RADIO'S LIVEST MAGAZINE

A GERNSBACK PUBLICATION

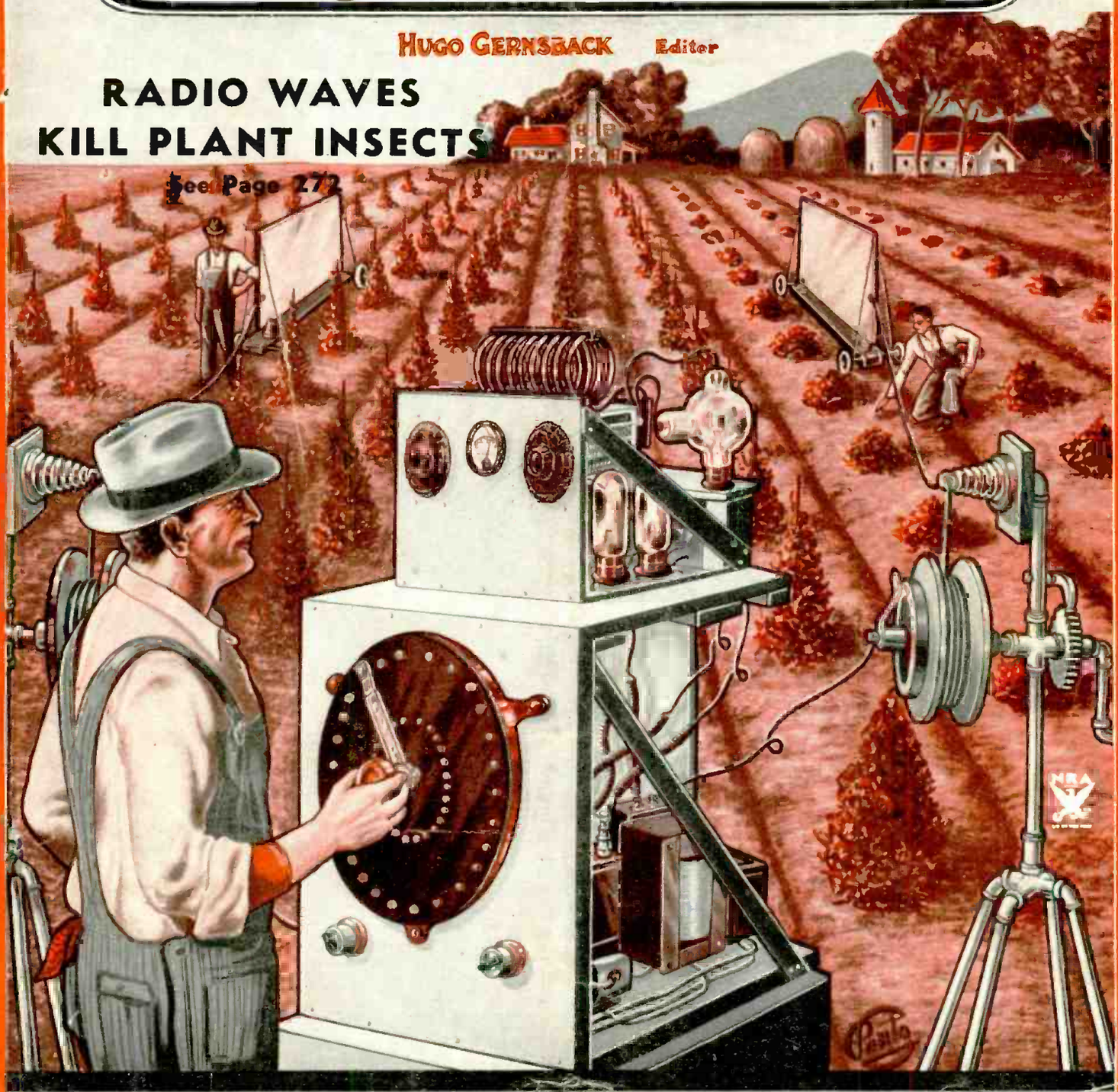
November
25 Cents
Canada 30¢

Radio-Craft

HUGO GERNSBACK Editor

RADIO WAVES KILL PLANT INSECTS

See Page 272



Drama of Radio — New "Echo" Studio — 4 Tube All-Wave Versatile Receiver
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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 postffice at Mt. Morris, Ill., as second-class matter under the act of March 3, 1879.

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START A SPARE TIME OR FULL TIME RADIO SERVICE BUSINESS WITHOUT CAPITAL

Many Make $40 $60 $75 a Week

J. E. SMITH, President National Radio Institute
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Spare time set servicing pays many N.R.I. men $5, $10, $15 a week extra. Full time men make as much as $40, $60, $75 a week. Almost every community offers trained men opportunities to enter this profitable field.

Loud Speaker Systems
Installing and servicing Loud Speaker Systems in auditoriums, for sporting events, political rallies, in schools, factories, railroad stations, etc., is another growing money-making field for Radio trained men.

The world-wide use of Radio sets for home entertainment—over 18,000,000 in use in the United States today—has opened many opportunities for you to have a profitable spare time or full time Radio service or retail business of your own. I show you an easy, quick way to do most Radio service jobs. The day you enroll I send you instructions for doing 28 Radio jobs common in almost every neighborhood. Many N.R.I. men make $5, $10, $15 a week extra in spare time while learning. I show you how to install and service all types of Radio receiving sets. I give you Radio equipment and instructions for conducting experiments, for building circuits and testing equipment, and for making tests that will give you broad, practical Radio experience.

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(Continued on other side)

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Broadcasting Station Operator
Aviation Radio Operator
Ship Radio Operator
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Auto Radio Installation and Service
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"I am doing lots of repair work on the latest model sets, and am getting along splendidly, thanks to you and N.R.I. training. It has surely helped me to get ahead in Radio. The depression did not seem to hurt me. I have been making an average of $55 to $65 a week." PETER J. DUNN, 901 North Monroe St., Baltimore, Md.

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Many N.R.I. Men Make $5, $10, $15 A Week Extra in Spare Time While Learning

Many of the 18,000,000 Radio sets now in use are only about 50% efficient. Some are out of date—need modernizing. Many need slight adjustments of tuning circuits—others lack tone quality. Still others need new tubes or need "balancing"—to put them in perfect working order. I will show you how to cash in on these conditions. I will give you the plans and ideas that have enabled many N.R.I. men to make $5, $10, $15 a week in spare time while learning. Ford R. Leary, 1633 Davison Road, Flint, Michigan, writes: "My part time earnings while taking the N.R.I. Course were $651."

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Mail the post card below for your FREE COPY of my big 64-page book, "Rich Rewards in Radio," which I want to send free to every ambitious person over 15 years old. It tells you all about Radio's spare time and full time opportunities; about my Training; what others who have taken it are doing and making. MAIL THE POST CARD NOW.

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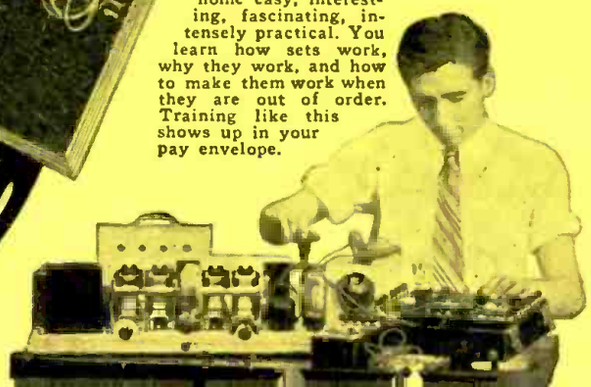

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Washington, D. C.

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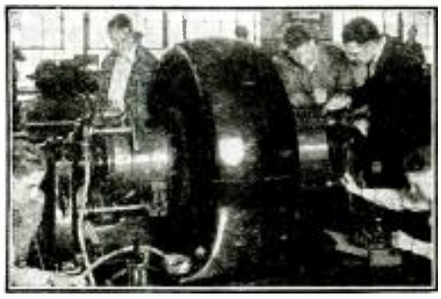

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The fastest growing industries in America today. Manufacturers and Distributors of Refrigeration and Air Conditioning equipment need Trained men who have Specialized in these rapidly expanding fields. Here at Coyne you will prepare to fill a job as Installation and Service Man, Shop Mechanic, Tester, Assembler, Inspector, etc. You will learn about various types of compressors, condensers, temperature control devices, thermostatic and expansion valves—you will do actual work on latest types Refrigerating and Air Conditioning machines. And, it won't cost you one extra cent to get this remarkable Training. I include it without charge with your regular Electrical Training.

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C. W. PALMER, Associate Editor
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IN OUR NEXT FEW ISSUES:

NEW DEVELOPMENTS IN TELEVISION. Although there has been very little publicity given to television within the last year or so, the development laboratories have continued, unabated, their efforts to improve television reception to the point where home television could be compared with home "talkies." Some of the results that have been secured are brought to public gaze in this article, which discusses several interesting developments.

HOW TO MAKE A TUBELESS "B" SUPPLY FOR FARM SETS. In the November issue of RADIO-CRAFT is described a simple, inexpensive "B" supply unit of the vibrator type, using a tube to rectify the high-voltage output of the step-up transformer, the primary of which is connected to a 6 V. storage battery. Now, we present in a forthcoming issue an interesting unit which, although still of vibrator type, does not require a tube rectifier. Instead of electrical rectification by means of a tube, mechanical rectification by means of additional contacts on the vibrating element is secured. All of the components are commercially available, thus insuring to the finished instrument a workmanlike appearance.

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HUGO GERNSBACK, President I. S. MANHEIMER, Secretary

Published by Continental Publications, Inc. Publication office: 404 N. Wesley Ave., Mount Morris, Illinois. Editorial and Advertising Office: 99 Hudson Street, New York City. Chicago Advertising Office: L. F. McClure, 919 North Michigan Avenue, Chicago, Ill. Western Advertising Office: Loyd B. Chappell, 511 So. Alexandria St., Los Angeles, Calif.

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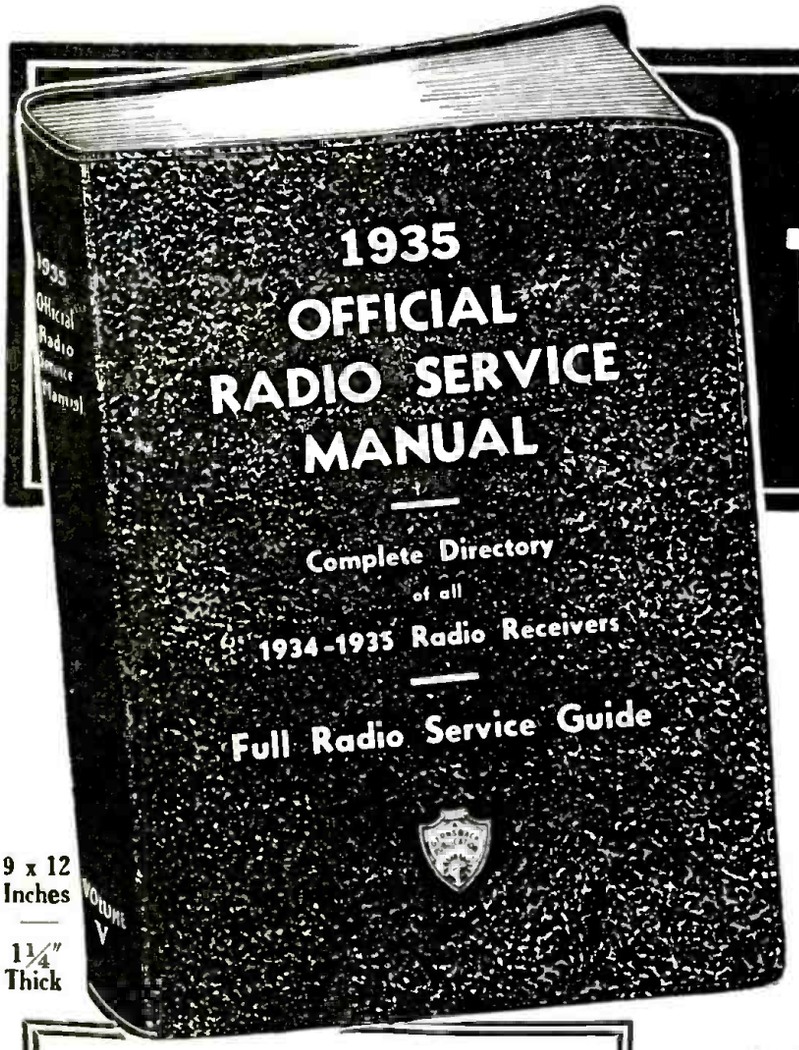

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1,000 PAGES

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Contents Reveal Important Chapters in the Contents of the 1935 Manual

● Over 1,000 pages full of diagrams and essential information of manufactured receivers—only data of real use in servicing is included. This new Manual is really portable since it will be extremely thin and light as well. ● Volume V continues where the preceding manual left off—none of the circuits published have ever appeared in any previous volumes of the OFFICIAL RADIO SERVICE MANUALS. ● Many circuits of extremely old sets not previously available are included. ● Service Men know every radio set has certain weak points which are really the cause of trouble. Wherever the information could be obtained, these weaknesses with their cures are printed right with the circuits. **This is an entirely new and valuable addition to the Manual.** ● All the latest receivers are included—all-wave sets, short-wave sets, auto-radio sets, midget and cigar-box sets, etc., as well as P. A. amplifiers and equipment, and commercial testing and servicing instruments. ● The cumulative index is even more complete than before; including cross-reference to sets sold under different names and type numbers identical with circuits printed in this or previous volumes. ● Volume V includes resistance data; socket layouts; I. F. data; voltage data; color codes of wiring, cables, etc.; and the purpose of each tube in the set is clearly indicated on the diagram. ● Tube data on latest tubes and all previous types will be included to facilitate servicing. ● Free question and answer service—as included in our last three manuals.

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SET SERVICING

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PUBLIC ADDRESS

The many pages on new, outstanding developments in Public Address Installation and Service will be found helpful to Service Men and P. A. specialists. Such prominent features as class A and B amplifier—single and dual channel systems—attenuators, and mixers—super-power stages—pre-amplifiers and other commercial devices available for public address and call work, will be found in this complete reference volume.

ALL-WAVE RECEIVERS

Information relative to short waves have found their way into the 1935 by popular demand. The numerous all-wave receivers now being sold by practically all the large radio set manufacturers are included. For these sets, wherever possible, complete aligning details for all wave bands are included in addition to the service material listed for other sets.

AUTO-RADIO RECEIVERS

No service manual could be complete without a section devoted to auto-radio. All available service information on new auto-radio sets has been included. From this section alone Service Men could derive sufficient knowledge to venture in a specialty field—that of servicing only auto-radios. It is one of the biggest opportunities in radio today.

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A Complete Compendium of the Most Important Experimental and Custom-built Receivers.

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How to get started in the business of servicing radios and how to make money in this field.

Book No. 6

Bringing Electric Sets Up to Date

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With Pentodes, Multi-Mus, Dynamic Speakers—Complete Information How to Modernize A. C., D. C. and Battery Operated Receivers.

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"Takes the Resistance out of Radio"

Editorial Offices: 99 Hudson St., New York, N. Y. HUGO GERNSBACK, Editor Vol. VI., No. 5, November, 1934

THE RADIO ART

An Editorial by HUGO GERNSBACK

THE ART of radio, which started with a very modest beginning, about 1900, has enlarged by leaps and bounds until, today, it has assumed gigantic proportions. It is almost impossible for the student of radio to keep track of all the various ramifications of the art, and it is now necessary to have experts for each of the various branches; as there is no longer any one who can master all the various sub-divisions of the radio art today.

Radio started out at first purely as a laboratory experiment. When Marconi took radio (then called "wireless") out of the laboratory in the year 1897, it soon became commercialized and, for many years thereafter, the art of radio had to do only with "wireless" communication which was done by code—dots and dashes. From then on the progress of radio was rapid, and the art increased by leaps and bounds.

From the day of Marconi's first message, and the early days of amateur radio, the art soon graduated into broadcasting; so that the spoken voice, music, and every imaginable sound is broadcast into space by numerous transmitting stations, to be intercepted and received by our radio sets. Broadcasting itself is a huge industry today, with hundreds of different ramifications, far too complex to cover in an article of this kind.

Soon, there appeared the still-photo and facsimile transmission radio, which is another branch of radio. By means of this particular instrumentality it is possible, today, for a man to write a "radio" check in New York and have it cashed in San Francisco, or vice versa. Other important events are transmitted pictorially from continent to continent within a few minutes. Thus, when Hindenburg lay on his death bed in East Prussia, and was thus photographed in the afternoon, the press of the United States featured the photograph next day in their morning editions. All this is accomplished by short-wave radio.

Another branch of the radio art, which already has achieved great proportions, is the allied field of electronics. Indeed, radio today could not exist without electronics, which comprises the use of vacuum tubes of one type or another and used in radio transmission or reception, and what not. Coupled with these, we have photo-electric cells and other electronic tubes, too numerous to mention. The operation of vacuum tubes is an art in itself and, while a sub-division of radio, it is also being applied to other fields of endeavor with an ever-increasing utility.

Television is still another branch of radio; because we cannot very well think of television without radio. Roughly, the same principles are used in the propagation of television programs that are applied to audible radio programs; except that we work at different frequencies, and the transmitter and receiver in television are, of course, different. Television itself promises to become a gigantic industry in its own right, as soon as all the details have been worked out.

Next, we have another sub-division, that of radio therapeutics or medical treatment, also described by the term of "radio fever." Certain diseases are being cured by means of radio waves, particularly the short waves, and, while this particular branch of radio is still in its infancy, it is also making rapid progress.

Allied to the foregoing, we have an entirely new sub-division which, for want of a better term I may call *Bio-radio*, which is the treatment of trees, plants, flowers, vegetables, etc., by means of radio waves. Such treatment kills the insect parasites and makes it possible to realize a larger crop, directly due to such radio treatments. A special equipment is used for this purpose and, in time, all farms, truck gardens, etc., will, very probably, kill their insect pests by means of radio currents.

Geo-radio is that branch of the radio art whereby it is possible to explore the ground for minerals, ores, oils, etc. This particular use of radio is still in its infancy, but a great deal of success has already been obtained by means of radio waves. The ground is explored in such a way that the prospector is assisted to locate mineral deposits in a much quicker and cheaper manner than has been possible heretofore.

Radio Tele-mechanics is that branch of radio whereby it is possible for a human being to work at a distance. By radio tele-mechanics, switches can be operated from a distance; airplanes and ships without anyone on board can be piloted; and many other distant effects can be accomplished.

Public address is still another offshoot of the art of radio, which has already assumed vast proportions. There is hardly a place of entertainment or assembly today which is not covered by some public-address loud-speaker system which can be hooked up to an existing radio set, so that a radio program can be amplified or the spoken word from the speaker's stand is brought to thousands in the audience.

Radio Servicing, the necessary adjunct to the radio art, became important when millions of radio sets made their appearance, and this particular art is also one of huge proportions today. Entirely new instruments in the form of analyzers, oscillators, etc., had to be originated for servicing the radio sets, to make it possible for the service man to quickly and accurately find the troubles on the deadened or inoperative radio set.

Short waves are not strictly a sub-division, because of their peculiarities, and also, their characteristics are different from those of broadcast waves. They form still another branch of the radio art, and one which in time will probably eclipse long wave broadcasting itself, particularly in international communication.

New branches of the radio art are developed from year to year, and how many new ones we will have ten years hence, it would be rash to prophesy.

THE RADIO MONTH

The stratosphere balloon prior to flight.

RADIO BALLOON RISES 17 MILES WITHOUT PILOT

IN A TEST flight, last month, to further man's knowledge about the cosmic ray, Prof. A. H. Compton, Nobel prize winner, directed the ascension of a hydrogen balloon in which was installed an automatic radio transmitter. The signals sent by this instrument, on short-waves, were received by the ground crew until the balloon reached a height of 17½ miles and were recorded on tape. The data thus obtained will make it possible to send up cosmic ray apparatus on future flights, with the assurance that results will be received on the ground.

The height to which the balloon had ascended was calculated from the rate of speed which it travelled until the transmitter stopped sending signals. A barometer had been installed, but was valueless in aiding the scientist, in view of the fact that the balloon had burst when it attained this altitude and eventually crashed.

While this great height was not a record, it was the largest balloon of its kind to go up without a pilot, and the first to broadcast without the assistance of a human being at the radio controls.

The miniature transmitter which sent automatic signals. It was attached to the balloon, and aided in determining the altitude.

"RADIO TALK WITH MARS POSSIBLE"—MARCONI

ON THE supposition that the planet Mars is inhabited by intelligent beings, one-eyed Senatore Guglielmo Marconi declared last month that it was entirely possible to communicate with them by means of radio. That is, also providing, we develop or improve our present wireless equipment. And while on that subject, it is interesting to note, the same Senatore Marconi was given world wide publicity, a few years ago, when he claimed to have picked up signals from Mars on his yacht in the Mediterranean. Although the "messages" did not resemble anything in our International code, he stated at that time that they indicated a wavelength of anywhere between 14,000 and 150,000 meters.

The Marchese (he is titled) recently developed a method for bringing ships safely into fog-bound harbors, and now is working on the development of television.

Anent the radio broadcasting of electrical power, he has this to say:

"Engineers tell me that waves of from 20 to 50 centimeters might kill mice and other small animals happening to be on their line of traverse. I have not experienced this fact myself, but I know the human body warms up when these waves pass through it. We might call them invisible light waves.

"Transmission of energy is within our reach already, and the only drawback at the moment is the great waste involved in the present method.

"To transmit a half-horsepower we require about 100 horsepower. We must improve existing apparatus."

Marconi, and the radio room of his yacht, some years ago when he announced that he received strange signals, possibly from Mars.

RADIO AMATEURS INCREASING

RECORDS compiled and published last month by the Federal Communications Commission disclosed that there were 46,390 valid amateur station licenses in existence at the close of the last fiscal year, June 30, 1934.

The Commission's report and figures on this subject are as follows:

During the year, 8,782 new station licenses were issued and there were 12,279 modifications, reissues and renewals. The figures follow:

Valid of record July 1, 1933	41,555
Issued during fiscal year, new and renewed	8,790
Total	50,345
Less cancellations	3,777
Other deletions, due to death, etc.	153
Revocations	25
Total	3,955
Valid of record close of June 30, 1934— 46,390.	

Authorizations as amateur operators totaled 16,686; operator license endorsements for higher privileges 209; duplicates of lost or destroyed licenses 161. and special authorizations 15, making a grand total of 38,132 authorizations is-

There are now 46,390 radio amateur stations.

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.

sued during the year, or well over 100 per day, relating to amateurs alone.

Applications for amateur operator station licenses pending July 1, 1933, were 497, while 33,184 were received during the fiscal year. Of the total, 21,672 were approved.

AMATEUR COUPLE FALL IN LOVE VIA SHORT WAVES

WHILE on the subject of radio amateurs it might be of interest to our readers to learn that some small percentage, yet nevertheless quite a few of the 46,390, are of the opposite sex. And, last month, the inevitable happened! Radio amateur C. L. Wright, of England, after some short-wave conversations with radio amateur Eleanor Fox of the U.S.A., proposed over his transmitter and heard the acceptance on his receiver.

The two radio fans met each other when one tapped out on their key a general call (CQ) for some one to converse with. Those who listen-in on short-waves will recall hearing amateurs with phone transmitters issuing this call repeatedly in an endeavor to establish long-distance communication. Since their first meeting while taking this dip in air waves, the two have corresponded (aerially) frequently, but have never seen each other.

And now Mr. Wright is en route to claim his American bride-to-be. There is one thing that the couple may be certain of—they share the interest of a mutual hobby, and one presumes that because of this they should live very happily.

Short-waves cause of two amateurs falling in love.

TELEVISION WITH TELEPHONES PLANNED IN GERMANY

OF EXTREME interest to the American radio enthusiast was the announcement last month by the German Postoffice that it planned to inaugurate "television" telephone service in the near future. This does not, by any means, indicate that the Germans are ahead of us in television progress, inasmuch as the staff of RADIO-CRAFT has seen numerous television demonstrations of American equipment that proved to be, in clarity of detail, as good as present-day home-movie outfits. The commercial sale of American television outfits now hinges only on the installation of a sufficient number of proper transmitting studios, in addition to the creation of the necessary channels for transmission of the signals for commercial purposes, by the Federal authorities.

However, the German radio fans are enthused over recent sound-film broadcasts which were made at the eleventh German radio show. This coupled to favorable tests that were made between Berlin and Munich have so impressed the postal authorities, that they plan to install a television-telephone network linking all of the larger cities—as reported to us.

All of this means that the telephone subscriber in Germany may, eventually, be able to both see and talk to other parties, via telephone. "May"—if the German scientist is successful in ironing out a number of obstacles that are not readily apparent.

Germany may install television with 'phone service.

The recent British radio show was a great success.

BRITISH RADIO SHOW INDICATES GREAT PROGRESS

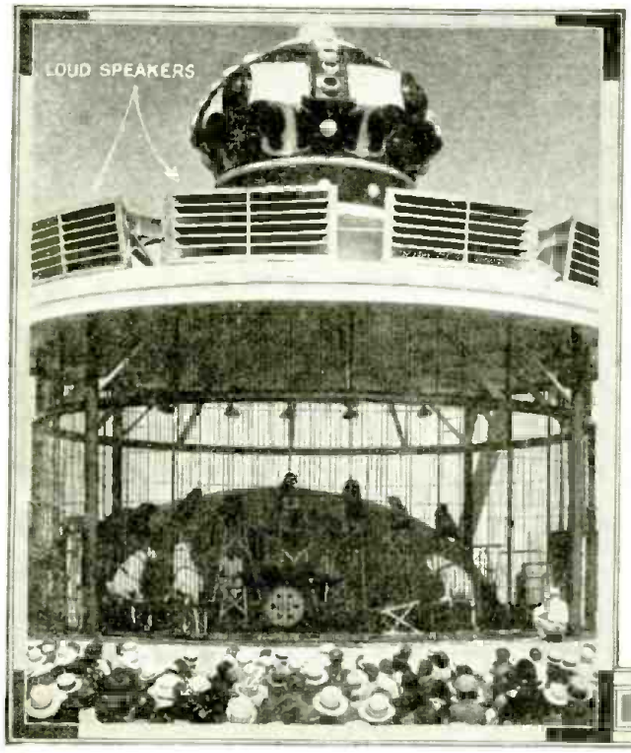
THE great strides made by Great Britain in the past year in the radio field, was indicated at their recent radio show held last month. British people are rapidly becoming radio conscious and the status of radio enthusiasm that exists there now, as indicated by the show, may be compared to radio's wave of popularity in America in 1926.

Battery receivers are featured extensively in view of the fact that Great Britain has a considerable number of homes unwired for electrical power. However, they are chiefly of the superhet. type employing battery type tubes which aid in holding down the power consumption of the set, and consequently minimize battery recharging or replacements. Another point of interest in British design is the cabinet appearance, circuit features, and other engineering points of a receiver which are as advanced as most up-to-date American sets. High prices, though, tend to make constructors' kits and sundry loose radio parts for home-built receiver purposes extremely popular.

Television demonstrations at the show were highly successful and the interest in these demonstrations proved that the Englishman was in a highly receptive and optimistic mood for this advancement. As a matter of fact, an English concern is now manufacturing and sell-

(Continued on page 299)

RADIO PICTORIAL



THE installation of public address equipment is made in many and sundry locations. One of the most novel uses is that shown in the above illustration. A circus act, in which wild animals in a cage enclosure are put through their paces, is amplified and the various sounds and roars then projected out to the audience by means of the loudspeakers indicated. This "Cage of Fury" features acts by the "big cats," and is a gift of the Standard Oil Co. of Indiana, to the World's Fair at Chicago. While the "act" is visible, the immense crowds necessitate a P.A. system!

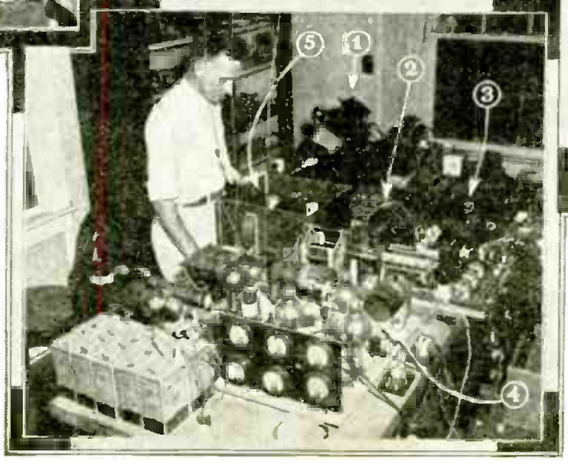
Press Photo.

THE photo on the right shows a recent improvement in police patrol cars. Radio transmitters are being installed, to facilitate communication between police cars and headquarters. The transmitter and generator are installed in the rear trunk compartment of the car. It is of low-power design, yet sufficient for operation over a few miles. The conventional receiving aerial is employed for transmission, but a throw-over switch, in the driver's compartment, permits switching the apparatus from "receiving" to "sending."

Photo, G. E.

HAVE you an accumulation of radio junk? The above photo shows how such material is disposed of in Paris, France. Some rare radio parts, dating back to the old "wireless" days, can be seen in this photo. Strange to say, the proprietor classes himself as a specialist instead of a junk dealer.

Press Photo.



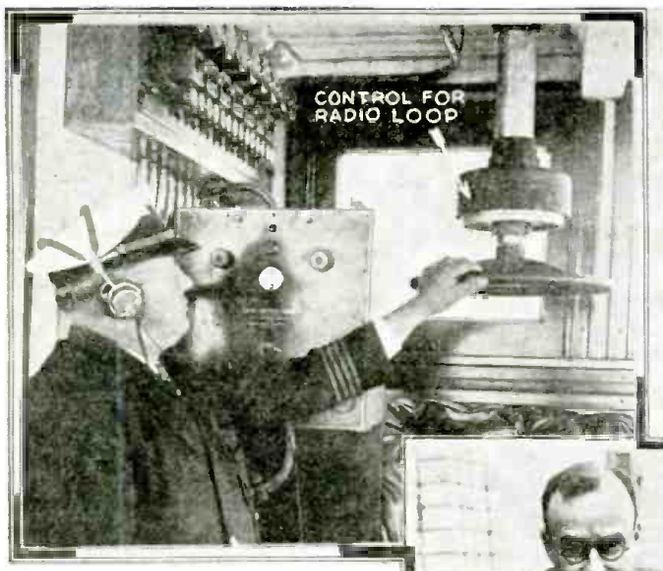
A PECULIAR radio phenomena, noted by many listeners, is now being studied by scientists. It involves "radio echoes" which in many cases have been heard from 1 to 30 seconds after the original signal was received. The photograph above shows apparatus stationed 15 miles out of Wash., D.C., for checking this puzzling problem. An operator constantly watches the recording of each echo. At 1 is the broadcast set; 2, a high-frequency converter; 3, an oscillograph.

