Radiall Company, depends upon the presence of a layer of thorium atoms on the outer surface of the filament. It will be noted that, unlike the oxide-coated filament found in some tubes, the thoriated tungsten filament is not merely thorium-coated, but it is permeated throughout its entire mass with the rare element thorium. During the normal operation of such a filament, the thorium on the outer surface is gradually evaporated, reducing the emission current and, if permitted to continue, rendering the tube short-lived.

However, while the heat of the filament serves to evaporate the thorium particles on the surface, it is also boiling fresh thorium particles out of the mass and up to the surface. Thus the surface is being continually replenished. Just so long as the filament voltage is not increased beyond 10 per cent above the rated value, this evaporation and replenishing process continues at an equilibrium rate, so that a constant layer of thorium is maintained on the surface.

When subjected to an over-voltage on the filament, however, the evaporation becomes excessive, so that the tube accordingly becomes more or less paralyzed. Operating these tubes at sub-normal voltages is also liable to paralyze them slowly, as the filament temperature is then so low that the process of boiling out the thorium from the interior of the filament becomes abnormally retarded. Hence it is important that the thoriated tungsten filament tubes be operated strictly at their rated voltage, by means of hand rheostats with an accurate voltmeter, or, better still and simpler, by means of amperites, the self-adjusting rheostats.

SUPERS IN DECEMBER

Read the December issue of Radio Age for another extensive group of how-to-make articles on the latest supers.

[Image of advertisement for Citizens' Radio Call Book]
The 1928 Sensations!

8 Tube 1 Control

All Electric
Or Battery Operation

AGAIN Marwood is a year ahead — with the Radio sensation of 1928 — a low price that smashes Radio profiteering. Here's the sensation they're all talking about — the new 8 Tube 1 Control Marwood. Here's the lowest price Marwood has ever sold a Radio for — only $69. All Electric operation — price far below that of smaller, less powerful Radios. Big discount to Agents from this price. You can't beat this wonderful new Marwood and you can't touch this low price. Why pay more for less quality? To prove that Marwood can't be beat we let you use it on 30 Days Free Trial in your own home. Test it in every way. Compare it with any Radio for tone, volume, selectivity, beauty. If you don't say that it is a wonder, return it to us. We take the risk.

New Exclusive Features
Do you want sound to fill all volumes enough to fill a theatre? Do you want amazing distances that only super-power Radios like the Marwood can get? Do you want ultra-selectivity to cut out interference? Then you must test this Marwood on 30 Days Free Trial. An amazing surprise awaits you. A flip of your finger makes it ultra-selective—or broad—as just as you want it. Every Marwood is perfectly BALANCED—a real laboratory job. Its simple one dial control gets ALL the stations on the wave band with ease. A beautiful, guaranteed, super-efficient Radio in handsome walnut cabinets and consoles. A radio really worth double our low price.

Buy From Factory—Save ½

Why pay profits to several middlemen? A Marwood in any retail store would cost practically three times our low direct-from-the-factory price. Our policy is high-quality plus small profit and enormous sales. You get the benefit. Marwood is a pioneer, responsible Radio, with a good reputation to guard. We insist on the best—and we charge the least. If you want next year's improvements NOW—you must get a Marwood—the Radio that's a year ahead.

AGENTS

Make Big Spare-Time Money

Get your own Radio at wholesale price. It's easy to get orders for the Marwood from your friends and neighbors. Folks buy quick when they compare Marwood quality and low prices. We want local agents and dealers in each territory to handle the enormous business created by our national advertising. This is our most important and big season demonstrating at home. No experience or capital needed. A Marwood will pay you. The biggest season in Radio history. Everybody wants a Radio. Get in now. Rush coupon for 30 Days Free Trial, beautiful catalog, Agents Confidental Prices and Agents New Plan.

MARWOOD RADIO CORP.
5315 Ravenswood Ave.
Dept. B-3
Chicago, Ill.

Get Our Discounts
Before Your Buy a Radio

Don't buy any Radio 'til you get our big discounts and catalog. Save half and get a Radio that IS a Radio. Try any Marwood on 30 Days Free Trial at our risk. Tune in coast to coast on loud speaker with enormous volume, crystal clear. Let your wife and children operate it. Compare it with any Radio at your store. If you can get as good a radio for half the price of Marwood for one of the biggest season in Radio history. Examine Marwood Free. Free catalog, Agents' New Plan.

