How to Make the WORLD'S SMALLEST TUBE SET!
See Page 138
"391" QUICK FACTS

1. DECIBEL RANGES
   -10 DB to +30 DB
   +5 DB to +35 DB
   referred to zero level of six megohms in 600 ohm line.

2. D.C. VOLTAGE RANGES
   (1000 ohms per volt)
   0 to 5 volts
   0 to 25 volts
   0 to 125 volts
   0 to 250 volts
   0 to 500 volts
   0 to 1250 volts

3. A.C. VOLTAGE RANGES
   (1000 ohms per volt)
   0 to 5 volts
   0 to 25 volts
   0 to 125 volts
   0 to 250 volts
   0 to 500 volts
   0 to 1250 volts

4. RESISTANCE RANGES
   0 to 500 ohms
   0 to 5,000 ohms
   0 to 50,000 ohms
   0 to 500,000 ohms
   0 to 5,000,000 ohms
   0 to 50,000,000 ohms

5. CAPACITY RANGES (Low)
   0.0000125 to 0.00125 mfd.
   0.00005 to 0.005 mfd.
   0.000125 to 0.0125 mfd.
   0.0005 to 0.05 mfd.
   0.00125 to 0.125 mfd.
   0.05 to 5.0 mfd.
   0.125 to 12.5 mfd.
   0.5 to 50.0 mfd.

6. CAPACITY RANGES (High)
   0.005 to 0.5 mfd.
   0.0125 to 1.25 mfd.
   0.05 to 5.0 mfd.
   0.125 to 12.5 mfd.
   0.5 to 50.0 mfd.

7. DIRECT CURRENTS
   0 to 250 microamperes
   0 to 1.25 ma.
   0 to 5.0 ma.
   0 to 25.0 ma.
   0 to 125.0 ma.
   0 to 250.0 ma.
   0 to 1.25 amp.
   0 to 5.0 amp.
   0 to 12.5 amp.

In a week or so the peak season of radio will be here. Thousands of new models will be installed, bringing new problems in radio servicing. Supreme engineers, always in closest touch with the new in radio reception design, have produced a line of instruments abreact of these new developments. Capacity for the all-metal octal tubes is only one of the features that add to the precision and speed of the serviceman. Don't be satisfied with make-shift methods. Get the MODERN equipment which progressive servicemen by the thousands have already acquired. Prices establish a new standard of quality and value at low cost.

The 391 Meter Dial. Note the evenly divided scale for voltage, current, and capacity readings, and the convenient division of ranges, so that values occurring most often are near the center of the scale or above. The 391-1 section is of a different color than the remainder of the scale, attracting the eye when measuring power levels.

The ohmmeter scale has been so chosen that the ranges overlap considerably, hence range can always be found which will give a good needle deflection for any resistor up to at least 10 megohms, and values up to 50 megohms can be read with but little trouble.
Learn RADIO

SEND TODAY FOR DETAILS OF MY Pay-Tuition-After Graduation Plan!

Train for Radio in 12 weeks, right here in the great Coyne Shops — not by correspondence — but on real Radio, Sound and Television equipment. Mail the coupon below. If you are short of money I'll send you all details of my finance plan and consider your application. If accepted, you won't have to start paying tuition back until five months from the date you start school, and then you'll have over a year to complete your payments.

Tremendous Developments Ahead in Radio and Television!

HERE is YOUR opportunity to cash in. Every day brings news of new developments in every branch of Radio and Television, with more opportunities, more jobs, and a greater future for the trained man than ever before. I consider the fellow who is ambitious enough to want to get ahead by taking my Training, worthy of my help. MAIL THE COUPON BELOW and you can prove to me that you are willing to spend just 12 weeks in the Coyne Training Shops learning Radio. Then, I'll tell you about my finance plan which has enabled many to get complete Training and pay tuition back later.

Learn By Doing In 12 Weeks

I don't care whether you are 16 or 45. It makes no difference to me if you don't know an oscillator from a spark coil. You don't need any previous experience or advanced education to master your Shop Training. Don't let lack of money hold you back from getting all details of my amazing plan.

MANY EARN While LEARNING

If you need part-time work to help pay your living expenses and will tell us your problems we may be able to help you as we have thousands of others. Then, in 12 brief weeks, in the great Training shops of Coyne, you will learn on a wide variety of modern, up-to-date A. C. Heterodyne sets, oscillators, analyzers and test instruments. Prepare for Amateur Broadcast, or Telegraph Radio Operator's License and to know all code and Dept. of Commerce rules for government License Examination.

TRAINING

By Actual Work

No dull books... you get individual training... real actual work with only the theory you will need. Building real radio sets, doing radio wiring and testing, trouble-shooting, repairing and servicing. That's a glimpse of how we help to make you a Radio expert, and fit you to qualify for jobs leading to the biggest pay.

Jobs - Pay - Future

"I got my present job two days after graduation, at higher hours, and wages increased $500 over my old job," reports Arne Wiklem of Minnesota. "I have my own shop, own a real car and make fine money in the radio business," writes E. Allen of Montana, "All this is possible because I came to Coyne." And I could go on quoting from hundreds of letters of successful Coyne Trained men. What they have done, you should be able to do.

Electric Refrigeration

Air Conditioning

Right now I'm including my big new Electric Refrigeration and Air Conditioning course at no extra cost.

Home of Coyne Shops

This is our fireproof modern building wherein are installed thousands of dollars' worth of Radio equipment of all kinds. Every comfort and convenience has been arranged to make you happy and contented during your Training.

COYNE

RADIO & ELECTRICAL SCHOOL

500 South Paulina Street, Dept. 65-8H, Chicago, Ill.

H. C. LEWIS, President

Founded 1899

H. C. LEWIS, President

Coyne Radio & Electrical School
500 S. Paulina St., Dept. 65-8H, Chicago

Dear Mr. Lewis: Without obligation send me your big free catalog and all details; also tell me all about your "Pay-Tuition-After-Graduation" Plan.

Name

Address

City State

GET THE FACTS

Coyne is your one great chance to get into Radio. This school is 36 years old — Coyne training is tested — proven beyond all doubt — endorsed by many large concerns. You can find out everything absolutely free. Simply mail the coupon and let me send you the big, free Coyne Book with photographs... facts... jobs... salaries... opportunities. Tells you how many earn expenses while training and how we assist our graduates in the field. This does not obligate you. So act at once. Just mail coupon.

Get this Free Book

BID PAY FACTS

www.americanradiohistory.com
CONTENTS—SEPT., 1935, ISSUE
Volume VII Number 3

Editorial: Radio Set Building Hugo Gernsback 133
The Radio Month in Review 134
Radio Pictorial 136
How to Make the World's Smallest Tube Set C. W. Palmer 138
Build This "6-in-4" Rowboat Portable N. H. Lessem 139
An Easy-to-Build 5-Meter Transceiver S. E. Lover 140
How to Build the "Metal-Tube 5" T.R.F. Set C. E. Denton 141
A Versatile 3-Tube Short-Wave "Receiver-Converter" Louis B. Sklar 142
"Bluebeard"—A 4-Tube T.R.F. Set Rudolph Stienmeyer 143
Make this 5-Tube All-Wave A.C.-D.C. Set H. G. Cisin 144
Building the Peanut "5" Superhet Howard G. McEntee 145
Design Problems of Tuning Dials Wilhelm E. Schrage 146
Making a 6-Tube Battery All-Wave "Farm-Portable" Set J. T. Bernsley 147
A "Multi-Set" Kit for 1 to 3 Tubes W. E. Harrison 148
Uses of the Cathode-Ray Oscilloscope, Part II F. M. Paret 148
An Efficient 4-Tube All-Wave Set William Kranz 149
A Camper's 4-Tube Portable Superhet Emanuel Mittleman 149
A Novel "Acorn"-Tube Regenerative Set Michael Blan 150
The Deflecting Plates in Cathode-Ray Tubes Alfred A. Ghirardi 150
A 3-Tube Short-Wave "Variable I.F.T." Tuner Donald Lewis 151
A New Idea in Set Building "Frequency" Modulation in Tomorrow's Set H. K. Bradford 151
A New High-Fidelity "Twin-Amplifier" M. J. Cuttler 152
RADIO-CRAFT'S "Ideal Radio Service Shop" Contest Charles R. Shaw 153
The Latest Radio Equipment 154
International Radio Review 155
Short-Cuts in Radio 156
"Controlled Sound" for Modern Theatres Harold Burris-Meyer 157
Readers' Department 158
The Listening Post for All-Wave DX-ers C. A. Morrison 159
Operating Notes 160
ORSMA Members' Forum 161
RADIO-CRAFT'S Information Bureau 162
RADIO SERVICE DATA SHEETS:
No. 145—Remler Model 36 Dual-Wave Auto Radio; Fada Model 155 5-Tube A.C.-D.C. Set 164
No. 146—Stromberg-Carlson Model 82 10-Tube All-Wave Receiver 165
Technicians' Data Service 167

METAL TUBES—IN OUR NEXT ISSUE
Metal tubes must figure largely in the development of radio in the immediate future. While the basic structure of the tubes is almost unchanged, the new type base with its 8 prongs and special "key" that speeds insertion in a socket, new small caps, and various other design features make it imperative for everyone connected with radio in any way to be well versed in every phase of the use of these interesting new units.

Sets, test equipment, and all existing electronic devices must be changed somewhat if the metal tubes, with their many advantages, are to be incorporated. For this reason the METAL TUBE NUMBER of RADIO-CRAFT will be indispensable to the radio technician, for the use of the metal tubes will be covered from every possible angle. Articles will include not only their use in future sets, but also adaptation to present sets. Also, interesting points in the design of the tubes themselves will be included.

Ask your dealer to reserve for you a copy of the OCTOBER 1935 METAL TUBE NUMBER of RADIO-CRAFT!

RADIO-CRAFT is published monthly, on the first of the month preceding the date of issue; its subscription price is $2.50 per year. (In Canada and foreign countries, $3.00 a year to cover additional postage.) Entered at the post office at Mount Morris, III., as second-class matter under the act of March 3, 1879.

Text and illustrations of this magazine are copyright and must not be reproduced without permission of the copyright owners. We are agents for WONDER STORIES and EVERYDAY SCIENCE AND MECHANICS. Subscription to these magazines may be taken in combination with RADIO-CRAFT at reduced club rates. Write for information.

Copyright 1935. Continental Publications, Inc.

HUGO GERNBSACK, President I. S. MANHEIMER, Secretary

European Agents:
Paris—Messageries Dawson, 4 Rue Faubourg, Poissonniere, Paris, France.
Australian Agent: McGill's Agency, 179 Elizabeth St., Melbourne.

www.americanradiohistory.com
I'll send you a FREE LESSON on Radio Servicing Tips to PROVE that it's Practical to Learn at Home to Make GOOD MONEY IN RADIO

Many Radio Experts Make $30-$50-$75 a Week

Mail Coupon Today! I'm so sure I can train you at home in spare time that I'll send a FREE LESSON to prove how easy it is to become a RADIO EXPERT.

Train for a job with a RADIO MANUFACTURER, DEALER or JOBBER, or to go into a BUSINESS OF YOUR OWN. Put facts about the opportunities in Radio, Television, Loud Speaker Systems, Short Wave Radios.

I will also send you my FREE 64-PAGE BOOK—"Rich Rewards in Radio"—telling about my training and the opportunities for which it fits you; how I give you Practical Experience with Radio Equipment I supply as well as Book Training; how I give you Extra Money Job Sheets to help you Make $5-$10-$15 Extra in your spare time while learning. My book ALSO contains many letters from graduates telling what they are doing and learning—But the facts about my MONEY BACK AGREEMENT and many other N.R.I. features.

Why put up any longer with a low pay, no-future job. Train for Radio at home in spare time. Get the facts now. Mail Coupon for my FREE BOOK and FREE SAMPLE LESSON.

MAIL THIS COUPON FOR FACTS

J. E. Smith
President
NATIONAL RADIO INSTITUTE
Dept. 57X Washington, D. C.

Please send me without obligation your FREE BOOK "Rich Rewards in Radio" and FREE LESSON ON SERVICING TIPS.

NAME__________________________
ADDRESS________________________
CITY________________STATE_______

14X-1

Please Say That You Saw It in Radio-Craft
$4.00

This Special Prepublication Offer Expires—August 20th. After this Date the Regular List Price of $5.00 Will Prevail.

Clip—Mail Coupon Today!

Please Say That You Saw It in Radio-Craft.
RADIO set building started back about 1905 when radio still was "wireless." In those days there was of course no broadcasting—which did not start until about 1921. Yet, in the old days, as I read through some of my former radio publications of that vintage, radio set building was as fascinating a hobby then as it is today. To be sure, in the very early days we did not have a half-million or more radio fans building crystal and one-tube sets such as was the case in the early twenties, because radio broadcasting, which later brought a tremendous new lot of radio builders into the field, did not then exist.

Since the radio boom in the twenties there naturally has been somewhat of a decline in set building, but not as much as one might imagine. I have often made the statement that there are at all times between two and three hundred thousand people in this country, during any given year, who build radio sets of some kind, and whether the set is a one-tube or a ten-tube affair makes little difference—the thrill is the same in all cases.

And, as the radio art progresses, I predict that radio set and equipment building will increase for some very simple and elementary reasons. In the first place, new blood is coming to the radio industry at all times. The itch to build a radio set is as strong today as it ever was, particularly to the man who has never before built a set. Secondly, there are today many more types of radio sets, to fit new needs than there ever were, and, further, believe it or not, there are still thousands of people who build crystal sets; if continuously receive letters from people who claim new records for crystal reception. The same general situation exists in connection with one- and two-tube sets.

Short waves have had a boom of their own, and this new branch of radio has added untold thousands to the roster of those whose greatest interest is in building radio equipment. At the present time there is a new group coming to life in the field of 10- and 5-meter short-wave radio. Totally unsuspected results are had by means of these extra-short wavelengths, with new discoveries being made every day in this latest branch of radio. At one time it was thought, for instance, that a 5-meter wavelength would not reach beyond the horizon. Yet, as we go to press, reports come in that for some unknown reason Chicago listeners have been able to receive 5-meter transmissions from New York, 720 miles distant—a point far below the Chicagoan’s horizon!

In the new builder’s fields we have, of course, automobile and boat radio, where special installations are always required. Then, we have the huge horde of professional radio builders who build special sets for special purposes—often at very fancy prices. Thus, recently one of our readers who is a professional builder installed in the home of a New York State millionaire, a radio set the installation of which cost, incredible as it may seem, $30,000! To be sure, this is a very elaborate installation, and a most unusual one too, but the expert radio builder who has grown up in the game frequently gets good customers if he knows what he is about. There is always a good trade in special, built-in custom radio sets, which must fit certain furniture, certain recesses, or give special performance. This is a condition that no factory-made set can possibly meet. Thus, if a Wall Street man wants a special radio set built into his desk drawer, which is about three inches deep, no possible stock model radio receiver can fill the demand, and here is where the professional builder shines.

But that is by no means the whole story. The thing most important in set building is that, as the past has shown, commercial sets usually are from six months to two years behind the professional builders’ ideas. The reason is, of course, very simple. In the first place, there are such things as new tubes. As these new tubes come out (and there have been many in the past few years) they tend to make even the latest commercial sets obsolete. It takes time and a tremendous amount of capital for a radio manufacturer to produce a new model, tool up, and place the instrument on the market.

The radio set builder has no such limitations. When he gets the new tubes, and after he sees their various advantages, he can immediately design a special set, and usually this set if the builder knows what he is about will be ahead of the factory-made model—much to the home set-builder’s delight. Of course, the amateur radio builder who constructs only a few sets over a period of time, selling them at cost in order that he may buy new components to try out a new circuit, is not in competition with the manufacturer of commercial sets; and even the professional builder does not sell many sets during the year.

Radio set building has often been termed a sport, and an interesting and exciting one too. Ninety-five per cent or more of set building is, of course, non-professional, and most of these sets are never sold—they are usually built for the sheer pleasure of putting a set together.

Modern set builders, it should be noted in passing, have it all over their brethren of former years, because there are now available radio parts of such diversity and excellence as were not dreamed of by the set builders of 1921-1927. For this reason the modern set builder usually has no difficulty in building a set that is not only very efficient and sensitive, but which also fits special needs and requirements as could no other set.

Furthermore, the best things in radio set building are still ahead! After all, the radio art is still new, and what with the new radio inventions that are swamping the patent office, and the new circuits that are constantly coming out, set building as the favorite sport will continue to grow with each successive year. ALL INDICATIONS POINT THAT WAY!
THE NORMANDIE TALKING LIGHT BEAM

When the S.S. Normandie made her triumphant arrival at New York harbor, early last month, engineers from the G.E. Co. completed elaborate plans to welcome her from the Statue of Liberty by means of their talking light beam (see Radio-Craft, April 1935, page 585).

Several days before the arrival of the liner, newspapers and magazines were duly notified of the "stunt" and many stories appeared about the experiment.

When the Normandie appeared, amid a din of whistles and surrounded by a fleet of tugs, fire boats and excursion boats, however, the talking light-beam experiment failed completely. Several days later, the G.E. Co. sent out a polite explanation that "smoke got in their eyes" from the ship's funnels.

An amusing aftermath of this incident was received by Radio-Craft, in the form of a somewhat different explanation of the cause of failure. It seems that the engineers who boarded the ship at Quarantine were not assigned an exact position on the deck and the party at the Statue were unable to locate their reflector on the expansive decks.

MANUFACTURERS ENTER SERVICE BUSINESS

Within the past month, two developments have taken place which promise to be of interest to Service Men. First, the Philco company has advanced their position in the servicing industry by arranging with the Western Union Telegraph Co. to permit set owners to call one of Philco's Service Men gratis by calling the telegraph company. Philco had previously set up a national organization of Service Men under their "Radio Manufacturer's Service."

The second development is the step taken by RCA in distributing a catalog of radio parts to Service Men throughout the country. Thus they have definitely entered the radio "parts" business.

S.-W. RADIO FOR N.Y. STOCK EXCHANGE

News has come to us during the past month that the New York Stock Exchange engineering staff is working on a radio development for speeding up 'Change stock quotations.

A radio transmitter of a portable type and tuned to a short-wavelength will be carried by the quotation boy. With this 'phone transmitter, the boy will not have to push his way through the crowd at the trading post in order to reach a telephone to send quotations to the dispatch room 15 floors above.

He can stand at the edge of the crowd and send his message to the telephone at the trading post some 10 to 20 ft. away which is equipped with a radio receiver. Then the telephone lines will carry the message to the dispatch room. Due to the short range, a license is said to be unnecessary!

Portable S.-W. transmitters of this type will be used to speed up stock quotations.

THE RADIO MONTH
IN REVIEW

600 MILES ON 5 METERS!

In a letter to Radio-Craft, last month, Mr. W. West of Kalamazoo, Michigan sends some startling news.

With a home-made ultra-short-wave super-regenerative receiver which Mr. West made, he has received signals over a distance of about 600 miles on 5 meters, from four stations on the east coast!

He has received verifications from two of these stations proving that they were actually received on 5 meters.

Reception over such a distance can only be possible if the waves bend over the surface of the earth, are reflected from the sky, or are carried through the ground. However, since Mr. West states that a rapid fading was noticed in each case, it is almost certain that the waves were reflected by the ionized layers above the earth.

With 5 meter DX possible, who can tell, we may have nation-wide ultra-short-wave television soon.

COLUMBIA SYSTEM AHEAD

Within the past month, several facts have become known regarding the Columbia Broadcasting System's business, which are of interest to radio fans.

In the first place, this national radio network made a net profit during 1934 of $2,274,120 after depreciation, Federal taxes, etc., had been deducted. This compares with a figure of $923,794 for the year of 1933.

Second, in an article which appeared in Fortune magazine it was explained that the sales of this network had increased from $5,000,000 in 1929 to $19,000,000 in 1934. And as Fortune explains—this is "all because they're smart."

CBS has jumped ahead by leaps and bounds, according to their 1934 figures.

RADIO LUXEMBOURG TAKES ADVANTAGE

While it has been known for some time that the 600,000 W. station in Luxembourg is the only station of prominence in Europe operating on the American plan (that is, accepts commercial advertising) it was not until last month that the complete story was made clear.

It seems that this powerful station is taking full advantage of the situation, by literally flooding England, France, Germany and Italy with ads of popular commodities used in these countries. And to further add insult to injury (an injury which the European powers are helpless against) programs reach these countries in their language!

There's a comic opera aspect to the entire situation, for it is a well known fact that there is propaganda "war" going on between certain European countries—yet, they let the little Grand Duchy of Luxembourg, with its superb geographical position take many, many thousands of their listeners away from them with ads for toffee, jam, canned soup, etc., which is readily proven by the results of a song title contest which brought in 121,714 letters.

"GHOST" GETS CONFESSION

Radio found a new application last month, in Martinez, California, where the confession of a Mexican, Anacleto Torrent, accused of murdering Area Cabrera was obtained.

A phonograph and a loudspeaker concealed in the cell of the prisoner comprised the "ghost." The speaker drowsed in Spanish—"You killed me. I am Area's ghost. You had better confess. You know you killed me."

After forty-eight hours of this, the prisoner confessed the killing.

RECORDINGS AID ONE-MAN SYMPHONY

Vladimir Karapetoff, Professor of electrical engineering at Cornell University, author of textbooks and a well known cellist disclosed a new and novel application of phonograph recording and P.A. amplification, last month.

Prof. Karapetoff uses cellulose acetate or aluminum records, of piano or orchestral accompaniments to musical selections. Then, the records can be played back and a singer or musician can have the advantage of ideal accompaniments when rendering solos.

The play-back device is equipped with volume and record speed controls, so that the musician or singer has full control of the rendition.

The advantages offered by this system can be readily appreciated by anyone who has tried to play solos on a musical instrument without proper accompaniment.

CZECHO RADIO DISPUTE

Last month, a rather interesting sidelight of the broadcast situation in Czechoslovakia has appeared. It seems that the Ministry of Posts and Telegraphs of that country has made a proposal that the electric power companies pay a certain percentage of their profits to a special fund for propaganda to expand the use of radio.

It is estimated that $3,000,000 worth of electricity is used per year for operating electric sets in Czechoslovakia.

The public utilities, however, claim that they give special rates for radio set power consumption and should not have to contribute more.
Right, one of the 80 loudspeakers which are installed in all parts of the Normandie. This one is directly alongside one of the decks. Below center, another of the loudspeakers, showing a close-up of an installation on one of the funnels. Below left, the same installation, viewed from a greater distance, giving a better comparison of size; note passenger. Bottom left, a close-up of the tubes used in one of the many transmitters. Note also, the peculiar fan-shaped tuning "dials" shown in detail elsewhere on this page. The radio equipment on this huge vessel is probably the most varied and complete installation on any passenger vessel in the world. In addition to the apparatus used for regular ship traffic, there is a high-fidelity transmitter for use in ship-to-shore phone traffic. The installation also includes a special cabin, not shown here, which houses the radio equipment used in connection with navigation. The photo directly below also shows one or two of many antennas. The complete antenna installation is arranged so that there is as little reaction between the various services as is possible. This means that duplex operation can be carried on over several frequencies at the same time. This is, of course, quite necessary, since there are always several types of transmission on the air at the same time.

At right, we see the appearance of the main shack of the Normandie, showing the various transmitters around the walls. The operating table in the foreground carries a set of controls for all the equipment, while on the low shelf in back of it are the receivers, the operating table being kept clear of apparatus. In striking contrast to the usual radio operating room, the color scheme here is a beautiful blue-grey, setting off in bold relief the black and white dials and meters. The transmitting range extends from 17 to 2,400 meters, while the receivers operate up to 20,000 meters. Several wavemeters are also included in the equipment, to assure operation on the proper wavelength. The many meters are placed so as to be visible from the operating position, without moving, making it easy to keep a check on the circuit conditions at all times. Below right, is shown a closeup of one of the novel tuning controls, which can hardly be called dials. To select a certain wavelength, one of the small numbered knobs is turned and the large knob is then screwed in till it locks at the position chosen. Thus rapid change of wavelength is possible, with absolute accuracy assured. The small knobs are attached to plungers which drop into holes in the main shaft, giving positive action. A more complete description of the equipment cannot be given here, due to space limitations, but will be found on page 187 of this issue.
An amazing new system of communication is depicted here. The First Officer shown at left can talk to any part of the ship, where a loudspeaker is installed, although there are no connecting wires of any kind. A speaker may be connected to any metal part as shown above and the voice will come through. This invention is the work of Dr. F. L. Satterlee. (Fairlawn Photos)

These views show loudspeakers of the new system installed in various parts of the ship. The crew talk to the bridge through the same loudspeaker. Since no wires are used, this is valuable in an emergency.

A machine at M.I.T. for computing the wave-lengths of spectrum lines of matter.

16 lb. airplane set by RCA.

New 20-watt airplane transmitter, for CW, ICW, or phone work.

Apparatus to show brain "action currents," above.

Machine for amplifying sound of heartbeats, also visible on screen.

Program manager of a Berlin television station selecting future programs.

Open-air radio tube connected to an electroscope for study of electron flow under many variable conditions. Left, insect "death ray" apparatus developed at the Smithsonian Institute.

Singer's voice being analyzed in apparatus to compare with "ideal" voice. At last, vocal standards!

RADIO-CRAFT for SEPTEMBER, 1935
HOW TO MAKE THE WORLD'S SMALLEST TUBE SET

The introduction of a new tube and battery have made possible this tiny tube receiver, also shown in the cover illustration. The cigarette case in which it is built is so small that it holds only 10 cigarettes!

C. W. PALMER

so encouraging that several of them were imported—and arrangements were made to have them made available in this country.

Due to the high sensitivity of the screen-grid tube as a detector, when fed into a high-impedance load, this type in the new "50 ma." series was selected. To meet the requirements of a high-impedance load, special piezoelectric or "crystal" headphones were used; their impedance is over 50,000 ohms, against 20,000 ohms, or so, for the "magnetic" type.

The little set shown here, completely enclosed in a small-size cigarette case—(the case is so small that it will only hold 10 cigarettes!) is the first use to which these tubes have been put.

To further aid the construction of this pocket set, a well-known battery manufacturer has just introduced a new 45 V. "B" battery which measures only 3 x 4 x 11/4 ins. deep. This battery (not yet on the market) supplies sufficient "B" voltage for the set and is small enough to fit easily into a coat pocket. The filament battery, as mentioned, can be small-size flashlight cells, so a "penlight" was adapted for the purpose.

PREPARING THE COMPONENTS

Some difficulty was encountered in finding coils and condensers small enough to fit in the bakelite cigarette case, but a solution was found in each case. The tuning condenser was a mica compression-type "trimmer" condenser having a maximum capacity of 500 mnf. The fixed condensers were unusually small bakelite covered mica units measuring ½ x ½ x ⅛-in.

The coil was made from two sections of a Hammarlund type CHX R.F. choke. The original choke contained five "pies" or sections and it was found that each section had about 200 microhenries inductance. This was about right for the tuning coil, so one section was separated from the others for this purpose. Next, the adjacent pie was "cut loose" from the remaining three, and 55 turns were removed to give the correct inductance (Continued on page 168)
BUILD THIS “6-IN-4” ROWBOAT PORTABLE


N. H. LESSEM

S

OPT music, the songs you love to hear, your “favorite” radio programs—all these are yours, to the accompaniment of waves gently lapping the sides of your canoe or rowboat as you slowly drift along, if you build the little radio set to be described.

This radio receiver contains its own power supply and loudspeaker, and has been designed solely as an entertainment instrument for that great army of nature lovers who each summer visit the tens of thousands of lakes within the domains of Uncle Sam.

New developments in circuit design and radio components have made this receiver possible.

The more important items concerning this receiver are enumerated for quick reference in the listing “Features of the Rowboat Portable; they are discussed at greater length as follows.

DESIGN FEATURES

The set was designed as follows:

Starting with the premise that the Rowboat Portable must be no larger than a standard A.C.-D.C. midget set, the first step then was to secure a cabinet of the type used to house these small sets. The cabinet (which measures only 7 1/4 x 10 1/4 x 5 1/4 ins. deep, outside dimensions), was obtained complete with a zipper-type carrying case, as shown in the heading illustration of the Rowboat Portable. The use of a dynamic-type reproducer was “out,” due to the weight being so much greater than that of a “magnetic.” Space limitations necessitated the use of special, small-space batteries, and a limited number of tubes each having small envelopes.

For a time this latter limitation was (Continued on page 182)

Features of the ROWBOAT PORTABLE

(1) Complete radio set, loudspeaker and power supply are contained in a cabinet no larger than that used for an A.C.-D.C. midget set;

(2) The superheterodyne circuit is selective and sensitive;

(3) New “B” batteries of smaller dimensions than any heretofore known to the radio field are utilized;

(4) Six-tube performance from 4 tubes;

(5) A recently-developed low-plate-drain power output pentode is used;

(6) A new variable-mu tetrode (screen-grid) tube is used;

(7) Two pentagrid converter tubes in high-efficiency circuits are utilized;

(8) Complete radio set fits into a zipper carrying case.

Fig. 1, above. Schematic circuit of Rowboat Portable. Note the use of new tubes; and two 1A6s. The latter 1A6 functions as a dual-service tube, both as diode second-detector and as first A.F.

Fig. 2, below. Pictorial layout of the receiver shown by diagram in Fig. 1. Note that the exact relation of the parts is not followed; refer to the photographic views for accurate placement of parts.

Fig. 8. Note the diminutive “B” units.

RADIO-CRAFT for SEPTEMBER, 1935

139
THe little transceiver described here can be made very compact and is very reliable for communication over a few miles. The tube used is the type 19 and serves the purpose very well. One section of the tube is used as the oscillator and super-regenerative detector while the other section is used as a modulator; and as a stage of audio when the switch is in the "receive" position. No trouble is encountered in receiving any signals on this receiver that can be picked up by various other 5-meter receivers of the super-regenerative type now in general use. Plenty of high-quality modulation is obtained from the one section of the tube.

The filament battery furnishes the current for the single-button microphone and when the mike is spoken into the plate current of the modulator jumps up to more than twice the normal plate current of 5 ma.

The mike winding is a 300-turn winding over the outside of the regular coils of an ordinary audio transformer. An old Crosley transformer was used in the original set as it was the only one at hand which had enough space for the winding. Number 28 enameled wire was used for this winding.

A 5,000 ohm gridleak was found to be the optimum value for transmitting. A .15-meg. variable resistor with a switch was used for the receiving gridleak and was varied for greatest sensitivity. When transmitting this is set to zero and the switch is turned off disconnecting the headphones so there is no danger of feedback between the phones and the mike. Also the phones then will not draw any power and this will keep the modulation high.

The two gridleaks are wired in series.

The modulation choke is one of those midget chokes used in A.C.-D.C. sets. They are very small and work very well in this outfit.

A .25-meg. volume control is used to vary the audio volume in the transceiver. This could be omitted but the writer believes in controlling everything possible. Switch Sw1 is a double-pole, double-throw toggle switch used in conjunction with R3/Sw2 to change from receive to send.

Condenser C2 is the tuning condenser. It is a 3-plate midget. A Hammarlund Star midget was employed in the original model as it was the smallest at hand and size in portable work means a lot.

The grid and plate coils L1 and L2 are wound on a 1/2-in. form and consist of 4 1/2 turns each of No. 14 enameled copper wire. The linear length of the mounted coils is 1 1/2 ins. The coils are removed from the form when mounted.

The R.F. choke is wound on a form consisting of a piece of 3/16-in. dowel and contains 100 turns close wound of No. 34 double silk covered wire.

Condenser C1 is the antenna coupling condenser and was made by mounting two aluminum plates about 3/4 x 3/4-in., with 1/8-in. separation at the bottom and top edges separated about 3/8-in.

With this method of coupling the aerial wire, the antenna wire will be much shorter than the one that is usually used with other methods; the antenna used with this method of coupling is about 6 ft. 8 ins. and that will put the best frequency for transmitting at about 56 mcs.

If the coupling to the antenna is too close, the detector will be thrown out of circuit oscillation. It doesn't take much coupling on 5 meters, so don't be afraid to spread the antenna condenser plates.

To find the frequency that you transmit at best, take a 6-8 V. pilot lamp; put a 1-turn loop on it about 1/4-in. in diameter; hold this close to coils L1, L2 so the bulb lights brightly and then tune the condenser C2 across the band until a decided dip in the brilliance of the bulb is noted. This point is the frequency at which your transmitter and the antenna are at resonance. If you can find no such point within the band, shorten or lengthen your aerial until you do. A calibrated receiver is handy for making these adjustments but a lecher wire setup will serve the purpose if no calibrated receiver is available.

Condenser C3, the super-regeneration condenser, is bridged with a fixed resistor. I find that this resistor stabilizes the detector when receiving. It also eliminates a lot of squeals from the receiver; the rest of which can be taken out by the bypass condensers C4 and C6. The transceiver is mounted on bakelite, and a fibre extension shaft 3 ins. long is used on the tuning condenser. This entirely eliminates body capacity.

The panel measures 6 1/2 x 5 1/2 ins. A bakelite subpanel extends back 4 ins. from the panel, on which is (Continued on page 183)
HOW TO BUILD THE "METAL-TUBE 5" T.R.F. SET

In this article the step-by-step procedure is given for modernizing a well-designed T.R.F. set to include the new "octal" (8-prong) metal tubes. The A.F. fidelity is excellent.