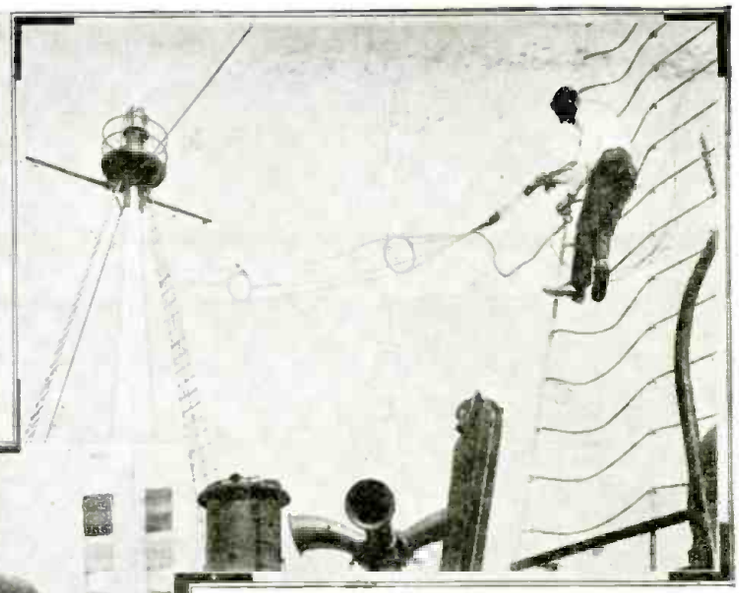
In the photo on the right, a more modern checking installation is seen, stationed at Beltsville, Md., and operated by the Bureau of Standards. At 1, recorder; 2, motor-driven cam; 3, receiver; 4, transmitter; 5, converter.

Photos, Underwood

A GENERAL view of a new radio station in Prague, Czechoslovakia, is shown above. It operates on a frequency of 1,204 kilocycles, and employs a power of 5 kw. Listeners-in that aim for European stations, and have occasional success, now have a new mark to shoot at.

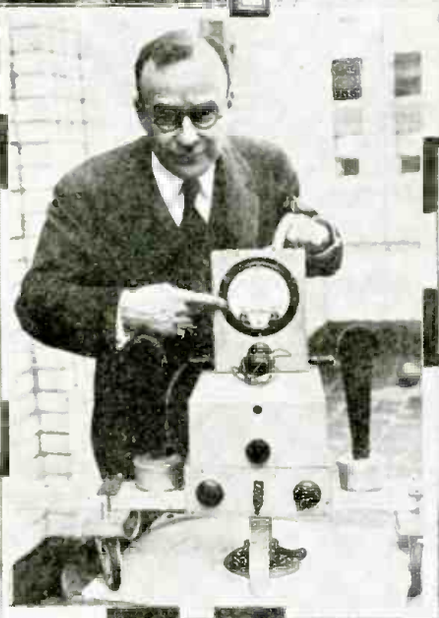
Press Photo.





UNCLE SAM protects billions of dollars every year in shipping, by means of radio beacon lightships. The above shows a captain guiding his ship, by radio compass which is actuated by the radio beacon signal.
Globe Photo.

ADJOINING shows a direction and distance range finder which will prevent a recurrence of mishaps such as when the lightship Nantucket was rammed.
International News Photo.



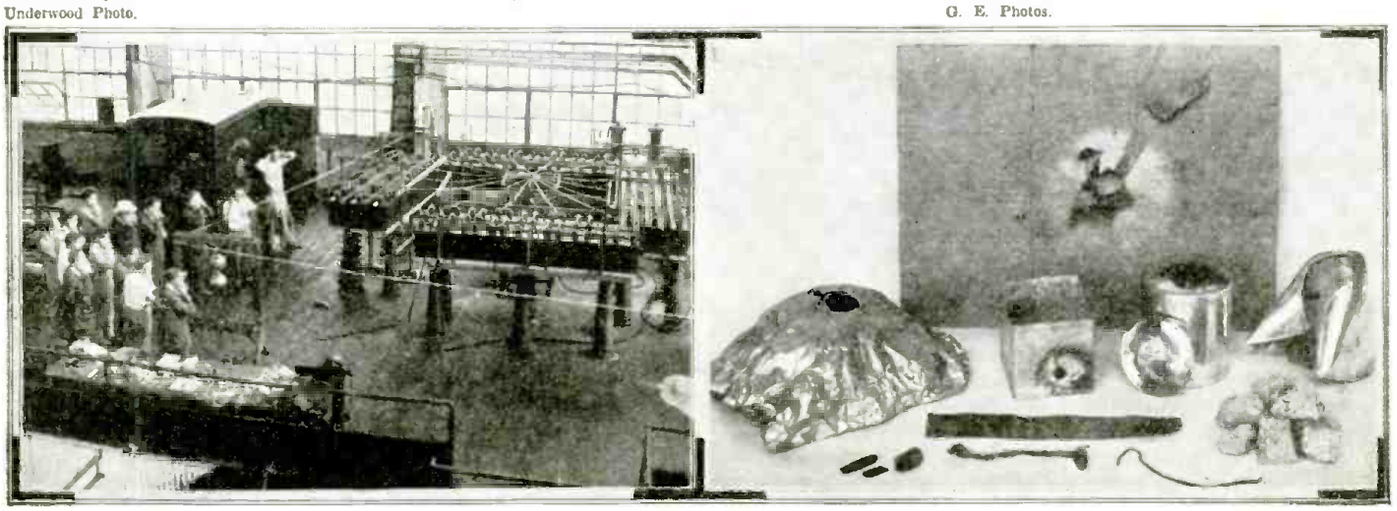
THE radio equipment employed on a lightship differs in a great many respects from that of the conventional transmitter and receiver employed by ships for commercial routine. The antenna being installed in the ship shown above is of "cage" construction with highly directional properties. Below it are the fog horns.
Globe Photo.

PHOTO on the right shows Ambrose Channel lightship sending out automatic radio signals for guiding ships.
Globe Photo.

A DEVICE which tunes out radio advertising, then starts the set up again in time for music, is now in use. Above shows the unit with various keys for various intervals of silence.
Underwood Photo.

WE'VE read about high-voltage discharges in laboratories, but now for the first time have discharges of over 250,000 amperes been attempted. Lower left, equipment at the—

G. E. LABS., in Pittsfield, Mass., for studying experiments of this nature. Just a sample of some of the damage done by the intense flash is illustrated in the photo below.
G. E. Photos.



THE DRAMA

MILLIONS of people turn to radio for a ready source of the news, entertainment and relaxation, available so regularly on the broadcast air channels almost every hour of the day and night. Hundreds of thousands also explore the short waves, either pursuing a fascinating hobby or carrying on two-way communication over and between continents. But radio reaches its full usefulness when it bridges, instant-like, the gap of space to bring relief to the sick, the injured, or to a sudden disaster that has severed all other forms of communication.

The use of radio at sea; the more recent adoption of police mobile-radio that has enabled the law to apprehend criminals almost at the moment of enactment of the crime—these are really prosaic applications compared with the sudden, thrilling use of radio in those swiftly gathering events of misfortune that every so often dot the pages of time. Frequently overshadowed by the headlined news of the day, radio's part in the drama of life is relegated to the background, only to break into national prominence at the time of a major calamity, when it offers the only means of succor and contact with the world. It is then that radio performs a function beneficial to mankind—does its work so well and so readily that its service has become almost commonplace.

Let us delve into the records of the past, re-create authentic incidents with facts that read as fiction, and re-live the moments when circumstances produced a hero of the air who used the knowledge of his craft to bend radio to the command of man at the hour of dire emergency.

PIRATES BOW TO RADIO

TO US, living in this present world of ultra-modern conveniences, with the globe explored, charted and inhabited to its furthermost ends, the thought of pirates conjures up a menace that only previous generations had to contend with. A 20th century Captain Kidd seems but a product of the stage or screen. Yet during 1932, pirates seized a fishing vessel off the coast of Africa, threatening death to the overpowered crew—when radio foiled their plans, bringing a hasty rescue and a much happier ending for the captured fishermen.

Spanish Naval dispatches of November 19, 1932, that lend authenticity to the story, reveal the details of the attack. The good ship *Los Borasones*, a fishing vessel homeward bound with a successful haul, accidentally grounded that day 30 miles south of Cape Juby in the Spanish Rio de Oro. (The Rio de Oro is in northwestern Africa, southwest of Morocco.)

Moorish pirates, present survivors of the tribes that have lived by piracy for many centuries, were quick to sense the plight of the luckless vessel. Taking to sea in the guise of rescuers, they caught the crew by surprise and lost no time in manning the ship, trusting to the rising tide for the getaway. Fortunately, and much to the chagrin of the sea-going freebooters the *Los Borasones* was equipped with a low-power radio transmitter. The young Spanish operator, sensing the intentions of the pseudo-rescuers, hurriedly tapped out a call for help, adding to it the ship's location, before he too was seized and pinioned—but too late! The alert Naval operator at Madrid standing watch for official business caught the signal of distress, and checking its location with the position of nearby Naval craft, radioed the gunboat Canovas to proceed full speed. Almost simultaneously, after intercepting the same call for help, a fishing vessel and a mailboat also started to the rescue.

Thus while assistance to repel the invaders lay not far away, without the aid of radio the outside world would have had no means of knowing the fate of the grounded ship, until perhaps some time later when the tragic details came to light. Thanks to radio and the quick wit of the man at the key, the story has a cheerful ending. Just think how the depredations at sea in the days of Morgan and Kidd would have been minimized were the ships of those years equipped with radio!

A SPARK COIL SAVES A LIFE

A FORTY mile gale on Lake Erie, storm-swept Cleveland with freezing temperature, a marooned man five miles from land suffering from sudden illness necessitating medical assistance at once—that was the setting one day in March, 1923.

It seemed that three men employed by the Cleveland waterworks department had to be stationed for a time at a waterworks "crib" five miles out on Lake Erie, beyond Cleveland Harbor. One of the three, Harry Holzworth, contracted tonsilitis and near-pneumonia that day in March when the elements conspired to visit a raging storm over the Lake front. Unable to communicate with shore by boat,

OF RADIO

The true anecdotes related below are from the pages of radio history. They seem to bear out the saying . . . "truth's stranger than fiction."

EDWARD E. LAUFER

one of the other men (an amateur in his spare time) had luckily brought with him a small transmitter—just the old type spark-coil outfit which in those days was good for a range of anywhere from 5 to 25 miles. Using his amateur call 8AJO, amateur Keller established contact on shore with 8AUV who in turn notified the waterworks Commissioner of Cleveland that medical help was urgent.

A small power boat, sheathed in ice, carrying Coast Guardsmen and a Doctor put to sea in the teeth of that 40 mile gale. Battling the heavy sea, taking what seemed to be hours for the short trip, the crib loomed ahead, but a landing was impossible. Facing this difficulty, their only hope lay in what was the best solution under the hazardous conditions. Circling the crib a dozen times, the doctor shouted to the friends of the stricken man. Learning then of his state and making a hasty diagnosis, instructions and advice were shouted back for his care. Heading about, the powerboat made for land, barely escaping destruction itself in the fury of the tempest.

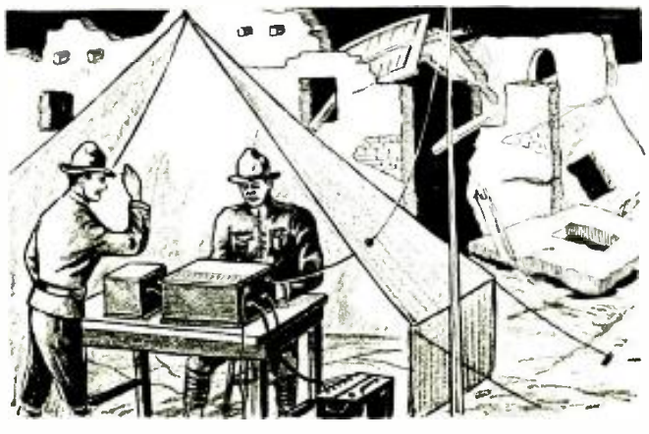
Preparation was made to dispatch a larger boat, but rising winds and mountainous seas left the rescuers powerless to effect a landing. All that day amateur radio was used to render words of encouragement and proper medical instruction until well into the evening, when with the storm abating, a boat landed and carried the sick man shoreward.

Harry Holzworth can thank the hobby of two young men for the quick action that probably saved his life.

ARMY RADIO MAN HERO DURING EARTHQUAKE

IF THE newspaper headlines of more than three years ago are recalled, we can recount the tragedy that befell the country of Nicaragua one day in 1931. At 10:10 A.M. on the morning of March 31, the earth trembled for a scant 6 seconds, and an underground adjustment of Nature razed Managua, the capital of Nicaragua, killing over 1,100 persons, and injuring other thousands in that panic-stricken city of 60,000 inhabitants.

The city of Managua maintains contact with the United States principally by means of the Tropical Radio Telegraph Company circuits. Luckily for the operators of the station, their lives were no doubt spared by the fact that no schedule was maintained at that early hour. The remote control offices of the station, located in the heart of the city, were demolished when the earth shook and the city fell in ruins.



The transmitting station, controlled from the city offices, is located 5 miles from Managua, where the 250 foot towers raise a lofty landmark. When the operators reached the shack they found the station and towers unharmed. They were ready to flash to the world the news of the catastrophe, but were severely handicapped by the destruction of the receiving station in the city. The operators fashioned an improvised receiver from many odd pieces of apparatus lying about the shack and then, in touch with the outside, proceeded to tap out details of the disaster and make preparation for assistance that the stricken city sorely needed.

It was only several days later that a brief, official communique of the War Department at Washington revealed the real hero of the Managua calamity.

That dispatch reported in stereotype form that Corporal Frank R. Coburn of the U. S. Army Signal Corps, on duty with the Army Engineer Battalion at Managua, sent out all the army messages and other Government reports, keeping open the line of communication from the devastated area to the other Army stations in Nicaragua. Using the small transmitter that he constructed himself, he supplemented the overworked tropical radio station, and for some time these were the only two stations in touch with the outside world.

Such an earth disaster many years ago would leave friends and relatives in other countries in the dark for many days before definite advice was available on the fate of the unfortunate inhabitants. Now, radio dispatches reassuring words instantly, and usually the hero is some unofficial radio operator that fills the breach.

AN AMATEUR HELPS OUT

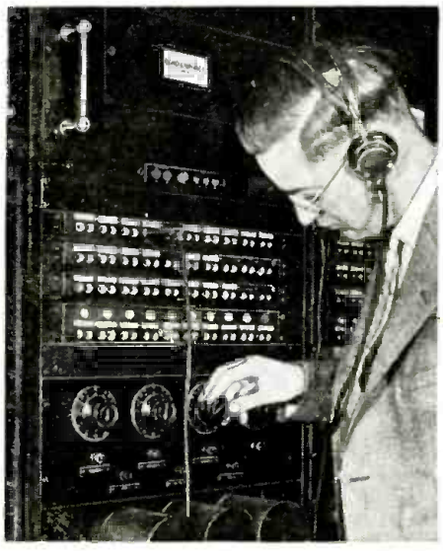
DRAMA on land is no less exciting than at sea—when radio plays the hero rôle. The exploits of the radio amateurs, from the early days of "wireless" down to today's activity on the ultra-short waves, are responsible for a great deal of the development of the art. The resourceful amateur has often proved the usefulness of his self-taught knowledge when he and his usual "home made" outfit perform a service to a community, especially at those critical times when the regular com-

(Continued on page 301)

"SYNTHETIC

Here is something new in broadcasting! The next time you sit down to listen to a program and hear the crashing roar and reverberation of a battle scene, or the backwash of sound (which is nothing more than an echo) typical of a large arena, — just remember that the sounds are in all probability artificially produced. An ingenious studio installation just made in the N.B.C. studios at Radio City permits simulating . . .

R. D. WASHBURNE



When the young lady above yodels "oh-de-lay-eee-ooh" the microphone picks up the sound, converts it into electrical energy and forwards it to—

An amplifier and control system, manipulated by an operator, as shown in the above photograph. At this point it branches off to the transmitter where it is broadcast into the ether, but, when the echo effect is also desired, the proper switch is manipulated.

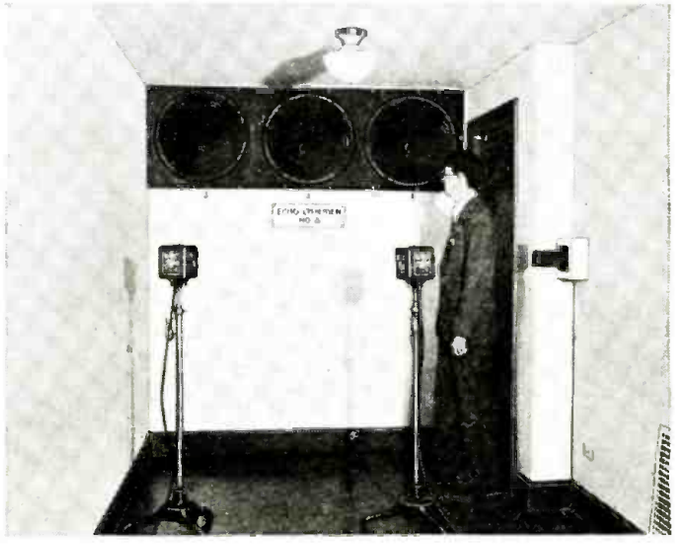
MAN-MADE echoes simulating anything from a convention at Madison Square Garden to a battle scene in the open country can now be produced in any of the studios of the National Broadcasting Company in Radio City—thanks to a novel system perfected by O. B. Hanson, chief engineer. Through this unique method the output of the smallest studio 15 x 20 ft. in size can be transformed to the acoustic proportions of the world's biggest auditorium and it is so cleverly done that it will completely fool the listener. This complete change from the deadened, softened walls of the studio is accomplished in the twinkle of an eye by the mere turning of a dial!

The idea used is especially interesting, involving the use of three "echo chambers" of average room-size proportions located at a point some distance from the studios in another part of the building. When it is desired to simulate a broadcast with echoes or reverberations the procedure is as follows:

Whatever is being broadcast in the studio is picked up by the microphones in the usual way and, of course, with the usual sound quality. This sound is then made to travel to three loud speaking units located at a point near any one of the three echo vaults. Attached to the 3 loud speaking units are three pipes, one 80 feet in length, another 40 feet in length and the third 20 feet in length, all of which are lined with cement. Attached to the other side of these pipes are three long trumpet-like horns mounted in the walls of the

The electrical impulses are converted into sound energy once more, made to traverse a pre-selected length of pipe as shown in the photograph below—

And projected into this chamber. The three sound outlets can be plainly seen. The walls are cement lined, causing the sound waves to "bounce" back and forth until they are finally picked up by the microphones installed in the chamber, which converts them into electrical energy again.



ECHO" STUDIO

the acoustic sounds of such scenes. Inasmuch as the effect is entirely dependent upon the "echo properties" of the sounds broadcasted, the sounds that originate in the studio are made to reverberate in a specially designed "echo chamber" which is completely described in this story. Consequently, when a program is to be broadcast that calls for an open air scene, realism is effected by simulating the necessary sound effects by this method.

echo chambers. Now, the original sound from the studio passing through these pipes is obstructed by their unusual length and encounters resistance caused by their cement linings, causing a lag in the sound when it emits from the trumpet horns located in the vault.

In view of the peculiar properties of sound waves, one of which is that as it travels a distance, an element of time is involved, it takes approximately one second for a sound wave to travel 1,100 ft. Consequently, as the sound waves travel through the pipe there is that time delay which exists from the moment it enters until the moment it leaves the pipes, caused by the friction of sound within the cement-lined pipes.

The purpose and design of the echo chamber is built exclusively upon acoustic principles. For example, we know that certain materials have a tendency to deaden or "soften" sound. This is readily realized if we were to speak in an empty room and notice how sound is prolonged, as compared to sound in a completely furnished room where it seems to be of a quiet or "deadened" nature. In a furnished room certain materials absorb the sound waves and prevent their reflection from polished or hard surfaces. It is for this reason that those who have visited broadcasting studios have found them equipped with heavy drapes, to prevent any possible reverberation; or sliding, sound-absorption panels which only slightly control the reverberation period of the room.

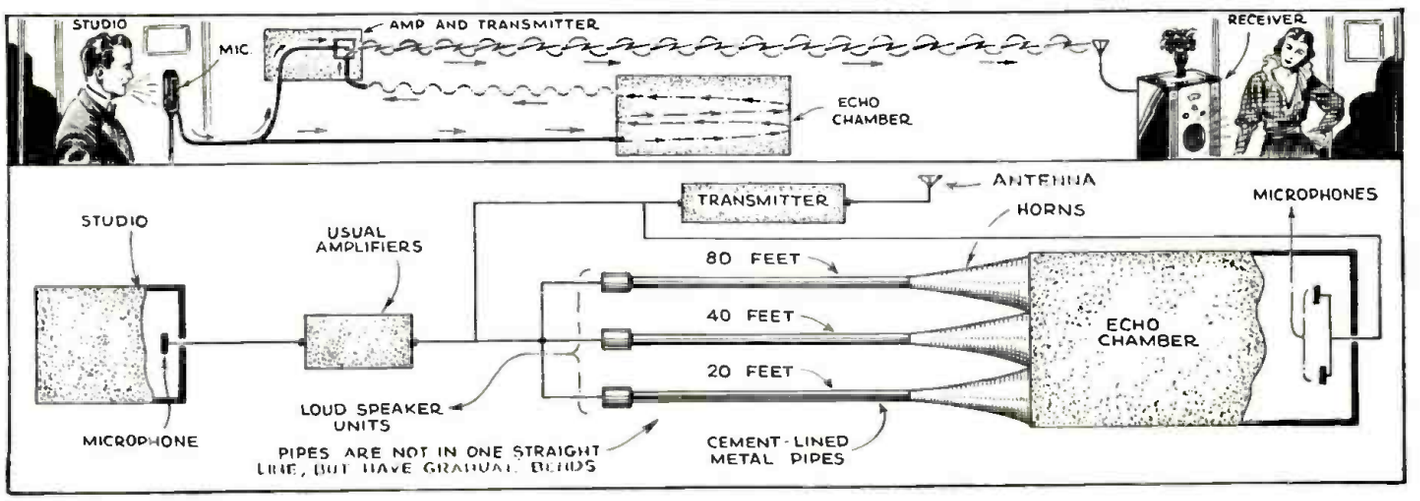
However, in the echo chamber there is no desire to deaden the sound projected into it; on the contrary, reflection of sound back and forth from the walls, or reverberation as acoustic engineers term it, is highly desirable. For that reason not only are the pipes cement-lined, but the floors, walls, and ceilings of the chamber are all of tile and concrete material. Consequently, as the sound leaves the horns to enter into the chamber, the walls, floor and ceiling make the sound waves bounce back and forth in this vault, the resulting reverberations then being picked up by two microphones which are placed in the chamber. These microphones transform the sound into electrical impulses once more which are then further amplified, then fed to the regular transmitter from whence they are broadcast.

There is, of course, a slight delay of time between the time that the sound which emanated from the studios was originally fed into the transmitter and the time at which the "echo" was broadcast. It is this "time delay" which causes the echo or hollow sound typical of broadcasts made in an arena or large auditorium. The simulated sound is so natural in effect that it is most difficult for the listener to be able to differentiate between it, and that which would originate under natural conditions.

It should be remembered that the echo chamber is not effective at all broadcasts. It is controlled at will by an operator, and is only inserted in broadcast programs where the requirements are such that the sounds to be broadcast are to simulate those originating in wide-open spaces, large auditoriums, arenas, etc. There have been innumerable plays that called for such scenery but which have been broadcast from closely-confined studios that were heavily draped for

(Continued on page 309)

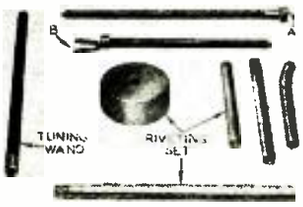
The impulses are then amplified once more, after which they are fed to the transmitter and broadcasted. The lapse in time between the broadcasting of sound originating in the studio, and that from the "echo" chamber, is small yet sufficient to cause the effect necessary. The block diagram below indicates the sequence and the apparatus through which the voice impulses are transformed and retransformed to obtain the essential effect.



THE LATEST RADIO EQUIPMENT

Newest service oscillator. (556)

A test-unit grid lead. (557)



New radio tools. (558)

Above, anti-theft lock. (559)

Below, newest battery set. (560)

ALL-WAVE SERVICE OSCILLATOR (556)

RADIO men prize a good oscillator, and the newest of these is especially worth having for several reasons. It is continuously variable from 50 kc. to 30 megacycles, as fundamental frequencies instead of harmonics. Electron coupling is used; the circuit utilizes 1 37 and 2 36s. Operates on 110 V., A.C.-D.C. Output 2 V. to 0.5-microvolt, at R.F.; 400 cycle A.F. modulated R.F.; or 400 cycle A.F. The dial accuracy is within 0.1%. A rotating wave-band coil assembly eliminates losses, etc., due to leads.

TEST-UNIT GRID LEAD (557)

OBTAINING commercial-appearing components for home-built test equipment often is a task. One less item to cause annoyance on this score, however, is the control-grid cap lead, complete with prod, which now is available "ready made." Use this serviceable item in your next tube checker or set analyzer.

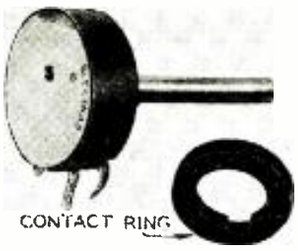
NEW RADIO TOOLS (558)

A TUNING WAND. The action of this device smacks of fairy magic. This service tool consists of a bakelite rod having a brass cylinder at one end and a special, finely-divided, high-permeability iron core at the other end. Inserting the brass cylinder into a coil lowers its inductance; inserting the iron core increases it. A reduction of signal strength in both instances indicates exact resonance—and without the trimmers (in, for instance, an all-wave set) having been disturbed.

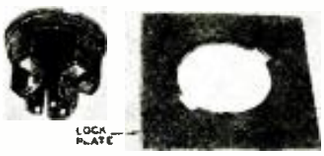
RIVETING SET. In order to do a shipshape job in servicing the modern radio set, the Service Man must not only remove rivets but he also must be able to replace them. A riveting set is required for this job, and is now available.

A—ALIGNMENT TOOL. This is a combination screwdriver and socket wrench. The metal screwdriver bit is so shaped that the increase in capacity caused by its touching a trimmer screw is offset by the reduction in inductance caused by its shape. This is very important when making adjustments on all-wave receivers where the screwdriver must be inserted through the end of the coil; the socket end fits trimmers.

B—ALIGNMENT WRENCH. An alligator-jaw end wrench and screwdriver are combined in this tool. The metal screwdriver is shaped to reduce detuning effects. The end wrench fits trimmer screws that are accessible only from the side. The shaft is of bakelite.



An improved volume control. (561)



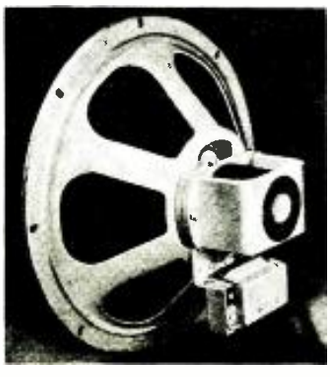
Replacement tube socket. (562)

Shielded cable plug. (563)

All-wave coil assembly. (564)

Above, french-type phone. (565)

Below, new 12 in. speaker. (566)



CAR-RADIO ANTI-THEFT LOCK (559)

THE practice of auto-radio thieves is first to lift the car hood and remove the nut from the bolt holding the radio set to the bulkhead. It is then only the work of a few seconds to break into the car, yank out the radio-control unit and, finally, remove the radio set. The new lock, however, makes life quite a bit harder for the light-fingered gentry—the lock slips over and encloses the nut (on the through-bulkhead bolt), and thus prevents it being tampered with.

7 TUBE DUAL-WAVE BATTERY SET (560)

THE resident of homes unequipped with electric power will welcome the newest in superheterodynes designed to operate on an air cell battery. Incorporates an 8 in. magneto-dynamic reproducer, tone control, automatic volume control—all in a mantel cabinet (batteries external, and cable-connected). Output 2.2 watts, utilizing a class B tube. Dual range: 540 to 1,720 kc., and 5.4 to 18 megacycles.

REPLACEMENT VOLUME CONTROL (561)

MANY graphite volume control faults have been overcome in the newest design. The actual resistance material is applied, and then baked at a high temperature, to the flat outer rim of a molded bakelite ring; the circular construction permits a 300 degree rotation. The aluminum shaft is easily cut to the desired length. An attachable power switch is available.

A LOCK-IN SOCKET (562)

ON THAT next job of replacing sockets, Mr. Service Man, try this new lock-in socket. It's small-space in size, and easy to install—no need to spend time chasing all over town trying to find a socket to fit the chassis hole. Just peen two slight protuberances in the present socket opening, screw the new socket, and solder its terminals into the circuit—and the job is done!

SHIELDED CABLE PLUG (563)

PREVIOUS types of shielded cable plugs have been quite expensive, but a new design has been worked

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

...ut which offers the features of shielding, sturdy construction, and convenience in installation—plus low cost. A collapsible cable opening permits cable diameters of ¼- to ⅝-in. to be used.

ALL-WAVE COIL ASSEMBLY (564)

TO MEET an insistent demand for simplification in the design and construction of all-wave sets, there has been developed by one well-known American coil manufacturer a complete tuning assembly consisting of shielded R.F. coils, trimmers and wave-change switch; an I.F. coil assembly with trimmers; and an oscillator coil assembly with trimmers, for reception on 540 kc. to 18.5 megacycles.

