A GERNSBACK PUBLICATION

RADIO'S LIVEST MAGAZINE

Special RADIO SET BUILDERS Number

Radio-Craft

September

25 Cents

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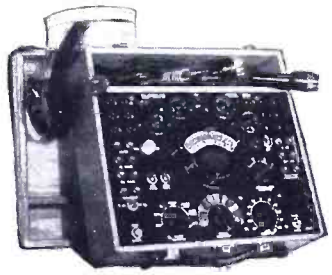
HUGO GERNSBACK Editor

How to Make the
WORLD'S SMALLEST TUBE SET!
See Page 138

"Bluebeard"-A 4-Tube Set! — A "Peanut"-Tube Superheterodyne "Metal"-Tube Sets — Short-Wave "Receiver-Converter" — Portables



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   referred to zero level of six milliwatts in 500 ohm line.

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   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 mfds.
   0.00005 to 0.005 mfds.
   0.000125 to 0.0125 mfds.
   0.0005 to 0.05 mfds.
   0.00125 to 0.125 mfds.

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   0 to 5.0 amp.
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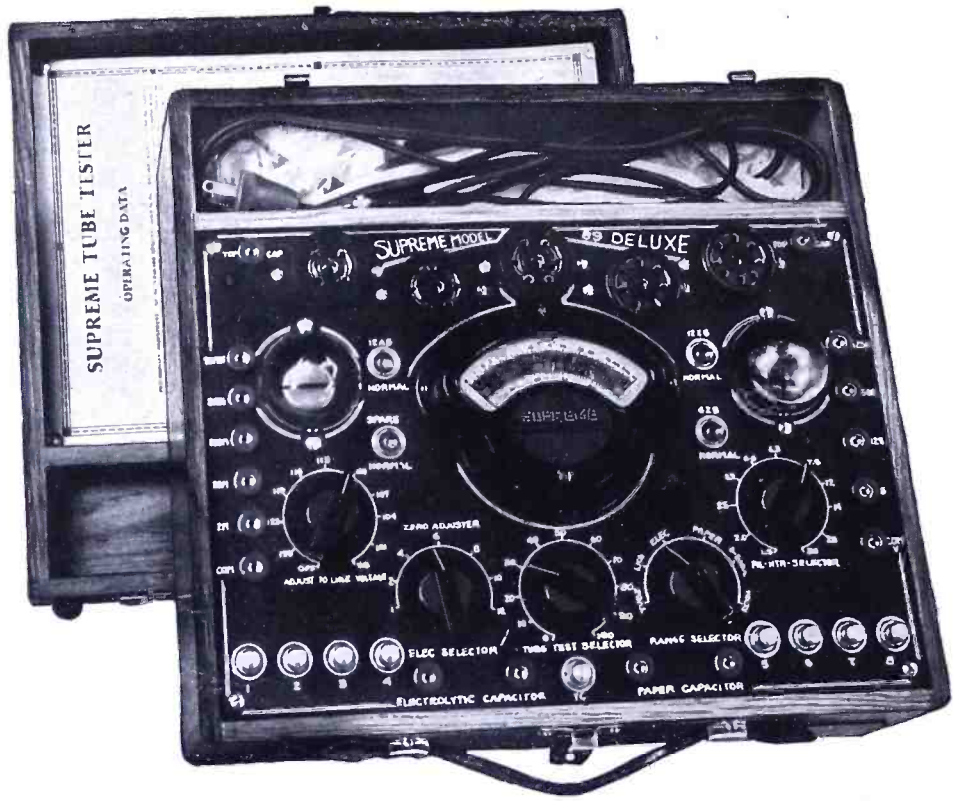

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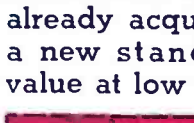

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2. Accurate. New circuit tests all tubes at RATED LOAD.
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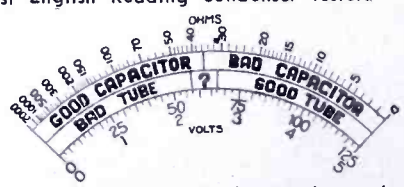
6. Sensitivity of neon leakage test LIMITED so as not to discard good tubes.
7. Quality test detects open circuited elements.
8. All leakage and "short" tests while tubes are heated.
9. Extra handling avoided by making leakage and short tests in same socket used for Quality test on English Reading "Good—Bad" Scale.
10. Tests all tubes without adapters.
11. Fixed ratio between tube and circuit resistance for extreme accuracy on Quality tests.
12. Easily adaptable to future tube developments.
13. Adjustable to varying power supply.
14. First English Reading condenser tester.



15. Accurately classifies all electrolytic condensers as "Good" or "Bad" on meter scale.
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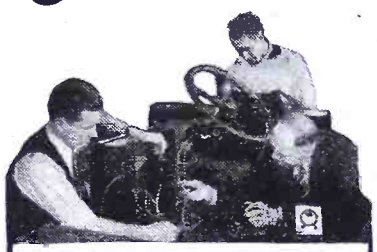

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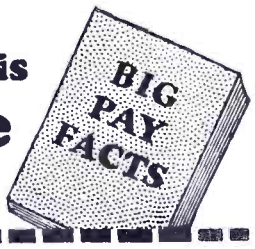

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Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN

CONTENTS—SEPT., 1935, ISSUE

Volume VII Number 3

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 that of date; 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, Ill., as second-class matter under the act of March 3, 1879.

HUGO GERNSBACK, President I. S. MANHEIMER, Secretary

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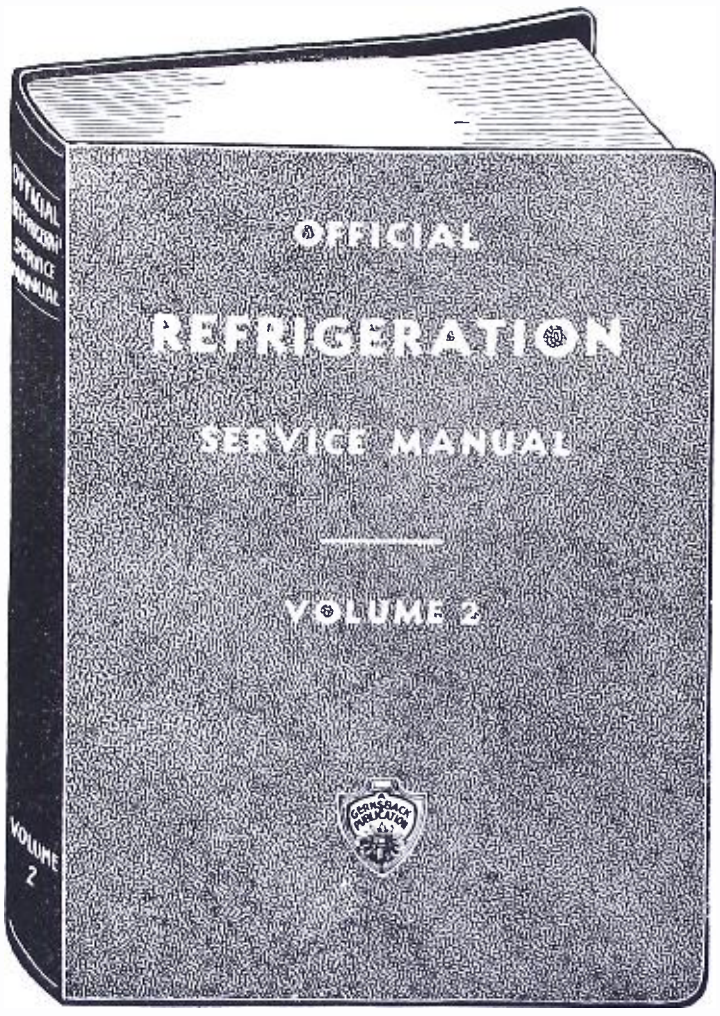

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Electric Control Devices
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Servicing Restrictor and Capillary Tube Systems
Charging Systems with Refrigerant
Electrical Service; Motors, Fuses, Hookups
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Estimating Refrigeration Loads, Coil and Machine Sizes
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Please Say That You Saw It in RADIO-CRAFT

Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN
"Takes the Resistance out of Radio"

Editorial Offices: 99 Hudson St., New York, N.Y. HUGO GERNSBACK, Editor Vol. VII, No. 3, September, 1935

RADIO SET BUILDING

An Editorial by HUGO GERNSBACK

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; I 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.

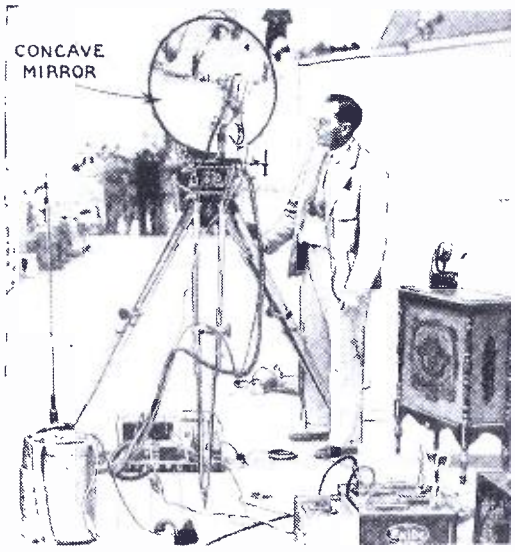
The radio set builder has no such limitations. When he gets the new tubes, and after he sees their various advantages, he can immediately design a special set, and usually this set if the builder knows what he is about will be ahead of the factory-made model—much to the home set-builder's delight. Of 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 RADIO MONTH



Here is the set-up (on the deck of the Normandie) which could not be found.

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.

CANADA BANS SUNDAY ADVERTISING

IN A report received from the Department of Commerce, last month, we learn that the Canadian Radio Broadcasting Commission has advised station managers to eliminate *all advertising* from their Sunday programs! Up to this time, the Canadian rules have closely paralleled those in force in the U.S., but this is a very definite step toward independent regulations.

This sound truck aided in finding a boy who was lost, one day last month.

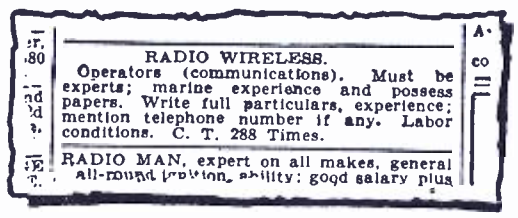
SOUND TRUCK AIDS SEARCH FOR BOY

WHEN Frank Sazama, the 7½ year old son of an athletic coach at the Naval Academy at Annapolis disappeared one day last month, every available means was employed in the search that followed.

One ingenious method used was to press into service a mobile P.A. system, ordinarily used for ballyhoo purposes in and around Annapolis.

The sound truck rolled through the streets "broadcasting" a description of the boy. The sound system also called for volunteers to aid in the search.

This unusual application of P.A. units may suggest other novel applications to the owners of such apparatus.



RADIO WIRELESS.
Operators (communications). Must be experts; marine experience and possess papers. Write full particulars, experience; mention telephone number if any. Labor conditions. C. T. 288 Times.

RADIO MAN, expert on all makes, general all-round position, ability; good salary plus

RADIO "OPS." STRIKE

WHEN the S.S. *Manhattan* prepared to sail from New York one day last month, an insurmountable difficulty in the form of a strike of the radio operators prevented the departure of the ship for more than 5 hours.

While a strike of radio operators is not new, their demands were unusual in that their union—the Radio Telegraphers' Association—asked for more than double pay and went so far as to picket the pier of the United States Lines with huge signs reading "Remember the Titanic, the Morro Castle, etc."—"Is Life Cheap?"—etc.

A temporary settlement was made by the company officials permitting the regular operators to sail—but it is interesting to notice the ad. printed above, which appeared in the *New York Times* the following morning!

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.

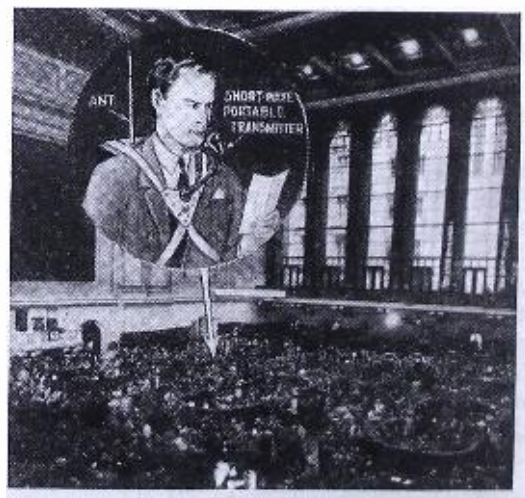
S.-W. RADIO FOR N.Y. STOCK EXCHANGE

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.



IN REVIEW

Radio is now such a vast and diversified art it becomes necessary to make a general survey of important monthly developments. RADIO-CRAFT analyzes these developments and presents a review of those items which interest all.

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.

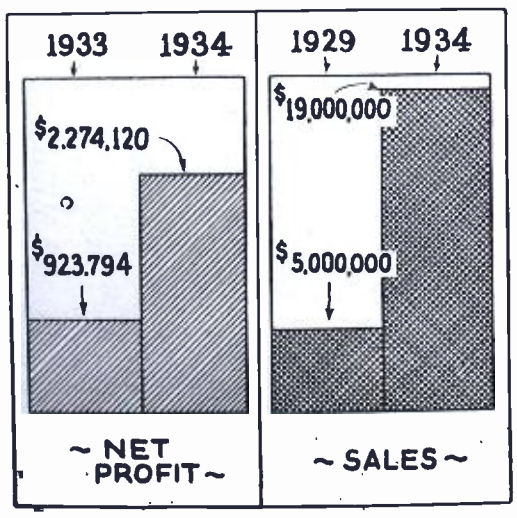
COLUMBIA SYSTEM AHEAD

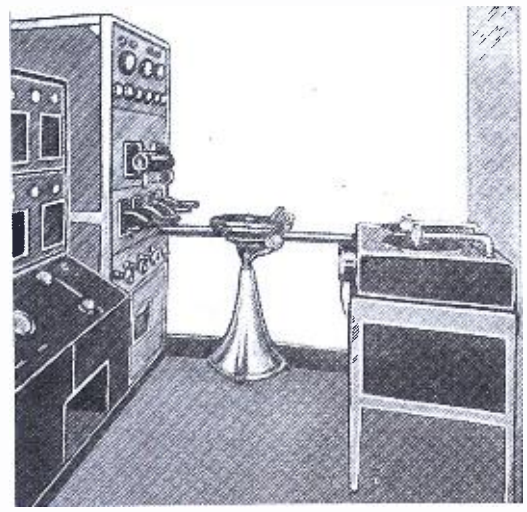
WITHIN the past month, several facts have become known regarding the Columbia Broadcasting System's business, which are of interest to radio fans.

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.





Part of the 200,000 W. transmitter at Luxembourg, showing the transcription turntables.

RADIO LUXEMBOURG TAKES ADVANTAGE

WHILE it has been known for some time that the 200,000 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!*

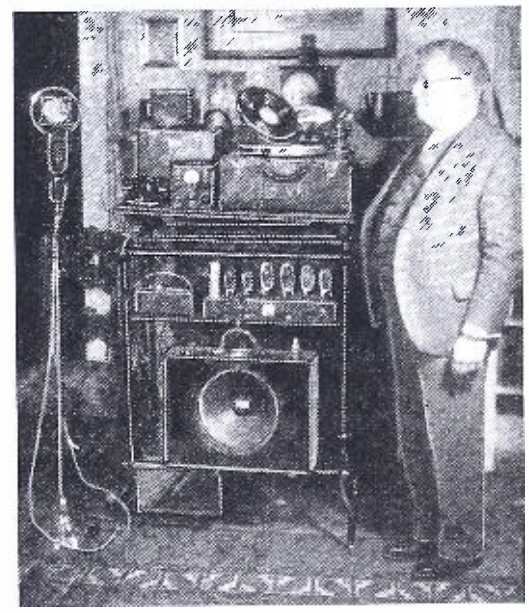
There's a comic opera aspect to the entire situation, for it is a well known fact that there is a propaganda "war" going on between certain European countries—yet, they let the little Grand Duchy of Luxembourg, with its superb geographical position take many, many thousands of their listeners away from 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 Torrest, accused of murdering Area Cabrera was obtained.

A phonograph and a loudspeaker concealed in the cell of the prisoner comprised the "ghost." The speaker droned 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.



Prof. Karapetoff with his accompaniment unit.

RECORDINGS AID ONE-MAN SYMPHONY

VLADIMIR KARAPETOFF, Professor of electrical engineering at Cornell U. author of text books 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.

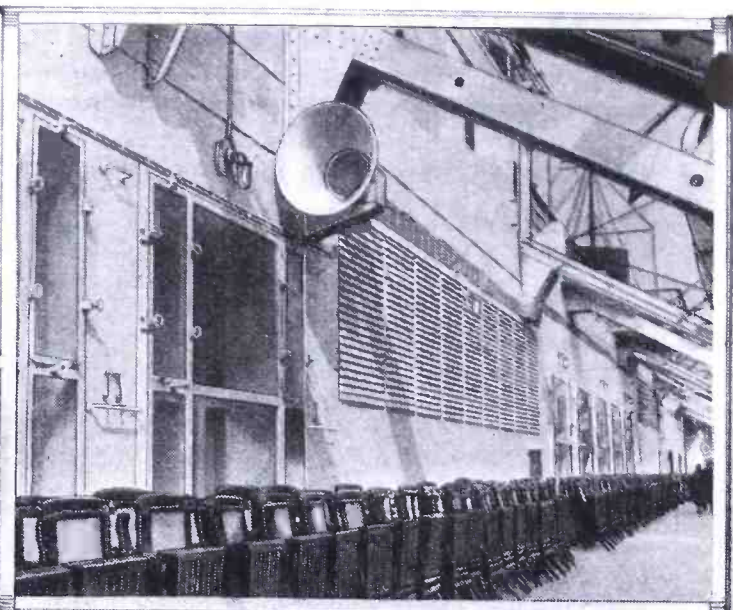
It is estimated that $3,000,000 worth of electricity is used per year for operating electric sets in Czechoslovakia.

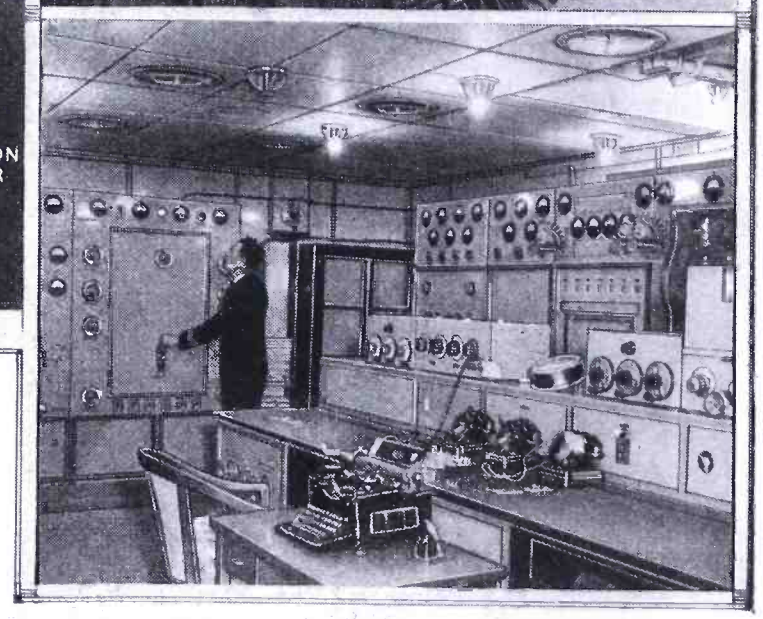
The public utilities, however, claim that they give special rates for radio set power consumption and should not have to contribute more.

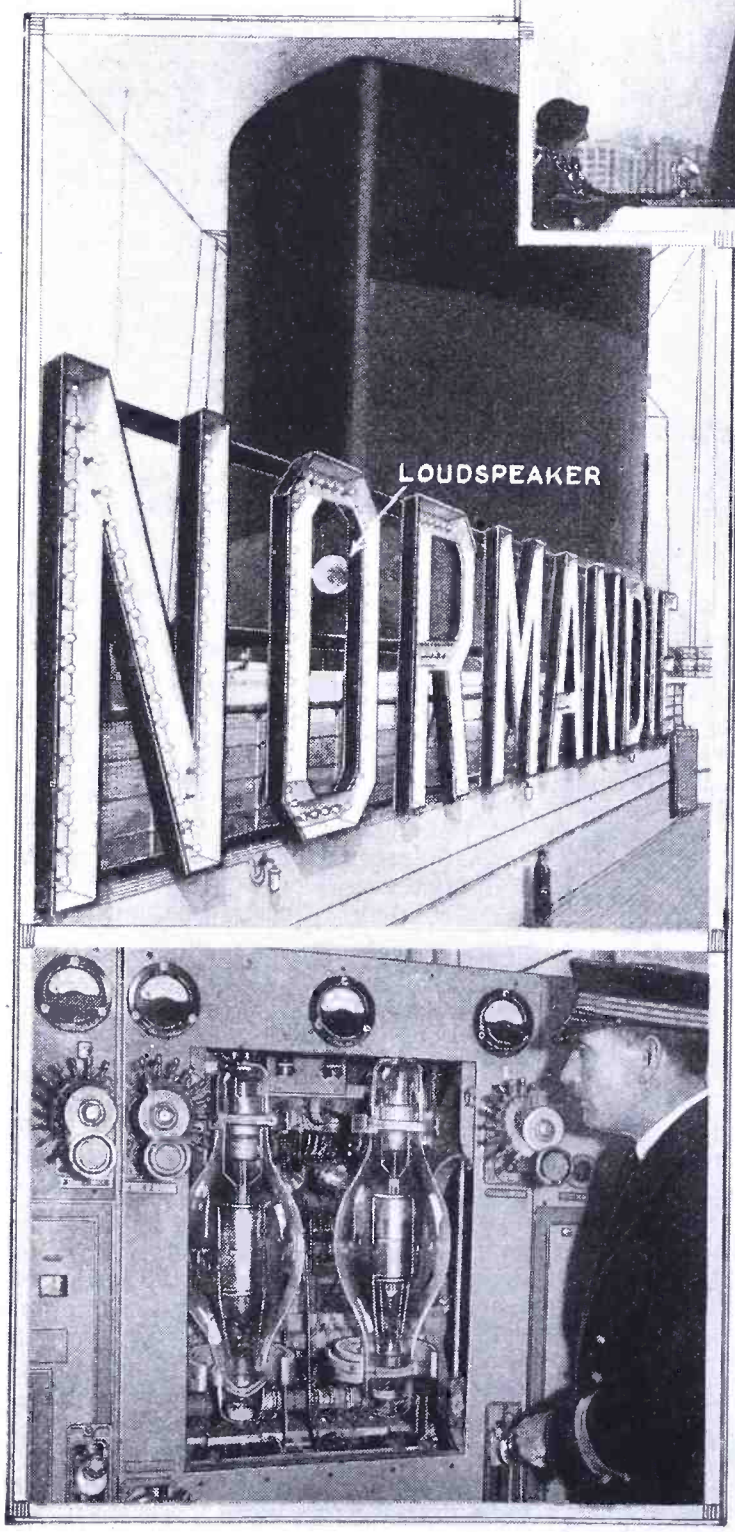
RADIO PICTORIAL

(WORLD'S LARGEST SEA-GOING RADIO SYSTEM)

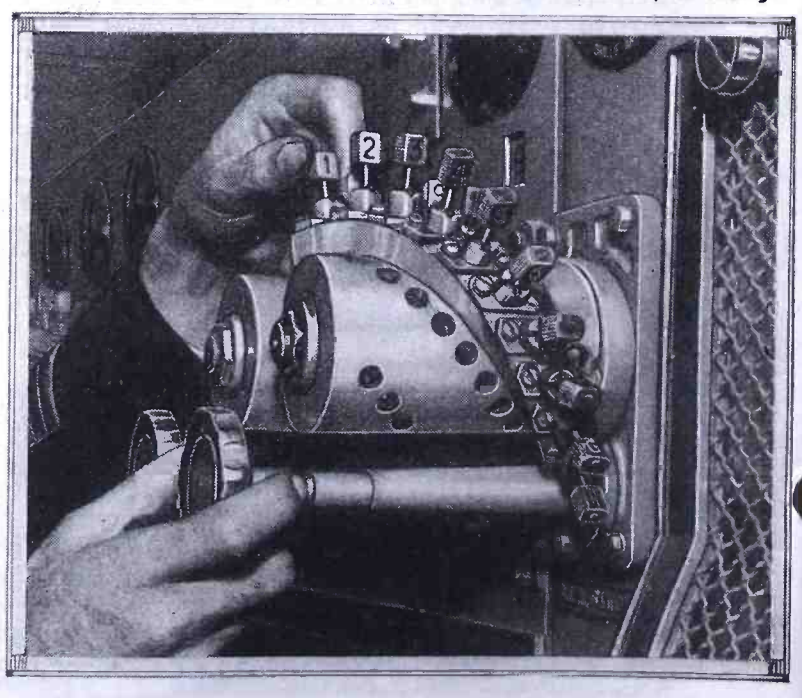
Right, one of the 80 loudspeakers which are installed in all parts of the Normandie. This one is alongside one of the decks. Below center, another of the loudspeakers, showing a close-up of an installation on one of the funnels. Below left, the same installation, viewed from a greater distance, giving 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.



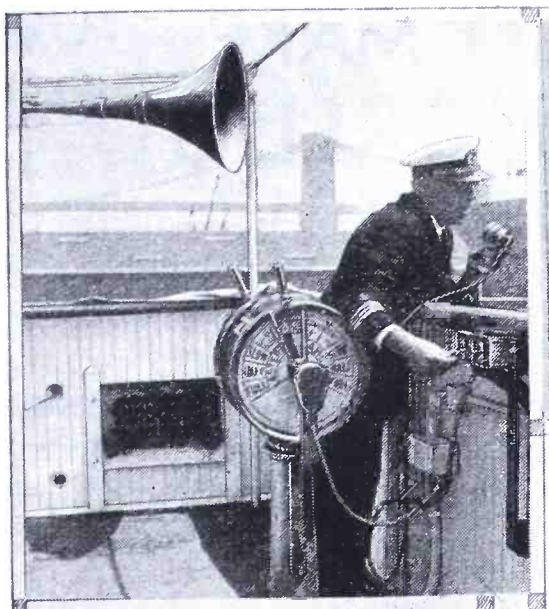


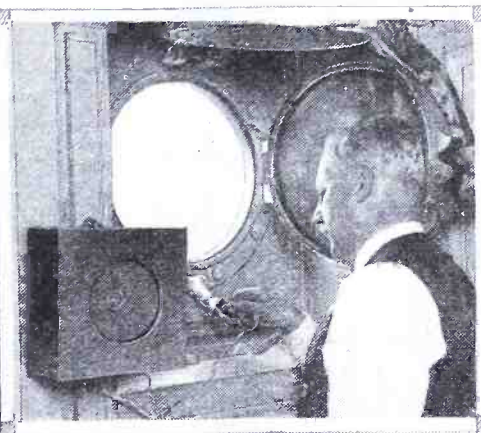


At right, we see the appearance of the main shack of the Normandie, showing the various transmitters around the walls. The operating table in the foreground carries a set of controls for all the equipment, while on the low shelf in back of it are the receivers, the operating table being kept clear of 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.

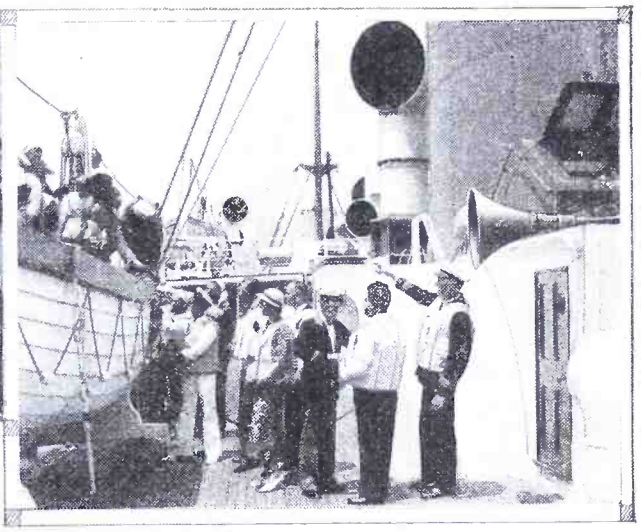


(Halbran Photos)

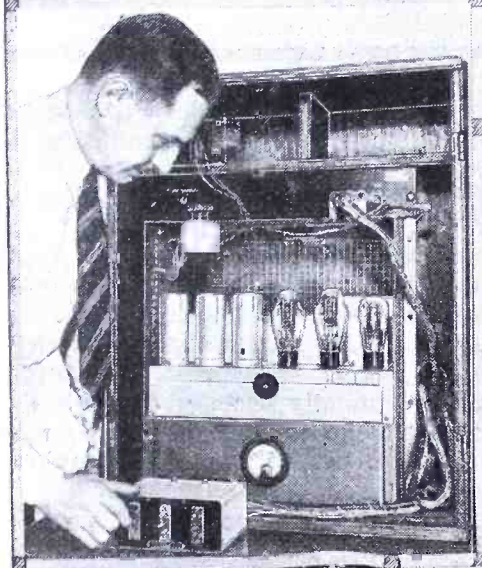


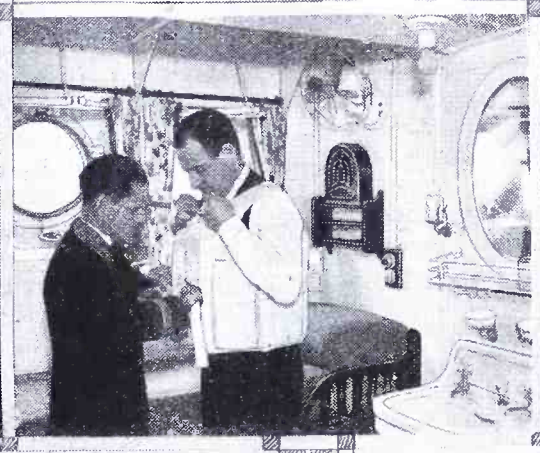


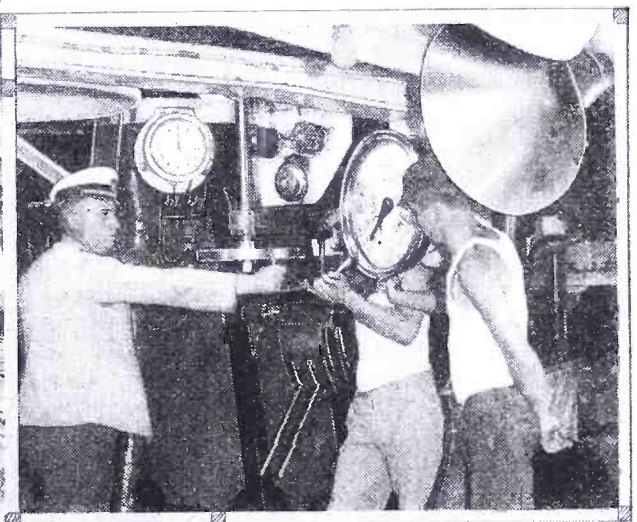
An amazing new system of communication is depicted here. The First Officer shown at left can talk to any part of the ship, where a loudspeaker is installed, although there are no connecting wires of any kind. A speaker may be connected to any metal part as shown above and the voice will come through. This invention is the work of Dr. F. L. Satterlee. (Halbran Photos)

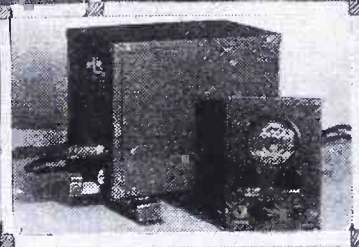


These views show loudspeakers of the new system installed in various parts of the ship. The crew talk to the bridge through the same loudspeaker. Since no wires are used, this is valuable in an emergency.







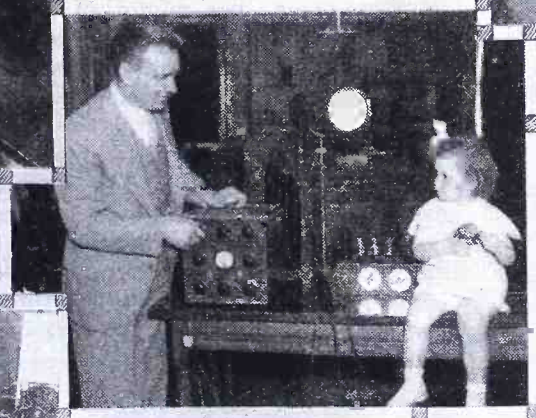


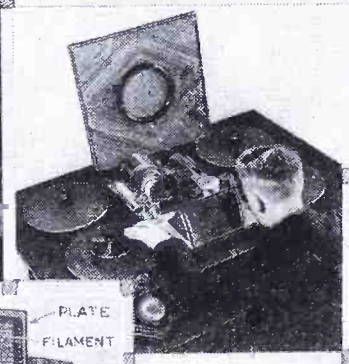
16 lb. airplane set by RCA.

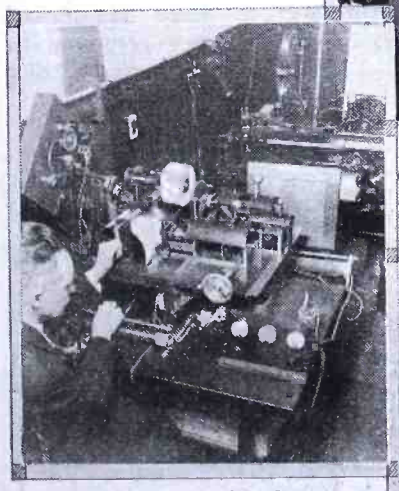
Apparatus to show brain "action currents," above.

"Victim" with electrodes on, in study of brain "currents."

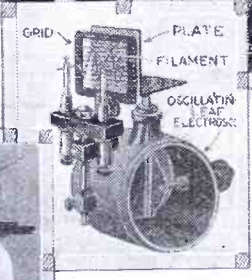
New 20-watt airplane transmitter, for CW, ICW, or phone work.





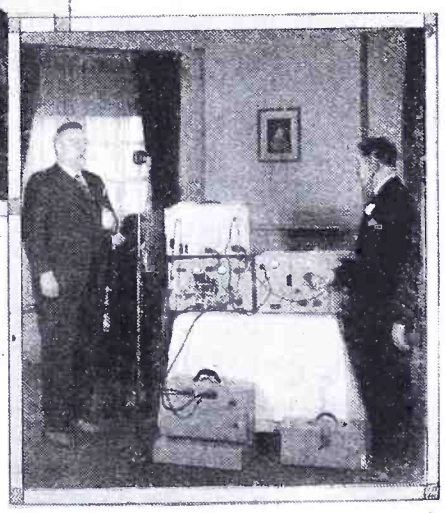


Machine for amplifying sound of heart beats, also visible on screen.



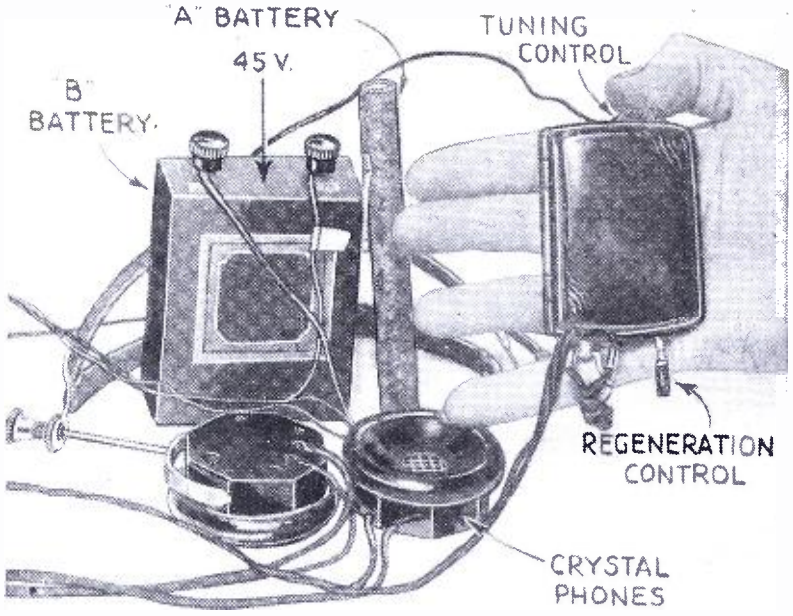
Program manager of a Berlin television station selecting future programs.

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. (Harris & Ewing Photo)



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

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



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

EVERY "dyed-in-the-wool" radio man has at one time or another had a desire (secretly or otherwise) to make a really small receiver—one which could be dropped (not stuffed) into a coat pocket to be ready when needed.

Many small sets have been built, but unfortunately the really small ones were all of the crystal type, since suitable tubes have not been obtainable. The small tubes such as the Western Electric type N tube and the more recent "acorn" tube require rather heavy filament current values which makes the battery problem a serious one.

However, as we announced in the *Radio-Craft* July issue, on page 11, an English tube company has just introduced three new types of tubes which are smaller than either of the two types mentioned above. And what is even more important, the filament requires only .06-A. at 2 V. In other words, two small dry-cells connected in series are sufficient to operate one of these tubes for many hours.