CLIFFORD E. DENTON

After waiting impatiently for samples of the new "metal" tubes, we were pleased when they finally arrived and immediately went to work and modified a receiver which had been designed for the conventional glass-envelope tubes, by changing sockets, etc., and various constants, in an attempt to see just where these metal-envelope tubes would differ from the conventional type. The first tubes that we received were the 6K7, 6J7, 6F6, and the 5Z4.

(In passing, the 6K7 is quite similar to the 6D6 while the 6J7 is similar to the 6C6. Our old friend the 42 power tube appears in a metal shell and is known as the 6F6. Another old timer appears, namely the 80-type rectifier tube, which, in its perforated metal jacket, is now known as the 5Z4.

The first thing that we found out about these metal tubes had to do with the mechanical angle. We found that the control-grid cap on top of the tubes is much smaller in diameter and the conventional cap will not fit. As no manufacturer has made a suitable cap as yet, the old-type caps had to be squeezed down and bent all out of shape to make a decent connection at the top of the tube.

Due to the closeness and smallness of the contact pins at the base of the tube, the sockets are much smaller and the contacts are much closer together. The type of socket which seems to work the best and permits of fairly rough handling without danger of short-circuiting the various contacts on the base of the tube through the socket contact, appears to be one where the socket is quite thick and offers a very deep seat for the key set locating pin on the tube base. With these practical considerations noted, we then proceeded to examine the tubes with regard to their electrical operation in comparison with "standard" (glass envelope) tubes.

THE MECHANICS OF THE JOB

A front-view photograph of the receiver in which the tubes were used indicates a lot of vacant space around the tubes. It must be remembered that this chassis was originally designed for glass-envelope tubes, and these small-size tubes offer tremendous economies in chassis size, as will be noted.

The reason for selecting a tuned R.F. job was two-fold. First, we had another receiver similar in appearance using the glass-envelope tubes, and this permitted direct comparison, which, after all, to the layman is the most interesting method of testing. Second, this particular type of receiver is best adapted to checking receiver performance on the basis of selectivity and sensitivity versus high-fidelity reproduction.

The detector tube of the receiver is of the bias type and has sufficient gain and rectifying efficiency to deliver ample audio signal to the A.F. power stage.

(Continued on page 183)

Looking at the bases of the 3 types of metal tubes used in this set.

Schematic circuit of the "Metal Tube 5"—a modernized T.R.F. receiver.
A VERSATILE 3-TUBE SHORT-WAVE RECEIVER-CONVERTER

This unit can be used equally well as complete receiver; or with a broadcast set, as a converter for S.-W. tuning.

LOUIS B. SKLAR

With the present all-wave receiver or a short-wave converter connected to a broadcast set, dissection is likely to occur in a family between the “short-wave” and “broadcast” fans. With this new arrangement, however, “Charlie” can take the “converter” up to his bedroom and have the time of his life listening to the King of England while mother and sisters sit comfortably in the parlor and rejoice in listening to the sweet melodies of the King of Jazz. And then again, if everybody in the family unanimously agrees that they would like to take a stroll around the globe on their radio receiver, Charlie and his short-wave “contraption” is dispatched from upstairs and the broadcast set becomes a short-wave set.

In addition to the double feature of this set, it is also so constructed that it can be used on either A.C., D.C., or batteries. The schematic diagram, Fig. 1, shows clearly how the three different types of electric energy can be applied to operate the set.

Of course, it is not necessary for every one to have the set built for either A.C., D.C. or batteries, except the radio Service Man or dealer who wishes to use it for display purposes at prospective customers’ homes, or if the set is to be used in two different places where in one of the places there is no electric current available, such as summer camps, farms, etc.

The reader will also observe a new method of I.F. coupling. For the sake of economy and somewhat better results the writer is using what could be called impedance-coupled I.F. amplification. Theoretically, it can be explained as follows: The I.F. current leaving the plate of the 6A7 tube has the choice of two paths: (1) through the R.F. choke 12; or (2) through R.F. choke 15 and midget variable condenser 16. Since 15 and 16 are connected in parallel and tuned to resonate to the intermediate frequency, the current will choose the path of least resistance and will pass through the 15-16 combination and very little current will pass through 12. Similarly, the current from the plate of the pentode section of the 6F7 tube will prefer to through 18-19 rather than through 26.

Some radio theorists may look with skepticism on this method of I.F. coupling, which, so far as the writer is aware, has never been used before. All the writer can say to anyone who is skeptical is to build a set and he will be astonished at the results obtained; in addition to a saving of about 400 per cent of the cost of a good I.F. transformer.

CONSTRUCTION

The construction of the set is very simple. All you have to do is follow the schematic diagram and see that all parts are neatly soldered. There is no special arrangement of parts; any neat layout will do.

The plug-in coils are shielded. The writer tried the set with and without shields on the plug-in coils and found that there is very little difference in results.

R.F. chokes 15 and 19 are shielded and, if possible, should be placed at right-angles to R.F. chokes 12 and 26. The change-over from electric to battery operation is accomplished by pulling out plug 40 and inserting plug 41. The schematic diagram also indicates that the electric supply can be built as a separate unit if this affords greater convenience.

When the set is completed, check the wiring and make sure that everything is OK according to the diagram. The next step is to align tuning units 15-16 and 18-19 so that they will resonate at approximately 450 kc. This can be done best with a signal generator.

If you have no signal generator you can attach the aerial to the control-grid of the 6F7 pentode and tune trimmer condensers 10 and 18 to a 550 kc. This will act as a substitute for a signal generator.

When the set is hooked up as a converter to a broadcast set the tuning (Continued on page 168)
"BLUEBEARD"  
A 4-TUBE T.R.F. SET  
This novelty receiver is an ideal adjunct to the children's room—or to the den.  
RUDOLPH STIENMEYER

DEIGNED especially for the den or children's room, "Bluebeard" becomes a highly efficacious means of keeping young Bobby Benson and Buck Rogers fans from cluttering up the living room during the late afternoon and early evening. In operation his eyes light up and he speaks through his beard, and a variety of amusing expressions obtain upon the faces of the listeners in as the different stations are tuned in or the volume control is varied. Little originality is claimed for the chassis: the circuit (Fig. 1) is strictly orthodox but the parts are arranged on the chassis to provide control of the tuning condenser by means of the right eye, and the volume control and switch by means of the left!

The chassis is so small that No. 18 gauge steel is sufficiently rigid. Aluminum may be used, but no great advantage is so obtained, and the fact that steel may be soldered anywhere without recourse to lugs makes its use desirable. It should, however, be plated with cadmium, tin, or zinc to prevent rust. Fig. 2 shows it folded and drilled. The parts may then be assembled in any order, since the design leaves all parts readily accessible. The holes in the back of the chassis are for ventilation and are very important since the heat developed by R7 is considerable. Incidentally, the correct adjustment for this resistor is obtained by moving the slider until the current flowing is .3 A. (hot) rather than by attempting to check tube voltages.

The "eyes" are simply ½-W. neon lights with which most radio men are familiar. They are dipped first in a frosting solution, and then partly immersed in a green pyroxylin lacquer to suggest the iris of an eye. Note that this dip should be slightly off-center. The orifice is represented by applying a blob of black lacquer in the center with a triangular slit to represent a "highlight"; and, incidentally, to act as pointer to indicate the position of the tuning control. See photo, Fig. A.

Years ago our common house lights had a different sort of base from that employed today. When the change was made, adapters had to be inserted into the old sockets to accommodate the new Edison-base bulbs. A diligent search of the average attic will yield a pair of these adapters; indeed, many electrical wholesalers still have them in stock. They are mounted to the condenser and volume control shafts by means of brass couplings which are tapped on one end to fit the threads in the adapter and drilled for the ¼-in. shafts and supplied with setscrews on the other. "Eye" details appear in Fig. 3. It will be seen that this arrangement automatically grounds one side of the bulbs, and well-insulated flexible leads connect the other side to the bakelite terminal block as seen on the photograph. The box is made of gumwood. The three sides are ¼-in. thick, the bottom ½-in., and the top 1 in., to provide for rounding off the corners. The box may be whittled with a jack plane, smoothed up with a coarse bastard file, and finished with sandpaper. Blocks ¼-in. square are glued in the vertical corners to reinforce the joints. It will be seen that the chassis slides into the box between a pair of cleats glued to

(Continued on page 106)

**Fig. 1.** The circuit of the receiver which is a conventional T.R.F. A.C.-D.C. type.

**Fig. 2.** The under side of the chassis, showing the "knob" sockets and speaker connections.

**Fig. 3.** Above. Details of tuning and volume knobs.

**Fig. C, lower left.** Details of the speaker mounting.  
**Fig. D, lower right.** Rear of the cabinet. Note the slots in which the chassis rests.
The circuit is built around the newer type 6.3 V. tubes and it has been tried out by the writer over a number of months so that it is certain to bring in the desired distant stations. It uses an untuned R.F. stage, a tuned regenerative detector and two audio stages. In all except the last audio or output stage 6C6 tubes are employed. In the R.F. stage and in the regenerative stage the 6C6 tubes are used as pentodes; in the first audio stage the 6C6 tube is connected as a triode. Resistance-capacity coupling is used between the detector and the first audio stage, and also between the first audio stage and the output stage. The 45 output tube has a power output of nearly 1 W., so that the volume and quality are more than ample.

Regeneration is controlled by varying the voltage on the detector plate. This method is very effective since it gives a smooth, even control of regeneration and at the same time permits the regeneration control-potentiometer to serve as a volume control.

Incidentally, the use of the lowly regenerative detector, while looked down upon by many so-called "big engineers," actually brings them in. This set will stand comparison with high-priced commercial sets and in many instances run rings around sets costing more than twice as much. The illustration shows only a few of the "veri" cards from Australia and other distant points received with this circuit which are proof of what it will do.

It will be noted that the circuit does not use a power supply transformer. Instead, the universal A.C.-D.C. circuit is used. This not only reduces the cost of the parts, but makes the set more flexible in that it may be used on any A.C. or D.C. line.

In designing this set, two alternative methods were available to make it an all-wave set. The one involved the use of a set of fixed coils with a change-over switch. The other involved the use of plug-in coils. In most commercial sets, the first method is employed. This method does not result in the highest efficiency, due to the losses inherent in switching and in the necessarily long leads to the coils. However, it is more convenient and this constitutes its main point of superiority. To offset the slight inconvenience in changing plug-in coils, the latter method produces increased efficiency. After all, the user of an all-wave set is primarily interested in hearing distant stations. For this reason, plug-in coils were selected for this set.

The new Hammarlund coils, which cover the band from 17 to 560 meters by means of five plug-in coils, are used. The variable tuning condenser is shunted by a small 7-plate condenser, thus providing a means for band spreading.

Rectification of the A.C. line potential is accomplished by means of a 2525 tube connected as a half-wave rectifier. A 300 ohm filter choke shunted by 16 mf. electrolytic condensers accomplishes nearly perfect filtering on A.C., reducing hum to a minimum.

INSTRUCTIONS FOR BUILDING

The parts which are mounted above the chassis deck include the variable tuning condenser, the dynamic speaker, the choke, the grid leak and condenser and the regeneration control. All other parts are mounted below the chassis deck. The antenna trimmer is mounted on the rear chassis wall with the coupling trimmer. These are shown in the top view. The bandspread condenser is mounted on the front chassis.

(Continued on page 169)
BUILDING THE PEANUT "5" SUPERHET.

A "new-old" set which has a lot of appeal for the enthusiastic set experimenter. This set has many possibilities for home and portable use. Midget tubes are used.

HOWARD G. McENTEE

This little set, besides being of interest because of its small size, is a contrast between the modern type of circuit, and what might be called the "old fashioned" type. The construction is as modern as possible, even the sockets being adapted to sub-panel mounting, but the circuit is one which was very popular back about 1922, when most tubes were general-purpose triodes, and the constructor had no such bewildering array to worry him as he has today. The circuit is called the Pressley, after its originator. It is designed to use a single triode tube as combined first-detector and oscillator, and yet prevent antenna radiation, which it does very successfully. It works on the Wheatstone bridge principle and is balanced so that no interlocking of the tuning circuits occurs.

The I.F. amplifier uses two iron-core I.F. transformers of the original type, while the air-core transformer, or "filter," as it was called, is a modern-type "interruption-frequency transformer" such as is used for high-frequency super-regeneration sets today. The intermediate frequency is around 30 kc.

The iron-core transformers can usually be obtained in secondhand stores, as the sets in which they were used were widely employed up to a few years ago. In case they are not available, it is quite possible to use 2 of the interruption-frequency coils, each one being tuned with a condenser across the secondary. This was tried and found to work perfectly, but the iron-core type was preferred because of its simplicity.

The transformers in the tuned circuits are those made for midget T.R.F. sets and come in sets of one antenna and one interstage coil, each in its own little shield can. The antenna coil is used exactly as it comes. The R.F. coil will need some work done on it, however. First, remove about 15 turns from the secondary coil, the one which is wound with stranded wire. Next, unwind about one-half the primary, which is wound with fine, single-strand wire. Also, make sure that the winding is in the same direction as the secondary, and if not, reverse the coil on the central wooden dowel. The primary should be slid up as close as possible to the secondary.

(Incidentally, to any of you who are experimentally inclined, the tuning coils offer an unlimited field, since none are available on the market which are small enough to use in this set. As most of the efficiency—or lack of it—comes from the circuits of the first tube, it pays to experiment for highest efficiency.)

The actual construction of the set starts with cutting the 1/16-in. thick aluminum pieces which form the panel and sub-base. The sub-base is, of course, cut in one piece and bent as shown on the drawings. After bending, the 5 holes for the sockets are cut, and then all the parts are spotted and mounted. In the original set, as few nuts as possible were used (as it is preferable on a small, crowded set of this type to tap all holes directly into the aluminum, so that the parts can be screwed on without the bother of using nuts). All the screws used are 6-32 except the two which hold on the dial plates, and these are 2-56.

It should be noted that the condenser tuning the oscillator coil must be insulated from the chassis. This is easily done with bakelite or fibre washers. Be sure the panel hole clears the shaft all around.

There are only two holes in top of the sub-panel for wires to pass down, these being from the variable condenser stators. Of course, four holes must be drilled or reamed out for the terminals of each coil to pass through.

(Continued on page 181)

Fig. 1, above. The schematic circuit. Fig. 2, below. The picture wiring layout.

Fig. A. The under-chassis view of the set. Note the iron-core I.F. transformers.
DESIGN PROBLEMS OF TUNING DIALS

WILHEM E. SCHRAJE

"Short-sightedness" is not only an ocular disability—it is, according to the author, also a manufacturers’ ailment!

WHILE tremendous strides have been made in radio receiver parts during the last few years, constructors have given little attention to tuning dials. That such is the situation can easily be seen by comparing present European dials with those of American design. Our constructors seem to prefer the old orthodox "electric meter" dial in use since 1850! More attention is today given to tuning dial decoration than to actual scale design. As a matter of fact, the present decoration fad is being overemphasized so much in many instances as to occupy twice the square-inch area allotment given to the really useful part of the dial—that is, the scale!

It is high time for the radio engineer to break down the dictatorship of the cabinet designer, and demand a tuning dial which will allow the listener to discard the "microscope or magnifying glass" so often needed for selective station tuning (especially on short waves). Modern tuning dials serve to promote activity for the oculist rather than to serve as a reative agent for the eye of the radio listener. The present high-fidelity movement toward fulfilling all the wishes of the musical-trained ear, should be accompanied by equal solicitude on the part of the engineer toward the welfare of the eye.

The average radio buyer merely asks for faithful speech and music reproduction, together with a simple method of station tuning. In order to learn the kilocycle indication for tuning in the desired station it is necessary today for the listener to refer to the radio program column in a daily newspaper or magazine. However, after "finding the proper kilocycle indication, and dropping the last cipher," the listener then must go through body exercises comparable to his daily dozen in order to adjust the tuning dial. Such body and head movements often consist of a 50 degree bending motion to the right or left, the angle depending upon the type of dial in use.

If the set dial is furnished with inclined numerals as in Fig. 1A, only the part indicated as "A" can be read without bending the head to right or left. Thus, about 50 per cent of the scale is ineffective insofar as ease of reading is concerned. Yet, surprising as it may seem, more than 22 per cent of American radio sets are equipped with this type of dial.

The same dial would be easier to operate if the numerals were horizontally arranged as shown in Fig. 1B. A scale (Continued on page 170)

![Fig. 1. above. The wrong (A) and right (B) way to number the tuning dial.](image1)

![Fig. 2. Poor (A) and good (B) dial angles.](image2)

![Fig. 3. Finding "optimum" size numbers.](image3)

![Fig. 4. above—Range "propeller" dial. Fig. 3, below. How we look at the dial.](image4)

![Fig. 5. Finding "optimum" size numbers.](image5)

![Fig. 6. above—Range "propeller" dial. Fig. 3, below. How we look at the dial.](image6)

![Fig. 7. above—Range window dial. Fig. 4, below. Finding "best" angle.](image7)

![Fig. 8. Two types of good dial lighting.](image8)
MAKING A 6-TUBE BATTERY ALL-WAVE "FARM-PORTABLE" SET

This deluxe battery receiver covers a complete tuning range of from 12 to 2,100 meters! It employs 2-V. tubes throughout, and operates with a minimum of "A" and "B" battery drain. It is ideal for the short-wave enthusiast, broadcast listener, and veteran commercial operator; and for European long-wave reception.

J. T. BERNSLEY

FOR SOME unaccountable reason the writer finds that in the numerous published constructional articles the subject of farm sets (particularly with modern features) is completely ignored. Of course the reader will find numerous battery sets of the short-wave type in practically any radio magazine that he may pick up. But, as a general rule, each was designed primarily to please the short-wave "fiend" or amateur exclusively, and as such were unsatisfactory and inefficient for broadcast and everyday reception purposes. The nuisance of plug-in coils, the tricky manipulation of a regeneration control, the rather broad tuning effect on the broadcast band, are all reasons why the rural listener cannot possibly adapt such a set for radio entertainment reception in the home.

Taking all of the above into consideration—the writer has designed a superheterodyne receiver (see the heading illustration, and Figs. A and B) that, in efficiency, appearance, and operation, compares with the finest of all-electric receivers—with several other meritorious features thrown in for good measure!

CIRCUIT DESIGN

Frankly, there are no tricks or peculiarities in the circuit (see Fig. 1) employed in this set. Everything is of conventional design—which, in the long run, makes for simplicity, and foolproof, consistent operation. Although only 6 tubes are employed full 9-tube efficiency is obtained by employing regular 2-V. tubes in a straightforward arrangement such as is used in the finer, standard all-wave electric sets.

This receiver may be employed for home use, as a table-model receiver since the case lends itself attractively for such a purpose, or as a portable radio set for beach, picnics, etc. Batteries and speaker are all contained within the case; and only a short, 20-foot wire extended on the ground is necessary as an antenna (a ground is not required). The weight of the complete receiver, with batteries, is approximately 25 pounds—not at all heavy for a receiver having the many features described in the text to follow.

No plug-in coils. Separate coils for each band, with a selective switching arrangement, are used in this portable. Small trimmers placed across each coil (excepting oscillator coils) compensate for any slight differences that may be created by the circuit wiring. Coils for a stage of tuned R.F., first-detector and oscillator, all tuned by a 3-gang variable condenser (350 mmf., each section) provide ample selectivity and gain, besides eliminating the conventional "birdies" and "tweets" which 2-gang superhet sets generally contain. A total of 15 coils is necessary to cover the complete range of from 12 to 2,100 meters (3 for each band) in 5 bands. No skipping of bands or any important wavelengths is the net result of such an arrangement.

A single high-gain I.F. stage furnishes ample amplification. The 1C8 tube (used as a composite first-detector and oscillator) has a translation gain of approximately 25 (practically) and is therefore equivalent to a stage of amplification in itself.

DELAYED A.V.C. EMPLOYED

In this receiver a type 25S tube is the equivalent of 3 separate tubes (triodes), and functions as a detector, A.V.C., and first A.F. stage. The tube is a duo-diode triode; one diode used for rectification, the other for A.V.C., and the triode for A.F. amplification. With this circuit, as shown in Fig. 1, a delayed A.V.C. action is obtained (Continued on page 171)
A "MULTI-SET" KIT FOR 1 TO 3 TUBES

Seventeen different circuits using from 1 to 3 tubes can be made from this flexible foundation unit plus a few parts.

W. E. HARRISON*

HERE is a new idea in radio set building—one which is sure to appeal to many set constructors and radio fans. How would you like to make a set which is so simple in construction that anyone, even though he doesn't know the first thing about a set can make it?

And then when you have tried it out and want to try something better—a set which is louder or will bring in stations from greater distances—you find that all the parts of the original receiver can be used in the new set.

This is the plan worked out for the "foundation kit" described below. From the single chassis and kit, plus a few additional, inexpensive parts, you can choose from 17 different circuits. These include battery, A.C. and universal A.C.-D.C. circuits and all will tune over the entire short-wave band as well as the broadcast wavelengths.

As an example of the type of sets that can be made, Fig. 1 shows a 1-tube A.C.-D.C. receiver using a 12A7 tube as both detector and rectifier. A glance at the circuit shows that each part is numbered as well as containing the value of capacity, resistance, etc., used. These numbers form the basis for the very simple instructions supplied for each of the 17 different circuits. Since the numbers correspond in each of the 17 circuits, changes from one circuit to another simply read—"remove the wire from 7 to 34", etc.

To give an idea just how versatile the "multi-set" kit is, a brief description of each circuit, and the type of tubes

(Continued on page 190)

USES OF THE CATHODE-RAY OSCILLOSCOPE

The analysis of A.F. circuits and tube testing by visual means with an oscilloscope are discussed this month.

F. M. PARET* Part II

THE general procedure in analysis work in audio equipment consists of supplying to the apparatus under test a voltage of known waveform and then comparing this waveform with the waveform at various points throughout the circuit. Any deviation in the wave shape of the output wave from the input wave indicates some form of distortion or overload.

It should be remembered that variations in amplitude between input and output waves do not indicate distortion. For comparison purposes it is advisable to adjust the gain of the oscilloscope amplifier so that the traces obtained are always of the same approximate amplitude.

A convenient method for comparing wave forms is to make a tracing of the input wave on a piece of thin paper which is then fastened in front of the cathode-ray tube. Any other wave then traced by the tube will show through this paper, and if the amplitude is adjusted to the correct value, any deviation in waveshape is immediately apparent. Figure 1 indicates the type of waves which might be obtained with second- and third-harmonic distortion, if the original input wave is a sine wave. It should be remembered that the phase relationships in the apparatus under test will determine the phasing of the fundamental with respect to the harmonics and consequently will affect the shape of the distorted wave.

The specific procedure to be followed is to connect the A.F. oscillator to be used to the vertical plates of the oscilloscope, directly or through the amplifier, adjust the sweep-frequency equal to the fundamental or to a sub-multiple of the oscillator frequency, and obtain a tracing of the input wave. The oscillator is then connected to the input of the apparatus to be tested and the vertical plates of the oscilloscope connected to the output or any intermediate point and the waveshapes compared. In this way overall performance as well as the performance of each individual component may be checked.

As the voltage input to the apparatus is increased, the change in distortion and the point of overload may be determined. Overload is usually indicated by a flattening of the top of the wave.

FREQUENCY RESPONSE

Frequency response of audio equipment and radio sets may be checked with the use of the sweep circuit. This method has the advantage that at the same time that (Continued on page 175)
AN EFFICIENT 4-TUBE ALL-WAVE SET

Electron-coupling and an unusual trap circuit make this A.C. all-wave receiver an ideal one for the set constructor.

WILLIAM KRANZ*

This A.C.-operated, all-wave receiver features electron coupling in the regenerative circuit. It consists of a 58 tuned R.F. stage, a 57 electron-coupled regenerative detector and a 2A5 power amplifier. It has a built-in power supply which utilizes an 80-type rectifier.

Electron coupling is a distinctive feature of this regenerative circuit. The electron-coupled circuit, originated by Lieutenant Dow, is perhaps the finest regenerator known in radio today. Unusual stability is only one of its features. In this circuit it supplies a regenerative control which is smooth and practically "non-detuning." In other words, it is not necessary to retune the set when shifting in and out of regeneration. This is a boon to any DX'er, especially when hanging onto a whisper from the other side of the earth.

The coils of this 4-tube all-wave receiver are accessible from the front of the panel, and are equipped with ready-grip handles to facilitate changing from one band to another.

An examination of the circuit shows several interesting points in addition to the electron coupling. The aerial coupler is so designed that a doublet-type aerial can be used for short-wave reception. In this case, terminals 2 and 3 connect to the two wires of the doublet. If a straight aerial is used, terminals 2 and 1 are connected together and number 3 is connected to the aerial lead-in.

Condenser C2 and coil 4-5 of the aerial coupler constitute a trap circuit (controlled from the panel) which is useful for reducing interference and increasing the apparent selectivity of the receiver.

Band-spread tuning can be added to this set by simply adding the condenser C shown dotted across tuning condenser C1 in Fig. 1. This band-spread condenser should have a capacity of 100 mmf.

The outstanding features of the set are: 1—low cost; 2—easy to build; 3—stability in operation; 4—ease of coil changing; 5—A.C. operation, entirely hum-free; 6—non-detuning regeneration; 7—adaptability to band-spread operation; 8—unit design making it (Continued on page 172)

Fig. 1. The circuit of the set—the speaker field supplies grid bias.

A CAMPER'S 4-TUBE PORTABLE SUPER.

This portable receiver weighs only 11 lbs. when ready for operation—making it a fine addition to the camper's kit.

EMANUEL MITTLEMAN*

Here is a portable receiver that will provide entertainment wherever it is carried. It will prove especially useful for outings, picnics, automobile trips, on boats, etc. It does not require any outside power source for operation as all batteries are self-contained.

The receiver incorporates one of the best battery superheterodyne circuits ever devised, using four multi-purpose 2V. tubes. One tube is utilized as first-detector and oscillator (type 1C6) one as L.F. stage (type 34); one as second-detector (type 32); and one as power output stage (type 33).

The large speaker reproduces music and speech with unusually fine quality. It is capable of handling the full output of the 33 pentode tube without rattenning or blasting.

A continuously-variable tone control is included in the set to permit variations of tone best suited for individual purposes.

The light weight and conveniently small size will make this set adaptable for many purposes. The complete receiver fully equipped, weighs, only 11 lbs. and measures 13 x 13 5/8 ins. Its compact construction, though, does not impair its efficiency, for a clever arrangement of the parts provides maximum selectivity and sensitivity with more than ample volume.

Batteries are easily accessible and can be changed in a jiffy. They are (Continued on page 172)

---

*Sales Mgr., Eagle Radio Co.

---

*Trymo Radio Co.
A NOVEL "ACORN"-TUBE REGENERATIVE SET

The use of the "acorn" tube on the broadcast band is entirely feasible as proven by this experimental set.

MICHAEL BLAN

for the "A" supply; and two 45 V. batteries of standard type for the "B"; grid-leak detection furnished maximum sensitivity and eliminated the need for a "C" supply.

It was decided to use our old standby, the "3-circuit tuner," in a regenerative circuit. However, to avoid the continual readjusting that ordinarily is necessary when tuning from one station to another, in order to main-

tain regeneration, we cast around for some artifice that might solve the problem.

We finally settled upon a solution that, in some respects, is quite novel.

If you're interested, and have all your Radio-Craft copies handy, you might refer to the article, "A New, Revolutionary Short-Wave Receiver," in the May, 1930, issue, wherein is described (Continued on page 173)

THE DEFLECTING PLATES IN CATHODE-RAY TUBES

THE BEAM of electrons which is projected in a cathode-ray tube from the cathode to the screen, is nothing more than an ordinary unidirectional (one-direction) electric current, since it consists merely of a beam of rapidly-moving electrons. Therefore, since it is the equivalent of a current-carrying wire without inertia, it can be deflected or bent by the application of the magnetic field of a magnet, of a current-carrying coil, or by a static field such as is set up between metal plates to which a potential is applied.

The latter method is the one used in the cathode-ray tubes employed in radio service work. These deflecting plates constitute the important elements as far as the actual use of the tube is concerned.

In Fig. 1A, plates P1 and P2 in one set are arranged almost parallel to each other in one plane along the axis of the tube, and are equidistant from the electron beam. They actually diverge slightly in the direction of the screen, so that even though they are mounted close to the electron beam.

The author gives further details about the action which takes place inside the cathode-ray oscilloscope tube. (Continued on page 172)
A 3-TUBE SHORT-WAVE "VARIABLE I.F.T." TUNER

"Variable selectivity" I.F. transformers result in true high fidelity. Correct aligning procedure is given.

DONALD LEWIS*

This 3-tube superhet, is not a "freak" receiver requiring delicate manipulation of many controls. There are only 3 controls—a volume, main tuning, and antenna trimmer. A 6A7 is used as the first-detector and oscillator, a 6F7 as the first I.F.

*Hammarlund Mfg. Co.

The chassis layout of the variable I.F. set.

amplifier and audio amplifier, and a 6B7 as a second I.F. amplifier, second-detector, and delayed A.V.C. tube, three tubes performing 7 functions. The 6A7 is a pentagrid converter, the 6F7—a combination variable-mu R.F. pentode with a separate triode, both sections of the tube employing a common cathode. The 6B7 consists of a variable-mu R.F. pentode and two separate diodes. (See Fig. 1.)

The first-detector and oscillator coils are the standard 4-prong plug-in type.

The new Hammarlund "variable coupling" air-tuned I.F. transformers are used, affording tremendously high gain with high-fidelity output. Two of the I.F. transformers used require slight changes for use in this receiver. In one unit, it is necessary to remove the control-grid lead, so that it appears at the bottom, and in the other unit the control-grid lead has to be brought out at the opposite end to which it now goes. This is done in the following way:

To change the position of the grid lead, first remove the collar from the top of the plunger rod which is held in place by one set-screw. Then take out the 4 screws—there is one on each side of the adjustment screws—on top and bottom. Now slowly and carefully remove the coil, being sure to see that the spring on the plunger does not (Continued on page 174)

A NEW IDEA IN SET BUILDING

Plug-in parts and a special chassis construction eliminate servicing difficulties and facilitate set manufacture.

H. K. BRADFORD*

(Continued on page 175)

Fig. A. The laminated base can be seen here.

The natural procedure tending toward the refinement of any mechanical device is based on shortcomings experienced with its use. For a good length of time all contributing members of the radio industry, that is, the design engineer, the manufacturer, the Service Man, and the buyer, have recogized certain faults which may be logically traced to inadequately engineered mechanical construction. Everyone associated with any branch of the radio industry will admit that in general, construction methods are largely of a "makeshift" character. Until now these methods have been the only ones known and it remained for someone to present a feasible remedy for this situation. Don H. Mills, Canadian radio service engineer, has not only done this but with his work has provided many other angles to the problem of facilitating the manufacture, sale, and servicing of receiving equipment.

The results of his five years of research and experiment in connection with this problem have been very gratifying. Through a carefully prepared system of case records of actual service jobs he has found that a good portion of radio troubles were directly or indirectly traceable to defective wiring and construction. All of Mr. Mills' work seemed to focus itself to a single solution which in one stroke eliminated all nuts, bolts, screws, mounting brackets, individual tube sockets, as well as hand methods such as wiring, soldering and assembling receivers.

Instead of the usual metal chassis, this receiver has simply a base plate of laminated construction, as shown in Fig. 1, consisting of alternate layers of (Continued on page 175)

Fig. 1. A detail of the laminated base showing how the "staples" replace connecting wires.

Fig. C. The parts are all provided with plugs to fit the eyelets in the insulated base.
HIGH-FREQUENCY currents generated by the oscillator of a modern radio transmitter have practically a pure sinusoidal form (sine wave), deviations from this form being corrected by adequate filtering systems. The pure sinusoidal current radiated from the antenna is commonly called the "carrier." The existence of the carrier can be detected by the receiver, generally through variations in the plate current. However, without the aid of high-frequency current from a local oscillator, the carrier cannot be transformed into an audible signal. As a figurative expression we might say that the "carrier" is similar to a blank sheet of paper—it is there but it does not carry a message. In order to perform this latter function the "carrier" must be modulated. By modulation we mean a continuous variation of the carrier from one set of conditions to another.

The carrier, having a pure sinusoidal form, has 3 independent characteristics (like all pure alternating currents): (1) amplitude, (2) frequency and (3) phase. Any of these elements can be varied in accordance with the frequency or the amplitude of an audible current, and, therefore, we distinguish three forms of modulation, namely: (1) amplitude modulation, (2) frequency modulation, and (3) phase modulation.

(It may also occur that the modulating current will cause continuous variations in more than one element; for instance, there may be simultaneously a variation of the amplitude and the frequency. The modulation then will be of the "mixed" type. However, we will limit this discussion to the simple forms in which only one factor varies.

AMPLITUDE MODULATION

All present-day broadcast stations use amplitude modulation, the action of which is described here. Figure 1A gives us an idea of a carrier before it is modulated. We see that the current during any cycle, the duration of which is T, starts with zero value (point a), increases gradually reaching a maximum value b at b' which corresponds to ¼ of the period T. Then it decreases gradually until it reaches zero at T (point c). After that the current becomes negative and at point d', or T/2, reaches a maximum value d' which is equal to b'b but has an opposite direction. During the last quarter of the period T the current gradually decreases and becomes zero again (point e). The cycle is now completed. The value b' (or d') is the amplitude and remains the same for any cycle as long as the carrier is not modulated.