A FRENCH PHONE (565)

THE hand or "French" telephone has come into general use in commercial telephony, but only now has an instrument of this design become available to the radio experimenter. The newest instrument is designed for use in small transmitters and transceivers, such as the 5 meter type. The rubber-covered frame holds a high-output microphone and 2,000 ohm earphone.

LOW-COST, HIGH-QUALITY 12-IN. SPEAKER (566)

UNUSUALLY high fidelity and sensitivity have been attained in a new low cost 12 in. dynamic reproducer. The overall diameter is about 12⅛ ins.; depth, 6¼ ins. The voice coil impedance at 400 cycles is 4.5 ohms. The reproducer is rated at 8 watts, continuous operation.

TUBE-LESS "B" VIBRATOR (567)

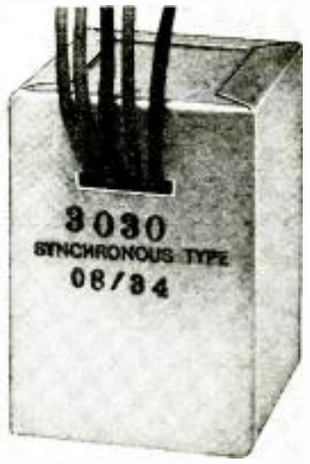
EARLY types of vibrator units for obtaining "B" supply from a 6-volt battery were not made as efficiently as the newer models, and are now requiring replacement. One make of replacement unit is of the synchronous type—that is, it is self-rectifying (does not require a tube for rectification), and delivers a full-wave output. This same unit is adaptable to the requirements of experimenters who may want to make up their own "B" unit.

A HEADPHONE ADAPTER (568)

EVERY now and then occasions arise where the operation of headphones would be a convenience. To this end there has been produced a device that permits headphones to be attached to any radio set. You merely plug the headphone tips into holes in the unit, clip one lead to the chassis, and slip a prong connection onto the plate prong of the A.F. output tube.

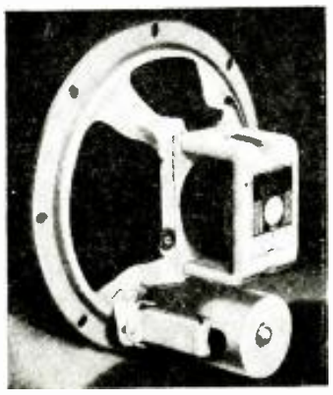
IMPROVED 6-IN. DYNAMIC REPRODUCER (569)

A NEW dynamic reproducer has been developed to meet the need for a low-price unit in the 6-in. class. The overall diameter of the cone housing is 6⅝ ins.; depth, 3 3/32 ins. A 3.5 ohm impedance, at 400 cycles) voice coil is used. This unit has been designed for unusual fidelity and sensitivity.



Self-rectifying "B" unit. (567)


Headphone adapter. (568)


High-quality 6 in. speaker. (569)


Above, improved antenna kit. (570)

Below, new "electric eye." (571)

DOUBLET ALL-WAVE ANTENNA KIT (570)

FURTHER developments in all-wave antennas have produced a set-up by which a single aerial, a single twisted-pair (noise-free) transmission line and two units, one of which is attached to the antenna and the other close to the radio set, act in such manner that the antenna wire will perform the functions of a Marconi antenna for frequencies within the broadcast band and a little beyond, and as a Hertz antenna for short-waves from about 5 megacycles, up.

IMPROVED "ELECTRIC EYE" (571)

THE newest in photo electric equipment is a P.E. cell and relay that, in conjunction with an improved light source, will operate at 90 feet with white light from a 6 V. lamp, or 40 feet from an infra-red (invisible or "black light") beam.

A 7 CONTROL ALL-WAVE SET (572)

A 12 TUBE, 5 band all-wave superheterodyne, combined with an automatic phonograph is now available to the person who does not need to draw the price line at too low a figure. Frequency range, 110 to 410, and 540 to 36,000 kc. Knob arrangement, left to right: sensitivity control, low-frequency tone control, power switch, range, high-frequency tone control, volume; eliminating any of these controls would reduce the flexibility of operation. Phonograph has 2 speeds, and a home-recording device with neon light modulation indicator.

CONTINUOUS-PROJECTION FILM ATTACHMENT (573)

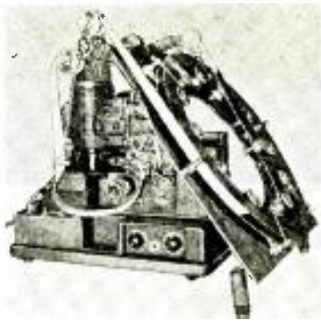
SERVICE Men who have picked up some "change" by selling and servicing home or industrial talkies machines will be interested in the new attachment that now permits continuous projection. Ordinarily, a 600 ft. film would require the services of an attendant after 16 minutes of projection. Now, however, a continuous performance can be given at convention display booths, and all kinds of public demonstrations. The film travels from the inside of the coil of film (which is made endless by splicing) and is returned to the outside of the coil. A mercury switch stops the projector in the event of a break in the film.

FREQUENCY TEST RECORDS (574)

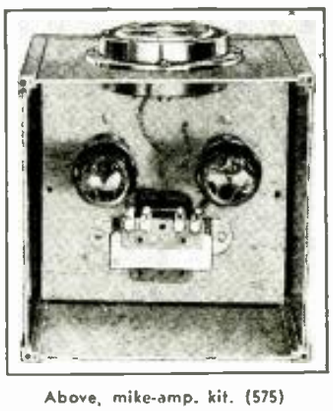
NEW test records are available, for operation at 33 1/3 or 78 r.p.m., for testing phonograph pick-ups, amplifier systems, and reproducers, and all other A.F. equipment operating within the frequency range of 50 to 7,000 cycles. There are 58 announcements, in a subdued undertone, as the frequency slowly and continuously varies from one

(Continued on page 299)

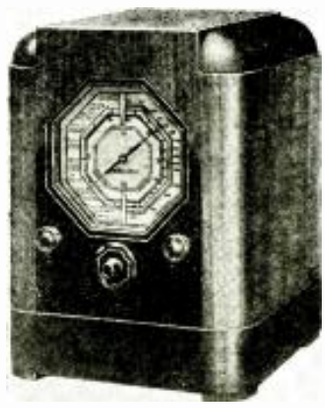

All-wave, 7 control set. (572)


Non-stop talkies. (573)


Frequency test record. (574)


Above, mike-amp. kit. (575)

Below, all-wave converter. (576)



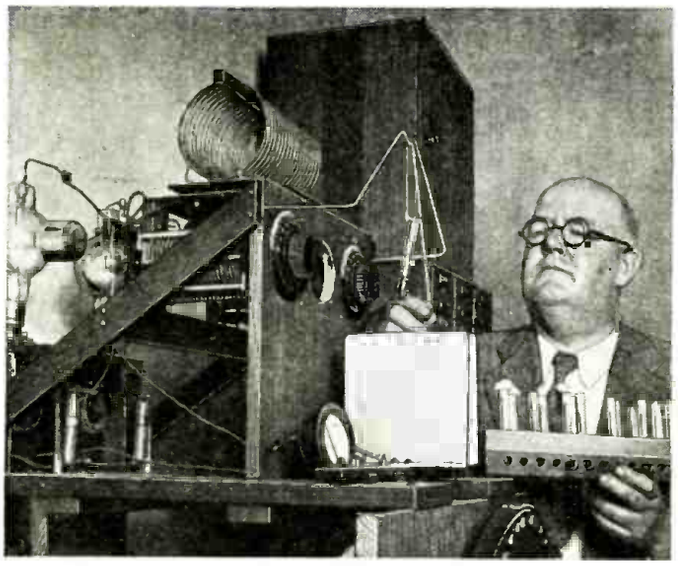


Fig. A. Laboratory method of killing a test tube full of insects.

RADIO WAVES PLANT PESTS

Has man at last found a way to cope with the insect menace, and will radio be the medium by which it is accomplished? Rutgers University is determined to find out, and to this end have constructed several short-wave transmitters and conducted numerous tests. Thus far the results have been most gratifying, and the application of their discoveries promises to be of great aid to agriculture.

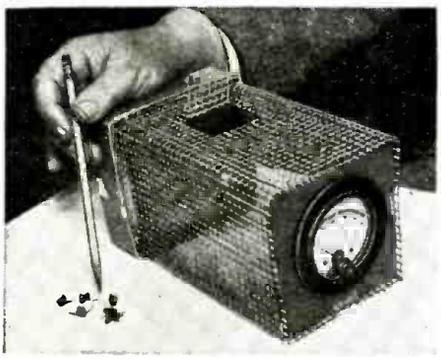
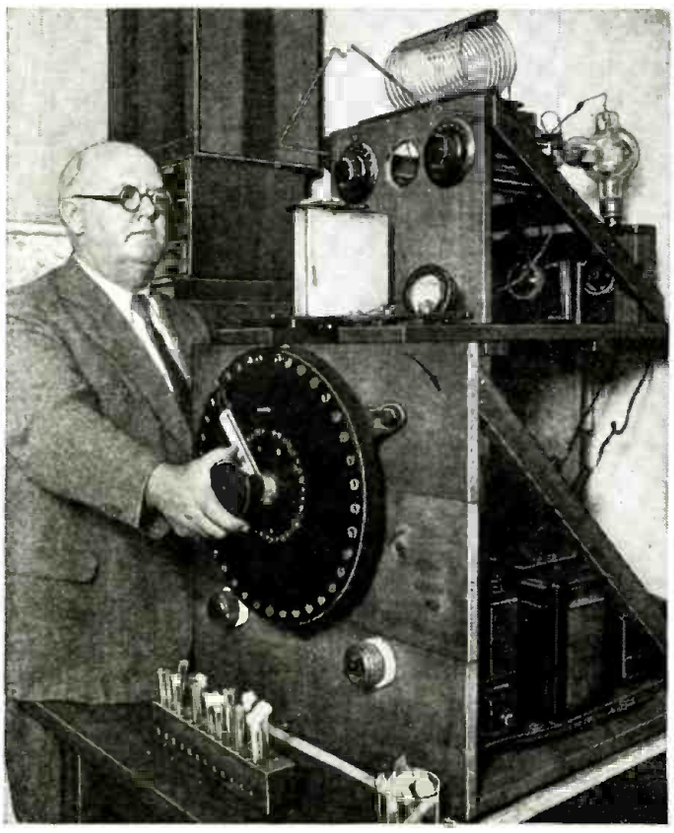


Fig. B, left.

A device for measuring energy absorption. It will permit determining the effective "range" of a transmitter's ability to destroy insects.

Fig. C, below

Dr. Thomas J. Headlee and his 100-watt radio insect destroyer. The rotating variable switch permits control of the amount of power. The frequency range is from 1,000,000 to 25,000,000 cycles.



THE never ceasing warfare between man and insects now has a more encouraging outlook due to the perfection of amazing high-frequency radio devices developed by Dr. Thomas J. Headlee, director of the Department of Etymology of the New Jersey State Agricultural Experiment Station at Rutgers University, New Brunswick, N. J. Through the use of these devices emitting deadly radio waves hundreds of thousands of insects have been destroyed and the principle used is no longer in the experimental stage —further research work being conducted largely to determine ways of increasing the range of the death-dealing waves, and to cut down on the amount of electric power necessary.

The efficiency of the apparatus is truly amazing and the writer saw innumerable insects killed in but 27 seconds by the mere pressing of a button or the turn of a knob. At the present time 3 different radio units are being used for this work. One is of 5 kw. power, another uses 100 W., while a third of extremely short-wave length uses but 50 W. power —all of them, however, utilizing the same principle.

Each unit is very similar in construction to a regular radio transmitter with the exception that where the aerial and ground connections ordinarily are made, the leads run instead to 2 square aluminum plates which serve as electrodes. An electrostatic field is built up between these 2 aluminum electrodes and insects are killed by exposing themselves to the lines of force in this electrostatic field. The field strength is variable at the will of the operator because research has shown that certain insects are killed at different frequencies than other insects. However, it has been conclusively proven that a frequency of 3,000,000 cycles per second and a field strength of 4,000 V. per linear inch

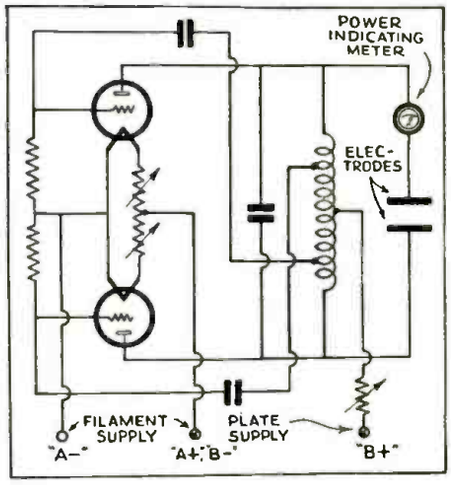


Fig. 1, right.

The circuit of the transmitter is of the conventional type, as shown by this illustration. It is a standard Hartley oscillator feeding into a pair of electrodes.

NOW KILL AND INSECTS

Furthermore, it is entirely possible that these same radio waves may, in the future, be applied to rid our atmosphere of germs that cause sickness and disease and thereby be of utmost benefit to mankind. These radio waves, in the hands of scientists at the present time, are in no way injurious to human beings or plant life, and should not be compared with so-called "death rays".

ANDREW HALBRAN

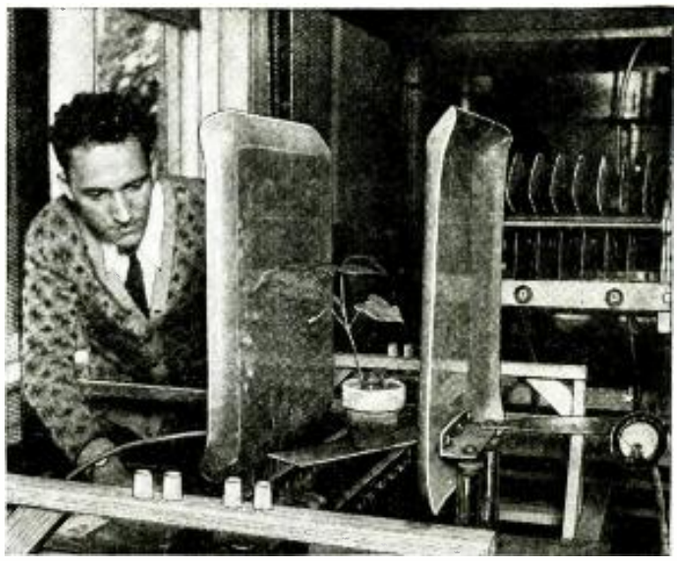


Fig. D. A giant 5 k.w. outfit. No insect survives between the 2 plates.

at the aluminum plates was an ideal condition in that the death dealing waves were quick in action on insects in general and yet harmless to plant life itself.

Another interesting fact disclosed was that the insects were killed by internal heat generated in their bodies when the killing radio waves passed through them. Also, that insects were killed by the development of internal lethal heat in their bodies when, after being enclosed in glass test tubes, they were executed. Upon being withdrawn from the glass tubes their bodies were found to be very warm yet the glass tubes themselves remained cold. While these deadly waves could, of course, kill human beings Dr. Headlee did not develop his devices for so-called "death ray" purposes.

Concerning this discovery, those who have kept abreast of short-wave developments will remember an interesting incident reported in the newspapers some few years ago. At that time development of short-wave transmission and reception was, comparatively, still in its infancy. Engineers in the General Electric laboratories, at Schenectady, were delving into the problems of this still unexplored field, particularly concerned with what is now known as "ultra-short-waves." The temperature outside, it being midwinter, was around the zero mark, and that of the room in which they were working not very much higher (in view of open windows).

To their amazement, after some few minutes of research on high-frequency radiations, they discovered that they were perspiring freely, this despite the low temperature of the room. Further analysis of this phenomenon brought forth the discovery that radiations of very high frequencies were absorbed by the body and caused an internal heating within the body—and thus a condition resembling fever. Since then the medical world has been utilizing this discovery for creating an "artificial fever" effect, in certain patients, as a means of aiding in the recovery of the sick.

It is on the basis of this phenomenon that experiments were conducted to determine how it might be utilized to destroy insects and other parasites that damage millions of dollars of crops every year. And the results proved that these same heat-generating waves, while comparatively harmless to man and plant life, would in a short interval of time kill all insects on which these rays were concentrated.

In Fig. A, Dr. Headlee is shown lowering a test tube full of live insects into the area between the 2 aluminum electrodes. He is studying the time necessary for the "kill." The turn of a switch and a few seconds time in the path of the deadly radio waves and the insects are destroyed.

An odd device carried around in the hand to measure energy absorption is pictured in Fig. B. It consists of a wired cage in front of which is mounted a micro-ammeter, in the center of which are 2 rigid wires and a crystal detector. In the rear is a box for holding live insects; extending out of this box is a one inch aerial. The object of the device is to test the distances from the radio transmitter at which insects can be killed, and to study energy absorption. As it is carried about, fluctuations in the micro-ammeter reveal data. Dead honey bees shown on the left were removed from the receptacle in the rear, after one of these tests.

In Fig. C is shown Dr. Thomas J. Headlee at his 100 watt radio insect destroyer. This particular model was developed

(Continued on page 299)

Fig. 2. How this discovery can be applied to destroy insects in all packaged goods.

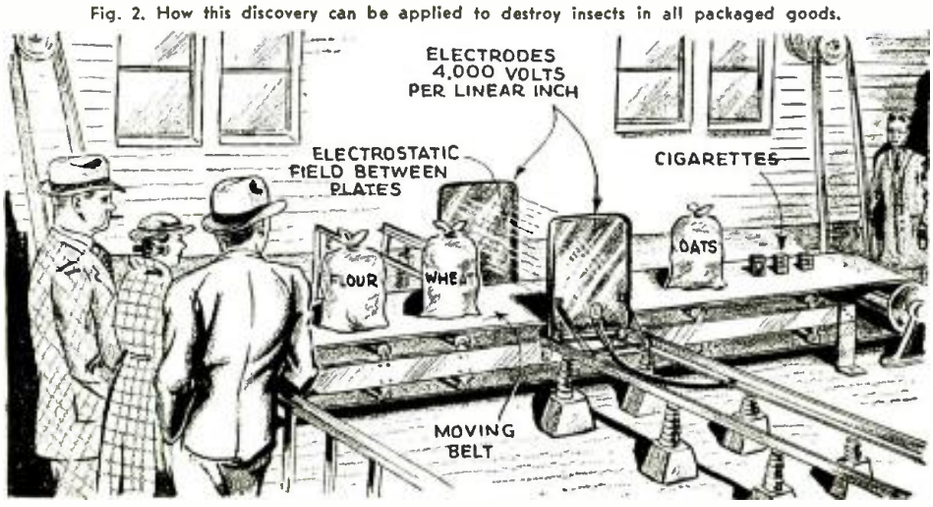


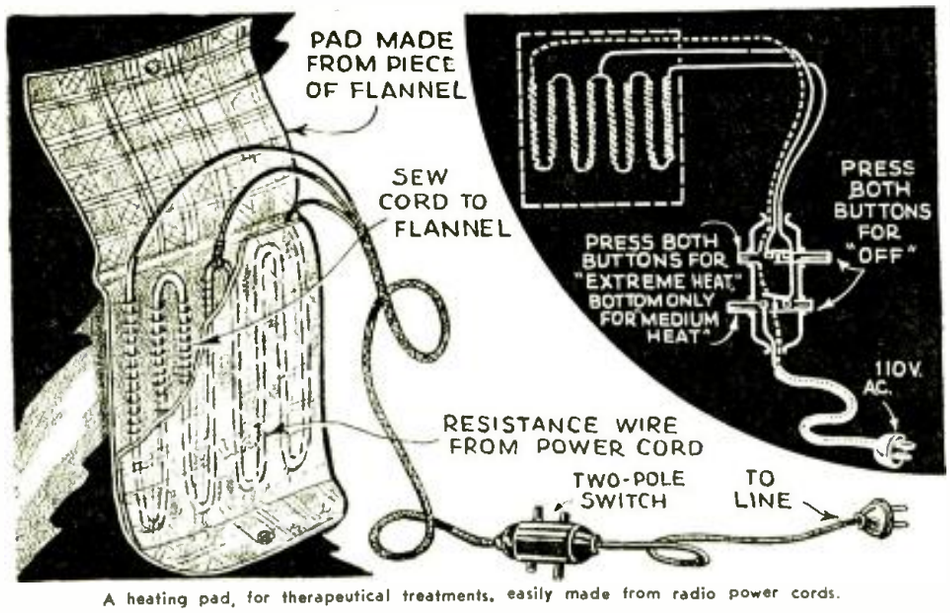
Fig. E. A 50-watt unit in a greenhouse.

SHORT-CUTS IN RADIO

FIRST PRIZE $10.00
SECOND PRIZE 5.00
THIRD PRIZE 2.50
Honoroble Mention

EXPERIMENTERS: Three cash prizes will be awarded for the best "short-cuts" — time- and money-saving ideas — submitted by readers of RADIO-CRAFT; Honorable mention will be given for all other published items concerning radio and its allied fields.

Send us your "kinks" right away.



A heating pad, for therapeutical treatments, easily made from radio power cords.

First Prize

A HEATING PAD, which is a most handy item in the home in case of illness, can be easily made from the resistance wire in "power cords" such as are employed with A.C.-D.C. receivers. Sufficient lengths should be obtained (from any radio parts retailer, especially those specializing in the sale of surplus parts) so that a total of 485 ohms of wire is sewed between two 10 in. by 15 ins. lengths of flannel as shown. A tap is taken 100 ohms from one end, and the unit connected as shown. The "power switch" controls the heat.

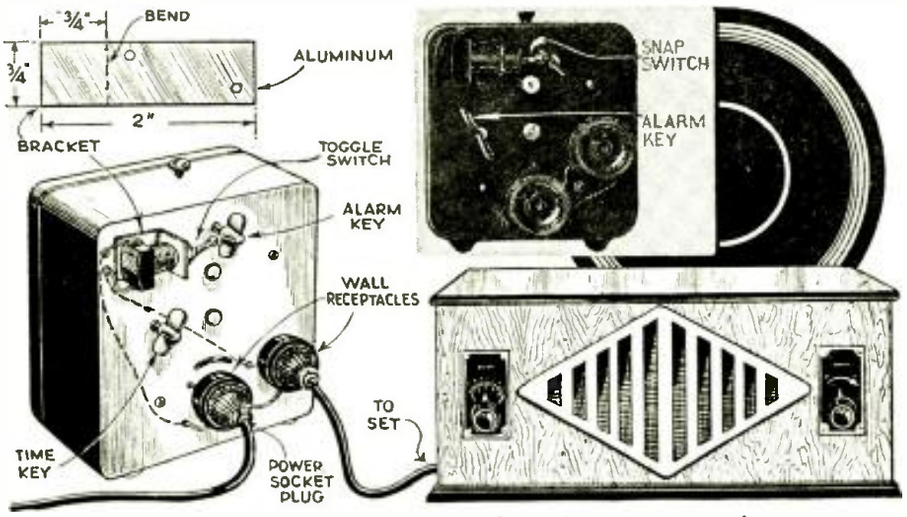
Joe Weber

Second Prize

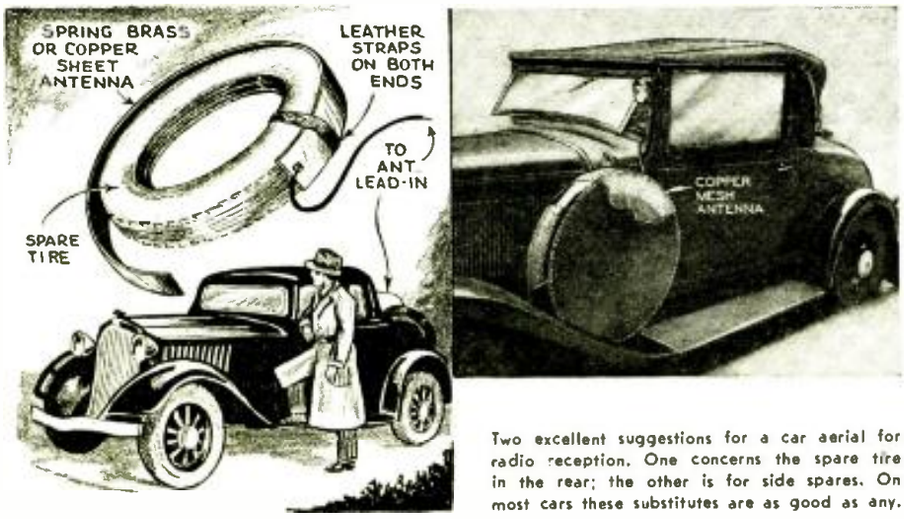
THE TIME SWITCH shown in the drawing on the right was actually built from one simple radio part and a piece of angle iron, in addition to the requisite alarm clock which must be of the spring-driven type. The angle iron is drilled and bent so that it will support a regular radio type toggle switch. It is then mounted, as indicated, so that the alarm key will temporarily engage in the lever end of the switch—when it is rotating.

This unit is ideal for turning on radio receivers at any desired time so that a favorite program will not be overlooked; or, for turning the set "off" by reversing the position of the toggle switch so that the downward movement of the alarm key flips the switch lever to the "off" position.

Jack Mullane



A simple, home constructed, time switch for radio receivers made from a few parts.



Two excellent suggestions for a car aerial for radio reception. One concerns the spare tire in the rear; the other is for side spares. On most cars these substitutes are as good as any.

Third Prize

CAR RADIO ANTENNAS always present a problem to the auto-radio installation man, particularly in the cases of older cars (where no provision was made to accommodate a receiver) by the manufacturer not including an antenna. The kinks suggested by the accompanying illustrations are as good as any of the substitutes sold at the present time.

One of the suggestions consists of a sheet of thin brass or copper, the width of the spare tire, strapped on both ends but kept clear of all metal parts which connect to the car frame. A lead-in soldered to the metal sheet is brought to the set. The other consists of copper screening placed inside of a spare tire cover to which is also soldered the lead-in.

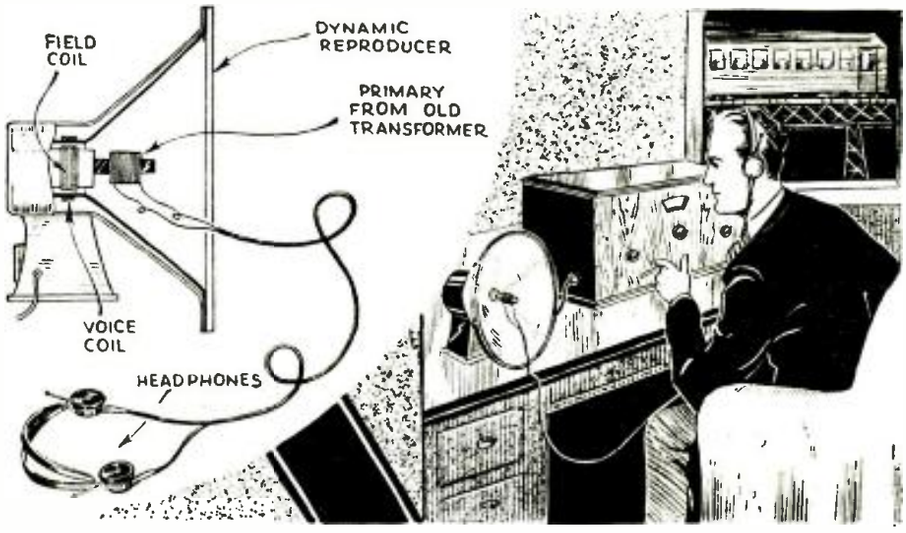
Frank Sayers

HONORABLE MENTION

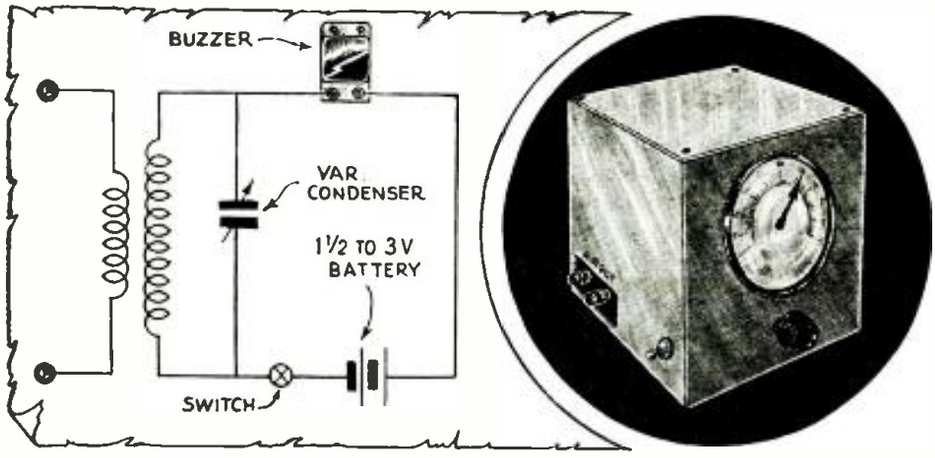
HEADPHONE RECEPTION is generally an impossible feat with most loudspeaker receivers, unless of course provision is made for connecting phones into the set. And the use of headphones is sometimes highly desirable, especially in instances where local noises tend to drown out or interfere with programs as heard from the regular loudspeaker.

The wrinkle shown in the illustration on the right permits a very simple solution to the problem, and doesn't interfere with normal loudspeaker operation. It consists of an ordinary iron-core inductance preferably of the high-impedance type, which is attached to the field core of the dynamic speaker. The magnetic force exciting this pole piece will hold the iron core inductance in place. Quality and volume are good.