The possibilities of these tubes for pocket receivers were 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 "60 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, completly 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 1¼ 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 mmf. The fixed condensers were unusually small bakelite covered mica units measuring ⅝ x ⅜ x $\frac{3}{16}$-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)

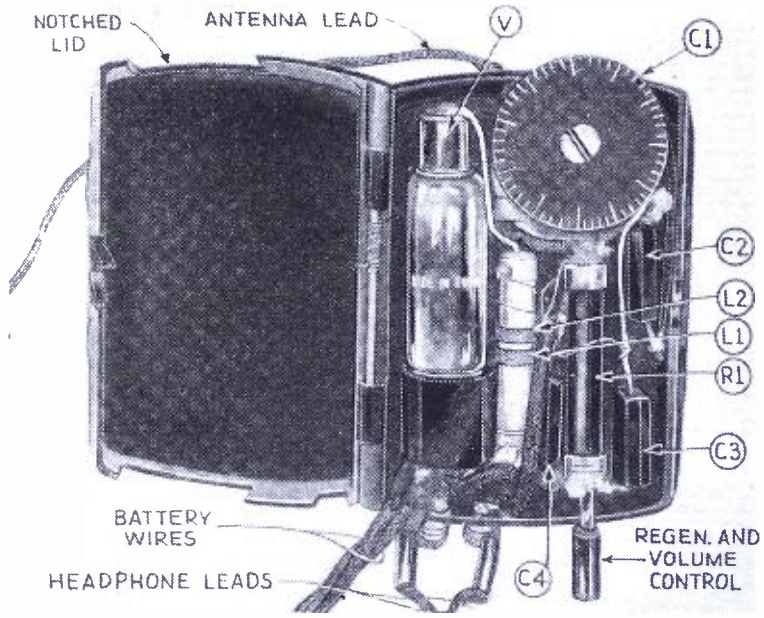
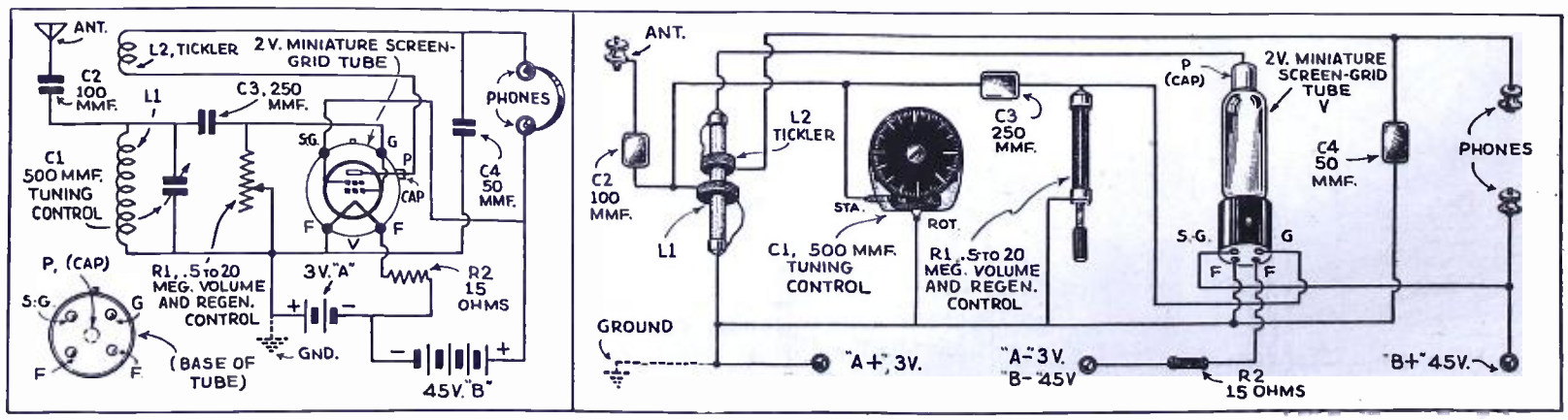


Fig. B, above. The positions of the tiny parts.

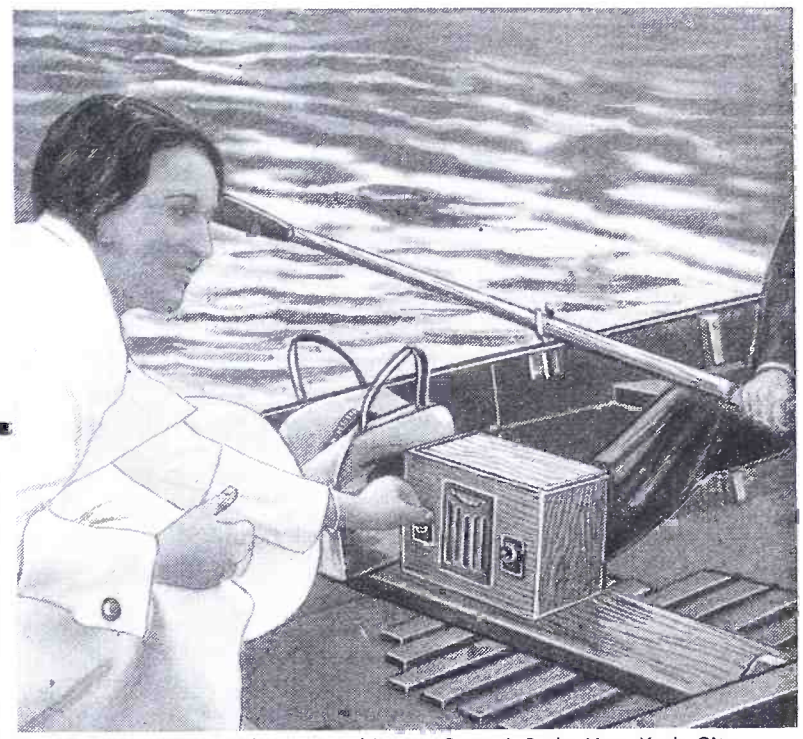
Fig. I, below. Schematic and picture diagrams.



BUILD THIS "6-IN-4" ROWBOAT PORTABLE

New tubes, new circuit arrangement, new arrangement of the components—in fact, a *new* radio set for the romanticist lakeward bound. A completely self-contained set.

N. H. LESSEM



Initiating the Rowboat Portable—at Central Park, New York City.

SOFT 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 7¼ x 10¼ x 5¾ 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)

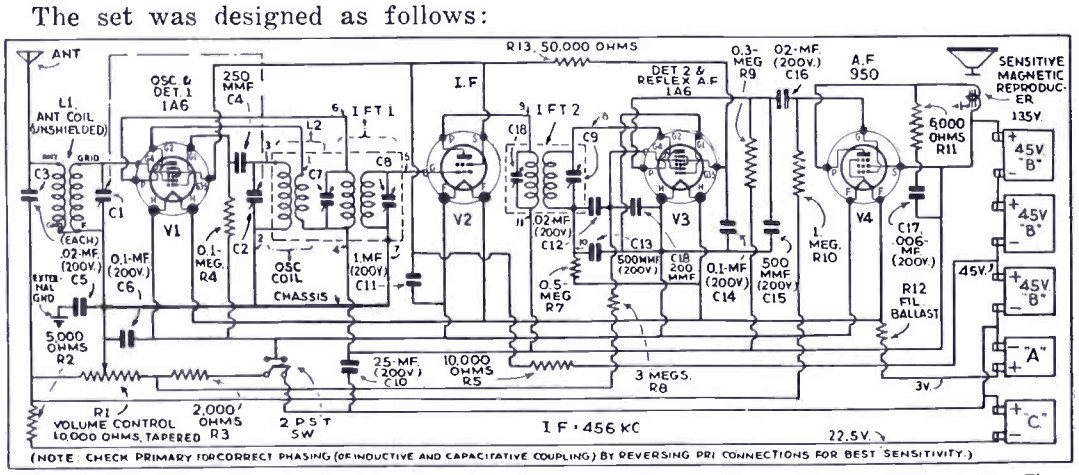
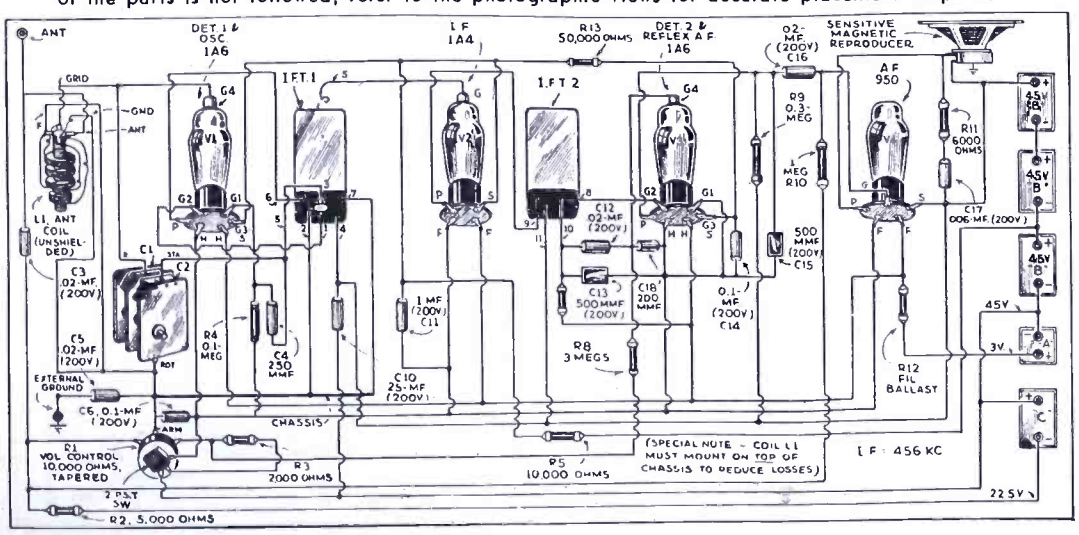


Fig. 1, above. Schematic circuit of Rowboat Portable. Note the use of new tubes; and two 1A6s. The latter 1A6 functions as a dual-service tube, both as diode second-detector and as first A.F.

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.



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;

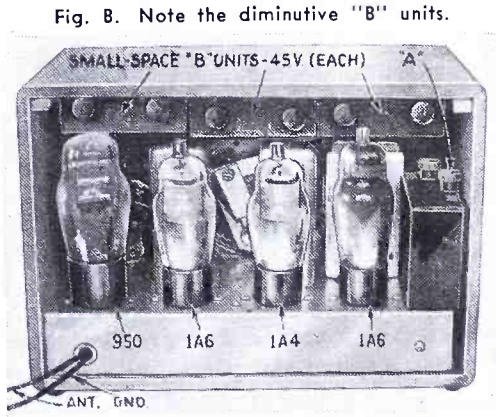
(5) A recently-developed low-plate-drain power output pentode is used;

(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. 8. Note the diminutive "B" units.



AN EASY-TO-BUILD 5-METER TRANSCEIVER

Here is a fine construction item for the "ham" or the experimenter who wants to break out with a transmitter.

S. E. LOVER

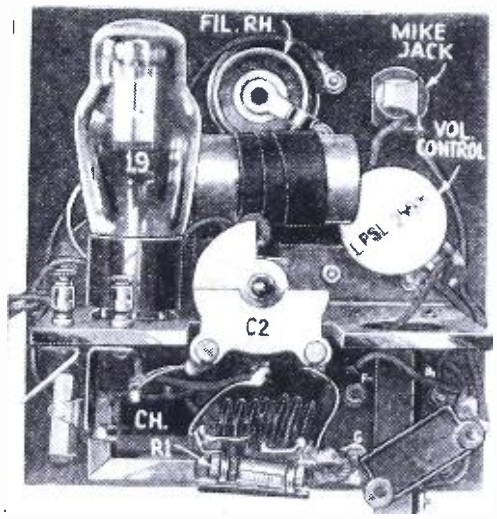


Fig. A, top. The panel of the transceiver.
Fig. B, above. The rear of the unit.

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 ½-in. form and consist of 4½ turns each of No. 14 enameled copper wire. The linear length of the mounted coils is 1½ 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 ⅞ x ⅝-in. with ⅛-in. separation at the bottom and top edges separated about ¾-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 ¾-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 brilliancy 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 6¾ x 5⅞ ins. A bakelite subpanel extends back 4 ins. from the panel, on which is

(*Continued on page* 183)

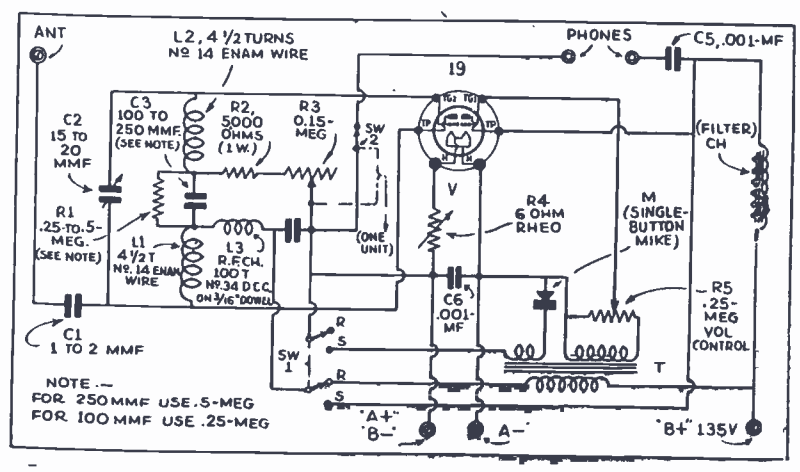
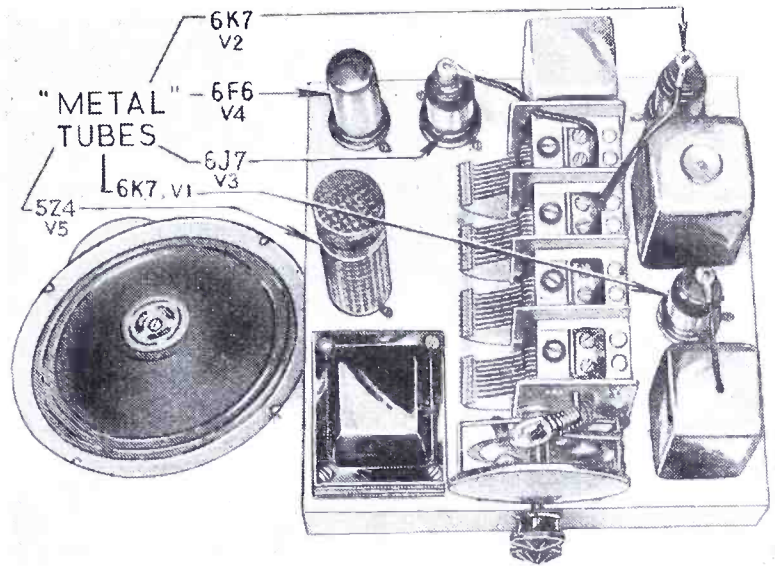


Fig. 1. The circuit showing how the two sections of the type 19 tube are used for oscillator and modulator, or for detector and A.F. stage by a simple switch-over.

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

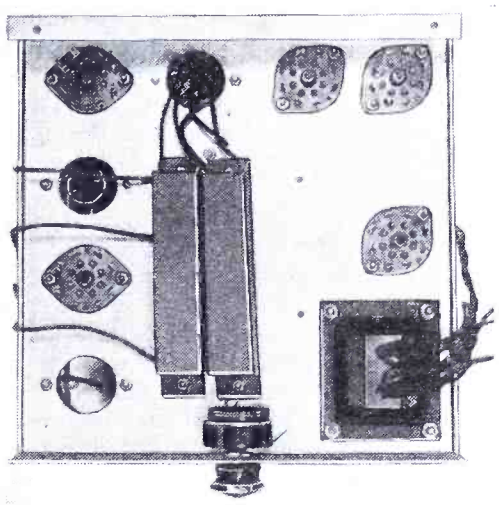
A front-view photograph of the receiver in which the tubes were used indicates a lot of vacant space around the tubes. It must be remembered that this chassis was originally designed for glass-envelope tubes, and these small-size tubes offer tremendous economies in chassis size, as will be noted.

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.

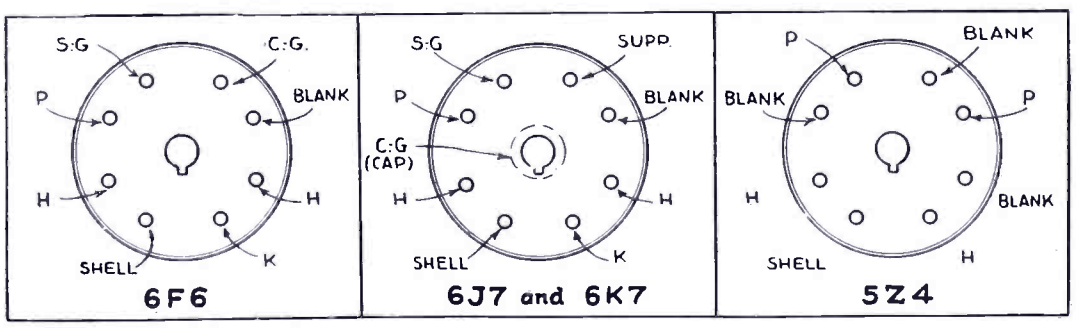
The detector tube of the receiver is of the bias type and has sufficient gain and rectifying efficiency to deliver ample audio signal to the A.F. power stage.

(*Continued on page* 183)

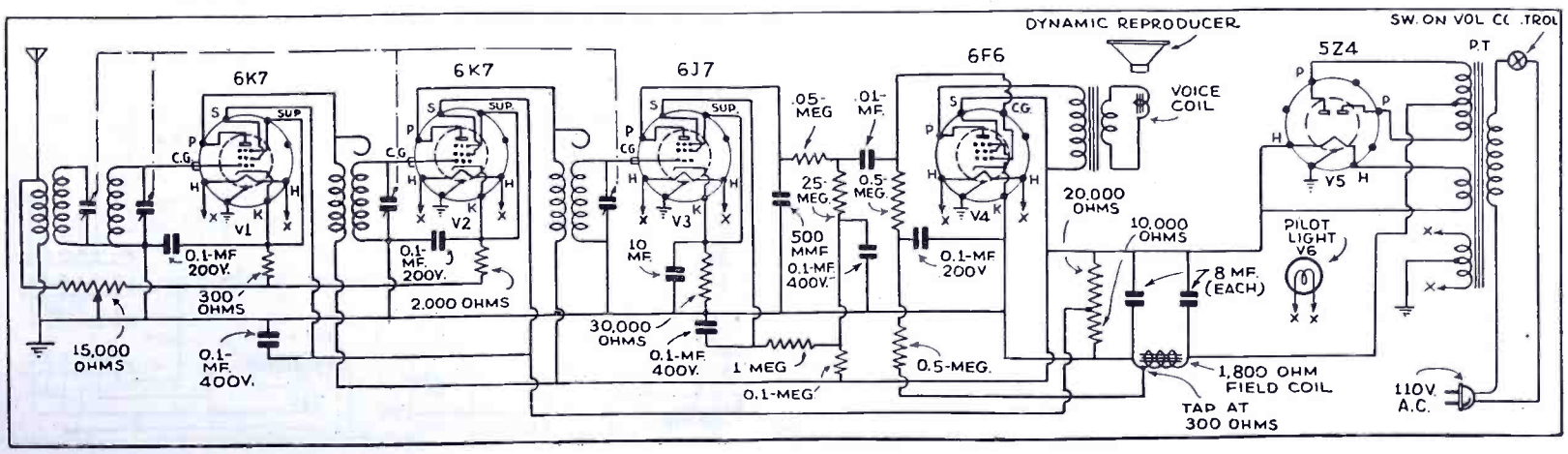
Underside view; major components ready for wiring.



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

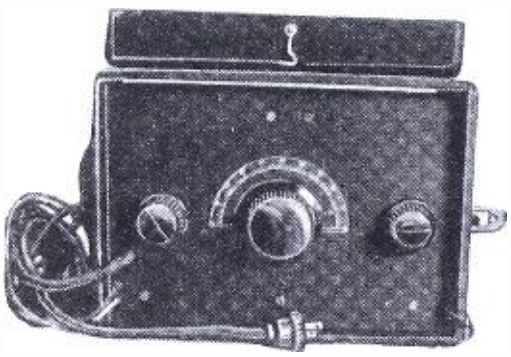


Fig. A. The panel view showing controls.

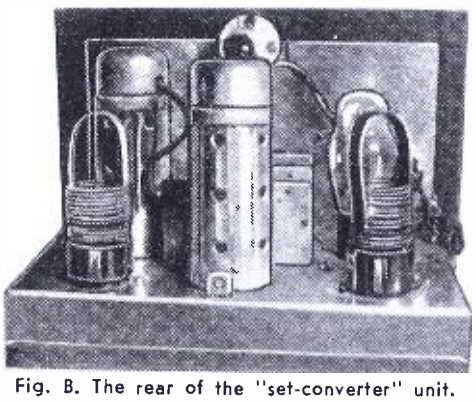


Fig. B. The rear of the "set-converter" unit.

WITH the present all-wave receiver or a short-wave converter connected to a broadcast set, dissension 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 go through 18-19 rather than through 26.

Some radio theorists may look with skepticism on this method of I.F. coupling, which, insofar 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 unshielded. 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 16 and 18 to a 550 kc. broadcasting station. Increase the capacity of the trimmers slightly until the station disappears. Disconnect the aerial, turn on the set, and tune in some nearby short-wave station; while listening to the short-wave station adjust the trimmers for maximum signal in the phones.

OPERATION

As a short-wave set it is operated like all short-wave or long-wave sets. The plug-in coils of the desired frequency are plugged into the coil sockets and the set is tuned by the 2-gang variable condenser. When the carrier wave of a station is heard in the earphones, stop turning the dial and bring in the station to maximum clarity and reception by adjusting trimming condenser 3. The listener will find, after a while, that he can lock the large variable condenser at any meter-band and get all the stations in that particular band with the small variable condenser.

When the set is hooked up as a converter to a broadcast set the tuning

(*Continued on page* 168)

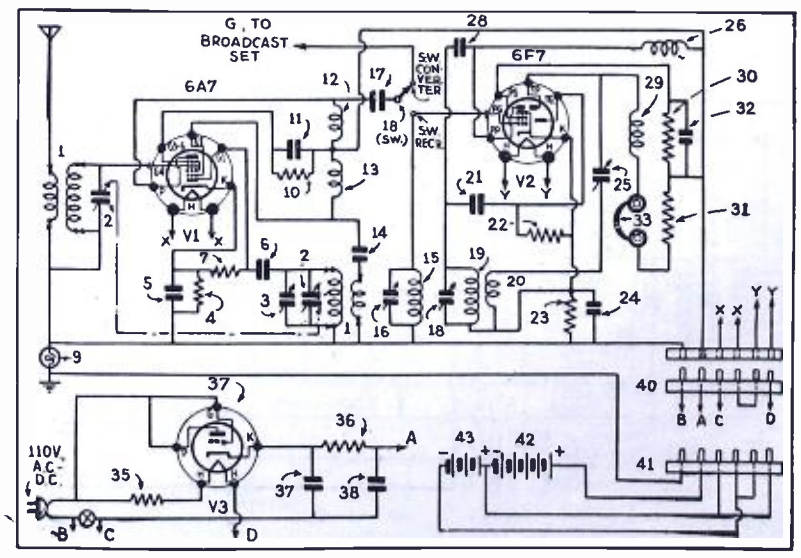


Fig. 1
The schematic circuit shows the unusual arrangement used to permit operation on either A.C. or D.C. power lines, or batteries. The switch (18) changes the unit from a converter to a complete set. Plugs 40 and 41 may be made up from tube sockets and bases.

"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

DESIGNED 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. Figure 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 ⅜-in. thick, the bottom ⅝-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 ⅜-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* 166)

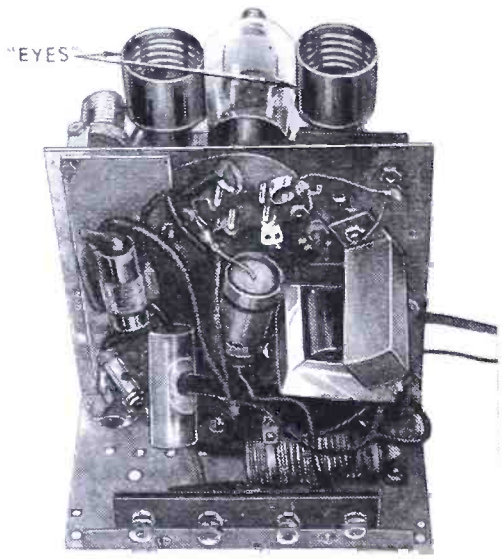


Fig. B. The under side of the chassis, showing the "knob" sockets and speaker connections.

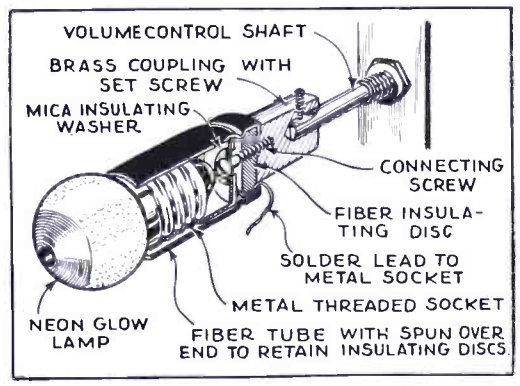


Fig. 3, above. Details of tuning and volume knobs.

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.

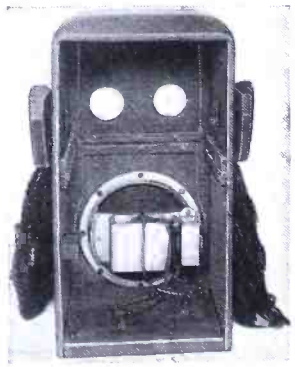
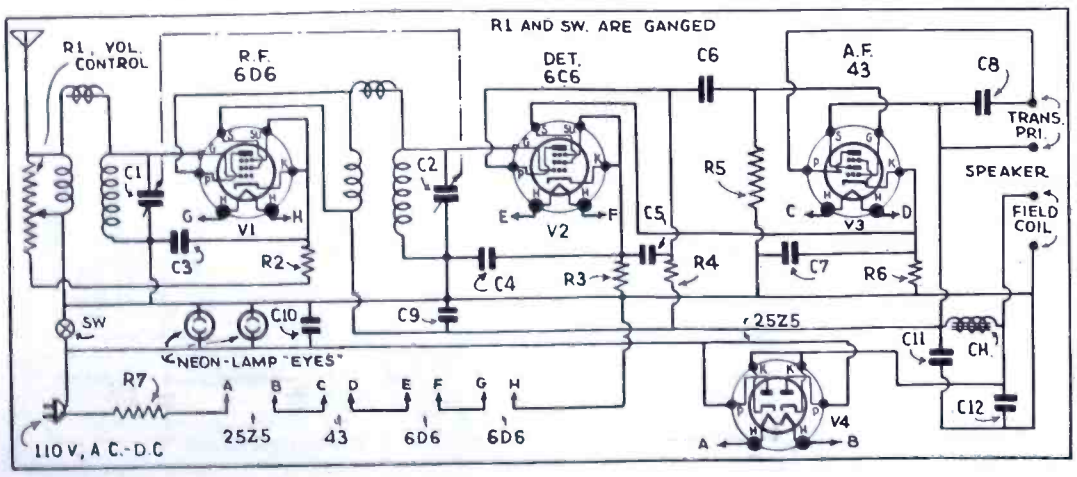


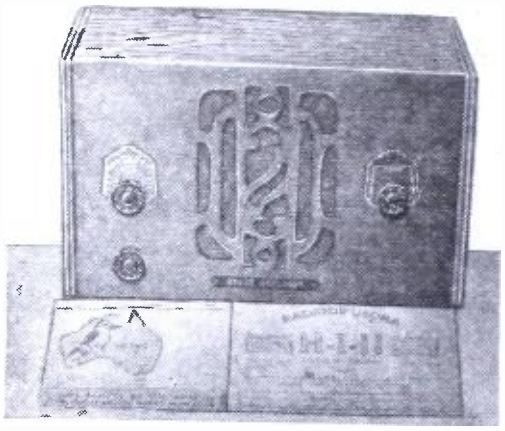
Fig. 1. The circuit of the receiver which is a conventional T.R.F. A.C.-D.C. type.



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

A sensitive all-wave set that the Service Man or custom set builder can make at a cost of about $15.00

H. G. CISIN



NOW that the all-wave receiver has become almost commonplace, Service Men often experience a demand for a good-all-wave set capable of bringing in foreign stations but still inexpensive enough to meet present economic conditions. Of course, if the prospective purchaser can afford to spend $75 or $100, it is a simple matter to go out and pick up a standard commercial set, but in most cases the Service Man will find that his customer will be far more interested and far more likely to buy, if he can obtain an all-wave set for around $25 or $30. With this thought in mind the writer has designed an efficient set which can be constructed readily at a cost of about $15! This allows a very nice margin of profit and there is practically no competition in this price class.

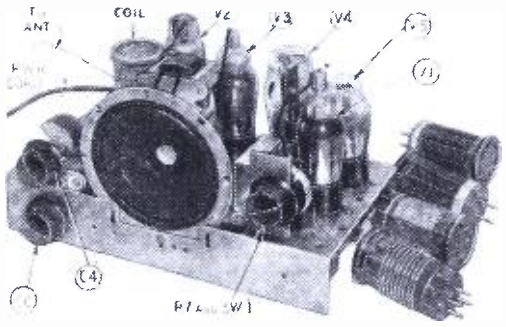


Fig. B. The chassis with one coil in place, ready for operation. Note the layout of parts.

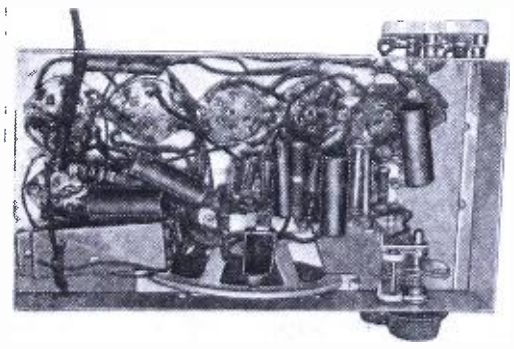
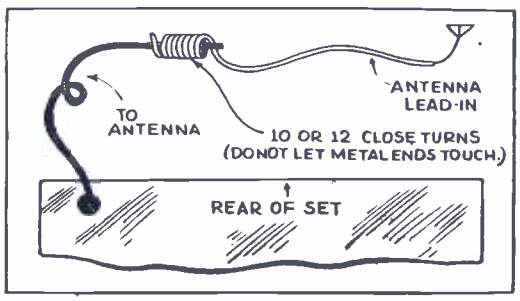


Fig. C. The underside of the chassis.

Fig. 2. One method of aerial coupling to increase selectivity on the broadcast band.



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 43 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.

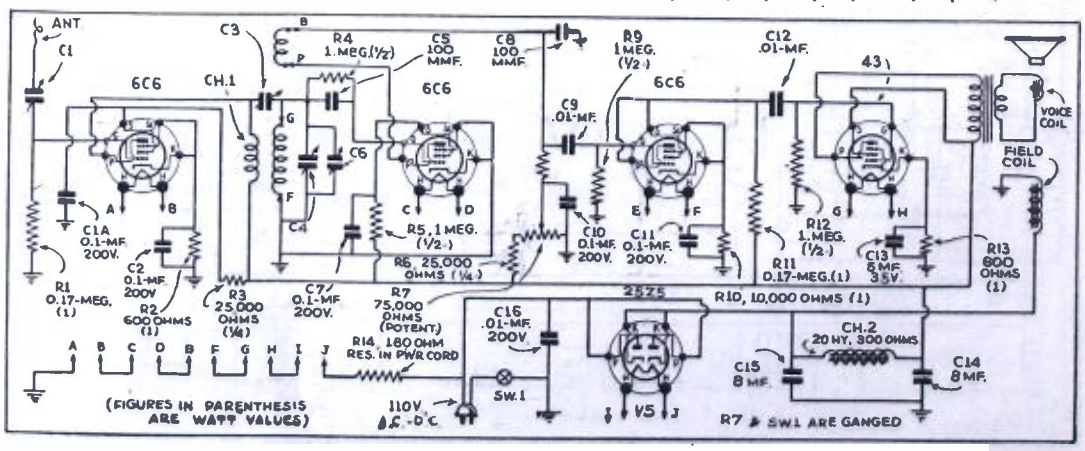
Rectification of the A.C. line potential is accomplished by means of a 25Z5 tube connected as a half-wave rectifier. A 300 ohm filter choke shunted by 16 mf. electrolytic condensers accomplishes nearly perfect filtering on A.C., reducing hum to a minimum.

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)

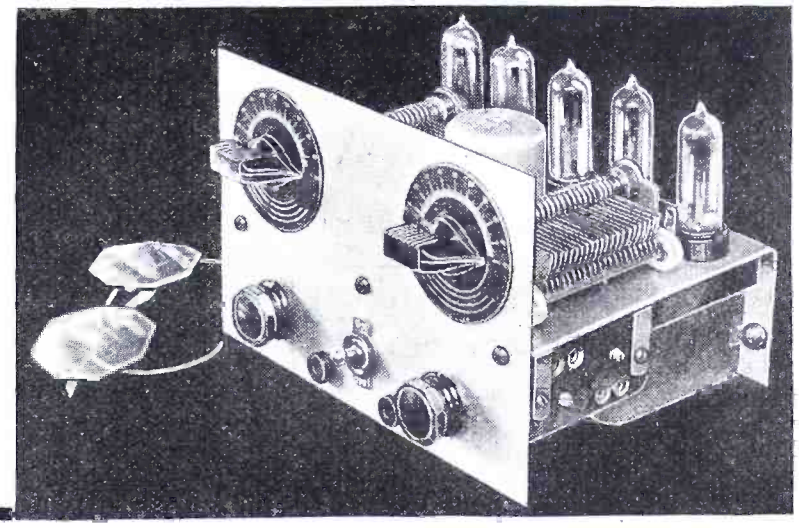
Fig. 1. The circuit of the set. Tube filaments: V1, A-B; V2, C-D; V3, E-F; V4, G-H; V5, I-J.



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 3 of the interruption-frequency coils, each one then 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.

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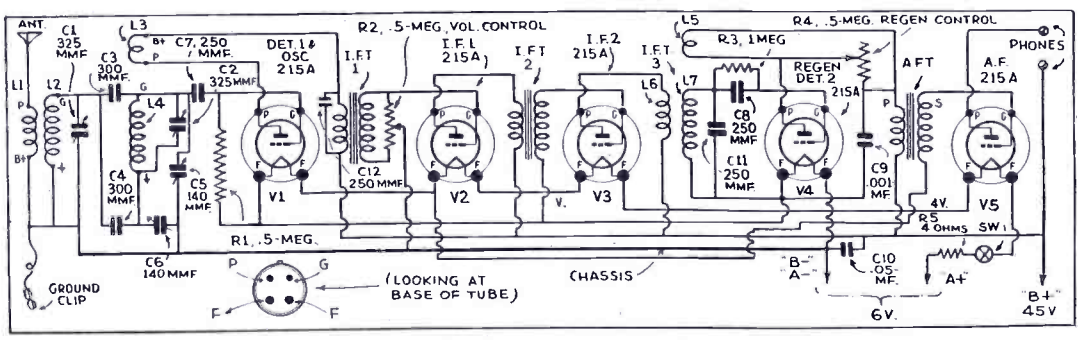


Fig. 1, above. The schematic circuit. Fig. 2, below. The picture wiring layout.

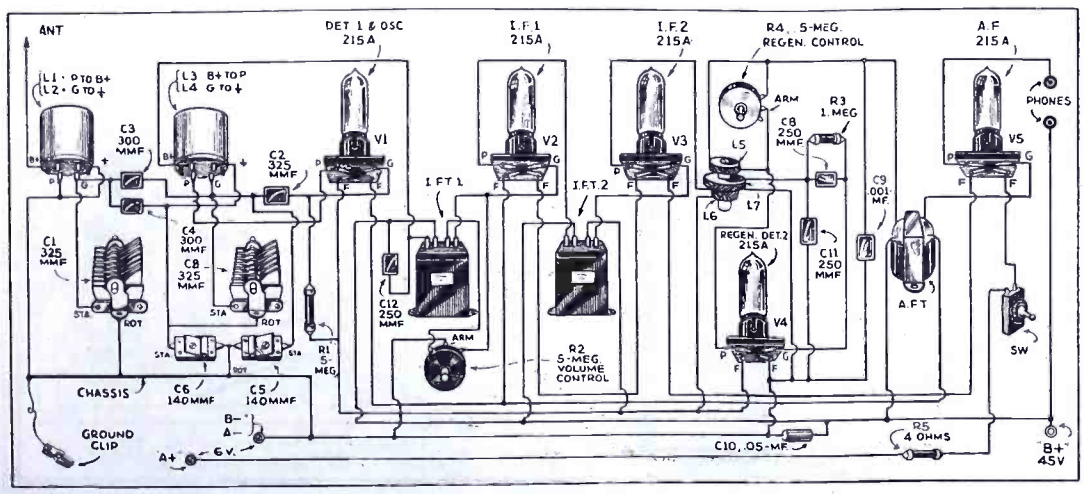
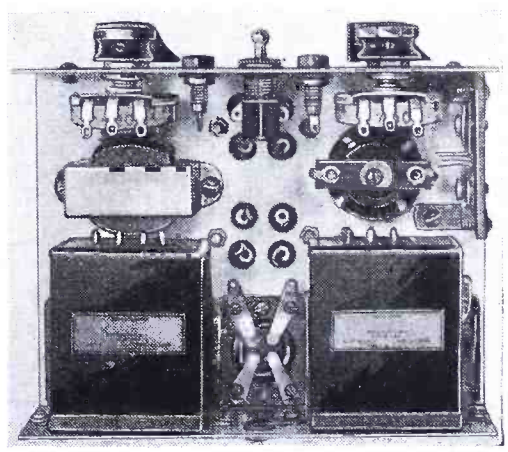


Fig. A. The under-chassis view of the set. Note the iron-core I.F. transformers.



DESIGN PROBLEMS OF TUNING DIALS

WILHELM E. SCHRAGE

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

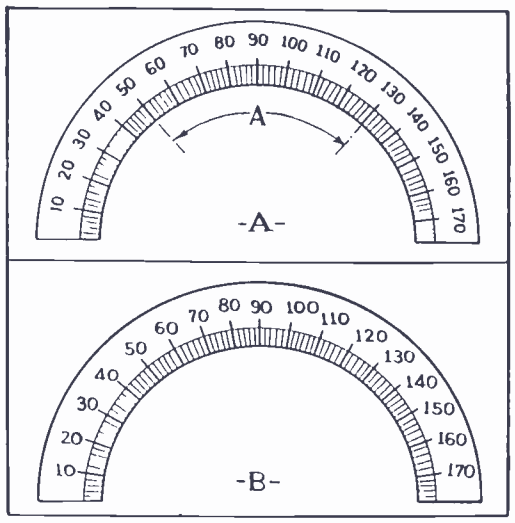


Fig. 1, above. The wrong (A) and right (B) way to number the tuning dial.