Figures 1 B and C show two carriers of frequency fo, each modulated by an audio current of which the frequency fi is considerably smaller than fo. On the time axis, (Fig. 1B) ab represents the period of the carrier while the period of the modulating current is given by 0000. We see that during the period 0000, the amplitude of each R.F. cycle is no more a constant. It has a maximum value at A and B and becomes zero at 01. In this case we say that the R.F. current is completely modulated. On the other hand, the amplitude of the current shown in Fig. 1C never becomes zero, although it has a minimum value at a. Such a current can be considered as a combination comprising (a) a completely modulated current and (b) an unmodulated carrier.

A mathematical analysis shows that a completely modulated carrier can be considered as consisting of two unmodulated waves. The frequency of one of these waves is equal to fo + fi, and the frequency of the other is fo — fi. The amplitude of both waves is equal to ½ the amplitude of the carrier.

As an example, let us consider the case of a megacycle carrier completely modulated by a 1,000 cycle audio frequency. Here fo = 1,000,000 and fi = 1,000. The frequencies of the two waves are then 1,000,000 + 1,000 = 1,001,000 and 1,000,000 — 1,000 = 999,000. These two waves are commonly called "sidebands."

When the R.F. carrier is modulated by more than one audio frequency the resulting current can be considered as the sum of elements of which every one results from the modulation of the carrier by one of the audio-frequency carriers.

(Continued on page 178)
A NEW HI-FIDELITY "TWIN AMPLIFIER"

A 12.5 to 25 W. amplifier with novel design features using the new 6A3 power tubes!

CHARLES R. SHAW*

WITH the present-day high state of development in engineering skill and manufacturing technique it is possible to build into an amplifier an exaggerated characteristic along almost any line that could be named. Such an accomplishment, as a matter of fact, is not nearly so difficult as designing a product in which there is a well-balanced relation between the various aspects of fidelity, power output, gain, simplicity and economy of operation, input signal required to attain maximum output, etc.

For example, take the characteristics of gain, power output, and input signal required for full output, all of which bear definite relations to one another. Beyond a certain point no one of these characteristics can be built into an amplifier except at the expense of something else. Thus, excessive power must of necessity bring with it higher operating costs and, all other things being equal, power output beyond a certain point penalizes fidelity.

From this it seems clear that the dealer, Service Man or technician who desire to purchase, build, or design an amplifier for permanency and maximum utility must aim for a skilful "blending" of all desirable features in proportions that will most nearly meet his needs, and at the same time conform to sound principles of engineering design and construction.

When one realizes that the primary purpose of an amplifier is to provide amplification of audible signals and, in the P.A. field in particular, it must perform unfailingly during operating periods (especially for rentals), it becomes self-evident that if an amplifier is not dependable the primary reason for its existence (as well as financial remuneration of the owner) is threatened.

Unless you have had the experience of an amplifier going "dead" during a high-priced rental installation, or the closing of a show because of an inoperative amplifier, you cannot begin to appreciate the security and peace of mind one feels when working with a truly dependable amplifier.

Though dependability is a broad term, amplifier men define it as meaning "freedom from trouble," and freedom from trouble depends upon proper design, good workmanship and careful selection and assembly of the parts and units into a complete unit.

The secret of the unusual dependability of the amplifier illustrated in Figs. A and 1 is the twin-channel arrange-

(Continued on page 177)

RADIO-CRAFT'S "IDEAL RADIO SERVICE SHOP" CONTEST

"The real purpose of this contest is to offer the service man an opportunity to tell manufacturers of service equipment just what is wanted in the service field."

Signed JACK GRAND, DIRECTOR

LETTERS, letters and more letters; some very good and others with very good intentions! Each letter packed with suggestions that bid well for both manufacturer of test equipment and the Service Man.

Please bear in mind, when writing letters for this contest, that you do not need to own the equipment you wish to describe!

The real purpose of this contest is to offer the Service Man an opportunity to tell the manufacturers of test equipment just what is wanted in the service field.

The following are the names of 25 letter writers with prize winning possibilities—received before this magazine went to press. Understand, these names and addresses are not necessarily those of prize winners, but are merely those of contestants whose letters are of high calibre (in accordance with Rule 10).

There is still time to enter this contest—so write a letter telling about the test equipment you would want in your Ideal Service Shop (following the simple rules in last month's issue)—and win a prize. You can write more than one letter, if you wish, so if you have already sent in an entry, why not try again? Maybe your second attempt will be a prize winner!

Metin Gauthier, 928 Hollywood Ave., Salt Lake City, Utah.
T. J. Preston, 4221 Rose Ave, Sacramento, Calif.
Barker Radio Service, Grand Ledge, Michigan.
Clifford Warner, 150 Paul Street, Columbus, Kansas.
J. Ashbold, 54-65 Place, Massapequa, N.Y.
John W. Ettenson 120 N. Center St., Martinsburg, W.Va.
Clarence J. Noel, 1626 W. Washington St., Indian Orchard, Mass.
Verne P. Thumag, 227 N. Commercial St., Gambrillsville, Texas.
Louis Burtin, 1513 S. 110 St., Chicago, Illinois.
Tom Freeman, Essex, Iowa.
Bud Shaw, 256 North 1750 W., Salt Lake City, Utah.
Terrence Conder, 126 South 1750 W., Salt Lake City, Utah.
E. H. F. Conn, 126 South 2100 W., Salt Lake City, Utah.
T. J. Wilson, 150 Nottinham St., Plymouth, Penna.
Arthur Connor Jr., The Radio Service Shop, 1600 N. 4th St., Little Rock, Ark.
Lee J. Dean, 136 Cotton St., Mansfield, Philadelphia, Penna.
W. C. Ryan, 155 Bryant Ave., New York City, N.Y.
Joel G. Driskel, P.O. Box 958, Texarkana, Texas.
Robert C. Hamps, 315 Hamilton St., Fulton, N.Y.

(Continued on page 178)
THE LATEST RADIO EQUIPMENT

14-TUBE ALL-WAVE SET

A feature of this powerful all-band receiver (with wave-length ranges supplied to meet individual requirements) is the two-unit chassis construction. The complete audio system and power supply is mounted on a heavy steel base; mounted on sponge rubber is a separate, chromium-plated base containing all the R.P. and I.F. circuits, including the second-detector and A.V.C. Thus this section of the set is free on the main base; the tuning condenser is individually mounted on rubber. The undistorted power output, fed to two speakers, is 25 watts, from four type-45 tubes in parallel push-pull. Power transformer is tapped for use on 110, 135, 220, or 250 volts.

"HIGH-FIDELITY" HEADPHONES

These headphones, which operate on the piezoelectric principle (see Radio-Craft, July, 1932), have these features: light weight (6 oz.); non-magnetic; high sensitivity; impedance of over 50,000 ohms; high-fidelity response range of 60 to 10,000 cycles. The Rochelle salt crystal drives a tiny cone diaphragm.

THE NEW 6A3 TUBE

(rygrade-Sylvania Corp.)

The new 6A3 (two triodes internally connected in parallel), recommended for use in high-fidelity A.F. circuits, is expected to give much better service than the 2A3; it is much more rugged, and has better heat radiating qualities. Electrical characteristics parallel those of the 2A3, except for the filament, which is rated 1.0 A. at 6.3 V.

NEW TESTING EQUIPMENT AIDS

(Alden Products Co.)

An adapter (left) for using present analyzer plugs in the new "octal" (8-prong) sockets. An adapter (right) for testing the metal tubes in present tube checkers. The insulated clip in center is for metal tubes.

TUBE TESTER

(Radio City Products Co.)

In addition to readings for the usual tube short, omission, and leakage tests, the fan-type meter is calibrated for condensers.

(Continued on page 189)

Name and address of any manufacturer will be sent on receipt of a self-addressed, stamped envelope. Kindly give (number) in above description of device.

154 RADIO-CRAFT for SEPTEMBER, 1935
A NEW ENGLISH DIAL

A NEW dial which has many advantages over existing types was described recently in Wireless World magazine. The dial has just been patented by a well-known company in England; the description and illustration in the above magazine were taken from the patent disclosure.

The construction of the dial can best be understood by reference to the sketch Fig. 1, which shows a longitudinal scale calibrated in frequency or wavelength. The pointer is mounted on a sliding carriage operated by the cable which also actuates the drum and condenser rotor. As the spindle is rotated, therefore, the carriage and indicator slide along the front of the scale.

A lever, also indicated, rests on the flexible metal strip at the bottom of the dial. As shown, the position of this strip is adjustable by the positions of the set screws which, in raising and lowering the lever, make the pointer move quickly or slowly over the scale. Thus, by proper adjustment, the tuning of the condenser and its associated coils can be made to correspond exactly to the frequency or wavelength calibrated scale.

A NEW MAGNESIUM BATTERY

A NEW battery, suitable for portable sets, deaf aids and other small devices, has just been developed in England and will be produced shortly, according to Wireless World.

It operates on an entirely different principle than other “primary” cells which are in use. The Gordon cell, as the new device is called, consists of a carbon tube within which is a rod of magnesium, the space between the rod and tube being filled with a wick of wood-wool. Four of these tubes are wired in parallel and the projecting wicks are bunched together. The electrolyte is tap water which is added to a level about half way up the wick section. A piece of potassium bromide is placed under the wick to reduce the internal resistance of the cell.

This cell does not polarize—it can be used for either intermittent or continuous service, supplying the same

(Continued on page 177)
FIRST PRIZE—$10.00
RESISTOR AND CONDENSER COMPARISON METER. Illustrated in Fig. 1 is a very practical instrument for the radio laboratory. It is a comparison meter for determining the values of resistors and condensers. The instrument has a range from 500 ohms to 1 meg. on the resistance scale and 0.05-mfd. to 8 mfd. capacity on the other scale. In making the instrument I would like to suggest that the inclined cabinet is the best as it will give full vision of the panel while working on the set. This saves the time of walking back and forth to observe the value.

SECOND PRIZE—$5.00
CLOCK-COMPARE VOLT METER. By using a couple of clock gears, strips of brass, battery wax and a shaving-tube cup, a fairly serviceable tuning control can be fashioned to resemble an airplane dial, as shown Fig. 2.

THIRD PRIZE—$5.00
KEEPS TEST LEADS HANDY. Keeping test leads handy on the service bench is always a problem. At our shop we have used the arrangement shown in Fig. 3 successfully and it has saved a great amount of time.

HONORABLE MENTION
A TUBE "SHORT" TESTER. This is a worthy addition to any tube testing equipment, and is very simple in construction and use. As may be seen from Fig. 5, the switch is the heart of the tester and will have to be home-made. Any 7-point switch will serve, but the arm must be replaced with a 7-contact fan, as shown. The seventh arm is of bakelite, with a contact on the end, which is connected to the circuit with a flexible lead.

HONORABLE MENTION
This dual comparison tester uses the very minimum of equipment.

HONORABLE MENTION
A GOOD, CHEAP, LOW-READING OHM METER. By using a trickle heater in series with a 0.1 ammeter and a resistor, it is possible to read quite accurately, resistances of around 500 ohms. As shown in Fig. 4, the units may be mounted together for convenient handling. The resistor is chosen so that the pointer is at the right end of the scale, just as any other ohmmeter.

HONORABLE MENTION
A TUBE "SHORT" TESTER. This is a very useful combination for checking R.F. coils, shorted turns, or as well as electrical equipment such as motors, irons and the like.

HONORABLE MENTION
Fig. 1. This dual comparison tester uses the very minimum of equipment.

HONORABLE MENTION
Fig. 2. A home-made airplane-type dial.

HONORABLE MENTION
Fig. 3. This keeps the leads from tangling.

HONORABLE MENTION
Fig. 4. A low-range ohmmeter.

HONORABLE MENTION
Fig. 5. Simple tube-shot tester.

HONORABLE MENTION
Fig. 6. How to figure watts drain by use of the regular house power meter.

HONORABLE MENTION
Fig. 7. A flashlight ohmmeter.

HONORABLE MENTION
This apparatus is very useful in checking R.F. coils, shorted turns, or as well as electrical equipment such as motors, irons and the like.

HONORABLE MENTION
A TUBE "SHORT" TESTER. This is a very useful combination for checking R.F. coils, shorted turns, or as well as electrical equipment such as motors, irons and the like.

HONORABLE MENTION
A TUBE "SHORT" TESTER. This is a very useful combination for checking R.F. coils, shorted turns, or as well as electrical equipment such as motors, irons and the like.

HONORABLE MENTION
A TUBE "SHORT" TESTER. This is a very useful combination for checking R.F. coils, shorted turns, or as well as electrical equipment such as motors, irons and the like.
"CONTROLLED SOUND"
FOR MODERN THEATRES

Over 30 performances have proven that proper control of sound induces physiological, physical and psychological effects—hysteria, for instance, in 40 seconds! (Controlled sound and 3-dimension movies would go far toward producing highly dramatic talkies.)

HAROLD BURRIS-MEYER

A TECHNIQUE has been developed for making sound in a theatre as controllable and as dramatically useful as is its light. Now, after 4 years work, and after checking the technique in over 30 performances, we find that not yet has there been a play which was not rendered more effective through the dramatic use of controlled sound.

By the "dramatic use of controlled sound" we mean increasing the effectiveness of the play: first, through the control of the intensity of any sound which may be used in the theatre; second, through the control of pitch; third, through the control of quality; fourth, by controlling the apparent direction from which the sound comes; and, fifth, by controlling the form of sound, that is, making it reverberant or non-reverberant as the play may demand.

It is axiomatic that in all cases the quality of the sound used in the theatre must be such that the audience shall never be aware of the presence of sound-reproducing apparatus.

Once this fundamental condition has been realized in practice, it then becomes possible to induce physical, physiological and psychological reactions; for instance, hysteria can be induced in a theatre audience in about 40 seconds!

The technique of "controlled sound," which has been developed along dramatic lines (as will be described) in the Theatre at Stevens Institute of Technology, involves only apparatus which is generally known to sound engineers. In fact, "auditory perspective" (see "The Third Dimension in Music," Radio-Craft, May 1934) is one of its most useful features—(though, for theatrical purposes the 3-channel system demonstrated by the Bell Laboratories is less useful than the mixing of outputs to 3 reproducers). "-controlled sound," which overcomes many interpretive difficulties long confronting the playwright and producer, and which opens up a new field to establishing and controlling audience reaction, constitutes a new tool for the artists in the theatre.

Theatrical presentations appeal to the audience through the senses of sight and hearing. What the audience sees is controlled by the lighting; what the audience hears, heretofore has been limited by age-old mediums—the human voice, effect machines, and musical instruments. Now, by proper choice of locations for suitable types of reproducers, and by complete control of the audio output, the audio appeal may be made as flexible and complete as the visual appeal.

EQUIPMENT REQUIRED

The reproducer system ordinarily used in the Stevens theatre incorporates 3 pairs of speakers (high- and low-frequency units—called, respectively, "tweeters" and "woofers") on the stage, 5 more speakers of various characteristics built into the proscenium (Continued on page 185)
"DOLLAR DISTANCE GETTER"

Editor, Radio-Craft:  
Tell Hugo his “distance getter for a dollar” got XEPN, the Pacific Coast, Denver, Salt Lake City, etc. But to make ‘er tune right I had to cut ¼” off sides of variable condenser. I also had to use insulated guide strips—the tin strips made ‘er bowl like a Blackfoot Injun.

I claim she’s a dandy. (Am 60 Years old)

E. L. Bricker, Jerome, Idaho.

Thanks “E.L.”, and keep up the good record. As a trouble shooter, you seem to be doing a swell job of holding your own with the younger experimenters who build radio equipment from any available material.

We do not have first hand information regarding the decibel level of a Blackfoot Indian’s A.F. output, but we presume the gain is up quite a bit.

"BROAD TUNING COMPLAINT WITH ZENITH 705"

Editor, Radio-Craft:  
My attention was called to a small article in your May 1935, issue, suggesting a change to be made in the circuit of our Model 705 and 715.

If this change that you suggested were made, the bias would be removed from the 2A6 tube. To make the change that you suggest would have two undesirable effects—the life of the 2A6 would be shortened very, very materially, and the quality of reproduction would be injured. The small amount of bias that the diode plate receives from this bias resistor is negligible, being on the order of 1.1 volt.

Prankly, I do not see any reason at all for any improvement in the operation of the set if this change were made, and it certainly produces some undesirable effects. Will you kindly publish a correction on this error?

Zenith Radio Corporation,  

We publish the following (author’s) reply on this correction without comment.

Editor, Radio-Craft:  
Regarding the article of mine you printed in the May issue of Radio-Craft concerning removal of QAVC from the models 705 and 715 Zenith radios.

We have gone to considerable trouble in determining the best and easiest method of removing the QAVC in these sets without impairing the tone quality. The results are as follows: first we removed the grounded end of the second-detector grid-return resistor (0.12-meg., ¾ W.) and connected it to the cathode of the 2A6 tube, which would ordinarily obtain our desired results. Due to carelessness in designing this set, however, it would then oscillate at the 550 kc. end of the dial, making it necessary to put a bypass from one side of the A.C. line to the chassis and also a larger condenser across the screen-grid of the I.F. tube. These latter conditions are probably the reason the manufacturer had to use QAVC in these sets to cover up the undesired effects. Otherwise there is absolutely no reason for using QAVC on this set as it is small with very little power, the way the manufacturer built it.

The method of removing QAVC that I have in my article was the one we finally decided on, because by just removing the bias from the 2A6 it was unnecessary to install the additional bypassing that I described above. We noticed no change in the tone quality under actual practice, even though we are more familiar with tone impairment that comes from insufficient bias on tubes than the manufacturer, due to our very close contact with the people who have to be pleased (the buyer). Also the rating of plate current of the 2A6 tube is .5 ma. and in making this change the plate current does not exceed this value.

We have made this change in about fifty of these receivers and have not as yet had any complaints on the sets but have numbers of the sets sent in to have this change made, alone.

We think that if more of these so-called engineers would try and listen instead of harping, we Service Men would have less “rebuilding” to do on sets, and more plain “servicing.”

Harry L. Chaney,  
Piedmont Radio Service Co.,  
Charlotte, N.C.

"WHO’S WRONG?" OR, "WHY SUPPRESSORS ARE WRONG"

Editor, Radio-Craft:  
I could not help but notice the answer to the question asked by A. F. Richardson on sparkplug suppressors in the June Radio-Craft.

Having been engaged in Aeronautical Engineering for a number of years, and for four years assigned to radio ignition (Continued on page 179)
THE LISTENING POST FOR ALL-WAVE DX-ERS

C. A. MORRISON

The listening post of R. T. Coales at Southsea, England where 4AY was received

The 25 W. station 4AY at Ayre, Australia showing the combined station and studio.

IT IS not generally known that often during the latter part of August, and especially during September, some of the best broadcast band foreign DX-ing may be experienced from New Zealand and Australia. Get your receiver all tuned up, your tubes tested, your aerial in good shape,—then wait for a fairly cool clear night—sharpen up the old pencil, open the log book, and you may be surprised at the way the “Aussies,” and New Zealand stations will come in. Approaching Fall here means approaching Spring in the Antipodes, and with the seasons nearly similar, good conditions for this type of long distance reception will be most auspicious. In New Zealand we find a complete renovation of the present class “A” Government stations in progress. Station 3YA, of Christchurch was the first to receive its full complement of 10,000 W., and it has been operating on 720 kc. with this power for quite some time, many DX-ers having already logged and verified it last Spring. 1YA, Auckland, New Zealand, on 650 kc. has also been testing with 10 kw. power, and 4YA, Dunedin, New Zealand, on 790 kc. will be completed and using 10 kw. in the early Fall. Our old time favorite and one of the most popular broadcast stations on the air for many years, 2YA, of Wellington, New Zealand, will become the super-power station of New Zealand and construction has already started (on the station) which will eventually make it a 60,000 W. transmitter by summer of 1936. 2YA, when it was only 5,000 W., was one of the most consistent of all stations in this part of the world. We wonder what it will sound like with a 60kw. voice?

Then a hop over to Australia where we find even more drastic changes in the radio set-up taking place. In addition to the fine group of Government or national stations now in operation we find several regional stations of from 7½ to 10 kw. being erected to supplement the present service. These stations are so erected that they can later be changed to 60 kw. power. In order to place these stations firmly in your mind we suggest referring to the August copy of Radio-Craft, which contains a complete list of “Aussies” (as they will be after Sept. 1st).

A powerful broadcasting station is being erected in the Fiji Islands, and even in Borneo we hear talk of a station, for so the first time this fall we may have these two new countries to shoot at.

It is well to remember that the open season for catching broadcast stations in Australia and New Zealand is from the latter part of August to the first part of November, only, so that it would be well to get an early start on what promises to be such a favorable season. The best time to tune for the “Aussies” and “Zedders” is always just about an hour, or half-hour before dawn (your local time); however, when at their peak strength they are sometimes received on clear channels after daybreak, especially on the Pacific Coast.

WORLD-WIDE SHORT-WAVE PROGRESS

In the building of new stations, and the adding of increased facilities is by no means restricted to the broadcast-band stations as in the short-wave world we find an almost feverish activity taking place, as nation after nation swings into line with a national or empire short-wave service modeled after those pioneers, Doventy, and Deecew. The latest country to swing into line with a period to tell the world about their own country is Japan, which recently inaugurated a world short-wave hour consisting of Japanese news, English news, and typical Japanese music and entertainment. This is of peculiar interest to us here, as the Oriental element in short-wave reception has been none too consistent to the present time, and this seems to add a balancing touch to the continental variety which has been interspersed with South American song and rhythm.

Pontoise, France, or Radio Colonist, the official voice of France, will soon blossom forth in a new building at Villejust near Paris, and with the most powerful short-wave transmitter in the world to the order of 120,000 W. The Government has authorized frequencies for the new station on all of the short-wave broadcast bands.

Sweden, heretofore a very vacant spot in the short wave’s log, is reported busy building an empire broadcaster for countrymen abroad.

Iceland, despite its name, a country where very cold weather is extremely rare, seeks to break down its isolation by constructing a very fine short-wave transmitter which should be testing by the time this article is in print. According to the new Govt. list of Reyjavik’s new transmitter will use the following calls, and frequencies: TFI, 5,058 kc.; TFK, 9,060 kc.; TFL 13,965 kc.; TFM 15,740 kc.; TPN 17,890 kc.

KGU, Honolulu, Hawaii, long one of the most popular of broadcast band stations, will soon have a short-wave relay and the haunting strains of their native melodies will be served to the world.

In all this feverish activity only the United States it... (Continued on page 180)
ANALYSES of RADIO RECEIVER SYMPTOMS
OPERATING NOTES

CROSLEY 58

This is a 5-tube T.R.F. set using three 24-type tubes, one 45-type and one 80-type. The tone, volume handling ability, and effective sensitivity were pleasantly improved by a simple and inexpensive circuit change. It can be applied to many small receivers, particularly orphan and strange-name sets.

The set came to the shop "dead," with the information that before the burn-out, the fading was bad at all times. The common screen-grid bypass condenser had shorted, burning to a crisp both the screen-grid voltage dropping resistor A and the stabilizing resistor B—see Fig. 1A.

Original data was not at hand, and since the color coding was burned off, a 30,000 ohm 1-W. and a 50,000 ohm 1-W. resistor were used for A and B, respectively, bypassed by 25-mf.

This made about 90 volts available at the screen-grids and restored operation for a few minutes until the signal completely faded out. It could be seen that the "24" heaters slowly dimmed out. Transformer voltages were correct at the terminals. Inspection showed that the chassis ground was used as one side of the filament line from transformer to tube sockets. I left that side of the filament line grounded but also ran an insulated lead from the transformer 2.5 V., secondary to the sockets as a regular filament wiring job.

This eliminated the fading but the set operated with a low overload point and characteristic distortion. This was normal according to the owner but I thought conditions could be improved.

Since the power detector is resistance coupled and actually gives it a low plate voltage, the poor operation was due to excessive voltage on the screen-grid. I disconnected the detector screen-grid from the R.F. screen-grids and loaded it with a 25-mf., 400 V. condenser as shown at B, Fig. 1. This reduced the screen-grid voltage to the correct value for A.F. service.

The connection of the 25-meg. resistor to the detector plate may seem unconventional, but it takes advantage of extra filtering of Y and Z and actually produces better results than taking the screen-grid voltage through this resistor connected to "B plus."

Percy Steelman

A.C.-D.C. HINTS

CLIMAX—EMERSON

I am radio service manager of a department store, and I wish to submit these hints which I have found in 50 of the following receivers.

Climax 4 tube A.C.-D.C. set. Little or no volume can be traced to an open in the detector load-resistor. Replacing this with a good 0.5- or 1-W. resistor. The value of the resistance is 0.5-meg. as shown at A in Fig. 2. The detector plate voltage should be about 15 V. when the resistor has been replaced.

Emerson 4 tube A.C.-D.C. receiver. In many of these sets I have found that distorted reproduction and low volume are caused by a defective condenser. The condenser is connected between the plate and cathode of the 38 type A.F. tube as shown at B of Fig. 2. In most cases it will be found to be shorted. This condenser should be replaced with a good .004-mf. condenser.

Vito Daidone

HUM IN SPARTON 57

When an A.C. hum appears in a Sparton 57, the set will act and sound as though a filter condenser is open. After checking tubes and condensers the trouble will be found to be caused by a loose connection in the first-detector coil. This wire is shown at X in Fig. 3. Resolder connection on front side of coil where the single wire connects, and the trouble will be remedied. (I have had 4 of these sets to service and all had the same trouble.)

Emery L. Duffield

"SOUND" EXPERIENCE

I am a sound motion picture operator. Recently at a continuous show, the volume of the P.A. system would keep gradually fading. The "fader" was increased each time to compensate for it. Finally a point was reached where no additional increase in volume could be obtained. A new set of tubes was inserted in the amplifier but the trouble still persisted. A spare amplifier was used but did not help!! The manager was in the booth and I inquired if he had been handling the reproducers backstage, to which he replied that he had. He was then requested to disconnect the horns that he had connected with the regular reproducers. This restored the volume to normal. Later I found that the gradual decrease in sound had been caused by a gradual shorting of reproducer leads which were lying on the stage, in the rear of the screen, by water soaking into the leads. This was caused by a window which had been left open during a heavy rainstorm.

Eino A. Kasari

(Continued on page 184)
COMBINATION CONDENSER

Radio-Craft, ORSMA Department:

Band-spread tuning condensers in one unit with a regular straight line tuning condenser can often be added by Service Men to short-wave sets as another source of profit. The condenser can be made in one unit supplying a combination of straight tuning with automatic band-spread at any desired setting of the main tuning dial. The automatic band-spread dial is in the center of the main tuning dial, as shown in Fig. 1. The combination is then a two-in-one affair, with all tuning centered on one dial.

Bakelite can be used for the band-spread shaft which will also reduce body capacity. The rotor shafts of the larger condensers should be drilled directly through the center for a 1/8-in. rod. If the band-spread condenser has a 1/4-in. shaft, a "reducer" should be used to couple to the smaller-diameter shaft. The job is completed by drilling the dial proper for a small knob. This feature will supply band-spread tuning for any desired setting of the dial, and bring in all kinds of stations that otherwise would never be heard.

GEORGE F. BAPTISTE,
Howard, R.I.

Thank you for your suggestion, Mr. Baptist. However, we suggest that the work can be made easier by obtaining variable condensers with the shaft hole already drilled out.

AUTO VIBRATORS AGAIN!

Radio-Craft, ORSMA Department:

I am not a member of your department, but as an old reader I thought you might be interested in one of my experiences.

Mr. Jesse Smith, Jr.'s question (Radio-Craft January 1935) about auto vibrators is what prompted this. I find by actual experience that the best thing to do when a vibrator gives trouble is to replace it, especially those that are designed for mechanical rectification. Some of these have screws for adjustment but I have never been able to get one to "stay put."

The unit will work fine until it is replaced inside the can and then it is as bad as ever.

I have experienced very little trouble with those using tube rectification. I have found leads shaken loose on Pors and on other make of which I have forgotten, solder had run and almost short-circuited the points; for a time, the flux furnished insulation and thus the trouble did not appear for several months.

Let me take this opportunity of expressing my satisfaction with your excellent magazines. I used to read The Electrical Experimenter when all "radio" was "wireless," and I obtained all my radio education from your original "Radio News" and "Radio-Craft."

I especially enjoy your editorials, and I have seen many of your prophecies come to pass.

Ben F. Rikard,
Hearne, Texas.

Fig. 1. A method of making band-pass condensers.

Fig. 2. Reinforcing springs in M-116 connector.

RCA-VICTOR "PORTETTE" SUPER-HET.

Radio-Craft, ORSMA Department:

The RCA-Victor M-116 is a portable radio receiver for either automobile or home use. Trouble develops in the cable to the set when it is repeatedly moved in and out of the car. This is caused by the contact springs in the plug being too soft. In order to cure this condition I cut a piece of rubber to the shape shown in Fig. 2. Be sure that the rubber is "live" and 1/8-in. thick. To insert the rubber remove the rivet in the center of the plug with a sharp screwdriver and then remove the two discs that hold the spring contacts in the slots. Fit the rubber pieces (cut as shown) into the inside of the springs. Finally, be sure when taking off the cross wires of the plug that they are also put back in their respective places. The other two prongs are for the "A" wires.

Clarence J. Noel,
Indian Orchard, Mass.

A very good idea Mr. Noel. It would be advisable for all installers and Service Men to make this change before the plug actually causes trouble.

(Continued on page 178)
ONE-TUBE A.C. SET

(335) Mr. J. J. Moreland, Buffalo, N.Y.

(1) I have a "Radiant Jr." 1-tube A.C.-D.C. set which requires repair. What is the circuit used in this set?

A. The development of the 12AX tube made possible the development of the "Radiant Jr."-in the circuit diagram of which is shown in Fig. Q.335A. Figs. Q.335A and Q.335B show the front and chassis side views of this single-receptacle receiver. (This circuit arrangement can be used for a single-band set or one with plug-in coils if preferred, rather than the band-switching arrangement shown in Fig. Q.335B.)

RESISTOR WATTS RATING

(336) Mr. M. Bernstein, Clearwater, Fla.

(1) Will you please let me know how the watts ratings of resistors are figured. I have had some trouble with resistors overheating, but I thought they were of sufficient capacity to carry the load.

A. Resistors are usually rated as capable of carrying a certain amount of power when they are surrounded by a foot of open air. This is illustrated in Fig. Q.336. Thus in the crowded quarters of the modern sets, particularly theidget type, the resistors must be chosen with this fact in mind.

Another factor which should be considered concerns the set components which surround the resistor. Such parts as coils and electrolytic condensers cannot stand much heat. Taking these two points into consideration, the resistors should be chosen with a very ample safety factor, and in some cases double or even triple the normal rating will not be too high.

THE "NON-RADIATING" PRESSLEY SUPERHETERODYNE

(337) K. L. Max, Akron, Ohio.

(1) I wish to experiment with a superhetodyne using triode tubes throughout; and with a combined oscillator and first-detector. I believe such a circuit was developed some years ago, and was said to be absolutely non-radiating. I would appreciate any such circuit you can give me.

A. One of the most successful sets of the type you mention was the Pressley superheterodyne, the circuit of which is shown in Fig. Q.337A. This utilizes a "balanced bridge" circuit similar to a Wheatstone bridge, as may more easily be understood from a study of Fig. Q.337A. If an oscillatory electromotive force is impressed from D to E, and it is desired that no current pass through the loop connected from A to B, the constants of the circuit C1, C4, C1 and C2 may be adjusted (just as a resistance bridge may be balanced) so that no current will pass through the loop. It follows, therefore, that no energy from the oscillator can be radiated by the loop antenna, but an incoming signal...
FIG. Q. 338A. Appearance of the phonograph adapter.

**PHONOGRAPH ADAPTER**

(35) J. Franklin White, Morristown, N.J.

(A): I would like to add a phonograph to my M-A radio set, but there is no provision on the set for such use and I hope to undertake any circuit changes in the set. Will you show me a possible connection of a phonograph pickup?

Weber's phonograph adapter has been developed for just such a use, and it can be used practically on any A.C. radio set and without any circuit changes in the set itself. (See also, How to Make a Novice Portable A.F.I., Phonograph Attachment, 'Indu.' Apr. 1941.) The adapter is a miniature broadcasting station, which is modulated by the phonograph pickup, and the quality of reproduction is equivalent to that of the set of the nearest local broadcaster. The adapter is a self-contained unit and can be used without any circuit changes in the set. The only connections are to the pickup and to antennas and speakers which are used in the set itself. A self-contained switch makes it possible to shift instantly between regular radio reception and to the phonograph pickup.

Fig. Q. 338A shows the circuit diagram of this adapter, while Fig. Q. 338B shows the outward appearance.

**SET CONSTRUCTORS**

The following interesting Crystal and 1-, 2-, and 3-Tube Circuits (and Articles) have appeared in past issues of Radio-Craft in order to conserve space the following legend has been used.

(A) = Short-wave converter
(B) = Short-wave receiver
(C) = All-wave receiver
(D) = Broadcast receiver
(E) = Broadcast booster
(F) = Broadcast pickup
(G) = Crystal

**RADIO-CRAFT for September, 1935**

163

**P.A. QUESTIONS & ANSWERS**

Conducted by

CHARLES R. SHAW

Here is a new department for the Radio Iskate. Service Man and Sound Technician who need more information and help in P.A.-work. This department will furnish valuable advice for the service-man. Address all questions to the Editor's Office. Publici Address. Forum. Only those questions of general interest will be published and we reserve the right to publish any of these inquiries and answers.

**MIKE CUT-IN**

(11) Mr. Sam Hoenikman, Chicago, Ill.