C. Frohwein



Headphone reception with loud speaker receivers is easily possible using the above wrinkle



A simple Service Man's oscillator, made from spare parts, and in a few minutes

HONORABLE MENTION

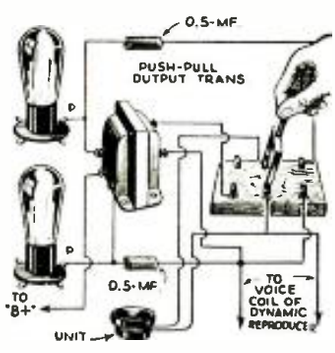
A SIMPLE SERVICE MAN'S OSCILLATOR can be built from odd parts that most radio experimenters always have—and in a few minutes too. All that is necessary is an ordinary inductance such as used for T.R.F. purposes, a variable condenser to suit, a low current consuming buzzer, a switch, a small "C" battery, and a shield can to house the unit, as shown in the illustration at the left. This type of oscillator was called a wavemeter in the "old days." The oscillations are produced by the sparking of the buzzer contacts and are of an undamped nature. For that reason the unit must be completely shielded.

N. Allen

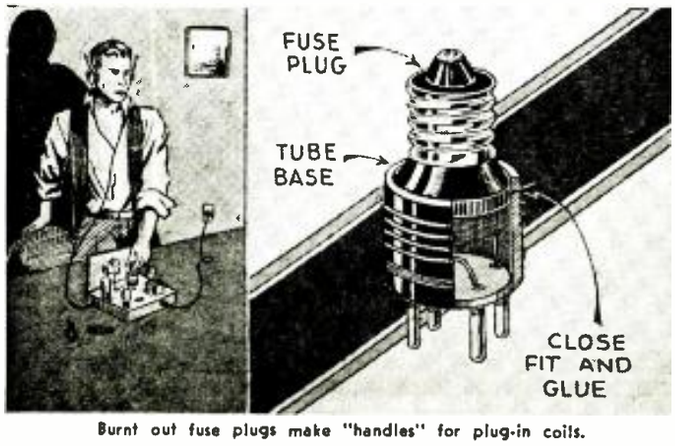
HONORABLE MENTION

SWITCH CONNECTIONS FOR HEADPHONE RECEPTION puzzle most constructors, particularly when push-pull amplification is employed in the power stage. A number of methods for making the proper connections, with a throwover switch for reconnecting the receiver to loudspeaker operation, have been previously described numerous times in this magazine. Unfortunately, a great many of the uninitiated seem to think that their set requires some special connections, if proper results are desired. That happens to be a fallacy, since the circuit which is shown pictorially (adjoining) can be universally adapted for any type of receiver that uses a dynamic speaker and two tubes in push-pull in the power stage. Bypass condensers, .5-mf. size, inserted in the plate lead of each tube isolate the phones from their high plate current.

William B. Rogan



How to connect a receiver, employing dynamic speaker and push-pull power stage, for headphones.



Burnt out fuse plugs make "handles" for plug-in coils.

HONORABLE MENTION

PLUG-IN COILS are extremely desirable in short-wave receivers, but since they require constant changing when one desires to switch from one wave band to another, they sometimes become a nuisance. This is particularly true when the coils are of such small size and no provision is made for grasping the coil when it is desired to remove it. For those who have encountered this difficulty then the kink shown in the illustration on the left may prove to be a time saver. It certainly permits a quick and simple removal of the coil when it is necessary. Ordinary fuse plugs, those of the "burned out" variety, are fastened into the open ends of the coils by means of glue and a force fit. If it is of the composition type some slight filing of the knurled edge may be required before it can be wedged into the coil. At any rate never use too much force in fitting the plug into the coil.

William B. Rogan

INTERNATIONAL RADIO REVIEW

Fig. A
A modernistic receiver of high efficiency.

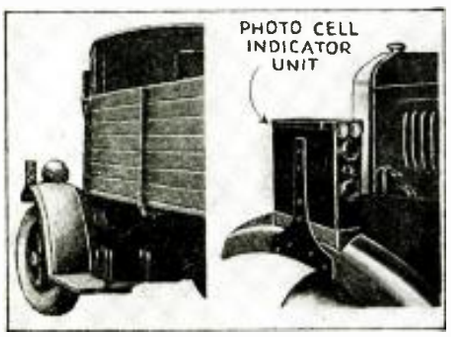


Fig. B
An "electric eye" approach indicator.

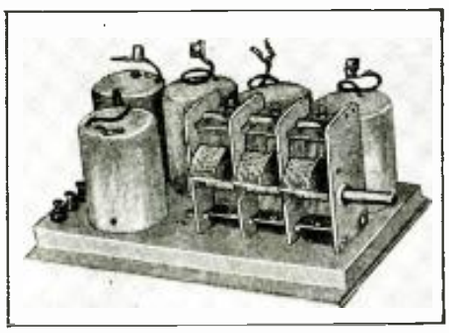
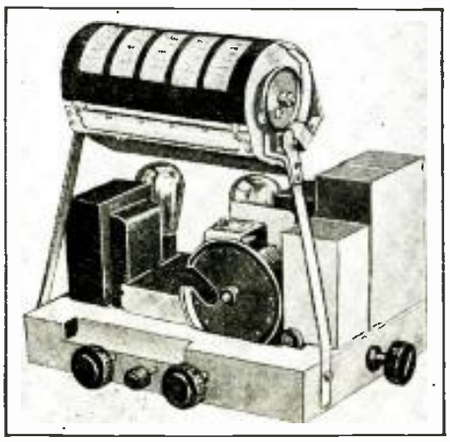


Fig. C, above.
A superhet. basic assembly.

Fig. D, below.
You write in the station calls.



HERE is what the radio experimenter has been wanting for a long time—a semi-technical review of the thousands of new ideas which are continually appearing in overseas publications. Each month there are received at the offices of RADIO-CRAFT hundreds of daily, weekly and monthly magazines originating from all over 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 for our readers reviews of all the really important, new developments illustrated and described each month in these publications.

NOTE that the only available information is that which is published; the experimenter must adapt the ideas to whatever equipment he has on hand.

A "SPOTLIGHT" SET

A RADIO receiver that is now in the English spotlight is the receiver shown at A. According to a July issue of THE BROADCASTER AND WIRELESS RETAILER (weekly), this instrument has aroused considerable interest because of its unique housing, which is reminiscent of a spotlight. The cabinet is circular and so is the speaker opening; the full-vision scale, which is calibrated for the foremost European stations, is semi-circular. The controls carry out the "circular" motif, being arranged in an arc. The cabinet is made of bakelite.

This receiver incorporates a 6 tube superheterodyne chassis. The modernistic trend is accentuated by the chromium-and-black finish.

The circuit incorporates such features as A.V.C., light-beam and shadow station indicator, dynamic reproducer, A.C.-D.C. operation, band-pass tuning, and dual-range reception, thus indicating that this set, far from being a toy, is a practical radio receiver of great utility.

AN "ELECTRIC EYE" SEES CARS IN REAR

AN AUSTRIAN firm, according to an August issue of WIRELESS WORLD (weekly) has produced an interesting device, Fig. B, that should have special appeal to Gotham's "finest," who have been endeavoring to soft-pedal New York City's traffic noises.

As the illustration shows, a photo-electric cell, and its accompanying lens system and amplifier, all housed in one case, are mounted on the mudguard of an automobile. It then remains only for the driver to set the apparatus in operation by manipulating a dashboard switch. Once this has been accomplished the equipment is then sensitive to the lights of vehicles approaching from the rear, whose drivers may then indicate their proximity or desire to pass the forward auto by flashing the headlights.

The resulting current generated by the photoelectric cells may actuate either an instrument-board meter or a loudspeaker.

This device is of a special value for loaded trucks, or pleasure cars, the rear-window view of which may be obscured by merchandise or a curtain; it also would help greatly to reduce the din of cars in traffic, hooting for roadway to pass the car ahead.

A SUPERHET. BASIC ASSEMBLY

IN THIS "hetero-tuner" (shown in Fig. C), states an issue of WIRELESS WEEKLY (Australia), is the heart of the modern superheterodyne. The R.F. and oscillator coils, tuning condensers, padding condenser, bias resistor, trimmer condensers, bypass condenser and I.F. coils that are intimately connected in the circuit are assembled on one chassis, scientifically aligned, and the adjustments sealed. (Several types are available to meet standard circuit requirements.)

To build a superheterodyne it is only necessary to install this complete tuning assembly on a base sufficiently large to accommodate the requisite tubes, and the accompanying second-detector, A.F. amplifier equipment and power pack, and the job is done.

The instrument shown in the illustration is designed to utilize one tube as a combined oscillator and first-detector, and second and third tubes as first and second I.F. amplifiers, respectively. Several circuit combinations are available to meet the requirements of outstanding circuit arrangements.

Several years ago sporadic efforts were made here in America to popularize the basic-assembly idea, but the proposition never gained very much headway—due, mainly, to the lack of results for the money involved, in comparison with equipment built up from apparatus picked up here and there at random prices.

Today, the story is a different one. Good tubes that are capable of all sorts of tricks are available at one-quarter the cost of a much inferior tube of 5 years ago. At the same time, these new tubes have assisted materially in the development of high-efficiency circuits that afford the ne plus ultra in results. Finally, these improved tubes and circuits require certain associated units that are hair-trigger in their performance—the slightest deviation from hard and fast specifications, and the whole

instrument is rendered worthless.

The day when set builders could make an efficient radio set from components won from the Radio Club's grab-bag is a thing of the past. Certain key components in the set assembly must be built, installed and aligned to rigid specifications. American manufacturers who cater to the custom set building trade may well study the idea illustrated, in Fig. C, and improve upon it if they can.

NOVEL DIRECT-READING 3 TUBE RECEIVER

"WRITE the call letters on my dial," invites the scale of the new Lumophon receiver described in BASTELBRIEFE DER DRAHTLOSEN for August, and illustrated in Fig. D.

This interior view shows the manner in which the cylindrical dial, which fits into the top-front edge of the cabinet, is arranged in relation to the rest of the chassis. The front, lower-right knob turns a large drum that is cable-geared to the small drum on the right-hand end of the long cylinder. When the desired station is tuned in at maximum volume, its call letters may be written directly onto one of the five blank panels provided for such data.

In order to keep the instrument compact, and to provide this novel tuning feature at minimum cost, the receiver circuit has been built around the new line of high-efficiency tubes, including the hexode, and thus only 3 tubes are required.

A dual-range superheterodyne circuit is utilized, with the first tube, a hexode, functioning as a combination electron-coupled oscillator and regenerative first-detector; the second tube, a tetrode, operates as the second-detector and power output unit; the third tube is a full-wave rectifier.

Dual-range reception is provided by means of a switching arrangement. An electrodynamic reproducer is included in the design, as are also a tone control, an A.V.C. circuit, and a condenser for compensating the differences that exist in the effective capacity of different antenna systems.

A "BODY-LINE" RADIO SET

THE TERM "stream-lined" has become a bit threadbare from over-use, it would seem, or maybe it's just good English to say that the radio receiver shown in Figs. E and F, and shown by diagram in Fig. 1, is a "body-line" radio set. At any rate, as AMATEUR WIRELESS (England) points out in a recent issue, the whole thing would be non-existent were it not for the new, midget-size tubes that have recently landed, with both feet, on a wide-open market. For, it must be remembered that battery sets of all kinds go over in a big way, in England, as pointed out in past issues of RADIO-CRAFT, and the new midget-size tubes recently described (RADIO-CRAFT, July 1934, pg. 16) were especially designed to meet all requirements in this profitable field.

As the schematic circuit, Fig. 1, indicates, our old stand-by, the regenerative detector, is utilized; this is followed by a stage of A.F. amplification. Tube V1 is a Marconi-Osram type H-11; V2, a type L-11. The filaments of these tubes consume 0.1-A. at 1. V.; the circuit is designed to use the filaments wired in series, and connected to a very small jelly-acid 2 V. storage cell.

Until tubes of these small dimensions make their appearance on the American market the constructor must content himself with adapting this circuit to the larger tubes in the 2 V. series, connecting the filaments in series or parallel, as desired, depending upon individual convenience and preference in the matter of "A" supply.

In order to reduce the set to its smallest proportions, compression-type variable condensers, such as are used to align radio receiver circuits, are employed. One condenser is used as the regeneration control and is pre-set to the position of optimum regeneration; the other one is the tuning condenser, and is adjusted by means of a screwdriver for the most powerful local station.

The original coil design called for 55 turns of No. 26 double cotton covered wire wound in a "hank" around a broom handle or other piece of wood about 1 in. in diameter, for the tuned inductance. The feedback or plate coil is made by winding 40 turns of the same size wire on a form about ¾-in. in diameter. These two coils, which are both wound in the same direction, are then connected together, the inside lead of one coil being connected to the outside lead of the other. These coils are then placed one on top of the other; if the circuit does not regenerate, turn the plate coil upside down.

Due to the fact that the tuning condenser selected for this set has a limited capacity range, only a few stations can be tuned in. Therefore, the constructor is recommended to vary the number of turns in the coil that now contains 55 turns, to obtain the desired wavelength response. (It may then be advisable to vary the number of turns in the plate coil in order to obtain satisfactory regeneration control.)

The "B" battery is made by connecting in series a number of 1.5 V. cells, of the pen flashlight type, to form a suitable plate-voltage supply. The tubes used in the original model operated very

(Continued on page 304)

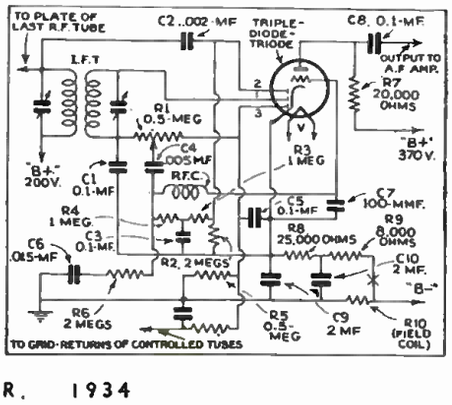


Fig. 2, left.
The connections of the triple-diode-triode.

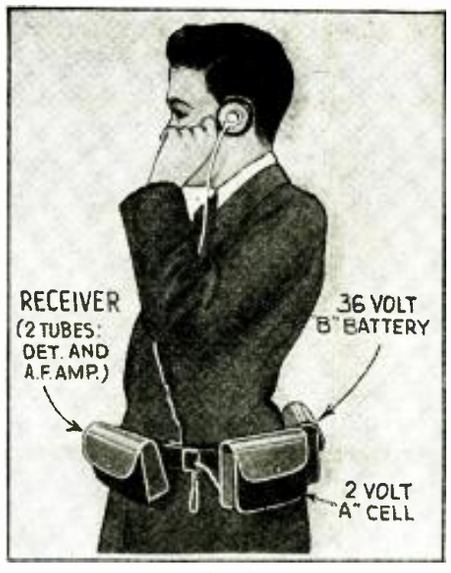


Fig. E
A form fitting "personal" set.

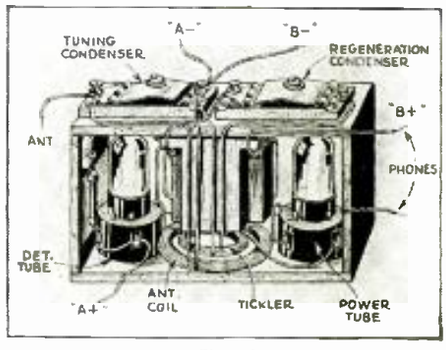


Fig. F
Details of the "personal" set.

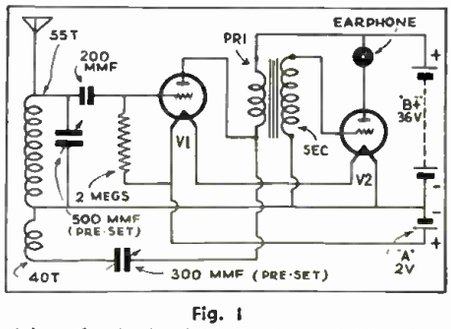
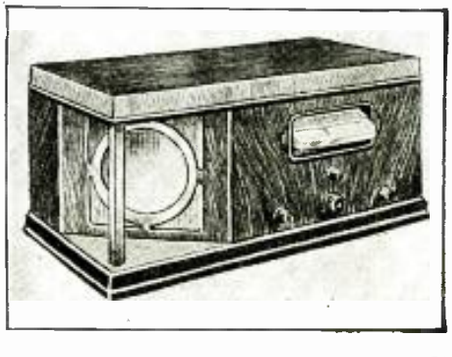


Fig. 1
Schematic circuit of the 2 tube portable set.

Fig. G
The tilting dial radio receiver.



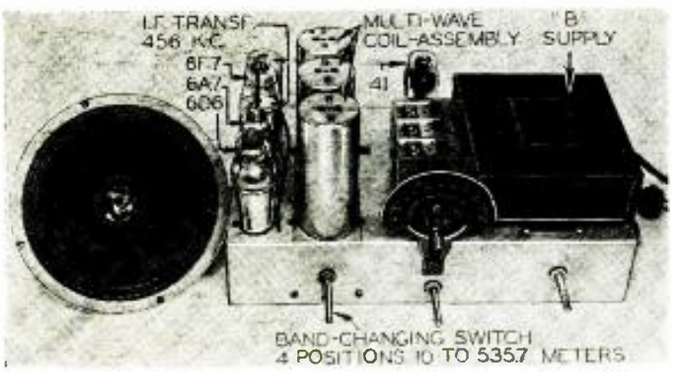


Fig. A. Complete receiver with indications of parts placement.

BUILD THIS

This receiver was designed for the rural or city constructor who does considerable moving about. It will operate from a 6 V. battery, or from 110 V. A.C., thereby solving the problem of electric power on a farm where electricity is not available, and in cities and towns where it is. With slight

"WHY not publish more descriptions of farm or rural types of receivers, a good many of your readers, as you should know, live in the country where power supply is not available," is the theme of a great many letters. Or, "Is it possible to construct a set that will operate in both a cabin and in a city apartment house? The apartment has 110 V. A.C. but no electricity in the cabin." and "How about an all-wave receiver that employs a minimum of tubes?—so many of the receivers for constructors that are being described nowadays use so many tubes that it requires a young fortune to operate and replace them." Well, it's a pretty tough order to fill—but, we believe we've done it. Here's a set that employs only 4 tubes in the receiver end, and a rectifier tube in the power supply unit—which can be eliminated, if the electric line happens to supply direct current, or if the unit is to be operated from a 6 V. storage battery unit, only.

The present make-up of the set is such that a total of 5 tubes is used, but then the obvious advantage of this arrangement is apparent since the receiver can now be used on 110 V. A.C.; 110 V. D.C. (with proper series resistor); 32 V. lighting plants (with proper resistor); or 6 V. D.C., generally supplied by a storage battery. For direct current use, a toggle switch on the chassis thrown to its proper position will permit operation on 110 V. D.C., with a 16 ohm resistor (700 W. rating) connected in series with the 6 V. cable leads to which a plug is attached. For 32 V. D.C. operation a 4 ohm resistor (200 W. size) is connected in this cable. For 6 V. operation no resistance is necessary, simply attaching the leads to the 6 V. D.C. source, after the toggle switch is placed in its proper position, being all that is required for such operation.

Consequently, when the set is to be moved from the city to the country where no power is available the car battery solves the problem of electric power for this set. Or if the set is built for farm use, and later moved to the city, no complicated rewiring or changes whatsoever are required. And contrary to any opinion that may be hastily formed, the cost of construction of this receiver is no more than that for one that will operate from one definite type of power supply. It does waste some power on 32 or 110 V. D.C. operation, but where the receiver is to be used for such supply only, the writer will be glad to specify a "B" transformer to replace the present one indicated as T1 in Fig. 1, and a larger type of vibrator unit to suit the individual needs of the constructor.

The Power Supply

An analysis of the wiring diagram of this receiver, shown in Fig. 1, will explain to most readers the necessity for this change. It will also serve to indicate the operation and features that are different from most other sets. First, a glance at the power supply will show that most of the differences exist in that unit. Instead of the conventional power transformer, rectifier tube, and filter supply we find a step-down transformer, another transformer, a vibrator unit, and a toggle switch of the two-pole double-throw variety. Further analysis shows that when the aforementioned switch is in the 6 V. D.C. position, the 6 V. input passes through the switch into a full-wave vibrator which breaks the D.C. into a pulsating current, then into a low-impedance primary winding of a step-up transformer. The secondary of this transformer delivers over 325 V. A.C. to the rectifier 84 tube which converts this current back into the direct type in the order of 300 V. The filtering is accomplished only by means of the speaker field (and condensers; no additional chokes being necessary), which is of the 1,800 ohm type tapped at 300 ohms.

When the switch is thrown to the A.C. position a step-down transformer is inserted into the power supply circuit. The 110 V. A.C. is brought down to 6.3 V. A.C., fed to the vibrator and power transformer (the vibrator must be kept in the circuit or else serious damage to the primary of the power transformer results) for "B" supply, and also fed to the heaters of the tubes (which now operate on A.C.).

This covers the features of the power supply which permit 6 V. D.C. or 110 V. A.C. operation, and 32 or 110 V. D.C. use if proper dissipating resistors or slight parts changes are made as explained previously.

The All-Wave Coil Assembly

Of primary interest, in the design of this set, is the all-wave coil and switch unit shown in Fig. D. It is the reason

Fig. B. Underside view of chassis.

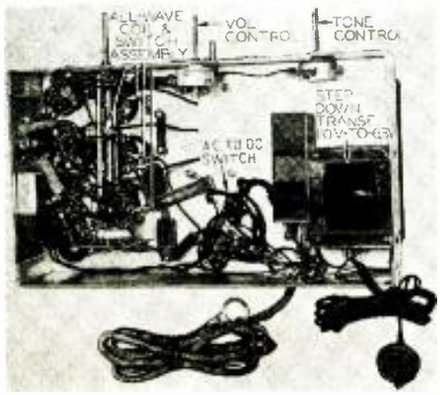


Fig. C. How the "B" power supply looks.

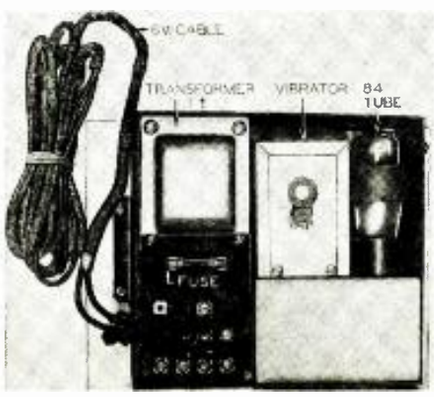
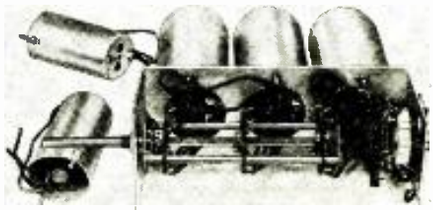


Fig. D. The extremely high efficiency of this receiver may be attributed to the all-wave coil assembly shown below. It is completely assembled and wired, ready to be incorporated within the set with only few additional connections necessary.



ALL-WAVE SET

changes it may be employed on 110 V. or 32 V. direct current. Its greatest feature is a new all-wave coil and switch assembly. This unit saves considerable time in wiring and assembly, eliminates complications from superhet. construction which frighten most laymen, and permits operation from 10 to 535.7 meters in 4 bands.

J. T. BERNSLEY

FEATURES

1. Almost universal current operation. Will operate on either 110 volts A.C., or from a 6 volt storage battery; slight changes are necessary for 32 or 110 volt D. C. use.
2. All-wave reception from 10 to 535.7 meters in 4 bands, selected at will by means of switch control.
3. No plugging in or out of coils, all band changing being accomplished by switching system.
4. Unusually high sensitivity, excellent tonal quality, no hum despite unique design of power unit.

for this receiver's high efficiency (about which more will be said shortly), and because of its highly engineered design, permits all-wave operation from 10 to 535.7 meters *without any necessity for plugging coils in and out* every time one desires to change wave bands. This range is covered by a switching arrangement, in 4 steps, as follows: (1) 10 to 40 meters, approximately; (2) 40 to 75 meters approximately; (3) 75 to 200 meters and (4) 200 to 550 meters. The coils are completely enclosed within shields and mounted on a sub-base which also incorporates the switch assembly. All trimming and padding condensers are also included and wired (as are the coils and switching unit) into circuit, and are easily accessible. Because of these ready-made connections the wiring of the receiver becomes a simple matter, since this unit needs only a few more connections to the variable (tuning) condenser unit and "Ant." and "G'nd." posts to complete the tuning circuit. This will be good news to many constructors.

Receiver Circuit

The circuit employed is of the superhet. type with one stage of tuned R.F. amplification (6D6) ahead of the combined first-detector and oscillator tube, the 6A7. Thus 3 tuning circuits in all are used, which provides more than ample selectivity. This is followed by a stage of intermediate frequency amplification (pentode section of 6F7) which is of the "power" detection design. Finally, the power stage which is resistance-coupled to the second-detector and uses a 41 tube. A tone control is connected in the plate lead of the output tube so that any degree of bass emphasis can be immediately controlled at will.

Construction and Adjustments

The construction of the receiver is made simpler by the assembled all-wave coil unit. A rectangular hole is cut in the chassis base according to the template supplied by the manufacturer of the coil assembly. The unit is then bolted down to the chassis. The power supply is built according to Fig. C., within a metal container, and then wired and fastened to the chassis. The rest is simple—wafer type sockets, I.F. transformers, and variable condenser being arranged and fastened to the chassis as shown in Figs. A and B.

The aligning and balancing of the set is a somewhat more difficult job, but can be done easily and efficiently if an all-wave oscillator (such as is described elsewhere in this issue) is available. Instructions for operating an all-wave oscillator (a present-day requisite for all Service Men) are given in this issue. Where no such oscillator is available the constructor will have to use whatever signal he can tune in on each wave-band as an adjusting signal. Try to obtain a signal on the low, medium and high points of the tuning dial, and adjust each padding or trimming condenser for maximum receiver output or volume. Later, when an all-wave oscillator is available, these adjustments can be checked and reset. The I.F. transformers and trimming condensers must be set by means of a calibrated I.F. oscillator which most Service Men are equipped with. The I.F. transformers peak at 456 kc.

Receiver's Efficiency

The performance of this receiver will amaze even the most experienced short-wave listener. While it will not receive C.W. signals and therefore will not satisfy most "hams" or amateurs, this can be readily accomplished by the inclusion of a beat oscillator. As it is, it tunes in a remarkable number of amateur phone stations on number 2 and 3 positions of the switch. Police calls all

(Continued on page 299)

Fig. 1. The diagram of the versatile All-Wave receiver. The power supply is a conventional auto "B" unit, with some slight changes.

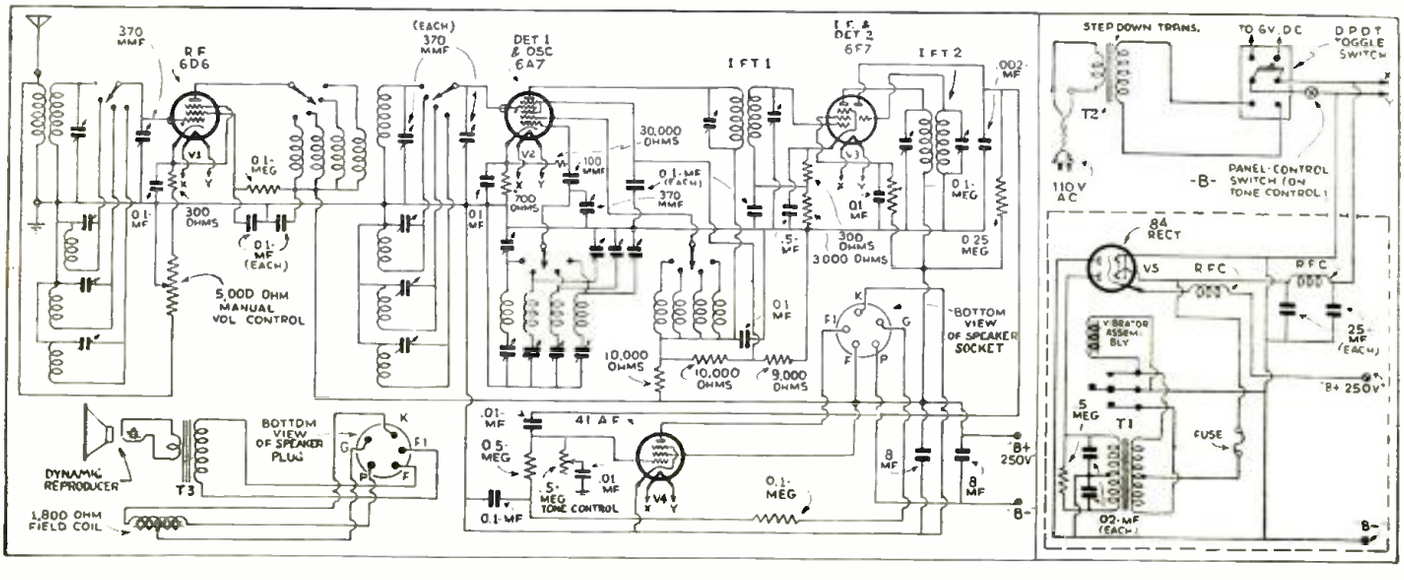


Fig. A
The completed unit is entirely shielded, and has a commercial appearance.

A "B" SUPPLY FOR FARM OR AUTO SETS

This unit will completely eliminate any need for "B" batteries with farm or automobile receivers. All its components are home-made, even the vibrator which converts the 6 volts (storage battery) input D.C., to high-voltage A.C.

ROY SLAWSON

Fig. B
A view of the home-made vibrator. It is enclosed in a can lined with sponge rubber.

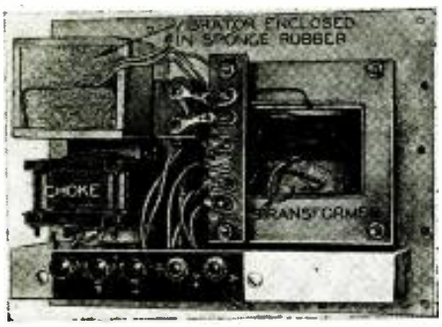


Fig. C
Internal view of the "B" supply unit, showing placement of parts and output terminal strip.

WHEN "B" batteries are used in an automobile radio installation, and farm receivers, they must be replaced at least once a year. The price has come down considerably in recent years, yet the cost of a new set of batteries is seldom less than three or four dollars, even for the cheapest product. Thus it seems desirable to install a "battery eliminator" and provide for many years of service—the first cost is little more than the cost of a set of batteries. But if the eliminator can be made at a cost less than that of the batteries, it appears that the effort required is eminently worth while.