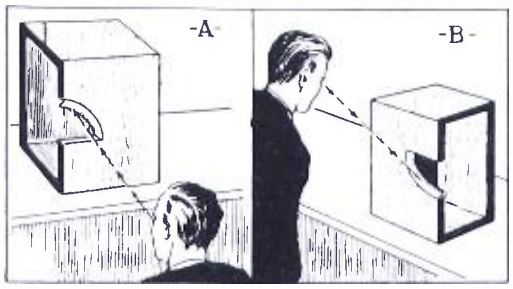


Fig. 2. Poor (A) and good (B) dial angles.

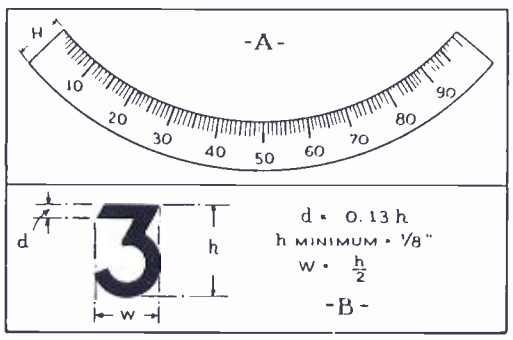


Fig. 5. Finding "optimum"-size numbers.

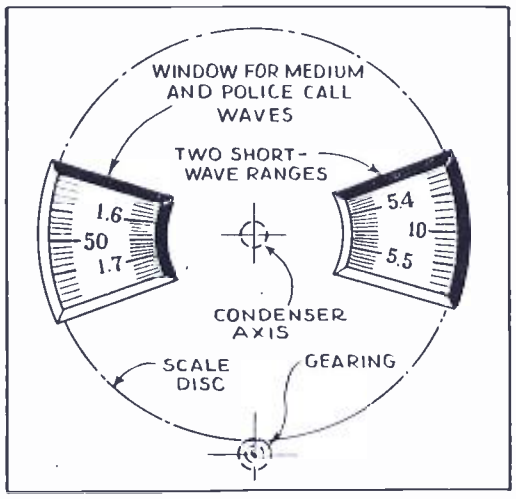
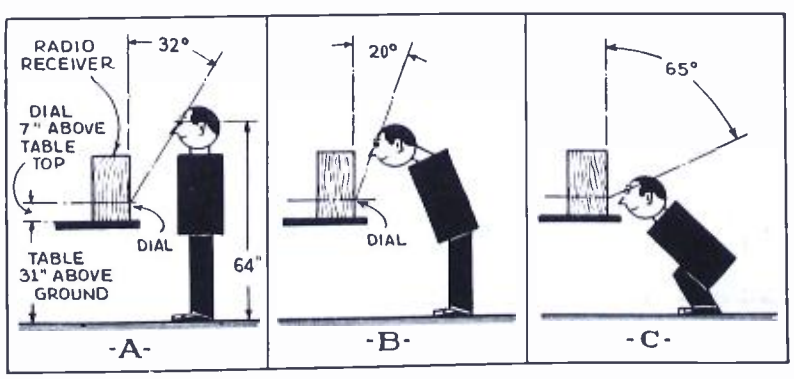


Fig. 6, above—4-range "propeller" dial.
Fig. 3, below. How we look at the dial.



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 restive 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)

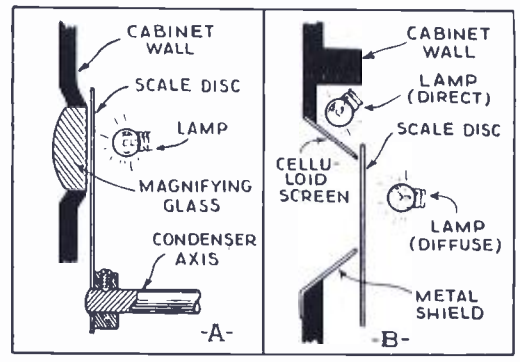


Fig. 8. Two types of good dial lighting.

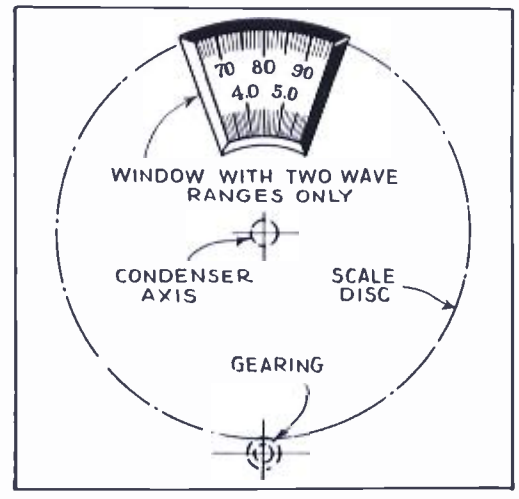
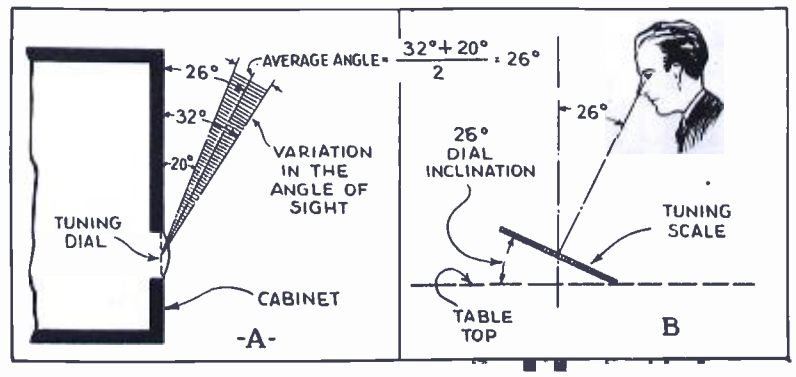
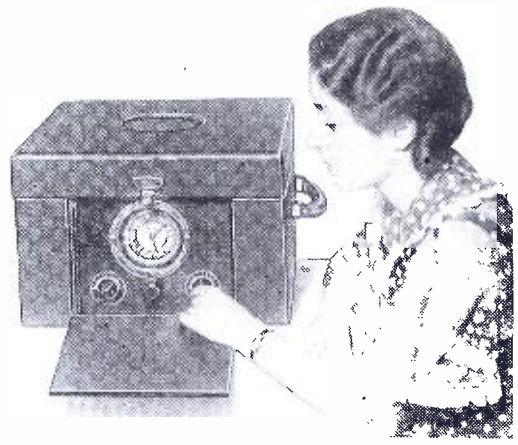


Fig. 7, above—2-range window dial.
Fig. 4, below. Finding "best" angle.



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.

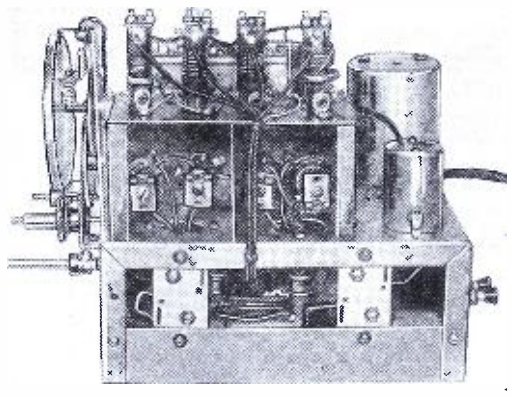


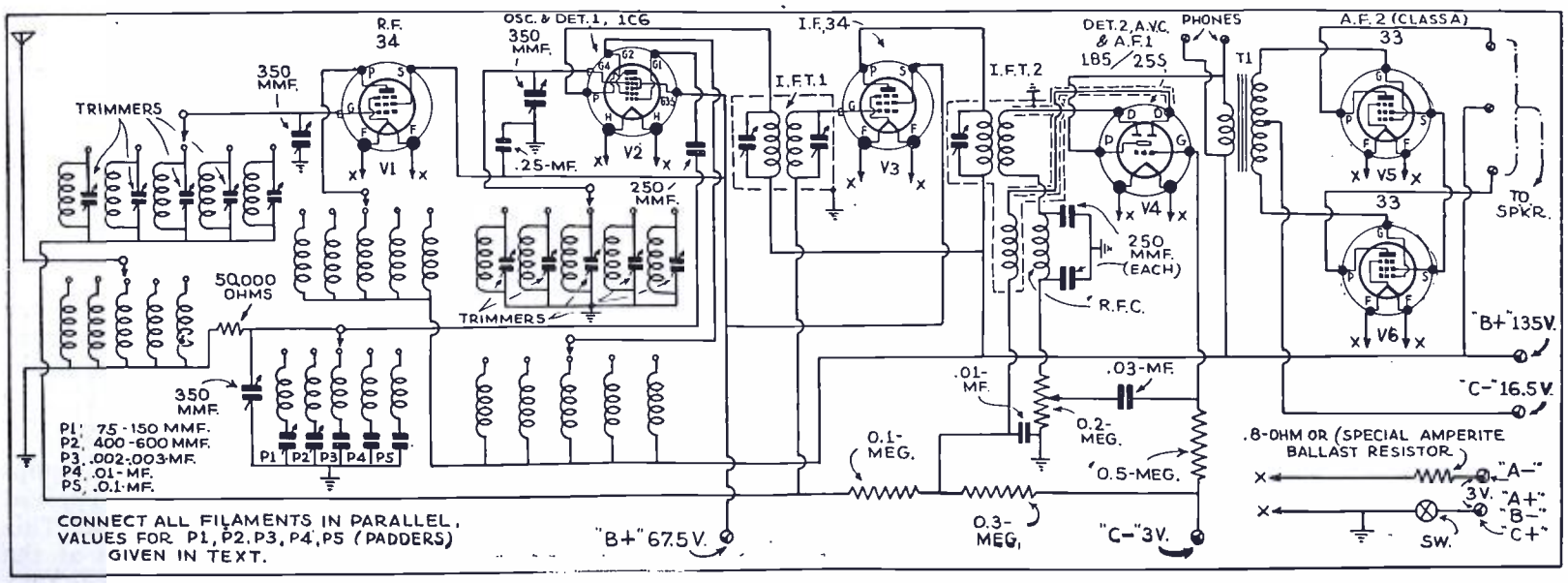
Fig. A, above. A "side elevation" photo.
Fig. 1, below. Circuit of 12-2,100 meter, 465 kc. set.

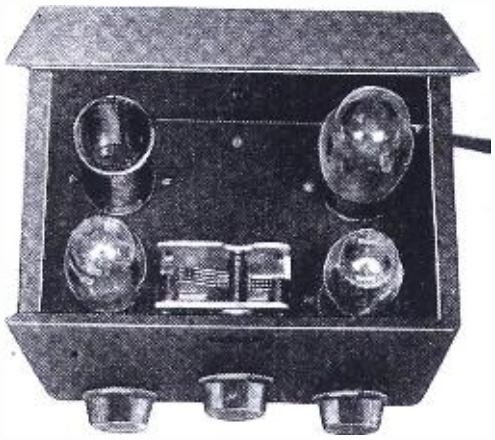
A single high-gain I.F. stage furnishes ample amplification. The 1C6 tube (used as a composite first-detector and oscillator) has a translation gain of approximately 25 (practically) and is therefore equivalent to a stage of amplification in itself.

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 three tube set made from the foundation kit and a few additional parts.

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.

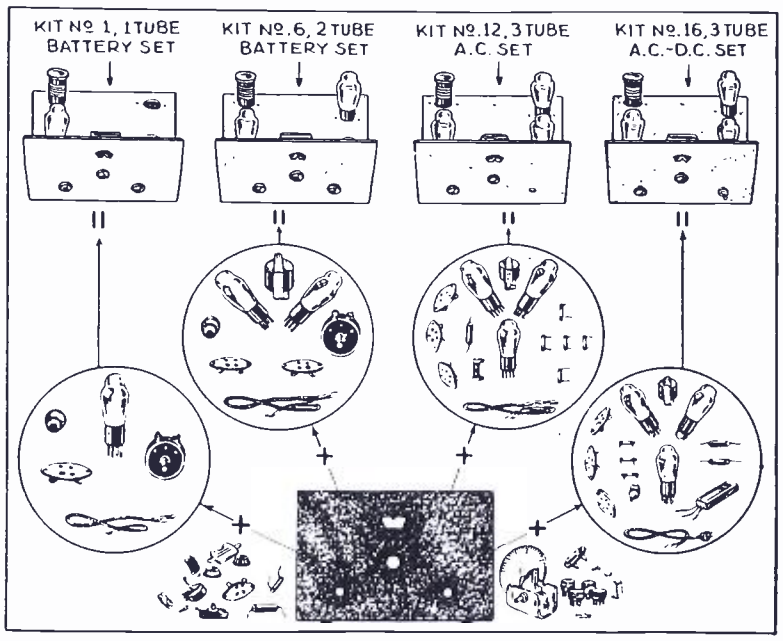
This is the plan worked out for the "foundation kit" described below. From the single chassis and kit, plus a few additional, inexpensive parts, you can choose from 17 different circuits. These include battery, A.C. and universal A.C.-D.C. circuits and all will tune over the entire short-wave band as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

Fig. 2. An idea of the flexibility of the "Multi-Set" kit can be obtained from the sketch below. Figure 1 shows 1 of the 17 basic circuits.



*President, Harrison Radio Co.

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.

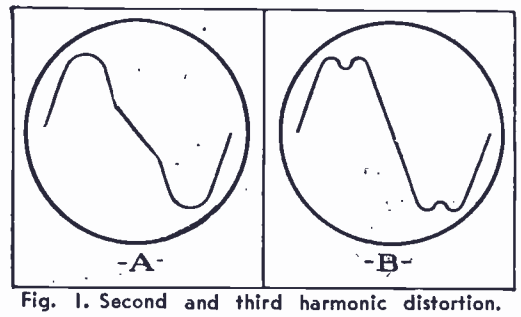


Fig. 1. Second and third harmonic distortion.

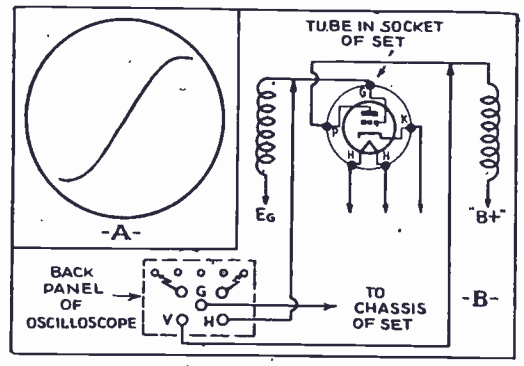


Fig. 2. The grid voltage—plate current tube curve, and circuit for tube testing.

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)

*Sales Eng., National Union Radio Corp. of N.Y.

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*

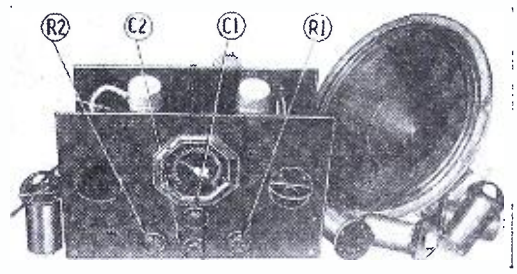


Fig. A. The receiver chassis with speaker and coils.

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 regeneration 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 equipped so 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.

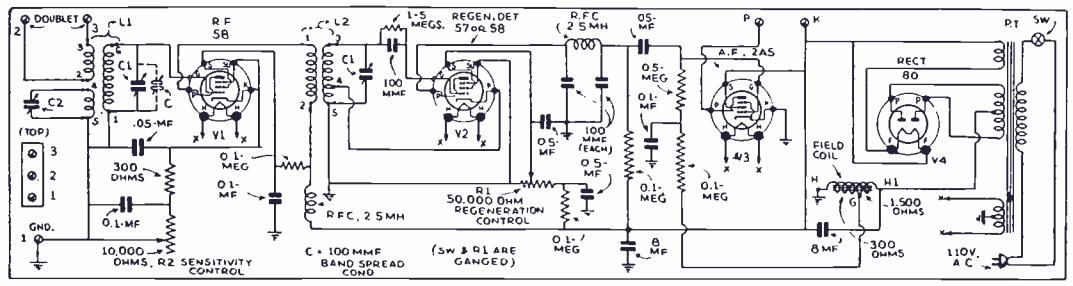
Condenser C2 and coil 4-5 of the aerial coupler constitute a trap circuit (controlled from the panel) which is useful for reducing interference and increasing the apparent selectivity of the receiver.

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.



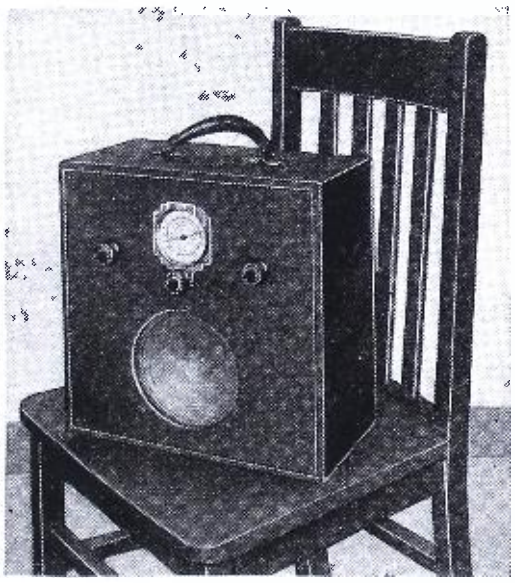


Fig. A, above. The front of the receiver showing the large-size speaker and full-vision dial.
Fig. 1, below. The circuit of the Camper's Portable Receiver. The first I.F. transformer and the oscillator coil are in the same can.

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 I.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 rattling 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 x 8¾ 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

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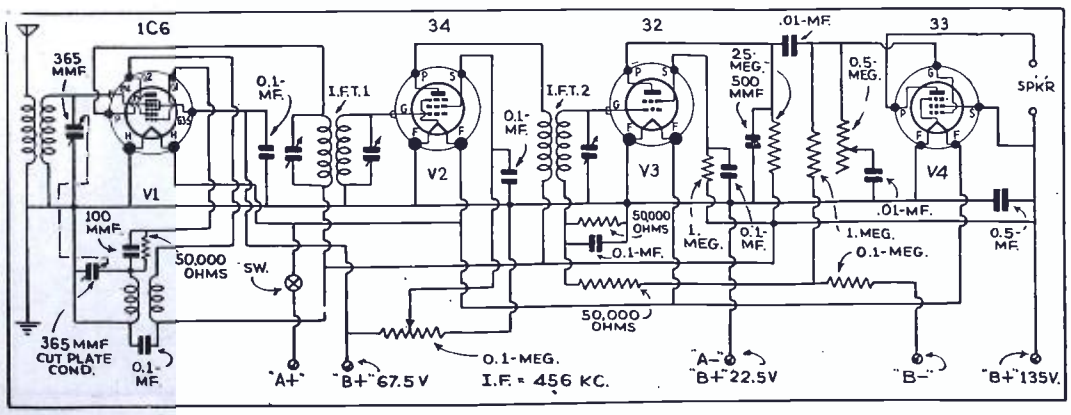
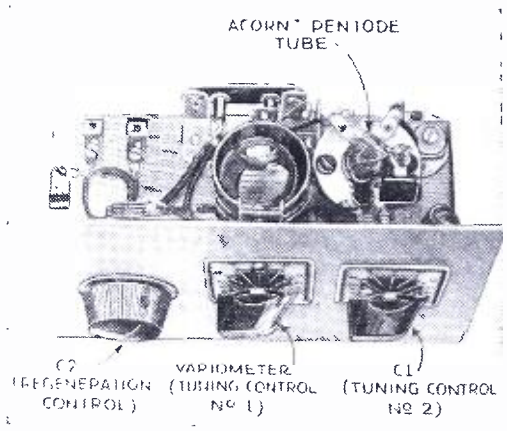
*Trymo Radio Co.





The appearance of the little "acorn" tube set looking down from the top. Note the tube mounting.

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

TRUE, the "acorn" tube is especially suitable for ultra-short-wave use, but who says it won't work swell on the 200 to 545 meter broadcast band? After hearing numerous radio men make the off-hand statement that the acorn, in both triode and pentode types, would do all sorts of strange things but operate at the broadcast frequencies, the writer decided to set up a little experimental breadboard and see what was what. The result is illustrated, in one of its experimental set-ups, in the photograph and in Fig. 1.

The pentode in the acorn series was selected for its higher sensitivity, and better matching into a resistance-capacity coupled A.F. stage. A small-size 6 V. "hot shot" battery was used 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.

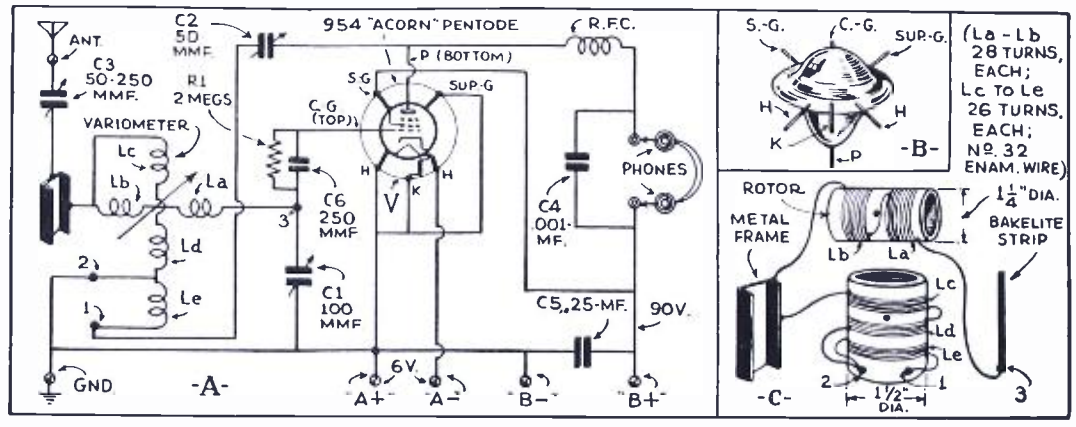
It was decided to use our old standby, the "3-circuit tuner," in a regenerative circuit. However, to avoid the continual readjusting that ordinarily is necessary when tuning from one station to another, in order to maintain regeneration, we cast around for some artifice that might solve the problem.

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 de-

(*Continued on page* 173)

Fig. 1. The circuit of the experimental "acorn tube" set.



THE DEFLECTING PLATES IN CATHODE-RAY TUBES

The author gives further details about the action which takes place inside the cathode-ray oscilloscope tube.

ALFRED A. GHIRARDI*

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.

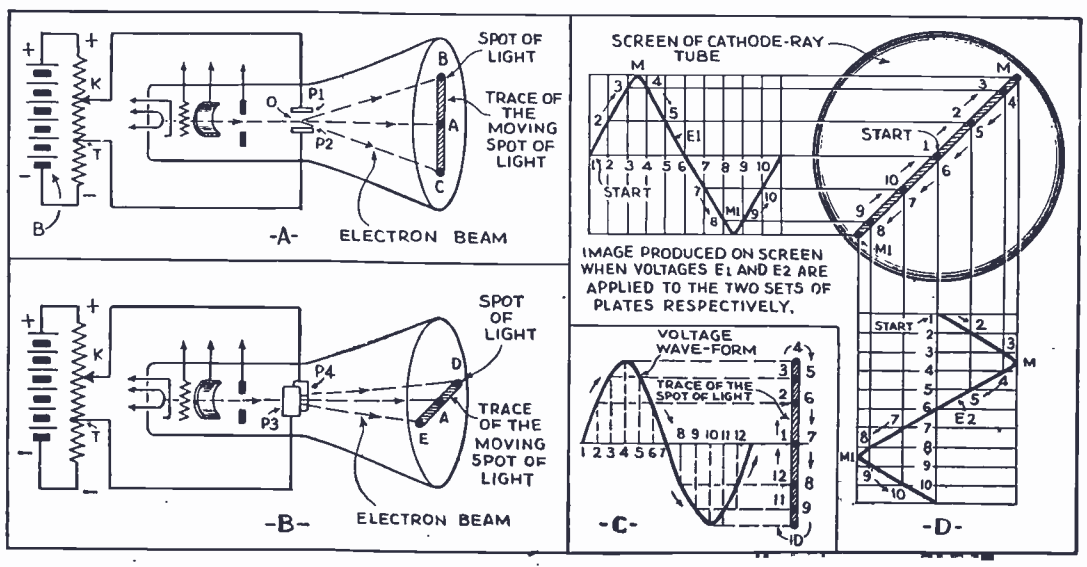
In Fig. 1A, plates P1 and P2 in one set are arranged almost parallel to each other in one plane along the axis of the tube, and are equidistant from the electron beam. They actually diverge slightly in the direction of the screen, so that even though they are mounted close to the electron beam for strong deflection control, they will not be in the way of the beam whenever it is deflected near the extreme edge of the screen. Plates P3 and P4 (Fig. 1B), constituting the second pair, are mounted at right-angles to the first pair, and are also equidistant from the electron beam.

The action of these deflecting plates upon the electron beam will now be studied. Suppose the cathode-ray tube is connected for operation and a spot of light is seen in the center of the fluorescent screen.

Now suppose that a voltage is applied to the two deflecting plates, P1 and P2, as shown in A of Fig. 1 (the other two plates are not shown here), so that Plate P1 is made *positive* and

(*Continued on page* 172)

Fig. 1. The action of the deflecting plates in detail.



*Radio Technical Pub. Co.

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.

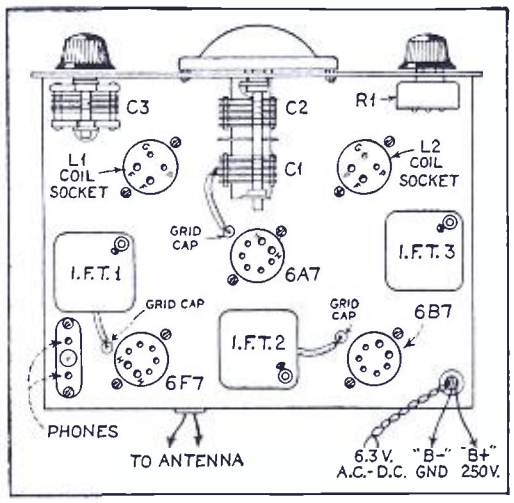
DONALD LEWIS*

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. 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.)

*Hammarlund Mfg. Co.

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

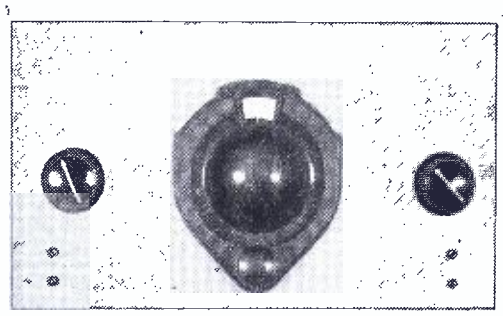


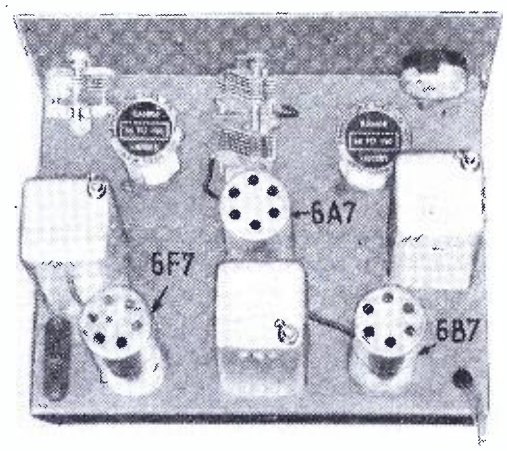
The first-detector and oscillator coils are the standard 4-prong plug-in type.

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)





The panel appearance (top) and the top view of the chassis of the set.

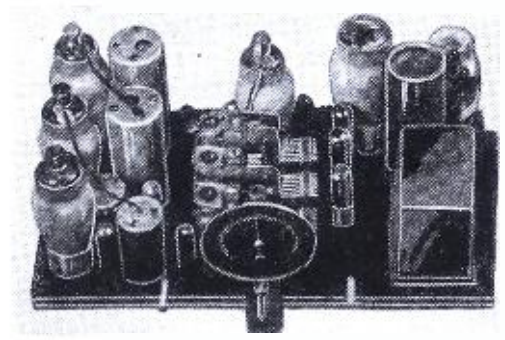


Fig. A. The laminated base can be seen here.

A NEW IDEA IN SET BUILDING

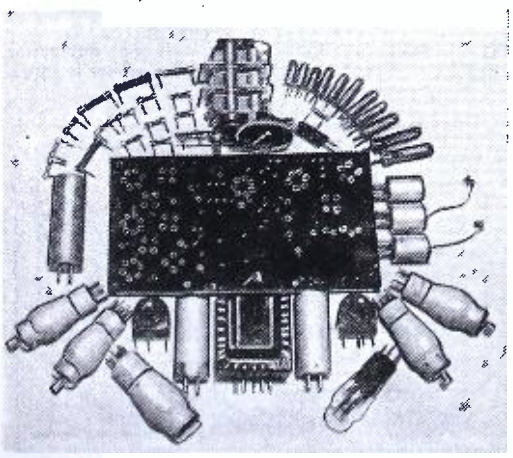
Plug-in parts and a special chassis construction eliminate servicing difficulties and facilitate set manufacture.

H. K. BRADFORD*

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 recognized 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.

*Tech. Director, Capitol Radio Res. Labs., Inc.

Fig. C. The parts are all provided with plugs to fit the eyelets in the insulated base.

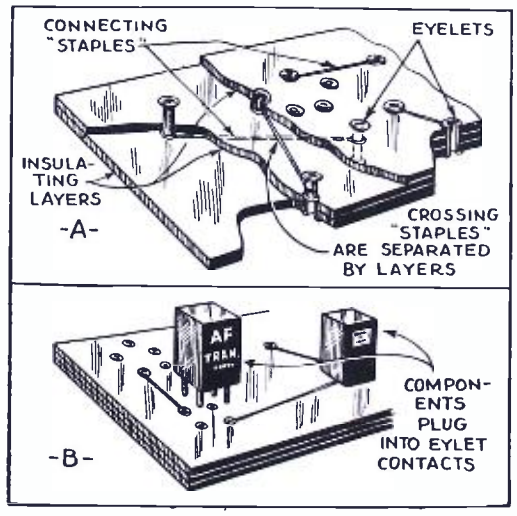


The results of his five years of research and experiment in connection with this problem have been very gratifying. Through a carefully prepared system of case records of actual service jobs he has found that a good portion of radio troubles were directly or indirectly traceable to defective wiring and 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.



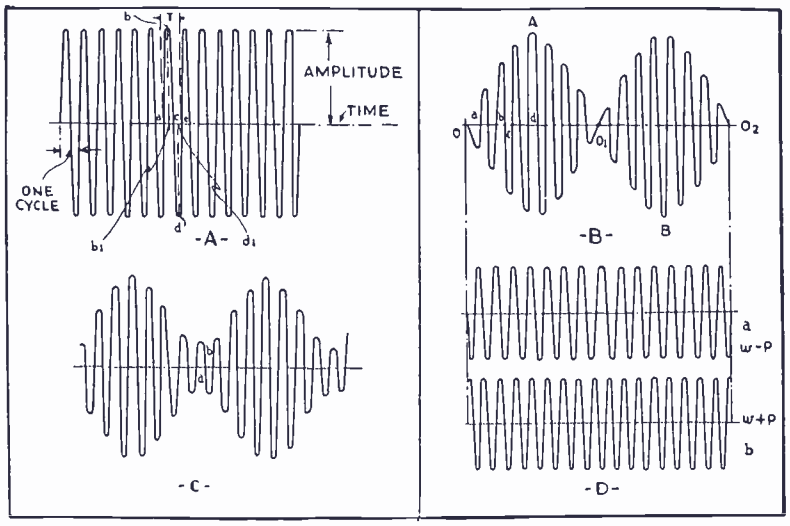


Fig. 1. The effect of amplitude modulation on the "carrier."

"FREQUENCY MODULATION" IN TOMORROW'S SET

Major Armstrong's new system of transmission which offers so many possibilities in the elimination of fading and static depends upon "frequency modulation"; explained here by the author.

M. J. CUTTLER

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 bb' at b' which corresponds to ¼ of the period T. Then it decreases gradually until it reaches zero at $\frac{T}{2}$ (point c). After that the current becomes negative and at point d', or ¾ T, reaches a maximum value dd', which is equal to bb' 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 bb' (or dd') 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 f_1 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 00_10_2. We see that during the period 00_10_2 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 0_1. 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 + f_1, and the frequency of the other is fo — f_1. The amplitude of both waves is equal to ½ the amplitude of the carrier. As an example, let us consider the case of a 1 megacycle carrier completely modulated by a 1,000 cycle audio frequency. Here fo = 1,000,000 and f_1 = 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 cur-

(*Continued on page* 176)

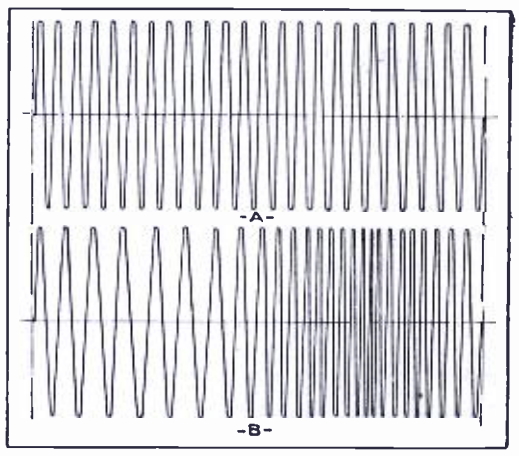
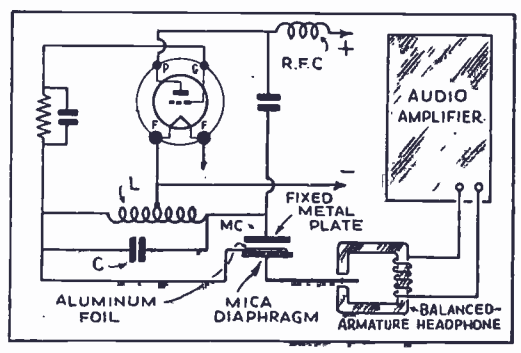


Fig. 2, above. Compare frequency modulation with amplitude modulation shown in Fig. 1.
Fig. 3, below. A simplified circuit for achieving frequency modulation; the practical method is much more complex.



A NEW HI-FIDELITY "TWIN AMPLIFIER"

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

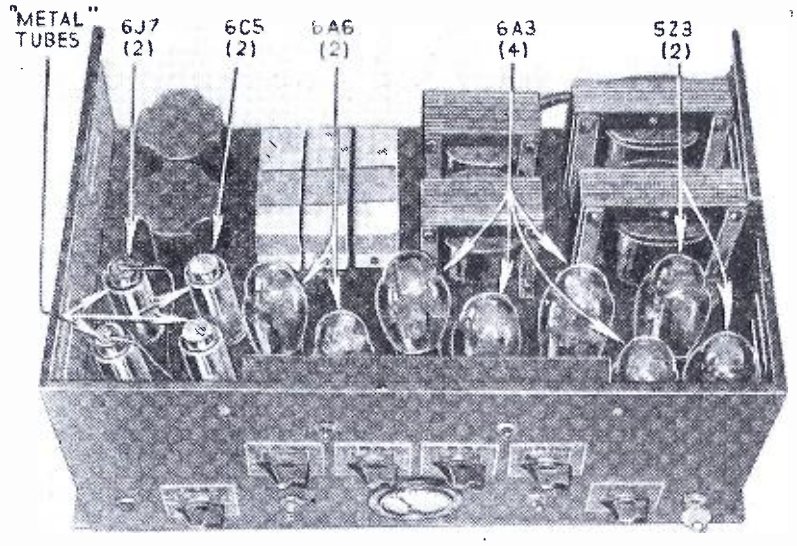
CHARLES R. SHAW*

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 cost, 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.

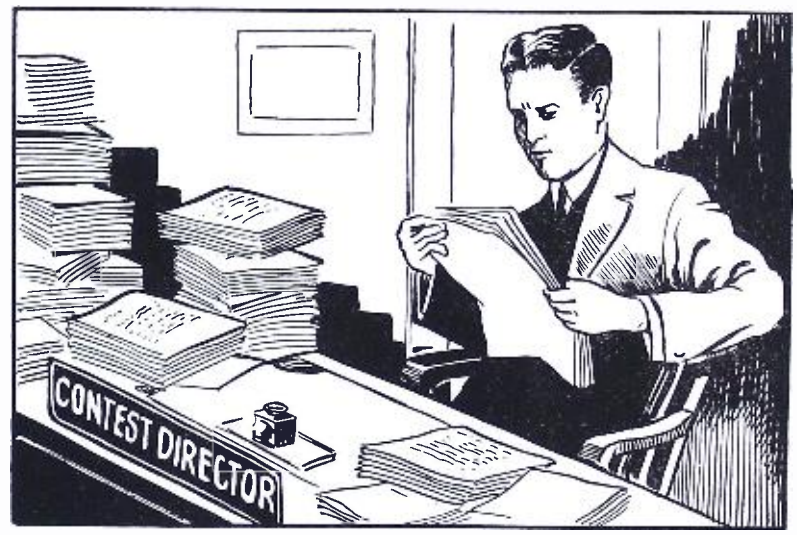
The secret of the unusual dependability of the amplifier illustrated in Figs. A and 1 is the twin-channel arrange-

(*Continued on page* 177)

*Design Engineer, Columbia Sound Co., Inc.

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.