(Q.) How can I quickly cut a microphone in and out of a preamplifier circuit? I have tried a few methods but a slight click is always heard in the amplifier output and a hum is heard in the "off" position.

(A.) A switch near the microphone will naturally introduce a mechanical noise which is picked up by the microphone before it goes through the amplifier. The effect of this can be eliminated by a "selective" switch which should be separated from the microphone by a suitable distance. The hum in the "off" position is caused by an "open line" switch. The switch should be arranged to short and not open the line when in the "off" position.

**AMPLIFIER HOWL**

(12) Mr. Albert Marshall, Cincinnati, Ohio.

(Q.) My amplifier system is rated 10 W., yet I can never get more than approximately 2 W. out of the system before it begins to howl and squeal. I understand this is audio feedback. How can I avoid it?

(A.) The only way to eliminate feedback is to keep the sound waves coming out of the loudspeaker away from the microphone. This is best accomplished by using directional microphones, either high-frequency or directional microphones, or by separating the loudspeaker from the microphone so that the sound reaching the microphone from the loudspeaker is of insufficient strength to activate it.

**ESTIMATED DB. GAIN**

(13) Mrs. Harry Palmer, Ontario, Canada.

(Q.) How can I quickly estimate amplification gain or "loss" of a circuit from its decibel rating without the use of graphs or higher mathematics? I do not understand logarithms and the usual formula is of no use to me.

(A.) Approximate conversions of either "gain" or "loss" may be made from db. ratings without the use of graphs or charts by remembering that db. gain of 10, 20, 30, 40, etc., represents the figure 1 followed by the number of zeros equivalent to 1/10 of the db. rating. For example, 40 db. is equal to a gain of 1 followed by 4 (1/10 of 40) zeros or 10,000 times. Similarly, 50 db. represents a gain of 100,000 (1 followed by five zeros).

**A MIKE PROBLEM**

(14) Mr. Jack Lanzing, Miami, Florida.

(Q.) How are microphones picked up from large areas? I have never tried anything more than four microphones spread across a stage 40 feet wide.

(Continued on page 192)

www.americanradiohistory.com
Radio Service Data Sheet

REMLER MODEL NO. 36 6-TUBE DUAL-WAVE AUTO-RADIO

(Bands covered: 540 kc. to 1,700 kc., and 2,200 kc. to 6,800 kc.; dynamotor power supply; anti-noise conditioning; heavy "police"-type construction; easily-adjusted antenna compensator; tone control; automatic volume control; three stages of A.F.; tuned R.F. stage.)

![Diagram of the Remler Model 36 radio]

A most unusual feature of this set is the use of a dynamotor in the power supply, in place of the usual vibrator. This unit is guaranteed for one year, and needs no oiling or attention of any kind. No rectifier tube is needed. Six tubes are used, all for actual reception. The "batt" battery lead into the set is completely filtered, making suppressors unnecessary on many makes of cars. A single 3/8-in. hole is needed for mounting. Normally furnished with connections for operation in cars with positive side of battery grounded. This can be changed to grounded negative by reversing two battery leads on the terminal strip on the underside of the set. The dial is calibrated in channels, the addition of one cipher to the markings giving readings in kilocycles. On the right-hand position the short-wave switch gives coverage of the broadcast band as well as the lower-frequency police band. On the left position, the dial covers from 2,200 kc. to 6,800 kc. In some cases the car antenna will not be sufficient for long-distance high-frequency operation. When better results are desired with the car parked, a 50 foot wire, with the far end as high as possible, may be used.

The various operating voltages are given in the following table:

<table>
<thead>
<tr>
<th>Tube</th>
<th>Cath.</th>
<th>S.-G.</th>
<th>Plate</th>
<th>C.-G.</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>3</td>
<td>80</td>
<td>215</td>
<td>1.0</td>
</tr>
<tr>
<td>V2</td>
<td>3</td>
<td>80</td>
<td>215</td>
<td>0.6</td>
</tr>
<tr>
<td>V3</td>
<td>3</td>
<td>80</td>
<td>215</td>
<td>0.6</td>
</tr>
<tr>
<td>V4</td>
<td>215</td>
<td>195</td>
<td>-</td>
<td>1.5</td>
</tr>
<tr>
<td>V5</td>
<td>9</td>
<td>155</td>
<td>-</td>
<td>25</td>
</tr>
<tr>
<td>V6</td>
<td>215</td>
<td>195</td>
<td>-</td>
<td>35</td>
</tr>
</tbody>
</table>
| * Osc. plate - 150 volts. Total battery drain is 6.7 A. Fuse - 15 A. Trimmers for the short-wave circuits are in the tops of the R.F. shield cans; I.F. trimmers are in the I.F. transformer cans. The series padding condenser for the broadcast band is reached from the bottom of the chassis. The antenna trimmer is in the same location. A kit of spark-plug suppressors is furnished with the set as well as two condensers, one for the generator, and one for the ammeter. On some makes of cars the suppressors will not be needed. |}

FADA MODEL 155 5-TUBE SUPER FADALETTE A.C.-D.C. SET

[Tunes from 540 kc. to 1,750 kc.; both dials illuminated; sturdy, matched-grain walnut cabinet; automatic overload control; full dynamic speaker; for use on any 110-volt line.]

Voltage readings on Model 155 receiver:

<table>
<thead>
<tr>
<th>Tube</th>
<th>Type Volts</th>
<th>Plate Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>3.2**</td>
<td>48</td>
</tr>
<tr>
<td>V2</td>
<td>2.6</td>
<td>102</td>
</tr>
<tr>
<td>V3</td>
<td>6.0**</td>
<td>95</td>
</tr>
<tr>
<td>V4</td>
<td>14.0**</td>
<td>89</td>
</tr>
<tr>
<td>V5</td>
<td>2.0</td>
<td>107</td>
</tr>
</tbody>
</table>

**These readings are taken across the cathode resistors for accuracy. Also, they indicate values as read on a 1,000 ohms-per-volt meter to approximate the results the average test set will give. Voltage across the speaker while others, extra work will be required to reduce noise, due to certain peculiarities in the wiring systems. The control head can be obtained in several styles, and either to go on the steering column, through a hole in the dash, or flush with the bottom of the dash. The fuse is located in a holder in the battery cable. The pigtail from this cable must be connected to the metal frame of the car to provide a secure ground. A separable connector is provided in the antenna lead, to facilitate removal of the set for servicing, without disturbing the antenna junction. Any type of antenna may be used, either in the roof or under the car. The procedure to follow in each realignment becomes necessary is the same as for any other superheterodyne receiver, and for best results a service oscillator should be used. The intermediate frequency is 250 kc. Most of the fixed resistors and condensers are mounted solidly on a strip which runs across the chassis on the bottom side. By the removal of four caps-nuts the chassis can be slid out.

Radio-Craft for September, 1935

www.americanradiohistory.com
STROMBERG-CARLSON 10 TUBE NO. 82 ALL-WAVE RECEIVER

(Four bands; covers 520 to 23,000 kc.; tuning meter; antenna selector; master oscillator tube; 15-watt audio output; selectortone dial; automatic low-level tone compensation; automatic volume control.)

The 6A7 tube is used as a modulator only, a separate 76 being used as the oscillator on all bands to secure more positive operation on the higher frequencies than is provided by the 6A7. Another type 76 tube is used as the demodulator and A.V.C. The three type 42 tubes are connected as triodes, the first being a driver for the two output tubes. The output stage works on the class AB principle, giving high audio quality. A low-level tone compensation feature keeps the tone quality evenly balanced between bass, treble, and middle register at the lowest volume level. A manual treble control is provided to adjust the reception to individual desires, or to reduce background noise. This control is continuously variable, and is combined with the on-off power switch.

The selectortone dial used on this set is designed for ease of operation, and is directly calibrated for each band available. Only the band in use is illuminated, the different pilot bulbs being operated by a section of the band switch. The tuning meter is also illuminated. A dual-ratio tuning knob gives the necessary band spread on the higher frequency bands.

The use of two separate antennas is possible with this set, since a section of the range switch selects the right one for the band in use. The antenna terminal strip carries four posts, marked "A", "AD", "GD", and "G". For use of the same antenna on all bands, it is connected to the "A" and "AD" posts, while the ground goes to the remaining two. Two separate antennas can be used, in which case the long one for the two lower-frequency bands connects to the "A" post, the short antenna to the "AD" post, and the ground to "GD" and "G". If a doublet is available, it can be connected to the middle two posts, with the ground on "G" alone, and the long antenna on "A". A special noise-reducing all-wave antenna coupler may be employed by connecting one terminal of the coupler to "A" and "AD" and the other to "GD". The ground goes to "G" alone.

The frequency ranges are as follows: A—520 to 1,600 kc.; B—1,500 to 4,000 kc.; C—0.7 to 10 mc.; D—8.5 to 23 mc.

The receiver is available in two types, one for use on 56-60 cycle power lines, and one for 23-60 cycle supply. The power consumption is 136 W. A fuse is located in a holder on the rear of the chassis, and in case renewal is needed, the rating must be 2 A.

The tuning on this set is just like that on any broadcast receiver, except that on the short-wave bands the tuning is much more sharp, and for proper results, the dial must be moved very slowly in order not to pass right over the stations. The set may be obtained equipped for use with phonograph pickup, and due to the high power available from the audio system, the results are very fine.

The following table gives the voltages at each terminal of each socket, the numbers corresponding to those on the under-chassis drawing shown below:

<table>
<thead>
<tr>
<th>Tube</th>
<th>Socket Terminals</th>
</tr>
</thead>
<tbody>
<tr>
<td>type</td>
<td>exp. 1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>V1</td>
<td>0 ... 240 95 4 0</td>
</tr>
<tr>
<td>V2</td>
<td>0 ... 240 95 95 -2 3.1 0</td>
</tr>
<tr>
<td>V3</td>
<td>... 195 30 0 ...</td>
</tr>
<tr>
<td>V4</td>
<td>... 0 0 0 ...</td>
</tr>
</tbody>
</table>

*These voltages are A.C., all others are D.C.

The heater voltage on all tubes is 6.4, except that of V10, which is 4.75, these readings being made with a line voltage of 120. A meter of 1,000 ohms-per-volt should be used, with the set tuned to 1,000 kc., on band A.

Four complete individual sets of coils are used, giving the same high sensitivity on all bands. All the idle tuning coils are grounded. There are seven pilot lights in all, two each being used on bands A and B, one each on bands C and D, and one in the tuning meters. They are all standard 6.3 V. bulbs, and may be reached from the rear of the cabinet, as they are all in removable type sockets.

An antenna filter is provided, capable of adjustment, but this is used only on the low-frequency or A band.

The loudspeaker plug has two of its prongs arranged to cut the high voltage, when it is pulled out with the set on.
THE "VIBROTEST"

A super-sensitive tube analyzer unlike any you have ever seen—now available in complete service model. As pictured—$44.50

(Distributor's Net Price, F.O.B. Little Rock)

Also due later Counter Model for any complete line easily tested on The VIBROTEST.

SOUTHWESTERN INSTRUMENT CORP.
419 Center Street, Little Rock, Ark.

3-WAY TUBE CHECK!
On Every Type of Tube—Including the New Metal Tubes!

"BLUEBEARD"

(Continued from page 148)

the sides, and wood screws through the chassis back into the sides hold it in place. The speaker is screwed into the cabinet separately, and the baffle hole covered with theatrical gauze to prevent the whiskers or other extraneous matter from reaching the voice coil. Connections from the speaker are made by means of color-coded binding posts on the chassis terminal strip (B in Fig. 2). The nose, eyebrows, and ears are separate blocks of wood glued in place; the lower lip is made of spotted or plastic wood. Pyroxylin lacquers are conveniently finished. A bright orange is sprayed on for the flesh color and the eyebrows, lips, and teeth touched up with a small brush using black, red, and white lacquers respectively.

The beard is simply a dark blue yarn glued and tucked in place. The individual strands are untwisted and presto! we have a nice curly beard of which any man might be proud.

LIST OF PARTS

Two Acratest antennas, type 11, L2.

One Acratest Q-gang 365 mmd. variable condenser, C1, C2.

One Centralab 8,000 ohm volume control and switch, R1.

One IRC 400 ohm, 1/4-W, resistor, R2.

One IRC 3,000 ohm, 1/2-W, resistor, R4, R5.

One Electrode 600 ohm, 1-W, resistor, R6.

A TUBE TESTER PATENT

The issuance of patent No. 2,002,425 covering the design of vacuum tube testers comes as a surprise and perhaps a shock to the manufacturers of such testers which come under the classification of "English Reading" types.

This patent which is assigned to a well-known manufacturer of testing equipment contains fourteen claims, including the use of an adjustable shunt for making all tubes read on the same point on the meter and the use of a selector for connecting the correct terminals of tubes to be tested to the meter and power supply circuits.

The claims granted in this patent cover practically every type of tube tester manufactured in the U. S. I.

Please Say That You Saw It in Radio-Craft
Radio-Craft Technicians’ Data Service
93 Hudson Street,
New York City, N.Y.
RC-935

Please send to me, without charge or obligation, the catalogs, booklets, and the numbers of which I have circled below:

2 3 4 5 6 7 8 9

My radio connection is checked below:
( ) Service Man operating own business.
( ) Service Man for manufacturer.
( ) Service Man for jobber.
( ) Service Man for dealer.
( ) Service Man for servicing company.
( ) Dealer.
( ) Manufacturer.
( ) Experimenter.
( ) Professional Set Builder.
( ) Clinic, School, Doctor.
( ) Licensed Amateur.
( ) Station Operator.
( ) Laboratory Technician.
( ) Public Address Worker.
( ) Manufacturer’s Executive.
( ) Student.

The literature listed in this department contains a wealth of very useful information.

A special arrangement between RADIO-CRAFT magazine and the publishers of this literature, which permits bulk mailings to interested RADIO-CRAFT readers, eliminates the trouble and expense of writing to each individual organization represented in this department.

2. HAMMARLUND 1935 CATALOG. Contains 12 pages of specifications, illustrations and prices on the new line of Hammarlund variable, mid-get, band-spread and adjustable condensers; trimming and padding condensers; E.F. and I.F. transformers, coils and coil forms; sockets, shields, chokes and miscellaneous parts for ultra-short-wave, short-wave and broadcast operation.

3. How to Get a HAMMARLUND 1935 SHORT-WAVE MANUAL. A circular containing a list of contents and description of the new 16-page Hammarlund Short-Wave Manual, which contains construction details, wiring diagrams, and list of pages of the most popular short-wave receivers of the year.

4. THE "COMET Pro" SHORT-WAVE SUPERHETERODYNE. Describes the outstanding, etc. features of the standard and crystal-type Hammarlund "Comet Pro" short-wave superheterodynes designed to meet the requirements of professionals, operators and advanced amateurs for a 15 to 255 meter code and phone receiver, but which can be adapted by anyone for laboratory, newspaper, police and steamship use.

5. ELECTRA 1935 VOLUME CONTROL AND RECEPTOR CATALOG. Contains 12 pages of data on Electra standard and replacement volume controls. Truvolt adjustable resistors, vibrionic wire wound fixed and adjustable resistors and voltage dividers, push-pull, and other high quality audio components, center-tapped filament resistors, high-quality attenuators, power (50- and 150-watt) headphones and other Electra resistor specialties.

25. LYNCH NOISE-REDUCING ANTENNA SYSTEMS. Complete descriptions and instructions issued by Arthur H. Lynch, Inc., for making all kinds of antennas for broadcast and short-wave reception, with a special supplement covering Ham Antenna Design, servicing as well as receiving all the amateur bands, including the ultra-high frequencies.

26. LYNCH AUTO RADIO ANTENNAS, FILTERS AND NOISE SUPPRESSORS. This folder describes a complete line of Lynch antennas, filters and noise suppressors designed for auto radio installations. The antenna system is of the under-the-car type. The installation includes data on Hi-Gain matched-impedance transmission lines which make the under-car antenna highly desirable for use with the new "Turret-top" cars.

27. LYNCH SUPER-FILTASTATS for AUTO RADIO INSTALLATIONS. Describes and illustrates, with instructions for using, the new Lynch Super-Filtastats which do away with the need for suppressors in auto radio installations, giving better performance in operation for both the car and radio sets.

34. SERVICE MAN'S 1935 ELECTRADO REPLACEMENT VOLUME CONTROL GUIDE. A 52-page vest-pocket size booklet containing a revised, enlarged and complete list, in alphabetical order, of all old and new receivers showing model number, value of control in ohms and a recommended Electrad control for replacement purposes. Contains specifications and voltage-control circuits for over 2,000 receiver models.

57. RIBBON MICROPHONES and HOW TO USE THEM. Describes the principles and operating characteristics of the Amperite velcro microphones. Also gives a diagram of an excellent humless A.C. and battery-operated preamplifier.

62. SPRAWBERRY VOLTAGE TABLES. A folder and sample pages giving details of a new 300-page book, containing 1,500 "Voltage Tables" covering receivers manufactured from 1927 to date, published by Frank L. Sprawberry to simplify radio servicing.

64. SUPREME NO. 395 AUTOMATIC TESTER. A technical bulletin giving details, circuits and features covering this new Supreme development designed for radio servicing. In addition to the popular features of Supreme analyzers and tube testers it contains many direct-reading features for eliminating guess-work or necessity of referring to charts or tables.

57. PRACTICAL MECHANICS of RADIO SERVICE. Information, including cost, features and outline of the lessons of the Frank L. Sprawberry course in Radio Servicing, and list of Sprawberry Data Sheets for modernizing old radio equipment.

72. HALLICRAFTERS' SKYDRIDER SHORT-WAVE RECEIVERS. Description of the Skydrider tuned R.F. and Super Skydrider superheterodyne short-wave receivers designed and built by Hallicrafters, Inc. Features: range of 20 to 200 meters (with broadcast or 10-meter band optional), automatic wave-change switch, continuous bandspread, built-in monitor, speaker and power supply (or batteries), high-fidelity audio, and other refinements.

74. SPRAWBERRY 1935 ELECTROLYTIC AND PAPER CONDENSER CATALOG. Gives specifications, with list and net prices on a complete line of wet and dry electrolytic condensers made by Sprawberry, and specifications of Sprawberry products made for the Sprague Products Co. for radio Service Men, set builders, experimenters and engineers. Information on the Sprawberry Capacity Indicator for making capacity tests on condensers and in servicing receivers, is included.

173. Sylvania’s Radio Service Hints now ready! It’s crammed with brand new material...service tips from crack service men all over the country.

SEND FOR YOUR FREE COPY TODAY

Maybe you are one of the 50,000 radio servicemen who sent for Volume 1 of Service Hints. Then you’ll be sure to want Volume 2 of this booklet, because it has more of the same helpful service lists...inside dope on special problems...but every bit of it brand new material!

This new volume of Service Hints contains the pick of service items sent in by thousands of service men...every one of them up-to-the-minute solutions of everyday problems. It’s compiled for men who are always willing to learn more about radio...and it’s a short cut to better servicing and better profits.

Don’t wait. Send today for Volume 2 of SYLVANIA SERVICE HINTS. It will iron out a lot of your troubles, and put you in line for more and better service jobs. There is no charge. Simply fill out and mail this coupon today and you’ll get your copy of this valuable booklet in a few days.


Please Say That You Saw It in Radio-Craft
R. A.

**ELECTRICAL POWER**

from a Windmill, from available Waterpower, from your Automobile, from a Bicycle, from a Hand Crank, from a Solar Battery, from the Power of the Sound of a Voice, or from the Power of a Radio (Radiotron) Tube.

In order to operate \(\text{A}^2\) Radio sets from 32 V. DC form 700 V. AC, you would have to operate \(\text{A}^2\) Radio sets from 32 V. DC form 700 V. AC, details of three phase and three phase AC, etc., etc.

**A.C.

TO MAKE THE WORLD'S SMALLEST TUBE SET**

*(Continued from page 158)*

for the regeneration coil. The last three sections were then removed from the insulated tubes, leaving the longer one in place.

The tube was prepared by filing off two opposite sides of the insulated base, so that the tube would fit into the correct cabinet. A smooth, flat file was used; only enough was removed from the tube base to permit the case to close. The use of a socket, of course, rules out the question, so the tube was cmented to the case with a drop of adhesive. Bands of wire soldered to the pins in the base.

The tuning condenser was prepared by cutting a three disc, slip and mounting it to the head of the compression screw of the condenser with acetone cement. White lead was then marked on this disc to give it the appearance of a dial. Calibration numbers could not be added since the compression screw made four revolutions between the maximum and minimum positions. The cigarette case was prepared for use as the container for the set by cutting a slot in the top edge of the upper section to permit the edge of the "dial" to protrude—thus giving a thumb control. Two holes were cut in the back to mount the tuning condenser and two more for the 'phone binding posts—which consisted of two No. 4.36 screws. A small slot was cut in the bottom edge of the upper section for the adjusting screws. The pluger-like variable grid-leak to protrude, so that regeneration could be controlled without opening the case. These slots for tuning and regeneration can be seen in the photos.

This completed the preparation—the parts were then assembled in place as shown in the photos and the few wires connected as shown in the circuit diagram (also shown in the picture circuit).

When these were completed, a 15-ohm resistor was secured to the top of the terminals of the filament battery and the battery wires were connected. The aerial wire (which consisted of about 25 or 30 ft. of flexible wire) was strung up as high as conveniently possible, and a pair of the new piezoelectric crystal headphones was connected to the phone terminals (with an iron core inductance in shunt in order to reduce D.C. through the crystal phones). These phones were used because they were unusually sensitive. If desired, though, smaller phones may be obtained. The set was tried out some 25 miles from New York City, and also in the heart of Manhattan, in both locations, all the local stations could be picked up with ample headphone volume.

There is no doubt that this unique little set can be put to many useful applications, for police use, etc., though it was designed simply in an effort to make the smallest possible pocket receiver.

**LIST OF PARTS**

One Solar 500 m.m.f. compression-type mica condenser, C1; One Cornell-Dubilier 100 m.m.f. midget mica condenser, C2; One Cornell-Dubilier 250 m.m.f. midget mica condenser, C3; One Cornell-Dubilier 50 m.m.f. midget mica condenser, C4; One Hammond 6 R.F. choke, type CHX, L1, L2; One Hi-Vac screen-grid tube, type X S G, V; One plugger-type headphone, 20-29 mgs., R1; One 15-ohm filament resistor, R2; One penlight—with two small cells, "A"; One special radio headphones; One pair crystal headphones; One bakelite cigarette case; Screws, wire, and rubber, etc., as needed. *(Name of manufacturer upon request)*

**METAL TUBES**

Don't forget that the next issue of RadioCraft will feature the new metal tubes in all types of applications. If you are interested in the radio you can't consider this unusually interesting material. The future of radio reception, P.A. work, electronics and practically every side-line of radio will be affected by these new tubes.

*Please Say That You Saw It in Radio-Craft*

**FREE**

With each generator, we supply a set of diagrams-blue prints and instructions showing hook-ups and installing explanations. We also furnish a set of paddles, directions, etc., etc., for which please send us *RCA Westinghouse Power Generator by Express collect*

Name

Address

City State

**WHEN CHOOSING A RADIO SCHOOL**

RCA, with its reputation established by 26 years of service, is an institution recognized as an important factor in the Radio Industry.

Whether elementary radio principles, advanced subjects, or whole courses in radio engineering, RCA Institute has the program to suit your interest and the instruction you need.

**RESIDENT SCHOOLS NEW YORK AND CHICAGO**

**EXTENSION COURSES FOR HOME STUDY**

Send for "Radio School" plan Illustrated Catalog on Request.

**R. C. A. INSTITUTES, Inc. Dept. RT-55**

75 Varick St., New York—1154 Merchandise Mart, Chicago

**A VERSATILE 3-TUBE SHORT-WAVE RECEIVER-CONVERTER**

*(Continued from page 142)*

procedure is the same except that certain changes have to be made.

Disconnect the aerial from the broadcast set, and connect wire "C" to the aerial binding post. Adjust the set to about 600 kc, and find a spot around that frequency where there is absolutely no reception from the broadcast receiver. Then set the volume control so that the tone produced on the loudspeaker with the volume at or near maximum. If you cannot find a dead-spot around that frequency, you find out, of course, that there is some regeneration, and of the volume, or by means of a wave-meter. You then tune to one of the AVC tubes, or by means of a wave-meter. You then tune to one of the three tubes. Then turn the volume control to the maximum and find a point where there is absolutely no reception from the broadcast receiver. You then adjust the volume control so that the tone produced on the loudspeaker is so that the tone produced on the loudspeaker is heard.

No special aerial is required for this set. A piece of wire 10 to 20 feet long is sufficient. The aerials consist of any kind of aerials and found out that an inside aerial is about 15 ft. long will bring in most of the American and European short-wave stations on the loudspeaker with local volume.

**LIST OF PARTS**

One set of plug-in coils, 1.
One Lafayette 150 mmf. variable condenser, 2.
One Lafayette 32 mmf. variable condenser, 5.
One IRC 200-ohm resistor, 4.
One Aerovox 0.1-mf. condenser, 5.
One Cornell-Dubilier 250 mmf. capacitor, 6.
One IRC 50,000-ohm resistor, 7.
One Sylvania or Raytheon type 6A7 tube, 8.
One 50 W., 110 V. (safety) lamp, 9.
One IRC 50,000-ohm resistor, 10.
One Aerovox 0.1-mf. condenser, 11.
One Hammond 4 mky. choke, 12.
One Hammond 4 mky. choke, 13.
One Cornell-Dubilier 250 mmf. capacitor, 14.
One 700 mhy. choke, 15.
One Solar 250 mmf. trimmer condenser, 16.
One Cornell-Dubilier .001-mf. condenser, 17.
One S.P.D.T. snap-switch, 18.
One 700 mhy. choke, 19.
One (approx.) 200 mky. choke (made up of 100 turns No. 30 D.S. wire random-wound on (19) spool), 20.
One Cornell-Dubilier 250 mmf. condenser, 21.
One IRC 2 mgy. resistor, 22.
One IRC 4800-ohm resistor, 23.
One Aerovox 0.1-mf. condenser, 24.
One Solar 250 mmf. trimmer condenser, 25.
One Hammond 4 mky. choke, 26.
One Sylvania or Raytheon type 672 tube, 27.
One Cornell-Dubilier .001-mf. condenser, 28.
One Hammard 4 mky. choke, 29.
One IRC 50,000-ohm resistor, 30.
One Sylvania or Raytheon type 672 tube, 27.
One Cornell-Dubilier .001-mf. condenser, 28.
One IRC 50,000-ohm resistor, 30.
One Aerovox 0.1-mf. condenser, 31.
One Trimm pair of earphones, 32.
One Solar or Raytheon type 73 tube, 34.
One power cord, 325 ohms, 35.
One IRC 10,000-ohm resistor, 36.
One Aerovox or Cornell-Dubilier 8 mwf. condenser, 37.
One Aerovox or Cornell-Dubilier 8 mwf. condenser, 38.
One Coast-to-Coast 6-prog. socket, 39.
One Coast-to-Coast 6-prog. plug, 40.
One Coast-to-Coast 6-prog. plug, 41.
One set of "R" batteries, 325 V., 42.
One "A" battery, 6 V., 43.

**A CORRECTION**

We have been advised by the author, Mr. R. H. Packard of the following correction to his article on page 18 in the July 1934 issue of Radio-Craft. In Fig. 1, upper contacts Nos. 1, 3, and 5 of the selector circuit should be connected by three diagonal wires (wires) to the right-hand side of the contact points. And the battery marked "2 V. cell" should be connected along with all wires leading to it. The two volts is obtained by tapping off one cell of the main 6 volt battery.

www.americanradiohistory.com
MAKE THIS 5-TUBE ALL-WAVE A.C.-D.C. SET

(Continued from page 144)

wall, directly below the variable tuning con-
denser.

To start wiring this set, one of the most im-
portant things is to study the bottom view
showing the socket terminals and also to ex-
amine the directions given to make sure that
the wires are soldered to the correct terminals.

Every socket used, including the four-prong
sockets, has two holes which are larger than the
other holes. On the tube sockets, these are for
the filament prongs of the tubes. Use these, in
every case, to determine the location of all
the other terminals.

Start wiring the filament first. The fila-
ments of all five tubes are wired in series with
terminal "J" grounded to the chassis and ter-
minals "A" of the three termi-

nals of the line cord. Next wire in the
plates, grids, cathodes and bypass condensers in
the order given. Proceed methodically, step by
step, in order to make sure that nothing is
omitted.

INSTRUCTIONS FOR TESTING

Place the tubes in their sockets in the posi-
tions shown in the diagram. Place the tube shields over V2 and place the screen-grid clips
on the caps of the tubes as shown. Plug in the
broadest coil for the preliminary test. Con-
nected to the flexible wire at the rear of the set. If the broadcast stations overlap when using an antenna, try operating the antenna wire, or short it, or use an
aerial, or loosen the antenna trimmer condenser.

Another method of making the set more sele-
ctor than the broadcast band is to use those
shades to. Join the antenna and make sure that
it operates the station selected. The set should
be used the regeneration control in the lower
left corner, when the station selected is turned.

Plug in the connection cord into any of the
holes. On some sets, the connection cord
would not be used, but it will get quite warm
when the set is in use. This heating is normal
and should be disregarded. Turn the knob
at the right of the radio until a whistle is
heard. Wait about 30 seconds for the tubes to warm
up. The set should then bring in stations when
the regeneration control in the lower left is turned. If set
is used on D.C., it may be necessary to reverse
the plug when the set is used on alternating cur-
rent. Since the set does not use a power trans-
former, it will operate on 25 cycles A.C. as well as 60 cycles. It can also be used on 220 V.

AC/DC, by means of a reducing bal-
last resistor.

TUNING DIRECTIONS

There are five contacts on this receiver. The
three most important ones are at the front.
At the right is the combined switch and reg-
eneration-volume control. Turning the knob in a clockwise direction turns the switch to the "on" position. As the knob is turned, it operates the regeneration control. The
control at the right is for the broadcast band.

To tune in a short-wave station, place one of
short-wave coils in the coil socket. Turn the
station selector until a whistle is heard.

It may be necessary to loosen the antenna trim-
ner to get the whistle. The antenna trim-
ner is located at the rear left of the set. There
is an additional trimmer condenser alongside
of this to the right. If the whistles are not
lighten the screw on this second trimmer. As
the station tunes in with the left hand,

The trimmer adjustment is not critical and
need be set only once for each coil except for
the reception of weak stations which require
careful adjustment all around for best re-
ception. On such stations, readjustment of the
station selector may be necessary following the
movement of any of the other controls.

If it is desired to use phones with this set,
the phone jacks may be connected one to either
side of the primary of the speaker output trans-
former. If it is desired to shift off the speaker
while using the earphones, this is accomplish-
ied by short-circuiting the secondary of the
speaker output transformer.

Although this receiver is highly efficient, it is
comparatively easy to construct. However, if
any difficulties should arise, the writer will
be glad to answer questions regarding it.

LIST OF PARTS

One Hammarlund antenna trimmer, type
MC53-70, C11;

One Cornell-Dubilier cartridge-type condenser,
1 mf., 200 V., C1A;

One Cornell-Dubilier cartridge-type condenser,
1 mf., 200 V., C2;

One Hammarlund trimmer condenser, type
MC51140, C3;

One Hammarlund variable tuning condenser,
type MC-140-M, C4;

One Cornell-Dubilier mica condenser, 100-
mmf., C5;

One Hammarlund band-spread condenser, type
MC-305, C6;

One Cornell-Dubilier cartridge condenser,
1 mf., 200 V., C7;

One Cornell-Dubilier mica condenser, 100-
mmf., C8;

One Cornell-Dubilier cartridge condenser,
0.1 mf., 200 V., C9;

One Cornell-Dubilier cartridge condenser,
1 mf., 200 V., C10;

One Cornell-Dubilier cartridge condenser,
1 mf., 200 V., C11;

One Cornell-Dubilier cartridge condenser,
0.1 mf., 200 V., C12;

One Cornell-Dubilier cartridge condenser,
35 V., C13;

One Cornell-Dubilier dual electrolytic con-
denser, 8 mf., cardboard container, C14, C15;

One Cornell-Dubilier cartridge condenser,
0.1 mf., 200 V., C16;

One I.R.C. metallized resistor, 0.17-meg., R1;

One I.R.C. metallized resistor, 600 ohms, 1/2-
W., R2;

One I.R.C. metallized resistor, 25,000 ohms,
1/4-W., R3;

One I.R.C. metallized resistor, 1 mez., 1/2-
W., R4;

One I.R.C. metallized resistor, 1 mez., 1/2-
W., R5;

One I.R.C. metallized resistor, 25,000 ohms,
1/4-W., R6;

One Electroad potentiometer with switch, 75-
1,000 ohms. Sw. 1, R7;

One I.R.C. metallized resistor, 17-meg., 1 W.,
R8;

One I.R.C. metallized resistor, 1 meg., 1/2-
W., R9;

One I.R.C. metallized resistor, 10,000 ohms,
1 W., R10;

One I.R.C. metallized resistor, 17-meg., 1 W.,
R11;

One I.R.C. metallized resistor, 1 meg., 1/2-
W., R12;

One I.R.C. metallized resistor, 600 ohms, 1
W., R13;

One resistor in line cord, 180 ohms, R14;

One Hammarlund midget R.F. choke, type
CH-X, Ch. 1;

One General Transformer Corp., filter choke.
20 hy., 300 ohms, Ch. 2;

One National Union or Raytheon 606 tube,
V1;

One National Union or Raytheon, 606 tube,
V2;

One National Union or Raytheon 606 tube,
V3;

One National Union or Raytheon 606 tube,
V4;

One National Union or Raytheon 43 tube,
V5;

One 4-prong socket for plug-in coil T1;

Five Na-Ald 6-prong sockets;

One set of Hammarlund plug-in coils cover-
ing band from 7 to 56 meters, T1;

One 6-in. dynamic speaker, output transformer
matched to 43 tube,

One metal chassis, 11 x 5 x 1½ ins. high:

One Hammarlund tube shield, type TS-50;

Three screen-grid clips;

One vernier dial;

One meter.