It may be that the experimenter or Service Man already has most of the materials necessary for the construction of the simple eliminator described in this article. This device is of the usual vibrator type and employs a 71A tube as a rectifier. The vibrator and transformer required are home-made. The other necessary pieces of apparatus are those shown schematically in Fig. 1. The 71A, the 01A and 12A are quite capable of giving long service as rectifiers. This fact has been demonstrated by several commercial automobile eliminators. The 71A tube is used because of its lower plate resistance.

The Transformer

Because the filament of the tube in an eliminator must be at a high potential with respect to the frame of the car, to which the radio set is grounded, the filament supply current has to be obtained through the transformer as shown in Fig. 1.

The core of this transformer may be obtained from any old transformer of sufficient size. The core used in the eliminator illustrated is from an old battery charger. Only about half the laminations in the original transformer were used, making the core about 1 in. thick. The outside dimensions of the laminations are 3 in. x 3¾ ins.; the openings for the windings have a length and width of 1⅞ in., and ⅝ in., respectively. A smaller core can be used, but if it is too small the openings for the windings will not be large enough to admit the wire.

On a wooden form slightly larger than the central leg of the core a few layers of paper are wound and over this is formed a base of cardboard on which the primary is wound. This consists of 40 turns of No. 16, or larger, cotton-covered or enameled wire. The ends are anchored with strong paper strips and glue. Because of the paper underneath, the winding can easily be removed from the wooden form.

The high-voltage winding is next wound on another cardboard base large enough to slip over the primary. This consists of 1,500 turns of No. 34 wire. Heavier wire should be anchored with paper strips and soldered to the ends

(Continued on page 300)

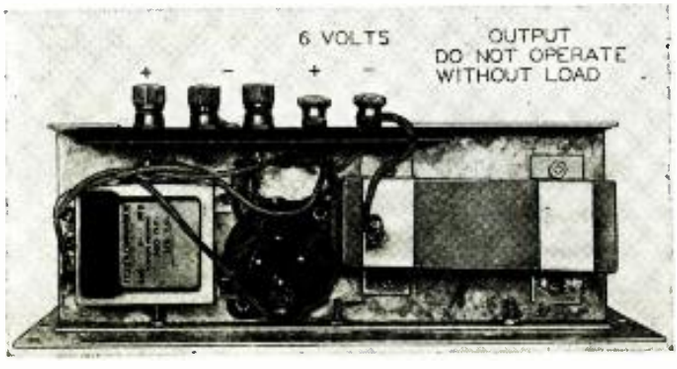
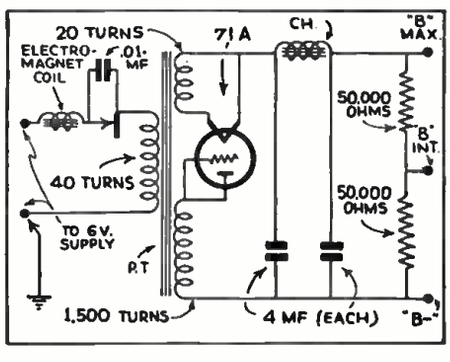


Fig. D, left.
Bottom view of unit, comprises tube socket and two filter condensers.

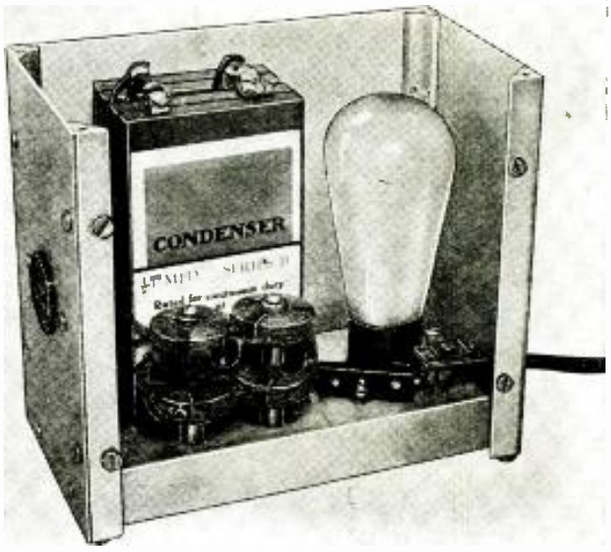
Fig. 1, right.
Complete diagram of the "B" supply. Operates from a 6-volt storage battery.



A TUNED ALL-WAVE LINE NOISE ELIMINATOR

Line noise filters are an essential item with all-wave receivers, particularly for eliminating noise on short-wave stations that many times seeps in through the power line. The filter described is of the tuned type.

J. B. CARTER



THE METHODS used to alleviate noise pick-up, especially for short-wave reception, have been confined mostly to antenna systems. The popular doublet, with transposed lead-in when properly installed is very effective in reducing noise pick-up by way of the aerial and is one of the outstanding achievements in this field. There are, however, two other ways of noise entering the receiver. They are:

(1) Tubes, wiring and any portion of the receiver that is not shielded.

(2) The power supply source.

As shielding is part of the receiver design, it is often very difficult to make any changes. The easiest method to increase the effective shielding efficiency is to inclose the entire receiver in a grounded metal box.

The power supply line is often more effective in transferring interference to the receiver than an aerial in the noisiest of locations. Most of this noise is produced by man-made static from motors, generators, sparking and kindred other devices. Some of this interference is radiated, but the larger portion is fed back directly to the power line and is often carried for miles. The easiest way of eliminating this type of interference is at the source, but this is often impractical to accomplish, and the alternative is to prevent it from entering the receiver.

Another trouble arising from the power line is voltage fluctuations, which may overload resistors and result in internal noise from expansion and contraction of these parts.

The common line filter, consisting of two chokes, bypassed with condensers, used very successfully for the ordinary broadcast receiver, was found to be totally inadequate when used with short-wave receivers.

After a number of experiments it was determined that by using a tuned resonant trap the noise could be quite effectively eliminated. The circuit shown in Fig. 1A makes an ideal filter for the short-wave regenerative set, but is not recommended for the superheterodyne. Chokes L1 are heavy commercial wound coils made especially for this purpose. However, these can be made by winding about 100 turns of No. 17 wire on a 1 in. cardboard form. Two are placed in series with each wire of the power line, the windings wound in the same direction and placed side by side in inductive relation to each other. Condensers C1 are non-inductive high-voltage filter condensers and C2 are the bypass type. The coil L2 is a Litz wire wound coil taken from an intermediate frequency transformer that happened to be lying around, but any small coil can be used, providing the ohmic resistance is low. Condensers C3 are small equalizing condensers with mica dielectric and are provided with an adjustment screw to change their respective capacities.

Tube VI is a line voltage regulator tube and is connected as shown. This tube consists of an iron filament wire having a high temperature coefficient of resistance, through which all current flows. The filament is inclosed in a glass bulb which contains nitrogen gas. When the line voltage rises the voltage drop across the tube varies, due to its change in resistance and the effective voltage to the receiver is practically constant. In general, with a 10% increase in current through the regulator tube the voltage drop across it increases 200%. The type of tube used in each particular filter depends upon the number of tubes used in the receiver or to be more correct the current consumption of the receiver. The selection of the proper regulator tube is important if good regulation is desired.

To install this filter, remove the aerial lead-in from the receiver and install the filter in the power line, turn up the volume control in the set and tune condenser C2 until the noise diminishes. If no difference is noticeable take off a few turns of wire from the coil L2 and continue this procedure until trap is resonated with the noise frequency.

(Continued on page 302)

Fig. A
The entire instrument is so laid out that ample space is available for each part. No crowded wiring is necessary. Bottom view shown below

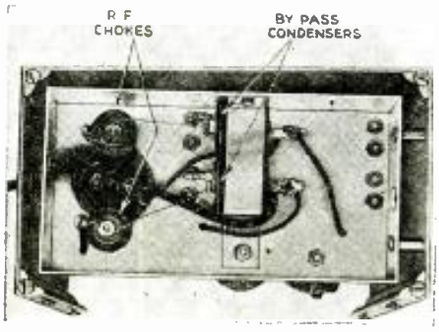
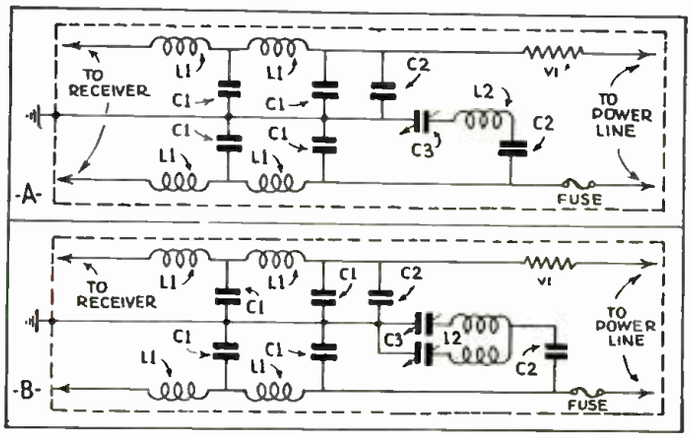
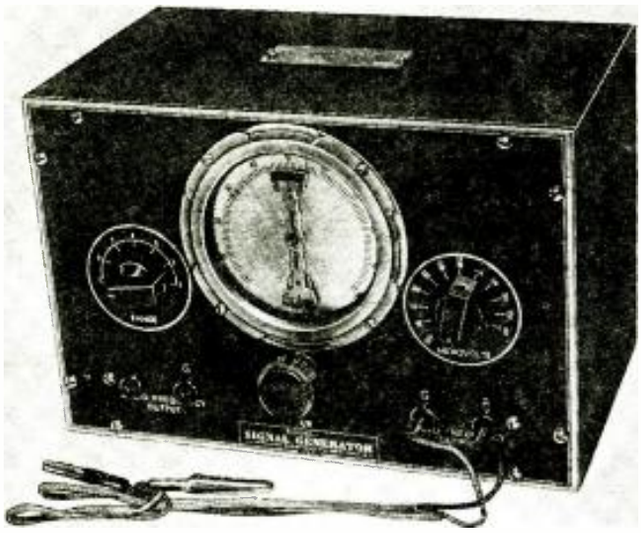


Fig. 1
The line noise eliminator employs tuned resonant traps. The construction of the R. F. chokes is described in the text. Wiring diagram of two units shown on right.





A SERVICE MAN'S ALL-WAVE OSCILLATOR

The all-wave oscillator described below incorporates several ingenious features which make it an ideal instrument for the Service Man or test laboratory. It will generate fundamental frequencies from 100 to 21,000 kc., either modulated or non-modulated.

*S. S. EGERT AND S. BAGNO

THIS all-wave signal generator has been designed to meet the current demand for an all-wave oscillator to perform general service work on all-wave receivers. The demand for such an R.F. oscillator has slowly gathered force the last two or three years and is due to the complexity of design which has entered into the set field, principally due to the multi-grid tubes, automatic volume control, as well as many other features which absolutely necessitate a single-source signal to be fed into the antenna.

There are many problems involved in the design of a good all-wave oscillator or signal generator. These problems pertain to such things as stability, attenuation, leakage, modulation, harmonic content, ease of operation, accuracy, portability, as well as many other minor factors. The writers have approached this problem from the standpoint of fundamentals and have attempted to solve the above-mentioned problems and requirements.

In order to thoroughly acquaint the reader with the exact specifications of this instrument, we are first describing a general circuit design and then giving the exact performance of each control.

Figure 1 shows the circuit diagram. Note coils L1 to L7, which are individual main R.F. tuning inductances. These coils operate in conjunction with a two-gang, seven-point switch which selects the individual coil to be connected to the standard oscillating circuit employing the type 30 tube. Condenser C1 is the main tuning condenser across these coils. The signal generated by the 30 tube is fed into the fourth grid of the 1A6, and the fourth grid and the plate of the 1A6 then operate as a radio-frequency buffer stage for the radio-frequency signal. The R.F. signal is then fed through a .006 mf. condenser and finally through a *logarithmic output* attenuator as shown. The audio signal is generated by means of grids Nos. 1, 2, 3, and 5 of the 1A6 tube in conjunction with coil L8 and condenser C2. By shorting the A.F. output posts, it is possible to cut out modulation. Modulation is accomplished internally in the 1A6. Battery leads are brought out as shown in the schematic diagram.

The main tuning control is varied by means of the knob directly under the airplane-type micro-vernier dial. This dial is calibrated to one-tenth of one division and therefore allows for extreme accuracy in reading the curves that are supplied with each instrument. (There is absolutely no back-lash in this dial, and in conjunction with the 16½ to 1 in 360 degrees ratio, it provides an ideal unit for an instrument of this type.)

The band switch is composed of a seven point 2-gang low-capacity switch. The user will note that there are markings on the front panel indicating switch positions ranging from one to seven. The individual ranges of these markings are as follows:

Position 1—	12,000 kc.	to	21,000 kc.
Position 2—	6,750 kc.	to	13,500 kc.
Position 3—	3,000 kc.	to	7,000 kc.
Position 4—	1,400 kc.	to	3,400 kc.
Position 5—	550 kc.	to	1,500 kc.
Position 6—	250 kc.	to	570 kc.
Position 7—	100 kc.	to	255 kc.

All these signals are generated at fundamental frequencies. When the oscillator is taken out of its covering metal case, you will note that there are seven individual coils, each of which covers one of the above circuits.

The on-off switch and attenuator perform both functions aforementioned. In an instrument of this type, a suitable attenuator is one of the most important units to be considered.

A Special Attenuator

This oscillator unit incorporates an entirely new development in the form of a non-inductive, constant input and output impedance, logarithmic and continuously variable attenuator. A fixed output impedance of 100 ohms to feed into the antenna of radio receivers is employed. Due to this development it is possible to obtain an approximate calibration in microvolts, as shown on the attenuator scale. Also, due to the constant input and output impedance characteristics of the attenuator, the

(Continued on page 304)

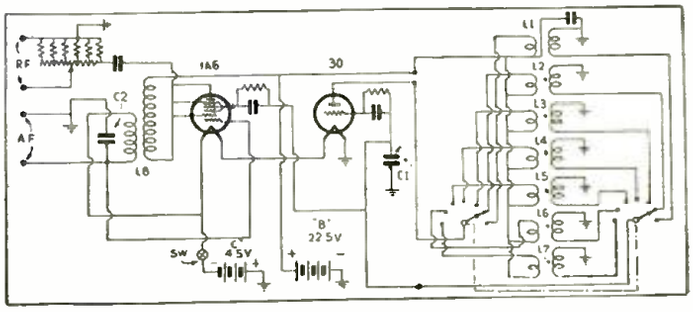
*Wireless Egert Engineering, Inc.

Fig. A, left.

Rear view of the oscillator illustrating the location of parts. It is battery operated, a small "C" battery being sufficient for "A" supply, and a 22½ V. battery for "B" voltage.

Fig. 1, left.

Wiring Diagram. The 30 tube is the R.F. oscillator. Part of the 1A6 acts as a 1,000 cycle A.F. generator, other part as a buffer stage.



THE LISTENING POST FOR ALL-WAVE DX-ERS

This page is devoted to the radio enthusiast who is solely interested in world-wide reception and facts that will aid him in obtaining the ne plus ultra in radio results.

C. A. MORRISON

DX listening requires careful tuning and patience.

NOTE: "The Listening Post for All-Wave DX-ers" is a new department of RADIO-CRAFT. Its popularity and usefulness will depend, in proportion, upon the support you, as readers, afford it. We are introducing this month some absolutely new DX-ing features of pertinent interest. Most of these are appearing for the first time in any radio department. We invite your comments. We have purposely designed some of these new features to permit you to participate in making them interesting. Your new DX Editor is well known to a great many of you. To those who have granted their cooperation in the past, your continued support is solicited and will be appreciated. While to new readers he wishes to extend cordial greetings, and to assure you he will endeavor with your support to make this the most alive radio department in existence. To new readers may he say he regards all of you as personal friends, and brother DX-ers. As a DX-er himself, and in constant association with DX-ers from all parts of the world he is well acquainted with what you are interested in, and what will be of the greatest value to you in the pursuit of this enjoyable pastime. Let us all put our shoulders to the wheel and make this radio department an outstanding one from all angles.

The DX Editor

THE WORD "DX" means simply "D" for distance, and "X" for the unknown, or in other words a radio listener reaching out for an unknown, and elusive station at some far away point—perhaps on another continent. DX-ing is a fascinating, and thrilling hobby because through it we are able to go astride the fabled magic flying carpet and instantly be transported to intriguing and exotic foreign lands where for a time at least we are permitted to dwell in fancy, far from the humdrum existence of everyday life. Young or old alike may participate in this sport, as in fact you will find DX-ers in every land and in every walk of life from Princes and potentates with their jeweled, custom-built receivers of the finest construction, to the beginner with his 1 or 2 tube set which he has painstakingly designed in his spare time from parts picked up here and there. DX, then is a common meeting ground where we can get together and with ardent enthusiasm tell about our own "rare catches," and about our own "gadgets" for improving reception, and about our thrilling adventures in coaxing in some exceptionally distant one.

Transmitting room of XGOA, a mark to shoot at.

Through these columns we shall tell you how to become a "DX-er" and how you may indulge to the fullest possible extent in this great hobby, explaining in clear and concise language just what you may expect, and how to go about getting it. For the experienced, old-time DX-er we will include in these columns information of the utmost value, and interest. We shall strip non-essential facts to the bone in order that we may give you in this small department the essence of the radio DX-ing information of the world.

There are two major fields of DX-ing; (1) Short-wave band listening, and; (2) Broadcast band listening. Each has its devotees and each has its thrills. Broadcast band DX-ing is confined to the radio channels of from 540 kilocycles to 1,570 "kc." (kilocycles) (there are 1000 cycles in a "kilo"-cycle) and may be indulged in with any ordinary receiver. Short-wave listening takes one into a little more specialized field or namely those radio channels of from 1,570 kc. to perhaps 20,000 or more kc. For convenience of figuring, this band is often spoken of in terms of "megacycles." There are 1,000 kc. to a megacycle (also, 1 "mega"-cycle equals 1 million cycles), or the above in megacycles would be represented as 1.57 to 20 megacycles. Some DX-ers also represent the short waves in terms of *meters* in which case the above would be represented roughly as 191 meters to 15 meters. These terms will become familiar with experience.

The first essential in DX-ing is naturally a radio receiver. For those who contemplate purchasing a receiver we cannot recommend too strongly the selection of an all-wave receiver, or one that covers both the broadcast band and the entire useful short-wave channels. These may be purchased now for nearly any price you are prepared to pay.

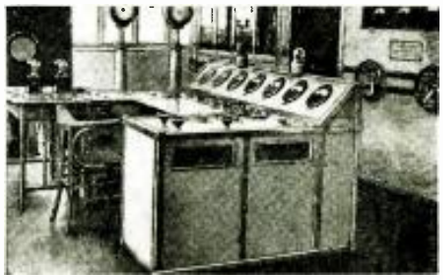
For those who already have receivers or do not contemplate the immediate purchase of all-wave receivers, do not be discouraged, as you may be surprised to learn that foreign reception is absolutely possible also on a broadcast-band receiver. Two or three years ago only a very few had ever tuned in a foreign station on the broadcast band, now thousands are doing this very thing each season—and in fact year 'round. This perhaps most fascinating of all DX-ing—foreign DX-ing on the broadcast band—has certain definite rules that *must* be observed *or you may never hear a foreign station on a regular broadcast receiver!* We do not intend to mislead you into believing this type of reception may be indulged in at all times of the year, or all times of the day but rather to tell you honestly what you can reasonably expect to do in your own home with average equipment. Whether for short-wave reception, or foreign broadcast reception the next most important requisite to the receiver itself is a *good antenna* AND *ground* system. For broadcast reception it is best to have the longest and highest aerial possible. It should be well insulated at all points, and be as far as possible away from surrounding objects. Complete technical details of various types of antennas, designed especially for all-wave reception, have been given in previous issues of RADIO-CRAFT. Remember, your set—and consequently the possibilities of getting DX—can be no more efficient than your antenna.

Although not absolutely essential it is best for DX work to make provision for the use of headphones with your set. Weak signals almost lost in the inherent noise of a speaker are audible in phones. Phones help one to concentrate on a weak and elusive foreign signal. Headphones may be used at any time of night without fear of waking less enthusiastic members of the family, who quite often do not appreciate a speaker going at the hours at which we are going to be listening for foreign signals.

Patience is necessary to a decided

(Continued on page 296)

Another DX catch—Warsaw, Poland.



CONVERTING OLD RECEIVERS

ROY MOULIN

Modernizing the Kolster Model 6D Set

THE KOLSTER Model 6D set offers many interesting possibilities to the experimenter and especially to the Service Man from a modernization standpoint. As this receiver possesses a pleasing tone, good sensitivity and at least fair selectivity (excellent for a T.R.F. receiver) it is too good a radio to be relegated to the junk heap. Having the above mentioned attributes and often being "housed" in an elegant cabinet the dealer may find that the owner of a Kolster 6D does not care to trade it in on a new 2-volt radio set. However, this same person is usually an excellent prospect for a wide-awake Service Man if approached from the modernization angle. All that is necessary is for the technician to explain the advantages and economy of operation to be had from a 6D as a modernized 2-volt job and he will then have another customer.

To enable fellow Service Men to be in a better position to give efficient and prompt modernization service on the Kolster 6D the writer has devoted considerable time in trying and testing the various methods of converting this receiver into a 2 V. set. The two most satisfactory ways that were tried from a performance and economy of operation standpoint will be explained in the discussion to follow.

Installing 2 V. Tubes as per Fig. 1

An inspection of the chassis and a reference to the original circuit (as this circuit is in Vol. 1 of your OFFICIAL RADIO SERVICE MANUAL it will not be illustrated in this article) and a comparison of this circuit with that in Fig. 1 will readily indicate to the experienced radio man the changes that are necessary to complete the job of modernization. To make these alterations proceed as follows:

Remove the chassis and turn it over with the back edge near you. Remove the volume control which is on your right along the metal panel. In so doing it is, of course, necessary to remove the switch and detector A.F. filament resistor as these items are a part of the control. Substitute in its place R3 which is mounted directly on the metal panel instead of being bolted to the condenser frame as the original control was. As one side of the secondaries of the R.F. transformers, including the variometer, are grounded, it is necessary to disconnect these sides of the two R.F. coils on your left and that of the variometer which is on the left of the metal panel.

Connect between each of these ungrounded lugs and the variable condenser frame a cartridge condenser—C1, C2 and C3. Resistor R1 is soldered to the terminal on the variometer to which C1 is connected. Using a length of hookup wire join R1, C2 and C3 together, as per diagram, and connect same to the center terminal of R3. With the chassis turned over, as stated previously, and the terminals of R3 pointing up, connect resistor R2 between the terminal on your right and the frame. Bypass R2 with condenser C4. Resistor R4 connects to the remaining terminal on R3 and the "C—"22½ V. wire. The filament switch Sw. is ganged with the volume control R3. With this circuit the —4½ V. and the +67½ V. battery leads are not used.

If a 2 V. storage cell is used to supply the filament power no filament resistor should be used. However, if an air cell battery is used it is necesary that R5 be used to provide the necessary voltage drop. If desired this resistor may be made from the original detector A.F. filament resistor by removing a small portion of the resistance wire. Remember that this resistor (R5) should have a value so that with a new air cell battery, the voltage applied across the filament terminals will not initially exceed 2.15 volts. This is important if long tube life is to be expected.

The type 30 tubes have an amplification factor of 9.3 as compared to 8 for the type 01-A tubes. This greater amplification, plus the use of 90 volts on the plates of the R.F. tubes and perhaps some additional coupling due to the type of volume control used, makes it necessary to increase the value of the 2nd R.F. grid suppressor (R6) to between 1,500 and 2,500 ohms, to maintain stability.

In some instances the Service Man may desire to use a simpler and cheaper type of volume control than

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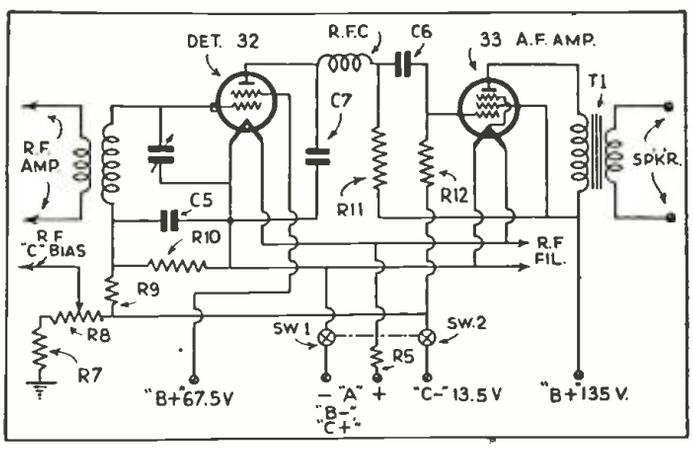
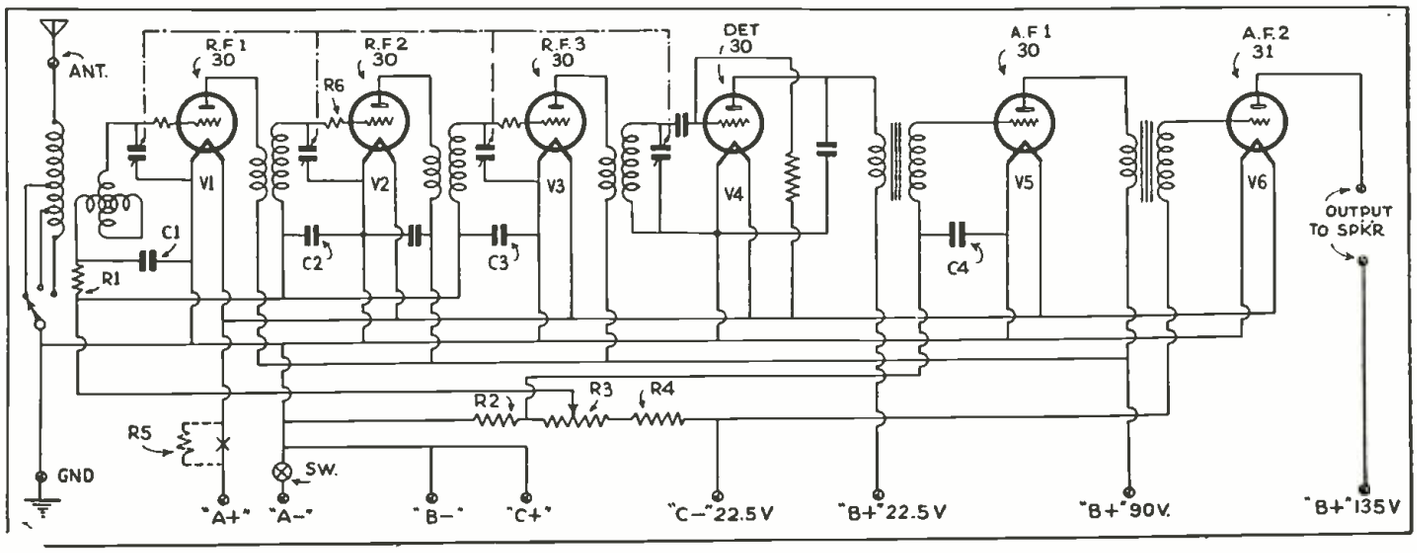


Fig. 1, below.
Diagram of a simple conversion job of a Kolster model 6D set. The changes necessary are few.

Fig. 2, left.
Same conversion job, but with improvement of power detection and power pentode last stage.



A SIMPLY CONSTRUCTED SERVICING MULTI-VOLT-OHMMETER

This compact test instrument for Service Men was designed to reduce the bulk necessary when making a service call. It will accomplish practically everything an analyzer does, especially in regards to point-to-point tests.

C. R. ISEMINGER

The dimensions of this instrument are 7 x 7 x 2⅝ in.

THE SERVICE MAN is gradually being overburdened by the weight and bulk of his test equipment. Tube testers, analyzers, tools, spare tubes, and so on, form no small burden to one who must carry them only from his car to the customer's receiver. It is with the idea of decreasing this burden that the writer has considered ways of reducing the weight and size of the equipment he is using.

This paper concerns what may be considered the heart of the service man's equipment—the volt-ohmmeter; a volt-ohmmeter with a built-in rectifier unit but without a transformer at all. Thus, a material saving in weight and expense is realized when we can eliminate this item of the transformer.

The ranges provided by the instrument here described are as follows: D.C. volts, 0-1-10-100-500; and resistance, 3,000-70,000-700,000 ohms and 7 megohms. It is entirely self-contained for all ranges and may be built into a rather small case.

The fundamental circuit (cf. RADIO-CRAFT, November 1932, page 282) employs a combination of the shunt method for measuring low resistances and the conventional series method used in continuity work. The actual circuit used in this instrument is shown in Figure 1, which needs no explanation. Symbols refer to items in parts list.

The most unique feature of the multi-volt-ohmmeter is the rectifier unit which provides the voltage for the two higher ranges of the ohmmeter. It employs a type 25Z5 rectifier tube connected as a voltage doubler to supply the 150 volts D.C. necessary to produce full-scale deflection of the meter on the highest resistance range. A tap on the voltage divider provides the 15 volts D.C. for full-scale deflection on the next highest range. On the two lower ranges a small flashlight cell provides the necessary 1½ volts feeding into the conventional continuity circuit for the third highest range and into the shunt circuit for the fourth highest range or low range. Reference to the schematic diagram Figure 1, will show that the series or continuity connection is used on the three higher resistance ranges while the shunt connection is used on only the lowest range. Adjustment to full-scale deflection is made in all cases by the dual control, the low resistance unit R1 being connected into the battery circuit as shown while the higher resistance unit R2 is connected into the rectifier output circuit. With this arrangement no line voltage adjuster is required, the D.C. voltage adjustment being satisfactorily handled without additional controls.

No Transformers or Chokes

As no line transformer is used, the voltage drop necessary to operate the heater of the rectifier tube at the proper potential is obtained by using a line cord which has the resistance of 290 ohms incorporated in one of its three leads.

The various resistance ranges and the position for reading external volts are all selected by a 4-pole 5-contact gang switch which makes the operation of the instrument practically accident proof.