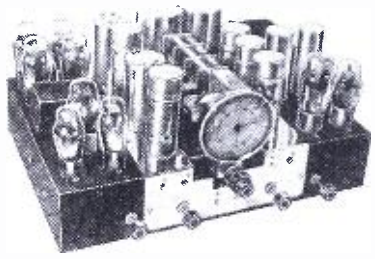
The following are the names of 25 letter writers with prize winning possibilities—received before this magazine went to press. Understand, these names and addresses are *not* necessarily those of prize winners, but are merely those of contestants whose letters are of high calibre (in accordance with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

Melvin Gardiner, 928 Hollywood Ave., Salt Lake City, Utah.
T. J. Preston, 4121 Sonoma Ave., Sacramento, Calif.
Becker Radio Service, Grand Ledge, Michigan.
Allen Shiavoni, 2014 South 13th St., Philadelphia, Pa.
Max Andress, 300 E. Virginia Ave., Peoria, Illinois.
Clifford Warner, 109 Paul Street, Coffeyville, Kansas.
J. Asheld, 54-45 65th Place, Maspeth, N.Y.
John W. Rittenour, 126 N. Center St., Martinsburg, W.Va.
Clarence J. Noel, 1356 Worcester St., Indian Orchard, Mass.
Vernon F. Turnage, 207 N. Clements St., Gainesville, Tex.
Louis Blevins, 1510 N. 11th St., Vincennes, Indiana.
Don Foreman, Bedford, Iowa.
Straughan Radio Service, W. C. Straughan, 540 Marigold St., Rocky Mount, N.C.
Rogan Shannon, New Albany, Mississippi.
J. M. Krechniak, Ozone, Tennessee.
T. J. Wilson, 150 Nottingham St., Plymouth, Penn.
Allen B. Dungan, Dungan Engineering Co., 1000 N. Wyoming Ave., Forty Fort, Penna.
Arthur Connerly Jr., The Radio Service Shop, 1000 N. 4th St., Little Rock, Ark.
Leo J. Draus, 155 Cotton St., Manayunk, Philadelphia, Penna.
W. J. Ryan, 1053 Bryant Ave., New York City, N.Y.
Joel O. Dillon, P.O. Box 958, Teague, Texas.
Robert C. Hannum, 512 Hannibal St., Fulton, N.Y.

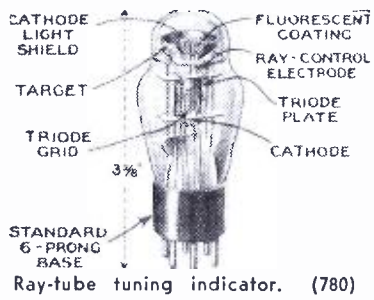
(*Continued on page* 178)

THE LATEST RADIO EQUIPMENT

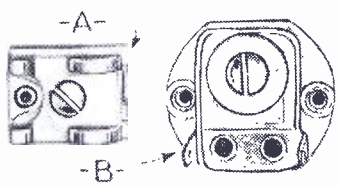


High fidelity on all-waves. (778)

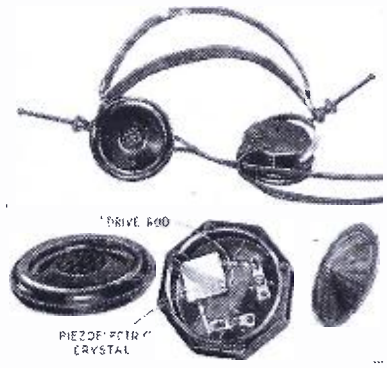
High-efficiency components. (779)



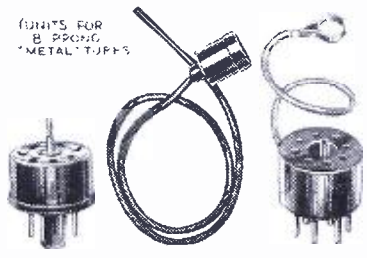
Ray-tube tuning indicator. (780)



Improved trimming condensers. (781)

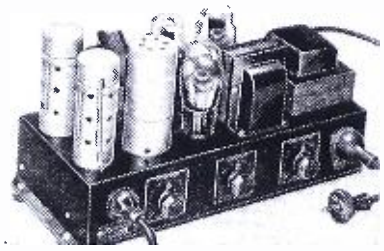


Above, high-fidelity phones. (782)

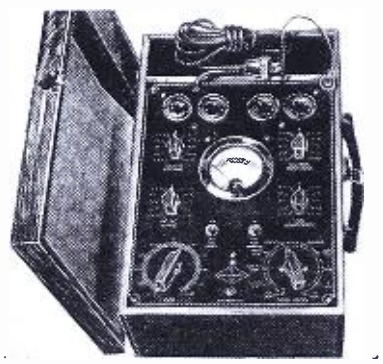


Units for metal tubes. (784)

Tester for metal tubes. (785)

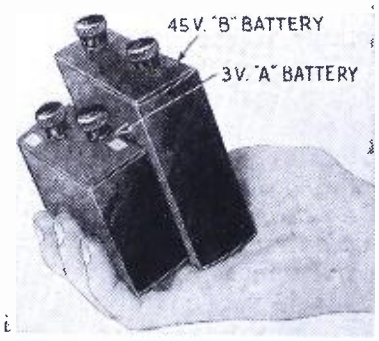


Multi-purpose amplifier. (786)



Above, this analyzer shakes tubes. (787)

Left, the 6A3 improved power tube. (783); right, the smallest "B" battery yet developed—and a new "A." (788)



14-TUBE ALL-WAVE SET (778)

A FEATURE of this powerful radio receiver (with wavelength 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.F. and I.F. circuits, including the second-detector and A.V.C. Thus this section of the set floats 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.

ULTRA-HIGH FREQUENCY PARTS (779)

(Hammarlund Mfg. Co.)

A 5-SECTION choke wound on isolantite is illustrated; the inductance is 2.5 mh. It is effective to below 2½ meters. The "acorn"-tube socket is of moulded ceramic. A stud prevents incorrect insertion.

CATHODE-RAY TUNING TUBE (780)

(RCA Manufacturing Co.)

VISUAL indication of correct tuning in receivers is made practical by this tube. It is a heater-cathode type of high-vacuum tube. Correct tuning is indicated by the change of light on a fluorescent target. (See "Cathode-Ray Tuning Indicator," page 527, March, 1934 *Radio-Craft*). Filament, 6.3 V.; 0.3-A. Plate, 200V.; 0.2-ma. Target, 200V.; 4 ma.

CERAMIC-BASE TRIMMER (781)

(Solar Mfg. Co.)

A NEW trimmer has been designed to prevent drifting, and permit more accurate aligning of sets. Capacity ranges of one model (A) are 30 to 180 mmf. (maximums); this type is adapted to support by the wiring of the set. Ranges of unit B are 70 mmf. to 1,600 mmf. (maximums).

"HIGH-FIDELITY" HEADPHONES (782)

THESE headphones, which operate on the piezoelectric principle (see *Radio-Craft*, July, 1932), have these features: light weight (6 ozs.); 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 (783)

(Hygrade-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.

The type 6A3 tube has also been announced by Raytheon Production Corp.

NEW TESTING EQUIPMENT AIDS (784)

(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 (785)

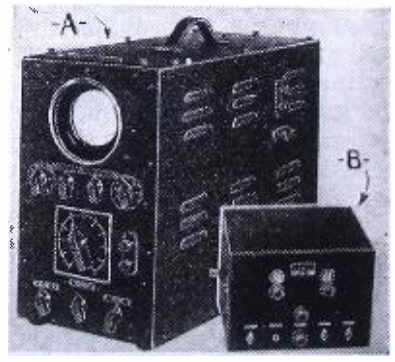
(Radio City Products Co.)

IN ADDITION to readings for the usual tube short, emmission, and leakage tests, etc., the 5 in. fan-type meter is calibrated for con-

(*Continued on page* 189)

Valuable ray-tube adjunct. (789)

Ray-tube set analyzer. (790)



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.

RADIO-CRAFT receives hundreds of magazines from all parts of the world. Since the cost of subscribing to each of these would be prohibitive for most radio men, we have arranged with technical translators to prepare reviews for our readers.

INTERNATIONAL RADIO REVIEW

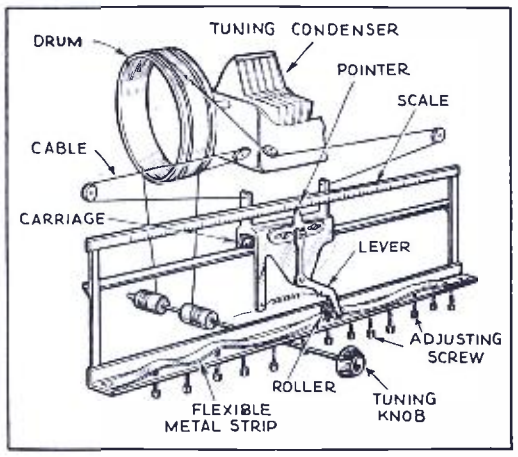


Fig. 1
An adjustable calibration dial which produces accurately calibrated sets.

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 PERMEABILITY TUNER

THE TREND, both in the U.S. and in Europe toward the manufacture of complete tuning units for set builders is evident from the recent units which have made their appearance.

Practical and Amateur Wireless described, in their latest issue, a new dual-wave tuner using "permeability"-type coils which are tuned by sliding the "iron" cores in and out of the paper forms on which the wire is supported.

It is claimed that these coils are wound by special methods which take full advantage of the nodal points, thus producing greater selectivity and sensitivity over the band covered.

The complete tuner, covering two bands—180 to 600 meters, and 800 to 2,000 meters—is only 4½ x 3½ x 1 in. deep. It is shown in Fig. A.

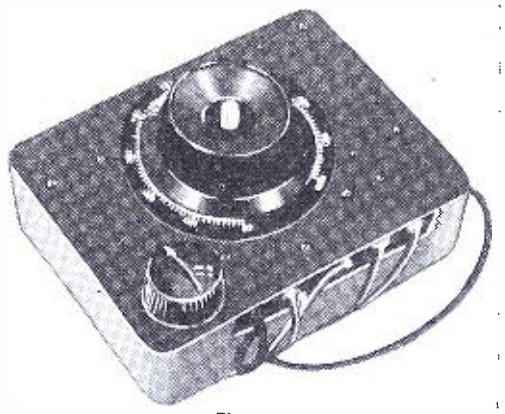


Fig. A
A permeability-type tuner unit which facilitates the construction of radio sets.

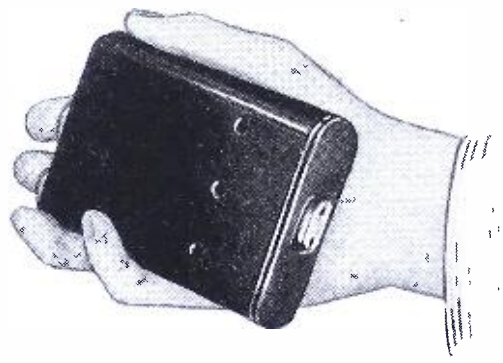


Fig. B
A 3-cell battery of the "Gordon" type.

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 parellel 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)

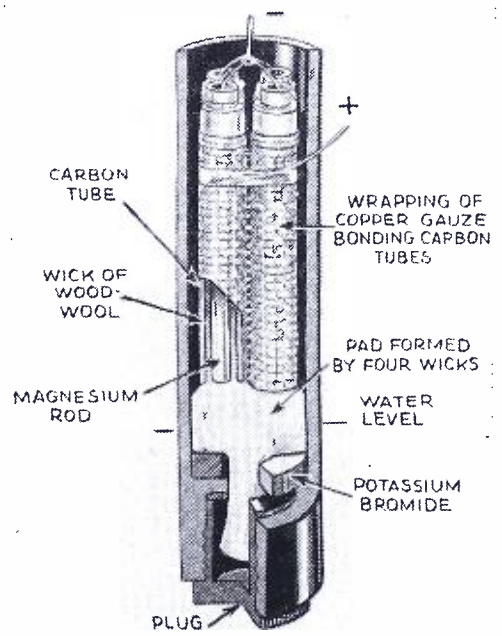


Fig. C, above
The interior of one cell of the battery, showing the unusual construction.

Fig. D
This wattmeter is designed for radio work—in repairing or selling receivers.

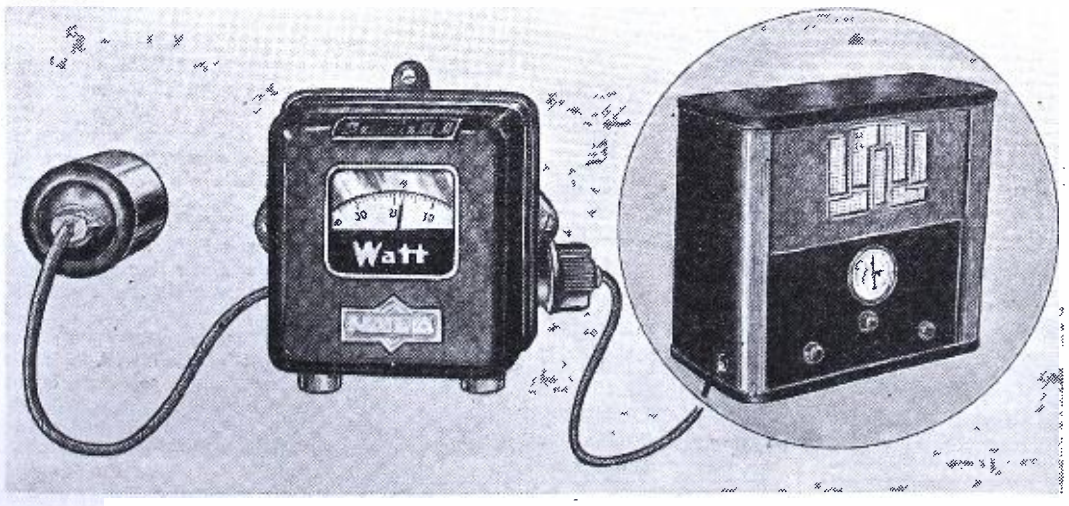
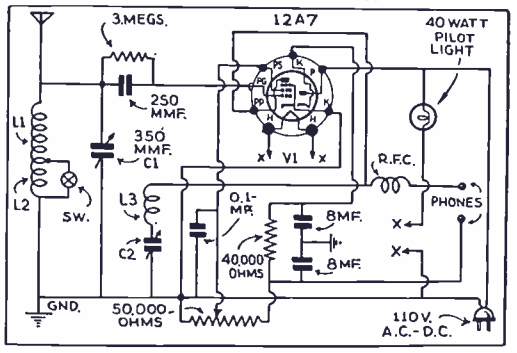


Fig. 2, below
A French set using the 12A7-type tube.



SHORT-CUTS IN RADIO

FIRST PRIZE	$10.00
SECOND PRIZE	5.00
THIRD PRIZE	5.00

Honorable Mention

EXPERIMENTERS: Three cash prizes will be awarded for time- and money-saving ideas. Honorable mention will be given for all other published items. Send in your best "kinks"!

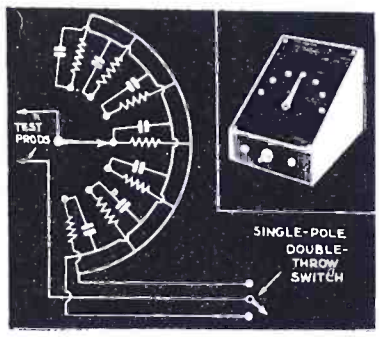


Fig. 1
This dual comparison tester uses the very minimum of equipment.

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 .005-mf. to 8 mf. 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.

DAVID CERVANTES

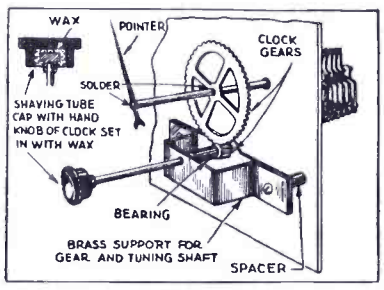


Fig. 2
A home-made airplane-type dial.

SECOND PRIZE—$5.00

CLOCK-GEAR VERNIER DIAL. By using a couple of clock gears, strips of brass, battery wax and a shaving-tube cap, a fairly serviceable tuning control can be fashioned to resemble an airplane dial, as shown Fig. 2.

In the event that the condensers have a bakelite frame and the rotor is grounded, it will be necessary to ground the brass strips, as the latter will change the capacity of the condenser slightly. Also the gears make a poor electrical connection. Wherever possible it is best to make connections by means of pigtails.

If plastic wood is available it will make a more firm bond for the shaving-tube cap to the shaft. The easiest way of mounting the pointer is to solder it on to the upper shaft.

JAMES M. GORDON

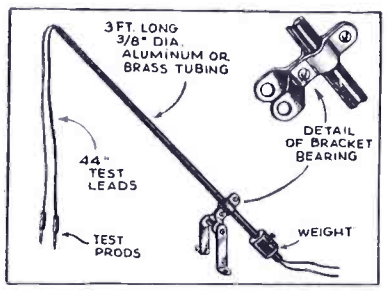


Fig. 3
This keeps the leads from tangling.

THIRD PRIZE—$5.00

KEEPING 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.

The test cords are 3 ft. in length and fastened to the end of a 3 ft. x ⅜-in. tube which is supported on an angle bracket formed to make a bearing for a ¼-in shaft which is set horizontally 44 ins. above the service bench. The weights are discs from an old RCA or Westinghouse disc rectifier. Add discs to the arm until the weight is sufficient so that the arm and cord will remain stationary to whatever the position the leads are brought.

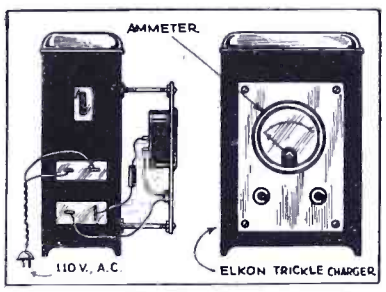
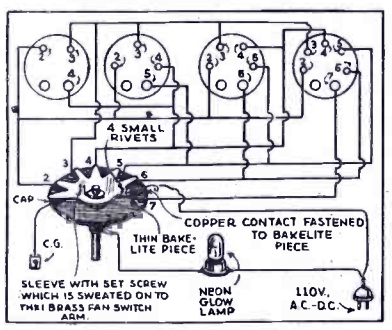


Fig. 4, above
A low-range ohmmeter.

Fig. 5, below
Simple tube-short tester.



In other words, the leads are used for balance. A stop is provided so that the arm returns to the same position at all times. The device is inexpensive to build and will pay any Service Man dividends.

R. F. STEWART

HONORABLE MENTION

A GOOD, CHEAP, LOW-READING OHMMETER. By using a trickle charger in series with a 0-1 ammeter and a resistor, it is possible to read quite accurately, resistances from 0 to about 300 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.

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

LOUIS B. PASCAL

HONORABLE MENTION

A TUBE "SHORT" TESTER. This is a worthy addition to any tube testing equipment, and is very simple to make 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, with is connected to the circuit with a flexible lead.

In operation, the switch arm is revolved rapidly over the contacts, a short showing up by a flash of the neon bulb.

A. E. ELLISON

HONORABLE MENTION

DETERMINING POWER CONSUMED. For the Service Man, experimenter or amateur a means of accurately determining the power in watts consumed by any electrical apparatus, radio receiving set or transmitter, which derives its power from the usual alternating current power lines, is very often beyond the range of available test equipment, due mainly to the expense involved in securing an accurate A.C. wattmeter.

In order to determine the power or watts input to any electrical equipment where a wattmeter is not available, the service kilowatt-hour meter which is provided for ultility customers can be used. Connect the unit to be checked to the source of supply, being very sure that it is the only equipment connected to the load side of the meter. Next count the number of revolutions made by the meter disc. Next determine the meter disc constant. This will be found on the nameplate.

After determining the meter disc constant and the number of revolutions per minute, it is only necessary to apply the following formula: Revolutions per minute x basic constant x 60 = Load in watts.

The basic constant is usually found on the name plate of the meter. Some of the constants watt-hours-per-revolution of the more commonly used meters follow:

General Electric—0.3
Westinghouse—⅓
Duncan—¼
Sangamo—5/24

These are all 60-cycle, single-phase meters of the basic 5 A., 115 V. 2-wire type. For 220 volt meters, the constant is doubled, while if it has a higher current rating, such as 10, 15, or 25 amperes, the rating is doubled, tripled, etc. Where instrument current transformers are used with a meter on larger installations, the result, after solving the formula must be multiplied by the transformer ratio.

A power rating in D.C. watts is figured the same way.

A. E. FRENCH

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

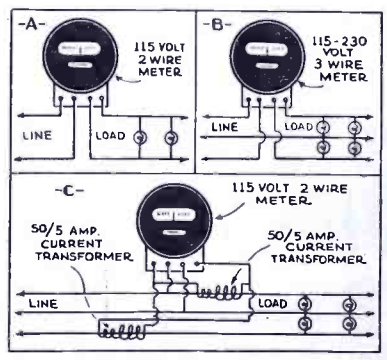
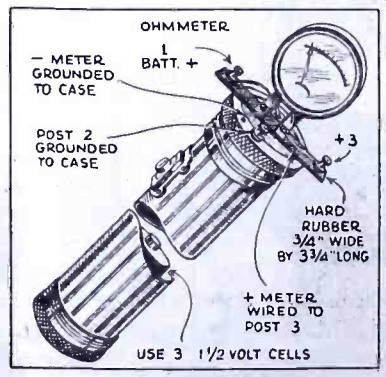


Fig. 7, below. A flashlight ohmmeter.



HONORABLE MENTION

FLASHLIGHT OHMMETER. This handy instrument is made from a 3-cell flashlight case. The lens and reflector are removed and a disc of hard rubber fitted in the end of the case. The meter brackets and the binding posts are mounted on the rubber. Posts 1 and 3 are used for resistance and continuity: 1 and 2 give 4½ V. for "C" battery use. Posts 2 and 3 enable the meter to be used for reading up to 4½ V.

(NO NAME GIVEN)

HONORABLE MENTION

PANEL ENGRAVING. For the experimenter who has no facilities for the regular type of engraving, it is possible to get good results at practically no cost as follows: take ordinary painter's white lead and mix white shellac with it to the proper thickness. Using a sharp pointed instrument, apply the mixture to the panel as required. If you desire to re-engrave, simply apply some plain shellac and wipe the panel clean. This type of "engraving" gives a very good appearance on test sets and the like and best of all, the mixture will not come off, even under hard use. The handier the builder is at engraving, the nicer the finished job will look. It may be necessary to experiment with the mixture to get a consistency which will flow properly and yet not be too thin.

ERIC ERICKSON

"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

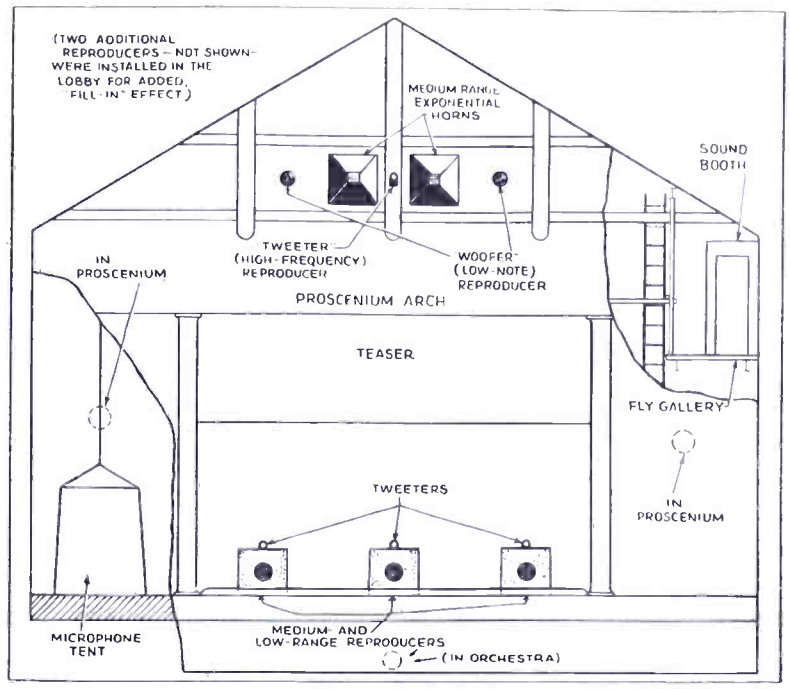


Fig. 1
Pretentious set-up for controlled sound.

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.

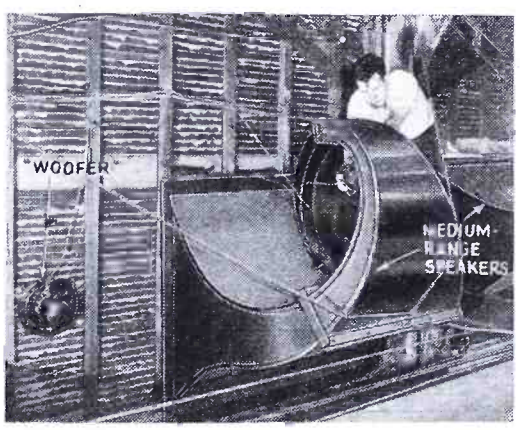
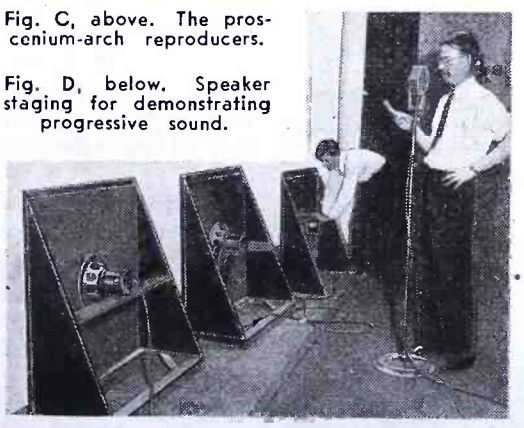


Fig. C, above. The proscenium-arch reproducers.

Fig. D, below. Speaker staging for demonstrating progressive sound.



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)

Fig. A
Three mute performers appear lost in thoughts while the audience listens to those of the minister.

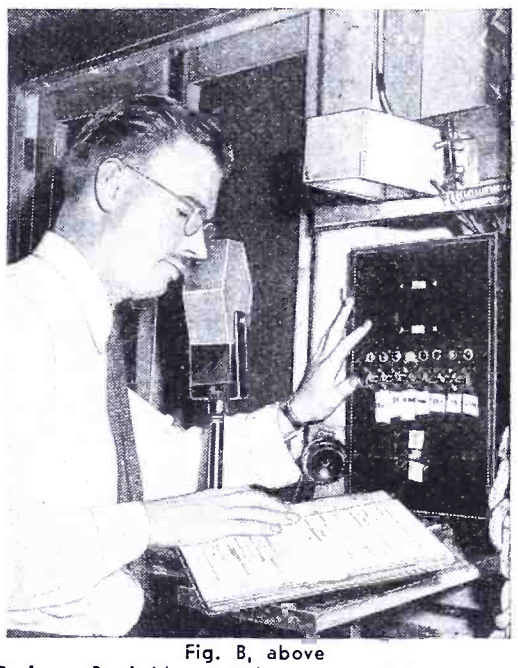
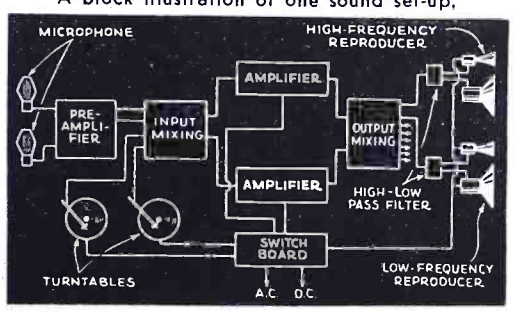


Fig. B, above
Professor Burris-Meyer at the controls of the monitor control board in the Stevens Institute theatre.

Fig. 2, below
A block illustration of one sound set-up.



READERS' DEPARTMENT

A department in which the reader may exchange thoughts and ideas with other readers.

"DOLLAR DISTANCE GETTER"

Editor, RADIO-CRAFT:

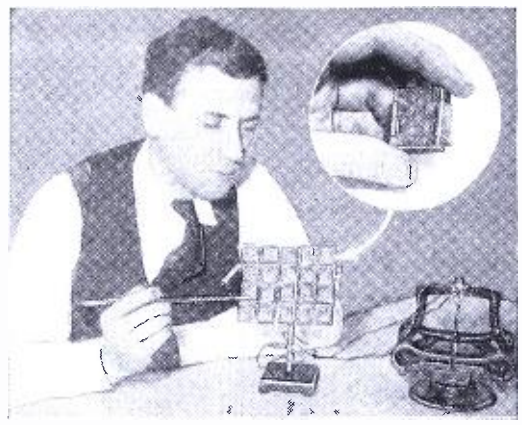
Tell Hugo his "distance getter for a dollar" got XEPN, the Pacific Coast, Denver, Salt Lake City, etc. *But* to make 'er tune right I had to cut ¼" off sides of variable condenser. I also had to use insulated guide strips—the tin strips made 'er howl like a Blackfoot Injun.

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.



An electric motor powered directly by sunlight, and believed to ante-date the "sun motor" illustrated on page 582 of the April issue of RADIO-CRAFT, was completed some months ago by J. Thomas Rhamstine, Detroit experimenter in photo-electricity. This photoelectric device is illustrated above.

For hours at a stretch, a rotating armature, 4 ins. in diameter and weighing only 3 ozs., spins in a sunny window of Rhamstine's laboratory.

The output of a total of 20 light-sensitive cells (a single cell is shown in the close-up view-insert) is used to drive the motor illustrated on this page.

"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.

Frankly, 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,
G. E. Gustafson, Eng. Dept.

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., ¼-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 .8-ma. and in making this change the plate current does not exceed this value.

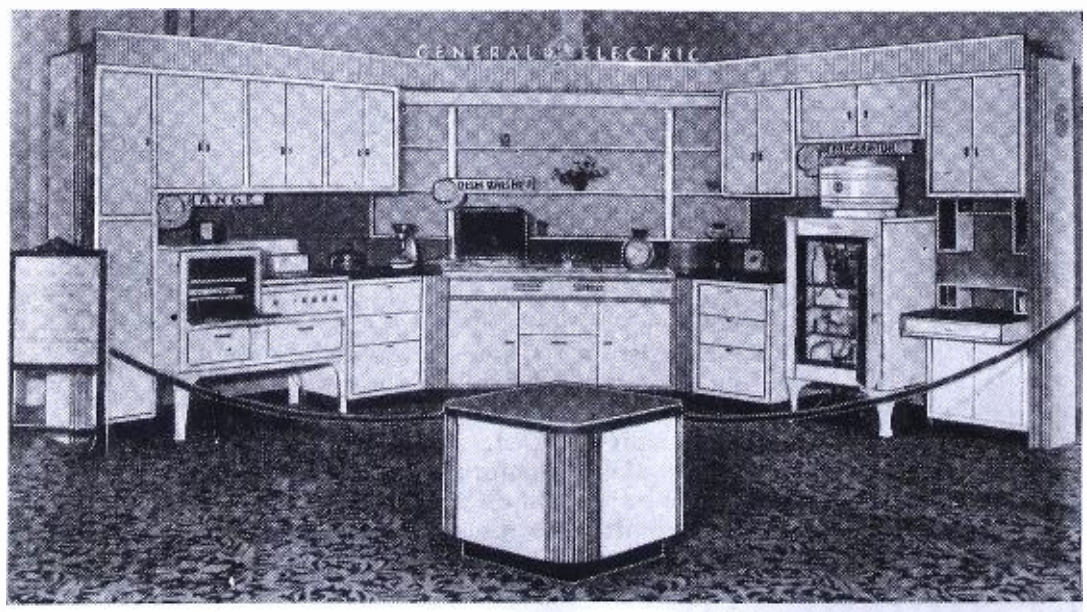
We have made this change in about fifty of these receivers and have not as yet had any complaints on the sets but have numbers of the sets sent in to have this change made, alone.

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.

A new and even more ingenious version of the famed "Talking Kitchen" shown for two years at the Century of Progress is illustrated below. This modern kitchen is completely equipped with electrical appliances that speak up and proudly point out their individual advantages and special features.

The four "voices" of the commentator (who introduces the devices), refrigerator, range and dishwasher all are made on one standard disc recording. A special automatic repeat mechanism resets the pickup to the "start" position at the end of the recording. (This is a G.E. development.)



"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 spark-plug suppressors in the June *Radio-Craft*.

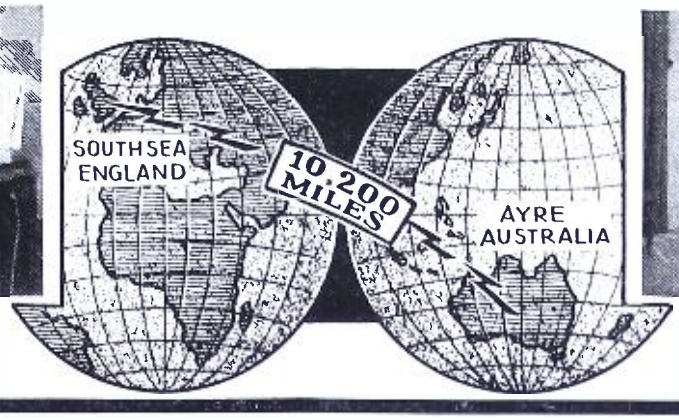
Having been engaged in Aeronautical Engineering for a number of years, and for four years assigned to radio ignition

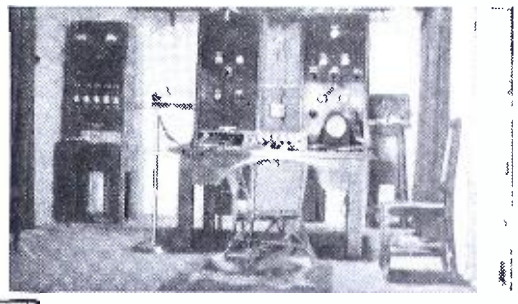
(*Continued on page* 179)

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.

A group of Tibetan Lamas who heard a radio receiver for the first time at the home of T. E. Plewman at Chengtu, China. The very interesting story here tells of their reactions.

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 k.c. 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, so for 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

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, *Daventry*, and *Deesen*. 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 Coloniale*, 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 waver'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 Reykjavik'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.; TFN 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

THE PURPOSE OF THIS DEPARTMENT

It is conducted especially for the professional Service Man. In it will be found the most unusual troubles encountered in radio service work, written in a practical manner, by Service Men for you.

Have you, as a professional man, encountered any unusual or interesting Service Kinks that may help your fellow workers? If so, let us have them. They will be paid for, upon publication, at regular space rates.

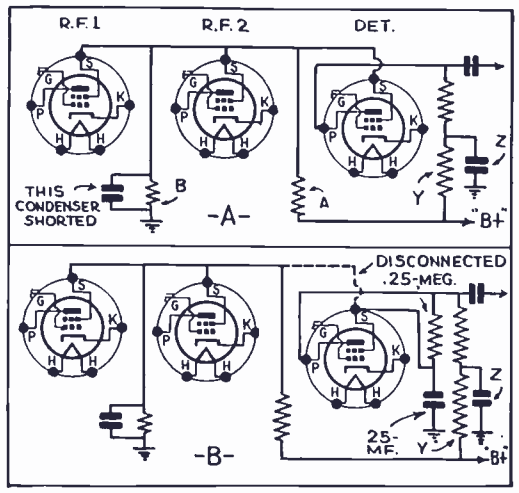


Fig. 1. Several repairs for the Crosley 58. Resistors A and B were burned out.

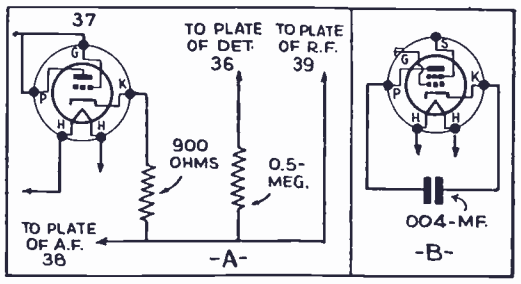
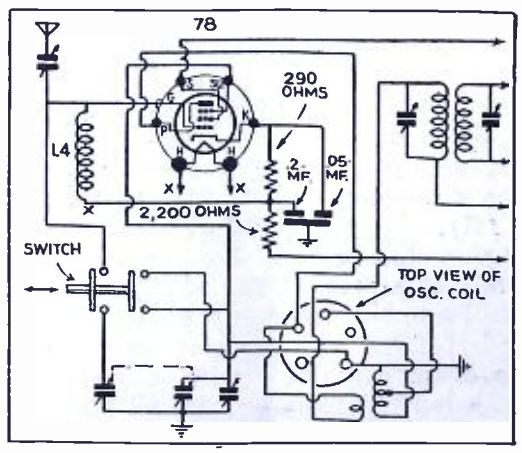


Fig. 2, above. Climax and Emerson notes. An open plate resistor at A and defective condenser at B cause trouble.

Fig. 3, below. Trouble is caused by a loose wire at X in Sparton 57s.



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)

MEMBERS' FORUM

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION, INC.

A department devoted to members and those interested in the Official Radio Service Men's Association. It is the medium for exchanging ideas, kinks, gossip and notes of interest to Service Men, or others interested in servicing.

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 ⅛-in. rod. If the band-spread condenser has a ¼-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. Baptiste. 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 Fords and on one, the 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.

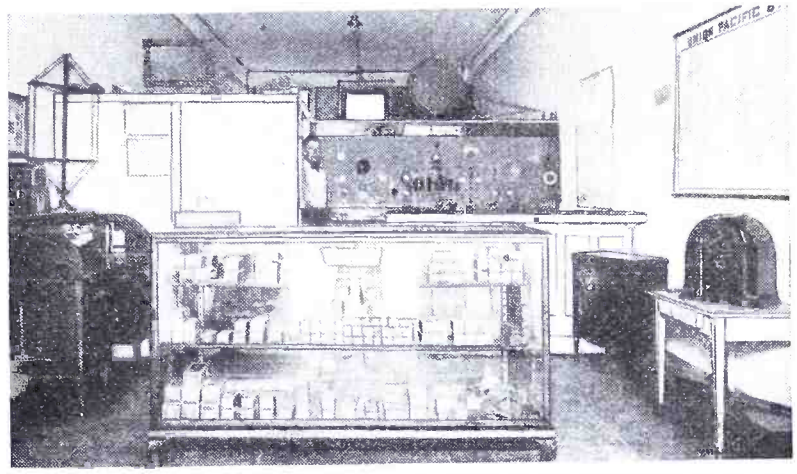


Fig. A. A neat service shop in Hollywood, Calif. It is operated by C. Llewellyn, who is shown at the rear of the shop alongside the large testboard. In the front of the shop is a large show case for tubes and accessories. Next is the service counter which separates the customer from the service bench and test equipment. We hope Llewellyn, who is an "Old Timer," will send us a close-up of the test board.