$3.58 brings your analyzer up-to-date.

THE WESTON SOCKET UNITS FOR THE NEW METAL TUBES

It's ready! You don't need to sock the bank roll for new equipment if you use the Weston Method of Selective Analysis. Just $3.58 equips your analyzer for the new metal tubes. The Units illustrated above fit your present Socket Selector Set. Order them now, and be all set for a profitable year. There is nothing more to buy.

If you don't use the proved Weston Method of Selective Analysis, you can bring your present analyzer out of the obsolete class with the complete Model 666 Type 1-B Socket Selector Set. It is readily adapted to any and all analyzers and will enable you to service all receivers using 4, 5, 6, 7 and 8 prong tubes. A bulletin is available describing Weston Socket Selectors, and the complete line of Weston Selective Analyzers. Ask for a copy today ... Weston Electric Instrument Corporation, 599 Frelinghuysen Avenue, Newark, New Jersey.

Weston Radio Instruments

Please Say That You Saw It in RADIO-CRAFT
**BARGAIN! 7 TUBE CHASSIS**

**With 11 Inch Dynamic Speaker**

200-550 Meters

One 4-1/2”, 2-2A5, in parallel and a type 80 full wave rectifier, in series with a 6N6, or other suitable type of tube, is the suggested type of a full-wave rectifier. The average table height is 31 ins., hence the tuning dial height averages 38 ins. above the floor, as shown in Fig. 3A, whereas the average table height is 44 ins. above the floor. At present it is custom to use the upper part of the circle for the tuning dial as shown in Fig. 3A, requiring the listener to stoop to a position which places the eyes on a level with the tuning dial. This may be the reason for this archaic design, because of similar “electric meter” style in dials having been used by our radioasts from 1910.

However, the use of the lower part of the circle as shown in Fig. 2B, for a tuning dial with an inclined scale will not give the desired satisfaction unless such inclination is to a certain degree accommodated to our eyes. An example of this is shown in Fig. 3A, in which a radio set is standing on a table tarsel height 31 ins. and with its tuning dial only 20° above the floor, that is, if the radio receiver has sufficiently large numbers, and if the listener is long-sighted his eyes will look upon the tuning dial at an angle of 22°. Should the listener be near-sighted (see Fig. 3B), the angle of his eyes will be only 20°. These angles of sight will be obtained if the radio listener is at an average height, that is 64 ins. above the floor. The deviations of a few inches more or less will not make a very great difference because of the comparatively short distance involved.

According to Fig. 4A, we have a variation in the angle of sight between 32° and 26°. The average angle of sight would then be:

\[
\frac{32° + 26°}{2} = 29°
\]

Upon drawing this angle in Fig. 4B, we find that the accurate inclination for our tuning scale should be 26° to the table top.

However, a dial constructed according to Fig. 4B, with an inclination of 26° will not fulfill its purpose if the numerals are not of a certain size. The radio listener does not like to carry a chair to the receiver, there never to remain sitting until he has found the desired station. It is much more pleasant to make some unpleasantries gymnastics (as shown in Fig. 3C) to tune in the desired station, because of insufficient illumination on the scale. This example shows the importance of providing tuning dials with large numerals.

In order to improve the vision of the eye the occultist has not the extreme minimum size of tuning dial numerals at 4/4. The numerals should be simple in design and the use of “d” and “w” (see Fig. 5B) should not be smaller than:

\[
d = 0.13h \\
w = \frac{h}{2}
\]

Many dial constructors claim that due to the small size of the dial it is impossible to use numerals of this size. This problem, however, like most, can be solved. The simplest method to obtain sufficient illumination of the numerals is that of constructing scales with a circle segment of 90 divisions, 100 divisions, or 110 divisions only. This type of scale, with numerals printed horizontally, affords a full sight over the full segment without bending the head. The distance between the scale divisions will become much greater, serving to give an effect of “greater” receiver sensitivity. Dial makers may then be employed with a thickness greater than those now in use, offering not only eye relief, but also helping to save considerable expense, and last but not least the “apparent selectivity” is greatly enhanced.

If the “W” of the scale shown in Fig. 5A, is of sufficient size it is relatively easy to divide the dial into several parts; this will afford sufficient space for several wave ranges. Dials of the suggested type can be designed to meet any demand, and with the right inclination and proper size of the numerals it should be possible for the dial to be first-class advertising and selling argument. What has been said about the semi-circle dial applies also to dials with designs of “full vision,” and “airplane type,” for scale readability. It makes little difference whether the dial is designed in the form of a circle or a semi-circle.

Many of the full-sized dials in use today are badly constructed—over a space of a few square inches we find three or four wave ranges, so that the average radio listener needs a magnifying glass to find his way through this labyrinth! From the point of usefulness, the dial design shown in Fig. 5A is best. However, if the cabinet designer believes at present that a full circle is desirable in order to secure some aesthetic effect, he may use a circular dial such as shown in Fig. 6. The dial shown in Fig. 7, often used today, utilizes the degrees of the full circle; an expensive feature is necessary if we wish to use the full 360 degrees. If there is a need for several wave ranges and if numerals of a larger size are desired, more space must be given to the window.

*An "Engineered" Dial*

All these disadvantages can be avoided by use of what might be termed a “propeller” dial. See Fig. 6. The evolution of this type of dial is perhaps one for the medium waves, the two together for police calls and the other one for two short waves. These are the most-used types in "full vision" set and are furnished with a multi-contact pilot-light switch, the correct-range windows can be respectively marked. The short waves are in the most divergent position of the scale, and if we use slender numerals their size can be quite large without enlarging the disc diameter. The small size of the dials are very useful for midgets because they can be a great deal of space, and so give the radio listener the full benefit of a good legible dial: the dial can be made still more legible of a magnifying glass (“bullseye”) is arranged in the window frame as shown in Fig. 8A. The indicator line can then be directly engorged into the glass.

If a good legible dial is desired, an important factor is the illumination of the scale especially as regards the color and material covering the scale divisions. It is essential for the scale to be well illuminated but not so strongly as to partially blind the eyes. One illumination system is shown in Fig. 8B. The front and the rear of the dial are illuminated. By using two small, low-voltage lamps instead of a single large one, a very pleasing effect can be obtained.

Color is another important consideration in dial design. At present most scale discs are made of some similar material showing a brownish cast. Some manufacturers use this material for scale discs only because of low cost; you would use a transparent sign of such color for he realizes the difficulty that would be encountered in read-illumination of a black and white scale printed with black divisions and numerals should be used for the disk. It might be useful to use red and green for the short-wave range. The use of white, transparent figures and divisions on a black background is recommended, for a dial of this type has a tendency to dazzle the eye. “White on black” may, however, be used for large discs with only a few divisions and numerals only—for example, in airplanes to avoid annoyance to the pilot who must look through dark glasses, but not for home radio sets. No electric meter manufacturer to-day manufactures “full-size” dials; ask any power station engineer to-day to interpret a scale having a negative design and the answer will be “No.” Dials made by stamping, after the first few hundred run off no longer show the clean-cut finish of the North American method of dial manufacturing, then, is that of photo-lithography. Scales made by the latter method 15 to 20 per cent cheaper than those of uniform, clean and crisp-cut division.

However, by the use of front illumination together with [illegible] method of dial manufacturing, then, is that of photo-lithography. Scales made by the latter method is 15 to 20 per cent cheaper than those of uniform, clean and crisp-cut division.

**We SPECIALIZE in the Design and Manufacture of Public Address Amplifiers SEND FOR FREE CATALOG! Number K-30**

**We SPECIALIZE in the Design and Manufacture of Public Address Amplifiers SEND FOR FREE CATALOG! Number K-30**

**Design Problems of Tuning Dials**

(Continued from page 146)

These motors were manufactured by the General Electric Company and originally intended for use by a large manufacturing company. Here are some specifications: 1/32 hp for home use. 0.25 hp for commercial use. Universal AC. and D.C. 110 volts at 60 cycles. Size: Diameter 3 inches, length 5 inches. Add 25c for special packing and mailing anywhere in U.S.A. Ship Weight: 3 lbs.

$2.45 Each DO NOT WRITE FOR CATALOG

**WELLWORTH TRADING CO.**

183 W. Washington St., CHICAGO, ILL.

For each: 5c for ship; 1c for post; 1c for post.

**Radio-Craft** for SEPTEMBER, 1935

Please Say That You Saw It in Radio-Craft

G. E. MOTORS

On June 1st, 1932, the following letter was received by the author from a member of General Electric: "I would like to order a *G. E. 824* motor which I am planning to use for the motor of a radio receiver. I would like to use a small motor, only to have it as a spare. I understand that the motor is of the right size and type for the project. I am enclosing a check for $2.00 for the *G. E. 824* motor. Please send the motor as soon as possible. Thank you for your help." The author is grateful to the member of General Electric for his help in obtaining the *G. E. 824* motor, and he is looking forward to hearing from the member of General Electric on the progress of his radio receiver project.

Please do not hesitate to contact us if you have any questions or concerns. We are always here to help you.

We hope you continue to enjoy your radio receiver project and wish you the best of luck in your endeavors. Please let us know if you need any further assistance.

Thank you for choosing us for your radio receiver project.

Sincerely,

[Your Name]
MAKING A 6-TUBE BATTERY ALL-WAVE "FARM-PORTABLE" SET

(Continued from page 147)

which makes it possible to get away from negatively biasing the A.F. circuit. This results in better fidelity and improved A.V.C. action.

The final (power output) stage employs a pair of 33 tubes in push-pull arrangement, class A. This results in ample, high-quality power output.

The L.F. peak employed is 465 kc. The second I.F. transformer secondary must have two separate secondary windings, as shown in Fig. 1.

The "on-off" switch is placed in the "A-", "C-" lead, so that, when the receiver is turned "off", absolutely no current will flow from any of the batteries. Either a permanent magnet-dynamic speaker, or a magnetic speaker (of rugged design and good quality) may be employed. In either case the "B" battery drain remains the same, approximately 40 ma; no current is required for field excitation. If the speaker is not provided with an output transformer having a center-tapped (three connection) primary it will be necessary to provide one.

CONSTRUCTIONAL DATA

It is rather difficult to advise a constructor exactly how to build a receiver, since set rules are often confusing and apt to make a simple job seemingly difficult. In addition, this writer has never been one for holding the constructor to details, but, rather, encourages ingenuity and making substitutions from the original to suit the convenience and facilities of the builder. A few words of precaution, in this direction, however, would not be amiss.

The antenna coils (for each band) need not be shielded, but the R.F. coils must be. There is no need for separately shielding each coil (individually) from each other since the selective switching system only introduces that coil which is necessary for a specified band coverage. Thus all R.F. coils may be placed in a single can or container without consideration given to individual shielding from each other. The oscillator coils, in this case, were mounted on the underside of the chassis since this medium is sufficient to shield them from those coils in the other tuned circuits. They were all arranged so that the trimmers for each coil were conveniently accessible when alignment or realignment would be necessary.

The padders are mounted on the side of the chassis, as shown in Fig. A, for convenience in alignment.

Only two padders were employed, one for broadcast and one for the long-wave band, fixed padders for the other bands being suitable—with these coils—for the higher-frequency bands.

BATTERIES AND VOLTAGE CHART

Two dry cells (total, 3 V.) suffice for the "A" battery and will give almost a month of service using the set a few hours each day. A ballast resistor serves to reduce this voltage to that required for the tubes—but its most interesting feature is that it tends to reduce this voltage drop as the batteries become weakened. This means that additional service may be obtained from cells which otherwise would have to be thrown away if an ordinary 8-ohm resistor was used in reducing the "A" supply to the tubes to 2 V.

The following is a table of voltages which the constructor can employ as a guide for trouble-shooting should this receiver ever fail to operate. All measurements are made from ground to terminal indicated.

<table>
<thead>
<tr>
<th>Tube</th>
<th>Plate</th>
<th>Type Purpose</th>
<th>Plate S-G.</th>
<th>C-G.</th>
<th>Volts</th>
<th>Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.F. Amp.</td>
<td>135</td>
<td>34</td>
<td>135</td>
<td>167</td>
<td>67.5</td>
<td>-3</td>
</tr>
<tr>
<td>Det. 1</td>
<td>135</td>
<td>167</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>167</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>R.F. Amp.</td>
<td>135</td>
<td>135</td>
<td>167</td>
<td>67.5</td>
<td>-3</td>
</tr>
<tr>
<td>25S</td>
<td>Det. 2</td>
<td>135</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>A.V.C.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>A.F. I</td>
<td>135</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>Output</td>
<td>135</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One</td>
<td>Output</td>
<td>135</td>
<td>-3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ALIGNMENT DATA

The receiver should only be aligned with the all-wave turned to maximum position. First align I.F. transformers by feeding a 465 kc. signal to the control-grid of the 1C6 tube, after removing the control-grid oscillator (of the original terminal).

Then adjust trimmers of coils in each band (separately) for maximum output, feeding to Ant. and Gnd. terminals of the receiver, the following indicated oscillator frequencies.

Use attenuator on oscillator only when output is too high.

Band No. 1 (long-wave): 150 and 450 kc.; Band No. 2 (broadcast), 540 kc. and 1,560 kc.; Band No. 3, 1,500 and 4,500 kc.; Band No. 4, 4,500 and 12,000 kc.; Band No. 5, 5,800 kc. and 24,900 kc.

The alignment of this receiver is similar to any all-wave superheterodyne receiver, in that individual adjustment of the trimmers is necessary on each band. The job should not be tried without the use of a good service-oscillator, preferably of the all-wave type, covering each band.

LIST OF PARTS

One Paragon 7 x 12 x 3 in. cadmium-plated steel cased chassis, 6 ½-lb.

One Paragon complete set of coils, 15 in all, for R.F., oscillator, and antenna circuits, to cover range of from 12 to 2,100 meters.

One Paragon 3-gang 356 mf. (each) variable condenser.

One Tuned push-pull input transformer.

One Paragon 8-deck (double row of contacts, 5 on each side) switch.

One Paragon airplane-type tuning dial, dual ratio.

One shield can for R.F. coils.

One 0.2-merc. variable resistor, with switch.

One Amperite ballast resistor (6-1 type).

Three Eby 4-prong wafer sockets:

Two Eby 8-prong wafer sockets.

One Na-Aid pin-jack terminal strip, for phones.

One Act. and Gnd. terminal strip.

One Solar 150 mf. (maximum) variable condenser, for long waves, P1.

One Solar 600 mf. (maximum) variable condenser, for broadcast, P2.

Three Cornell-Dubilier tubular-electric fixed condenser sections—900-mf., P3; 91-mf., P4; 6-1 mf., P5.

One IRC 1/2-W., 0.1-merc. resistor.

One IRC 1/2-W., 0.3-merc. resistor.

One Hammond R.F. band, 55 r. m. y.

One Lafayette 464 kc. double-tuned I.F. transformer.

One Paragon special single-tuned 465 kc. I.F. transformer.

Two Cornell-Dubilier 259 mf. (postage-stamp size) fixed condenser sections.

One Cornell-Dubilier .03 mf. tubular condenser.

One IRC 0.3-merc. (1/2-W.) resistor.

One battery cable.

One Lafayette speaker (permanent magnet, or magnetic with center-tap).

One Cornell-Dubilier 0.1-mf. tubular condenser.

One 0.25-mf. tubular condenser.

One Bayrock or National Union complete set of tubes.

One Paragon special portable case.

Miscellaneous, such as wire, hardware, knobs, etc.

Please Say That You Saw It in Radio-Craft

Now—a high-powered—

Radio Engineering Library

—especially selected by radio specialists of McGraw-Hill publications

relate to most complete, dependable coverage of facts needed by all whose fields are grounded on radio fundamentals

—available at a special price and terms.

These books enter circuit phenomena, tube theory, network arrangements and other subjects—are special treatments of all fields of practical design and application. The bound set of radio engineering books you will refer to and be referred to often. If you are practical designers, constructors or engineer in any field based on radio, you want these books for the help they give in hundreds of problems throughout the whole field of radio engineering.

5 VOLUMES, 2061 PAGES, 3000 ILLUSTRATIONS

1. Everett's COMMUNICATION ENGINEERING

2. Terman's RADIO ENGINEERING

3. Chaffee's THEORY OF THERMIONIC VACUUM TUBES

4. Hund's HIGH FREQUENCY MEASUREMENTS

5. Henney's RADIO ENGINEERING HANDBOOK

10 days' examination. Special price. Monthly payments. $26.80 worth of books cost you only $22.50 under this offer. Add these standard works to your library now. post small monthly installments, while you use the books.

SEND THIS ON-APPROVAL COUPON


Send the Radio Engineering Library, 5 vols., for 10 days' examination. I will send you all 5 books on approval. You may return book within 10 days. I enclose $35.00 in postpaid money order or, if asked for, $35.00 in postpaid merchandise check. I will pay any balance due if not returned postpaid, within 10 days. No risk, as I may return the books at my expense and be reimbursed by resident of book involved.

Address.

City and State.

Position.

Company.

Business No. (if any).

RC-23-55

Data

Send for new 1935 catalog. Also sample copy of Research Worker.

AFROX CORPORATION

27 Washington St.

New York, N. Y.

TRIPLE-SEALED TUBULARS

See those wax-filled ends? Something new—and important—in Valox condenser. Say goodbye to machining! For your condenser may be made of metal! No holes to line up—and machines can be Alexandrite of non-inductive sections! (12) Wax-inlaid tubes with insulated aluminum foil. (5) Wax-sealed only. BENEFIT: Freedom from humidity; 1½ times longer life! And these AFROX quality units cost no more.

DATA

Send for new 1935 catalog. Also sample copy of Research Worker.

AFROX CORPORATION

27 Washington St.

New York, N. Y.

REAP THE HARVEST OF YOUR OWN SKILL

Build the

EAGLE

E. C. FOUR

Supersensitive All-E-Fern! Easy to build, easy to operate.

Complete Kit $1425

Including all R.F. Coils. Send for Free Eagle Cyclopedia also pay as you build plan.

EAGLE RADIO Dept C 84 Everitt St. New York, N. Y.
AN EFFICIENT 4-TUBE ALL-WAVE SET

(Continued from page 149)

easy for the set builder to purchase one unit at a time.

LIST OF PARTS

Unit No. 1

- Eagle foundation chassis and panel, with built-in coil shields and shielded rectifier compartments. Everything stamped out; no further drilling required. Shipped fully constructed and black cranked finish unless otherwise specified. (A 25/16 to 550 meter coil kit is available—special.)

- Four Eagle 6-prong coils, range 12 to 255 meters.

- Four Eagle 5-prong electron-cooled coils, 12 to 255 meters.

- One Eagle power transformer, P.T.

- One Eagle 150 mmf. double-gang variable condenser.

- One Hammond 50 mmf. variable condenser, C1.

- One Cornell-Dubilier dual 8 mmf. electrolytic condenser.

- Three Cornell-Dubilier 100 mmf. mica condensers.

- Two Cornell-Dubilier .05 mmf. condensers.

- Two Cornell-Dubilier 1.0 mmf. condensers.

- Two 2.5 mh. R.P. chokes, sectional-wound.

- One 360 ohm, 1 W. resistor:

  - Four 0.1 mmf., 1 W. resistors.

  - One 0.5 mmf., 1 W. resistor.

  - One 5 mmf., 1 W. resistor.

- One Centralab 18,000 ohm potentiometer, R2.

- One Centralab 50,000 ohm potentiometer, RI, with switch, SW.

- Three Eby 6-prong wafer sockets.

- One Eby 4-prong speaker socket.

- One Eby 5-prong speaker socket.

- One Lafayette 6-prong inoxet socket.

- Three bakelite knobs.

- One power line cord:

  - Three tube shields.

  - Misc. hardware, etc.

Unit No. 2

- Eagle foundation chassis and panel, with built-in coil shields and shielded rectifier compartments. Everything stamped out; no further drilling required. Shipped fully constructed and black cranked finish unless otherwise specified. (A 25/16 to 550 meter coil kit is available—special.)

- Four Eagle 6-prong coils, range 12 to 255 meters.

- Four Eagle 5-prong electron-cooled coils, 12 to 255 meters.

- One Eagle power transformer, P.T.

- One Eagle 150 mmf. double-gang variable condenser.

- One Hammond 50 mmf. variable condenser, C1.

- One Cornell-Dubilier dual 8 mmf. electrolytic condenser.

- Three Cornell-Dubilier 100 mmf. mica condensers.

- Two Cornell-Dubilier .05 mmf. condensers.

- Two Cornell-Dubilier 1.0 mmf. condensers.

- Two 2.5 mh. R.P. chokes, sectional-wound.

- One 360 ohm, 1 W. resistor:

  - Four 0.1 mmf., 1 W. resistors.

  - One 0.5 mmf., 1 W. resistor.

  - One 5 mmf., 1 W. resistor.

- One Centralab 18,000 ohm potentiometer, R2.

- One Centralab 50,000 ohm potentiometer, RI, with switch, SW.

- Three Eby 6-prong wafer sockets.

- One Eby 4-prong speaker socket.

- One Eby 5-prong speaker socket.

- One Lafayette 6-prong inoxet socket.

- Three bakelite knobs.

- One power line cord:

  - Three tube shields.

  - Misc. hardware, etc.

Unit No. 3

- One Eagle power transformer, P.T.

- One Eagle 150 mmf. double-gang variable condenser.

- One Hammond 50 mmf. variable condenser, C1.

- One Cornell-Dubilier dual 8 mmf. electrolytic condenser.

- Three Cornell-Dubilier 100 mmf. mica condensers.

- Two Cornell-Dubilier .05 mmf. condensers.

- Two Cornell-Dubilier 1.0 mmf. condensers.

- Two 2.5 mh. R.P. chokes, sectional-wound.

- One 360 ohm, 1 W. resistor:

  - Four 0.1 mmf., 1 W. resistors.

  - One 0.5 mmf., 1 W. resistor.

  - One 5 mmf., 1 W. resistor.

- One Centralab 18,000 ohm potentiometer, R2.

- One Centralab 50,000 ohm potentiometer, RI, with switch, SW.

- Three Eby 6-prong wafer sockets.

- One Eby 4-prong speaker socket.

- One Eby 5-prong speaker socket.

- One Lafayette 6-prong inoxet socket.

- Three bakelite knobs.

- One power line cord:

  - Three tube shields.

  - Misc. hardware, etc.

Unit No. 4

- One Lafayette airplane dial with black face and white numbers to match the panel.

- Complete with pilot light.

A CAMPER'S 4-TUBE PORTABLE SUPER

(Continued from page 149)

of the portable size, small and light in weight.

The aerial for this set is built in.

Where greater volume and sensitivity are needed, however, it can be stretched out and supported on any suit of hanger or other high object.

A full-vision, airplane-type tuning dial aids ease of tuning.

The rear of the cabinet showing the complete set and batteries.

THE DEFLECTING PLATES IN CATHODE-RAY TUBES

(Continued from page 150)

plate P2 is made negative. The positive plate will attract the negative electrons flying past it, and cause the beam to bend or deflect toward it as shown. The negative plate will repel the negative electron stream, aiding the action of the other plate in deflecting the beam to the position shown. Upon this action of the deflecting voltage, the spot of light moves from point A to point B on the screen. (Naturally, the point of deflection depends upon the intensity of the beam, the anode voltage, and the voltage applied to the deflecting plates.)

If now, the polarity of the deflecting plates is reversed, as shown at B, Fig. 1A, the electron beam will be deflected in the opposite direction, and the spot of light will move back through point A to point C on the screen.

A simple explanation of the operation of the deflecting plates is given at Figs. 1 and 1A, and is essentially the same as that shown in previous articles. The beam is a continuous electron stream which passes through the electron gun (or cathode-ray tube), in which a constant voltage is maintained. The gun is enclosed in a tube which is evacuated to a very low pressure, and consists of three parts: the cathode, which emits the electrons; an anode, which attracts the electrons; and a screen, which focuses the electron beam into a spot on a fluorescent screen.

In the cathode-ray tube, the electrons are accelerated by a high voltage applied to the cathode. The electrons then strike the anode, which is made of a material that emits light when struck by electrons. The light is then focused by the screen onto a phosphor-coated screen, which produces the images we see on the screen.

The deflecting plates are used to deflect the electron beam in the horizontal and vertical directions, allowing us to change the position of the spot on the screen. The deflecting plates are usually made of metal, and are positioned in the path of the electron beam.

When a voltage is applied to the deflecting plates, it causes the beam to deflect to the desired position. This is accomplished by changing the forces acting on the electron beam, which causes it to deflect towards the positive plate or away from the negative plate.

The deflection of the beam is proportional to the voltage applied to the deflecting plates. The greater the voltage, the greater the deflection of the beam. This allows us to control the position of the spot on the screen by changing the voltage applied to the deflecting plates.

The deflecting plates are typically made of metal, and are arranged in pairs to deflect the electron beam in both the horizontal and vertical directions. The pairs of deflecting plates are usually arranged symmetrically around the electron beam, with one plate in each pair being positive and the other plate in each pair being negative.

The voltage applied to the deflecting plates is typically controlled using a potentiometer, which allows us to adjust the position of the spot on the screen. The potentiometer is used to control the amount of voltage applied to one of the deflecting plates, which in turn causes the beam to deflect to the desired position.

The deflection of the beam is also proportional to the width of the deflecting plates. The wider the deflecting plates, the greater the deflection of the beam. This allows us to control the size of the spot on the screen by changing the width of the deflecting plates.

In conclusion, the deflecting plates are essential components of the cathode-ray tube, allowing us to control the position and size of the spot on the screen. The deflecting plates are typically made of metal, and are arranged in pairs to deflect the electron beam in both the horizontal and vertical directions. The voltage applied to the deflecting plates is typically controlled using a potentiometer, allowing us to adjust the position and size of the spot on the screen.
A NOVEL "ACORN"-TUBE REGENERATIVE SET

(Continued from page 156)

scribed a system of tuning that combines a vario-
meter and variable condenser, in shunt to each
other, as the resonant circuit. In principle, you
set the varimter for minimum
and crank up on the condenser, which brings
the circuit part-way up the wave range; then,
you wind the varimeter shaft around until
maximum inductance is reached, for the bal-
ance of the wave range. Or, you can work
out the other way 'round—tuning first with the
varimeter and then using the condenser for
the balance of the range. This condenser
in Fig. 1A is C1; it must be insulated from the
metal panel.

The four sections of the varimeter selected
for this purpose are La = Ld (rotor), Le = Lc (rotor),
Le-La (stator): a fifth winding, Le, is used as the
back-feed back. (The varimeters
sets as three to appear in the
Fig. 1A.45°-1

It is an inherent quality of varimeters that,
where rotor and stator inductance values exactly
balance, the external electromagnetic field is nil
when the rotor winding is so positioned (min-
mimum inductance) within the stator as to be in
complete opposite of the rotor. The
only coupling that can remain, then, between the
total inductance of the varimeter
and an external inductance, (L) is capacitative
as a result of the two masses of metal.

In most regenerative sets the feed-back at the
longer wavelengths is due almost entirely
to inductive coupling; at the shorter, to both
inductive and capacitative coupling. Now, by
using the idea incorporated in the circuit of the
acorn set, the inductive coupling at the shortest
wavlengths is practically nil, there remaining
only capacitative coupling. The degree of
regeneration is determined by the setting of
condenser C2 (which must be insulated from
the metal panel).

Due to the fact that the "tube within a tube"
design of varimeter is used in this set, the
ductance graph has a letter-'S' figure. This
causes a slight increase in the amount of feed-
back at about one-third the way up the wave
length range. This condition may be
compensated, however, by adjusting antenna cou-
lpling condenser C3 until maximum absorption
occurs at the desired position. The adjustment
of C3 will vary with individual antenna, and
with the degree of selectivity required for a
given location.

Note that choke R.P.C. should be of the single-
windding type, and in this case, the widening type
will have insufficient self-capacity for good
regeneration control. It is necessary to tap the
antenna into the condenser circuit (see IA), by
connection to the frame (see Fig. 1C), inasmuch
as the coupling at the shorter wave-
lengths afforded by this is too
good volume. Note that the varimeter must be
completely insulated from the metal panel (the
writer used an "auto-transformer" with two
supporting screws); the panel is grounded.

LIST OF PARTS

One RCA Raditron type 954 "acorn" pentode, V1;
One Hammerslund "acorn"-tube socket, for
tube V1;
One small varimeter or may be built to the
B&K, given, L4-L6;
One Hammerslund type APC, 100 mmf. padding-
type condenser (tuning), C1;
One Hammerslund type APC, 50 mmf. padding-
type condenser (regeneration), C2;
One Solar mica-dielectric padding-type condenser,
50 to 250 mmf. (antenna coupling), C3;
One Cornell-Dubilier grid condenser, 250 mmf.,
C3;
One Cornell-Dubilier phone bypass condenser,
0.01 mf., C4;
One Aerovox coupling-mmf., 200 V condenser, C5;
One Electro grid leak, 2 meg., R1;
One wooden stockboard, 4x10x-in. thick;
One aluminum panel, 6x7x1/2-in. thick;
Two tuning scales and pointer knobs:
One arrow-shaped knob;
One speaker connection strip;
Miscellaneous hardware.

Please Say That You Saw It in Radio-Craft
A 3-TUBE SHORT-WAVE “VARIABLE I.F.T.” TUNER

(Continued from page 151)

pop out. Next, remove the grid lead from the top coil lug and solder on a lead of the proper length to reach to your tube cap. Then drill a hole in the opposite side of the can and insert this new grid lead through this hole, while of course, replacing the coil in its original position.

In the other coil, the same removal procedure is followed except that the grid lead is not brought from the side of the can, but is left at the bottom. This is done since the second-detector is a grid-driven diode, the diode connection must be made to the base of the tube and not to the cap.

Be sure that all control-grid leads are covered with metal shielding braid, at least to within 1/8-in. of the point to where the wire is soldered.

HOW TO ALIGN “VARIABLE I.F. TRANSFORMERS”

For complete satisfaction, those I.F. transformers should be aligned very carefully. This is done by using an 0-25 millimeter and in the following way: Connect up the set and plug in the set of coils covering the 40-meter band. (Incidentally, it is advisable to remove about 1/2 turns from the grid winding of the oscillator coil on this particular band to insure proper tracking.) Turn the dial until a signal is picked up. Bring it up to maximum with the aid of the antenna trimmer. Connect the millimeter in series with the “B+” lead to the receiver. With 250 V. applied to the set, the meter should read between 20 and 25 ma. Adjust the set screws on the sides of the can of the first I.F. Do this slowly with a wooden or bakelite screwdriver, and note the meter reading. Adjust the other I.F.s. similarly. Now note the sensitivity of adjustment of the main tuning control. The meter reading should go up about as the set is tuned away from the station. Now tune the station in again and repeat the lining-up procedure of the I.F. transformers. Watch the meter reading and adjust the set screws for minimum current on the meter. (If the station is fast, the meter will fluctuate continually during the operation, and it will be necessary to take an average reading on the meter.) Repeat this procedure once more for certainty.

Be sure to shield separating the variable condenser section is grounded. The plungers on the I.F. transformers should be set to keep them in a stable condition for selectivity control.

LIST OF PARTS

Two Hammarlund split-plate midget variable condensers, type MCD-140-M, C1, C2;
One Hammarlund midget variable condenser, type MC-56-M, C8;
Three Cornell-Dubilier condensers, 300-mf., C4, C7, C12;
Eleven Cornell-Dubilier condensers, 1-mf., 500 V., C6, C7, C8, C9, C10, C12, C13, C14, C15, C18, C20;
Two Cornell-Dubilier condensers, 5-mf., 500 V., C1, C4;
One Cornell-Dubilier electrolytic condenser, 5 mf., 25 V., C10;
One Cornell-Dubilier condenser, 0.1-mf., 500 V., C22;
One Electrostatic potentiometer, 100,000 ohms, R1;
One I.R.C. resistor, 50,000 ohms, 1/2-W., R2;
Three I.R.C. resistors, 10,000 ohms, 1/2-W., R3, R12, R19;
One I.R.C. resistor, 50,000 ohms, 1 W., R1;
One I.R.C. resistor, 20,000 ohms, 1/2-W., R3, R11, R17;
Three I.R.C. resistors, 1,000,000 ohms, 1/2-W., R7, R15, R18;
One I.R.C. resistor, 100,000 ohms, 1 W., R8;
One I.R.C. resistor, 50,000 ohms, 1/2-W., R9;
Two I.R.C. resistors, 500,000 ohms, 1/2-W., R10, R16;
One I.R.C. resistor, 400, ohms, 1 W., R13;
One I.R.C. resistor, 1,500 ohms, 1 W., R14;
Three Hammarlund VT-465 transformers, IPT1, IPT2, IPT3;
Two Hammarlund standard 4-prong plug-in coil kits, type SWK-4, L1, L2;
One Hammarlund isolantite small-base 7-prong socket, type CL-7;
Two Hammarlund isolantite sockets, 5-prong, type S-5;
One Hammarlund tube shield, type TS-50;
Two Eby 7-tube small wafer sockets;
One Eby headphone terminal strip;
One Eby antenna terminal strip;
One Eby ground binding post;
One vernier tuning dial;
One front panel, 11 x 11/4 in.;
One chassis, 8 1/2 x 11 1/2 in.