The formulas here given, when substitutions are made for the variables, will give the resistance value in ohms for any current value indicated on the meter. The current-resistance curves may therefore be readily calculated mathematically. However, for your convenience a set of curves are shown in Figure 2 as examples. The user, however, should bear in mind that the

(Continued on page 293)

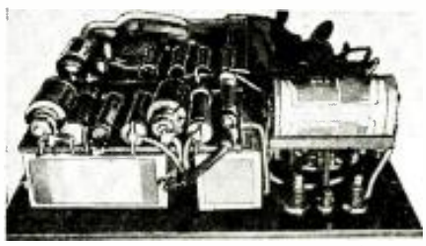


Fig. A

Side view of instrument. Note compact assembly, to facilitate obtaining light weight and a unit of small dimensions.

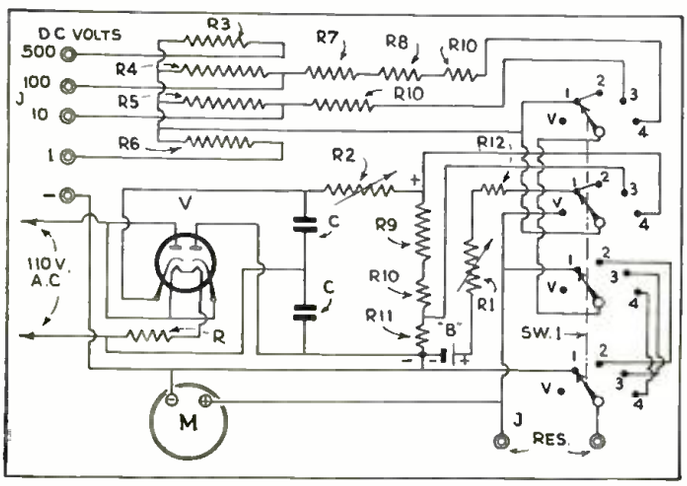
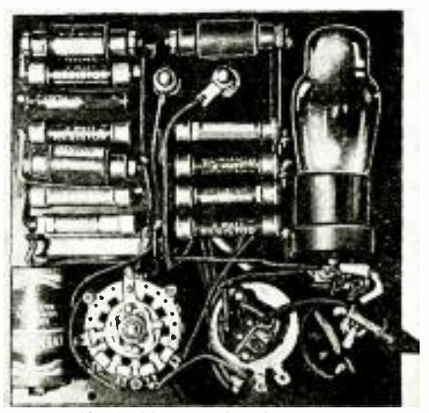


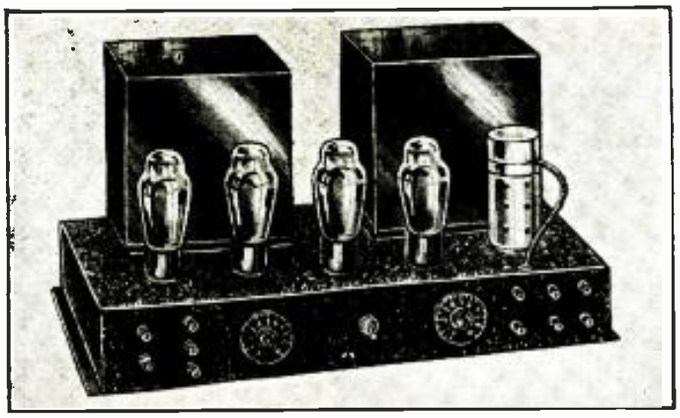
Fig. 1, left

Wiring diagram of the instrument. High resistance tests are enabled by the use of a 25Z5 tube which acts as a voltage-doubler, operated from 110 volts A.C. Complete ranges of unit described in text.

Fig. C

Interior view of multi-volt-ohmmeter. A rectifier tube furnishes the required voltage for high-resistance measurements.





A PUSH-PULL "2B6" P. A. AMPLIFIER

High fidelity at high power levels is the keynote of this 5 tube amplifier. The output of two "duplex triodes" in class A prime will more than fill a large auditorium.

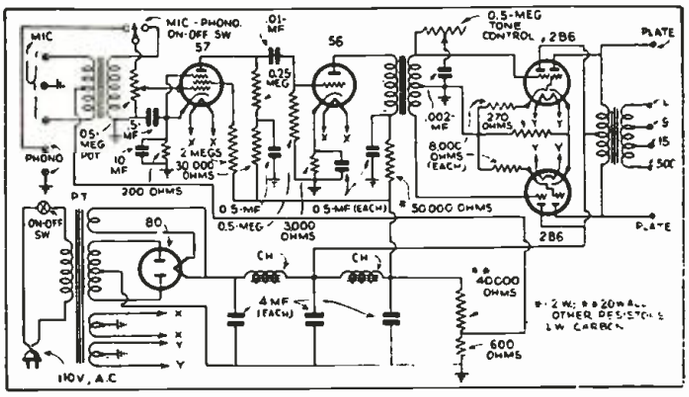
S. MILLER*

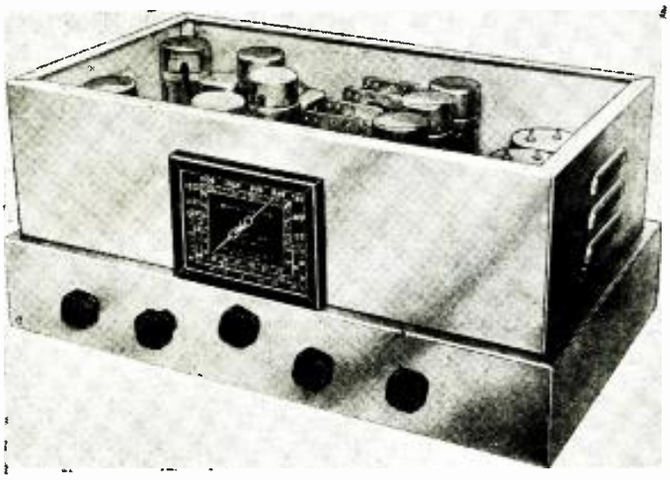
EVERYONE is talking high fidelity these days and therefore design data concerning any equipment to be operated in this field is of general interest. What with the advent of crystal, velocity, and dynamic microphones, newly developed "tweeter" (high-frequency) and "woofer" (low-frequency) reproducers, wide-range sound recording on film and disc, and radio receiver chassis with adjustable selectivity, exceptional frequency and volume demands are made upon the A.F. amplifier in order to secure natural reproduction.

Newest among amplifiers of this advanced type is a unit that has a power output rating of 20 W., using two type 2B6 direct-coupled tubes in push-pull class "A" prime. The frequency characteristic is considered to be substantially flat from 20 to 17,000 cycles.

As the schematic circuit of this amplifier indicates, a type 57 tube is used to feed a 56, which is transformer-coupled to two type 2B6 tubes in push-pull. This combination results in power output performance nearly paralleling results that ordinarily would require the use of two type 50 tubes with the initial attendant high cost for these tubes, their expensive associated components, and costly replacements.

(Continued on page 299)





A 14 TUBE ALL-WAVE "DOUBLE-SUPERHET."

By heterodyning the signal first to 1,600 kc., and then to 125 kc., the designer obtains greater sensitivity, more flat-top selectivity, and operation without either tube noise or the hiss that usually characterizes superheterodyne reception.

A. C. MATTHEWS*

WITH so many so-called "custom built" radio sets on the market claiming the super-ne-plus-ultra in engineering quality and performance it may well be asked, "Why another?" The answer is that this new receiver has so many distinctively different and novel features, that a comparison of them with other receivers will show improvements that are worthy of the consideration of the reader. This set is custom built for the individual radio enthusiast, and while the basic features of the set, as outlined in the text to follow, are retained in every model—nevertheless a simple questionnaire, which every customer fills out, aids in completing the construction so that it meets with the specific requirements of each, thus assuring him of the best possible performance in his particular location.

The receiver is divided into three parts: basic tuner chassis, power amplifier chassis, and oversize dynamic speaker. The entire tuner chassis is quadruple chromium plated and has been designed so that no external cabinet is necessary. Operating controls have been reduced to a minimum and will of course vary with individual and specific requirements. A novel, full-vision, modernistic dial, fully calibrated on each band, and attractively illuminated, is used. The customer's name is photographically included, when the dial is made up from the artists drawing, along with any wording the owner may wish. A new type of wave-change indicator shows on which of the bands the receiver is operating.

The basic chassis is the nucleus of an all-wave, 14 tube "double-superheterodyne" receiver covering completely the band from 13 to 560 meters. This may be extended from 10 to 2,100 meters when required. Only this basic chassis is shown in the photographic illustration.

(Continued on page 298)

READERS' DEPARTMENT

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

AND NOW—A 22 TUBE SET!

Editor, RADIO-CRAFT:

Multi-tube receivers are no longer a 7-day wonder, but the writer submits the illustration and description of a set that contains features which warrant more than a passing glance. Not the least of these items is the use of 22 tubes in the complete chassis.

The writer built this receiver, shown in the illustration at the upper right, for a radio layman friend who had lost interest in short-wave reception because of the bother of tuning. With this 22 tube receiver, however, there is no difficulty whatever in getting short-wave broadcasts; the switch for the desired band is turned to the desired setting and then the airplane-type tuning dial is moved *rapidly* between its scale markings of 80 and 90. If no station is heard and the receiver is functioning normally (normal operation is partially indicated by the readings of the panel milliammeter and voltmeter) the operator can be reasonably certain that no station is energizing the neighborhood of the receiver. The wavelength range of this set is 18 to 3,000 meters.

This large number of tubes is required in order to obtain high efficiency, and ease of multi-waveband reception. The tubes are utilized in the following manner: 170 to 545 meters (straight superhet.), V1, R.F. amplifier; V2, R.F. detector; V3, oscillator; V4, I.F. amplifier; V5, I.F. detector; V6, I.F. amplifier and detector for A.V.C.; V7, V8, A.F. voltage amplifiers; V9, V10, A.F. power amplifiers; V11, V12, rectifiers for "B" voltage. On 25 meter band (double superhet.), V13, R.F. amplifier; V14, R.F. detector and oscillator combined. On 49 meter band (double superhet.), V15, R.F. amplifier; V16, R.F. detector and oscillator combined. On 19 meter band—using plug-in coils (double superhet.. not controlled from panel), V17, R.F. amplifier; V18, R.F. amplifier and oscillator combined. On 80 to 200 meter band (double superhet.), V19, R.F. amplifier; V20, R.F. detector and oscillator combined. On 440 to 3,000 meter band (straight R.F. amplifier), V21, R.F. amplifier; V22, R.F. detector.

The tubes used are as follows: 2 50s, 1 55, 5 56s, 7 58s, 2 81s, 4 2A7s, and 1 2B7.

H. P. HAINES,
1 Dana Terrace,
Watertown, Mass.

Mr. Haines appends a lengthy list of "catches." Although at first thought it might seem that this receiver uses "too many" tubes, undoubtedly considerable stability of operation is to be expected from multi-tube design, as stated in RADIO-CRAFT Data Sheet No. 121 ("Howard Explorer Model W DeLuxe 19 Tube All-Wave Super."), in the September, 1934 issue of RADIO-CRAFT.

RE. "PHILCO 37 BATTERY SET"

Editor, RADIO-CRAFT:

On page 189 of the September, 1934 issue of RADIO-CRAFT, you have a paragraph about the Philco 37 battery set, stating that the filament current of this receiver is too high to permit operation from an Air Cell battery and therefore a storage battery is recommended.

As this receiver is manufactured, this statement is true. However, by removing the pilot light, the filament current is reduced to 660 ma. Although the nominal maximum permissible current drain from the Air Cell battery is 650 ma., this is set with a reasonable factor of safety and an additional 10 ma. drain will not cause any complications. We know that many of these receivers, with the pilot lamp removed, are being Air Cell operated with completely satisfactory results.

In using the Air Cell battery the ballast tube that is supplied for dry cell "A" battery operation should be used.

Your publication of the foregoing will help to dispel any misunderstanding that may be created by the item already published. In any event it will be helpful to assure dealers whose customers have requested that something be done to make it possible to operate this receiver from an Air Cell "A" battery.

L. S. FOX,
National Carbon Co., Inc.,
30 E. 42nd St.,
New York, N. Y.

We appreciate the opportunity to present to the readers of RADIO-CRAFT this very interesting bit of information concerning the operation of Air Cell batteries, which have been described in complete detail in past issues of RADIO-CRAFT.

A "THANK YOU" FROM CANADA

Editor, RADIO-CRAFT:

I have been reading RADIO-CRAFT for some time.

In the Operating Notes department of the August, 1934 issue there appeared many items concerning foremost faults in Canadian radio receivers.

I want to thank you for these Notes. Let us have more of these references for Canadian Service Men.

ROLAND A. PLANTE,
47 rue Carrier,
Levis, Quebec, Can.

A 22 tube, 18 to 3,000 meter receiver.

As previously stated in RADIO-CRAFT, we will print as much Canadian material as possible, but the amount must necessarily be somewhat in proportion to the number of Canadian readers—so-o-o, as Ed. Wynn might say, the more Canadian readers, the more data we will be able to print. We appreciate Mr. Plante's card of thanks.

A "1 TUBE" SET FAN

Editor, RADIO-CRAFT:

I was very interested to see in the June, 1934 issue of RADIO-CRAFT a description of a "Beginners' 'All-Electric' 1 Tube Set," using the type 12A7 tube. Some of our modern tubes perform surprisingly well when used alone as a detector, and any such circuits are most interesting to an experimenter. Using a single 57 as a detector on short waves, without any R.F. or A.F. amplification, I have had some very interesting results.

I have received foreign broadcasting stations as well as the American ones. Both DJC and DJD, Germany, have been heard with ample volume for headphone reception. Having a knowledge of the code, I pick up many foreign code stations. I remember in particular, on Memorial day morning, I was tuning around for DX, and picked up a code station, PLF, on the island of Java in the Dutch East Indies—almost exactly on the other side of the world from here! Such reception is proof of the remarkable performance that some of the latest tubes are capable of giving.

(Continued on page 294)

THE ANALYSIS OF RADIO RECEIVER SYMPTOMS

OPERATING NOTES

WHAT THIS DEPARTMENT IS FOR

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.

"ROYAL" A.C.-D.C. RECEIVER

SET uses a 25Z5, 43, 77, and a 78. Quality was mushy, tone distorted. Tubes were OK, voltages slightly low on 43, but OK on 77 and 78. All condensers, resistors and coils were tested at better than rated voltages and no shorts, opens or leaks were found. Acid flux had been used on many joints and on all grounds to chassis. A No. 16 insulated wire was soldered to the two tuning condenser rotor-wiper contacts and then in turn to all grounds to chassis thus eliminating the chassis as a common return, although no grounds to it were removed. This gave a fine-acting set, and brought all voltages to normal. In any number of short-wave receivers the writer has restored and often bettered performance by this matter of using a one-piece copper lead, securely fastened to the chassis instead of relying on the chassis alone as a common return. Refer to Fig. 1 for the "Royal" receiver hookup and points, X, to be soldered. Be sure that none are missed.

GENERAL ELECTRIC H-31 OR H-51

A TEMPORARY repair, which gave the customer the use of his set while waiting for a new first I.F. transformer, was made by hooking up the set to work without it. The procedure was to, first, remove the tuner chassis; second, remove the first I.F. transformer and can completely; third, remove the 24 I.F. tube and leave it out until the new transformer is installed; next connect the blue lead (which normally goes to the plate of the now removed first I.F. 24 tube) to the plate of the 24 first detector. Leave all else as it is. The original and revised hookups are shown at A and B, respectively, in Fig. 2,

The set has two instead of three I.F. transformers now, the local-distance switch is inoperative, and it may be found that even if the volume control is completely turned off stations will still be heard faintly. Barring these temporary disadvantages the set works fine and the same procedure could be applied with discretion to similar supers. when it is necessary to wait for parts not at hand or readily obtainable.

JOHN MUEHLKE

ATWATER KENT 40

WE HAD an A.K. 40 in the shop. The complaint was that the customer could only get WCAO, a local, and faintly. All the tubes were tested and found to be OK. All voltages were tested and found to be correct. Then a circuit-to-circuit test was made.

First, the antenna circuit was checked and the small flat-type coil tested "open." It was found that one of the connections had come loose from the lug. That was repaired. Still the set did not respond as it should. All locals now came in, but excepting WCAO, lacked volume. The detector grid lead was touched with the finger and it was noted that the usual loud hum was not present, indicating that the trouble must be from the detector stage on. The R.F. coil was tested and found to be OK; in fact, the whole circuit was found to test OK. The tuning condenser was looked over and found to be all right, but the grid condenser which connects to the tuning condenser and hangs down alongside of it, was found to be shorted by being too close to the tuning condenser; the free end was pushed out so

(Continued on page 304)

DEFECTIVE TUBES—

Are not to be considered as the subject for an Operating Note. It is assumed that all Service Men test tubes when making a service call. Their experiences on the subject of testing tubes, unless most unusual, are not of sufficient interest to other Service Men. Operating Notes should be confined to those faults which are characteristic of, and repeatedly occur in connection with a particular model of radio receiver.

Fig. 1
A "copper-return" circuit improved a "Royal."

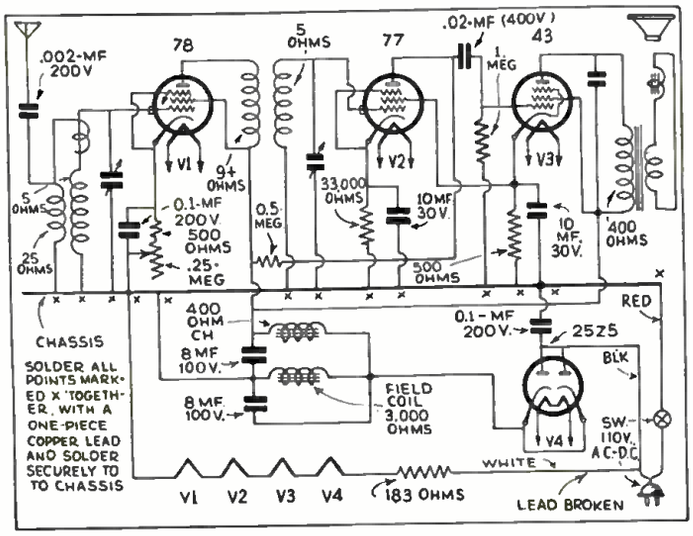
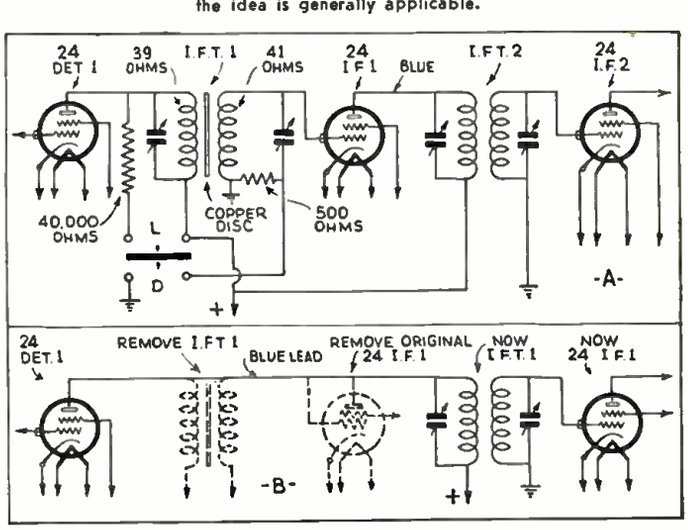


Fig. 2
A novel repair that gave temporary service. Although used on a G.E. set, the idea is generally applicable.



HOWARD "HIGHWAYMAN" 6 TUBE AUTO-RADIO SUPERHETERODYNE

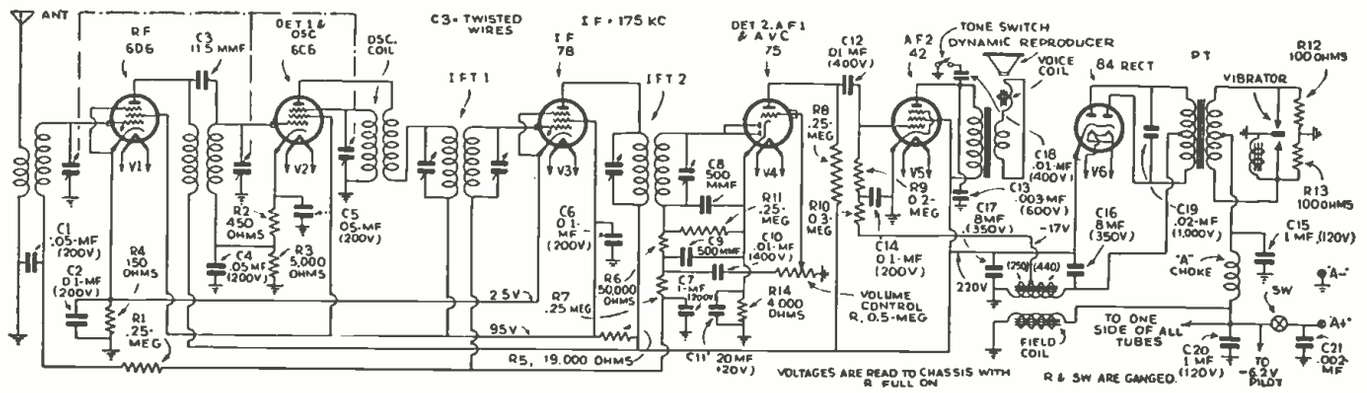
(Incorporates A.V.C., tone control, and dynamic reproducer; power output, 3 W. Utilizes a non-polarized "A" circuit.)

With the receiver tuned to a weak, high-frequency station, adjust the antenna trimmer for maximum response. This unit is reached by removing the plug button from the top of the case. The sensitivity of this set is 0.5-microvolt-per-meter. Motor interference is reduced by connecting the set on the battery side of the ammeter, so that the current drain does not indicate on the instrument.

Voltages to chassis are shown on the schematic circuit. If the fuse blows frequently, despite the insulating sleeve being over it, the trouble probably is in the vibrator unit, which should be replaced by plugging in a new one and returning the old one to the factory; do *not* attempt to adjust the vibrator points.

To align the receiver, note the following procedure. First, align the I.F. circuits, with the ganged variable condenser at its maximum capacity position and the volume control full-on. Connect the output of the service oscillator to the control-grid cap of V2, through a fixed condenser of 0.1-mf. capacity.

Next, align the R.F. circuits. Connect the service oscillator to the antenna lead through a 200 mmf. fixed condenser, with the variable condenser at its minimum capacity position. Adjust the oscillator trimmer (at shaft end) at 1,550 kc.; then, the R.F. trimmers, at 1,400 kc. Alignment check frequencies are: 1,200, 1000, 800, 600 and 530 kc. *Do not bend the plates of oscillator section under any condition.*



STROMBERG-CARLSON NO. 64 DUAL-RANGE 8 TUBE SUPERHETERODYNE

(Frequency range: 540 to 1,500 kc. and 1,400 to 3,600 kc. Incorporates "touch tuning" and "free wheeling"; also, first R.F., A.V.C. and Q.A.V.C.

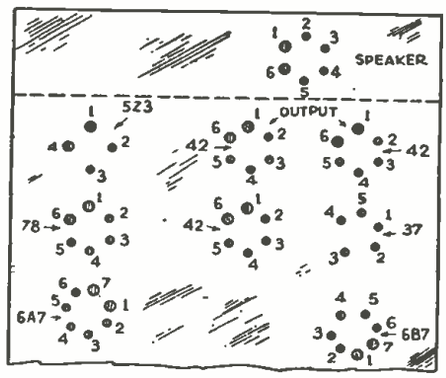
Antenna aligner C1, to be adjusted on very weak stations, is located on the rear top of the chassis.

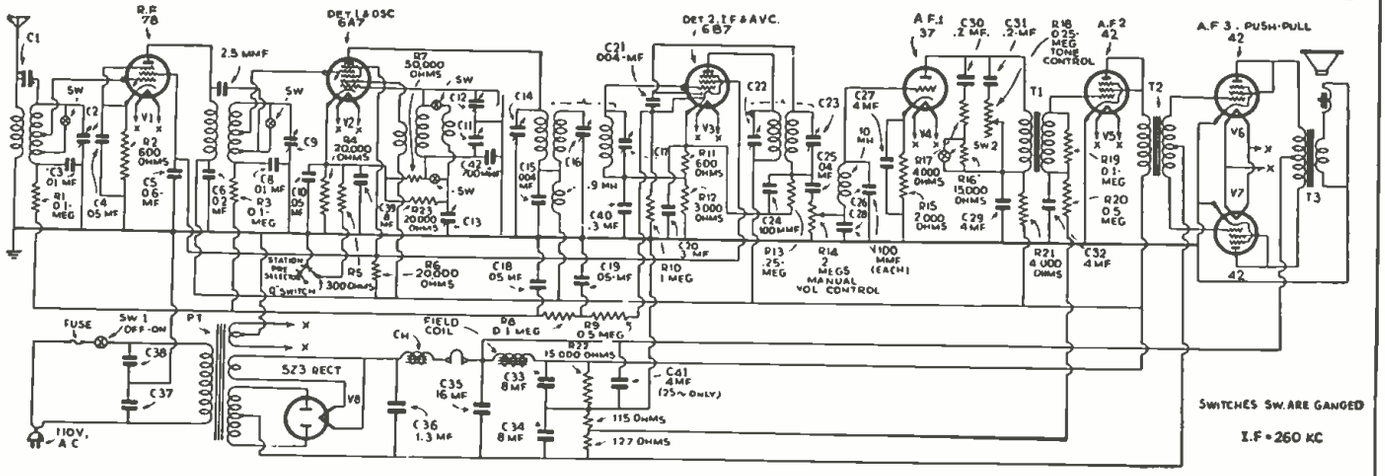
The power consumption of this set at a line potential of 125 V. is 160 W. If the receiver does not respond over the dial when the "Q" switch is in the "all-stations" position, or if the pre-selector arms cause the grounding (outer) contact on the spring assembly to make contact when the brush rides up on the end of the arm (determined by listening with the "Q" switch in the "pre-selected stations" position), adjust the grounding spring on the contact assembly to the right, looking at the back of the receiver, so that it makes contact when the "Q" switch is in the "all-stations" position only, and at no other time. This set is designed for high A.F. fidelity.

Readings are to chassis (terminal reference at right), with tubes, speaker and cable plug in place. Line, 120 V., and volume control full-on.

Tube		SOCKET TERMINALS*				
Type	*Cap*	*2*	*3*	*4*	*5*	*6*
V1		210	90	2.5	2.5	
V2		210	90	210	35	2.5
V3	12	210	90		2.5	15
V4		190		10		
V5		190		3.5		
V6		350		35		
V7		350		35		
V8		480				
**		210	350	350	350	

*Tubes V1, V5, V6, V7, terminals 1-6, V2, V3, terminals 1-7, and V4, terminals 1-5, 6.3 V.; V8, terminals 1-4, 5V. ** Speaker socket voltages.





RADIO-CRAFT'S INFORMATION BUREAU

"HIGH-FIDELITY AMPLIFIER"

(293) Mr. Clarence Senobe, Rockford, Ill.

(Q.) I have read the article, "A New High-Fidelity, Dual-Channel Amplifier," which appeared in the September, 1934 issue of RADIO-CRAFT, and note that Wright-DeCoster high-frequency reproducers are recommended. I have the latest Wright-DeCoster catalog, but fail to find a high-frequency speaker listed. Also, the large speaker looks like a Jensen Ortho-dynamic. Is it?

(A.) The amplifier in question was designed to utilize a Jensen model Q Hi-Range reproducer and a Jensen Ortho-dynamic reproducer for the low frequencies; both Jensen units are shown in the illustration of the complete assembly. The Wright-DeCoster company does not as yet make a high-frequency reproducer; although a Wright-DeCoster low-frequency reproducer may perhaps be used as an alternate for the original Jensen low-frequency unit, only the latter make for both units should have been specified in the List of Parts.

MULTIPLE HEADPHONE OUTLETS

(294) Mr. Bayard Pakins, Dubuque, Ia.

(Q.) Please suggest a circuit for the use of several pairs of headphones, either individually or collectively, for use in conjunction with a "deaf-set." Most connections that have so far been tried either distort the reproduction or vary the volume of the other units in the circuit, or else they require the use of too many components, thus making the cost of even a simple installation quite high.

(A.) A circuit that is easy to set up is shown in Fig. Q. 294. If more than 5 outlets are desired, connect a choke coil across the output terminals of the deaf-set, as shown dotted. The "volume control" type of plug has a built-in resistor. Use a standard, 2,000 ohm earphone.

This is a good set-up for use in churches, theatres, lodge rooms and other places where several hard-of-hearing people are congregated.

"WELDING TRANSFORMER"

(295) Mr. Sam Brown, Kirkland Lake, Ont., Can.

(Q.) Regarding the description of an electrical lead burner ("A Welding Transformer," RADIO-CRAFT March, 1933) please advise whether the figures as given are correct. You state that the winding is to fit on a core 5 x $8\frac{1}{2}$ x 2 ins. thick. Calculations seem to indicate that these core dimensions will not permit sufficient wire to be wound in the available space.

(A.) Please correct the third paragraph, third sentence of the description as follows: "Wind this coil over an iron core *15* inches long." (Note the length is to be 15 ins., instead of 5.)

"DECADE" RESISTANCE BOX

(296) Mr. Henry Nolan, Brownsville, Tex.

(Q.) How is a "decade" box made, for the measurement of resistance values?

(A.) The schematic circuit of a commercial unit is shown in Fig. Q. 296. The model shown in the schematic circuit and Figs. 296A and 296B is designed to cover a resistance range of 100 ohms to 1,111,000 ohms, in steps of 100 ohms. It utilizes 10 precision resistors, each with a resistance of 100 ohms; 10, of 1,000 ohms; 10, of 10,000 ohms, and 10, of 0.1-meg.

Another model has a range of 10 ohms to 111,100, in steps of 10 ohms. The precision resistors required for this range are as follows: 10 resistors of 10 ohms, each; 10 of 100 ohms; 10 of 1000 ohms, and 10 of 10,000 ohms.

Even more precise measurements may be made over a limited range, by designing the unit to cover a range of 11,110 ohms. This set-up requires 10 resistors of 1 ohm, each; 10 of 10 ohms; 10 of 100 ohms, and 10 of 1,000 ohms.