Welcome to the "Forum" Mr. Hearne. We are always pleased to hear from our "old" readers. Send along any ideas that you might have.

RCA-VICTOR "PORTETTE" SUPERHET.

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 ⅛-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)

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

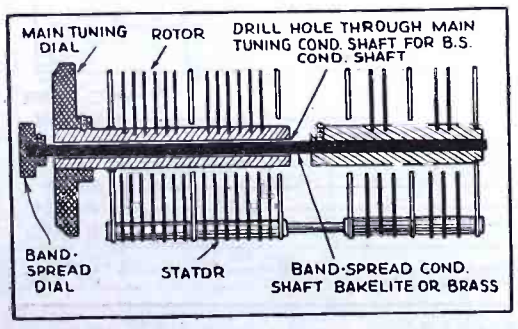
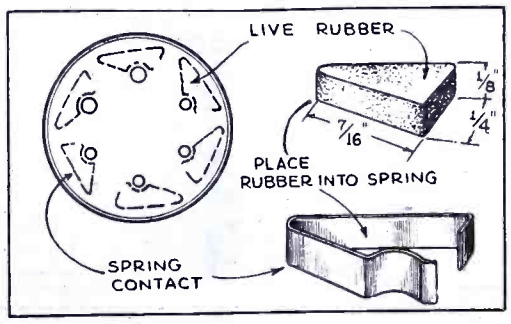


Fig. 2. Reinforcing springs in M-116 connector.



RADIO-CRAFT'S INFORMATION BUREAU

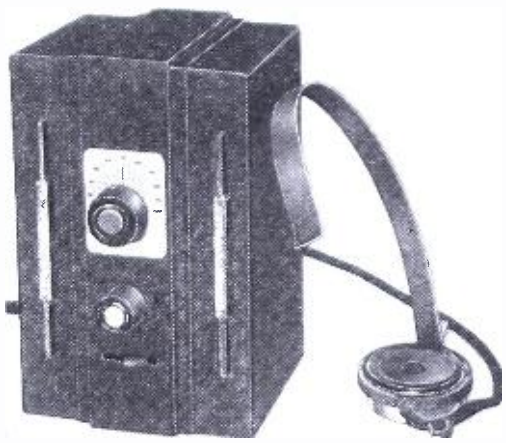


Fig. Q. 335 A
Front view of 1-tube power line set.

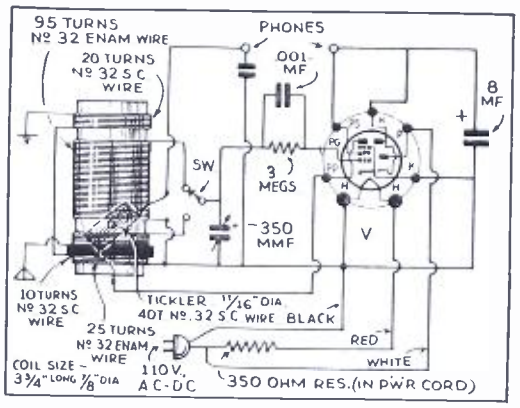


Fig. Q. 335 B
Notice that the single tube contains two sections.

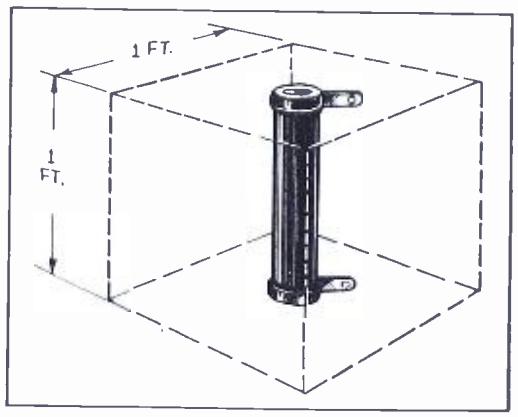


Fig. Q. 336
Conditions for normal resistor watts ratings.

ONE-TUBE A.C. SET

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

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

(A.) The development of the 12A7 tube made possible the development of the "Radiart Jr.," the circuit diagram of which is shown in Fig. Q.335B; Figs. Q.335A and Q.335C show the front and chassis side views of this simple regenerative 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.

(Q.) Will you please let me know how the watts ratings of resistors are figured. I have had some trouble with resistors over-heating 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 the midget 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.

(Q.) I wish to experiment with a superheterodyne 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.337B. 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 C3, 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

SPECIAL NOTICE

Those questions which are found to represent the greatest general interest will be published here, to the extent that space permits. (At least 5 weeks must elapse between the receipt of a question and the appearance of its answer here.) Mark such inquiries, "For Publication."

Replies, magazines, etc., cannot be sent C.O.D. Back issues of *RADIO-CRAFT* prior to December, 1932. are available at 50c per copy; except the following issues: 7/29, 1, 2, 3, 4, 6, 7, 9 and 11/'30; 5, 8 and 9/'31; and 7/'33, which are out of print. Succeeding issues are still available at the regular price of 25c per copy.

Inquiries to be answered by mail MUST be accompanied by 25c (stamps) for each separate question; answers are subject to subsequent publication if considered of exceptional interest.

Furnish sufficient information (in reference to magazine articles, be sure to mention issue, page, title, author and figure numbers), and draw a careful diagram (on separate paper) when needed to explain your meaning; use only one side of the paper. *List each question.* Be SURE to sign your name AND address.

Enclose only a STAMPED and self-addressed envelope for names and addresses of manufacturers; or, in connection with correspondence concerning corrections to articles, as this information is gratis.

Individual designs can be furnished at an additional service charge. The fee may be secured by addressing the inquiry to the SPECIAL SERVICE department, and furnishing COMPLETE specifications of desired information and available data.

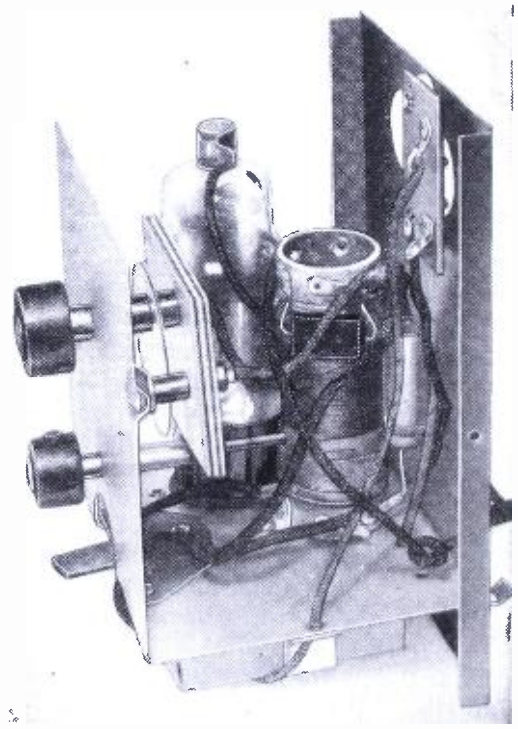
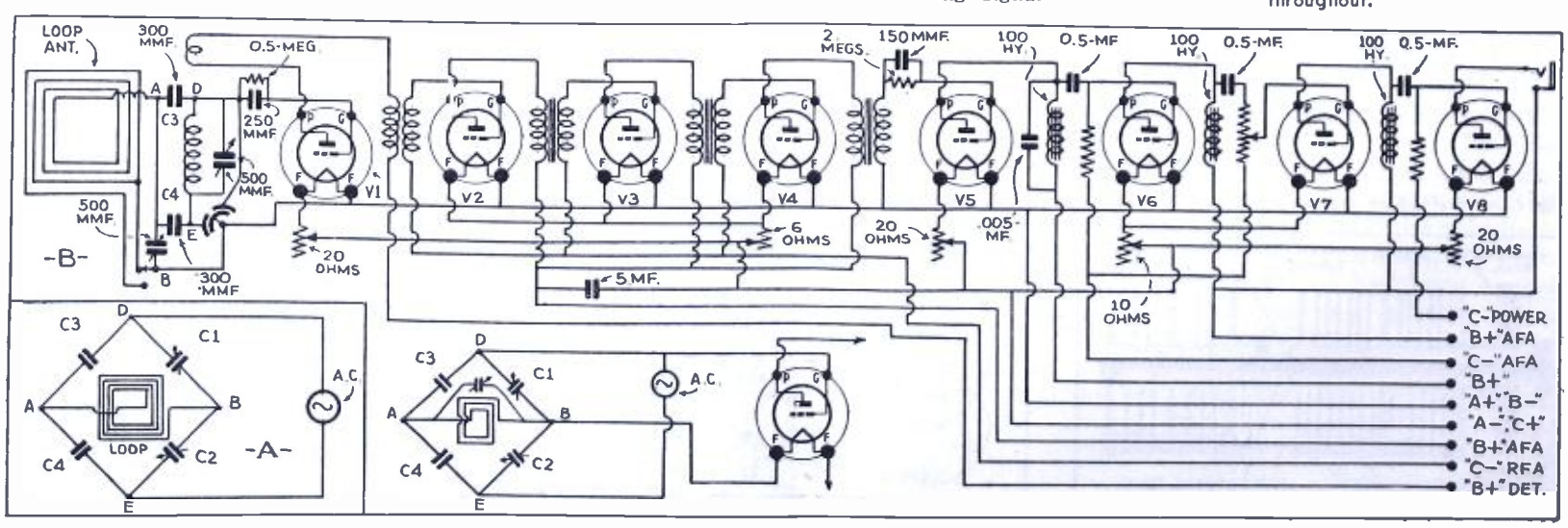
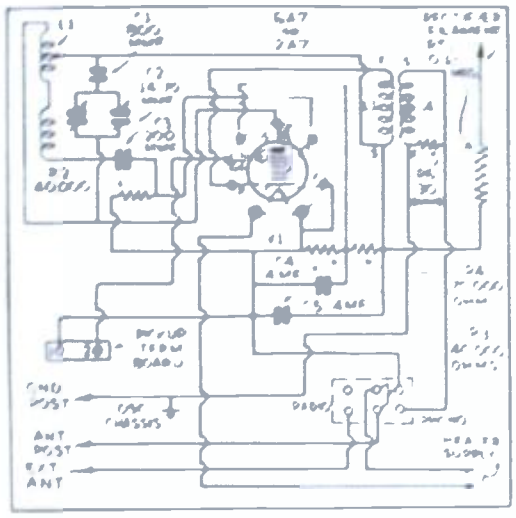


Fig. Q. 335 C, above
Chassis of single-tube A.C.-D.C. set.

Fig. Q. 337, below
The Pressley superheterodyne, using triodes throughout.





will induce a voltage in the loop which will be communicated to the oscillator tube, the latter also acting as the detector tube.

(This Frosley circuit incidentally is utilized in the tube midget super chassis elsewhere in this issue.)

PHONOGRAPH ADAPTER

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

(Q.) I would like to attach a phonograph to my RCA radio set, but there is no provision on the set for such use and I hesitate to undertake any circuit changes. Is there any sort of accessory to be used without changing the set in any way?

(A.) Since the particular set number is not mentioned we cannot give any specific information as to a possible connection of a phonograph pickup.

However, the RCA phonograph oscillator has been developed for just such cases since it can be used on practically any A.C. radio set and without any circuit changes in the set itself. (See also, "How to Make a Novel, Portable A.C.-D.C. Phonograph Attachment," *Radio-Craft*, April 1934.) The oscillator is a miniature broadcasting station, which is modulated by the phono pickup, so the quality of reproduction is equivalent to that of the best nearby local broadcaster. The oscillator or adapter as it is usually called, derives its power from the broadcast set, through the medium of three clips which can be fastened to tube prongs in the set. The only other connections are to the pickup and to antenna and ground which connections are very simple and entail no actual changes in the set itself. A self contained switch makes it possible to shift instantly to either regular radio reception or to the phono. pickup.

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

TRANSMITTER BLEEDER RESISTORS

(339) Mr. R. F. Pasquale, Havana, Cuba.

(Q.) I would like to know whether there is a simple general formula for designing bleeder resistors for transmitter and, in fact, all general power supply work.

(A.) Bleeders for power supplies are usually figured on the basis that the bleeder itself will draw about 10 per cent of the total current sup-

(*Continued on page* 192)

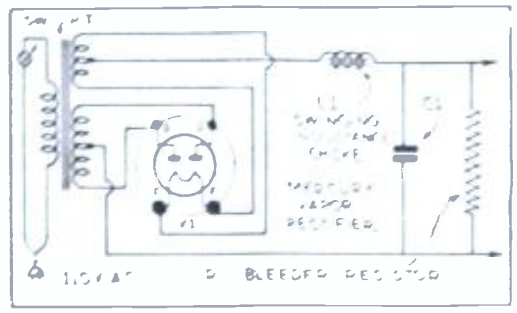


Fig. Q 339 above
This schematic shows the location of the bleeder resistor in a power supply.

Fig. Q 338 A left
This phonograph adapter connects to Ant. and Gnd.

Fig. Q 338 B right
Appearance of the phonograph adapter.

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.

Letter
SWC—short-wave converter
SWA—short-wave adapter
AWR—all-wave receiver
SWR-A—short-wave receiver-adapter (connects to any broadcast set—but merely for power supply)
BCT—broadcast tuner (to be used with any A.F. system)
SWR—short-wave receiver
BCR—broadcast receiver
BCSB—broadcast superheterodyne booster
BTWT—booster-type wavetrap
BCB—broadcast booster
DWR—dual-wave receiver
LWT—long-wave tuner
SWB—short-wave booster
LW—long-wave

CRYSTAL

Letter	Issue	Year	Page
AWR	D	1932	354
AWR	I	1932	354 etc.
BCR	Jan.	1934	419

1-TUBE

AWR	Dec.	1931	36-37
AWR & BCR	July	1931	39
BCR	Nov.	1932	550
BCR	Apr.	1932	609, etc.
BTWT	Apr.	1932	621
BCR	June	1932	741
BCR	June	1932	744
BCR	Dec.	1932	12, 13, etc.
BCR	Aug.	1932	105
BCR	Oct.	1932	232
BCR	Nov.	1932	267
DWR	Jan.	1933	400
BCR	Jan.	1933	419
BCR	Feb.	1933	448
AWR	Mar.	1933	544
BCR	Mar.	1933	601, 602
BCR	Sept.	1933	180, 191, etc.

2-TUBE

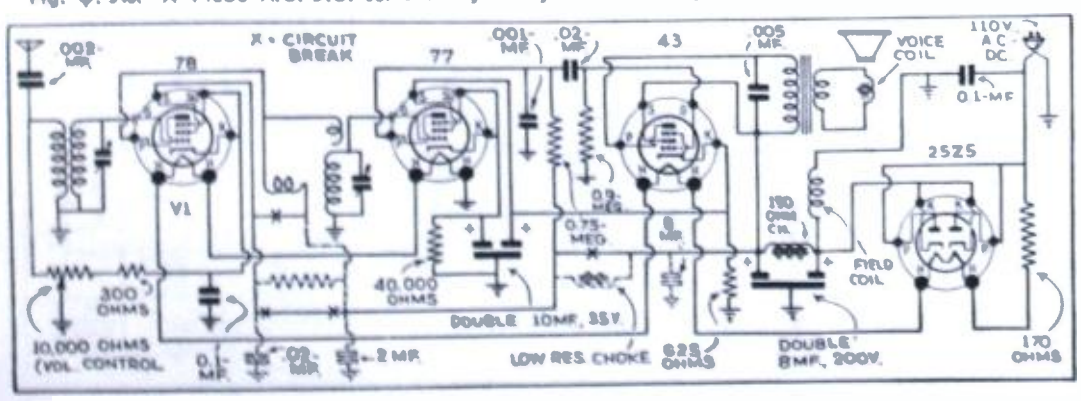
BCR	Aug.	1931	88, 89
SWR	Oct.	1931	228, 229
WC	Apr.	1932	606
BCR	Apr.	1932	606 etc.
AWR	May	1932	668 etc.
AWR	Nov.	1932	263
BCR	Mar.	1933	529
BCR	Apr.	1933	604
DWR	June	1933	725, 736, etc.
DWR	July	1933	96 etc.
BCR	Sept.	1933	160, 161, etc.
LW & BCR	Oct.	1933	228
BCR	Nov.	1933	292 etc.
BCR	Dec.	1933	335
BCR	Dec.	1933	342, 343, etc.

3-TUBE

SWR & SWR-A	July	1931	35, etc.
SWR	Aug.	1931	90, 91, 92
SWC	Aug.	1931	93
SWR	Sept.	1931	156, 157 etc.
LW & BCR	Jan.	1934	429
BCR	Feb.	1934	461, etc.
SWR	Feb.	1934	464, 465, etc.
AWR	Mar.	1934	523
AWR	Aug.	1934	90 etc.
SWC	Oct.	1934	2-3 etc.
BCR	Oct.	1934	224
BCR	Nov.	1934	277
BCR	Dec.	1934	332
AWR	Jan.	1935	398 etc.
SWR	Jan.	1935	406
AWR	Jan.	1935	410 etc.
SWC	Feb.	1935	486
AWR	Mar.	1935	544 etc.
SWR	Mar.	1935	545 etc.
BCR	May	1933	670
BCR	May	1933	671
BCR	Aug.	1933	90, 91, etc.
BCR	Nov.	1933	278, 279 etc.

(*Continued on page* 192)

Fig. Q. 340. A 4-tube A.C.-D.C. set showing changes for reducing hum when used on 30-cycle line.



P.A. QUESTIONS & ANSWERS

Conducted by
CHARLES R. SHAW

Here is a new department for the Radio Dealer, Service Man and Sound Technician who require general information and help in P.A. work. This department will furnish valuable aid for the asking. Address all questions to *Radio-Craft's* Public 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 Hoenigman, Chicago, Ill.

(Q.) How can I quietly cut a velocity 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 "dead." To eliminate this effect, the switch should be separated from the microphone by some suitable distance. The hum in the off position is caused by an "open" line. 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 loud-speaker away from the microphone. This is best accomplished by using directional reproducers, either highly-damped or directional microphones, or by separating the loudspeaker from the microphones 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. gains of 10, 20, 30, 40, etc., represent 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 Lansing, Miami, Florida.

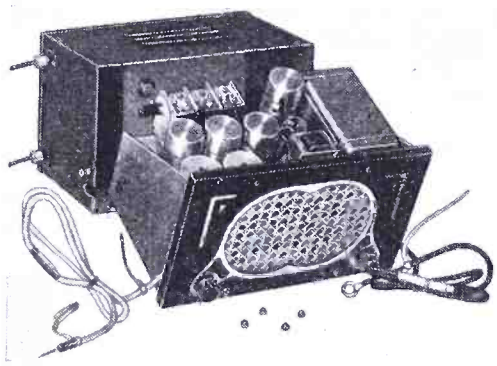
(Q.) How are programs picked up from large stages? I have tried as many as four microphones spread across a stage 40 feet wide

(*Continued on page* 192)

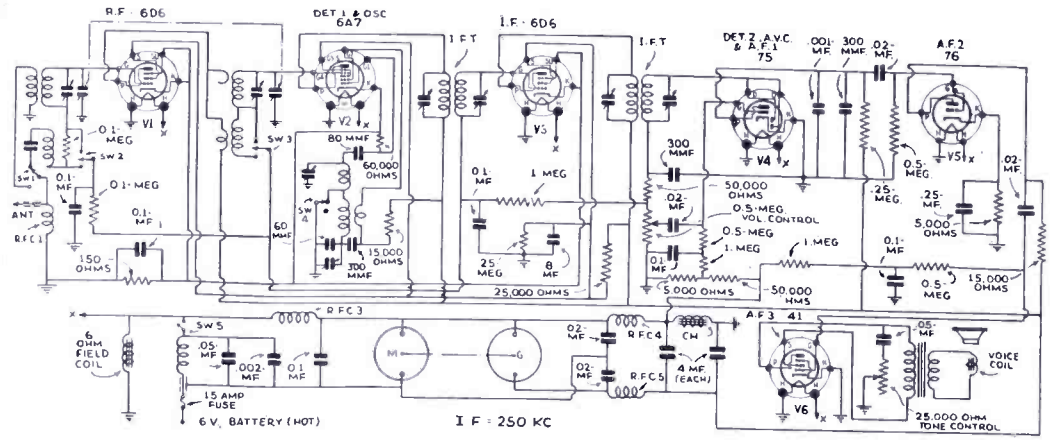
Radio Service Data Sheet

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.)



Remler No. 36 features accessibility



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 "hot" battery lead into the set is completely filtered, making suppressors unnecessary on many makes of cars. A single ½-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:

Tube Type	Cath. Volts	S.-G. Volts	Plate Volts	C.-G. Volts
V1	3	80	215	....
V2*	3	80	215	....
V3	3	80	215	....
V4	—	—	85	1.5
V5	9	....	155	....
V6	....	215	195	15

*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, while on 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 case re-alignment 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 cap-nuts the chassis can be slid out.

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

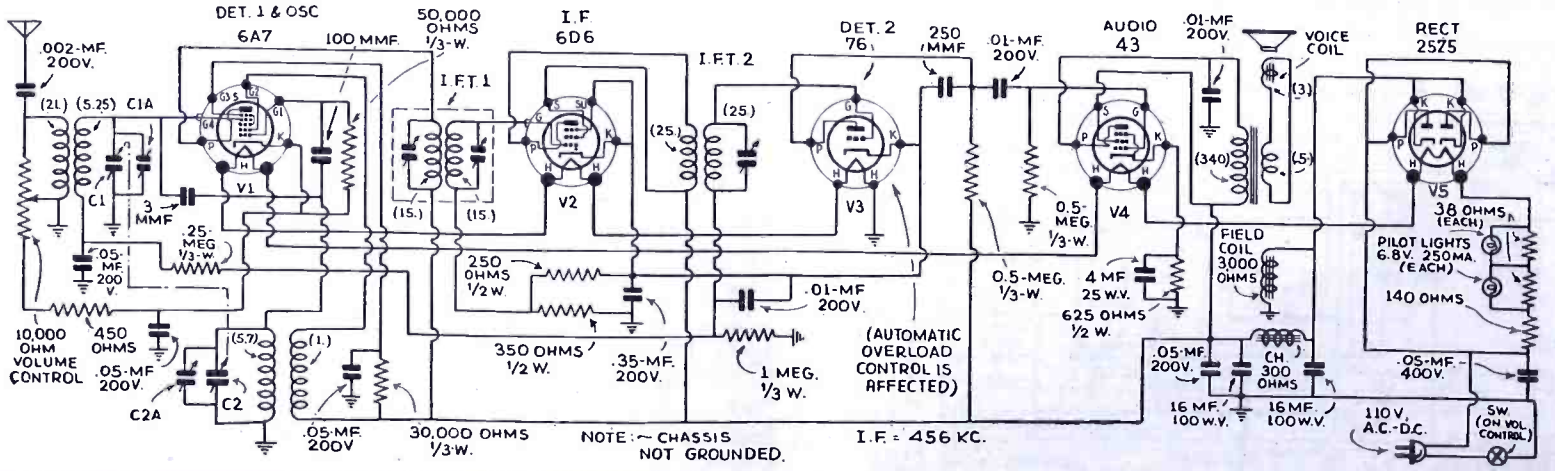
(Tunes from 540 kc. to 1,750 kc.; both dials illuminated; sturdy, matched-grain walnut cabinet; automatic overload control; full dynamic speaker; for use on any 110-volt line.)

Voltage readings on Model 155 receiver:

Tube Type	C.-G. Volts	S.-G. Volts	Plate Volts	Plate Ma.
V1	2.0**	48	107	1.0
V2	2.6	102	102	8.0
V3	6.5**	---	34*	0.1
V4	14.0**	95	89	18.0
V5	....	....	....	76 total

**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 field, 120; across the 300-ohm filter choke, 11 volts.

When lining up this set the tuning condenser should be turned to a point where no station is heard, or the oscillator section should be grounded. Alignment should start with the trimmer in the plate circuit of the 6A7, and proceed toward the second-detector. The ganged condenser should be adjusted at a frequency of 1500 kc. The D.C. resistance values of the various inductances in the set are indicated on the circuit diagram by numerals in parentheses, as (21.0). The voltage across the first electrolytic filter condenser is 120, with 109 across the second section. The two dial lights are rated at 6.8 V., 25-A.



Radio Service Data Sheet 146

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; selectorlite 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 high 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 selectorlite 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 4,200 kc.; C—3.7 to 10 mc.; D—8.5 to 23 mc.

The receiver is available in two types, one for use on 50-60 cycle power lines, and one for 25-60 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:

Tube type	Tube cap.	Socket Terminals 1	2	3	4	5	6	7
V1	0	....	240	95	4	0	....	....
V2	0	....	240	95	95	—2	3.1	0
V3	....	....	195	30	0	....	....	....
V4	....	....	0	0	0	....	....	....
V5	0	....	240	95	3.5	3.5	.	. .
V6	0	....	68	20	1	1	....	....
V7	0	....	390	390	0	37	....	....
V8	0	....	390	390	0	37	....	....
V9	....	....	230	230	0	21	....	....
V10	....	410	398	*398	*410	....	....	....
Speaker	s'k't.	0	245	400	400	390	0	....

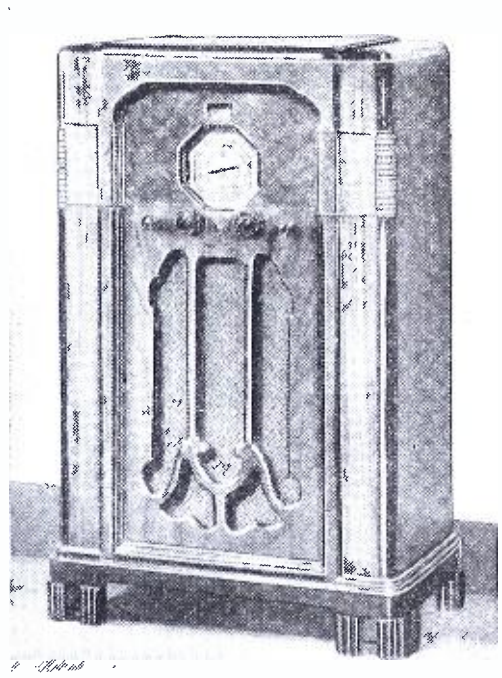
*These voltages are A.C., all others are D.C. The heater voltage on all tubes is 6.4, except that of V10, which is 4.75, these readings being made with a line voltage of 120. A meter of 1,000 ohms-per-volt should be used, with the set tuned to 1,000 kc., on band A.

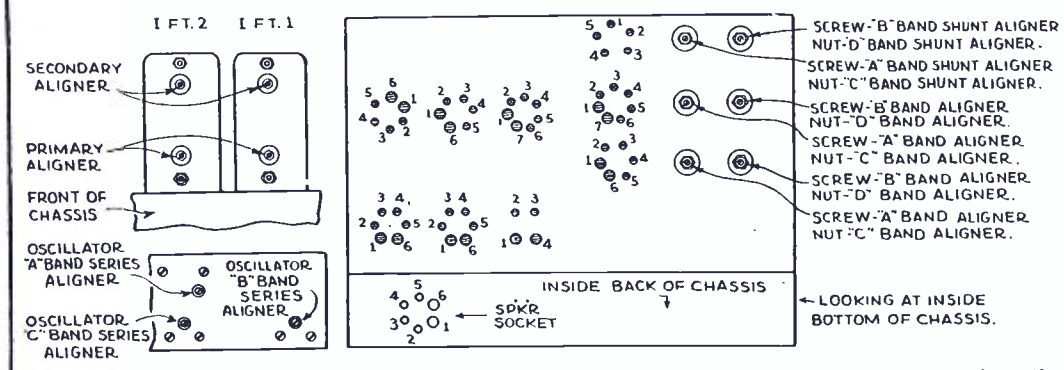
Four complete individual sets of coils are used, giving the same high sensitivity on all bands. All the idle tuning coils are grounded.

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 meter. 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.

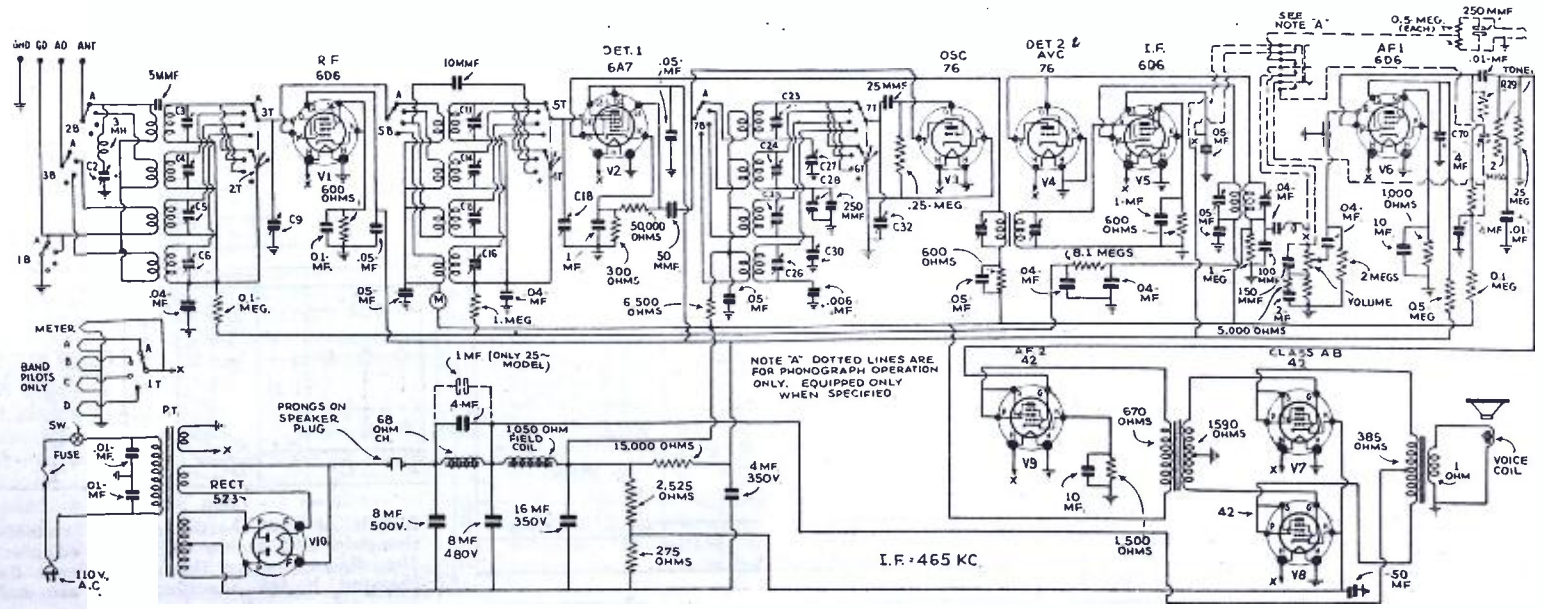
An antenna filter is provided, capable of adjustment, but this is used only on the low-frequency or A band.

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





Above drawing shows location of all sockets and trimmers. The socket numbers are those used on the voltage table above; the two illustrations at the left are as viewed from the front of the chassis, and the third is a bottom view. Below is the circuit diagram, a study of which will disclose many novel features. Note particularly the many functions performed by the range switch.



"BLUEBEARD"

(*Continued from page* 143)

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 spot-putty or plastic wood.

Pyroxylin lacquers are convenient finishes. 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 dark blue yarn glued and tacked in place. The individual strands are untwisted and presto! we bave a nice curly blue beard of which any man might be proud.

LIST OF PARTS

Two Acratest antenna and R.F. coils, L1, L2;

One Acratest 2-gang 365 mmf. variable condenser, C1, C2;

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

One IRC 400 ohm, ¼-W. resistor, R2;

One IRC 20,000 ohm, ¼-W. resistor, R3;

Two IRC .3-meg., ½-W. resistors, R4, R5;

One Electrad 600 ohm, 1-W. resistor, R6;

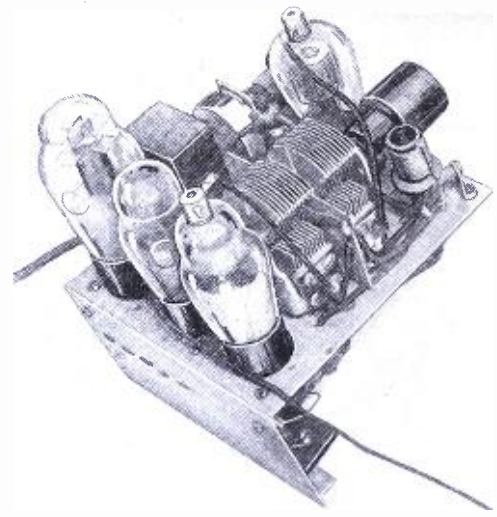


Fig. E.
The top of the chassis looking from the back. Note the ventilation holes.

One Electrad resistor with slider, 250 ohms, 25 W., R7;

Two Aerovox .1-mf., 200 V. condensers, C3, C9;

One Aerovox .25-mf., 200 V. condenser, C4;

One Aerovox 250 mmf. mica condenser, C5;

Two Aerovox .05-mf., 200 V. condensers, C6, C10;

One Cornell-Dubilier 25 mf. 25 V. dry electrolytic condenser, C7;

One Aerovox .005-mf., 200 V. condenser, C8;

Two Cornell-Dubilier 16 and 8 mf., 200 V. dry electrolytic condensers, C11, C12;

One Hammarlund 150 ohm midget choke, Ch.1;

Four Na-Ald 6-prong sockets, 1½-in. mounting centers;

Two G. E. neon bulbs, ½-W.;

One 5 in. dynamic speaker with 3,000 ohm field and transformer for single 43 tube;

One Sylvania or National Union type 6D6 tube, V1;

One Sylvania or National Union type 6C6 tube, V2;

One Sylvania or National Union type 43 tube, V3;

One Sylvania or National Union type 25Z5 tube, V4;

Chassis materials, gumwood for cabinet, hardware, etc.

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 at the same point on the tester 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.!

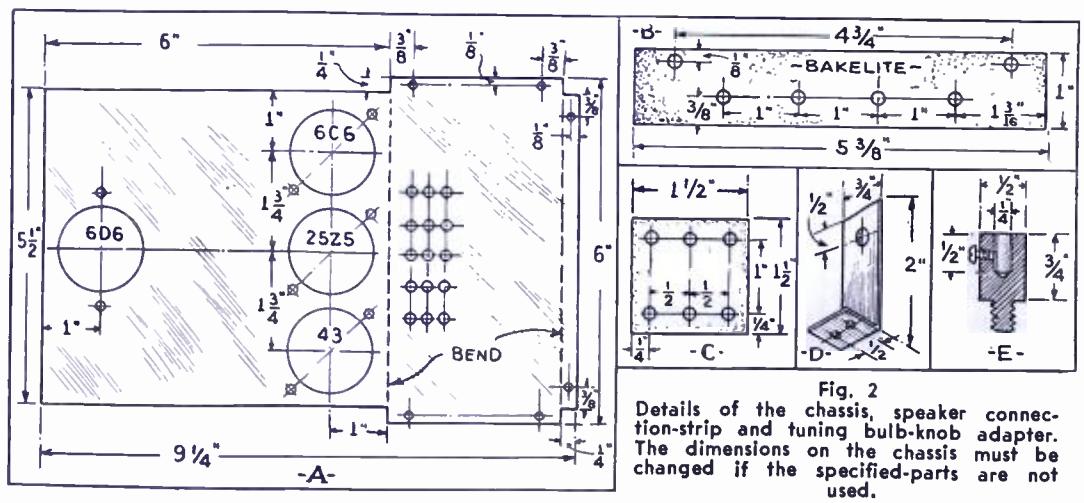


Fig. 2
Details of the chassis, speaker connection-strip and tuning bulb-knob adapter. The dimensions on the chassis must be changed if the specified-parts are not used.

TECHNICIANS' DATA SERVICE

JOSEPH CALCATERRA DIRECTOR

Radio-Craft Technicians' Data Service
99 Hudson Street,
New York City, N.Y. RC-935

Please send to me, without charge or obligation, the catalog, booklets, etc. the numbers of which I have circled below.

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( ) Service Man for manufacturer.
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( ) Service Man for servicing company.
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( ) Jobber.
( ) Experimenter.
( ) Professional Set Builder.
( ) Amateur Set Builder.
( ) Licensed Amateur.
( ) Station Operator.
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( ) Laboratory Technician.
( ) Public Address Worker.
( ) Manufacturer's Executive.
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Avoid delay. The catalogs and booklets listed are now in stock and will be sent promptly as long as the supply lasts.

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, midget, band-spread and adjustable condensers; trimming and padding condensers; R.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 parts of 12 of the most popular short-wave receivers of the year.

4. THE "COMET PRO" SHORT-WAVE SUPERHETERODYNES. Describes the outstanding features of the standard and crystal-type Hammarlund "Comet Pro" short-wave superheterodynes designed to meet the exacting demands of professional operators and advanced amateurs for a 15 to 250 meter code and phone receiver, but which can be adapted by anyone for laboratory, newspaper, police, airport and steamship use.

5. ELECTRAD 1935 VOLUME CONTROL AND RESISTOR CATALOG. Contains 12 pages of data on Electrad standard and replacement volume controls. Truvolt adjustable resistors, vitreous wire-wound fixed and adjustable resistors and voltage dividers, precision wire-wound non inductive resistors, center-tapped filament resistors, high-quality attentuators, power (50- and 150-watt) rheostats and other Electrad 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 for transmitting 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 ignition noise suppressors designed for auto radio installations. The antenna system is of the under-the-car type for easy installation. It 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.

28. 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 set.

34. SERVICE MAN'S 1935 ELECTRAD 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 volume-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 velocity microphones. Also gives a diagram of an excellent humless A.C. and battery-operated preamplifier.

62. SPRAYBERRY 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. Sprayberry to simplify radio servicing.

64. SUPREME NO. 385 AUTOMATIC TESTER. A technical bulletin giving details, circuits and features covering this new Supreme development designed to simplify radio servicing. In addition to the popular features of Supreme analyzers and tube testers it contains many direct-reading features which eliminate guesswork or necessity of referring to charts or tables.

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

72. HALLICRAFTERS' SKYRIDER SHORT-WAVE RECEIVERS. Description of the Skyrider tuned R.F. and Super Skyrider superheterodyne short-wave receivers designed and built by Hallicrafters, Inc. Features: range of 13 to 200 meters (with broadcast or 10-meter band optional), automatic wave-change switch, continuous band-spread, built-in monitor, speaker and power supply (or batteries), high-fidelity audio, and other refinements.