NEW MYSTERY STATION

This new station is located very near Chicago's downtown loop, and although it is in operation every week, it has never been barged, even by the most ardent DXer! It is complete in every respect, the actual transmitter is quite large, lying by 125 feet long. In addition to this, there are mixing panels, control panels, and a complete sound proofed studio. This novel station is located in the Coyne Electrical School, and is used for the sole purpose of training prospective radio operators. Every type of studio equipment is available, and the material "hands-on" is quite varied: recordings being used in some cases, while in others, actual vocal and instrumental programs are employed.

The system is operated entirely by the students under the direct and personal supervision of competent radio instructors. By working on the equipment, the students acquire the technique of radio broadcast work and in addition, they have the responsibilities of handling expensive equipment, and learn the precautions necessary for this work.

Since the station is absolutely complete except for connection to an aerial, we to the students have all the work to do just as they would in one of the country's best stations.

The circuit of the tuner including the values of all parts.

Please Say That You Saw It in RADIO-CRAFT.
A NEW IDEA IN SET-BUILDING

(Continued from page 151)

insulating material and connecting staples (the staples take the place of the usual wire con-nections). The various layers are held together by a group of tubular rivets (eyelets) extending all the way through the base plate and forming connecting sockets for the components of the receiver to plug into, such as tubes, resistors, condensers, transformers, coils, controls and other leads. The number of laminations used depends on the com-plexity of the wiring and the number of places where connecting staples must cross one another.

Fig. A shows the front view of a 6-tube superhet receiver constructed as an experimental model by this means. The laminations are clearly visible at the front of the base plate and the remarkable simplicity of the lay-out is striking. This base plate is 11x5½-in. thick.

The photograph in Fig. B presents a view of the bottom portion of the plate of this receiver. Each eyelet shown is a connection to some part and each part can be tested individually from this location. In the factory model the circuit diagram can be placed here symbolically with all values of parts to further facilitate any testings.

In less than five minutes the entire receiver may be reduced to the base plate and control panel. Fig. C. This view shows the top of the base with all of the parts comprising the circuit removed. It will be ob-served that most of the parts are standard. Note the absence of small hardware ordinarily used.

Each of the parts comprising the circuit is provided with two or more rigid spring clips contacts to insure a perfect lead. The num-ber to the eylets. Perfect connections of the eylets to the staples are insured in three ways, namely: (1) by a long wire ring pressure con-tact; (2) the rivet clinch; and, (3) solder. A ground plate is included in the laminations to segregate high-frequency components, obviating feedback and other undesirable coupling in the circuit. Thus the chassis of several plates, breaking up feed-in- ing parts, and profusion of inaccessible units is completely eliminated.

This type of construction from the point of view of the Service Man as well as from every other viewpoint is almost without parallel. Some of the more outstanding ones are: rapid testing; instantaneous re-placement of any part; no soldering whatever to be done by the Service Man; performance tests by substitution made very rapidly; im-mediacy of testing of parts with values marked on them or by their size; and, in ease of handling.

With this type of construction the base plate may be made automatically. Various layers starting from the bottom, having been prop-erly punched for a particular circuit will be fitted with staples to connect certain eylets in a straight line. Upper layers will form when this is completed the eylets will be in-serted and clinched. This structure will then be insulated making it impervious to moisture and the parts inserted by machinery.

The entire process can be done at the rate of one receiver an hour by the automatic machinery developed by the Inventor for this purpose. Process testing of the unit while being made as well as when finished will be done in one operation.

The dealer will be relieved of the risk of ob-solescence as well as of the labor involved in the satisfaction operation to his purchasers. Uniform performance will be outstanding.

The under-side of the laminated chassis with the components plugged in. Note the absence of wires.

USES OF THE CATHODE-RAY OSCILLOSCOPE

(Continued from page 148)

the frequency response is being taken the opera-tor has a continuous check of distortion and overload. For each frequency setting, the sweep frequency should be adjusted to that frequency primary or a sub-multiple of it. It is also possible to check the overall audio fidelity of a set by applying a modulated oscillator to the input terminals of the receiver and connecting the vertical plates of the oscilloscope across the audio output coil of the speaker. The audio modulating voltage is then varied and the overall re-sponse at each frequency determined.

VACUUM TUBE CHARACTERISTICS

Dynamic curves of vacuum tubes may be taken with the oscilloscope with the tubes oper-ating normally in the actual circuit in which they are to be used. In this way tubes may be tested for performance and compared for quality under actual individual operating condi-tions instead of under some set of rated con-ditions which may or may not be similar to those encountered in that particular set.

The general procedure to be followed is to apply a sweep voltage to the grid amplifier in the horizontal plates of the oscilloscope. The vertical plates are connected through the other amplifier in the oscilloscope unit to the load impedance in the plate circuit of the tube under test. The re-sulting traces of plate and voltage plate current curve of the tube under actual operating voltages and conditions. (See Fig. 2A.)

Desirable characteristics for all amplifier tubes are: maximum length of straight portion of characteristic curve; minimum steepness (indicating maximum mutual conductance); closeness approach to straight line over whole length. By this method tubes may be compared in the actual circuit and the tube giving a curve clos-est to the characteristics outlined above will be the most satisfactory for use in that particular circuit.

The circuit diagram for this application is given in Fig. 2B. Performance curves of detector circuits may be obtained by following the same general pro-cedure. The oscilloscope curves the nearest approach to the "ideal" dynamic (AC) test—the final and most conclusive test is actual operation of the tube in the specific radio receiver in which it is intended to be used.

MEGADYNE EXPERIMENTS

Some work has been done along the lines of adding an audio stage to the new famous MEGADYNE. Several experimenters have run into trouble along these lines, so a few hints may be of some help to those who are having difficulty. Mr. J. M. Nithander, who is using a type 22 tube, tried adding a type 33 audio stage, in order to get good loudspeaker volume on distant stations. This was first tried with a separate audio amplifier, using the 33 tube with 90 volts on the plate. This worked nicely on one set the next was too weak for reproduction of the amplifier in the set proper. As soon as this was attempted, however, a loud howl was heard. A number of bypass condensers stopped the howl but ruined the tone and cut down the volume. Another audio transformer was tried with about the same results. The howl was finally removed by re-arranging the parts so that the grid of the crystal detector of the 22 tube was only about one inch long. A 250 mmf. condenser across the primary of the audio transformer seemed to help the regeneration action. When these changes were made, the performance was exceptionally fine, the tone being plenty of a melodic tone with volume to spare on most stations. Stations up to 1000 miles away coming in with good loudspeaker volume under good conditions.

The type 22 tube gave good results with only 2 volts on the grid while the cap on the control-grid was run at 22½ volts with 90 on the plate. The 33 tube was also run with 90 volts on the plate and with 9½ volts bias on grid.

Please Say That You Saw It in RADIO-CRAFT

Train Now for New Radio Opertunities

Analyzer & Resistance Tester—Lathe Design—YOURS Without Extra Cost

Get Into a Line Where There's Action—Every Day—And a Payday Every Week—You Be the Boss!

Right now while hundreds are look-ing for work there isn't any. You've been trained here. With the proper training and the necessary equipment, you can enter this field and make a comfortable living.

We include with our course this modern set analyzer and trouble shooters without any extra charge. This piece of equipment has proved to be a valuable help to our students. After a brief period of training, you can take the set analyzer out on service calls and easily com-pete with "old-timers." We show you how to wire short wave receivers—analyze and repair all types of radio sets. It's a profitable job for the radio enthusiast. If you think you're interested in this interesting work this is our business and we have trained operators with every facility to help you learn quickly yet thoroughly. If you possess average intel-ligence and the desire to make real progress on your own merits, you will be interested.

ACT NOW—MAIL COUPON

Mail this card today! Send for full detailed plan and one free booklet that explains how easily you can be trained in radio quickly. Don't put it off! Write today. SEND NOW!

RADIO TRAINING ASSN. of AMERICA
Dept. RC-59, 4151 Ravenswood Ave., Chicago, III.
Gentlemen: Send me details of your Enrolment Plan and information on how to learn to make real money in radio quick.

Name.

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

Tomorrow's Magnetic Speaker—Today!

The Revolutionary NEW Wright-DeCoster "HYFLUX"

The answer to the trade's demand for Quality at a Price. • Manufacturers. • Distributors. • Sound Engineers. • Dealers. Write for complete details, specifications, prices.

WRIGHT-DECASTER, Inc.
2251 University Ave.
St. Paul, Minn.

Also at largest stock of Sine & Sans Co.
Cable Address: SIMONTRICE. New York.

www.americanradiohistory.com
"FREQUENCY MODULATION"
IN TOMORROW'S SET
(Continued from page 152)

rents. The number of sidebands will be twice the number of modulating frequencies. When the modulating current of the example just mentioned has a second and third harmonic the frequencies of which are 2,000 and 3,000 cycles, the modulated current can be considered as consisting of 6 waves having the following frequencies: 1,000,800; 1,000,900; 1,000,1,000; 1,000,1,100; (4) 999,900; (5) 998,900, and (6) 998,000. In order to operate without distortion a radio receiver has to be capable of receiving simultaneously the six sidebands with the same condition which excludes sharp tuning. Together with the sidebands, a portion of the carrier is also transmitted when the latter is not completely modulated.

It may seem at first glance that the unmodulated carrier is useless and that its suppression is desirable. A closer examination, however, shows that the two sidebands alone cause a beat, in the receiver, the frequency of which is twice the modulating frequency. In other words, a modulation would lead to doubling the pitch of the transmitted sound (a condition which hardly conforms with good transmission!). But when the carrier is added the modulated carrier corrects this effect. Each of the sidebands "heterodynes" (produces a beat frequency) with the modulating current and the result is a beat note of the modulating frequency. Only a negligibly small portion of the heterodyned waves is necessary to produce an audible audio signal of double frequency. The above consideration explains why the modulation index must often exceed some 35 per cent when high-quality broadcasting is desired. It is clear that the carrier can be suppressed without affecting the quality of transmission if the receiver itself can supply the carrier from some internal source. Successful experiments have also been conducted on transmission while using a single sideband and the carrier.

FREQUENCY MODULATION

However, in frequency modulation (which is the basis of Major Tree's system of transmission, described in the August 1935 issue of Radio-Craft, on page 75) the amplitude and the phase do not vary. Frequency is the only variable element. If the frequency of the unmodulated current is fo, the modulated frequency varies for a given amplitude of the audio signal between fo + f and fo - f. The amplitude at any one frequency is equal the square of the audio amplitude. The variation of the frequency may be caused by the maximum audio amplitude, any instantaneous frequency value of the frequency-modulated carrier being the sum of two cosine waves: fo ± f. For example, a frequency-modulated 1,000,000-cycle carrier for a given audio amplitude may have a variation of 1,000 cycles which means that while the audio signal varies during the cycle, the frequency of the carrier will vary between 1,000,001 cycles and 999,000. A much larger audio amplitude the variation may be 2,000 cycles and the variation range therefore 1,002,000 and 998,000. If mf is the maximum frequency variation which may be caused by the maximum audio amplitude, any instantaneous frequency value of the frequency-modulated carrier is between fo + mf and fo - mf. Frequency modulation is shown graphically on A and B in Fig. 1. In B it will be noted that the amplitude of the modulated wave (B) is the same as the carrier (A).

There are several elements in, an oscillator, the variation of which may cause a change in the frequency of the modulating current. However, most convenient method for producing a pure frequency modulation is to act either the capacity or inductance of the oscillator circuit—preferably on the capacitor.

Figure 3 shows a simple set-up for frequency modulation and carrier rejection. In parallel to condenser C of the oscillator circuit is connected a modulating condenser MC which is fed from a telephone or an earphone or a Baldwin headset reverbilt for this purpose. The latter is easily constructed as follows.

The mica condenser is covered with thin aluminum foil, electrically connected to one end of C. A heavy, insulated metal plate is fixed in front of the diaphragm and is connected to the other end of C. The modulating frequency is supplied, in this case, by the audio amplifier. With such an arrangement, the fundamental of a given frequency and amplitude will cause a sinusoidal variation of the pitch.

If the frequency variation f is small with the comparison to fo, the ratio of the capacity change C1 to the total capacity Co is twice f. For instance, if Co = 250 mmf; fo = 1,000,000, and we wish to have a maximum variation of 2,000 cycles; f is equal to 2,000. The ratio

\[
\frac{f}{2} = \frac{2,000}{2} = 1,000,000
\]

and the capacity ratio

\[
\frac{C_1}{C_0} = \frac{1}{2} \times \frac{f}{C_0} = \frac{1}{2} \times \frac{2,000}{250,000} = 0.04
\]

Thus a variation of 1 mmf. in the capacity of the modulating condenser will produce a change of 2,000 cycles in the frequency of the generator. A mathematical analysis of frequency modulation, and carefully conducted experiments proved that the frequencies of the sidebands in frequency modulation generally exceed the number of sidebands by one or two cycles. The sidebands are in pairs and their respective frequencies are equal to + p, f0 + p, f0 - p, etc. Where f0 is the frequency of the carrier and p the modulating frequency, the frequencies of the carrier and the sidebands depend upon the ratio of the number of sidebands to the "modulation index." The modulation index m is equal to a constant k multiplied by the ratio of the two frequencies m = \(f/p\).

We see that the amplitudes of carrier and sidebands depend upon the modulating frequency. In the example, each pair of sidebands in amplitudes modulation will vary from twice the frequency of the sidebands in frequency modulation generally when the sidebands are of equal power. In this higher sidebands become more noticeable.

An "acoustical" detector cannot produce an audio signal from a frequency which is higher than the original frequency. This can be done by inserting a tuned circuit between the antenna and the detector, or by using a filter system. This is the reason why, practically any receiver with VERY SHARP tuning cannot be used for modulated signals. The quality is another question; and in a modern system, a special network of current limiting and other circuits are used to maintain a high-quality output.

PHASE MODULATION

A mathematical analysis of phase modulation shows that similarly to frequency modulation the modulated current can be considered as consisting of an infinite number of pairs of sidebands. Using fo as the carrier frequency and p as the modulating frequency, the frequencies of the sidebands are: fo + p, fo − p; fo + 2p, fo − 2p; fo + 3p, fo − 3p, etc. The amplitudes of the carrier and the sidebands are a function of the modulating index mp. For example, a frequency modulation is independent of the modulated carrier frequency. Here again when the modulating index is small, the maximum shift of the phase angle is small, and the frequency modulation has practically no influence.

An aperiodic detector cannot rectify a phase modulated wave (similar in this respect to frequency modulation). The transmitted wave has to be amplified and detected before it reaches the detector. This is accomplished by inserting a tuned circuit between the antenna and the receiver or by using a simple system in the same position in the circuit. From the above consideration it may easily come to the conclusion that neither frequency nor phase modulation will have any effect on the bandwidth. As a matter of fact it appears that when the modulating waves are of ideal conditions the bandwidth of the latter is smaller than the bandwidth of the former. When the phase modulation is modulated, amplitude modulation, though it is true that in the case the problem of bandwidth is much more acute than in the former case, can be said about the practical merits and defects of the latter two systems of modulation, as experimental data are quite limited.
A NEW HI-FIDELITY "TWIN AMPLIFIER"
(Continued from page 155)
ment wherein two amplifiers are housed in one compact case, each of which is entirely independent of the other, and either one of which may be used as the emergency or reserve system.
A careful perusal of the schematic diagram will disclose the fact that each channel has its own universal, two-position input circuit arrangement as well as its individual universal output transformer. These features permit the amplifier to be used in a number of novel arrangements.
By connecting the two circuits in parallel and operating both amplifiers simultaneously, 25 W. of pure class A audio power is obtained with less than 2.5 per cent of total harmonic distortion (which cannot be detected by the average ear).
This practically distortion-free output is made possible by using high-fidelity, balanced-type input and output transformers particularly designed for the type 6A3 tube.
These same transformers contribute in no small measure to the true high-fidelity response characteristics of the amplifier which has a variation of less than 2 db., between 20 cycles and 14,000 cycles. The upper limit may be stretched up to 12,000 cycles by utilizing the frequency equalizer incorporated into each channel.
It will be noted that the variable equalizer is placed between the second A.F. stage and the "inverter-driver" plate (because of the inclusion of either bank or treble response to suit the taste of the listener, or the acoustics of the room).
During simultaneous operation of both input circuits, the output transformers may be individually connected to their own key of speakers or to one bank of speakers (by paralleling the 4, 8, 16, 200 and 500 ohm taps).
A number of significant and valuable sound effects are easily achieved in many novel ways. For instance both clear channels used in their normal manner may be appropriately paired microphones and speakers are capable of reproducing sound in two dimensions, while two such systems (utilizing four clear channels) may be used to recreate sound in "four dimensions" (see Radio-Craft for Jan., 1935, Page 407, and Feb., 1935, Page 441). Needless to say, when power outputs of 12.5 W. are required, one of the channels may be left in the "idler" position (no plate or "ready" position). In the "idler" position, the channel is "cold." While in the "ready" position all of the cathodes (anodes) are at operating temperature, but no current is flowing in the plate circuits. The "ready" channel may be set into operation instantaneously simply by closing the plate supply switch.
THE NEW 6A3 POWER OUTPUT TUBE
The development and perfection of the 6A3 which is a prototype of the 2A3 plus many additional electrical and mechanical refinements (see further technical details on page 154 of this issue) marks another step in the design of dependable, universally powered P. A. amplifiers incomparable as it represents the most logical class of amplifier.
A small tube to use in universal (110 V., A.C.—4V., D.C.) amplifiers for it is unsurpassable in high-fidelity performance at relatively low plate voltages. In fact, it is a new secret that the 6A3 is expected to ultimately obsolete the 2A3.
By employing a three-plate two-way switch or a plug and socket, it becomes a simple matter to change from 110 V. A.C. operation to 6 V. storage battery use or vice versa. (See Fig. 1.) An important feature of this amplifier which should not be overlooked, is the twin 110 V. A.C. power supply and the twin dynamos or two 6 V. batteries. The inclusion of these two separate 110 V. A.C. and 6 V. D.C. power supplies is a 100 per cent insurance against operating failure during an emergency installation.
The author will gladly supply an itemized parts list for this amplifier. Address requests and questions care of Radio-Craft.

INTERNATIONAL RADIO REVIEW
(Continued from page 155)

power output under either condition—and the potential is practically constant throughout the life of the cell. A battery of three cells is shown in Fig. B, and a detail of one cell appears in Fig. C.

A 1-TUBE ELECTRIC SET
THE 12A7-TUBE ELECTRIC SET has found many novel applications in radio design, in this, country because of the economy of the pentode section.
A French application of this tube was described recently in La T.S.F. Pour Tous, a magazine published in Paris. As shown in Fig. 2, this set consists of a regenerative-type detector of the pentode type. Regeneration is controlled by a variable condenser C2, while sensitivity and volume are controlled by the 50,000 ohm potentiometer in the screen-grid circuit. The power supply is obtained by use of the diode section of the tube, the output of which is filtered by a 40,000 ohm resistor and two 8 mf. condensers. The filament of the tube is connected in series with a 40 W. lamp to reduce the voltage to the correct value.
The set is a dual-wave unit, the wave-change being accomplished by shorting out part of the grid coil.
It is interesting to compare this European adaptation of the 12A7 with American sets of similar design.

THE RADIO WATTMETER
FOR THE benefit of radio set dealers and Service Men in selling and repairing radio receivers, a German company has introduced a wattmeter which indicates directly the current consumption of a radio receiver or electrical appliance.
This meter, shown in Fig. D, is equipped with a socket for the radio receiver to be plugged into. It is explained by our Berlin correspondent that the use of such an unit can be used as a selling point in the merchandising of sets, as well as indicating certain defects in repairing sets.

Fig. 1. Circuit of Twin-Amplifier Channel No. 1; channel No. 2 is identical. Figure A (heading, pg. 151) shows complete unit.

METAL RADIO TUBES!
National Union gives Service-Dealers new testers to test them.
Send coupon for details!


ELECTROLYTICS featuring exclusive C-D-patented development, "hi-formation" assembly process, now available at no extra cost.

CORNELL-DUBILIER CORPORATION
4247 BRONX CORP. NEW YORK

Please Say That You Saw It in Radio-Craft
A MAGAZINE WHICH NEEDS NO INTRODUCTION TO SHORT-WAVE FANS

SHORT WAVE CRAFT

This popular monthly magazine, SHORT WAVE CRAFT, contains everything you want to know about Short Waves. The numerous tips, stories, illustrations, questions and answers, and articles on all types of Short Waves are clearly described and illustrated. Latest practical information for radio fans, experimenters and hams will be found. Tells you how to build short-wave receivers and transmitters, constructs sets of all types, and explains the advantages of Short Waves. Tells best first stations to listen to and when to listen. Each number of SHORT WAVE CRAFT is edited by Hugo Gernsback.

NEW FEATURE RECENTLY ADDED—To the short wave enthusiasts, a number of short-wave stations from all over the world. For them, each month will award a magnificent 24" silver trophy.

Special This Month Only

For the month of August only, we offer readers of this magazine the opportunity to read radio's greatest Short Wave magazine as a special saving. The regular subscription price is $2.50 per year. You can now get SHORT WAVE CRAFT for the low price of $1.00 for a year. Only 25c per copy.

8 MONTHS FOR $1.00

4-Color Cover

Over 200 Illustrations

9x12 inches in size

$25 C for The Copy

On all NEWSSTANDS

Send remittance by check, money order or U.S. Postage Stamps to Gernsback Publications, 959 Hudson Street, New York, N.Y.

SHORT WAVE CRAFT

959 Hudson St.
New York, N.Y.

AIR CONDITIONING is America's Next Great Industry

The idea of electrics, radio service men and other technicians servicing Air Conditioning and Refrigeration units is self-evident and the opportunity for employment is on the increase. However, over sixty thousand of these trained in one air conditioning equipment has been installed in public auditoriums, theaters, studios, department stores and manufacturing plants. The tremendously broad potential in the new mediums is being rapidly expanded and success to near-manual training is well on the way.

Well-known Engineer Edits Manual

The OFFICIAL AIR CONDITIONING SERVICE MANUAL is edited by L. K. Wright, an engineer and a leading authority on air conditioning and refrigeration. This Air Conditioning Service Manual and the page is illustrated; every modern installation and individual and carefully edited; diagrams of every known equipment; special care given to the servicing and installation and the most specialized tools are illustrated and explained; there are plenty of charts and pages after page of service data.

CONTENTS IN BRIEF


352 Pages

600 Illustrations

9x12 inches

Flexible, Loose-Leaf

Leatherette Cover

$5.00 A COPY

Send remittance by check, money order or unused U.S. Stamps. Return letter if contents stamps or currency. (Not payable in Canada)

GERNSBACK PUBLICATIONS, INC.

959 Hudson Street
New York, N.Y.

RADIO-CRAFT'S "IDEAL RADIO SERVICE SHOP" CONTEST

(Continued from page 155)

P. E. Pain, W2JCF, Northeastern Laboratory, 655 Monthell Ave., N.E., Atlanta, Georgia.

TYPICAL LETTERS

The two letters reproduced below have been received from our subscribers and may be typical examples of what may be received by others to whom contemporarily entering the contest. The names of both the letters are eligible for decision by the judges.

Contract Director

My Ideal Radio Service Shop would contain the following equipment as listed:

1. A complete test panel for measuring voltages, currents, resistances, and capacitances. It must have ratings high enough to take care of all auto and home sets as well as amplifiers and P.A. systems. The reactance must have the measure to 1,000 V. A.C. and D.C.: current ranges from 20 amperes to handle vibrators; to 20 megohms for resistors and to 16 mf. for capacitors.

2. An all-wave oscillator. Its ranges should be from 100 kc. to 30 mc. and properly modulated and attenuated so as to feed a signal through a radio circuit to test the receiving circuits of the set. A suitable output meter must accompany this oscillator.

3. An oscilloscope and frequency modulator. This is required for visual alignment and should set it apart on high frequencies. Also a calibrated chart for use with the oscilloscope.

4. A universal test tube. This should have various field- and voice-coil resistances to take care of all radio sets on the market today.

5. A complete set of service manuals. These should cover a few of time and amateur's sets and be complete with cost, parts and expense.

6. A good tube checker. It must test all tube elements and indicate defective ones. It must also test inter-electrolyte and inter- mittently operating tubes.

7. A complete set of tools. Not only the necessary repair tools but a set of good neutralizing tools.

8. A complete stock of first-class repair parts and tubes.

This is my Ideal radio service shop. With the above equipment I believe I could give my customers a finer class of work and have less calls-back than I now have. It would enable me to expand my business. It would serve to include at least one day a week in the smaller town around me where now I only get there when I have a call from that town. It would also give me a chance in the P.A. field which is in its infancy in this section. In plain words, this equipment would mean a standing of a class A No. 1 radio Service Man.

JOHN D. RITNER

Radio-Craft, for SEPTMBER, 1935

Please Say That You Saw It in RADIO-CRAFT

Editor, Radio-Craft:

Altho much I am not in the habit of writing, I have decided to write a letter in the January issue, in this department, under the heading of "Something Wrong." By Mr. J. Smith, Jr.

It would take quite some space to explain the reasons for not repairing defective vibrators, but it may be necessary to give the time to correct put an old vibrator in shape is too great to warrant such a procedure. Furthermore, it seems that once the parts have become pinned, they are more or less useless, as it is very hard to judge the exact point to which the tungsten parts should be brought in order to get the correct results.

As the best rule to be adopted, may I suggest that the old vibrator should always be replaced by one that will make a long-lasting repair job, as the new vibrators on the market are in low price and the better type model sets and also the cheaper type sets. The new vibrators are required to be superior old vibrator and as much as the price of a new one. A new parting shot, after repairing the old unit, you are never sure of the job.

WINNER MILLER

Empire Coast and Trans. Co., Clifton, N.J.

A LETTER CONCERNING "SOMETHING WRONG"

Editor, Radio-Craft:

Although I am not in the habit of writing, I have decided to write a letter in the January issue, in this department, under the heading of "Something Wrong." By Mr. J. Smith, Jr.

It would take quite some space to explain the reasons for not repairing defective vibrators, but it may be necessary to give the time to correct put an old vibrator in shape is too great to warrant such a procedure. Furthermore, it seems that once the parts have become pinned, they are more or less useless, as it is very hard to judge the exact point to which the tungsten parts should be brought in order to get the correct results.

As the best rule to be adopted, may I suggest that the old vibrator should always be replaced by one that will make a long-lasting repair job, as the new vibrators on the market are in low price and the better type model sets and also the cheaper type sets. The new vibrators are required to be superior old vibrator and as much as the price of a new one. A new parting shot, after repairing the old unit, you are never sure of the job.

J. M. Kriekho

ORSMA MEMBERS' FORUM

(Easy-Made Chassis)

Radio-Craft, ORSMA Department:

The average custom set builder does not purchase a set when he builds a set and therefore must secure, cut and drill his own chassis. Aluminum chassis are not obtainable in all stores, and a loudspeaker (loud-conduct) iron is made of such iron metal that it will not make a solid base for a set after it has been cut and drilled. Here is my suggestion for a good chassis.

A sheet of nearest sheet metal dealer and buy a sheet of No. 14 or 10 or 25; have the men cut out the corners and bend the sides. (Do not try to do this yourself.) You may leave the corners as they are or add angle brackets for additional strength. Cut all the holes necessary and paint the entire unit with aluminum paint. When painted thus, the chassis takes on a pleasing appearance.

JAMES RICHARDSON,
San Francisco, Calif.

SAVING A PART

Radio-Craft, ORSMA Department:

I would like to suggest to ORSMA members to save the No. 3615 batteir boxette boxes out of Philco radio sets. These boxes have a resistor and condenser inside. The condenser as a rule breaks down, while the resistor remains intact. Remove this resistor and use it for making up any value from 259 ohms down. It is thick covered and very handy in making small resistors for tuning meters.

E. L. LAUREL,
Shelbyville, III.

Ideas for helping the Service Man are always welcome. Members should send in their moneysaving ideas.

www.americanradiohistory.com
shielding. I take exception to the reply.

Sparkplug manufacturers have spent years
for this. A sparkplug has the lowest possible
the electrical circuit. After all, we defeat the very
Suppressors are not used on aircraft en-
weaker the efficiency of the engine is the extent that the manufacturer
prefer to spend around $200 for a complete
of shielding, rather than add resistance to
the disturbance. I also am a wholesaler of radio tubes
was a tube that at the rate of about three per week I
point is in a position to know what I am talking about. As shown in the diagram, the
"B" drain is impossible. Also, the life of the
of a very short, the method of providing
a "C" bias on the R.F. tubes is neces-

Also a point that you bring this to
the attention of your readers.

Vern Peters
Hove, Montana.

Dear Sir:

Your letter to Radio-Craft was referred to
by me and I too have discovered a very serious error in the diagram in Fig.
4, on page 149 of the Sept. issue of Radio-
Craft. For I'm afraid you promised that all
the rebuilt sets are a compromise between
the ideal and the practical. If you spent enough time and money on this job we could not be
built almost to the ideal type. The idea is to
spend as little time and money possible on the
job consistent with the results.

I shall answer each of your statements as
I came to them in the book where there is
the "C" bias on the R.F. tubes." That is true,
but what about 36s in class B with no bias? What
about tube engineers recommending 36s
as being interchangeable with 10s—except
for the filament voltage which should be changed to 2 V. We know, of course, jobs way back when the 36s first came out,
and most of them still have their original tubes with a few exceptions—and these
were tubes in any particular position in the set. I
have made a trip personally to see a com-
petitor of mine in another city who also has
had a wide experience in using the 36-type tubes.
He tells me that he has never had any
trouble from lack of bias. However there are
certain difficulties in doing this, which are
outlined in the article, together with my sug-
gested solution. There may be a variation (in
different makes of tubes) in their life under
varying filament voltages. Here are the results of checking the circuit in question, on plate current. These readings
were carefully taken with all the voltages exactly
as shown in the diagram of Fig. 4. Volume full:
17 ma total plate current (the two R.F. tubes
draw only 8 ma, both) and about 36-A filament
Current. If a 30-type tube is substituted in place of the 36, the total drain is
then only 1 ma. At this time a set of bates
lasts a long time.

Comparing this with 36As in the same circuit,
we find: 29 ma total drain (the R.F. tubes
take 17 ma of this), and about 1.3 A filament
current. Using an OA1 in the last stage
stead of an 12A, the total drain then is about
25 ma.

If the resistor of 20,000 ohms shown in Fig.
4 is omitted, the two 36s in the R.F. stages
will draw about 30 ma. Instead of 5. This
resistor may be advisable to suit one or
more. The set you are rebuilding. I am not
saying this is the best way to solve this sit-
uation of high filament voltage, but it is a good,
economical and practical way to get the re-
sults with very little trouble. It is the rea-
on this set operating with low drain as it
does while still using no "C" bias.

As Mr. Moore points out, the 20,000 ohm re-
sistor is the heart of the solution, since it drops
the plate voltage to a lower value, due to the
current passing through it, and so tends to
cause a lower plate drain by the R.F. tubes.
And also, as pointed out by Mr. Moore, the
most scientific method is not always the best
from a practical standpoint. Results, as always,
are the criterion to strive for, regardless of the
results.

Please Say That You Saw It in Radio-Craft
IT ALL SEEMS to fall into place. The burden of forbidden Tibet, lies the mysterious and ancient city of Chengdu. Here in the midst of the high-mountainous, undeveloped land of perhaps 15 English-speaking people reside, and operate "Commercial Mission."

One of these, the Reverend T. Loud, who is connected with the Mission Press. Mr. Plewman is one of the many DX-ers in all China, but his DX-ing differs quite a lot from what we experience here. Almost any night you may call him into the tubes. Calling Mr. Plewman may be seen carefully turning the dials of his receiver, and listening intently for croaky, three-weeks-old talking from London, Paris, Lisbon, or even New York. Anything that Mr. Plewman hears in the nature of news, of course, is sent to all DX logs in hankies or little press book. The next day will see Mr. Plewman setting these notes up in type in what is perhaps the most unique newspaper in the world. This tiny sheet goes under the name of "THE AIR," and is the only English newspaper for 1,000 miles around. The London newspapers are embarrassed by comparison. "THE AIR" reaches Chengdu, so it can well be imagined with what avidity the few English families eat up their few English words, and have them only with the outside world.

Mr. Plewman's radio set was the first in West China to receive foreign broadcasts. And upon possession of it, it was necessary for him to pay over $160.00 levy on it to the Chinese War Lords who control the province. This set, however, is a very long river that gives them their only access to the Ocean. This was an illegal levy, but in order to get his radio set he must pay it. Before the receiver was finally delivered it was necessary for him to get on the backs of coolies for part of the journey. The magic of radio reception was retarded at first by many of the natives with mixed awe, and fear and no little superstition, for in a city where white people are still accused of bottling up the blood of children, it is not surprising that the natives should look on voices from the air with trepidation.

The local supply also constituted quite a problem as it was only on certain days, usually when the set was not needed, and was found to fluctuate severely in voltage as to make reception a sort of gamble.