AGENTS

Has Complete A-B Power Unit
A REAL ALL ELECTRIC Radio with one of the best 8-A-B power units on the market—no better ones needed—at the world's lowest price. This Marwood can't be recalled at ANY price. If you have electricity in your home, plug into the nearest outlet and forget batteries. No more battery trouble and expense. Costs less than 2¢ a day to operate. Always have 100% volume. ALL ELECTRIC Radios are high priced because they are new. We cut price to the bone and offer a $23.00 outfit for $9.95 retail. Big discount to Agents. Don't buy any Radio till you test all of this sensational new ALL ELECTRIC Marwood.

Rush for Free Trial

MARWOOD RADIO CORPORATION
5315 Ravenswood Ave., Dept. B-3, Chicago, Ill.
Send Agents' Confidential Prices, 30 Days Free Trial, New Catalog and Agents' New Money Making Plan. No obligations on our part.

Name __________________________
St. or RFD. ______________________
City ____________________________
State ___________________________
Radio A Continuous Story

In order to get the most out of his radio magazine the reader should follow it issue by issue, for the reason that many of the more important constructional articles partake of the character of serials, covering the development of a circuit. For example readers probably will not want to miss future articles on the Quad- rode Superheterodyne.

Comprehensive articles on other circuits will be starting in the December issue. The set builder should get the original articles so that he can follow the circuits through their various stages.

Give your order for the December issue to your dealer now or, better still, send $2.50 in stamps, money order, or registered currency remittance for a year's subscription.

RADIO AGE
500 North Dearborn Street, Chicago, Ill.
10,144 Mile Reception with a Subantenna

10,144 miles—and the music came in loud and clear! Mr. J. O. White residing at 217 Wyckoff Ave., Brooklyn, New York, established the world's distance record for reception within the B.O.L. band of 200 to 550 meters by tuning in 2FC and 3AR Australia with a simple six tube tuned radio frequency set—and a Subantenna. Think of it! 10,144 miles, and reception that was not only audible—but loud, crystal clear, enjoyable music and song that Mr. White listened in on for some time before turning it out and seeking other far away stations. The results obtained by Mr. White prove the distance getting capabilities of Subantenna beyond all doubt.

For Mr. White writes that during his tests neither 2FC nor 3AR could be heard on a two hundred foot up-in-the-air aerial, but the instant that he switched back to Subantenna, either station came in clearly.

Ground Waves are Practically Static-Free—That's Why Subantenna Gives Greater Distance and Clarity

The same radio waves that you have always taken out of the air, also travel through the ground. The only difference between the air and ground components of the broadcast wave is that the latter is practically static free, while the air component is always accompanied with static or noise of one kind or another. Scientists have long recognized this fact, and knew that if some device could be perfected for the reception of ground waves, clear, loud, long distance reception would be a reality for the owner of the modest three or four tube set as well as for the possessor of the larger, more powerful set. Subantenna is the answer—tried, tested and proved by thousands of owners of all kinds of sets, and recommended to you by such leading radio laboratories as Radio News, Popular Radio, Radio Digest, and others.

Free Circuit Diagram

The Circuit Diagram of the set with which Mr. White tuned in Australia—10,144 miles away—on a Subantenna, will be sent FREE to anyone who mails coupon from this announcement.

Try It On Your Set FREE

Install Subantenna. Leave your old aerial up. Select a bad night when DX is almost impossible with the ordinary aerial. Make a comparison on your station, connecting first your aerial, then Subantenna. If, from stations that are just a memo of jumbled noise with the old aerial, you don’t get reception that rivals loud and clarity the instant you switch to Subantenna, this test won’t cost you even a single penny. Obtain a Subantenna from your dealer or send coupon at once for scientific explanation of Subantenna and for particulars of GUARANTEE and FREE TRIAL OFFER.

CLOVERLEAF MANUFACTURING Co.
2713-K Canal Street - CHICAGO, ILLIN
Please Mention Radio Age When Writing

Other users get greatly increased distance

Cuba—also South America

"To show you that, I received a program from Station PWX in Havana, Cuba, I enclose herewith a verification card from that station. On January 31st I received a program on my set broadcasted from Buenos Aires, South America, at 10:15 in the evening. Many other long-distance stations have been heard on my set after installing the Subantenna. I never could receive such distance on my outside antenna."—W. C. F., Chicago.

More Stations—No Static

"I get plenty of stations with my Subantenna, on the hoof speaker, that I have never been able to reach with my outside aerial. It absolutely cuts down interference to the minimum, cuts static out too—not just partly out—but ALL out."—H. S. M., North Carolina.