Note that this type of resistance box is adjustable in units of 10 (the word "decade" means groups of 10, from the Greek *deka*, or *10*). The switches are manipulated in their numerical order. The use of precision resistors is imperative.

RE. "POINT-TO-POINT CAPACITY TESTER"

(297) Mr. P. J. Prosser, Sr., Tulsa, Okla.

(Q.) I have built the "Point-to-Point Capacity Tester" described in RADIO-CRAFT, July, 1933.

The L circuit works perfectly with nothing heating up too much, but I cannot get the meter needle to move for circuit M or H. Also, resistor 9 will not adjust the meter, and resistor 2 wants to burn up *immediately*. If you are a good guesser kindly send me your guess of the trouble.

Mr. R. H. Nelson, Verdun, Prov. Que., Canada.

(Q.) In the article, "Point-to-Point Capacity Tester," in the July, 1933 issue of RADIO-CRAFT, is mentioned twice, in the text, a T.P.D.T. switch, Sw. 3; the List of Parts, however, mentions a T.P.T.T. unit as Sw. 3. Which is correct? Where can the switches be obtained?

Further, I am at a loss to understand whether resistor R3 remains in all circuits—O-M-H—or only one of them.

(A.) We are advised by the author, concerning these queries, as follows:

The difficulties encountered by Messrs. Prosser

(Continued on page 303)

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."

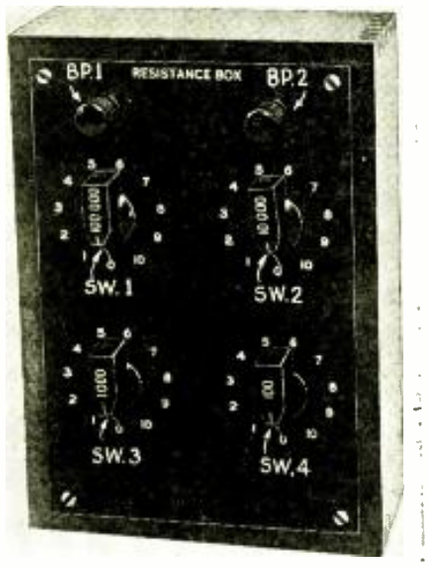
Replies, magazines, etc., cannot be sent C.O.D. Back issues of RADIO-CRAFT prior to December, 1932, are available at 50c per copy; except the following issues: 7 '29, 2, 3, 4, 6, 7, 9 and 11 '30; 5, 8 and 9 '31; and 10 '32, which are out of print. Succeeding issues are still available at the regular 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.

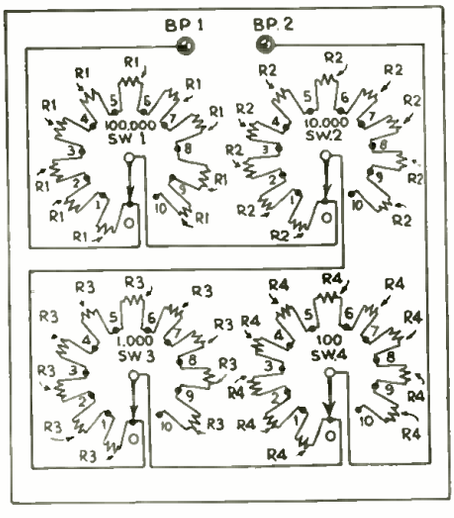
Enclose only a STAMPED and self-addressed envelope for names and addresses of manufacturers; or, in connection with correspondence concerning corrections to articles, as this information is gratis.

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.

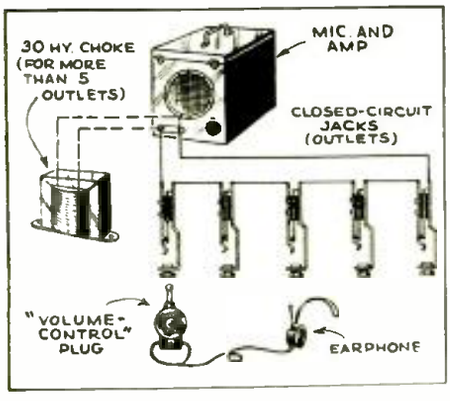


Above, Fig. Q.296A
The completed "decade" (units of 10) resistance box. (Illustration, Shallcross)

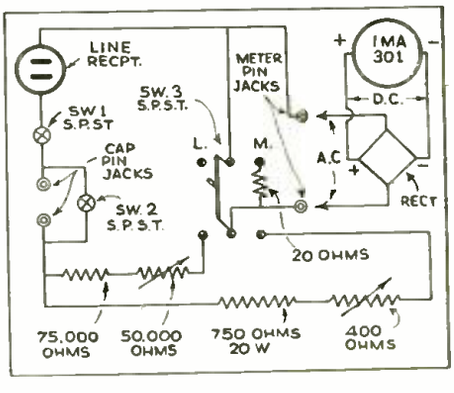
Right, Fig. Q.296
A decade-type resistance box. Every experimenter should have one in his laboratory.



Below, Fig. Q.294
Deaf-aid connections for groups. (Universal Mic. Co.)

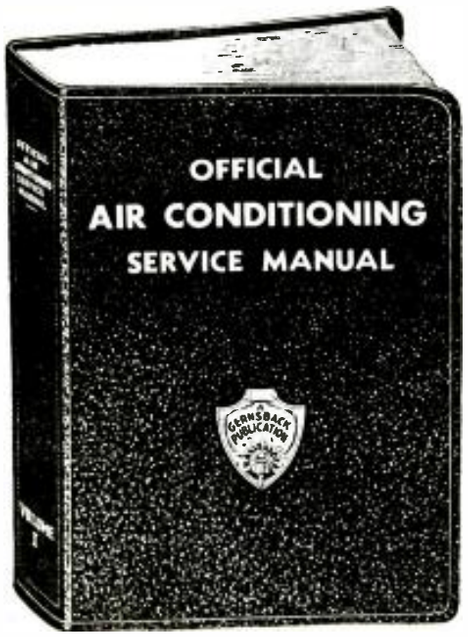


Below, Fig. Q.297
A simplified capacity tester. A more extensive design, having wider application, has appeared in RADIO-CRAFT (July, 1933).



NOW READY

Official Air Conditioning Service Manual



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A GOLDEN OPPORTUNITY FOR ALERT MEN IN THE NEXT GREAT INDUSTRY

THE idea of electricians, radio service men and other mechanically inclined men servicing Air Conditioning and Refrigeration Units is self-evident and the thought has occurred to some untold thousands ever since air conditioning equipment has been installed in public auditoriums, theatres, studios, department stores, office buildings and manufacturing plants. The tremendously broad possibilities in this new industry are bound to give employment and success to men far-sighted enough to see its advancement and development. We quote an excerpt from Mr. Hugo Gernsback's editorial which appeared in a recent issue of Everyday Science and Mechanics:

"I advise young and progressive men to go into the air-conditioning business during the next few years; because this, without a doubt, is the coming industry in this country. Thousands of small firms will spring up, undertaking to air-condition private houses, small business offices, factories, etc. We are not going to tear down every building in the United States immediately. It will be a gradual growth; yet small installation firms will air-condition small houses, and even single offices in small buildings."

This is only partial proof of the certain success of this new field. Further assurance is that engineering schools have already added many important courses on air conditioning to their regular curriculum. Architects and building contractors are giving considerable thought to installation of this equipment in structures which are now being planned and built. The beginning of this business will probably be similar to the auto and radio industry, but in a few short years it will surpass these two great fields.

The OFFICIAL AIR CONDITIONING SERVICE MANUAL is edited by L. K. Wright, an expert and a leading authority on air conditioning and refrigeration. He is a member of the American Society of Refrigerating Engineers, American Society of Mechanical Engineers, National Association of Practical Refrigerating Engineers; also author of the OFFICIAL REFRIGERATION SERVICE MANUAL and other volumes.

In this Air Conditioning Service Manual nearly every page is illustrated; every modern installation and individual part carefully explained; diagrams furnished of all known equipment; special care given to the servicing and installation end. The tools needed are illustrated and explained; there are plenty of charts and page after page of service data.

Remember there is a big opportunity in this new field and plenty of money to be made in the servicing end. There are thousands of firms selling installations and parts every day and this equipment must be cared for frequently. Eventually air conditioning systems will be as common as radios and refrigerators in homes, offices and industrial plants. Why not start now—increase your earnings with a full- or spare-time service business.

Here are some of the chapter heads of the AIR CONDITIONING SERVICE MANUAL:

CONTENTS IN BRIEF

History of Air Conditioning; Fundamental Laws; Methods of Refrigeration; Ejector System of Refrigeration; Compression System of Refrigeration; Refrigerants; Lubricating Oils; Liquid Throttle Devices; Servicing Expansion and Float Valves; Servicing Refrigerating Systems; Control Devices; Thermodynamics of Air Conditioning; Weather in the United States; The Field of Air Conditioning; Insulating Materials; Heat Transmission Through Walls; Complete Air Conditioning Systems; Estimating Requirements for the Home, Small Store, Restaurant; Layout of Duct Systems; Starting Up a System; Operating and Servicing Air Conditioning Systems; Air Filtration, Ventilating and Noise Eliminating Devices; Portable Electric Humidifiers and Room Coolers; Automatic Humidifiers; Air Conditioning Units for Radiator Systems and Warm Air Systems; Central Conditioning Units, etc.

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Gentlemen: Enclosed you will find my remittance of Five Dollars for which you are to send me One Copy of the OFFICIAL AIR CONDITIONING SERVICE MANUAL, **POSTAGE PREPAID.**

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GERNSBACK PUBLICATIONS, INC.

99 Hudson Street New York, N. Y.

ATWATER KENT "TUNE-O-MATIC" CONTROL (FOR MODEL 511 SUPERHETERODYNE)

(The tune-o-matic control, as designed for use with the model 511 receiver, affords automatic selection (twice) of 7 stations' programs.)

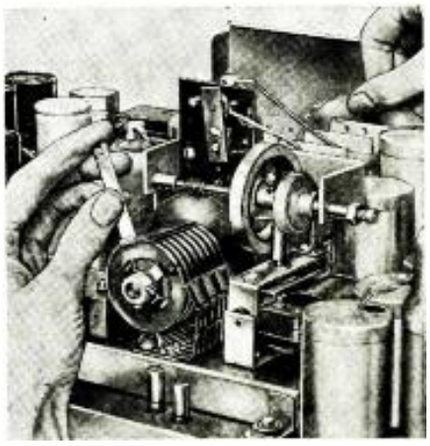
The model 511 set for which the tune-o-matic control was designed is of moderately standard design, being a dual-range job covering 540 to 1,600 kc. and 5,500 to 15,500 kc.

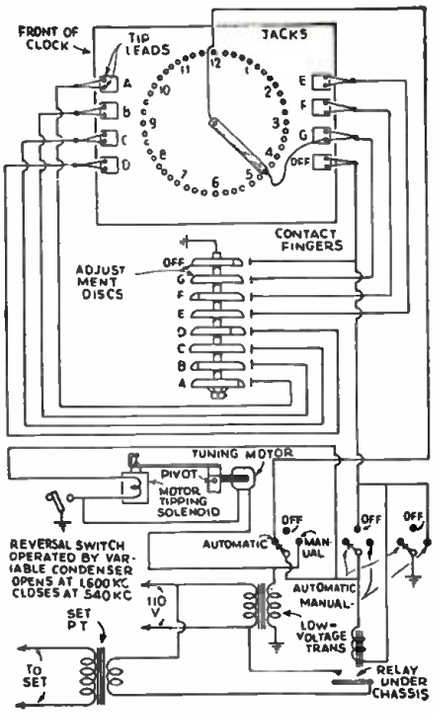
The tune-o-matic unit is a device that automatically tunes the radio set, twice, to any desired combination of 7 radio stations, so that their programs may be received in any desired sequence and duration over a 12-hour period. (It also will operate in conjunction with the remote control attachment available for use with this set.)

To set the control, turn the control to extreme right, turn the off-on switch to "manual," and tune in a station. Then, grasp the dial gear at the front of the variable condenser in one hand, and move the *rear* disc by means of a special wrench, as shown in the pictorial view, until the rear contact finger is on the small insulated sector of the rear disc.

Now, plug one of the top left-hand pair of tip leads into the jack at which the *hour* hand points or has just passed, turn the off-on switch to "automatic" and tune off the station (which will cause the set to shut off and start the tune-o-matic motor). The action is described as follows.

With the switch set to "automatic," when the contact blade on the rear of the jack panel comes to the desired time-jack a motor and solenoid circuit is completed, the solenoid tipping the motor shaft against a wheel which turns the variable condenser from the automatic-off position, near 1,600 kc., until the desired station is tuned in. At this point, the insulated sector of one of 7 discs on the extended shaft of the variable condenser comes under its contact finger and opens the disc-to-ground circuit. This connects a high-impedance relay into the motor circuit, reducing the motor and solenoid current until the motor nearly stops, whereupon a solenoid lever moves the motor drive shaft against a brake wheel that stops the motor at the exact station setting. Simultaneously, a relay has completed the 110 V. power circuit to the set power transformer and the set begins to operate. In the "off" position, no current is drawn by the set; the only current used is that required to operate the clock, as the circuit at right indicates.





L. TATRO MODEL 094 PRESIDENT 9 TUBE 32 VOLT SUPERHETERODYNE

(Incorporates A.V.C., tone control, vibrator-type "B" supply.)

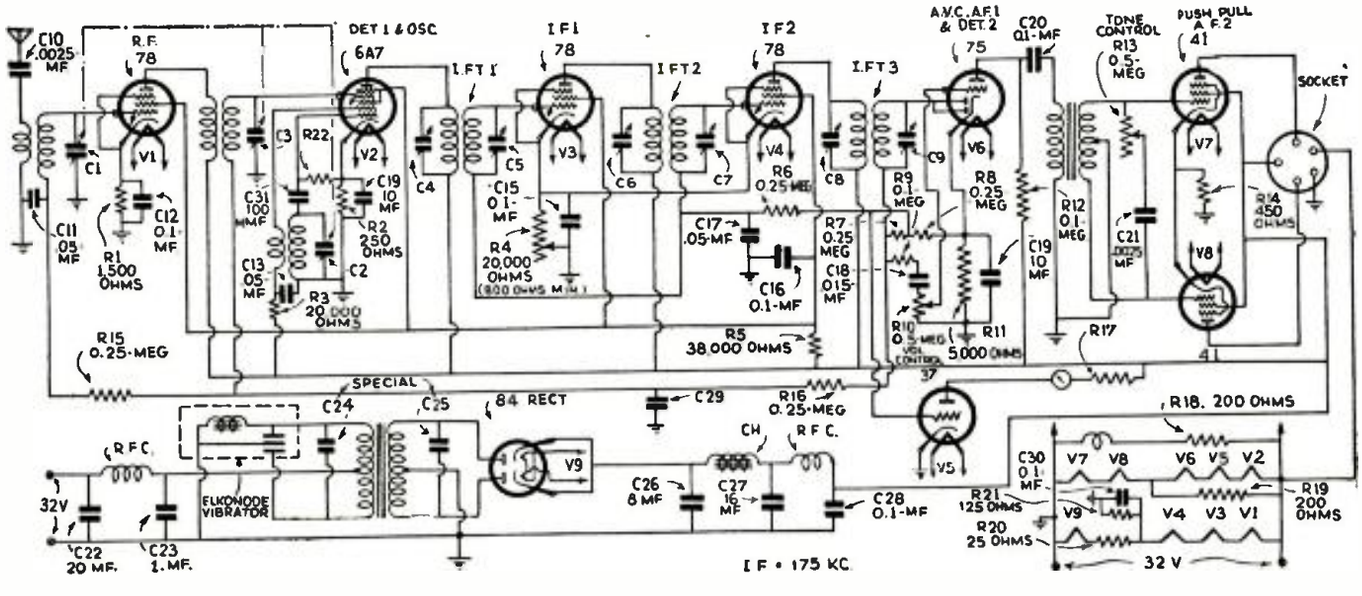
Voltages to chassis, measured with a high-resistance meter, are as follows:

Tube Type	*Plate Volts*	*S.-G. Volts*	*Cath. Volts*
V1	155	60	3
V2*	155	60	1.6
V3	155	60	3.1
V4	155	60	3.1
V5	65	—	0
V6	198	—	1.6
V7	198	204	20
V8	198	204	20

*Anode grid, 115 V.

Replace V9 if voltages are low. Slight variations from a filament voltage range of 6.3 to 6.4 V. is normal. Use only a good signal generator and output meter if it is essential that the factory-adjusted trimmers be readjusted by field Service Men.

If one tube is removed the remaining tubes in the series network will not light. To test for an open filament, remove the tubes and touch one filament prong to the central portion of the dial light socket, and the other to the chassis. If the filament is open the dial light will not dim. Condenser C19 shunting R2 should be shown as C14.



A SIMPLY CONSTRUCTED SERVICING MULTI-VOLT-OHMMETER

(Continued from page 285)

curves shown are correct only for a meter having an internal resistance of 70 ohms, which is true of the meter used by the writer. Curves for use with meters of other resistance may be plotted from values obtained by making substitution for Rm in the formulas. In the formulas Rx = unknown resistance in ohms, Rm = internal resistance of meter in ohms, Rc = resistance of external circuit in ohms exclusive of unknown resistance and meter (disregard resistance of battery as it is quite small), i1 = current through meter in amperes, Vb = the nominal voltage of the battery and I = fullscale deflection of meter in amperes.

The formula used for calculating the low range or shunt circuit curve is

$$Rx = \frac{Rm\ i1}{I - i1}$$

It will be noted that the unknown resistance varies directly as the indicated current flowing through the meter. The formula for calculating the second or series range is

$$Rx = \frac{Vb - (Rc + Rm)\ i1}{i1}$$

in which Rx varies inversely as the indicated current flowing through the meter. This latter curve serves also for the 3rd. and 4th. resistance ranges it being only necessary to multiply the resistance value obtained on the curve by the factor 10 or 100 depending on the voltage used (as indicated by the position of the range switch).

The following List of Parts has been chosen for this assembly though substitutions may of course be made where necessary.

Note 1

This resistor unit may be ordered made up as a special by your manufacturer, or for ordinary work a 1 or 2 W. resistor of the correct value may be found among those marked 900 or 1,000 ohms in your jobber's stock. It is only necessary to check over the resistors in these groups until one nearest approaching the proper value is found. Usual tolerances of 10% of rated value should provide the necessary value. The value, 930 ohms, is of course obtained by subtracting the resistance of the meter (70 ohms) from 1000, the total resistance required for full-scale deflection of the meter when 1 V. is applied.

Note 2

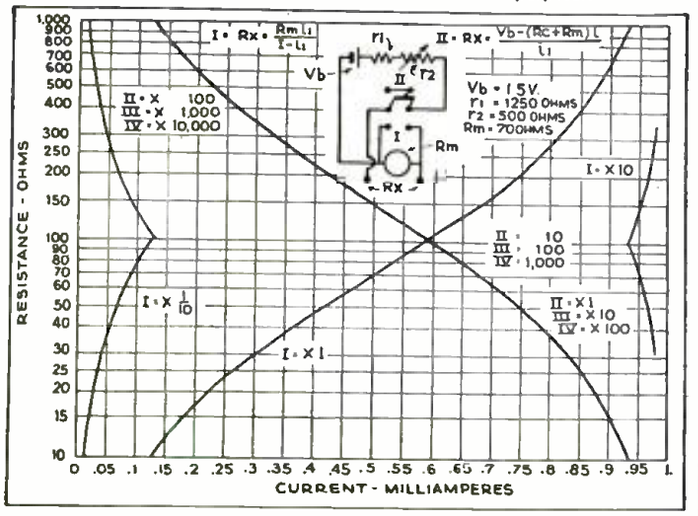
The battery clip used by the writer (for the No. 935 flashlight cell) was made from an Amperite clip which is similar to the conventional grid leak mounting. It was found that by rebending the springs sufficient grip was obtained to make good contact when the cell was placed between them. It is important to insert the cell so that the polarity is as shown in the schematic diagram.

Note 3

The dual control referred to as R1, R2 in the text requires a word of explanation. This is a special control having a shaft approximately 6 ins. long. Obviously the shaft with the exception of a length of ⅜-in. should be cut off. The 550 ohm unit is of the potentiometer (3 terminals) type, while the 15,000 ohm unit is of the rheostat (2 terminals) type arranged for counter-clockwise rotation. In order to permit the use of both units to decrease the resistance with clockwise direction, a third terminal should be soldered in place in the space where the third terminal should be. A soldering lug cut off so as to pass through the slot in the insulation and make contact with the wire winding of the resistance strip, may be used to good advantage. Through an oversight, the manufacturer's designation of this control (which is R1741TP) was omitted. This control is also fitted with an S.P.S.T. switch which may be used to control the application of line voltage to the voltage doubler circuit. For this use it may be connected in the line lead opposite to the one in which the cordohm resistor is connected (see Fig. 1).

A caution to users: When using the instrument as an ohmmeter, all external radio receiver leads (including ground, antenna and power leads) should be disconnected in order to avoid possible damage to the instrument.

Fig. 2
A set of current-resistance curves for reference purposes.



List of Parts

One Weston 0-1 ma. D.C. meter, M;
One Sylvania type 25Z5 rectifier tube, V;
One 6-prong tube socket, V;
One 4-gang 5-point switch, Sw.1;
One power cord, No. 1, 290 ohms, R;
Two Electrad dual wire-wound control, 500 and 15,000 ohms, R1, R2;
One Lynch 500,000 ohm precision resistor, R3;
One Lynch 100,000 ohm precision resistor, R4;
One Lynch 10,000 ohm precision resistor, R5;
One Lynch 930 ohm precision resistor, R6; (note, see following text)
One Lynch 25,000 ohm precision resistor, 2 W., R7;
One Lynch 20,000 ohm precision resistor, 2 W., R8;
One Lynch 10,000 ohm precision resistor, 2 W., R9;
One Lynch 3,500 ohm precision resistor, 2 W., R10;
One Lynch 1,500 ohm precision resistor, 2 W., R11;
One Lynch 1,250 ohm precision resistor, 2 W., R12;
Two Aerovox filter condensers, 2 mf., C;
One flashlight cell, B;
One battery clip, BC; (note, see following text)
Seven cord tip jacks, J;
One instrument case;
One panel, 7 x 7 x ¼ ins. thick (depth of instrument approximately 2¼ ins.).

READERS' DEPARTMENT

(Continued from page 287)

I am glad to see that RADIO-CRAFT publishes circuits using only a single tube, as these circuits give the beginner an excellent chance to learn all about the new tubes. Needless to say, the old-timers could obtain some valuable information from them too.

R. A. CURTIS,
Radio W1EXZ,
58 Thorndyke St.,
Springfield, Mass.

Confidentially, Mr. Curtis, the "old-timers" *devour* the new and novel 1 tube circuits with just as much gusto as the veriest tyro!

PRO—"BEWARE—THE SERVICE GYP!"

Editor, RADIO-CRAFT:

Congratulations to the anonymous contributor of the article in the September, 1934 issue of RADIO-CRAFT, "Beware—The Service Gyp!"

I am writing you in behalf of our organization, requesting permission to reproduce this article incorporating all or part of it in an organization advertisement in a local newspaper.

JAMES T. GOMPERTS, *Secretary,*
Greater Bridgeport Radio Service Men's Association,
1527 North Ave.,
Bridgeport, Conn.

Evidently, the Greater Bridgeport Radio Service Men's Association is very much on their collective toes. Other radio interests may take a lesson or two from this progressive association. (Reprint permission has been granted.)

However, the G.B.R.S.M.A. vote of "aye" is not shared by the writer of the following letter.

CON—"BEWARE—THE SERVICE GYP!"

Editor, RADIO-CRAFT:

This writer is of the opinion that the publication of such articles as "Beware—The Radio Gyp," by "Anonymous," in the September, 1934 issue of RADIO-CRAFT, does more harm than good to the radio service profession in general, and to the honest Service Man in particular.

True, there are many individual Service Men, as well as service organizations, many of whom even advertise in the newspapers and through radio broadcast stations, whose business methods are subject to sharp criticism. But why create the impression that all radio men are dishonest? Only too often have conscientious Service Men been unjustly so accused by customers who have become victims of this opinion.

If Mr. Anonymous (Why didn't he sign his name?) knows *definitely* of any Service Man or service company employing unethical business methods, why doesn't he mention names and instances? The Better Business Bureaus should be interested in knowing about these things. Mr. John Q. Public, reading the anonymous article, cannot help but conclude that all radio men are being referred to in that accusing manner.

It isn't fair to class radio service with ordinary labor. The simplest of radio troubles sometimes take hours of painstaking application to locate, and very often unforeseen complications develop, which require additional time to remedy. The average customer will think it ridiculous to pay five or six dollars for soldering a broken connection, or replacing a noisy resistor, if he is told that such was the only trouble with his radio set. The fact that the Service Man may have spent half a day in locating the trouble usually means nothing to the set owner. So, in order to protect himself, the shrewd Service Man sometimes has to resort to an exaggeration of the real trouble. This is not necessarily lack of integrity on the part of the honest Service Man, but rather a defense mechanism—something with which to combat an unfair customer's tendency to belittle his knowledge and ability.

A surgeon may ask several hundred dollars for an appendicitis operation. Does the patient say, "Why, doctor, the whole job takes only an hour; the medicines amount to only a dollar or two. You're asking entirely too much!"? Of course not. The patient has learned to realize that the doctor didn't acquire his skill and knowledge merely by a casual look into a book of recipes. The thorough radio man likewise has spent years in accumulating the knowledge and ability which enable him to delve into the most intricate receiver and locate the "bug."

The writer once listened-in on a conversation between a Service Man and a "chiseler" type of customer. The latter had insisted upon watching his radio receiver being taken apart and repaired, although he had been given a guaranteed price on the job. When the work was finished, after a relatively brief period, the set was handed over, and payment of $6.50 requested. The customer protested. "Why so much?" "Fifty cents for fixing the trouble, and six dollars for knowing how!" came back the laconic reply.

In an industry which has mushroomed as rapidly as radio, there is bound to seep in an element that fleeces the customer whenever the opportunity presents itself. But these tactics are a boomerang in the end, and those who practice them are bound to drop out of the running before very long. It is this writer's belief that professional radio men who have stood the test of the years are, as a general rule, conscientious, hard-working, and fundamentally honest. Articles which indirectly, even though unintentionally, reflect upon their character as business men, have no place in any publication.

JOSEPH LEEB,
1380 Miriam Ave.,
Bronx, N. Y.

Apparently Mr. Leeb, in voting "nay," didn't notice two important points in the article. First, the story does not relate to those who practice legitimate business methods; we quote as follows from the "blurb" under the heading, "It" (referring to gyp practices) "is not meant to apply to the Service Man or service organizations who conduct their business on a legitimate basis." Second, "Mr. Anonymous" is thoroughly familiar with the work of the Better Business Bureau. In fact, we quote from the end of the first column, pg. 145, as follows, "As an indication of the 'racket' methods and inconsistencies of the 'gyp' Service Man, herewith is a reprint from a bulletin published by the Kansas City Better Business Bureau—" The name of Mr. Anonymous has nothing to do with the facts of the cases as set forth in the article. Nevertheless, we are greatly interested in Mr. Leeb's constructive comments, and we feel that many other radio men will want to digest his viewpoints. The next issue of RADIO-CRAFT will carry several more letters that have been received on this subject.

ENTER—THE RADIO CHISELER

Editor, RADIO-CRAFT:

"The Radio Chiseler" has come into being, the fellow with a meter and a lot of nerve. He calls at his neighbor's house, fiddles around a while, says "It needs a couple of tubes and it acts like the power transformer or the filter condenser has gone bad."

There are thousands of fellows, one in every block of our larger cities who put in a tube or string up an aerial for their neighbors. They get a set to repair, then send to some "wholesale" house and get the necessary parts. Nine times out of ten the set does not work and the baffled, self-styled "Service Man" takes it down to a well-equipped shop where five or ten minutes work puts the set in order again. The well-equipped shop with many dollars invested in equipment and parts gets a dollar or so for their part while the "chiseler" gets the cream, usually several dollars and the credit for a satisfactory repair job. It is not right for this type of Service Man to get wholesale prices on parts and supplies; he has no money tied up in expensive test equipment and usually sells his supplies before he orders them.

Contrary to what might be expected, I am not a big dealer. I sell no sets but do service work exclusively. I have been in the radio game since 1920, was licensed as amateur operator and had station W9CEN in 1924, and W9CXG from 1928 to date. Have been actively engaged in service work over the entire period.

We carry only a moderate stock of parts, about $200 including tubes, have about $250 worth of test equipment.

In town I have a fellow of the type referred to. He does not carry a dollar's worth of supplies, has two or three meters as test equipment and ruins several dollars worth of legitimate trade for me each year.

Let us have the wholesale prices where they belong and exterminate this pest, "The Radio Chiseler."

CHARLES M. CONLEY,
Burlington, Colo.

We agree whole-heartedly with Mr. Conley that something ought to be done about men who indulge in servicing but know nothing about it. However, the fault is not entirely with the wholesaler or radio dealer who sells him parts at a discount, and thereby places this outsider in a position to compete with the more active and experienced Service Man. The fault, we believe, is rather with the individual who, knowing the man for what he does and how he conducts his business, condones these tactics by permitting repairs at a price which allows the "chiseler" to reap a profit. While we do not believe in exorbitant charges in the ordinary routine of service work, there are exceptions to every rule. This type of case calls for an exception, which, if made, should not result in a stricken conscience.

There are, of course, individuals who might be classed as being in the "apprentice" stage, that is, active Service Men with insufficient experience to repair the more complicated types of receivers. While we can't very well advise that a Service Man aid his competitor to the extent that it injure or jeopardize his own business, nevertheless it would be an ideal condition if there existed that mutual professional regard that exists with doctors and surgeons. The inexperienced Service Man should realize his limitations, and in complicated cases call in, or turn over, the "job" to a more capable technician. In return for this, the man who does the work should be willing to divide a percentage of the profit; we suggest about 15 percent as being a fair figure, and as a sort of commission.