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

75. SPRAGUE TEL-U-HOW CONDENSER GUIDE. A valuable chart, compiled by the Sprague Products Co. which tells the proper types, capacity values and voltages of condensers required in

(*Continued on page* 173)

HOW TO MAKE THE WORLD'S SMALLEST TUBE SET

(*Continued from page* 138)

for the regeneration coil. The last three sections were then removed from the isolantite core, leaving the two useful coils in place.

The tube was prepared by filing two opposite sides of the insulated base, so that the tube would fit into the cigarette case. 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, was out of the question, so the tube was cemented to the case with a drop of acetone cement and wires were soldered to the pins in the base.

The tuning condenser was prepared by cutting a fibre disc 1¼-ins. in diameter and cementing it to the head of the compression screw of the condenser with acetone cement. White lines were 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 strip of the plunger-type 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 mounted 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 positive terminal 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 mmf. compression-type mica condenser, C1;
One Cornell-Dubilier 100 mmf. midget mica condenser, C2;
One Cornell-Dubilier 250 mmf. midget mica condenser, C3;
One Cornell-Dubilier 50 mmf. midget mica condenser, C4;
One Hammarlund R.F. choke, type CHX, L1, L2;
One Hi-Vac screen-grid tube, type X SG, V;
One plunger-type grid-leak, ¼-20 megs., R1;
One 15-ohm filament resistor, R2;
One penlight—with two small cells, "A";
*One special 45 V. "B" battery, "B";
*One pair crystal headphones;
*One bakelite cigarette case;
Screws, wire, acetone cement, etc., as needed.
(*Name of manufacturer upon request.)

METAL TUBES

Don't forget that the next issue of *Radio-Craft* will feature the new metal tubes in all types of applications. If you are interested in radio you can't afford to miss 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.

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 "G" 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 nearby stations on the loudspeaker with the volume at or near maximum. If you cannot find a dead-spot around that frequency, find one at any other frequency; say between 500 and 700 kc. Now, turn switch 18 on the short-wave set from position S.-W. to position B. Plug the short-wave set into a 110-V. socket or connect the battery cable to the set. When operating the set as a converter all the tuning is done with the converter dials; do not touch any of the controls on the broadcast set except the volume control.

No special aerial is required for this set. A piece of wire 10 to 20 feet long is sufficient. The writer has tried all kinds of aerials and found out that an inside aerial 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, 3;
One IRC 200-ohm resistor, 4;
One Aerovox 0.1-mf. condenser, 5;
One Cornell-Dubilier 250 mmf. condenser, 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 Hammarlund 4 mhy. choke, 12;
One Hammarlund 4 mhy. choke, 13;
One Cornell-Dubilier 250 mmf. condenser, 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 mhy. 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 meg. resistor, 22;
One IRC 400-ohm resistor, 23;
One Aerovox 0.1-mf. condenser, 24;
One Solar 250 mmf. trimmer condenser, 25;
One Hammarlund 4 mhy. choke, 26;
One Sylvania or Raytheon type 6F7 tube, 27;
One Cornell-Dubilier .001-mf. condenser, 28;
One Hammarlund 4 mhy. choke, 29;
One IRC 50,000-ohm resistor, 30;
One IRC 50,000-ohm resistor, 31;
One Aerovox 0.1-mf. condenser, 32;
One Trimm pair of earphones, 33;
One Sylvania or Raytheon type 37 tube, 34;
One power cord, 325 ohms, 35;
One IRC 10,000-ohm resistor, 36;
One Aerovox or Cornell-Dubilier 8 mf. condenser, 37;
One Aerovox or Cornell-Dubilier 8 mf. condenser, 38;
One Coast-to-Coast 6-prong socket, 39;
One Coast-to-Coast 6-prong plug, 40;
One Coast-to-Coast 6-prong plug, 41;
One set of "B" batteries, 135 V., 42;
One "A" battery, 6 V., 43;

A CORRECTION

We have been advised by the author, Mr. R. H. Packard of the following corrections in 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 lines (wires) to lower contacts Nos. 2, 4, 6, respectively. And the battery marked "2 V. cell" should be eliminated along with all wires leading to it. The two volts is obtained by tapping off one cell of the main 6 volt battery.

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

(*Continued from page* 144)

wall, directly below the variable tuning condenser.

In starting to wire this set, one of the most important things is to study the bottom view showing the socket terminals and also to examine the sockets themselves to make sure that the wires are soldered to the correct terminals. Every socket used, including the four-prong socket, 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 filaments first. The filaments of all five tubes are wired in series with terminal "J" grounded to the chassis and terminal "A" connected to one of the three terminals 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 positions shown in the diagram. Place the tube shield over V2 and place the screen-grid clips on the caps of the tubes as shown. Plug in the broadcast coil for the preliminary test. Connect the antenna lead-in to the flexible wire at the rear of the set. If the broadcast stations overlap when using an antenna, try operating the set without an antenna, or use a shorter aerial, or loosen the antenna trimmer condenser. Another method of making the set more selective on the broadcast band is to use a loose coupling antenna connection such as shown in Fig. 2. Do not use a ground on this set.

Plug the connection cord into any 105 to 120-V. house lighting circuit. (The line cord contains a limiting resistor and 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, thus switching the set "on." Wait about 30 seconds for the tubes to warm up. The set should then bring in stations when the station selector at the left is turned. If set is used on D.C., it may be necessary to reverse the plug before it will operate since it operates on direct current with the plug inserted in one way only. It is not necessary to reverse the plug when the set is used on alternating current. Since this set does not use a power transformer, it will operate on 25 cycles A.C. as well as 60 cycles. It can also be used on 220 V. A.C. or D.C. by means of a reducing ballast resistor.

TUNING DIRECTIONS

There are five controls on this receiver. The three most important ones are at the front. At the right is the combined switch and regeneration-volume control. Turning the knob in a clockwise direction turns the switch to the "on" position. As the knob is turned further, it operates the regeneration control. The knob at the left operates the station selector. The control at the lower left is for band-spreading.

To tune in a short-wave station, place one of the short-wave coils in the coil socket. Turn the station selector until a whistle is heard. It may be necessary to loosen the antenna trimmer to get the whistles. The antenna trimmer 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 weak, tighten the screw on this second trimmer. As the station whistle is tuned in with the left hand, turn the regeneration control in a clockwise direction with the right hand until the set "spills over" or a distinct hiss is heard. The antenna trimmer should now be adjusted, either tightened or loosened for the loudest hiss. The station selector knob is turned until a continual whistle is heard and it should be left at this point where the squeal is loudest. The squeal can now be cleared by turning the regeneration control back until the circuit stops oscillating. A slight further adjustment of the station selector may be necessary.

The trimmer adjustment is not critical and need be set only once for each coil except for the reception of very weak signals which require careful adjustment all around for best reception. 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 transformer. If it is desired to shut off the speaker while using the earphones, this is accomplished 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 MICS-70, C1;
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 MICS-140, 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-50-5, C6;
One Cornell-Dubilier cartridge condenser, .1-mf., 200 V., C7;
One Cornell-Dubilier mica condenser, 100-mmf., C8.
One Cornell-Dubilier cartridge condenser, .01-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, .01-mf., 200 V., C-12;
One Cornell-Dubilier cartridge condenser, 5 mf., 35 V., C13;
One Cornell-Dubilier dual electrolytic condencer, 8 mf., cardboard container, C14, C15;
One Cornell-Dubilier cartridge condenser, .01-mf., 200 V., C16;
One I.R.C. metallized resistor, 0.17-meg., 1 W., R1;
One I.R.C. metallized resistor, 600 ohms, ½-W., R2;
One I.R.C. metallized resistor, 25,000 ohms, ¼-W., R3;
One I.R.C. metallized resistor, 1. meg., ½-W., R4;
One I.R.C. metallized resistor, 1. meg., ½-W., R5;
One I.R.C. metallized resistor, 25,000 ohms, ¼-W., R6;
One Electrad potentiometer with switch, 75,-000 ohms. Sw. 1, R7;
One I.R.C. metallized resistor, .17-meg. 1 W., R8;
One I.R.C. metallized resistor, 1 meg., ½-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., ½-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 6C6 tube, V1;
One National Union or Raytheon, 6C6 tube, V2;
One National Union or Raytheon 6C6 tube, V3;
One National Union or Raytheon 43 tube, V4;
One National Union or Raytheon 25Z5 tube, V5;
One 4-prong socket for plug-in coil T1;
Five Na-Ald 6-prong sockets;
One set of 5 Hammarlund plug-in coils covering band from 17 to 560 meters, T1;
*One 5-in. dynamic speaker, with output transformer matched to 43 tube, T2;
One metal chassis, 11 x 5¾ x 1⅞ ins. high; high;
One Hammarlund tube shield, type TS-50;
Three screen-grid clips;
One vernier dial;
Knobs.
*Obtainable from Wholesale Radio Service Co.

DESIGN PROBLEMS OF TUNING DIALS

(*Continued from page* 146)

designed in this manner may be used over the entire semi-circle. The suggested dial type must be of slightly wider diameter than those in present use; however, this demands only a cut-down of the decoration area customary at present.

Another important point concerning the dials used today, (and one which is worthy of change) is that of *dial direction.* The average table height is 31 ins., hence the tuning dial height averages 38 ins. above the floor, as shown in Fig. 3A, while the average eye is 64 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. 2A, requiring the listener to stoop to a position which places the eyes on a level with the table top. Apparently the only reason for this archaic design is because of similar "electric meter" style in dials having been used by our grandfathers since 1850.

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 "unaccommodation" is shown in Fig. 3A, in which a radio set is standing on a table (average height 31 ins.), and with its tuning dial 7 ins. above the top. In this case if the radio receiver has sufficiently large numbers, and if the radio listener is long-sighted his eye will look upon the dial at an angle of 32 degrees. Should the listener be near-sighted (see Fig. 3B) the angle under the same conditions will be only 20 degrees. These angles of sight will be obtained if the radio listener is of average height, (eyes 64 ins. above the floor). Small 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 degrees and 20 degrees. The average angle of sight would then be:

$$\frac{32^\circ + 20^\circ}{2} = 26^\circ$$

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

However, a dial constructed according to Fig. 4B, with an inclination of 26 degrees *will not fulfill its purpose if the numera's are not of a certain size.* Since the radio listener does not like to carry a chair to the receiver, there to remain sitting until he has found the desired station, it is necessary for him to make some unpleasant gymnastic exercises (as shown in Fig. 3C) to tune in the desired station, because of insufficiently large numerals on the scale. This example shows the importance of providing tuning dials with large numerals.

In order to be of greatest ease to the eye the oculist has set the extreme minimum size of tuning dial numerals at ⅛-in. The numerals should be simple in design and the size 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 space for use of larger numerals is that of constructing scales with a circle segment of 90 divisions, 100 divisions, or 110 divisions only as in Fig. 5A. This type of scale, with numerals printed horizontally, affords a full sight over the full segment without bending the head to the left or right. The distance between the scale divisions will become much greater, serving to give an effect of "greater" receiver selectivity. Division lines may then be employed with a thickness greater than those now in use, offering not only eye relief, but also helping to cut down adjustment expenses, and last but not least the "apparent selectivity" is greatly enhanced.

If the width "H" 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 prove to be a first-class advertising and selling argument. What has been said about the semi-circle dial applies also to dials well known under the designations "full vision," and "airplane type," since 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-vision 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 poor radio listener needs a guide 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 should use a *circular* dial such as shown in Fig. 6. The dial shown in Fig. 7, often used today, utilizes only 180 degrees of the full circle; an expensive gearing 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" scale (see Fig. 6.) Two small windows are used one for the medium waves, the two together for police calls and the other one for two short-wave ranges. By use of a wave-range switch ganged with a multi-contact pilot-light switch, the correct-range windows can be respectively illuminated. The numerals are horizontal in any position of the scale, and if we use slender figures their size can be quite large without enlarging the disc diameter. Such propeller-like dials are very useful for midgets because they do not require 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 if a magnifying glass ("bullseye") is arranged in the window frame as shown in Fig. 8A. The indicator line can then be directly engraved 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 carrying the scale divisions.* It is essential for the scale to be sufficiently 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 celluloid or some similar material showing a brownish cast. Some manufacturers uce this material for scale discs only because of low cost, yet no advertising manager would use a transparent sign of such color for he realizes the difficulty that would be encountered in reading and illuminating it. Only a white material printed with black divisions and numerals should be used for the disk. It might be useful to use *blue* numerals for the police-call range, and red ones for the short-wave range. The use of white, transparent figures and divisions on a black background is not be recommended, for a dial of this type has a tendency to dazzle the eye. "White on black" may, however, be used for large dials with a few divisions and numerals only—for example, in airplanes to avoid annoyance to the pilot who must look through darkness, but not for tuning dials on home radio sets. No electric meter manufacturer today would use these "negative" dials; ask any power station enginer whether he prefers 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 appearance of the earlier dials. A much better method of dial manufacturing, then, is that of photo-lithography. Scales made by the latter method have the distinctive advantage of uniform, *clean and clear-cut* divisions.

However, by the use of front illumination together with a magnifying glass (a third manufacturing method) the "photo-eched" type of dial is very satisfactory. These dials, which are opaque, are made of a white metal having a semi-polished surface. They are not costly if identical dials on quantity basis are needed and they give the radio cabinets a more expensive appearance.

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 I.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+, B—, 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., since no current is required for field excitation. If the speaker is not provided with an output transformer having a center-tapped (3 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 moderate departures 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 aligning.

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

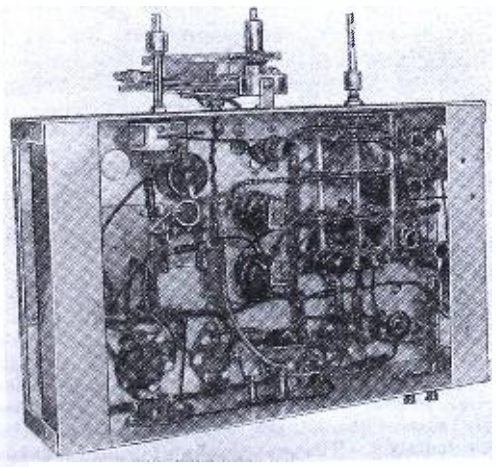
Two dry cells (total, 3 V.) suffice for the "A" battery and will give almost a month of service using the set a few hours each day! A ballast resistor serves to reduce this voltage to that required for the tubes—but its most interesting feature is that it tends to reduce this voltage drop *as the batteries 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.

Tube Type	Purpose	Plate Volts	S.-G. Volts	C.-G. Volts
34	R.F. Amp.	135	67.5	—3
1C6	Det. 1	135	67.5	—3
	Osc.	67.5	—	—
34	I.F. Amp.	135	67.5	—3
25S	Det. 2	—	—	—
	A.V.C.	—	—	—
	A.F.1	70	—	—3
33	Output	130	135	—16.5
33	Output	130	135	—16.5

Fig. B

The under-chassis view showing the positions of parts, particularly the wave-change switch and the five oscillator coils on the right hand side.



ALIGNMENT DATA

The receiver should only be aligned with the volume control turned to maximum position. First align I.F. transformers by feeding a 465 kc. signal to the control-grid cap of the 1C6 tube, after removing the control-grid cap 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 service 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 1,500 kc.; Band No. 3, 1,500 and 4,500 kc.; Band No. 4, 4,000 kc. and 12,000 kc.; Band No. 5, 8,000 kc. and 24,000 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 chassis;
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 350 mmf. (each) variable condenser;
One Trutest push-pull input transformer;
One Paragon 3-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-meg. volume control with switch;
One Amperite ballast resistor (6-1 type);
Three Eby 4-prong wafer sockets;
Two Eby 5-prong wafer sockets;
Two Eby 6-prong wafer sockets;
One Na-Ald pin-jack terminal strip, for phones;
One Ant. and Gnd. terminal strip;
One Solar 150 mmf. (maximum) variable padder, for long waves, P1;
One Solar 600 mmf. (maximum) variable padder, for broadcast, P2;
Three Cornell-Dubilier mica-dielectric fixed padding condensers—.002-mf., P3; .01-mf., P4; 0-1-mf., P5;
One IRC ½-W., 0.1-meg. resistor;
One IRC ½-W., 0.3-meg. resistor;
One Hammarlund R.F. choke, 85 mhy.;
One Lafayette 465 kc. double-tuned I.F. transformer;
One Paragon special single-tuned 465 kc. I.F. transformer;
Two Cornell-Dubilier 250 mmf. (postage-stamp size) fixed condensers;
One Cornell-Dubilier .03-mf. tubular condenser;
One IRC 0.5-meg. (½-W.) resistor;
One battery cable;
One Lafayette speaker (permanent magnet, or magnetic with center-tap);
One Cornell-Dubilier .01-mf. tubular condenser;
One Cornell-Dubilier 0.1-mf. tubular condenser;
One .25-mf. tubular condenser;
One Raytheon 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

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 compartment. Everything stamped out; no further drilling required. Shipped fully constructed in black crackled finish unless otherwise specified. (A 235 to 550 meter coil kit is available—special.)

Unit No. 2

Four Eagle 6-prong coils, range 12 to 235 meters;

Four Eagle 5-prong electron-coupled coils, 12 to 235 meters.

Unit No. 3

One Eagle power transformer, P.T.;
One Eagle 150 mmf. double-gang variable condenser, C1;
One Hammarlund 50 mf. variable condenser, C2;
One Cornell-Dubilier dual 8 mf. electrolytic condenser;
Three Cornell-Dubilier 100 mmf. mica condensers;
Two Cornell-Dubilier .05-mf. condensers;
Three Cornell-Dubilier .1-mf. condensers;
Two Cornell-Dubilier .5-mf. condensers;
Two 2.5 mh. R.F. chokes, sectional-wound;
One 300 ohm, 1 W. resistor;
Four 0.1-meg., 1 W. resistors;
One 0.5-meg., 1 W. resistor;
One 5 meg., 1 W. resistor;
One Centralab 10,000 ohm potentiometer, R2;
One Centralab 50,000 ohm potentiometer, R1, with switch, Sw.;
Three Eby 6-prong wafer sockets;
One Eby 4-prong speaker socket;
One Eby 5-prong speaker socket;
One Lafayette 5-prong isotex socket;
One Lafayette 6-prong isotex socket;
Three bakelite knobs;
One power line cord;
Three tube shields;
Misc., hardware, wire, 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 used with this set is built in. Where greater volume and sensitivity are needed, however, it can be stretched out and supported on any nearby tree or other high object. A full-vision, airplane-type tuning dial affords 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 the application of this deflecting voltage, the spot of light moves from point A to point B on the screen. (Naturally, the amount 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.

Now suppose that a potentiometer connected across a battery serves as a source of adjustable voltage to be applied to these two deflecting plates P1 and P2 as shown in Fig. 1A. When arm K is above center-tap T on the potentiometer, plate P1 is made *positive* with respect to plate P2 and the normal electron beam (which takes the path OA when no potential is applied to the plates) will be deflected toward plate P1 and strike the screen at point B. When the arm K is below the point T, the spot of light will appear at point C, because P2 is now *positive* with respect to P1 and the electron beam. These plates attract the electron beam just as the plate of any radio tube attracts electrons. However, in this case, the entire beam is bent by the attractive (or repulsive) force. If the contact K is now moved back and forth rapidly, the spot of light will move up and down the screen in a straight line B-A-C and will trace this straight line on the screen.

Although each section of the line is generated at a slightly different time, the entire line will appear continuous for two reasons: first, because of the "persistence of vision" property of the eye (Persistence of vision is a property of the eye which enables it to retain the image of an object after the object has been removed. It is upon this principle that the motion picture projector works.); and, second, because the spot on the screen actually remains bright for a short time after the spot itself moves away.

Furthermore, the movement of the beam follows the variation in potential instantaneously, since an electron beam has no inertia. For this reason, the movement of the cathode-ray beam will respond faithfully to rapid changes of the deflection potentials, even though these changes may take place in a small fraction of a millionth of a second. Therefore, this device may be used even on high radio frequencies.

In a similar manner, if the deflecting voltage is applied to plates P3 and P4, as shown in Fig. 1B, and varied in the same way, the line which the spot of light traces will appear in the horizontal direction shown. The amount of deflection of the beam is proportional to the voltage applied to the deflection plates, and the amount of voltage required to deflect the spot of light a distance of one inch over the screen is a measure of the sensitivity of the cathode-ray tube. (For instance, this value for a commonly used tube is approximately 75 V. per inch.)

Now, let us suppose that an alternating voltage from a transformer is applied to one set of deflecting plates, and the second set is open; the resulting path traced over by the spot of light will be a straight line, as shown at the right of Fig. 1C. The voltage waveform is shown at the left. At any instant, the deflection of the spot of light from its zero position, A, will correspond to the value of the voltage at that instant. For instance, at instant 1 on the voltage wave the spot of light is at point 1 on its path, at instant 2 on the voltage wave it is at corresponding point 2 on its path, etc. During the interval that the voltage wave goes through the complete cycle shown, the spot of light moves over the straight-line path 1-2-3-4-5-6-7-8-9-10-11-12-1.

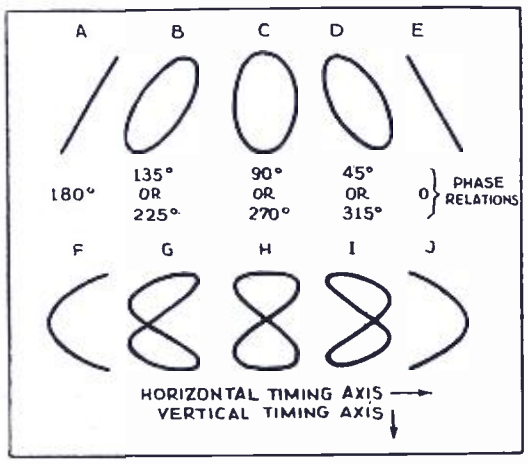
ACTION OF BOTH PAIRS OF PLATES

Now, with this same voltage applied to one set of plates, suppose another identical voltage is applied to the second pair of deflecting plates in the tube, and let these two voltages be in the same phase—reach zero and maximum at the same instants. The waveforms of these voltages

are drawn on their respective horizontal and vertical axes of the cathode-ray tube in Fig. 1D. There are now *two* forces acting on the electron beam simultaneously at every instant, one tending to move it in one direction, and the second trying to move it at right-angles to the first. The resulting location of the spot on the screen at any instant depends upon the *algebraic* sum of both these forces at the instant. The resulting pattern traced out by the spot of light is a straight line inclined at an angle of 45 degrees with respect to each of the lines that would be obtained if the other voltage were removed. This is shown as line M-M1, on the screen in Fig. 1D.

If the waveforms, frequencies or phase relationships of these applied voltages are changed, the resulting image may take any one of a number of shapes or patterns. Thus, if one of the voltages is of greater amplitude than the other and differs in phase with it by 90 degrees or 270 degrees, the resulting pattern traced out will be an ellipse, as shown by C of Fig. 2. If the phase relation is such that one voltage leads the other by 45 degrees or 315 degrees, the resulting pattern traced will be that of D; if leading by 135 degrees, or 225 degrees, the resulting pattern will be that of B. By means of the cathode-ray tube, the resultant pattern is traced on the fluorescent screen by the moving spot of light. Conversely, from the pattern observed, the frequency and the phase relations of the two deflecting voltages can be determined. Where, in addition, the waveform is known for one of the deflecting voltages, the waveform of the other can be readily obtained by graphical analysis. Details A to E in Fig. 2 represent the patterns traced by the spot of light if the voltages applied to the two sets of deflecting plates have a 1-to-1 frequency ratio. When the frequency ratio is 2-to-1, the patterns of A to E change respectively to those of F to J. As the ratio of the frequencies of the two deflecting voltages increases, the patterns change from these shapes and become increasingly complex. (See "Fundamental Facts About Cathode Ray Tubes," Parts I and II, in the April and May, 1935 issues of *Radio-Craft*, respectively; also, "The Fluorescent Screen in Cathode-Ray Tubes." —*Editor*)

Fig. 2. Some of the tone forms produced on the fluorescent screen for various phase relations.



TECHNICIAN'S DATA SERVICE

(Continued from page 167)

the various circuits of radio receivers and amplifiers, and how to locate radio troubles due to defective condensers. Includes data on condenser calculations.

76. FACTS YOU SHOULD KNOW ABOUT CONDENSERS. A folder, prepared by the Sprague Products Co., which explains the importance of various characteristics of condensers, such as power-factor, leakage, capacity and voltage in determining the efficiency or suitability of a given condenser to provide maximum filtering and safety in operation.

77. SUPREME 391 P.A. ANALYZER. This booklet describes the features and use of the new Supreme 391 P.A. Analyzer, designed to equip the radio Service Men to cash in on the constantly growing opportunities for service in the sound equipment and public address systems used in movie theatres, schools, churches, auditoriums, etc.

A NOVEL "ACORN"-TUBE REGENERATIVE SET

(Continued from page 150)

scribed a system of tuning that combines a variometer and variable condenser, in shunt to each other, as the resonant circuit. In principle, you set the variometer for minimum inductance and crank up on the condenser, which brings the circuit part-way up the wave range; then, you wind the variometer shaft around until maximum inductance is reached, for the balance of the wave range. Or, you can work it the other way 'round—tuning first with the variometer 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 variometer selected for this set are shown in Fig. 1A as La-Lb (rotor), Lc-Ld (stator); a fifth winding, Le, is used as the feed-back coil. (The variometer acts as an "auto-transformer," with sections Lc-Ld acting as the primary or antenna winding, and with La-Lb-Lc-Ld, all in series, constituting the secondary.)

It is an inherent quality of variometers that, where rotor and stator inductance values exactly balance, the external electromagnetic field is nil when the rotor winding is so positioned (minimum inductance) within the stator as to be in complete inductive opposition to the stator. The only coupling that can remain, then, between the total effective inductance of the variometer, and an external inductance, (Le) 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 wavelengths 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 variometer is used in this set, the inductance 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 wavelength range. This condition may be compensated, however, by adjusting antenna coupling 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.F.C. should be of the single-winding type; a multiple- or "pie"-winding type will have insufficient self-capacity for good regeneration control. It is necessary to tap the antenna into the variometer circuit (see Fig. 1A), by connection to the frame (see Fig. 1C), inasmuch as the coupling at the shorter wavelengths afforded by coil Le is too slight for good volume. Note that the variometer must be completely insulated from the metal panel (the writer used extruded rubber washers under the two supporting screws); the panel is grounded.

LIST OF PARTS

One RCA Radiotron type 954 "acorn" pentode, V;
One Hammarlund "acorn"-tube socket, for tube V;
One small variometer or may be built to the specs. given), La-Le;
One Hammarlund type APC, 100 mmf. padding-type condenser (tuning), C1;
One Hammarlund 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., C6;
One Cornell-Dubilier phone bypass condenser, .001-mf., C4;
One Aerovox .25-mf., 200 V. condenser, C5;
One Electrad grid leak, 2 megs., R1;
One wooden baseboard, 4x7x½-in. thick;
One aluminum panel, 6x7x1/32-in. thick;
Two tuning scales and pointer knobs;
One arrow-inscribed knob;
One speaker connection strip;
Miscellaneous hardware.

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 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 diode and 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 ½-in of the point to where the wire is soldered.

HOW TO ALIGN "VARIABLE I.F. TRANSFORMERS"

For complete satisfaction, these I.F. transformers should be aligned very carefully. This is done by using an 0-25 milliammeter and in the following way: Connect up the set and plug in the set of coils covering the 49-meter band. (Incidentally, it is advisable to remove about 1½ 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, bringing it up to a maximum with the aid of the antenna trimmer. Connect the milliammeter 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.Fs. similarly.

Now detune the set slightly by adjustment of the main tuning control. The meter reading should go *up* 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 fading, 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, that the shield separating the variable condenser section is grounded.

The plungers on the I.F. transformers should all be set in about the same position for selectivity control.

LIST OF PARTS

Two Hammarlund split stator midget variable condensers, type MCD-140-M, C1, C2;
One Hammarlund midget variable condenser, type MC-50-M, C3;
Three Cornell-Dubilier condensers, .001-mf., C4, C17, C21;
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., C11, C24;
One Cornell-Dubilier condenser, 1 mf., 500 V., C16;
One Cornell-Dubilier electrolytic condenser, 5 mf., 25 V., C19;
One Cornell-Dubilier condenser, .01-mf., 500 V., C22;
One Electrad potentiometer, 100 000 ohms, R1;
One I.R.C. resistor, 50,000 ohms, ½-W., R2;
Three I.R.C. resistors, 100,000 ohms, ½-W., R3, R12, R19;
One I.R.C. resistor, 300 ohms, 1 W., R4;
One I.R.C. resistor, 20,000 ohms, 1 W., R5;
Three I.R.C. resistors, 10,000 ohms, ½-W; R6, R11, R17;
Three I.R.C. resistors, 1,000,000 ohms, ½-W., R7, R15, R18;
One I.R.C. resistor, 100,000 ohms, 1 W., R8;
One I.R.C. resistor, 500 ohms, 1 W., R9;
Two I.R.C. resistors, 500,000 ohms, ½-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, IFT1, IFT2, IFT3;
Two Hammarlund standard 4-prong plug-in coil kits, type SWK-4, L1, L2;
One Hammarlund isolantite small-base 7-prong socket, type S-7B;
Two Hammarlund isolantite sockets, 5-prong, type S-5;
Three Hammarlund tube shields, type TS-50;
Two Eby 7-prong small wafer sockets;
One Eby headphone terminal strip;
One Eby antenna-ground terminal strip;
One Eby ground.binding post;
One vernier tuning dial;
One front panel, 11½x7 ins.;
One chassis, 8½x11½ ins.

NEW MYSTERY STATION

This new station is located very near Chicago's downtown loop, and although it is in operation every week day it has never been logged, even by the most ardent DXer! It is complete in every respect, the actual transmitter measuring 6½ feet by 12½ feet long. In addition to this, there are mixing panels, control panels, and a complete sound proofed studio.

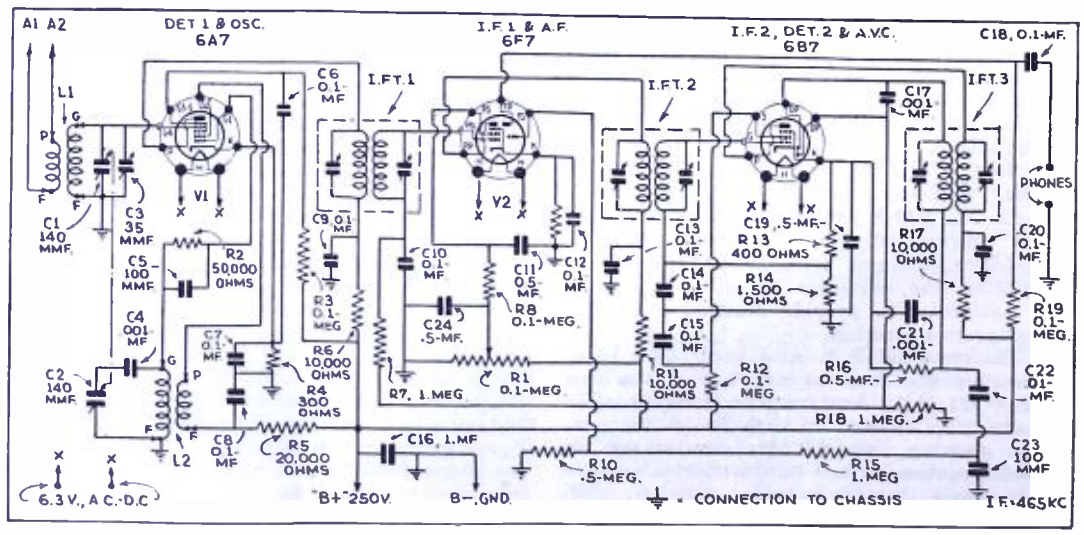
This novel station is located in the Coyne Electrical School, and is used for the sole purpose of training prospective radio operators.

Every type of studio equipment is available, and the material "broadcast" 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 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, 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.



A NEW IDEA IN SET-BUILDING

(*Continued from page* 151)

insulating material and connecting staples (the staples take the place of the usual wire connectious). The various layers are held together by a multiplicity of tublar rivets (eyelets) extending all the way through the base plate and forming connecting sockets for all of 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 complexity 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 superhetrodyne 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 layout is striking. This base plate is 11x6x½-in. thick.

The photograph in Fig. B presents a view of the bottom of the base 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 testing which may be necessary.)

In less than five minutes the entire receiver may be reduced to the base plate and the individual parts as shown in Fig. C. This view shows the top of the base with all of the parts comprising the circuit removed. It will be observed that most of the parts are standard. Note the absence of small hardware ordinarily used in set construction.

Each of the parts comprising the circuit is provided with two or more rigid spring plug contacts to insure a perfect electrical connection to the eyelets. Perfect connections of the eyelets to the staples are insured in three ways, namely: (1) by a long wiping pressure contact; (2) the rivet clinch; and, (3) solder. A ground plate is included in the laminations to segregate circuits carrying high-frequency components, obviating feedback and other undesirable coupling in the circuit. Thus *the chaos of tangled wires, soldered joints, brackets, dangling parts, and profussion of inaccessible units is completely eliminated!*

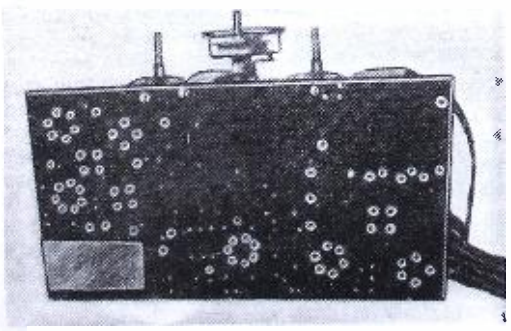
The advantages of this type of construction from the point of view of the Service Man as well as from every other viewpoint are almost without number. Some of the more outstanding ones are: rapid testing; instantaneous replacement of any part; no soldering whatever to be done by the Service Man; performance tests by substitution made very rapidly; immediate identification 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 properly punched *for a particular circuit* will be fitted with staples to connect certain eyelets in a straight line. Other layers will follow and when this is completed the eyelets will be inserted and clinched. This structure will then be impregnated making it impervious to moisture and the parts inserted by machinery.

The entire process can be done at the rate of one per one-half second 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 obsolescence as well as his cost of guarantee of satisfactory 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 operator has a continuous check of distortion and overload. For each frequency setting, the sweep frequency should be adjusted to that frequency or a sub-multiple of it. It is also possible to check the overall audio fidelity of a radio set by applying a modulated oscillator to the input terminals of the receiver and connecting the vertical plates of the oscilloscope across the voice coil of the speaker. The audio modulating voltage is then varied and the overall response at each frequency determined.

VACUUM TUBE CHARACTERISTICS

Dynamic curves of vacuum tubes may be taken with the oscilloscope with the tubes operating normally in the actual circuit in which they are to be used. In this way tubes may be checked for performance and compared for quality *under actual individual operating conditions* instead of under some set of rated conditions which may or may not be similar to those encountered in that particular set.

The general procedure to be followed is to apply a small A.C. signal, of any desired frequency, to the control-grid of the tube under test. This same signal is applied as a sweep voltage through the amplifier to 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 resulting trace obtained will be the grid 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 curve; maximum steepness (indicating maximum mutual conductance); closes approach to straight line over whole length.

By this method tubes may be compared in the actual circuit and the tube giving a curve closest to the characteristics outlined above will be 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 procedure.

The oscilloscope affords the nearest approach to the "final" dynamic (action) 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 now famous "Megadyne." Several experimenters have encountered trouble along these lines, so a few hints may be of some help to those who are having trouble. Mr. J. M. Nighswander, 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 fine so the next step was to incorporate 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 lead from the crystal detector to 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. When these changes were made, the performance was exceptionally fine, the tone having plenty of base, with volume to spare on most stations. Stations up to 1600 miles away coming in with good loudspeaker volume under good conditions.

The type 22 tube gave good results with only 2 volts on the filament, while the cap or 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 9 volts bias on grid.

"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 respectively 2,000 and 3,000 cycles, the modulated current can be considered as consisting of 6 waves having the following frequencies: (1) 1,003,000; (2) 1,002,000; (3) 1,001,000; (4) 999,000; (5) 998,000, and (6) 997,000 cycles. In order to operate without distortion a radio receiver has to be capable of receiving simultaneously the six sidebands with the same efficiency—a 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, such a modulation would lead to doubling the pitch of the transmitted sound (a condition which hardly conforms with good transmission!). The presence of the unmodulated carrier corrects this effect. Each of the sidebands "heterodynes" (produces a beat frequency) in the receiver with some portion of the carrier and the result is a beat note of the modulating frequency. Only a negligible portion of the two sidebands hetrodynes together to produce an audio signal of double frequency. The above consideration explains why the modulation does not usually exceed some 35 per cent when high-quality broadcasting is desired. It is obvious that the carrier can be suppressed without affecting the quality of transmission if the receiver itself can supply the carrier from a local oscillator. Successful experiments have also been conducted on transmission while using a single side band and the carrier.

FREQUENCY MODULATION

However, in frequency modulation (which is the basis of Major Armstrong's new system of transmission, described in the August 1935 issue of *Radio-Craft*, on page 75) the amplitude and the phase do not vary; the 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; (f is the frequency variation). For instance, a *frequency-modulated* 1,000,000-cycle carrier for a given audio amplitude may have a variation f = 1.000 cycles, which means that while the audio signal varies during the cycle, the frequency of the carrier will vary between 1,001,000 cycles and 999,000 cycles. For a larger audio amplitude the variation may be 2,000 cycles and the variation range therefore 1,002,000 and 998,000. If f_1 is the maximum frequency variation which may be caused by the maximum audio amplitude, any instantaneous frequency value of the frequency-modulated carrier lies between fo + f_1 and fo — f_1. Frequency modulation is shown graphically at A and B in Fig. 2. 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 generated current. However, the most convenient method for producing a pure frequency modulation is to act either on the capacity or on the inductance of the oscillatory circuit—preferably on the capacity. Figure 3 shows a simple set-up for frequency modulation using capacity variation. In parallel to condenser C of the oscillatory circuit is connected a *modulating condenser* MC which is either a condenser microphone or a Baldwin headphone rebuilt for this purpose. The latter is easily constructed as follows.