Results—Almost Unbelievable!

"After years of trying I was at last able to receive stations in the Subantenna. The first night I used it was a very hot summer night. Static was very bad on my outdoor aerial. I connected my Subantenna and one could hardly believe the results. It was wonderful."—F. L. C., Massachusetts.

Says "Static Is No More"

"I have received the Subantenna. My error at the start, STATIC IS NO MORE, I am now well satisfied. I can tune in stations I could not hear, even though I had long aerial."—E. F. Kansas.

Confirmation letter from IAR, Melbourne, Australia

Mr. JOHN WHITE of Sydney, Australia has tuned in Australia with a tube set and a Subantenna

Confirmation letter from 2FC, Sydney Australia

Confirmation letter from 3AR, Melbourne, Australia
CLASSIFIED ADVERTISEMENTS

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

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

All Classified ads for December issue must be sent in by Nov. 10.

AGENTS


AIRPLANES

SEND for free illustrations and plans of our wonderful two-place companion type. Simple, high lift wing, ample baggage舱, and information on how to build this ship, and be sure it will also interest others. Crawford Aeronautical Manufactory, 2225 American Avenue, Long Beach, California.

BOOKS AND MAGAZINES


Twentieth Century Book of Receipts, Formulas and Processes, a 307 cash bound book containing 10,000 proven formulas for the manufacturer, workshop, laboratory, office and home. Sent prepaid upon receipt of $4.00. Send dime for our 48 page catalog of latest and best practical scientific and mechanical industrial books. Midland Products Co., Dept. RA, 524 Court and Ave., Park Ridge, Ill.

BOYS

Boys get a three feet model aeroplane free. No selling. Write for particulars. Aero Shop, 3030 Huron Ave., Detroit, Michigan.


BUSINESS OPPORTUNITIES


LAND FREE if planted to bananas. Bananas bear a full crop the second year. $5.00 monthly will plant one acre, which should make $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 Jamaica Plantation Co., Empire Building, Block 980, Pittsburgh, Pa.

FOR SALE—Pentagon from tainau me and duster. I have party offered to take the hundred dozen per month. Lester Desk, McMinnville, Tennessee.

DETECTIVES

BE A DETECTIVE. Make some extra spending money. Earn $5.00 to $50.00 per week. Work home or office on your own. E. S. G. Agency, 196 Flatiron Building, New York City.

ELECTRICAL

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

FORMULAS


MALE HELP WANTED

MEN, get Forest Ranger job. $125-$200 mo. and home furnished. permanent. Sunt. ind. tax. For details, write North, 255 Temple Court, Denver, Colo.

MISCELLANEOUS

NEUTRODYN AND HETERODYNE ARE GOOD AS FAR AS THEY GO. THE BEST ONE TUBE SET FOR EVERY HOME is the A.M. AND R.F. SYSTEM. SATISFACTION GUARANTEED. FIFTY CENT TUNES BY A.M. INDUSTRIE PRODUCTS COMPANY, LAUREL, MISS.

GILLETTE STYLE Razor with 10 Blades 65c Prepaid. Land special. 62c. Speak-Unit $1.10 prepaid. Transmitter 25c, Mole Station A, New Haven, Conn.

PANEL ENGRAVING

SINGLE PANEL and medium quantity engraving of highest quality. Also sandblasting, metal etching and machine engraving on small parts. Careful attention to simple designs and exact work. Writes for prices. A. L. WEYDY, 19 S. Wells St. Chicago.

PERSONAL


RADIO

EXTRA HEAVY Antenna wire 2 Nos. 18 $1.50 100 feet. 17 Nos. 22 braided 5-8c width $2.80 100 feet all prepaid. Geo. Seibert, Calumet, Michigan.

Radio set builders send for our new wholesale catalogue. 1c per copy. Kansas City Radio Company, Kansas City, Mo.


SILICON Transformer Sold to order .014", 10 lbs. 15 cents, 5 lbs. 30 cents, 10 lbs. 35 cents per lb. 4 cubic inches to the lb. paid extra. At least 12, cash with offer—balances C. G., D. G. Seibert, Calumet, Michigan.


For Sale: One Improved "Arco" regenerative kit, for 10,000 condensers. Price $3.00. Also the following straight wire frequency condensers, two Brainerd-Tully 10,000 condensers, price $3.00 each. One Dufour 10,000 condensers, price $2.00, two Colton midget condensers $1.00 each, one set of Braungw-Braungw coils, price $2.50, one A. M. American self tuned radio frequency transmitter, price $2.00, one "Arco" antenna condenser, price $2.50. Extra Fy. P. O. Box 187, Eastham, Iowa.