Despite all of these handicaps, Mr. Plewman has been receiving reports that his set was excellently received by the native Chinese. For instance, during one of his early broadcasts one night in September Mr. Plewman lists Prague, Czechoslovakia; Belgrade, Yugoslavia; Stockholm, Sweden; Berlin, Germany; Hamburg, Germany; Ho by, Sweden; Brno, Czechoslovakia; Copenhagen, Denmark; Leningrad, Russia; Leipzig, Germany; Vienna, Austria; Budapest, Hungary; Graz, Austria; Brusel, Belgium; West Berlin, Germany; Poltava-Ostrava, Czechoslovakia; Glogow, Germany. All of these stations were of course logged on the regular broadcast bands, as at that time Mr. Plewman did not have an all-wave set. Since this time however Mr. Plewman has bought a new all-wave set and he finds that he can now do a great deal of his DX work much more to his liking.

One of Mr. Plewman's new DX stations he states was some months ago the death of the late Lams of Lhasa, an occasion of greatest importance in this remote country of the world. A group of Tibetan lamas from Frisco and from Chengdu, and then crossed legged on the pavement in front of Mr. Plewman's house, thereby becoming the first native of his age to die of death of their supreme ruler, for news travels slowly in Tibet. The lamas immediately broke into tears, and then turned their heads back in silence, like the holy men in the ceremonies attendant upon the Pönzö of the Prince, and Princess in Great Britain, and when the king and queen turned their heads back in silence, like the holy men in the ceremonies of the King's Sliver Anniversary.

Even as we write this story tumbles of traitors seeping away from Tibet are reaching our ears, and a report states that over 2.000 Communists have been shot in one bloody battle at Chengdu. Many of the Tibetan people have removed from the city, and perhaps before this epistle goes into the air you will be forced to flee for his life from this strange city which has been his home for the last twenty years.

ROAMING THE HIGH FREQUENCIES

Clarence W. Jones, Director of short-wave stations, HJCHQ, Quito, Ecuador, informs us that HJCHQ is now transmitting the following schedule of 36.5-meter; a frequency of 8,314 kc. They are on from 6:30 to 11:30 pm., E.S.T., and Monday from 7:00 to 11:00 pm., and then on from 4:00 to 10:00 pm., and Quito time, which is one hour later. He will gladly send a verification to all radio fans who prove receptions of its programs with a print log, and send an international reply coupon.

An official communication from short-wave station, HJQO, Cable, Wireless, Libreiro, of Nairobi, Kenya Colony, Africa, states that the present schedule of the station is as follows: Sunday 11:00: 11:00: 12:00; Monday 12:00 am. - 12:30; Tuesday, Wednesday, Thursday, and Friday from 11:30 am. to 12:30 pm.; and Saturday from 11:30 am. to 3:30 pm.; E.S.T. The station is received Saturday from 11:30 am. to 3:30 am. E.S.T. VQLO urges caution in reporting their station, for many incorrect, or mistaken reports are received by them.

Short-wave station HJIAAB, Barquisimeto, Colombia, 46.60 meters, is again issuing verifications for correct reports.

HJIZ into Domingo is back on the air on 8.2 mc., with a reported 75 W. transmitter. T-RCQ, San Jose, Costa Rica, 6,550 kc. operates regularly from 4:30 to 9:30 pm., and T-4J, also in Costa Rica, on about 7,400 kc. operates on Saturday from 4:00 to 9:00 pm.

YVRC, Caracas, Venezuela, 49.08 meters has increased their power to 1,000 W. and are continuing to transmit around the world in strength. YVRC is now sending out a regular OS1 card in addition to their booklet descriptiv.

RNE, Moscow, 25 meters has replaced RV50 on its 2:00 to 6:00 p.m., E.S.T. schedule. This station is heard regularly in California. YVRC is seldom heard in the summer time.

EL, Madrid, Spain, 30.34 meters has increased their power to 1,000 W. and are continuing to transmit around the world in strength.

LEADING COMMERCIAL STATIONS OF THE U.S.A.—PART I.

In answer to numerous requests we are pleased to start a series of lists of the leading commercial stations of the world and their
kilocycle frequencies. Next month we will list the leading commercial stations of Germany.

Bolinas, California. KEC, 5,185; KEL, 5,495; KEJ, 5,010; KEK, 6,080; KER, 10,800; KES, 10,410; KET, 9,480; KEZ, 10,490; KIKE, 4,550; KKL, 15,475; KMM, 20,780; KQZ, 17,980; KKK, 15,469; KLD, 20,809; KNL, 18,060; KWE, 15,430.

Diave, California. KWJ, 15,355; KJV, 10,440; KWW, 7,618; KYY, 7,566.

Kahuku, Hawaii. KTO, 11,680; KKH, 7,520; KKK, 16,940; KQJ, 5,840; KRO, 3,040; Ocean Gate, New Jersey. WOG, 16,270; WOO, 6,722; WWO, 8,568; WZP, 19,389.

Lawrenceville, New Jersey. WCN, 6,077; WKA, 21,060; WKF, 19,220; WKK, 10,840; WLA, 18,240; WIK, 16,218; WMA, 13,390; WMF, 14,470; WMN, 14,590; WNA, 9,170; WNB, 16,670; WOA, 6,755; WOF, 9,706; WQJ, 13,950; WQW, 9,876; WRY, 4,572; WTH, 5,820; WTH, 17,120.

Rocky Point, New Jersey. WAD, 4,550; WBU, 21,260; WVO, 19,380; WDA, 6,733; WDB, 6,718; WDG, 4,535; WDN, 4,555; WEA, 16,610; WED, 14,770; WED, 16,630; WEM, 12,920; WER, 7,415; WEM, 7,480; WES, 9,450; WET, 9,479; WED, 8,675; WFX, 19,980; WIR, 4,540; WKM, 18,860; WQK, 16,680; WDU, 14,830; WUL, 17,980; WQA, 21,220; WQB, 17,940; WQC, 17,260; WQF, 17,920; WQG, 15,640; WQJ, 21,248; WQK, 5,260; WQL, 26,260; WQT, 13,885; WQY, 14,808; WQW, 16,610; WQX, 20,180.

BUILDING THE PEANUT "5" SUPERHET.

(Continued from page 145)

Due to the lack of wiring above the deck, the set is exceptionally neat looking. When starting to wire, the two iron-core L.F. transformers are removed and all possible wiring done before putting them in place. This makes the job a lot simpler, since it is rather crowded even with them out.

The wiring is quite simple and may be done with push-back wire. Bare No. 18 tinned copper wire covered with thin spaghetti makes a very simple, neat, and safe job, however, and is recommended. Care should be taken with the filament circuit and various grid returns, since the filaments are wired in series, a practice not much used in battery sets, but utilized here to afford "C" bias for the various tubes. Hence, the diagram must be carefully followed. When the wiring is finished, it should be carefully checked, and if an ohmmeter is handy, all circuits should be checked for shorts.

A potential of 5 V is needed for full filament efficiency, and the set works quite well on as low as 4.25 V, so, in a pinch, 3 cells can be used. The filament drain is between 200 and 260 ma, and nothing is gained by operating at a higher current. In fact, with good tubes, best results are seem to be obtained near the lower value.

When the set is first hooked up to try out, a milliammeter of about 0 to 20 scale should be hooked in series with the "B+" lead. This will show when the oscillator is operating correctly and will also give a check on the rest of the set. The "B" supply need not exceed 45 V, which makes the set very economical for portable work. The plate current runs from 8 to 80 ma., depending upon filament voltage.

The second-detector regeneration control, when turned up, should not cut the 0/220 ma. meter needle, which naturally cut out regeneration. As the resistance is cut in, a "plop" should be heard in the phones: at the same time, the plate current will drop abruptly a slight amount. If no circuit oscillation can be obtained, reverse the tickler leads. (The tickler, incidentally, can be any small universal-wool cloth from 10 to 25 mhy. inductance.)

Oscillation in the first-detector is checked by touching the grid terminal of the socket, which should cause a rise in plate current, showing that the tube circuit has stopped oscillating. It may be necessary to reverse the tickler in this circuit, also, to get oscillation. Also, try the various tubes in the first-detector socket to see which is the best oscillator.

The tubes in this set are Western Electric 215 As, or "N" tubes, as they are sometimes called, and these are not all uniform, especially if some of them have been previously used. They are employed simply because of their small size, as they are not especially economical as to filament drain. (There are other tubes, such as the 236, which are more efficient due to their higher amplification factor, but they are bigger.)

With the two balancing condensers all the way out, and the antenna coil tuning condenser at mid-scale, it will be found that rapid rotation of the oscillator condenser will cause a click in the phones. This means that the first tube circuit has got out of control, because of absorption of energy by the other tuned circuit. The two balancing condensers must then be "juggled" until the click in the phones disappears or gets very weak (balanced condition).

The set will be found to give very fine tone quality, because of the broad L.F. band passed, and if coupled to a power source, very fine results can be had. No output tube was built into the set because this would necessitate higher plate voltage and current and it was desired to use the very smallest "I" batteries obtainable.

LIST OF PARTS

Two Hammarlund condensers, 355 mmf., variable C1, C2.

*Two condensers, 800 mmf., bakelite postage stamp type, C3, C4.
*Four condensers, 250 mmf., bakelite postage stamp type, C7, C8, C11, C12.
One Hammarlund double condenser, Type BBT-146 D, C5, C6.
One condenser, .001-mf., bakelite postage stamp type, C9.
One Aerovox tubular condenser, .065-mf., C10.
Two midsize coils, one Ant, one R.F., L1, L2-L3, L4.
Two iron-core L.F. transformers, see text, L.F.T.1, L.F.T.2.
One interruption-frequency coil, L6, L7 of L.F.T.8.
One small R.F. choke of 10 to 20 mhy., L5.
One midget-type A.F. transformer, 3 to 1 ratio, A.F.T.
One 1/8-W. 5-meg. resistor, R1.
One 1 1/2-W. 1 meg. resistor, R3.
*Two 2-meg. variable resistors, R2, R4.
One wire-wound resistor, 4 ohms, R5.
One single-pole, single-throw toggle switch.
Sw.
Five "N" tubes with sockets, V1-V5.
Two pin jacks.
One Blan aluminum panel, 3/8 x 3/4 x 1-1/2 in. thick.
One Blan aluminum sub-panel, 3/4 x 3/4 x 1-1/2 in.
Two Na-Ald or I.C.A. 2 in. diodes with bar knobs.
(Names of manufacturers will be sent upon request.)

Fig. 3. The panel and subpanel dimensions and drilling layouts.

Please Say That You Saw It in Radio-Craft
BUILD THIS "6-IN-4" ROWBOAT PORTABLE

(Continued from page 139)

a stickler. In order to secure stable operation at high gain (necessitated by the limited signal level available in a small boat), and reasonable selectivity, the logical choice was a super-heterodyne circuit. Automatically, then, the following service steps were required:

(1) First detector; (2) local oscillator; (3) I.F. amplifier; (4) second-detector; (5) first-stage A.F. amplifier; and, (6) second-stage A.F. amplifier. By using two dual-purpose pentagrid converters the tube complement was reduced to four, the tubes then functioning as follows: V1, 1A6, combined oscillator and first-detector; V2, 1A4, I.F. amplifier; V3, 1A6, combined second-detector and (by means of a reflex connection, described some time ago in technical papers) first A.F.; and, V4, 550C, second and A.J1. All these tubes (except the 550C) have small envelopes. "Skin-tight" shields are required over V1, V2 and V3; for the sake of clarity they are not shown in the photograph.

To be completely self-contained it was essential of course that the entire power supply ("A," "H" and "C" batteries) be included in the cabinet with the chassis. The ordinary small-size "B" batteries (the so-called "Signal Corps" size of 45 V. "B" battery measured 3 5/8 x 3 1/4 x 11/8 ins. deep) promised to kill the "sell-out" idea almost at the start, until it was found that one nationally-known manufacturer was working on a 15 V. unit measuring only 3 3/4 x 1 1/8 x 11 ins. deep. The saving of 16 cu. ins. in the latter instance did the trick. The "H" and "C" batteries, although also of a special size were not such a problem.

These "H" batteries establish a new high in small dimensions of an individual cell, and consequently the "B" drain must be kept to a low minimum. The 33 was out of the question, not only because of its "A" drain of 26-A, but mainly because, at 115 V. plate, its "B" drain (total) is 17.5 ma. This IS MORE THAN IS CONSUMED BY THE ENTIRE Rowboat Portable!

The answer, as to a suitable output tube, was found in the type 90B mentioned in past issues of Radio-Craft (see, for instance, "A Super Battery Portable," Radio-Craft, June 1941). Its characteristics follow:

Filament, 2.8 V.; 12-A.
Plate, 115 V.; 5 ma.
Control-grid, 115 V.
Screen-grid, 135 V.; 2 ma. (max.)
Mutual conductance, 550 mmhos.
Amplification factor, 90
Power output, 450 milliwatts. As previously intimated, not all the saving in "B" drain was achieved through the use of a low-drain output tube: utilizing a new, low-drain variable-mu pentode (the 14A1) as the I.F. amplifier in place of, for instance, a 34 variable-mu pentode, reduced the "B" drain by 0.8 ma.

The characteristics of the 14A1 are as follows:

Filament, 2.8 V.; 0.6-A.
Plate, 135 V.; 2.3 ma.
Control-grid, 115 V.
Screen-grid, 67.5 V.; 0.7 ma.
Amplification factor, 720.
Plate resistance, 0.96 meg.
Mutual conductance, 720 mmhos.*

A hasty examination of the circuit indicates the following details.

An unshielded antenna L1, is utilized in order to secure the best results in this portion of the circuit. Coil L2 is a "composite" unit incorporating in one tube both the oscillator and the I.F. transformer coils. The construction eliminates all except electron coupling within tube V1. Both the primary and the secondary sections of transformers T1 and I.F.T.2 are tuned (C7, C8, C18, C9). This results in high selectivity.

The reproducer must be a high-quality, sensitive unit (the first one we tried resulted in distortion and low volume); the choice is left to the builder. In order to order both chassis and cabinet from the same concern to make certain they fit one another. (The chassis used for this receiver had many cutouts and holes, but only the four socket holes and speaker cutout could be used.)

The first step is to arrange the 5-inch mazetic speaker and then place the other parts around it as indicated in the illustrations. The unit directly behind the speaker is the composite oscillator-coil-I.F. transformer. The one at right is the second transformer, which is wired to the receiver (and this is true of all small-space sets) do not cut the pigtail leads of the transformers and condensers just enough to make the connection; leave about a half-inch of "slack" on each lead so that the various units may be moved about slightly for easy soldering. If the diagram is followed carefully the set should work "right of the bat."

SPECIAL NOTICE

Last-minute developments in the design of this set call for slight alterations, as follows:

Referring to Fig. 1, return R7 to negative I.F. terminal of V3, instead of present positive I.F. connection. In some cases it may be advisable to try connecting R8 to the negative I.F. terminal of V3, instead of to the R1-R3 tap. Added sensitivity is obtained by returning terminal of condenser to the negative I.F. terminal of V3, instead of to chassis. Note that the antenna primary phasing must be correct so that inductive and capacitative coupling aid. This can be checked by reversing primary connections to determine best sensitivity. Use of the Wayne R-334 may be impractical for this purpose.

LIST OF PARTS

One Wholesale Radio, type Premier, 5-in. magnetic speaker:
One Wholesale Radio, 5-watt variable condenser, 350 mmf., with 465 kc. tracking section, CI, C2.
One Wholesale Radio, type "BC Ant.," high-gain antenna coil for broadcast reception, L1; One Wholesale Radio, type NY-491, composite oscillator coil and 465 kc. I.F. transformer, I.F.T.1; One Wholesale Radio, type NY-490, 465 kc. I.F. transformer, I.F.T.2; One Electric 10,000-ohm tapered volume control with attached D.P.S.T. switch, RI, Sw.; One Crystal 9-C.D.C. type crystal oscillator cabinet, with 4-tube chassis to fit, and zipper carrying case; Four Cornell-Dubilier tubular condensers, .02-

Fig. 3. Coil wiring details for the set.

Please Say That You Saw It in Radio-Craft
HOW TO BUILD THE "METAL-TUBE 5" T.R.F. SET

(Continued from page 141)

A study of the circuit diagram shows the use of tuned circuits, a hand-pass input section. Proper design and precision matching of the coils and condensers will result in a fairly uniform degree of amplification throughout the broadcast band. The receiver uses 5 tubes in all; the first two tubes are used in T.I.F. stages, and in this little receiver the 6K7 tube replaces a 6DK in both positions. The detector tube employs the 6A9, replacing a 6DK. The output stage uses a single 6FS power pentode in place of a 42s. The antenna used with the receiver was about 50 feet overall; ground connection is made in the conventional manner.

Study of the circuit diagram indicates that the circuit used is very conventional in every respect, and that no difficult would be experienced on the part of the person building this very simple receiver. Of course, sub-division can be made, as we went out after considerable testing, by simply changing the coil and using tubes of the 6DK type in the two R.F. stages, a 6FS in the detector stage, and a 42 in the output stage, and an 89 rectifier. We bring this point out at this time as there may be a receiver of this type who would be desirous of building this receiver, but who will not be in a position to obtain the metal tubes for some time. To overcome this the author would be necessary to make the socket changes to satisfactorily mount the conventional glass envelope tubes.

CONSTRUCTION

Very little need be said about the construction of this particular receiver and the two pictures show most of the details of the placement of parts except those small fixed condensers and the coil and resistor, which are held in place or more or less by wires and by solder.

Note in passing that the loudspeaker is equipped with a transformer having a plate impedance of 8,000 ohms. This is fairly satisfactory for use with the 6FS power tube. The speaker field coil resistance of the particular unit used with this receiver is 1,100 ohms at 360 volts. This 1,000-ohm tap delivered sufficient bias voltage for the amplifier, and by means of a decoupling condenser and resistor this circuit was kept free from hum and degeneration.

WIRING AND OPERATION

Wiring of the receiver is very simple. Make all soldered connections of the "hot" type. Do not hesitate to stay on the con-nection as poorly soldered connections always reduce efficiency. The usual procedure first is to mount the rectifier plate circuit and filament circuits. Wire in the remainder of the filament circuits, and then start connecting the plate and grid circuits to their respective terminals. Place the various tubular-type condensers recommended and the carbon resistors near their points of connection so that the minimum strain will be placed on the antenna. The same sense used in the placement of the parts not indicated in the photographs will insure very satisfactory operation of this type.

To place the receiver in operating condition, connect a service oscillator to antenna and ground terminals. Place the tubes in the sockets. Plug the power cord into the 110-volt outlet plug and turn on the power. Turn volume control to maximum position.

With the service oscillator connected to antenna and ground, set the tuning dial on the receiver to B. Set your service oscillator to 1,000 kc. Adjust the four trimmers to maxi- mum reading on output meter if available, also master control and loudspeaker. Keep the power oscillator at a very low level to insure accurate tuning. If necessary, check at power frequency, but as this particular receiver was designed so that the coils and condensers are matched with the dial, satisfactory tracking is then obtained if 1,000 kc is tuned in at 8 on the dial.

LIST OF PARTS

One Acratex chassis;
One Acratex 4-gang tuning condenser, 360 mm.; each 4 1-8 mfd.
One Acratex pre-selector coil;
Two Acratex
Five Na-Ald 8-prong sockets;
One Electro 15,000-ohm volume control, and
off-on switch.
Three Aerovox condensers, 1-mfd., 400 V.;
Three Aerovox condensers, 0.1 mfd., 200 V.;
One Aerovox condenser, 0.01 mfd., 400 V.;
One Cornell-Dubilier condenser, 100-mfd., 35 V.;
One Aerovox mica condenser, 500 mfd.;
Two Cornell-Dubilier electrolytic condensers, 8 mfd., 450 V.;
One Centralab resistor, 300 ohms, 1/4-W.;
One Centralab resistor, 12,000 ohms, 1/4-W.;
One Centralab resistor, 10,000 ohms, 2 W.
One Centralab resistor, 20,000 ohms, 2 W.
One Centralab resistor, 5,000 ohms, 1/4-W.
One Centralab resistor, 10,000 ohms, 1/2-W.
One Centralab resistor, 9.0 meg., 1 W.
One Centralab resistor 15 meg., 12 1/2 W.
Two Centralab resistors, 1/4-meg., 1/2-W.
One Centralab resistor, 1 mfd., 1 W.
One General Transformer Corp. power transformer;
One Ilan line cord and plug;
Three Na-Ald metal-tube control-grid caps;
One Acratex dynamic speaker;
One Ilan E-86 speaker;
One Acratex tuning dial and dial lights.

AN EASY-TO-BUILD 5-METER TRANSCEIVER

(Continued from page 140)

mounted the tube socket, audio transformer, modulation choke, tuning condenser, bypass C4, and R.F. choke L8.

Condenser C6 is soldered directly to the filament terminals of the socket. The antenna coupling condenser is also mounted on the bakelite sub-panel.

The coils L1, L2 are soldered directly to the terminals of the antenna tuning condenser, and L2, C8 are soldered directly to the inside ends of the coils.

At the center and top of the panel is mounted the D.P.D.T. toggle switch, Sw.1. Directly underneath the tuning control, which is placed in the center and slightly above the middle, is mounted the filament rheostat. On either side of the tuning control and slightly lower are mounted variable resistors. The phone and mike jacks are mounted directly underneath these and on the same line as the filament rheostat.

The phone coupling condenser is mounted on a bracket underneath the subpanel. A binding post is mounted on the back of the subpanel for connecting the antenna (a ground wire) to.

Wires are brought out to the batteries directly.

The type 19 tube is mounted in its socket upside down.

When transmitting, the plate voltage may be raised to more than 180 V. without doing the tube any harm. Higher voltage results in greatly shortened tube life.

The total plate current for the oscillator and modulator for 135 V. on the plate is about 30 ma. It is not advisable to raise the tube any higher than about 55 ma. total for both sections. The modulator draws about 1/10 the total plate current.

When receiving, the voltage on the detector may be reduced to 90 V., or less without any loss of efficiency. In fact, a gain is sometimes experienced. It may be necessary to bend the antenna coupling condenser plates farther out from the detector circuit from going out of oscillation at the antenna resonance point. No trouble will be encountered in receiving signals from as far as can be transmitted from.

The writer will be glad to answer any questions in regard to this outfit.

METAL TUBES

Radiio men in every branch of the industry are interested in the new metal tubes—you can't afford to miss the October/November Tube-issue of Radio-Craft.

Please Say That You Saw It in Radio-Craft

BUILD YOUR OWN SHALSCROSS UNIVERSAL TESTER

VOLTS
A.C. D.C.
0-2,000 0-500
0-100-1000

MILLI-
AMPERES

0-1-10-100

CAPACITY
300-500-1000-5000-10000

INDUCT-
ANCE
1-10-100-1000

5,000,000 ohms D.C. Resistance

Send 6c in stamps for the new Bulletin No. 611-PA containing the complete wiring diagram and operating instructions for this modern serviceman's instrument.

SHALSCROSS MFG. COMPANY
Electrical Measuring Instruments, and Accurate Resistors
700 W. BROADWAY, COLLINGDALE, PA.

COMPLETE PARTS FOR THE ALL-WAVE 6-TUBE BATTERY SUPER

Complete parts for the "All-Wave" 6-Tube or Parallel Circuit Super, less case, tubes and bulbs.

All-Wave U.t.r kit, matched set, R.F. oscillator 4-1 bands, 15,000 meters with print and 11 1/2 by 21 1/2-inch case, $2.25; Super set, $5.50.

All-Wave U.t.r kit, matched, 13,550 meter 1st R.F. and 900-3,000,000 Hz. super set, $9.00.

Write for All-Wave Kit List Data Custom Built Receiver of Special Design, Our Specialty

PARAGON RADIO PRODS.
135 Liberty St.
New York, N. Y.

LITTLE GIANT ULTRA-COMPACT ELECTROLYTIC CAPACITORS

Half the size—full capacity—full voltage protection! Minimum thickness makes 5 ft. less than any other. Taped instead of leaded wires. New in this size and price.

For literature ALL SIZE CAPACITORS

In 4 ratings—45 v., 100 v. and 200 v.

SOLAR MFG. CORP.

BUY THESE GREAT BOOKS

Chirradl's MODERN RADIO SERVICING

Chirradl's and Freede's RADIO FIELD SERVICE DATA

Send for FREE CIRCULAR today!

www.americanradiohistory.com
ABOUT RADIO

The radio-craft library series - a splendid complete and authoritative set of volumes - treats to-1
dividually, important divisions of radio. Each book has been designed to give you the know-how to learn one or more branches of radio. The authors of the books are well known to everyone. Each is an expert radio man, an authority on the subject - each is a\nquality familiar with the field which he represents.

All Books Uniform

The colours in the radio-craft library series are all uniform. It is 6 x 9 inches. Each book contains on an average of 90 to 120 illustrations. The books are printed on an exceptional grade of paper which makes the type easy reading.

Here Are the Series:

Book No. 1 - Radio Field Engineers
And How to Use Them By L. Van Der MEL

Book No. 2 - Modern Vacuum Tubes
And How They Work By R. Hertzberg

Book No. 3 - Modern Radio Hook-Ups
The Best Radio Circuits By R. D. Washburne

Book No. 4 - How to Become a Radio Service Man
By Louis Martin

Book No. 5 - Bringing Electric Sets Up to Date
By Clifford E. Denton

Book No. 6 - Radio Kinks and Wrinkles
For Service Men and Experiments
By C. W. Palmer

Book No. 7 - Radio Questions and Answers
By R. D. Washburne

Book No. 8 - Automobile Radio and Servicing
By Louis Martin

Book No. 9 - Home Recording and All Related Subjects
By George J. Saliba

Book No. 10 - Point-to-Point Reception Measurements
By Clifford E. Denton

Book No. 11 - Public Address Installation and Service
By J. T. Bernsley

BUILD THIS "6-IN-4" ROW PORTABLE

(Continued from page 182)

mf. 250 V. C5, C6, C12, C16; Two Cornell-Dubilier tubular condensers, 1,500
mf., 250 V. C6, C12, C16;
One Cornell-Dubilier tubular condenser, 1, mf., 250 V. C11;
One Cornell-Dubilier mica condenser, 500 mf., 250 V. C13, C17;
One Cornell-Dubilier tubular condenser, 600
mf. 250 V. C12, C16;
One Cornell-Dubilier tubular condenser, 250
mf. 200 V. C4, C11;
One Cornell-Dubilier tubular condenser, 200
mf. 200 V. C11.

One Electrode resistor, 5,000 ohms, 1/4-W., R2;
One Electrode resistor, 2,000 ohms, 1/4-W., R3;
One Electrode resistor, 6,100 ohms, 1/4-W., R4;
One Electrode resistor, 10,000 ohms, 1/4-W., R5;
One Electrode resistor, 15,000 ohms, 1/4-W., R7;
One Electrode resistor, 2 meg., 1/4-W., R8;
One Electrode resistor, 1 meg., 1/4-W., R10;
One Electrode resistor, 50,000 ohms, 1/4-W., R13;
One Electrode resistor, 100,000 ohms, 1/4-W., R9;
One Electrode resistor, 6,000 ohms, 1/4-W., R11;
One Electrode filament ballast resistor, 3 ohms, R12;
Two N5-AM 6-prong wafer sockets (for V1 and V3);
One N5-AM 1-prong wafer socket (for V2);
Three N5-AM screen-grid clips (for V1, V2 and V3);
One Bia Wiring color coded battery cable;
* Three special, extra-small size 15 V. "R" batteries;
* One special, extra-small size 2 V. "A" battery;
* Three special, extra-small size 7 1/2 V. "C" batteries;
* Two National Union 1A6 tubes, V1 and V3;
* One National Union type 1A4 tube, V2;
* One National Union type 305 tube, V4;
* Three National Union skin-tight tube shields, for V1, V2 and V3;
* Miscellaneous hardware, hook-up wire, etc.

(Manufacturer's name upon request)

OPERATING NOTES

(Continued from page 160)

LYRIC MODEL C-M-4

This is a 4-tube regenerative radio superhet, using a 6AX7 as 1st detector and oscillator, a 6H7 reflected for use as an I.F. amplifier, second detector, automatic volume control and first audio, a 43 in the output stage and a 25Z5 rec-\n\nifier. The receiver was a "dead." The tubes did not light, and a check revealed the filament of the 6H7 to be open. A new tube restored the series circuit, but signals were faint. All "B" voltages were very low on the tubes and a careful check showed the 16 mf. 150 V. electrolytic \n\ncapacitor which is mounted on the top side of the chassis and tied to the speaker frame to be defective. (See Fig. 4) This was replaced \n\nputting the receiver into normal operation. A volt-\n\nage reading taken from a common "B" re-\n\n
currence point to the output cathode of the 25Z5 showed a jump that was not too much about right, though the D.C. output will vary in different localities with the applied line voltage.

STANLEY STORLA

When Five (5) Books or More Are Ordered, Deduct 20% from Your Remittance

GERNSBACK PUBLICATIONS, INC.
320 Madison Ave., New York, N. Y.

MAIL THIS COUPON TODAY!

GERNSBACK PUBLICATIONS, INC.
320 Madison Ave., New York, N. Y.

I have enclosed the numbers below of books in the radio-craft library series which you will send me and have deducted 20% for ordering more than 5 books or more. I have included my remit-\n\ntance in full, at the price of 50c each, when less than five books are ordered.

The amount of my remittance includes, postage, check or money orders accepted. Circle numbers wanted: 1 2 3 4 5 6 7 8 9 10 11 12

Name

Address

City State

All books are sent postage prepaid

10c the Get your copy today! Copy on all newsstands

To Readers of RADIO-CRAFT

FREE POST CARDS MAY BE HAD UPON\nWRITING TO PUBLISHERS

* These postcards make it easy for you to answer any of the advertisements which appear in RADIO-CRAFT, and without putting any valuable articles or data which you may wish to save.

Many radio manufacturers request you to "clip the coupon" when answering their ads. This means destroying part of an article on the reverse page you may need later for reference. Therefore four radio-craft issues complete. If you should ever want to see bound volumes, or complete copies of radio-craft, the price of several issues is a very small price, higher than that of mutilated ones. Furthermore, as numbers are already out of print, and the earlier ones cost 20 cents apiece. Be sure for a supply of these free post cards and use them in answering all RADIO-CRAFT advertisers.

Please Say That You Saw It in Radio-Craft
arch, and either sound or speech issued from the auditorium wherever they may be necessary. Figure 1 shows one such set-up, requiring 16 reproducing stations, in the "Brainstorm" scene of The Addling Machine, during presentation of The Sound Show.

In Fig. A is illustrated an "alter ego" set-up: all the performers are mute—only the thoughts of the minimum number of persons can be reasonably heard issuing from the sound system. Professor Burrus-Meyer is shown in Fig. A, at the controls of the mixed control board, and leading his voice as the "thoughts." In Fig. C appear three of the five reproducers that were high overhead in the proscenium arch. In Fig. D are shown loudspeakers arranged in a row: a voice picked up by a single microphone is fed from one reproducer to the other, creating the illusion that the person stationary in front of the "milk" window is moving across the stage. (Tweeters are not shown as they are not required in certain types of progressive sound—"the tramp of feet on a dirt road, for instance; on cobble stones, however, tweeters would be needed.)

Two amplifiers are used and the source of sound may be disc or film records of any type of sound produced in front of microphones. The unique feature of the installation is the mixing system which provides for massive flexibility, that is, the use of either or both amplifiers to reproduce all or part of wide or narrow bands of frequency and the mixing of all outputs from either or both amplifiers. (Figure E illustrates this equipment, in the top left corner, above the stage, being controlled by one of the skilled operators—a student at the college.)

The following description of how this equipment was used in "The Sound Show," a presentation which was designed to illustrate the flexibility and adaptability of controlled sound, gives some idea of the technique involved.

"THE SOUND SHOW."

So that the reader may gain a more realistic mental picture of just how controlled sound fits perfectly into the manuscript of a play, the following excerpts from the program of "The Sound Show" are presented.

OVERTONE

1. Speech from an identifiable but invisible source as applied to a play involving the alter ego.

HAMLET

Act 1—Scenes 4 and 5
2. Speech with unnatural, predetermined pitch and quality of source.

THE ADDING MACHINE

Scene 6—A Pleasant Place
3. The reproduction and control of orchestral music as applied to a scene requiring fidelity, range of volume, and an invisible source of sound.

THE ONLY JAILBIRD OF EMERY

A Play for Dancers
4. Speech in perspective as applied to pantomime.

THE ADDING MACHINE

Scene 2—An Office
5. The audible but unspoken aside: mental conflict expressionistically interpreted in sound and light.

The demonstration involved first the one-act play, "Overtone," by Elmer Rice. This play involved the "alter ego" (other personalities) of two characters. The actress spoke the lines of the invisible personalities. The invisible personalities were heard in the voice which was common to both personalities from whatever position the actress was in, the situation occupied but without the necessity of her opening her mouth. Although Rice did not invent this type of reproduction which also involves perspective, the ghost in Hamlet has always had a voice which seemed to come from somewhere other than the scene. An exclamation which has been the subject of many sorts of reproduction which also involves perspective.

The voice in Hamlet has always had a voice which seemed to come from somewhere other than the scene. An exclamation which has been the subject of many sorts of reproduction which also involves perspective. How the ghost in Hamlet has always had a voice which seemed to come from somewhere other than the scene. An exclamation which has been the subject of many sorts of reproduction which also involves perspective.

The audible but unspoken aside; mental conflict expressionistically interpreted in sound and light.