The mica diaphragm 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 a sound of a given frequency and amplitude will cause a sinusoidal variation, of the part f.

If the frequency variation f is small with 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

$$\frac{f}{fo} = \frac{2{,}000}{1{,}000{,}000} = \frac{2}{1{,}000}$$

and the capacity ratio $\frac{C_1}{Co} = 2\frac{f}{fo} = 2\frac{2}{1{,}000} = \frac{4}{1{,}000}$

$$C_1 = Co\frac{4}{1{,}000} = 250\frac{4}{1{,}000} = 1 \text{ mmf.}$$

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 prove that a current modulated in the manner just described can be considered as consisting of an unmodulated carrier and an infinite number of sidebands. The sidebands are in pairs and their respective frequencies are: fo + p, fo — p, fo + 2p, fo — 2p, fo + 3p, fo — 3p, etc. Where fo is the frequency of the carrier and p the modulating frequency, the amplitudes of the carrier and the sidebands depend upon a certain factor mf called the "modulation index." The modulation index mf is equal to a certain constant K multiplied by the ratio of the two frequencies $mf = \frac{K_1 fo}{P}$

We see that the amplitudes of carrier and sidebands depend upon the modulating frequency. While the amplitudes in each pair of sidebands in amplitude modulation are equal, the sidebands in frequency modulation generally differ. When the modulating index mf is small the amplitudes of the sidebands above the second are negligible and may be neglected. However, when mf increases, the importance of the higher sidebands becomes more noticeable.

An "aperiodic" detector cannot produce an audio signal from a frequency-modulated current. The *frequency*-modulated signal must be converted into one which is *amplitude*-modulated in order to be made audible.

This can be done by inserting a tuned circuit between the antenna and the detector, or by using filter systems. This means that *practically any receiver with* VERY SHARP *tuning can receive frequency modulated signals.* The *quality* is another question; and in Armstrong's system, a special network of current limiting and filter 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 unmodulated carrier and 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 and fo — p; fo + 2p and fo — 2p; fo + 3p, and fo — 3p, etc. The amplitudes of the carrier and the sidebands are a function of the modulating index mp (mp = K_1fo) which unlike frequency modulation is independent of the modulating frequency. Here again when the modulating index is small, in other words when the maximum shift of the phase angle is small the bands above the second have 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 *amplitude modulated* before it reaches the detector. This is accomplished by inserting a tuned circuit between the antenna and the receiver or by using a filter system in the same position in the circuit. From the above consideration we may easily come to the conclusion that neither frequency nor phase modulation narrow the band width. As a matter of fact it appears that only under ideal conditions is the band width of the latter two systems equal to that in amplitude modulation, though it is true that in short waves the problem of band width is less acute than in the broadcast range. Very little 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* 153)

ment wherein two amplifiers are housed in one compact case, each one 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 clear channel has its own universal, two-position input mixing circuit arrangement as well as its individual universal output transformer. These two features permit the amplifier to be used in a number of novel arrangements.

By connecting the input 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 tubes.

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 17,000 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" so as to fan out either bass or treble response to suit the taste of the listener, or the acoustics of the room.

During simultaneous operating of both input circuits, the output transformers may be individually connected to their own bevy of speakers or to one bank of speakers (by paralleling the 4, 8, 16, 200 and 500 ohm taps).

A number of "trick" and valuable sound effects are easily achieved in many novel ways. For instance both clear channels used in their normal manner with appropriately placed 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 481).

Needless to say, when power outputs of 12.5 W. are required, one of the channels may be left in either the "idle" or "ready" position. In the "idle" position, the channel is "cold," while in the "ready" position all of the cathodes (and heaters) 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 inasmuch as it represents the most logical class A amplifier tube to use in universal (110 V. A.C.—6V. D.C.) amplifiers for it is unsurpassable in high-fidelity performance at relatively low plate voltages. In fact, it is no secret that the 6A3 is expected to ultimately obsolesce the 2A3.

By employing a three-pole 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 dynamotors used for 6 V. operation. The inclusion of two separate 110 V. A.C. and 6 V. D.C. power supplies are 100 per cent insurance against operating failure during an important 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-type tube has found many novel applications in radio design, in this country, because of the inclusion of a rectifier in the same envelope as 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.

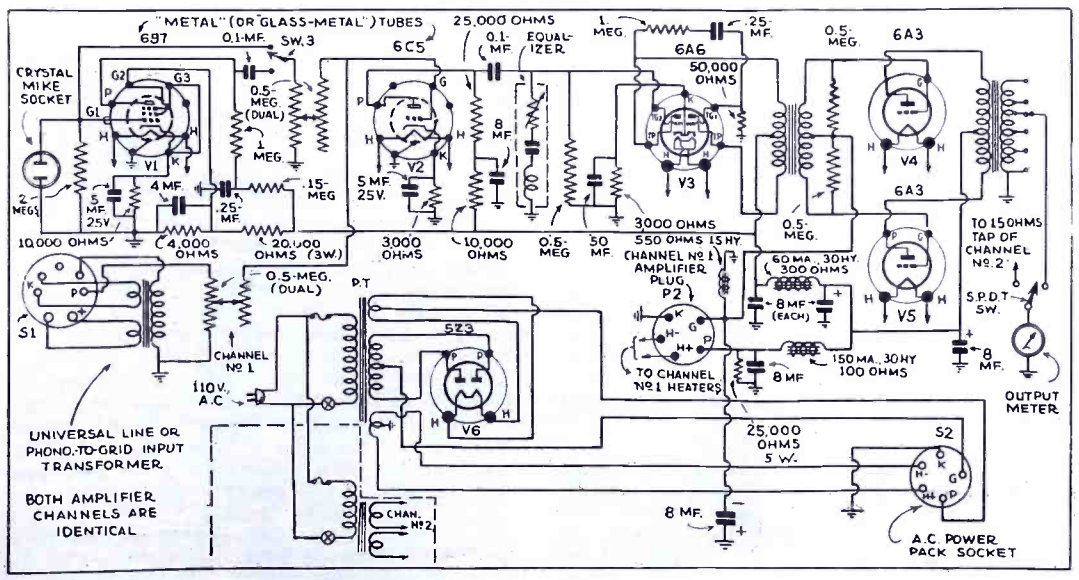
It is interesting to compare this European adaptation of the 12A7 with American sets of similar design.

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 a 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. 153) shows complete unit.



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

(*Continued from page* 153)

P. K. Pate, Kirkwood Radio Laboratory, 615 Moreland Ave., S.E., Atlanta, Georgia.
D. E. Greathouse, Oilton, Oklahoma.
Edward H. DuForce, 16 Jewett Ave., Poughkeepsie, N.Y.

TYPICAL LETTERS

The two letters reproduced below have been picked from the many hundreds received as being typical examples which may be of use to others who contemplate entering the contest. Both of these letters are eligible for decision by the judges.

Contest Director:

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

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

(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 set without causing the A.V.C. circuit to operate. A suitable output meter must accompany this oscillator.

(3) An oscilloscope and frequency modulator. This is required for visual alignment so as to get it as near as possible on high frequencies. Also a calibrated chart for use with the oscilloscope.

(4) A universal test speaker. This unit should have various field- and voice-coil resistance values to take care of all radio sets on the market today.

(5) A complete set of service manuals. These will save me a lot of time and save my customers a lot of unnecessary waiting and expense.

(6) A good tube checker. It must test all tube elements and indicate defective ones. It must also denote a gassy tube and an intermittently operating tube.

(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 aforementioned equipment I believe I could give my customers a finer class of work and have less call-backs than I now have. It would enable me to expand my field of service to include at least one day a week in the smaller towns around me where now I only get there when I have a call telephoned 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 give me a standing of a class A No. 1 radio Service Man.

JOHN D. RITENOUR

Contest Director:

The Ideal: To repair and/or adjust any radio receiver, no matter how complicated, with the least possible expenditure of time and effort, and to return it to the owner performing with the efficiency it was designed to give.

To make this ideal possible of realization in the face of increasingly more complicated receivers, would require the following equipment:

Analyzer unit incorporating a volt-ohm-milliammeter with A.C-D.C. ranges up to 1,000 V., and ohms to 20 megs.—one-switch selector.

Wheatstone bridge with capacity, inductance and resistance standards, provisions for external standard; arranged for use with D.C. and galvanometer, or A.C. and phones—by the turn of a switch.

Vacuum-tube voltmeter (slide-back type) using VOM in grid and galvanometer in plate circuits.

All-wave signal generator with calibrated output, variable modulation and provisions for external modulation.

Variable-frequency A.F. generator with range of 50-15,000 cycles.

Selective analyzer, switch-type.

Two-unit condenser tester with choice via switch of: short or open tests with neon bulb; leakage tests with milliammeter.

A master switch to enable the insertion of any of the above into radio set circuits via selective analyzer without jumpers.

Power pack to provide juice for above units and external use.

All of the above to be mounted in one unit and so arranged that they can be thrown into receiver one after another by merely turning one switch—it can be done!

Visual-adjustment unit: frequency modulator; oscilloscope.

Substitution units: universal speaker; resistance decade box; condenser box.

Miscellaneous: dynamic mutual-conductance tube tester; vibrator tester; 1,000 cycle harmonic filter, and 1,000 cycle Wien bridge fundamental filter—for distortion analysis with A.F. generator; complete library of service manuals; tools including coil winder; adequate supply of replacement parts.

This equipment would enable the making of the measurements and adjustments necessary completely to realize the ideal.

J. M. KRECHNIAK

ORSMA MEMBERS' FORUM

(*Continued from page* 161)

EASILY-MADE CHASSIS

RADIO-CRAFT, ORSMA *Department:*

The average custom set builder does not purchase a kit when he builds a set and therefore must secure, cut and drill his own chassis. *Aluminum* chassis are not obtainable in all stores but *lead-coated iron* is offered. The lead-coated iron is made of such "fine" 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.

Go to your nearest sheet metal dealer and buy a sheet of No. 14 or 16 *galvanized* iron. Have him cut out the corners and bend the four 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 bakelite 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 250 ohms down. It is silk covered and very handy in making small resistors for shunting meters.

E. L. LAUDELL,
Shelbyville, Ill.

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

A LETTER CONCERNING "SOMETHING WRONG"

Editor, RADIO-CRAFT:

Although I am not in the habit of writing, I have decided to do so after reading the 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 mentioned that the time to correctly put an old vibrator in shape is too great to warrant such a procedure. Furthermore, it seems that once the points have become pitted, they are more or less useless, as it is very hard to judge the exact point to which the tungsten points have become carbonized.

As the best rule to be adopted, may I suggest that the old vibrator should always be replaced with a new one. This is the safest way of making a long-lasting repair job, as the new vibrators on the market are low in price and usually better than those used in the earlier-model sets and also the cheaper type sets. The actual time required to repair an old vibrator is as much as the price of a new one. And as a parting shot, after repairing the old unit, you are never sure of the job.

WERNER MULLER,
Empire Coil and Trans. Co.,
Clifton, N.J.

READERS' DEPARTMENT

(*Continued from page* 158)

shielding. I take exception to the reply.

Sparkplug manufacturers have spent years in trying to develop a sparkplug having lowest possible resistance and yet one which would stand up and resist heat and corrosion. After all of their efforts, we defeat the very thing which they have tried so hard to attain by adding a resistance to the electrical circuit.

Suppressors are not used on aircraft engines, because they lower the efficiency of the engine to such an extent that the manufacturers prefer to spend around $200 for a complete set of shielding, rather than add resistance to the electrical circuit.

Suppressors do cause a loss of efficiency as can be proven by reports available in the Bureau Aeronautics, Dept. of Commerce. These reports also prove that in cold weather suppressors cause a harder starting engine, because the oil is thicker and as a result the compression is greater and the greater the compression the harder it is for the spark to jump the gap. Now if you add a resistance to the circuit it introduces a still greater load on the ignition system.

One thing however, the wire-wound suppressors do not lower the efficiency of an engine as do the graphite resistors. The former acts more on the principle of a choke and to some degree changes the frequency of the disturbance and removes it from the broadcast band.

No aircraft engine can be licensed that uses suppressors of any kind.

Suppressors will affect an engine that is worn or not in the best of condition; it surely, then, will affect a good running engine—but to a smaller degree.

Anything that affects the ignition to any degree, also affects fuel consumption and therefore the gas mileage.

I would like to debate this matter with anyone qualified.

H. E. ANDERSON,
Aviation Instructor,
Stewart Tech. School,
New York City.

We do not dispute Mr. Anderson in his vehement condemnation of suppressors on aircraft engines. The failure of a suppressor system at any altitude would be most disastrous. However, we reiterate our statement in the June issue, "that the use of suppressors on autos will not affect in any detectable way the operation of a normal engine." After all, a suppressor is only a series resistance in a high-potential circuit and does not take power from it. If the resistance was in shunt then there would be trouble.

Let's hear from our readers who install car sets and know engines. What has been actual experience? We have told you the results of dynamotor tests. Now the field should be heard from!

TUBE CUTTING TOOL

Editor, RADIO-CRAFT:

In *Radio-Craft,* June issue, third prize article (Short Cuts Department), the statement is made that house wiring porcelain tubes cannot be cut or broken to reduce the length, but must be ground.

I enclose two cuttings from a tube, using ordinary tube-cutting pinchers, so as to show what can be done. If the cuttings are longer, the ends are almost glass-smooth.

Tubes can be cut with the tube-cutting pinchers just as easily and with as little pressure, as cutting off chunks of wire with wire-cutting pliers.

ERNEST H. DANN,
Cloverdale, B.C.

Thank you, Mr. Dann, for calling this matter to our attention. We were aware of the tube-cutting pliers but did not feel that they would be found in most shops and it would not pay to have a reader purchase one purposely. Grinding was recommended as the best method so as to save the reader breaking tubes.

"CONVERTING OLD SETS"

Editor, RADIO-CRAFT:

I have just been looking over the Sept. issue of your magazine. While reading Fig. 4 on page 149 regarding the rebuilding of old battery radio sets, I find a very serious error.

I note that no "C" bias is provided for the R.F. tubes. As I have rebuilt about one hundred battery sets and am now rebuilding them at the rate of about three per week I think I am in a position to know what I am talking about. As shown in the diagram, low "B" drain is impossible. Also, the life of the type 30 is very short. Some method of providing a "C" bias on the R.F. tubes is necessary.

I am also a wholesaler of radio tubes and last year had quite a bit of trouble from Service Men in this district who wanted replacement when the trouble was due to lack of "C" voltage on the R.F. tubes. The life of the tube was about two months and the "B" battery lasted about half the time it did with the type 01A tubes.

Would suggest that you bring this to the attention of your readers.

VERN PETERS.
Havre, Montana.

Mr. Vern Peters.
Dear Sir:

Your letter to *Radio-Craft* was referred by them to me. It seems that you have discovered a very serious error in the diagram in Fig. 4, on page 149 of the Sept. issue of *Radio-Craft.* First, however, let me remind you that most rebuilt sets are a compromise between the ideal and the practical. If you spent enough time and money on any old set it could be rebuilt almost to the ideal type. The idea is to spend as little time and money possible on the job consistent with practical results.

I shall answer each of your statements as I came to them in the letter. "There is no "C" bias on the R.F. tubes." That is true, but what about 30s in class B with no bias? What about tube engineers' recommending 30s as being interchangeable with 99s—except for the filament voltage which should be changed to 2 V. We have made dozens of converted jobs 'way back when the 30s first came out, and most of them still have their original tubes with a few exceptions—and those were not tubes in any particular position in the set. I have also made a trip personally to see a competitor of mine in another city who also has had a wide experience in using the 30-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 suggested 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 taken with all the voltages exactly as shown in the diagram of Fig. 4. Volume full on: 17 ma. total plate current (the two R.F. tubes draw only 5 ma. together) and about .36-A. filament current. If a 30-type tube is substituted in place of the 31, the total drain is then only 14 ma. At this rate a set of batteries lasts a long time.

Comparing this with 01As in the same circuit, we find: 29 ma. total "B" drain (the R.F. tubes take 17 ma. of this), and about 1.3 A. filament current. Using an 01A in the last stage instead of a 12A, the total drain then is about 26 ma.

If the resistor of 20,000 ohms shown in Fig. 4 is omitted, the two 30s in the R.F. stages will draw about 30 ma. instead of 5. This resistor may be changed in value to suit each case in the set you are rebuilding. I am not saying this is the best way to solve this situation of high current drain, but it is a good, economical and practical way to get the results with very little trouble. It is the reason this set operates with as low drain as it does while still using no "C" bias.

LLOYD MOORE,
Moore's Radio Shop,
Chariton, Iowa.

As Mr. Moore points out, the 20,000 ohm resistor 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 method.

THE LISTENING POST FOR ALL-WAVE DX-ERS

(*Continued from page* 159)

seems is falling down, for the little South American Republic of Colombia has almost twice as many short-wave stations as we here in the U.S. do, and strangely enough not a single short-wave broadcasting station may be found west of the Mississippi river. W2XHI, the long delayed short-wave relay for station WOR, seems to be the only major short-wave station in this country in actual erection. It would seem a fine thing to us if the United States could organize at least one high class short-wave station on the lines of Daventry, so that we too might *officially* sell to the World the best points of our own country, as the other nations of the world are doing daily with their excellent programs of fine music, and entertainment. Although not advocating a turning away from our own successful system of commercial sponsorship, I would suggest that one station at least be free from advertising "plugs" for the complete enjoyment of our many hundreds of Americans living abroad.

DX-ING IN REMOTE WEST CHINA!

In the province of Szechwan (in the most remote part of west China) and near the border of forbidden Tibet, lies the mysterious and ancient Chinese city of Chengtu. Here in the midst of some 400,000 Chinese a small colony of perhaps 75 English-speaking people reside, and operate the "Canadian Mission."

One of these, is Mr. T. E. Plewman, who is connected with the Mission Press. Mr. Plewman is one of the most enthusiastic DX-ers in all China, but his DX-ing differs quite a lot from what we experience here. Almost any night far into the wee hours of the morning Mr. Plewman may be seen carefully turning the dials of his receiver, and listening intently for certain far away "News Periods" from London, Paris, Berlin, or even New York. Anything that Mr. Plewman hears in the nature of news, or events of the day, he carefully notes in his little press book. The next day will see Mr. Plewman setting these notes up in type in what is perhaps the smallest, and most unique newspaper in the World. This tiny sheet goes under the heading of "News From the Air", and is the only English newspaper for 1,000 miles around. The London newspapers are already three weeks old by the time they reach Chengtu, so it can well be imagined with what avidity the few English families eat up these fragmentary notes that serve to give them their only touch with the outside world.

Mr. Plewman's radio set was the first in West China, and before he could get possession of it, it was necessary for him to pay over $100.00 levy on it to the Chinese War Lords who control traffic on the 1,000 mile long river that gives them their only access to the Ocean. This was, of course, an illegal levy, but in order to get his radio receiver he must pay it. Before the receiver was finally delivered it was necessary for it to be carried on the backs of coolies for part of the journey. The magic of radio reception was regarded 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 power supply also constituted quite a problem as it was only on at certain hours, usually when the set was not needed, and was found to fluctuate so badly in voltage as to make reception a sort of gamble.

Despite all of these handicaps, Mr. Plewman soon became proficient in the use of his receiver, and found that reception at its best was excellent from the larger stations. For example, in a sample log kept during one night in September Mr. Plewman lists Prague, Czechoslovakia; Belgrade, Yugoslavia; Stockholm, Sweden; Berlin, Germany; Hamburg, Germany; Horby, Sweden; Brno, Czechoslovakia; Copenhagen, Denmark; Toulouse, France; Leipzig, Germany; Vienna, Austria; Budapest, Hungary; Graz, Austria; Breslau, Germany; West Regional, England; Moravska-Ostrava, Czechoslovakia; Gleiwitz, Germany. All of these stations were of course logged on the regular broadcast band, as at that time Mr. Plewman did not have an all-wave receiver. 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 News gathering in the daytime, much to his delight.

One of Mr. Plewman's strangest experiences he states was some months after the death of the Delai Lama of Llhasa, Tibet, an occasion of greatest importance in this most remote country of the world. A group of Tibetan lamas from the Tzagulas Lamasery had visited Chengtu, and here seated crossed legged on the pavement in front of Mr. Plewman's house, they became aware for the first time of the death of their supreme ruler, for news travels slowly in Tibet. The lamas immediately bowed their heads down to the pavement in homage to this strange god which spoke prophecy from the sky, and then shook their heads in consternation and half unbelief.

Other high spots in radio reception in this community was Mr. Plewman's feat in pulling in the ceremonies attendant upon the marriage of the Prince, and Princess in Great Britain, and the more recent reception of the Jubilee Ceremonies of the King's Silver Anniversary.

Even as we write this story rumbles of trouble in far away Chengtu are reaching our ears, and a report states that over 2,000 Communists have been slain in one bloody battle at Chengtu. Many of the white people have removed from the city, and perhaps before this article goes into print Mr. Plewman 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 station HCJB, Quito, Ecuador, informs us that HCJB is now transmitting on a new wavelength of 36.5 meters—a frequency of 8,214 kc. They are on the air each evening of the week except Monday from 7:00 to 11:00 pm. Sunday they are on from 4:00 until 10:30 pm. Quito time is 14 minutes slower than E.S.T. HCJB will gladly send a verification to all radio fans who prove receptions of its programs with a correct log, and who send an international reply coupon.

An official communication from short-wave station VQ7LO, Cable and Wireless Limited of Nairobi, Kenya Colony, Africa, states that the present schedule of the station is as follows: (Sunday 11:00 am. to 2:00 pm.; E.S.T. Monday, Tuesday, Wednesday, Thursday, and Friday from 5:45 to 6:15 am., E.S.T.; Monday, Tuesday, Wednesday, Thursday, and Friday from 11:30 am. to 2:30 pm.; Tuesday and Thursday from 8:30 to 9:30 am., E.S.T., and Saturday from 11:30 am. to 3.30 am., E.S.T.) VQ7LO urges caution in reporting their station as many incorrect, or mistaken reports are received by them.

Short-wave station HJ1ABB, Baranquilla, Colombia, 46.60 meters, owned by Elias Pellet is again issuing verifications for correct reports.

The new Icelandic short-wave station when completed will use the following calls, and frequencies: TFK, 9,060 kc., TFL, 13,965 kc., TFM, 15,740 kc. The new station will probably be testing about the time this article appears in print.

HIZ, Santo Domingo is back on the air on 6.34 mcs. with a reported 75 W. transmitter.

TI-RCC, San Jose, Costa Rica, 6,550 kc. operates regularly from 6:00 to 7:00 pm., E.S.T., and TI-5JJ, also in Costa Rica on about 7,400 kc. operates on Saturday from 4:00 to 6:00 pm. with but 15 W.

YV2RC, Caracas, Venezuela, 49.08 meters has increased their power to 1,000 W. and are coming through with greatly increased signal strength. YV2RC is now sending out a regular QSL card in addition to their booklet describing Venezuela.

RNE, Moscow, 25 meters has replaced RV59 on its 2:00 to 6:00 p.m., E.S.T. schedule. This is a fortunate move for U.S. DX-ers as RV59 is seldom heard in the summer time.

EAQ, Madrid, Spain, 30.43 meters has inaugurated a period of their program dedicated to the U.S., daily. This takes place at about 6:30 pm., E.S.T., and consists of news and items of particular interest in English.

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, 5,105; KEI, 9,490; KEJ, 9,010; KEM, 15,490; KER, 10,390; KES, 10,410; KET, 9,480; KEZ, 10,490; KIKC, 4,550; KKL, 15,475; KMM, 20,780; KQZ, 17,980; KRR, 15,460; KSS, 20,820; KUN, 18,060; KWE, 15,430.

Dixon, California. KWU, 15,355; KWV, 10 840; KWX, 7,610; KWY, 7,565.

Kahuku, Hawaii. KIO, 11,680; KKH, 7,520; KKP, 16,030; KQH, 14,920; KRO, 5,840.

Ocean Gate, New Jersey. WOG, 16,270; WOO, 4,272; —4,753; —8,560; —12,840; —17,-120; WOP, 19,380.

Lawrenceville, New Jersey. WCN, 5,077; WKA, 21,060; WKF, 19,220; WKK, 21,420; WKN, 19,840; WLA, 18,340; WLK, 16,270; WMA, 13,390; WMF, 14,470; WMN, 14,590; WNA, 9,170; WNB, 10,675; WOA, 6,755; WOF, 9,750; WOK, 10,550; WON, 9,870; WOY, 4,272, 4,753, 8,560, 12,840, 17,120.

Rocky Point, New Jersey. WAD, 4,550; WBU, 21,260; WCG, 10,380; WDA, 6,733; WDB, 6,718; WDG, 4,535; WDN, 4,555; WEA, 10,-610; WEB, 14,770; WED, 10,630; WEF, 10,620; WEG, 7,415; WEM, 7,400; WES, 9,450; WET, 9,470; WEZ, 8,075; WFX, 18,980; WIR, 4,540; WKM, 18,860; WKQ, 16,000; WKU, 14,830; WLL, 17,900; WQA, 21,220; WQB, 17,940; WQC, 17,860; WQF, 17,920; WQG, 15,040; WQJ, 21,240; WQN, 5,260; WQQ, 20,-260; WQT, 13,885; WQV, 14,800; WQW, 10,-640; 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 I.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 neater and safer job, however, and is easier. 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. However, the set works quite well on as low as 4.25 V., so, in a pinch, 3 dry 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 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 5 to 8 ma., depending upon filament voltage.

The second-detector regeneration control, when turned so as to short the tickler, will 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-wound choke of 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 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 they 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 230, which are more efficient due to their higher amplification factor, but they are bigger.)

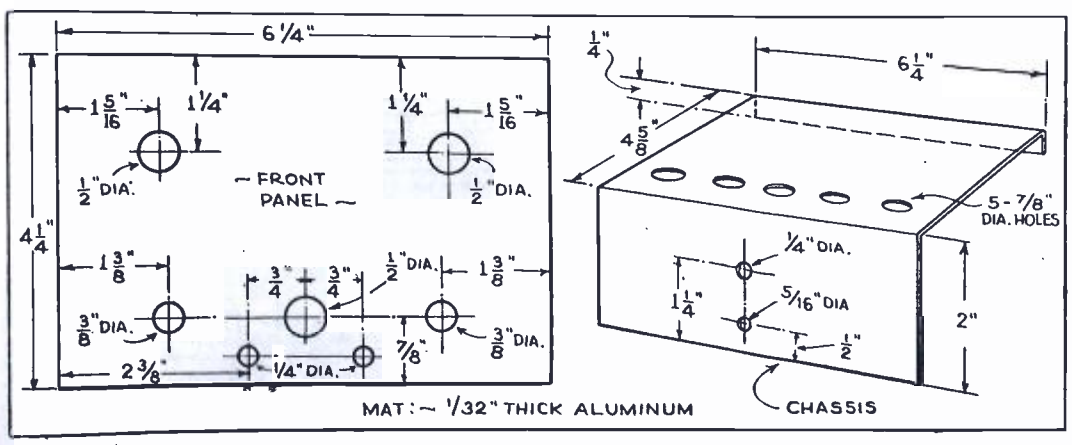
With the two balancing condensers all the way out, and the antenna coil tuning condenser at mid-scale, it will be found that rapid rotation of the oscillator condenser will cause a click in the phones. This means that the first tube circuit has gone out of oscillation, because of absorption of energy 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 I.F. band passed, and if coupled to a power stage, 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 "B" batteries obtainable.

LIST OF PARTS

Two Hammarlund condensers, 325 mmf. variable C1, C2;
*Two condensers, 300 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-140 D, C5, C6;
*One condenser, .001-mf., bakelite postage stamp type, C9;
One Aerovox tubular condenser, .05-mf., C10;
*Two midget coils, one Ant., one R.F., L1, L2—L3, L4;
Two iron-core I.F. transformers, see text, I.F.T.1, I.F.T.2;
*One interruption-frequency coil, L6, L7 of I.F.T.3;
One small R.F. choke of 10 to 20 mh., L5;
One midget-type A.F. transformer, 3 to 1 ratio, A.F.T.;
One ¼-W. .5-meg. resistor, R1;
One ¼-W. 1 meg. resistor, R3;
*Two .5-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, 4½ x 2¼ x $\frac{1}{16}$-in. thick;
One Blan aluminum sub-panel, 6¼ x 6⅞ x $\frac{1}{16}$-in.;
Two Na-Ald or I.C.A. 2 in. dials with bar knobs.
(*Names of manufacturers will be sent upon request.)

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



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 pick-up afforded in a small boat), and reasonable selectivity, the logical choice was a superheterodyne circuit. Automatically, then, the following services 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 functioned 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, 950, second A.F. All these tubes (except the 950) have small envelopes. "Skin-tight" shields are required over V1, V2 and V3; for the sake of clarity they are not shown in the photographs.

To be completely self-contained it was essential of course that the entire power supply ("A," "B" and "C" batteries) be included in the cabinet with the chassis. The ordinary small-space "B" batteries (the so-called "Signal Corps" size of 45 V. "B" battery measures 3¾ x 3¾ x 2¼ ins. deep) promised to kill the small-set idea almost at the start, until it was found that one nationally-known manufacturer was working on a 45 V. unit measuring only 3 x 4¼ x 1¼ ins. deep. The saving of 16 cu. ins. in the latter instance did the trick. The "A" and "C" batteries, although also of a special size were not such a problem.

These "B" 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 135 V. plate, its "B" drain (total) is 17.5 ma. THIS IS MORE "B" CURRENT THAN IS CONSUMED BY THE ENTIRE Rowboat Portable!

The answer, as to a suitable output tube, was found in the type 950 mentioned in past issues of *Radio-Craft* (see, for instance, "A 'Super' Battery Portable," *Radio-Craft*, June 1934). Its characteristics follow:

Filament, 2.0 V.; .12-A.
Plate, 135 V.; 5.5 ma.
Control-grid, —16.5 V.
Screen-grid, 135 V.; 2 ma. (max.)
Mutual conductance, 950 mmhos.
Amplification factor, 80
Power output, 450 milliwatts

As previously intimated, not all the saving in "B" drain was affected through the use of a low-drain output tube; utilizing a new, low-drain variable-mu tetrode (the 1A4) 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 1A4 are as follows:

Filament, 2.0 V.; .06-A.
Plate, 135 V.; 2.3 ma.
Control-grid, —3 V.
Screen-grid, 67.5 V.; 0.7-ma.
Amplification factor, 720
Plate resistance, 0.96-meg.
Mutual conductance, 750 mmhos.*
(*at —15 V. grid bias, 15 mmhos.)

A hasty examination of the circuit indicates the following details.

An unshielded antenna coil, L1, is utilized in order to secure highest efficiency in this portion of the circuit. Coil L2 is a "composite" unit incorporating in one case both the oscillator and the I.F. transformer inductances. This construction eliminates all except electron coupling within tube V1. Both the primary and the secondary sections of transformers I.F.T.1 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 cause — iron filings in the air gap, and too great spacing of polepiece and air gap). Also, the frame of this reproducer *must* be grounded — to either the chassis or the ground terminal (lead), *but not both.*

MECHANICAL DETAILS

We do not recommend the construction of a metal chassis since a very suitable one can be obtained already formed and drilled from any mail order house. In fact it would be best 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 mount the 5-inch magnetic 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 of it is the second I.F. transformer. In wiring the receiver (and this is true of all small-space sets) do not cut the pigtail leads of the resistors and condensers just short 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 off 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 H terminal of V3, instead of present positive H connection. In some cases it may be advisable to try connecting R8 to the negative H terminal of V3, instead of to the R1-R3 tap. Added sensitivity is obtained by returning the secondary of L1 to the negative H terminal of V1, 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 a wire dropped overboard and into the water for the ground, and a 5 or 10 ft. length of wire strung at random within the boat for the antenna.

LIST OF PARTS

One Wholesale Radio, type Premier, 5-in. magnetic speaker;
One Wholesale Radio 2-gang variable condenser, 350 mmf., with 465 kc. tracking section, C1, C2;
One Wholesale Radio, type "BC Ant.," high-gain antenna coil for broadcast reception, L1;
One Wholesale Radio, type NY401, composite oscillator coil and 465 kc. I.F. transformer, I.F.T.1.;
One Wholesale Radio, type NY400, 465 kc. I.F. transformer, I.F.T.2;
One Electrad 10,000-ohm tapered volume control with attached D.P.S.T. switch, R1, Sw.;
*One A.C.-D.C. type receiver cabinet, with 4-tube chassis to fit, and zipper carrying case;
Four Cornell-Dubilier tubular condensers, .02-

(*Continued on page* 184)

Fig. A. The front view of the chassis removed from the cabinet.

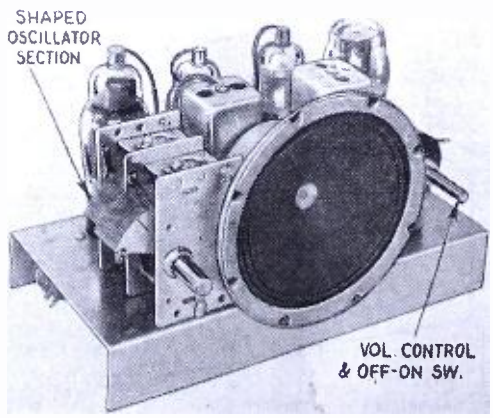
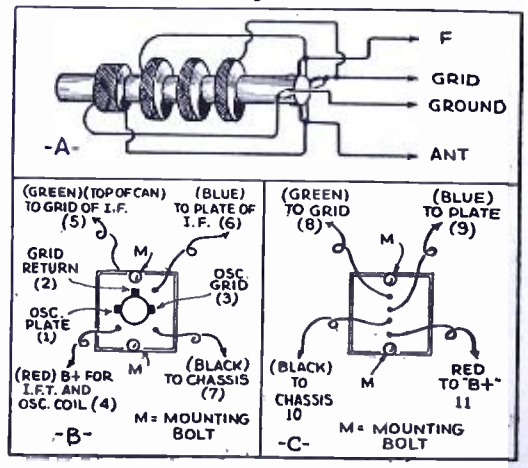


Fig. 3. Coil wiring details for the set.



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 four tuned circuits with a band-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.R.F. stages, and in this little receiver the 6K7 tube replaces a 6D6 in both positions. The detector tube employed is the 6J7, replacing a 6C6. The output stage uses a single 6F6 power pentode in place of a 42. The antenna used with the receiver was about 50 ft. 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 difficulty would be experienced on the part of the person building this very simple receiver. Of course, substitution can be made, as we found out after considerable testing, by simply changing the socket and using tubes of the 6D6 type in the two R.F. stages, a 6C6 in the detector stage, a 42 in the output stage, and an 80 rectifier. We bring this point out at this time as there may be some who would be desirous of building this receiver, but who will not be in a position to obtain the metal tubes for sometime to come. Of course it 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 as the two pictures show most of the details of the placement of parts except those small fixed condensers of the tubular type, and the carbon resistors, which are held in place more or less by wiring 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 6F6 power tube. The speaker field coil resistance of the particular unit used with this receiver was 1,800 ohms overall with a tap at 300 ohms. This 300-ohm tap delivered sufficient bias voltage for the 6F6 output tube, 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 permit any resin to stay on the connection as poorly soldered connections always reduce efficiency. The usual procedure first is to wire-up 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 pigtail leads. Common sense used in the placement of the parts not indicated in the photographs will insure very satisfactory operation of a receiver 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 V. line, plug in the speaker 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 8. Set your service oscillator to 1,500 kc. Adjust all four trimmers to maximum reading on output meter if available, also maximum sound and loudspeaker. Keep the power from oscillator at a very low level to insure accurate tuning. If necessary, check at lower frequencies, but as this particular receiver was designed so that the coils and condensers are matched with the dial, satisfactory tracking is then obtained if 1,500 kc. is tuned in at 8 on the dial.

LIST OF PARTS

One Acratest chassis;
One Acratest 4-gang tuning condenser, 360 mmf. each section;
One Acratest pre-selector coil;
Two Acratest R.F. coils;
Five Na-Ald 8-prong sockets;
One Electrad 15,000-ohm volume control, and off-on switch;
Three Aerovox condensers, .1-mf., 400 V.;
Three Aerovox condensers, .1-mf., 200 V.;
One Aerovox condenser, .01-mf., 400 V.;
One Cornell-Dubilier condenser, 10-mf., 35 V.;
One Aerovox mica condenser, 500 mmf.;
Two Cornell-Dubilier electrolytic condensers, 8 mf., 450 V.;
One Centralab resistor, 300 ohms, ½-W.;
One Centralab resistor, 2,000 ohms, ½-W.;
One Centralab resistor, 10,000 ohms, 2 W.;
One Centralab resistor, 20,000 ohms, 2 W.;
One Centralab resistor, 30,000 ohms, ½-W.;
One Centralab resistor, 50,000 ohms, ½-W.;
One Centralab resistor, 0.1-meg., 1 W.;
One Centralab resistor ¼-meg., ½-W.;
Two Centralab resistors, ½-meg., ½-W.;
One Centralab resistor, 1 meg., ½ W.;
One General Transformer Corp. power transformer;
One Blan line cord and plug;
Three Na-Ald metal-tube control-grid caps;
One Acratest dynamic speaker;
One Blan 5-wire speaker cable;
One Acratest 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 L3.

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

Coils L1, L2 are soldered directly to the terminals of the tuning condenser, and R1 and C3 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 the two 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 is not used).

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 not 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 to 35 ma. It is not advisable to run the tube any higher than about 55 ma. total for both sections. The modulator draws about 1/10 the total current.

When receiving, the voltage on the detector may be reduced to 90 V. or less without any loss in sensitivity. In fact, a gain is sometimes experienced. It may be necessary to bend the antenna coupling condenser plates farther apart to keep the detector circuit from going out of oscillation at the antenna resonance point. No trouble will be had in receiving signals from as far as you can transmit them.

The writer will be glad to answer any questions in regard to this outfit.