For Sale at Half Price. 5 201A Antennas. 1 pr. Brand new brackets. 2 Glustones. 1 Frast 20 ohm rectifier. 1. 5 Am. Variable condensers. 1. 0003Mfd 4 0005 and 2. 0005. 1. midget condensers. 20 Front panel pull switches. 1. Carter Imp 500 ohm rheostat. 1. Frast 500C 500 ohm 0.001 rheostat. 1. Brush coil form. Some parts are slightly used, others are new. Krace Co., 416 Griswold, N. W. Mart. St., Kalamazoo, Pa.


Large Core 3-1 Audio Transformers $1.50. Raytheon "Bi" Kit $16.75, 50-125 MA choke $2.50, 50-500 MA choke $2.25, 25-250 MA choke $2.50, 100-500V Raytheon Transformer $5.50. Write for special lists. Transom, Metrics, etc. Radio Parts Sales Co., Orange, N. J.

Gendron RCA VU 202 watts, brand new in original finishing. Can be used as direct current, radio tubes or power tube. Only $2.25 each prepaid. Mitchell Radio Co., 1252 Sheridan Road, Chicago, Illinois.

METERS—CONDENSERS—"9" eliminator parts. Power transformers $2.00 up. High grade mikes $2.25 up. Write for list of specials. Can supply parts on any material you require. Radio Parts Sales Co., Urbandale, N. 2.

RUBBER STAMPS


RUBBER STAMP SI NAME, Address, two lines 25c. Three lines 35c. G. Brush Company, Aurora, Nebraska.

SALESMEN WANTED

75 MILES ON 1 GALLON—New Mixture Gas Stove. All Cars. 1 Free. CRITICLOW, AZ-91, Wheaton, Ill.

STAMPS

1000 different $1.00, 500 different 50c, 50 French colonies 1c. Kestner, 042 Meredith Ct., Dayton, Ohio.

100 foreign stamps and hinges free to approval applicants; pays 50 cents each. Banks, 1130 Riverview Ave., Dayton, Ohio.

TYPOWRITERS

TYPOWRITERS, all standard makes, 750 up. Fully guaranteed. Write for complete illustrated lists. Northwestern Typewriter Exchange, 121 N. Francisco Ave., Chicago.
BUILD A
SHIP MODEL LOUD SPEAKER

$12.50

A combination of a beautiful ship model and a loud speaker that is easily worth $100. You can build it yourself in a few spare hours with no other tool than a small tack hammer.

The famous Melody Ship which has met with instant approval everywhere it has been shown and played can now be purchased in knock down form at the startlingly low price of $12.50. This remarkable speaker combines

PERFECT TONE - - PLENTY OF VOLUME - - NO DISTORTION

No doubt you have often admired ship models and yearned to possess one but could not do so because the price was too high. Now it is possible to own a beautiful ship model and loudspeaker combined at a small cost. Let the WORLD’S LARGEST BUILDERS OF SHIP MODELS AND SHIP MODEL LOUD SPEAKERS supply you with all the necessary parts, cut to fit and ready to assemble from which you can build a beautiful model of the historic Mayflower, the Santa Maria or the La Pinta in a few hours. To all outward appearances the completed model is a beautiful ship model but upon closer observation a loudspeaker can be seen cleverly incorporated into the mainsail.

The loud speaker unit is of the Electro Magnet type. Power amplification is not needed to force the low tones through. They come through with perfect ease and do not interfere with the high notes, giving faithful reproduction at all frequencies. The mainmast, upon which the unit is securely fastened is seated two inches deep in a three and a half pound solid wood hull, making it impossible for counter vibrations to affect the perfect reproduction of the Melody Sail. The driving pin is attached to our super-vibrating, especially prepared, Melody Sail. The installation of the Melody Sail does not change the appearance of the model in any way. Melody ships come in three beautiful models, the Mayflower, the Santa Maria and the La Pinta, with parts cut to fit and ready to assemble. No tool needed but a small hammer.

You need not know anything about ship building or carpenter work in order to build one of these ships. No special knowledge of ship model building is necessary either. We will supply all the parts from the hull down to the smallest piece of rigging, all cut to fit and ready to assemble. You cannot go wrong. Diagrams and plans of parts that are included with each kit tell exactly what to do with each part. These plans show you step by step just how the model is constructed. Everything is made so simple that even a small child can build a beautiful model.