The demonstration involved first the one-act play, "Overtone," by Elmer Rice. This play involved the "alter ego" (other personalities) of two characters. The actress spoke the lines of the invisible personalities. The invisible personalities were heard in the voice which was common to both personalities from whatever position the actress was in, the situation occupied but without the necessity of her opening her mouth. Although Rice did not invent this type of reproduction which also involves perspective, the ghost in Hamlet has always had a voice which seemed to come from somewhere other than the scene. An exclamation which has been the subject of many sorts of reproduction which also involves perspective. How the ghost in Hamlet has always had a voice which seemed to come from somewhere other than the scene. An exclamation which has been the subject of many sorts of reproduction which also involves perspective. How the ghost in Hamlet has always had a voice which seemed to come from somewhere other than the scene. An exclamation which has been the subject of many sorts of reproduction which also involves perspective.

The audible but unspoken aside; mental conflict expressionistically interpreted in sound and light.
"CONTROLLED SOUND"
(Continued from page 185)

TECHNICAL DETAILS

Figure 2 shows in block form the complete set-up of the sound system for "Strange Women," by Verdi, which demands that the audience feel a strong positive empathy toward the protagonist. Specially-designed velocity microphones were used. The microphones are usually located in a "tent" of heavy drapes set up in the wings. Due to the nearness to the loudspeakers, the directional characteristics of the microphones were very useful.

The two 5-stage resistance-coupled preamplifiers form a single unit and with their batteries are completely enclosed in a very heavy sheet-iron box. The mixing system provides for 3 inputs and 2 amplifiers which may be used together when desired. Also, on the same panel is the output mixing of the complete panel it is possible to control the volume of each of the 3 inputs, the 2 amplifiers, any loudspeaker, and the system as a whole. Altogether, 11 attenuators are provided. (It may be easily seen that a man skilled in operating is needed. See Fig. E.)

Two 2-speed turntables are provided. However, very great care is required in the selection and use of records as, with a high-quality system standard recordings show many defects.

Credit is here given to Mr. Daniel F. Hoth for his invaluable aid in preparing this article. Photos are by Halbrun.

Especially, the system so far developed for control of sound in the theatre is admirably crude; two points stand out quite definitely: first, that it is evident that controlled sound is an important and significant tool; and second, the critical consensus of leaders in the American theatre who have attended demonstrations of controlled sound at the Stevens theatre is that its general adoption is inevitable.

SERVICING FORM

The illustration below shows a carefully prepared service form used by an all-service company in New York—this greatly facilitates the maintenance of complete records.

Bill No. Name
No. 2001 Address
Promised Apt. Appointment
Type
Complaint
Charges Parts
Tubes
Aerial
Service Charges
Total
Send in Service Forms. Customer's Signature

ALL REPAIRS ARE C. O. D.

Air-Way Radio Service
"AT ITS BEST"
We Are Thoroughly Equipped To Service Any Make Radio
1211 Jerome Ave. South Wee Gee 1660
Phone Topping 2-6400

Please Say That You Saw It in Radio-Craft
RADIO INSTALLATIONS OF THE NORMANDIE

THESE installations some of which are shown on page 186 of this issue are comprised of: (1) a radiotelegraph and radio-telephone apparatus for use in handling commercial traffic; and (2) a radiotelegraph apparatus for use in communications relating to navigation of the vessel.

COMMERCIAL INSTALLATIONS

Located in the same cabin known as the "Commercial Cabin" these installations comprise:

(a) A large telegaph transmission panel, 15½ ft. in length by 5½ ft. in height, divided into the following sections:
   One panel of general current distribution (power panel) and charging of the storage batteries.
   One short-wave telegraph transmitter in 3 chassies for C.W. and I.C.W. transmission: power: 2 to 2½ kw.; range: 15 to 150 miles; number of waves available: 15.
   One long-wave telegraph transmitter in 2 chassies for C.W. transmission covering the 600-800 meters range; power: 600 W. in the antenna system which is made available for this unit is provided with emergency storage batteries to be used in case of power failure of the direct current feeding.

This entire telegraph transmission panel is controlled from an operating table, 12½ ft. in length, on which are built in all the apparatus required for handling with the utmost efficiency on both long and short waves.

(b) On this table are located the two corresponding receivers.

(c) A system of duplex press reception functioning independently from the other installations, and if necessary at the same time, covering waves of 13 to 250 meters.

The power for the operation of this receiver is obtained through special filters from the ship's direct current.

One medium and long-wave radio-telephone receiver covering the ranges 300-5,000 meters. The power for this receiver can be obtained through special filters from the ship's direct current, under normal operating conditions, from storage and dry batteries in case of power failure.

(d) A system of duplex press reception functioning independently from the other installations, and if necessary at the same time, covering waves of 13 to 250 meters.

The power for the operation of this receiver is obtained through special filters from the ship's direct current, under normal operating conditions, from storage and dry batteries in case of power failure.

(e) A special receiver for handling radio-telegraphic and telephonic conversations with subscribers of the French, English and American telephone systems. This unit is provided with adequate apparatus permitting an effective service of radio-broadcast if desired.

This transmitter has a power of 1 to 1½ kw. in the antenna, depending on the power wave emitted; it covers the range of 17 to 70 meters and has 8 available waves. The dimensions are 9½ ft. in length by 6 ft. in height. The frequency stability is 1/10,000 and all harmonic frequencies have been eliminated.

(f) A special receiver for handling radio-telegraphic and telephonic conversations with subscribers of the French, English and American telephone systems. This unit is provided with adequate apparatus permitting an effective service of radio-broadcast if desired.

(g) A special receiver for handling radio-telegraphic and telephonic conversations with subscribers of the French, English and American telephone systems. This unit is provided with adequate apparatus permitting an effective service of radio-broadcast if desired.

BRIDGE INSTALLATIONS

A special cabin has been reserved for the bridge to control the radio installations used in work relating to navigation. This cabin comprises:

(a) A system of radio-telephone transmission in the form of a short wave in length by 5½ ft. in height composed of 2 units.
   One panel in 2 chassies of current distribution for the transmitter and charging of the storage batteries.
   One medium and long-wave radio-telephone transmitter in 3 chassies for C.W. and I.C.W. transmission: power: 500 W.; range: 600 to 2,400 meters; number of waves available: 6.

This transmitter can be obtained from commercial storage batteries in case of power failure of the ship's current.

(b) Two receivers, one for short waves and one for long waves, located on the control table sitting in a special receiver, these receivers are operated exclusively by storage and dry batteries.

(c) In the ship's board radio-direction-finder of great selectivity adapted to a directional oriented frame. This apparatus can take bearings of radio stations transmitting on any wave in the range of 450 to 8,000 meters and is located in the chart-room adjacent to the bridge radio cabin.

(d) A sounding device, working on ultrason, also installed in the chart-room.

In connection with this installation the following should be mentioned that two motor life-boats are equipped with distress sirens whenever apparatus composed of radio transmitters of the "short-wave" or "long-waves" type and with radio receivers. These installations are adapted to the special batteries.

The apparatus described above has been specially designed for the NORMANDIE and was constructed in accordance with the specifications of the U.S. Navy for commercial use.

With reference to technical specifications of this apparatus, these are found in the literature allowed or prescribed by the international radio regulations now in force; purity of emission; frequency stability; in case of discrepancies in the ship's power; voltage variations or discord in antenna tuning characteristics; precision and conservation of adjustments; selectivity of the receivers, sensitivity, lack of interfering noises, ease and consistence of their tuning, etc.

In addition to the special care extended in the presentation and appearance of the apparatus its design is an ideal of strength as well as a model of ease and safety of operation.

The control panel of the ship is the chassis in the case of copper-plated tin, the bases of all suspended circuits are rigid castings; the panels are moved by the automatic safety controls. All insulators have been chosen with great care; quartz, glass, micales, staurolite being employed.

The features involved in the pilot circuits and successive stages of the apparatus, its transmission and reception of the ship's telephone, are particularly adapted to the special "fast" radio transmitters, automatic contactors, embody a great flexibility of action as well as absolute security. (Good working conditions of all its parts, particularly the tubes, and proper protection of the personnel.)

The panels are specially located to permit the simultaneous operation of two transmitters with duplex facilities (simultaneous transmission and reception).

In conclusion, intrinsic precautions have been taken in the selection of the apparatus to reduce fire hazards (metallurgical construction, location and insulation of all cables, all of which carrying capacity, metal conduits throughout). All low tension circuits are fused and high tension ones equipped with circuit-breakers. A unique and simple operation cuts off one or more transmitters in case of need. No ground returns are used.

The power capacity of the batteries has been calculated to permit direct telegraph and telephone communications between Havre and New York during the entire voyage.

To give an idea of the size of the radio installations of this giant vessel it is in order to state that:

(1) The total power of the various transmitters will ship a charge over 25 kw.

(2) The total weight of the apparatus described above is less than 18 tons.

The enormous proportions of the installations in this ship, as well as the attractive appearance can be realized from the photos on page 186.
NOW READY!

The 1935 Official AUTO-RADIO SERVICE MANUAL

Here now—is the second volume of the OFFICIAL AUTO-RADIO SERVICE MANUAL—the 1935 Edition. With no large number of new auto-radio sets placed on the market by different manufacturers, the 1935 OFFICIAL AUTO-RADIO SERVICE MANUAL becomes an essential part of Service Men’s equipment. Remember, there are nearly 1,800,000 auto-radio sets in use today.

The 1935 OFFICIAL AUTO-RADIO SERVICE MANUAL (Volume II), contains 100% new material. It gives schematic diagrams, chassis layouts, mounting instructions, and trouble-shooting hints on all modern auto-radio receivers, and older models as well.

There is absolutely no duplication of material between the 1932 edition (Volume I) and the New 1935 Edition (Volume II). The material is 100% new.

Every radio man connected in any way with the booming auto-radio business needs a copy of the new OFFICIAL AUTO-RADIO SERVICE MANUAL. It contains only auto-radio service "dope."


- 240 big pages crowded with diagrams, service material and other essential data required for proper servicing of new auto-radio receivers. Included are diagrams of sets which appeared during 1934, and which were not included in the supplement to the first edition.
- Complete schematic diagrams, chassis layouts, voltage tabulations and servicing instructions are included for practically all sets. "Under-side" tube symbols are also included to facilitate the job of servicing the sets.
- Instructions are included with many sets telling how to suppress stubborn cases of ignition interference. This includes the newest "suppressorless" sets—and what to do when interference is encountered with this type of set.
- Details on how to make installation in "turret-top" cars are included. The different methods used by car makers and set manufacturers are listed with the individual circuits and service information.
- The index contains the listing of sets which were published in the first edition, as well as the sets which appear in the new volume. This information helps the Service Man to locate the circuit and details for any receiver that has been made.
- The book is bound in a handy, flexible leatherette cover. To be sure the pages are sturdy, to withstand constant use, the book will be printed on a special "bible" stock. This is a very durable, but thin paper. The book printed in this paper can be easily rolled to fit into your pocket or slipped in the service kit.

Here is a complete list of sets covered

- Allied Radio Corp.
- Alvaor A. Mfg. Co.
- Audion Radio Co.
- Autograph Radio Co.
- Broadcast Equipment Corp.
- Carter Motor Corp.
- Chrysler Motor Corp.
- Colonial Radio Corp.
- Consolidated Industries Ltd.
- Crosby Radio Corp.
- Delta Electric Co.
- Delta Radio Corp.
- Emerson Electric Co.
- Emerson Radio & Phonograph Co.
- Fada Radio & Electric Corp.
- Feador Electric Corp., Inc.
- Ford Motor Corp.
- Ford-Majestic
- Franklin Radio Corp.
- Fredco Television & Radio Corp.
- General Electric Co.
- General Motors Corp.
- H. N. L. Co.
- Hereford Radio Co.
- Hudson Motor Co.
- Hudson Motor Car Corp.
- Imperial Radio Corp.
- Karoldo Corp.
- P. R. Mfg. Co.
- Montgomery Ward & Co.
- National-Peugeot Motors Corp.
- National-Sears Industries, Inc.
- Newell Radio & Television Co.
- Niven Radio Corp.
- Pierce Bros. Inc.
- Premier Electric Co.
- Rhone-Poulenc & Co.
- Sears-Roebuck & Co.
- Sentinel Radio Corp.
- Skolnick Radio Corp.
- Smith-Hawken Co.
- Stewart-Warner Corp.
- Stromberg-Carlson Tel. Mfg. Co.
- The Ultra Prod. Corp.
- Transistor Corp. of America
- United American Radio
- United Auto-Craft Laboratories
- United Motors Inc.
- United Radio Corp.
- Utah Radio Products Co.
- V. V. Radio & Television Co.
- Westinghouse Radio & Television

Gernsback Publications, Inc.
99 Hudson Street
New York, N. Y.

MAIL ORDER TODAY!

Gernsback Publications, Inc.
Dept. RC-5
99 Hudson Street, New York, N. Y.

Enclosed you will find my remittance of $2.50 for which send me one copy of the 1935 Official Auto-Radio Service Manual (Volume II). (Send remittance in cash or money order; register letter if it contains cash or currency).

Name
Address
City State

(The 1935 Official Auto-Radio Service Manual is shipped postage prepaid.)

Please Say That You Saw It in Radio-Craft.
THE LATEST RADIO EQUIPMENT
(Continued from page 154)

denser leakage or ohms readings up to 0.5-meg. Available in compact and portable models, and in kit form. The small meter indicates line voltage. Tests metal tubes.

ALL-PURPOSE AMPLIFIER (786)
(The Radolek Co.)

Designed to be used for any purpose where a medium power, high-quality P.A. system is needed. Uses any type of microphone and any number of speakers up to seven; it is equipped with tone control, and two separate input channels, each having complete mixing and fading equipment. The frequency curve is flat from 100 to 7,000 cycles.

NEW ANALYZER SHAKES TUBES (787)
(Southwestern Instruments Corp.)

This new equipment introduces the mechanical element in tube testing, in that the tube undergoing electrical test, or normal bias, is vibrated vigorously at the same time to disclose mechanical defects; the test sockets are mounted on a cushioned arm attached to the vibrator.

SMALLEST "B" BATTERIES (788)
(National Carbon Co.)

Illustrated here are two new developments for the small-set builder. Made possible by a new, small-size cell, the 45-volt "B" block is only 3 x 1½ x 2¼ ins. high. The 3-volt "A" battery is 3 x 2½ x 1¼ ins. high. A "C" battery, available but not shown here, is proportionally small. These units are undergoing development and will, no doubt, be marketed in the fall.

CATHODE-RAY RECEIVER SERVICER (790)
(Clough-Brengle Company)

A feature of this cathode-ray equipment is an entirely new sweep system that produces on the cathode-ray tube a selectivity curve calibrated to read directly in kc. width. By feeding an R.F. wave modulated by a 100 cycle sine wave into the receiver at the antenna, and observing the output at the voice coil of the speaker, overall audio distortion can be traced to its source. Complete equipment consists of a special signal generator, B, and companion oscilloscope, A.

ElectRONIC SWITCH (789)
(Allen B. Dumont Labs.)

This remarkable device renders the cathode-ray oscilloscope of much greater value. It permits applying two separate waveforms to the same cathode-ray tube for simultaneous viewing. Furthermore, they may be adjusted individually for amplitude and position; they may even be superimposed if desired. The apparatus consists of a switching tube and two amplifiers, and is self-contained in a box 13 x 9 x 9 ins. deep.

SUPREME 385 AUTOMATIC ANALYZER (791)
(Supreme Inst. Corp.)

A tester called automatic because it so quickly and easily gives the desired test. The ohm ranges run from 0 to 20 megaohms in three steps with self contained power supply. A.C. or D.C. V. up to 1,250 are available as well as D.C. ma. to 1,250. The three-range capacity tester covers 0 to 12.5 mfd., in both paper and electrolytic types with a special "good-bad" English reading scale for the latter.

ALL-WAVE COIL KIT (792)

All-wave set builders will be interested in this complete coil kit, consisting of separate oscillator and L.F. transformers, and a unit containing all R.F. coils, paddling condensers, and the band switch.

PROFESSIONAL RECORDING MACHINE (793)
(Universal Microphone Co.)

A new recording machine which has every feature necessary to do the highest class of work. It is completely adjustable in every sense. 78 or 33½ R.P.M. are available and the current supply may be 50 or 60 cycles. The machine comes set for 108 lines per inch but may be easily changed to any desired number.

PRECISION DIAL (794)

Accurate calibration on one from five bands is possible with this new dial. It is available in window and full-division types. An adjustment at any point in a range does not affect those previously made. The mechanism is accurate in operation and fool-proof.

HANDY SHOP TOOL (795)

Called grinder, this little tool can be used for a great variety of uses. It turns at very high speed, about 8,000 R.P.M. average under load, and is surprisingly powerful for its size. It is supplied with a chuck which makes it a simple matter to change tools. The maker lists a great variety of tools of every conceivable type, including such odd ones as a tiny sand-paper drill, drills, polishing tools, saws and many others.

(Continued on page 191)

---

Sensational Value! "DEPENDABLE" TUBE TESTER
New Model 305

Kit, $17.85
Ready to Operate, $21.95

Not merely the newest and most accurate in tube testers, but tests resistances and condensers as well. Tests new metal tubes and all others for years to come. A fan-type meter in plain view of operator and customer. New screw-base neon lamp indicates shorts and leakages up to 500,000 ohms.

Size: 14" x 9¼ x 2½", with handsome etched panel and weatherproof case. Also portable and deluxe counter models.

Write Dept. RC-9 for Catalog of Other New Test Equipment.

RADIO CITY PRODUCTS CO.
28-30 W. Broadway, New York

---

RESISTOR SPECIALISTS

Featuring:
- New Quiet Carbon Volume Controls
- Vitreous Resistors
- Truvolt Resistors
- Power Rheostats

Write Dept. RC-9 for Catalog

125 Varick St., New York, NY

---

ELECTRAI

THE ROAD TO A MORE SUCCESSFUL SERVICE BUSINESS

With your request for our new, FREE BOOKLET for servicemen only. Let it point the way to doing all types of service work easier and quicker—by building YOUR business on a sounder, more successful basis. Hundreds of enthusiastic users throughout the world. You can't lose! Let us send the booklet without delay.

L. Sprayberry, 2346 University Place, N. W., Washington, D. C.

SPRAYBERRY’S PRACTICAL MECHANICS RADIO SERVICE

EVEREADY SERVICE CEMENT
"The Original Spallati Cement"

This is the best cement for replacing broken Grom, or resetting old rattrap or tone cones. It can be used for other Fall work, such as replacing broken switch and valve caps, the tank of your clock, the Merrick, the spallati end of your slot, etc. It is vibration-proof and just the thing for a repair job. This cement cures hard in your job. If it can not suit your needs write us. (Read for Radio, Theatre, TV, Service Business)


---
**190**

---for the real servicing "dope" you can't find a better book!

No other radio book is comparable to the new 1935 OFFICIAL RADIO SERVICE MANUAL. With contents, in style of printing, in grade of paper, in illustrations, there has never been published such a comprehensive volume. The 1935 Manual contains over a thousand pages—but it is only 1¼ inches thick because it is printed on a special Bible stock which is an exceptionally good stock, yet one of the thinnest and most durable papers. This 1935 Manual is the most authentic and elaborate service guide ever used in the radio industry. Service Men and dealers who use this 1935 Manual are astonished by finding in it such a wealth of profitable information which has never been published before.

**Contents of the 1935 Manual**

Over 1,000 pages full of diagrams and essential information of manufactured receivers—only data of real use in servicing is included. This new Manual is really portable since it will be extremely thin and light as well. Volume V continues where the preceding manual left off. Many circuits of old sets are included. Service Men know every set has certain weak points which are really the cause of trouble. Wherever the information could be obtained free weaknesses with their cures are printed right with the circuits. This is an entirely new and valuable addition to the Manual. All the latest receivers are included—full-wave sets, short-wave sets, auto-radio sets, midget and clear-box sets, etc., as well as P.A. amplifiers and equipment, and commercial servicing instruments. The cumulative index is even more complete than before; including cross-reference to sets sold under different names and type numbers. Volume V includes resistance data; socket layout; I.F. data; and voltage data. Tube data on latest tubes. Free question and answer service—as included in our last three manuals.

What Others say about this Manual:

Norfolk, Va.

I received the OFFICIAL RADIO SERVICE MANUALS ordered as per my letter of March 26, 1935 in good order. I am very well pleased with same, as it is a very valuable Radio Service data reference and guide.

ARTHUR J. FREEZENY.

Detroit, Mich.

Received your 1935 OFFICIAL RADIO SERVICE MANUAL and certainly is something to rave about. It's great.

A. HEDKE.

Stillwater, Maine.

I have received the 1935 Manual, and I am very much pleased with my investment.

FRANKLIN J. HOLMES.

Swift Current, Saskatchewan, Canada.

I beg to acknowledge receipt of my 1935 issue of the OFFICIAL RADIO SERVICE MANUAL.

Your Manual is fine, and would not be without any of them. The Manuals may be improved for Canadian use.

A. M. FORD.

---O Ver 1,000 Pages---

Over 2,000 Illustrations. Flexible, loose-leaf leathere-tte covers. Size 9 x 12"—yet only 1¼" thick

GERNSBACK PUBLICATIONS, Inc.

99 Hudson Street

New York, N.Y.

MAIL COUPON TODAY!

GERNSBACK PUBLICATIONS Inc., 99 Hudson St., New York, N.Y.

Enclosed find my remittance of $1.00 for which send me, POSTAGE PREPAID, One Copy of the 1935 OFFICIAL RADIO SERVICE MANUAL. (Send remittance by check or money order; or register letter if it contains cash, currency or unused U.S. Postage stamps.)

NAME ____________________________________________

ADDRESS ________________________________________

CITY ________________________________________________ STATE ________________ RC-4-35

Please Say That You Saw It in RADIO-CRAFT
THE LATEST RADIO EQUIPMENT

(Continued from page 199)

ALL WAVE SUPERHET. CATACOMB

(796)

FOR CONSTRUCTORS who wish to avoid the pitfalls of coil winding and aligning, this "preselector"—a complete, factory-aligned tuning unit is offered, for matching into any desired I.F., second-detector, and A.F. arrangement, by making 7 connections. It is equipped with a hand-spun tuning condenser, which is an integral part of the complete unit; coils are wound with silver-plated wire and with split, both of which are continuous from 540 kc. to 22,000 kc., with continuous hand-spun and no slips. Its output is 450 kc.

"MICROMASTER" DIAL

(797)

THIS vernier dial is available in a large variety of sizes, drives, and scales. The one illustrated has a scale diameter of 3½" and a planetary drive with slow speed of 4½ to 1, fast speed of 9 to 1. The small pointer travels 18 times faster than the large double one. A number of types and finishes are available on the escutcheons, and the crystals are convex and unbreakable.

VOLTAGE REGULATING TRANSFORMER

(798)

[General Transformer Corp.]

DESIGNED for use with electrical apparatus and particularly radio sets in locations having wide line voltage fluctuations. Power rating, all types, 160 W.; other sizes to order. Voltmeter on box indicates output voltage; selector switch adjusts voltage.

HIGH-EFFICIENCY CARBON RESISTORS

(799)

CARBON resistors have been developed to a remarkable degree, as the graphs indicate. On the hours scale, at A, results of humidity tests over 1,000 hours at 90 per cent humidity and temperature of 131 deg. F.; B, results of life and overload tests for 750 hours, on-load 1½ hours and 1-hour off, at 94 deg. F. On the resistance scale, C, load characteristics, with readings taken at 10 per cent intervals up to 100 per cent overload (or up to max. rated voltage), at 94 deg. F.; D, voltage characteristic, with uniform voltage increments up to a voltage representing 180 per cent overload watts (or up to max. voltage rating), at 94 deg. F.

Above, No. 796. Coll catacomb.
Above, No. 798. Line regulator.
Left, No. 797. Vernier dial.
Below, No. 799. New resistors.

QUESTIONS ABOUT METAL TUBES

—Do you know the answers?

1. What are the base connections of the types 524, 6A8, 6C5, 6FS, 6DS, 6F8, 6H6, 6J7, 6K7 and 6L7 METAL TUBES?

2. What are the differences between these tubes and the nearest equivalent in the glass-envelope type?

3. What are the Service Men's diagrams of 1935-36 car and home radio sets utilizing METAL TUBES? You will find the answers to these and hundreds of other questions, in the October 1935, METAL TUBES NUMBER OF RADIO-CRAFT.

SERVICE ENGINEERS' PENCIL

(800)

[RCA Mfg. Co.]

IG is a simple matter to figure the value of a "shot" resistor with the new "engineers'" pencil. The three colored bands that turn on the barrel of the pencil do the trick. It is only necessary to align the colors on the bands to correspond with the colors on the resistor. Then the value of the resistor down to the last decimal place, is plainly visible in embossed figures.

NEON TATTLEITE TESTER

(801)

[Litelfuse Labr.]

THIS tester can be used for a variety of purposes on voltages up to 250. A.C., D.C. and R.F. can be tested. A neon lamp is the indicating device and a series limiting resistor is built into the instrument. Only 0.5-ma. is needed to operate the device.

RCA INSTITUTES COURSE—A CORRECTION

In connection with the item on page 102 of the August issue of Radio-Craft concerning the new course instituted in the School of Communication Engineering of RCA Institutes, the closing paragraph should read as follows:

"While both of these courses have been taught for the last 3 terms in the Day School, they are being offered for the first time in the Evening School beginning with the 1935 Fall Term. This notice is being printed to point out that the Evening Course as previously given will be complete in every respect except for the two specific, new courses (Vacuum Tubes, and circuit elements) referred to above.

Above, No. 800. Code pencil.
Below, No. 801. Neon tester.

FREE DIAGRAMS

sent upon request for any of the Thor Amplifier or Power Kit. 115-220 Volt Amplifier, 10 and 25-Watt Amplifier High Fidelity Tuner—Just the one for your amplifier!

THOR RADIO

167 GREENWICH ST.
NEW YORK, N. Y.

HAVE YOU A RADIO-CRAFT INDEX?

By subject, issue and author, the July 1932 to June 1932 issues of RADIO-CRAFT are indexed and re-indexed, in a publication you may obtain for only 50¢. Send this amount to the publishers of this magazine, and we will send you a bound copy. Its use will save you time and money.

FREE SERVICEMAN!

Complete line Replacement Parts, Short Wave and All-Wave Receivers, Amplifiers, Test Equipment and Accessories. All at Rock Bottom Prices.

CONSOLIDATED RADIO PRODUCTS CO. 5540 W. 30th St., Chicago, Ill.

DRASTIC CUT

in Radio Noise on ALL Waves

Unconditionally Guaranteed with the new LYNNCH Hi-Fi Antenna

Arthur H. Lynch, Inc., 227 Fulton St., N. Y. PIONEER OF NOISE-REDUCING AERIALS

Please Say That You Saw It in Radio-Craft
Bigger and Better Than Ever
The Radolek 1935 Profit Guide is the most complete Radio Serviceman's "Buying Guide" ever published. 150 pages of valuable money-saving "radio-buying" information, the most accurate, complete listings of thousands of Radio Parts, Test Instruments, Tools, Amplifiers and Radio Receivers—8,000 items always in stock—available to you at the lowest wholesale prices.

Valuable Information
The Profit Guide is more than an ordinary catalog. Packed with new diagrams, charts, data and illustrations, this big catalog is a valuable reference book.

You Need This Book
Take advantage of the hundreds of "specials" and genuine bargains offered by Radolek. Send for this latest 1935 Profit Guide—now, RADOULE restricts distribution of this catalog to active and legitimate Radio-Men. Please enclose your business card or letterhead.

COUPON
RADOULE COMPANY
622 W. Randolph St., Chicago, Ill.
Please Rush the 1935 Profit Guide.

Ken-Rad Radio Tubes
Ken-Rad Radio Tubes are made to give clear, dependable reception. They satisfy customers and build good will for dealers. Write for full information.

THE KEN-RAD CORP., Inc., Owensboro, Ky.
Division of The Ken-Rad Tube and Lamp Corp.
Also Mfrs. of Ken-Rad Incandescent Electric Lamps

MIKE CUT-IN

MIKE CUT-IN

Please Say That You Saw It in Radio-Craft
EVERYWHERE, radio enthusiasts are saying: "Have you seen the new 18-tube, 6-band, Acousti-Tone V-Spread Midwest?" It’s an improvement over Midwest’s 18-tube set, so popular last season. This amazingly beautiful, bigger, better, more powerful, super selective, 18-tube radio... is not obtainable in retail stores... but is sold direct to you from Midwest Laboratories at a positive saving of 30% to 50%. Our performance is $250.00. Approved by over $20,000 customers. Before you buy any radio write for FREE 40-page catalog. Never before so much radio for so little money. Why pay more? You’re truly protected with One-Year Guarantee, Foreign Reception Guarantee and Money-Back Guarantee.

PUSH-BUTTON TUNING
Now, offered for first time! Simply pushing Silencer Button bushes set between stations... while pressing Station Finder Button automatically indicates proper dial position for bringing in extremely weak stations.

METAL TUBES
This Midwest is furnished with the new glass-metal counterpart tubes. Set sockets are designed to accept glass-metal or METAL tubes, without change. Write for FREE facts.

Acousti-Tone V-Spread Design
(Pat. Pending)
Send for FREE 40-page catalog illustrating new 1936 Midwest models and chassis in four colors. Full Scope High Fidelity Console, at left, shows dispersive waves and exclusive V-fleet that prove High Fidelity waves uniformly to the ear.

DEAL DIRECT WITH LABORATORIES
No middlemen’s profits to pay—you buy at wholesale price direct from laboratories... saving 30% to 10%. Increasing costs are sure to result in higher radio prices soon. Buy before the big advance NOW while you can take advantage of Midwest’s sensational value. You can order your 1936 Full Scope High Fidelity Acousti-Tone radio from the 40-page catalog with as much certainty of satisfaction as if you were dispensing to come yourself to our great radio laboratories. You save 30% to 10% . . . you get 10 days FREE trial ... as little as $5.00 puts a Midwest radio in your home. Satisfaction guaranteed or money back. Write, today, for FREE catalog.

PUSH BUTTON COVERING 4 1/2 to 2400 METERS • 12,000 MILE RANGE

30 Days FREE Trial!

EVERYWHERE, radio enthusiasts are saying: "Have you seen the new 18-tube, 6-band, Acousti-Tone V-Spread Midwest?" It’s an improvement over Midwest’s 18-tube set, so popular last season. This amazingly beautiful, bigger, better, more powerful, super selective, 18-tube radio... is not obtainable in retail stores... but is sold direct to you from Midwest Laboratories at a positive saving of 30% to 50%. Our performance is $250.00. Approved by over $20,000 customers. Before you buy any radio write for FREE 40-page catalog. Never before so much radio for so little money. Why pay more? You’re truly protected with One-Year Guarantee, Foreign Reception Guarantee and Money-Back Guarantee.

PUSH-BUTTON TUNING
Now, offered for first time! Simply pushing Silencer Button bushes set between stations... while pressing Station Finder Button automatically indicates proper dial position for bringing in extremely weak stations.

METAL TUBES
This Midwest is furnished with the new glass-metal counterpart tubes. Set sockets are designed to accept glass-metal or METAL tubes, without change. Write for FREE facts.

Acousti-Tone V-Spread Design
(Pat. Pending)
Send for FREE 40-page catalog illustrating new 1936 Midwest models and chassis in four colors. Full Scope High Fidelity Console, at left, shows dispersive waves and exclusive V-fleet that prove High Fidelity waves uniformly to the ear.

DEAL DIRECT WITH LABORATORIES
No middlemen’s profits to pay—you buy at wholesale price direct from laboratories... saving 30% to 10%. Increasing costs are sure to result in higher radio prices soon. Buy before the big advance NOW while you can take advantage of Midwest’s sensational value. You can order your 1936 Full Scope High Fidelity Acousti-Tone radio from the 40-page catalog with as much certainty of satisfaction as if you were dispensing to come yourself to our great radio laboratories. You save 30% to 10% . . . you get 10 days FREE trial ... as little as $5.00 puts a Midwest radio in your home. Satisfaction guaranteed or money back. Write, today, for FREE catalog.

30 Days FREE Trial!
HERE'S THE RECEIVER SHORT-WAVE LISTENERS HAVE BEEN WAITING FOR

THE NEW 1936
GENERAL ELECTRIC RADIO

The invention and development of all-metal tubes by General Electric engineers opened up new possibilities in short-wave and long-wave reception not thought possible before. So phenomenal were the results obtained that they inspired the design and manufacture of a completely new line of General Electric receivers. Experimenters who go DXing with a 1936 General Electric Radio will receive a new thrill in world-wide reception.

FEATURES OF MODEL A-82
NEW METAL TUBES
More effective shielding and short leads result in higher I.F. gain with greater stability—less harmonic distortion on high modulation—less audio gain required—quieter operation.

AIR TRIMMER PERMALINER
Accurate calibration and alignment settings are maintained indefinitely. The receiver operates at maximum performance at all times.

SLIDING-RULE TUNING SCALE
"Easy to read as a ruler." Only one band visible at a time. Variable ratio drive for easy tuning.

"SENTRY BOX" R.F. UNIT
All coils mounted directly on band control switch—Minimum length of Leads—Maximum Efficiency.

HIGH GAIN I.F. TRANSFORMER
Operates at new high maximum efficiency due to perfect shielding of metal tube.

HIGH-LEVEL DIODE DETECTION
Greater gain in R.F. and I.F. units enables the diode to operate at higher signal level. The result is increased usable sensitivity and better quality of reception.

FREQUENCY RANGE
140 to 410 and 540 to 19,500 kc. in 4 bands.

And many additional outstanding features.

Ask your General Electric Radio Distributor for complete details, or write the General Electric Company, Section R-779, Merchandise Dept., Bridgeport, Conn.