BUILD THIS "6-IN-4" ROW-BOAT PORTABLE

(*Continued from page* 182)

mf., 200 V., C3, C5, C12, C16;
Two Cornell-Dubilier tubular condensers, .1-mf., 200 V., C6, C14;
One Cornell-Dubilier tubular condenser, 1. mf., 200 V., C11;
Two Cornell-Dubilier mica condensers, 500 mmf., 200 V., C13, C15;
One Cornell-Dubilier tubular condenser, 600 mmf., 200 V., C17;
One Cornell-Dubilier tubular condenser, 250 mmf., 200 V., C4;
One Cornell-Dubilier tubular condenser, .25-mf., 200 V., C10;
One Cornell-Dubilier tubular condenser, 200 mmf., 200 V., C18;
One Electrad resistor, 5,000 ohms, ½-W., R2;
One Electrad resistor, 2.000 ohms, ½-W., R3;
One Electrad resistor, 0.1-meg., ½-W., R4;
One Electrad resistor, 10,000 ohms, ½-W., R5;
One Electrad resistor, 0.5-meg., ½-W., R7;
One Electrad resistor, 3 megs., ½-W., R8;
One Electrad resistor, 1 meg., ½-W., R10;
One Electrad resistor, 50.000 ohms, ½-W., R13;
One Electrad resistor, 0.3-meg., ½-W., R9;
One Electrad resistor, 6,000 ohms, ½-W., R11;
One Electrad filament ballast resistor, 3 ohms, R12;
Two Na-Ald 6-prong wafer sockets (for V1 and V3);
One Na-Ald 4-prong wafer socket (for V2);
One Na-Ald 5-prong wafer socket (for V4);
Three Na-Ald screen-grid clips (for V1, V2 and V3;
One Blan 6-wire color coded battery cable;
*Three special, extra-small size 45 V. "B" batteries;
*One special, extra-small size 2 V. "A" battery;
*Three special, extra-small size 7½ V. "C" batteries;
Two National Union type 1A6 tubes, V1 and V3;
One National Union type 1A4 tube, V2;
One National Union type 950 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

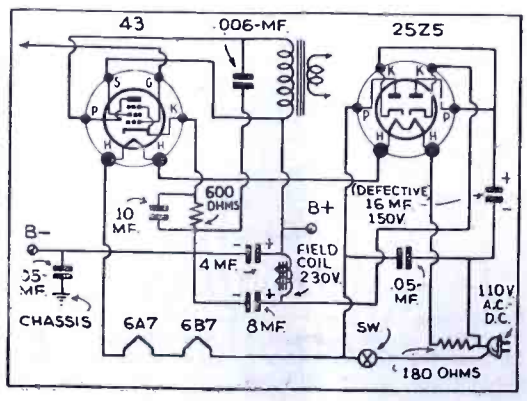
(*Continued from page* 160)

LYRIC MODEL C-M-4

THIS is a 4-tube regenerative reflex superhet. using a 6A7 as 1st detector and oscillator, a 6B7 reflexed for use as an I.F. amplifier, second detector, automatic volume control and first audio, a 43 in the output stage and a 25Z5 rectifier. The receiver was "dead." The tubes did not light, and a check revealed the filament of the 6B7 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 condenser 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 putting the receiver into normal operation. A voltage reading taken from a common "B" reference point to the output cathode of the 25Z5 showed a jump to 230 V., which is about right, though the D.C. output will vary in different localities with the applied line voltage.

STANLEY STOLBA

Fig. 4. A defect in the Lyric C-M-4.



"CONTROLLED SOUND"

(*Continued from page* 157)

arch, and still other speakers distributed about the auditorium wherever they may be necessary. Figure 1 shows one such set-up, requiring 16 reproducers, in "The Brainstorm" scene of "The Adding 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 minister are presumably heard issuing from the sound system. Professor Burris-Meyer is shown, in Fig. C, at the controls of the monitor control board, and lending his voice as the "thoughts."

In Fig. C appear three of the five reproducers that perch high overhead in the proscenium arch. In Fig. D are shown three loudspeakers arranged in a row; a voice picked up by a single microphone is faded from one reproducer to the other, creating the illusion that the person stationery in front of the "mike" actually 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 most unique feature of the installation is the mixing system which provides for mass flexibility, that is, the use of either or both amplifiers with any group of inputs and the mixing of all outputs from either or both amplifiers. (Figure E illustrates this equipment, in the main control room above the stage, being manipulated 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.

OVERTONES

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, and a translucent 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 JEALOUSY OF EMER

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, "Overtones," by Alice Gerstenberg. This play involved the "alter egos" (other personalities) of two characters. The actress spoke the lines of the visible personalities. The invisible personalities were heard in the voice which was common to both personalities from whatever position the actress in question occupied but without the necessity of her opening her mouth. Absolute fidelity is required from this sort of reproduction which also involves perspective.

The ghost in Hamlet has always had a voice which sounded very much like a live man's voice. Moreover if the ghost is actually played by an actor the audience does not react to him very well, since no actor satisfies the translucent —has not the transparent or ethereal quality that supposedly characterizes disembodied spirits. In the Stevens production of the two scenes which involve the ghost, the ghost was

Fig. F. An Assistant "riding the gain."

produced by projecting a motion picture on gauze so that the resultant figure could move about, could appear to walk through walls and characters on the stage, and could be seen through and moved through. Through ordinary perspective the ghost was equipped with a voice which came from any position the ghost might occupy or which moved as the ghost moved. The voice itself was made to have an utterly unearthly but perfectly understandable quality which was not reminiscent of a radio or phonograph. This was accomplished by developing a special microphone technique and microphone designed for that specific purpose and by the use of filters to take out such frequencies as were undesirable.

A technique similar to that employed in "Overtones" was employed in a scene from Elmer Rice's "The Adding Machine" in which a man went mad and the audience was enabled to hear all of the racket which went on within his brain. The noise was composed of symbolical sounds generally accepted to indicate incipient mental derangement. As the insanity grew more and more apparent the volume was increased and *the audience reaction was more apparent than it is in conventional productions of the same scene.*

A dance pantomime was staged in which the dancers were supposed to carry long, and rather involved speaking parts as they moved about the stage. A dancer seldom has the breath to carry a long speaking part and for that reason they were furnished with voices in perspective so that voices appeared to come from the dancers no matter what positions on the stage they occupied or how fast they moved. In this case of course the voice could be suited to the character which the dancer was supposed to represent without the necessity of the dancer having that kind of a voice at all.

A scene from "The Adding Machine" which is accompanied by orchestral music has always been hard to produce since the orchestra has a tendency to drown out the actors or make them shout, and the scene is one which would be utterly spoiled if the actors shouted. The desired effect was secured on the Stevens stage by placing the orchestra in a room some distance from the stage, reproducing the music and at the same time picking up all the speech from the stage with other microphones, and then reproducing the speech at the same time the music was reproduced. The effect of this system made it possible for the actors' voices to be heard over the music no matter how loud the music played. (A project is now afoot to apply similar technique to opera.)

In the "office" scene from "The Adding Machine," the theatrical "aside" was demonstrated to be unnecessary. The characters, instead of speaking their straight lines and then turning from the audience and delivering asides which were not supposed to be heard by the other actors on the stage, said only their straight lines. The lines of the aside were heard in the voices of the actors and apparently from the position of the actors but the actors went about their business and did not open their mouths. The theatrical aside has always been a clumsy convention and it is now rendered unnecessary.

(*Continued on page* 186)

"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 3-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. By means 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 Halbran.)

Although the technique so far developed for the control of sound in the theatre is admittedly crude, two points stand out quite definitely: first, it is evident that controlled sound is a much more powerful means of creating audience reaction than many other devices which are used in the theatre; 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 tag used as a record form by an alert service company in New York—this greatly facilitates the maintenance of complete records.

Bill No. ..... Date .....

Nº 2001 Promised .....

Name .....
Address .....
Apt. ..... Appointment .....
Type .....
Complaint .....

CHARGES

Parts	
Tubes	
Aerial	
Service Charges	
Total	

Sign If Satisfactory
Customer's Signature .....

ALL REPAIRS ARE C. O. D.

Nº 2001 CLAIM CHECK Total Cost $ _____

RADIO INSTALLATIONS OF THE NORMANDIE

THESE installations some of which are shown on page 136 of this issue are composed of: (1) radio-telegraph and radio-telephone apparatus for use in handling commercial traffic; and (2) radio-telegraph 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 telegraph transmission panel, 19½ ft. in length by 5½ ft. in height, divided into the following units:

One panel of general current distribution (power panel) and charging of the storage batteries.

One short-wave telegraph transmitter in 3 chassis for C.W. and I.C.W. transmission; power: 2 to 2½ kw.; range: 15 to 120 meters; number of waves available: 10.

One long-wave telegraph transmitter in 2 chassis for C.W. transmission covering the 600-800 meters range; power: 600 W. in the antenna; number of waves available: 7. This unit is provided with emergency storage batteries to be used in case of power failure of the ship's direct current.

This entire telegraph transmission panel is controlled from an operating table, 12½ ft. in length, where two operators can simultaneously handle traffic on both long and short waves.

On this table are located the two corresponding receivers.

(b) One short-wave radio-telegraph receiver covering the range 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-telegraph receiver covering the range of 300-5,000 meters. The power for this receiver can be obtained through special filters from the ship's direct current, under normal operation, or from storage and dry batteries in case of power failure.

(c) A system of duplex press reception functioning independently from the other installations, and if necessary at the same time, covering all waves between 8,000 and 20,000 meters. The power for this receiver is obtained from the ship's direct current.

(d) A 3-panel unit for short-wave radio-telephone transmission to handle passenger telephone 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 wave emitted; it covers the range of 17 to 70 meters and has 8 available waves. The dimensions are 9¾ ft. in length by 6 ft. in height. The frequency stability is 1/10,000 and its audio-frequency characteristics have been particularly extended for high fidelity.

(e) A special receiver for handling radio-telephone traffic, located in a shielded cabin independent of the "Commercial Cabin". This receiver has exceptionally good frequency characteristics and covers the range of 14 to 80 meters. Its power for operation is obtained from the ship's direct current.

(f) A switchboard installed near the passenger's booth permitting the "Radio Secretary" to communicate with the land station and complete telephone connections for the passengers.

(g) Two frequency meters, one for long and the other for short-waves, for the tuning of the various apparatus in the cabin.

In addition, a cabin adjacent to the commercial cabin contains the different machines and contactors insuring the current distribution to the above described units and an additional compartment houses the storage batteries.

BRIDGE INSTALLATIONS

A special cabin has been reserved for the bridge to receive the radio installations used in work relating to navigation. This cabin comprises:

(a) A system of radio-telegraph transmission in the form of a panel 8½ ft. in length by 5½ ft. in height composed of 2 units:

One panel in 2 chassis of current distribution for the transmitter and charging of the storage batteries.

One medium and long-wave radio-telegraph transmitter in 2 chassis 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 operated from emergency 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 one operator. These receivers are operated exclusively by storage and dry batteries.

(c) A ship-board radio-direction-finder of great selectivity adapted to a directional oriented frame. This apparatus can take bearings on stations of all descriptions transmitting in the range of 450 to 3,000 meters and is located in the chart-room adjacent to the bridge radio cabin.

(d) A sounding device, working on ultra-sound, also installed in the chart-room.

In conclusion, it may be mentioned that two motor life-boats are equipped with distress signaling apparatus composed of radio transmitters of the spark (damped waves) type and with radio receivers. These installations are operated by storage batteries.

The apparatus described above has been specially designed for the NORMANDIE and was constructed (with the exception of the sounding device) by La Societe Francaise Radio-Electrique. It has benefited by the latest inventions and discoveries in the progress of science and its possibilities of performance have definitely surpassed those of its predecessors; equipment now on the PARIS, ILE DE FRANCE, LAFAYETTE, CHAMPLAIN, etc.

With reference to technical specifications of the apparatus, they are well within the limits allowed or prescribed by the international radio regulations now in force: purity of emission; frequency stability (even 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 construction is all-metal (the chassis are of copper-plated tin, the bases of all suspended circuits are rigid castings; the panels are movable and equipped with safety contacts.) All insulators have been chosen with great care; quartz, glass, micalex, steatite being employed.

The features involved in the pilot circuits and successive stages, independency of the 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 6 aerials are specially located to permit the simultaneous operation of two transmitters with duplex facilities (simultaneous transmission and reception).

In conclusion, infinite precautions have been taken in the construction of the apparatus to reduce fire hazards (metallic construction, location and insulation of all cables, all of ample 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 of the transmitters have been calculated to permit direct telegraph and telephone communications with Le Havre or New York during the entire voyage.

To give an idea of size of the radio installations of this giant vessel it is in order to state that:

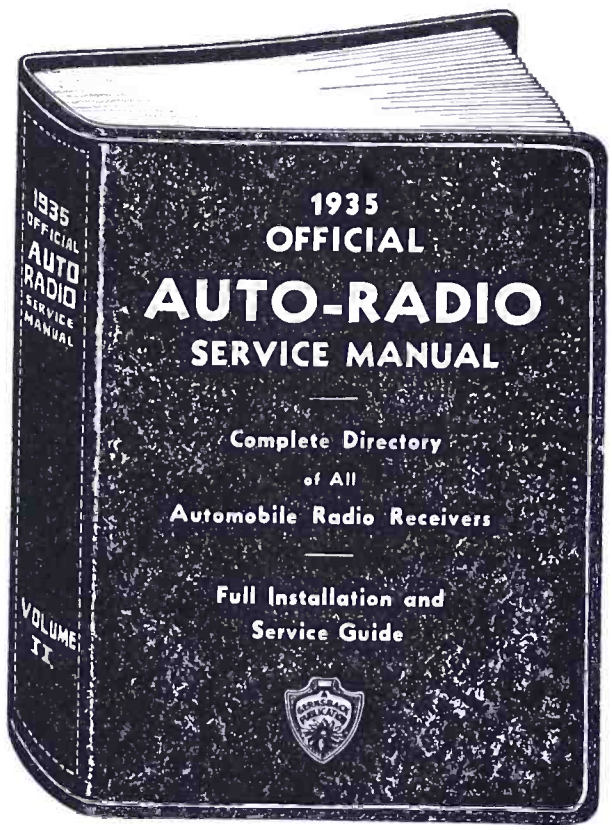
(1) The total power of the various transmitters will absorb an energy of over 25 kw.

(2) The total weight of the apparatus described above is in excess of 16 tons.

The enormous proportions of the installations in this ship, as well as the attractive appearance can be realized from the photos on page 136.

NOW READY!

The 1935 *Official* AUTO-RADIO SERVICE MANUAL



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- 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.
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Atwater Kent Mfg. Co.
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Autocrat Radio Co.
Automatic Radio Mfg. Co.
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Carter Motor Corp.
Century Radio Products Co.
Chevrolet Motor Corp.
Chrysler Motor Corp.
Colonial Radio Corp.
Consolidated Industries Ltd.
Crosley Radio Corp.
Delco Appliance Corp.
Detrola Radio Corp.
Emerson Electric Mfg. Co.
Emerson Radio & Phonograph Co.
Fada Radio & Electric Corp.
Federated Purchaser, Inc.
Ford Motor Corp.
Ford-Majestic
Franklin Radio Corp.
Freed Television & Radio Corp.
Galvin Mfg. Corp.
General Electric Co.
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Grigsby-Grunow Co.
Gulbransen Co.
Halson Radio Mfg. Co.
Hi-Lo Radio Co.
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Howard Radio Co.
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International Radio Corp.
Karadio Corp.
P. R. Mallory & Co.
Melburn Radio Mfg. Co.
Mission Bell Radio Co.
Montgomery Ward & Co.
National Company, Inc.
Noblitt-Snarks Industries, Inc.
Philco Radio & Television Corp.
Pierce Airo, Inc.
Premier Electric Co.
Radio Chassis, Inc.
Radolek Company
RCA Manufacturing Co., Inc.
Remler Co., Ltd.
R. K. Radio Lab.
Sears Roebuck & Co.
Sentinel Radio Corp.
Simplex Radio Co.
Sparks-Withington Co.
Stewart Radio Corp.
Stewart-Warner Corp.
Stromberg-Carlson Tel. Mfg. Co.
L. Tatro Products Corp.
Transformer Corp. of America
United American Bosch Corp.
United Motors Service Inc.
U. S. Radio & Television Corp.
Utah Radio Products Co.
Wells Gardner & Co.
Wholesale Radio Service Co.
Wilcox-Gay Corp.
Rudolph Wurlitzer Mfg. Co.
Zenith Radio Corp.

GERNSBACK PUBLICATIONS, Inc.
99 HUDSON STREET NEW YORK, N. Y.

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 counter 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, *at normal bias*, is vibrated vigorously at the same time to disclose mechanical defects; the test sockets are mounted on a cushioned strip 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 1¼ x 4⅜ ins. high. The 3-volt "A" battery is 3 x 2⅝ 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 400 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 megs. 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 mf., 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 I.F. transformers, and a unit containing all R.F. coils, padding 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 33⅓ 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.

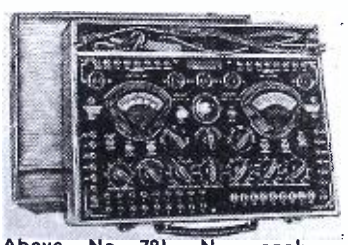
PRECISION DIAL (794)

ACCURATE calibration on from one to five bands is possible with this new dial. It is available in window and full-vision types. An adjustment at any point in a range does not affect those previously made. The mechanism is accurate in operation and fool-proof.

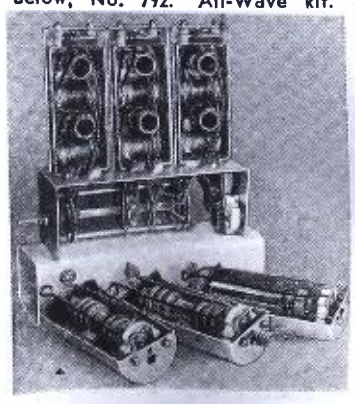
HANDY SHOP TOOL (795)

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 makers list a great variety of tools of every conceivable type, including such odd ones as a tiny sandpaper drum, drills, polishing tools, saws and many others.

(*Continued on page* 191)

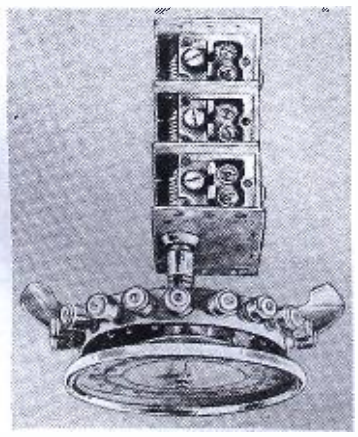


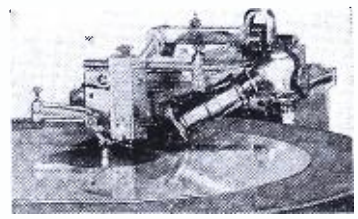
Above, No. 791. New analyzer. Below, No. 792. All-Wave kit.



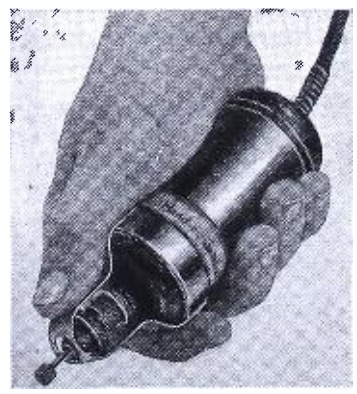
Above, No. 793. Professional recording machine; Right, close-up view of same outfit.

Below, No. 794. Special dial.





Below, No. 795. Builders' tool.



A "MULTI-SET" KIT FOR 1 TO 3 TUBES

(*Continued from page* 148)

employed, are listed below:

BATTERY MODELS

(1) One type 30 or 01A tube—recommended for the beginner in set building.

(2) One type 19—this 2-in-1 tube equals a detector and a stage of A.F.

(6) Two type 30 or 01A tubes—this is a detector and transformer-coupled A.F. stage.

(7) One 30 and one 33—this is similar to No. 6, but uses the power pentode for more volume.

(8) Two 30s and one 33—a detector and two A.F. stages giving full loudspeaker volume.

(9) One 19 and one 33—similar to set No. 2 but with a power pentode to give loudspeaker volume.

A.C. MODELS

(3) One 56, 27, 37, or 76 tube—an easily-built 1-tube set which requires only 45 volts of "B" potential.

(10) Two 56 or 27 tubes—supplies a detector and one A.F. stage with transformer coupling.

(11) One 56 and one 2A5 tube—similar to No. 10, but using a power pentode for greater volume and better quality.

(12) Two 56s and one 2A5—a powerful set having a detector and two stages of A.F., one of which utilizes a power pentode.

A.C.-D.C. SETS

(4) One 12A7 tube—this receiver supplies its own power; the circuit is shown in Fig. 1.

(5) One 76 and one 12Z3—a triode detector and a separate rectifier for plate supply.

(13) One 6F7 and one 12A7—a new 4-in-2 circuit. Each tube acts as two separate tubes.

(14) One 78 and one 12A7—which supplies 3-tube performance—a detector, pentode A.F. amplifier, and rectifier.

(15) One 76 and one 12A7—similar to No. 14 in performance.

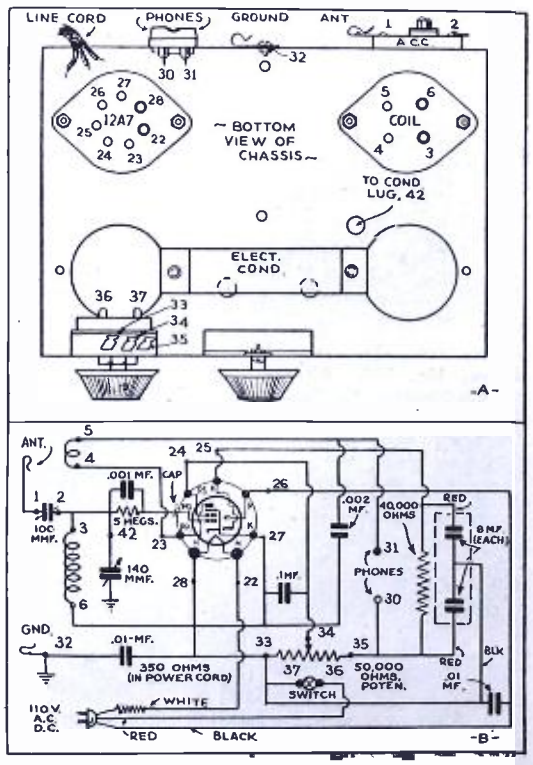
(16) Two 76s and one 12Z3—a new A.C.-D.C. circuit supplying a triode detector, a triode amplifier, and a separate rectifier.

(17) One 6F7, one 76 and one 12Z3—one of the largest sets that can be made from the foundation kit.

This brief outline of the 17 different circuits which have been devised will serve to show you just what possibilities there are for the radio fan and set constructor.

(Additional information about the "multi-set" kit is available gratis. Merely include postage when writing for the data.—*Author*)

Fig. 1
The circuit and layout for set No. 4—note the numbers which facilitate wiring.



THE LATEST RADIO EQUIPMENT

(*Continued from page* 189)

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 band-spread tuning condenser, which is an integral part of the complete unit; coils are wound with silver-plated wire and with litz. Tuning range is from 540 kc. to 22,600 kc., with continuous band-spread and no skips. Its output is 456 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 45 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 top 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 ½-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 characteristics, with uniform voltage increments up to max. voltage representing 100 per cent overload watts (or up to max. voltage rating), at 94 deg. F.

QUESTIONS ABOUT METAL TUBES

—Do you know the answers?

(1) What are the base connections of the types 5Z4, 6A8, 6C5, 6F5, 6D5, 6F6, 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.)

IT 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 TATTELITE TESTER (801)

(Littelfuse Labs.)

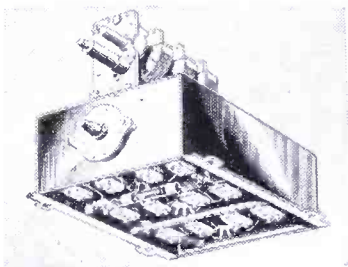
THIS tester can be used for a variety of purposes on voltages up to 250. A.C., D.C. and R.F. can be tested. A neon light is the indicating device and a series limiting resistor is built into the instrument. Only 0.5-ma. is needed to operate the device.

RCA INSTITUTES COURSE —A CORRECTION

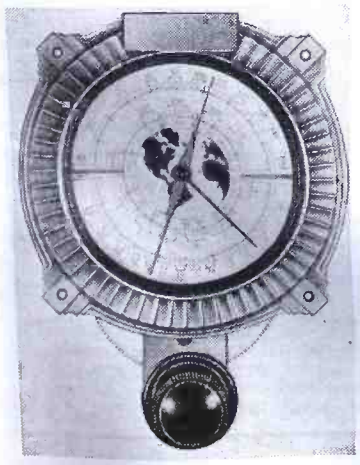
In connection with the item on page 102 of the August issue of *Radio-Craft* concerning the new course instituted in the School of Communication Engineering of RCA Institutes, the closing paragraph should have read as follows:

"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 was complete in every respect except for the two specific, new courses (Vacuum Tubes, and circuit elements) referred to above.



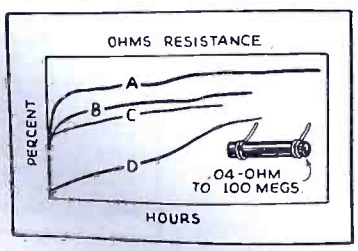
Above, No. 796. Coil catacomb.

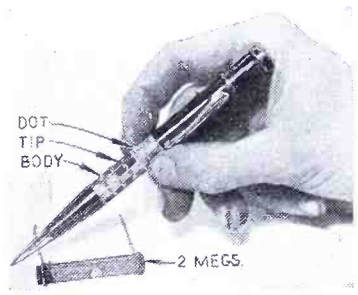


Above, No. 798. Line regulator.

Left, No. 797. Vernier dial.

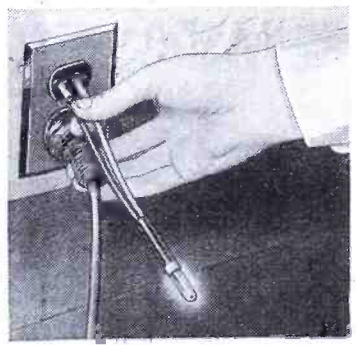
Below, No. 799. New resistors.





Above, No. 800. Code pencil.

Below, No. 801. Neon tester.



RADIO-CRAFT'S INFORMATION BUREAU

(*Continued from page* 163)

plied by the power pack under load. A simple formula for this follows:

$$\text{Bleeder res.} = \frac{10 \text{ (plate voltage)}}{\text{total plate current in amperes}}$$

VIBRATION IN SPEAKER

(340) Mr. George Desilets, Jr., Nicolet, P.Q. Canada.

(Q.) I am enclosing the wiring diagram of a 4-tube set I am using on 110 V., 30-cycle A.C. This set works well, but there is a good deal of rattle (vibration) in the loudspeaker, especially on the lower wavelengths (200 to 350 meters).

Can you suggest some remedy; is the noise possibly due to the 30-cycle supply or to the loudspeaker?

(A.) From your description, it seems quite possible that the speaker is at fault. However, the fact that the trouble is more pronounced at the low-wave end of the band suggests that there may be regeneration present, which will cause the hum from the 30-cycle line to become very evident. In the diagram, Fig. Q.340, some changes have been made in power supply leads to the first two tubes of the set. These changes are designed to prevent regeneration and also to give additional filtering for these two tubes. The 5,000 ohm resistor and the .02-mf. condenser provide "decoupling," while the extra choke and the 2 mf. paper condenser increase the filtering. The choke should be as low resistance as possible. It will also help to add another 8 mf. condenser in parallel with the one on the left of the choke.

SET CONSTRUCTORS

(*Continued from page* 163)

SWC	Sept..	1931	159. etc.	BCR	Feb..	1934	461
SWC	Oct..	1931	224, 225. etc.	AWR	Apr..	1934	603
BCR	Oct..	1931	227. etc.	AWR	June.	1934	734. etc.
AWR	Oct..	1931	228	AWR	June.	1934	735. etc.
BCSB	Jan..	1932	416. etc.	SWB	June.	1934	735. etc.
BCR	Apr..	1932	592. 593. etc.	SWB	July.	1934	28. etc.
SWR	May.	1932	675. etc.	BCR	July.	1934	33. etc.
AWR	July.	1932	41	SWB	Jan..	1935	409
SWC	July.	1932	64A	SWB	Jan..	1935	410. etc.
AWR	Aug..	1932	103	BCR	Mar..	1935	548
AWR	Dec..	1932	398	AWR	Apr..	1935	609. etc.
BCR	May.	1933	657. etc.				

4-TUBE

SWC	July.	1931	23. etc.	AWR	Sept..	1933	144,145. etc.
BCT	July.	1931	30. 31. 32. etc.	BCR	Dec..	1933	339
				DWR	Dec..	1933	352
BCT	Aug..	1931	76. 77	LW & BCR	Feb..	1934	460
bCR	Aug..	1931	97. etc.	LW & BCR	Mar..	1934	526
AWR	Sept..	1931	172. 173	BCR	Mar..	1934	527
BCR	Oct..	1931	216	SWR	May.	1934	650
SWR	Oct..	1931	222, 223. etc.	SWC	May.	1934	662
SWR	Dec..	1931	362	BCR	July.	1934	27
BCR	Jan..	1932	398	SWC	Aug..	1934	92. etc.
BCR	Feb..	1932	464	BCR	Sept..	1934	149. etc.
SWC	Feb..	1932	502	AWR	Sept..	1934	157. etc.
BCR	May.	1932	697	BCR	Sept..	1934	160. etc.
BCR	July.	1932	19. etc.	BCR	Oct..	1934	210
BCR	Aug..	1932	80. 81. etc.	DWR	Oct..	1934	230
BCR	Aug..	1932	86. etc.	BCR	Nov..	1934	288
BCR	Oct..	1932	212. etc.	BCR	Jan..	1935	418. etc.
BCB	Feb..	1933	458. 459. etc.	BCR	Jan..	1935	419
LWT	Feb..	1933	461, etc.	DWR	Jan..	1935	419
BCR	Feb..	1933	464. 465. etc.	AWC	Jan..	1935	422
BCR	Apr..	1933	589. etc.	BCR	Feb..	1935	484
BCR	May.	1933	658. 659. etc.	DWR	Mar..	1935	550
BCR	June.	1933	737	BCR	May.	1935	676
BCR	June.	1933	741	BCR	June.	1935	722
BCR	July.	1933	35	BCR	June.	1935	723
BCR	Aug..	1933	72. 73				
BCR	Aug..	1933	94				

MIKE CUT-IN

(*Continued from page* 163)

but find that I must increase the gain until feedback results before I get adequate pick-up.

(A.) The rick is to use more microphones arranged in such a way that each microphone picks up sound *from its immediate vicintty only* and not from the reproducing loudspeakers. (See Q. 12.) (As many as 50 microphones are sometimes used in the Radio City Music Hall, in New York City, to pick up stage presentations, and orchestra music. These are distributed in stage floor traps, footlights, program stands, lights bridg and in the orchestra pit.)

DAMPED MICROPHONES

(15) Morris Feldberg, Brooklyn, New York.

(Q.) What is the essential difference between a highly-damped and a freely-damped microphone?

(A.) A highly-damped microphone is less sensitive than a freely-damped type and requires that the performer "hug" the instrument in order to attain an amount of output equivalent to that produced by a freely-damped microphone picking up sound from a considerable distance. Usually the more the microphone is damped, the better is it's frequency response as the damping tends to flatten all peaks and depressions.

Index to Advertisers

(While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)

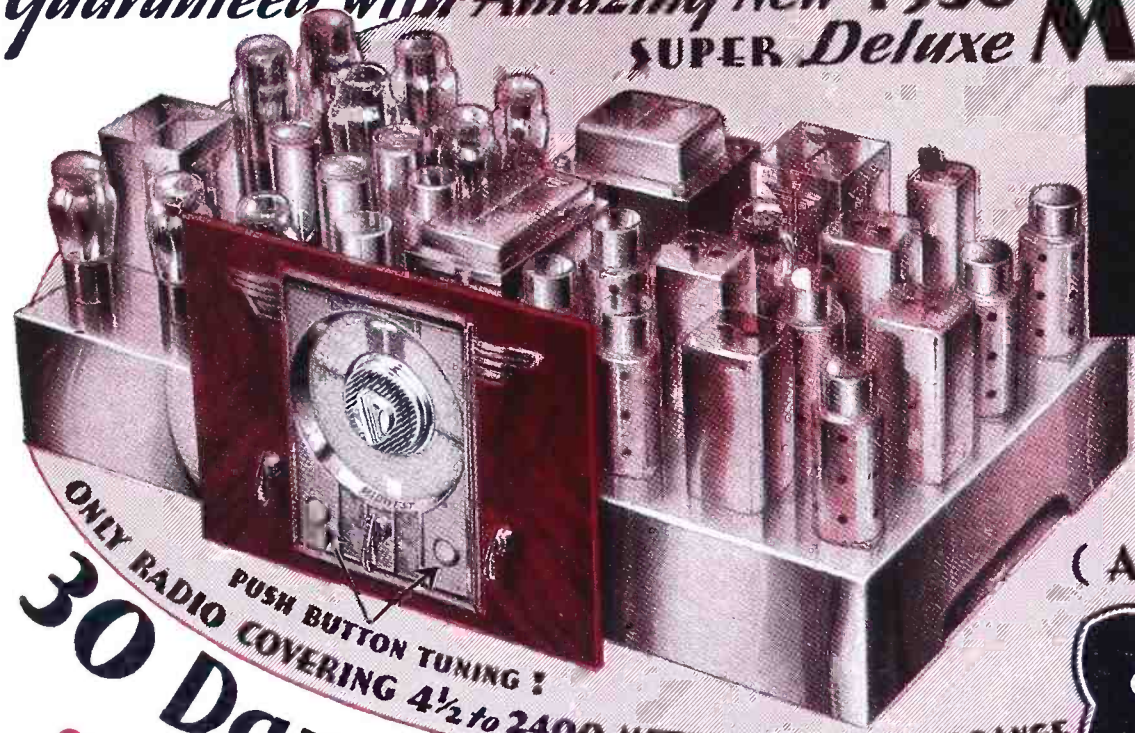
Please Say That You Saw It in RADIO-CRAFT

KABLE BROS. CO., PRINTERS

SAVE UP TO 50% *by* BUYING YOUR RADIO *Direct from* MIDWEST LABORATORIES

Exciting World-Wide Entertainment... Glorious New Acousti-Tone

Guaranteed with Amazing New 1936 SUPER *Deluxe* MIDWEST



18-Tube SIX-IN-ONE Radio

(ALL WAVE - 6 BANDS)

ONLY RADIO COVERING 4½ to 2400 METERS - 12000 MILE RANGE

30 Days FREE Trial !

WORLD'S GREATEST RADIO VALUE

$59.50 *with New* GIANT THEATRE-SONIC SPEAKER (LESS TUBES)

TERMS AS LOW AS **$5.00** DOWN

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 16-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%. Out-performs $250 sets. Approved by over 120,000 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 triply protected with: *One-Year Guarantee, Foreign Reception Guarantee and Money-Back Guarantee.*

PUSH-BUTTON TUNING

Now, offered for first time! Simply pushing Silencer Button hushes 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.

80 ADVANCED 1936 FEATURES

Midwest's brilliant performance made possible by scores of advanced features, many of them exclusive. Only Midwest tunes as low as 4½ meters and as high as 2400 meters...6 bands...18 tubes... push button tuning...acousti-tone V-spread design ...pre-aged adjustments...Fidel-A-Stat...Triple Calibration...etc. See pages 12 to 20 in FREE catalog. Six-bands . . . offered for first time! E, A, L, M, H and U . . . make this super deluxe 18-tube set the equivalent of six different radios . . . offer wave bands not obtainable in other radios at any price! Now, thrill to new explorations in sections of radio spectrum that are strangers to you. Every type of broadcast from North and South America, Europe, Asia, Africa and Australia is now yours. Send today for money-saving facts!

FULL-SCOPE HIGH FIDELITY . . . SPLIT-HAIR SELECTIVITY

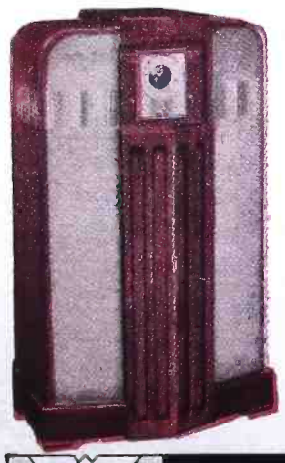
Now, get complete range of audible frequencies from 30 to 16,000 cycles as being transmitted by four new High Fidelity Broadcasting stations—W1XBS—W9XBY—W2XR —and W6XAL. Bring in distant, weak foreign stations, with full loud speaker volume, on channels adjacent to powerful locals.

Delighted With Super Performance

Davison, Mich. A radio engineer confirmed my opinion — that no other make of radio will compare with my Midwest for tone, selectivity, volume, ease of tuning and wider range. It is great entertainment. R. F. Collier.

Praises World-Wide Reception

Maysville, Ky. My friends envy my Midwest and say it beats theirs in price and performance. It is amazingly sensitive and brings in Holland, Spain, etc. Its full, rich, non-fading tone denotes super quality and advanced workmanship. W. E. Purdon, Rural Route No. 1.



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 dispersing vanes and exclusive V-front that propel High Fidelity waves uniformly to the ear.

DEAL DIRECT WITH LABORATORIES

SAVE UP TO 50%

No middlemen's profits to pay -- you buy at wholesale price direct from laboratories . . . saving 30% to 50%. 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 values. 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 to come yourself to our great radio laboratories. You save 30% to 50% . . . you get 30 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.

MAIL COUPON TODAY! FOR *FREE* 30-DAY TRIAL OFFER *and* 40-PAGE FOUR-COLOR *FREE* CATALOG

MIDWEST RADIO CORP., Dept. 12C, Cincinnati, Ohio.
Without obligation on my part, send me your new FREE catalog and complete details of your liberal 30-day FREE trial offer. This is NOT an order.

User-Agents Make Easy Extra Money
Check Here for Details ☐

Name_____

Address_____

Town_____ State_____

☐ Check here, if interested in a Midwest Auto Radio.

MIDWEST RADIO CORP.

DEPT. 12C CINCINNATI, OHIO U.S.A.

Established 1920 Cable Address MIRACO All Codes

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.

MODEL A-82

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.

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