All you need is a small hammer to tap the parts into place. Here is a part of the instructions copied word for word from the diagram and instruction sheet that goes with the kits. “Take part No. 57 place it in front end of part No. 56 and tap lightly with a hammer. Next take part No. 58 and place it up against No. 57 and tap it with a hammer to bring it into place.”

Easy! Nothing simpler. The instructions are like that from beginning to end. Do this and that and before you realize it a beautiful ship model has grown before your eyes.

Write for our free beautifully illustrated catalog which contains a photograph of all our models together with complete details and price of each. We will send this catalog without obligation to you. Fill in the coupon below and we will act upon it immediately.

If, after assembling the model you do not think it worth many times the purchase price, return it to us in good condition and we will gladly refund your money.

MINIATURE SHIP MODELS, Inc., DEPT. Z2
Canadian Branch: 1455 Bloor St., Montreal, Canada
Canadian Prices Slightly Higher. Send all Canadian Orders to Canadian Office.

MINIATURE SHIP MODELS, Inc., DEPT. Z2
Please send me complete parts, cut to fit and ready to assemble for the Melody Ship $12.50. I agree to pay postman $12.50, plus postage.
PLEASE PRINT NAME AND ADDRESS PLAINLY
Name

Street or R. F. D.

City

State
When the ball goes 'round the end for 40 yds.

...a Crosley Radio...

The Crosley Radio Corporation; Wm. E. Young, President, Chicago, Ill. (1927)

 Tubes always put obstacles in our way. When men begin to study a new invention or discovery they find that there are many problems to solve before a useful device can be built. This was the case with the steam engine, the printing press, the automobile, the aeroplane, and every other major invention that you can think of. Even the vacuum tube is, perhaps, one of the most remarkable inventions ever made. We found that we could use it to amplify the radio signals. But when we tried to tune these amplifiers, so that they would help us select the desired signal, we found that the vacuum had a tendency to misbehave.

When a tube is used to amplify, the output voltage is much stronger than the input voltage. This is the normal result of the amplification. But there is a path back through the tube, via another path, of the strong output voltage which comes back to the input side of the tube. This voltage is then amplified again and again resulting in a greater output voltage. The result being that the tube may fail.

To overcome this difficulty the Crosley Bandbox was invented. It is a miniature loudspeaker station on its own hook. If we can provide a second path from the output circuit to the input circuit, we can divert the output voltage back through the tube in such a way that the output voltage is divided into two, so that one is amplified and the other is not.

The Hazeltine Diode method of obtaining this path through the tube is to use a second diode. The unique advantages of this method have been discovered. This is why Crosley Radio uses the Hazeltine "neutro-dyne" method.

Signal Voltages leaving Tube Greatest Amplified but Some Blound Induced and Input Signals amplified Signal Voltages entering Tube Leaking Tube...Amply Amplified...but Some Blound...Induced in Output Circuit...Signal Amplifiers...tube itself...We can present the output voltage...The problem is created.

Signal Voltages leaving Tube Greatest Amplified...but Some Blound...Induced in Output Circuit...Signal Amplifiers...tube itself...We can present the output voltage...The problem is created.

The "All American" radio of 1928! With license to participate in the enormous radio resources of The Radio Corporation of America, The General Electric Co., The Westinghouse Co., The American Telephone and Telegraph Co, and The Hazeltine and The Latour Corporations, the Crosley Bandbox of 1928 is an "eleven" of super-efficient features and amazing co-ordinated performance. In it are incorporated:

1-The best idea of balancing.
2-The best ideas of shielding.
3-The best ideas of sharp tuning.
4-The best idea of controlling volume.
5-The best idea of station selection.
6-The best idea of finish and color.
7-The best idea of power tube use.
8-The best idea of console installation.
9-The best idea of power supply connections by enclosing all leads in a cable.
10-The best idea of AC tube operation.
11-The best idea of converting AC current to necessary DC.

Operation of the Bandbox receiver from house current is possible with the AC model at $65, which uses the new amazing R. C. A. AC tubes. The Crosley Bandbox transformer costs $60 more.

These new Bandbox receivers are now on display at over 16,000 Authorized Crosley dealers. Their faultless reception of the many wonderful events constantly on the air is proving such a startling demonstration that a national enthusiasm sweeps the country in the natural exclamation—"You're there with a Crosley!!" If you cannot locate the nearest dealer, write Dept. 63 for his name and literature.