Mail order houses cannot appreciably help in suppressing the aforementioned type of "chiseler," inasmuch as a business letterhead (which any man can have printed up at little cost) of a new account looks as legitimate and real as the next concern who may have been doing business with them for a long time. New accounts cannot reasonably be turned down because of fear of "chiselers" entering the profession. Business is conducted along principles of "cash" or "credit," and the individual who can readily pay for his merchandise, or whose credit is good for it, will always be successful in being able to buy. Volume of business has little to do with it, since a good majority of capable Service Men stock very few parts and buy only as they need. To discriminate in selling wholesale to "chiselers" would mean discriminating against practically all radio Service Men who operate individually.

THE LISTENING POST FOR ALL-WAVE DX-ERS

(Continued from page 283)

degree, for foreign signals have a way of evading a beginner time after time, but what a thrill it is to tune in your first foreigner on the broadcast band. I will never forget the great thrill it gave me to realize for the first time I was listening to 2BL in Sydney, Australia on 855 kc. It was 4 A.M. C.S.T. (Central Standard Time) when I heard a clock chiming the hour of 8 P.M. that night in Sydney. Then the announcer's slow-measured British voice saying, "This is 2BL in Sydney." This was followed by weather reports for various parts of the Commonwealth which made it absolutely certain that I was really in tune on the broadcast band with a station thousands of miles away. As any DX-er will tell you this is a "thrill of a lifetime" and although I have since duplicated this feat many times it always brings a new thrill to me.

Another requisite for this type of reception is a good alarm clock, as many DX-ers have slept through the hours when signals were fairly prancing up and down their aerial, literally begging to be let in.

Do not fail to equip your radio den with a good world map, or globe, and some kind of a chart or device for converting time in any part of the world to your own time, or converting your time to that of other parts of the world.

We do not expect you to grasp all these points at first but we will explain it all in future articles, and in the meantime we are going to tell you how you may try for certain foreign signals. If you don't succeed the first night, *try again* as weather conditions may be against you. There is also a certain "feel" of foreign signals on the dial that once experienced will enable you to repeat your performance.

What to Listen For

There are only two times of the year when signals from Australasia (Australia and New Zealand) may be reasonably heard in North America on the broadcast band. These are from about *September 15 to November 15* in the fall, and from about *February 15 to April 15* in the spring. During these two periods of solar and vernal equinoxes the Northern Hemisphere is enjoying fairly approximate good weather conditions. During the remainder of the year it is summer in one or the other of the hemispheres. Summer is out of the question, in most localities, for foreign reception on the BCB (broadcast band), due to static disturbances and attendant weak signals. It should also be always remembered that a total path of darkness should prevail from the transmitting station to the receiving point for the best reception of these particular kinds of signals. I have myself identified some 20 "Aussie" (Australian) carriers (the actual stations' "waves", on which "ride" the program) in one night, and other DX-ers have done far better than that. We would suggest, however, for a beginning that you concentrate on one of the following spots: 2YA, Wellington, New Zealand, 570 kc.; 4QG, Brisbane, Australia, 760 kc.; or 2BL, Sydney, Australia, 855 kc., as these are in most cases the most consistent. You may comb the dial for Aussies and Zedders (New Zealand) until the local Eastern coast stations start to come on the air, or on clear channels until daylight.

Japanese Stations

One other type of foreign signals may be heard at this time of the year; this is a Japanese station. You will only be likely to receive these in the Pacific coast area this early in the season, although later they are occasionally heard in the middle and Eastern sections of the country. Next month some South American signals will begin to put in an appearance; and—the most elusive of all—European stations will occasionally begin to break through. Full information next month on snaring these stations.

Notice

We shall give a prize of a year's subscription to RADIO-CRAFT, award to be announced for each month in successive issues, for the DX-er sending in the best list in order of consistency of the ten best foreign stations as heard in this country. For the January issue we shall give a similar award for the most nearly correct list in the consecutive order of their consistency, of the ten best American stations as heard in foreign countries. Verifications MUST be included.

the ten best American stations as heard in foreign countries. Verifications MUST be included.

New Australia Transmitters

Broadcast band DX-ers should be on the lookout for the following new Aussie transmitters which will be in operation at the approximate dates given in this schedule:

Kc.	*Power*	*Location*	*Date of Completion*
630	7 kw.	Launceston, Tasmania	September 30, 1934
640	7 kw.	Townsville, Queensland, Aust.	November 15, 1934
560	10 kw.	Kantanning-Wagin, West Aust.	December 4, 1934
660	7 kw.	Grafton, New South Wales, Aust.	December 31, 1934
550	10 kw.	Nhill, Mortoa, Victoria, Aust.	January 19, 1935
830	7 kw.	Sale, Victoria, Aust.	February 28, 1935
580	10 kw.	Dubbo, New South Wales, Aust.	March 4, 1935

Ten Best Heard Australian Stations

The following are the best heard Australasian stations, given in exact order of their consistency.

Call	*Kc.*	*Watts*	*Name and Location*
2YA	570	5,000	The N. Z. Broadcasting Board, Featherstone St., Wellington, N. Z.
4QG	760	5,000	Nat'l Broadcasting Station, Brisbane, Aust.
2BL	855	5,000	Nat'l Broadcasting Station, Sydney, Aust.
4BC	1,145	600	J. B. Chandler and Co., 43 Adelaide St., Brisbane, Aust.
2CO	560	7,500	Nat'l Broadcasting Station, Corowa, Aust.
3LO	800	5,000	Nat'l Broadcasting Station, Melbourne, Aust.
5CK	635	7,500	Nat'l Broadcasting Station, Crystal Brook, S. Aust.
2UE	1,025	3,000	Radio House, 296 Pitt St., Sydney, Aust.
5CL	730	5,000	Nat'l Broadcasting Station, Adelaide, Aust.
4RK	910	5,000	Nat'l Broadcasting Station, Rockhampton, Aust.

Best Stations for October-November

Freq.	*Local*	*Australia*	*Japan*	*Others*	*Start Tuning At*
560		2CO (7½ kw.) Corowa			3:30 A.M. C.S.T.
570		2YA (5 kw.) Wellington, N. Z.			3:00 A.M. C.S.T.
590	XEPN		JOAK-2 (10 kw.) Tokyo		2:00 A.M. P.S.T.
610		3AR (5 kw.) Melbourne		KZRM (50 kw.) Manila, P. I.	3:30 A.M. C.S.T. (Australia) 3:00 A.M. P.S.T. (Manila)
630		5CK (7½ kw.) Crystal Brook			3:30 A.M. C.S.T.
650		1YA (2½ kw.) Auckland, N. Z.			3:00 A.M. C.S.T.
660	WEAF			XGOA (75 kw.) Nanking, China	4:00 A.M. P.S.T.
665		2FC (5 kw.) Sydney			3:30 A.M. C.S.T.
680	KPO		JOLK (½-kw.) Fukuoka		3:00 A.M. P.S.T.
710	WOR		JOJK (3 kw.) Kanazawa		2:00 A.M. P.S.T.
720	WGN	3YA (2½ kw.) Christchurch, N. Z.			3:00 A.M. C.S.T.
730		5CL (5 kw.) Adelaide			3:30 A.M. C.S.T.
750	WJR		JOBK-1 (10 kw.) Osaka	KGU (2½ kw.) Honolulu	2:00 A.M. P.S.T. (Japan) 3:00 A.M. C.S.T. (Hawaii)
760	WJZ	4QG (5 kw.) Brisbane			3:30 A.M. C.S.T.
770	WBBM		JOHK (10 kw.) Sendai		2:00 A.M. P.S.T.
790	WGY		JOGK (10 kw.) Kumamoto		2:00 A.M. P.S.T.
800	WBAP	3LO (5 kw.) Melbourne			3:30 A.M. C.S.T.
810	WCCO		JOCK-1 (10 kw.) Nagoya		2:00 A.M. P.S.T.
830	KOA		JOIK (10 kw.) Sapporo		2:00 A.M. P.S.T.
850	WWL		JOFK (10 kw.) Hiroshima		2:00 A.M. P.S.T.
855		2BL (5 kw.) Sydney			3:30 A.M. C.S.T.
870	WENR		JOAK-1 (10 kw.) Tokyo		2:00 A.M. P.S.T.
910	CRCM	4RK (5 kw.) Rockhampton			3:30 A.M. C.S.T.
1025		2UE (3 kw.) Sydney			3:30 A.M. C.S.T.
1080	WBT		JOBK-2 (10 kw.) Osaka		2:00 A.M. P.S.T.
1140	KVOO	4BC (.6 kw.) Brisbane			3:30 A.M. C.S.T.
1170	WCAU		JOCK-2 (10 kw.) Nagoya		2:00 A.M. P.S.T.
1240				WKAQ (1 kw.) San Juan, P. R.	
1320				KGMB (¼-kw.) Honolulu, T.H.	3:00 A.M. C.S.T.

NOTE: This chart is by no means complete with respect to every foreign signal you may hear but these are the ones most likely to be heard at this time of the year.—EDITOR

A 14 TUBE ALL-WAVE "DOUBLE-SUPERHET."

(Continued from page 286)

Anti-Hiss Circuit

This newly developed circuit results in greater sensitivity and selectivity than can be obtained with the old-type superheterodyne connection employed in practically all the superheterodyne receivers sold in the last 12 years. Tube noise and superheterodyne hiss formerly thought unavoidable has been reduced to the vanishing point.

Following the first 6D6 R.F. amplifier (which prevents cross-modulation, image-frequency interference and hiss on the broadcast band) is a low-loss, high-gain all-wave transformer feeding another 6D6 for maximum amplification on all bands at all times. This stage eliminates repeat spots in short wave reception thus making it possible to accurately calibrate the tuning dial on the short-wave bands. The signal is now fed into the 6A7 modulator tube at a comparatively high level so that the tube can operate efficiently without the usual increase in hiss introduced with low-level detectors. The 6A7 also acts as a coupling tube for the electron-coupled oscillator.

All circuits that carry signal and oscillator currents have been wired with rigid bus-bar to prevent frequency shift and maintain the dial calibration. This together with the inherent stability of the electron-coupled oscillator keeps the signal continually tuned correctly with no troublesome drifting.

Novel I. F. Amplifier

The heart of the superheterodyne is in the I.F. amplifier section, which incorporates two different I.F. units.

Naturally the signal must be amplified sufficiently at the signal frequency for quiet operation but it is in the I.F. amplifier that the main amplification takes place. Here is where the newly developed circuit makes it possible to use 3 stages of I.F. amplification without introducing tube noise, hiss or instability.

The signal-frequency circuits are so designed that a fairly large difference in frequency is maintained between the signal frequency and the oscillator. This results in perfect one-spot reception even on the shortest wavelengths. Oscillator frequency shift is also eliminated since there is no trace of "pulling" even though the percentage difference becomes very small as it does at the shortest wavelengths. The use of a high I.F. however has some inherent disadvantages such as poor selectivity, extraneous pickup through capacitative coupling, etc. However practically all multi-wave receivers available now use an I.F. of 456 kc. and sacrifice the selectivity on the broadcast band slightly. This has been the one really weak point in all-wave receiver design.

In the new receiver the I.F. is actually shifted to a very low frequency so that it is no trick at all to receive a station on each channel without overlap. This is accomplished in a frequency-converter stage. (Although this is now an exclusive feature of this particular set, we feel sure that within the next few months this new development will be copied wholesale by manufacturers of high-quality receivers.)

The use of this circuit results in enormous controllable sensitivity, absolute 10 kc. selectivity and no tube noise or hiss since the amplification now takes place on three optimum frequencies.

Sensitivity or Noise Control

The sensitivity control is used to regulate amplification. It will cut out noise between stations or it may be opened up fully to get very weak stations.

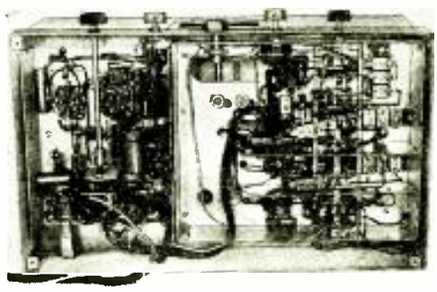
Following the I.F. amplifier which provides practically all of the signal selectivity on any superheterodyne are the second-detector and automatic volume control tubes.

An 85 tube is used as a full-wave diode second-detector. The full-wave feature was added so that no filtering need be employed to keep the I.F. from the audio circuits. (This is an essential feature for high-fidelity reception.) The 85 tube terminates the tuner and feeds the drive stage in the power amplifier. A headphone jack is incorporated for those desiring headphone reception. One knob on the receiver controls the tone to suit individual preferences.

Push-Pull Class A Prime Output Stage

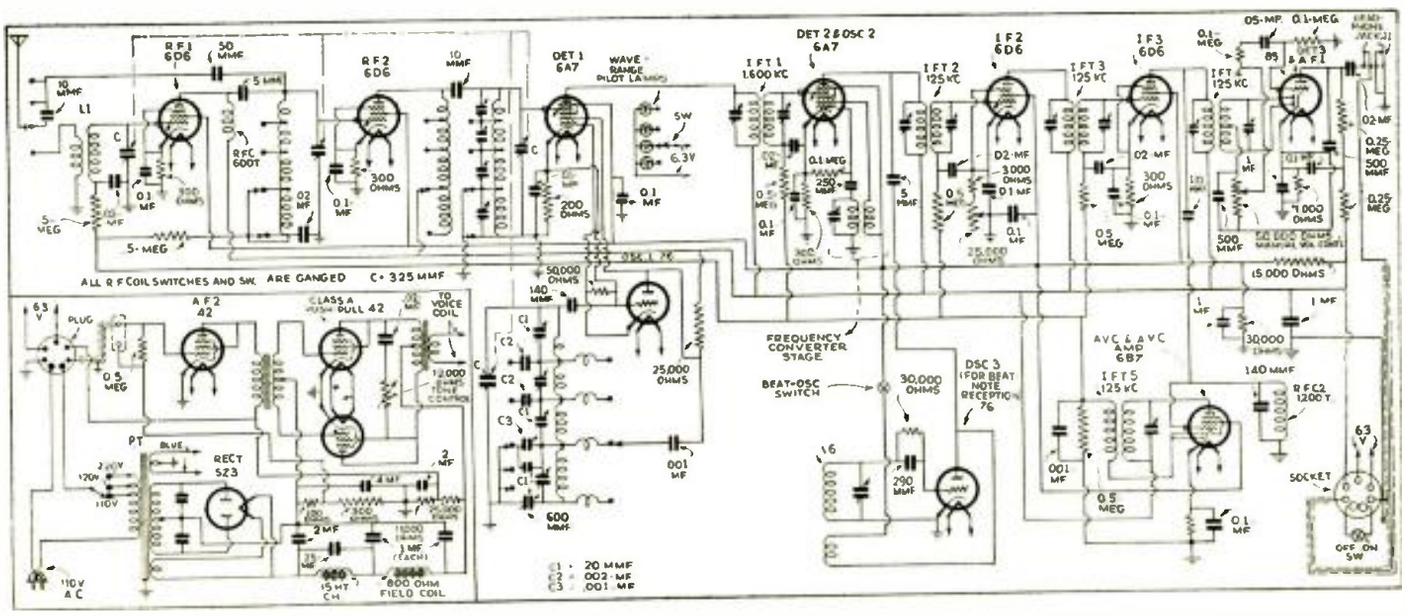
The power output stage uses two type 42 tubes connected as triodes in Class A prime with its resultant good quality. An oversized high-fidelity speaker of the finest design is supplied as standard equipment.

In general the construction is of the finest, with all parts liberally oversize. Rubber insulation is used throughout to eliminate microphonics and howls so often associated with the reception of short-wave stations. Every part is specially treated to withstand the worst rigors



Bottom view of receiver chassis.

Diagram of 14 tube all-wave "Double-Superhet."



of tropical humidity and salt air. Transformers are double baked and condensers are completely sealed.

A switch built into the tone control operates an audio beat oscillator. To find a weak short-wave station you simply turn the tone control to the left, and immediately a short-wave station is tuned in. It makes its presence known by a whistle. You then turn off the beat oscillator and if it is a broadcast station in comes the music from the station.

LATEST IN RADIO

(Continued from page 271)

end of the range to the other. Both sides of the record are utilized. A 1000 cycle test note begins and ends the record, and is used for general checking purposes. The response from about 7,000 cycles to 250 cycles is substantially flat; at 100 cycles the output is down 7 db; and at 50 cycles, about 12 db. This characteristic is exceptionally fine for a recording. Use this record in conjunction with a good pickup to modulate your service oscillator with A.F.

CONDENSER MICROPHONE KIT (575)

RADIO amateurs, experimenters and manufacturers of sound equipment will be interested to know that a kit of parts for the construction of a high-grade condenser microphone head amplifier is now available. The actual condenser-type microphone is fully assembled and laboratory tested at the factory, but the 2 stage pre-amplifier associated equipment (except the shield-can) is in knock-down form. The kit includes resistors, condensers, split-secondary (200 ohms and 50 ohms) output transformer, and sockets for two type 30 tubes (total battery requirements: "B," 5 ma. at 180 volts; "A," 60 ma. at 6 volts).

4 TUBE, ALL-WAVE CONVERTER (576)

THIS converter or selector when connected to the antenna and ground posts of any broadcast receiver converts it into an all-wave set for operation over a frequency range of 1,500 to 25,000 kc. (200 to 12 meters). A superheterodyne circuit is utilized. This converter is exceptionally well designed, and establishes a new high level in converter performance. A bank of 12 individual coil units is used in order to obtain complete wave-range coverage at high efficiency. A stage of tuned R.F. amplification ahead of the first-detector is another "secret" of the efficiency of this instrument.

NOW RADIO KILLS PLANT INSECTS

(Continued from page 273)

for experimental work to permit close observation of the effect of the death-dealing waves on insects. The 2 square aluminum plates are small, in this instance, as is also the electrostatic field set up between them. By placing the insects at a point between the 2 plates this device will, however, destroy them in about a half-minute. It has a variable frequency range of 1,000,000 to 25,000,000 cycles. Dr. Headlee has his hand on the death switch which enables him to control the amount of power.

In Fig. D is shown D. Manley Jobbins, research assistant, adjusting the giant electrodes in the big 5 kw. outfit. Between the electrodes is a live plant infested with numerous insects. When the current is turned on every insect will be destroyed but the plant will remain unharmed. The principle used in these deadly radio devices is apparent in this photo. The 2 big plates are the electrodes and between them and around them is set up the electrostatic field. The separation between these plates is variable, the greater the separation the more powerful the radio equipment must be. Thus, the effective range is really unlimited provided sufficient power is used behind it.

The small 50 W. extremely short-wave transmitter utilizing frequencies up to 60,000,000 is stationed in one of the greenhouses for further research purposes. Fig. E clearly shows this installation. Adjoining it and extending out to the left is a specially constructed wavemeter for determining extremely short wavelengths. It is called a "Lecher" apparatus and consists of a long support for 2 parallel wires with a wire loop and a miniature incandescent bulb at one end. (A "Lecher" apparatus is one whose antenna system has the same physical dimensions as those of the transmitted wave.)

A PUSH-PULL "2B6" P.A. AMPLIFIER

(Continued from page 286)

A novel connection of the microphone-phonograph switch eliminates the need for fading systems or dual volume controls. The input voltage for maximum output is .03-V.; the input impedance values are: 500,000, 200, and 100 ohms. The output impedances are: 9, 15, 500, 4,000. A gain of approximately 83 db. is realized at 1,000 cycles and power consumption of 90 W. The instrument has been designed to fit on a standard 15 x 11½ x 8½ in. chassis (used by the same manufacturer for other units), which is made of heavy-gauge, auto-body steel, with a black crystalline finish. The complete amplifier weighs 45 lbs.

(One of the outstanding peculiarities of the 2B6 duplex-triode is that best matching is obtained when the output load value *matches* the output impedance value of the tube. These and other characteristics of the 2B6 are discussed in the article, "The 2B6—A Duplex Triode" which appeared in the September, 1933 issue of RADIO-CRAFT. Further development of this tube, which contains within one envelop one triode directly coupled to the other, has resulted in many interesting circuit applications of which this new amplifier is the latest.)

A complete P.A. system for utilizing this amplifier would incorporate the following units: the amplifier previously described; two 10 in. A.C. dynamic reproducers; two 16-x-16 in. celotex baffles; a telescoping floor stand and double-button microphone; and 25 ft. of heavy-duty, 3 wire shielded microphone cable. Additional equipment which could be used to advantage includes 2 flare type, weather proof, 2½ feet baffle horns, a high-impedance pickup, and a phonograph turntable and motor.

THE RADIO MONTH IN REVIEW

(Continued from page 263)

ing a commercial receiver complete with projecting lenses, scanning equipment, etc., housed in a handsome cabinet, and supposedly ready for immediate television broadcasts. While we are not acquainted with the efficiency of this device, we wonder whether it has the clarity and detail of 16 mm. film projection. If it hasn't then American television development is far ahead, because recent demonstrations in N. Y. have shown that detail and clearness. The commercial manufacturing of these television receivers in America is contingent upon the inauguration of sufficient television transmitters and studios, and which in turn, is pending availability of the required broadcasting channels.

BUILD THIS ALL-WAVE RADIO SET

(Continued from page 279)

over the country were heard on position No. 3. Broadcasts from Germany and England were heard consistently (on position No. 2) when a 7 tube all-wave receiver of commercial make was unable to receive them. South American short-wave broadcasting stations are received almost as well as locals. Concerning U. S. broadcast stations between 200 and 550 meters, this set will do as well as many receivers employing a greater number of tubes.

(Continued on page 310)

"B" SUPPLY FOR FARM OR AUTO SETS

(Continued from page 280)

as terminals. Between layers of the secondary winding should be several turns of wax paper. This precaution prevents internal sparking between the layers. Over the secondary is wound another thickness of cardboard, upon which is placed the filament winding—20 turns of No. 20 wire. When all the coils are completed, they are dipped in melted paraffin. Now the laminated core is assembled over the coils and fastened to its original mounting brackets. A terminal strip is desirable and can easily be made of a piece of bakelite, some tubular brass rivets and soldering lugs.

As regards phasing of the primary and high-voltage windings—if the two coils are in the same direction, the beginnings of the coils are at opposite potentials. Thus, if the beginning of the primary winding is attached to the positive battery terminal of the eliminator, the beginning of the secondary is to be soldered to the negative high-voltage terminal. However, the proper phasing may be determined experimentally by reversing one set of terminals. The secondary terminals should be separated at one point by a distance of only 1/64-in., thus serving as an air gap to relieve occasional high voltages.

The Vibrator

Ford (Model T) coil points are used in the vibrator. They can be obtained from garages or automobile parts stores for 25 cents or less. The upper contact point is used in its original form (R, Fig. 2). The strip carrying the point must press against the stop A but should bend back rather easily when touched. The lower point is cut off as shown in S, Fig. 2, and the two small holes drilled. About 1 in. length of bell wire is now soldered to the tip of the lower point. Sandpaper the tip thoroughly before attempting to solder. This wire increases the moment of inertia of the vibrating point, thus giving stability to the vibration.

The pole piece of the vibrator magnet is made of a strip of soft iron ½-in. wide, 4 in. long, 3/32-in. thick; it is bent into the shape indicated in U, Fig. 2. Fifty turns of No. 16 wire are wound along the long side. Taps are taken off at the 25th, 30th and 40th turns.

The separate parts of the vibrator are now assembled on a plate of bakelite or other rigid, non-conducting material and several holes drilled (T, Fig. 2). Figure B shows the completed vibrator. The upper contact arm is held away by the spring B, and adjustment is obtained by means of screw C. The nut on the adjustment screw is soldered to the upper arm.

For those who prefer to purchase the vibrator complete, instead of constructing it as per the aforementioned instructions, it should be added that this unit is manufactured and available. As a matter of fact, present up-to-the-minute manufactured "B" supply units for auto sets eliminate the rectifier tube by employing a combined "mechanical inverter and rectifier." That is, the vibrating member has additional contacts attached to it which serve the purpose of reversing the A.C. back to D.C., consequently eliminating the need for a rectifier tube. This unit is also commercially available to those who may desire to elaborate on the design of their eliminator. (Its compactness and construction are well illustrated in the description of one such newly-designed unit in the Latest in Radio department of this issue.)

Assembling the Parts

The other necessary pieces of apparatus consist of a choke coil, two 4 or 8 mf. filter condensers, a .01 mf. (or larger) condenser, two 50,000 ohm resistors and a 4-prong tube base. Any available filter choke or the primary winding of an A.F. transformer can be used as the choke coil. If the winding is not already protected against moisture, it should be dipped in melted paraffin. The filter condenser nearest the tube should have a voltage rating of 400V. or more. Either a paper or dry-electrolytic condenser will serve. The other filter condenser may have a lower voltage rating and even 2 mf. capacity is sometimes sufficient for this position. The .01-mf. (or larger) condenser is connected across the vibrator points to minimize sparking. An automobile ignition condenser can be used. For the higher outputs of the eliminator a .001-mf. fixed condenser across the transformer high-voltage terminals is desirable. Across the output terminals are two 50,000 ohm resistors. This arrangement provides voltage for screen-grids. Other voltages and grid bias can be secured by proper choice of resistors.

The photographs show how the parts were mounted. Sheet iron 1/16-in. thick was used, though ply-wood can be used effectively. If thinner metal is employed, braces for the platform will be required. The platform is 3½ in. wide, 9 in. long. Two 8 mf. dry-electrolytic condensers (4 x 1¾ x 15/16), the small condenser and the resistors can be accommodated under it. The condensers are held by two sheet metal brackets. The transformer is fastened on the platform and the choke is mounted on the backplate.

Vibrator Case

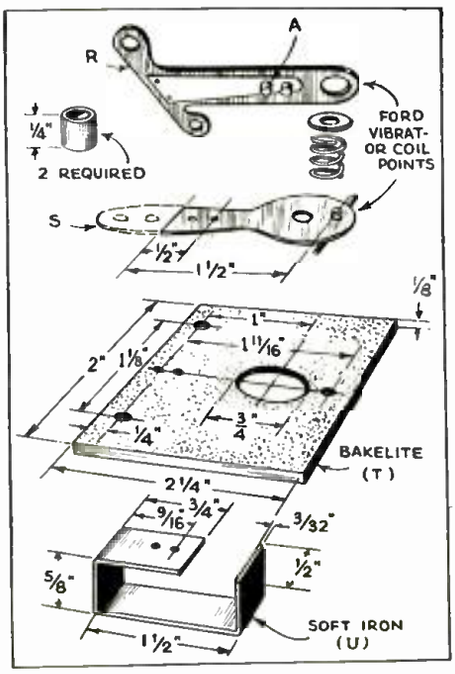
To eliminate the sound of the vibrator as much as possible a box made of "wallboard" is mounted on the back-plate and the vibrator is suspended in the box by strips of sponge rubber fastened with rubber cement. A metal or wood box can also be used. The rubber soap dishes sold in the "ten cent" stores will furnish the sponge rubber. When the sheet metal cover of the eliminator (see Fig. B) is put on, little sound can be heard. Thus the eliminator can be used inside the automobile. The frame of the eliminator is connected by a wire to either the + or — primary terminal, corresponding to the terminal of the automobile battery that is grounded.

An independent switch is used to operate the eliminator. One primary terminal is grounded and to the other is connected a *shielded* No. 14 stranded wire (Fig. 3) leading to the switch. The wire from switch to battery terminal need not be shielded. The shield must be connected at the eliminator direct to the car frame by as short a wire as possible. This will eliminate noise pickup in the receiver. Apparently, however, the Crosley 90, 91, 92 and the Philco 3 require a choke coil in one of the battery leads. At least 5 ft. of shielded wire should be used (even if all of it isn't necessary). When in use the eliminator should not be turned on until sufficient time has been allowed for the receiver tubes to "warm up," otherwise the output voltage becomes excessive. A 10 ampere fuse in the primary circuit is a desirable addition to the eliminator installation.

Current and Voltage Values

The results obtained with the eliminator vary with the type of tube used and with the electron emission. Those containing traces of gas cannot be used, however tubes with this defect constitute a very small minority. A new 71A will give as high as 40 ma. at 200 volts, but for continuous operation a current drain of greater than 25 ma. at 140 volts should not be expected. For a fairly good tube the following results were obtained:

Fig. 2
Details of Ford-coil vibrator.



Ma. Load	*"B" Volts*	*Battery Current*	*Vibrator Turns*
10	120	1.2 amp.	40
16	120	1.7 "	40
18	180	2.1 "	40
21	130	2.1 "	30
25	140	2.4 "	30
30	150	2.6 "	30

Of course for a given adjustment of the vibrator the voltage will increase as the current is decreased. For the initial trial of the eliminator leave the contacts open and close the battery circuit. Then slowly close the contacts by means of the adjustment screw. To a limited extent the output will increase as the adjustment is tightened. The voltage readings must be obtained with a high-resistance meter. The output of this eliminator is sufficient for most any 5 or 6 tube set and for some 7 tube sets.

If any changes in design of the eliminator are contemplated, the following points should be remembered:

(1) The resistance of the primary circuit must be very small—thus allowing the battery current to build up to a high value when the vibrator contacts are closed.

(2) The primary winding of the transformer, for greatest efficiency, is wound directly over the core, thus preventing "leakage reactance."

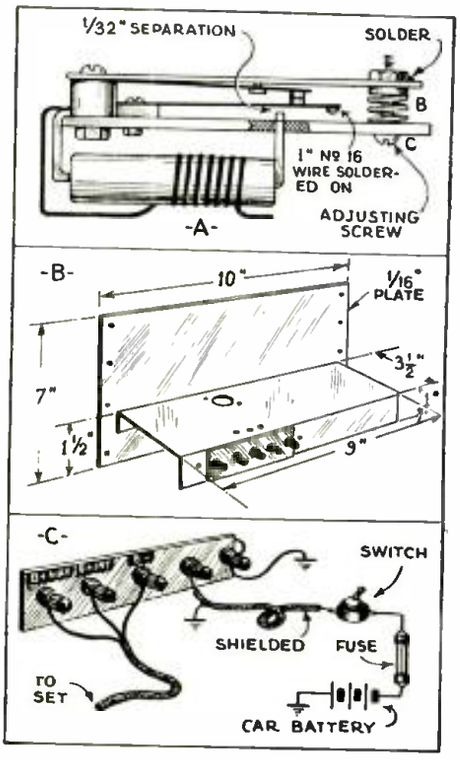
(3) The secondary voltage is dependent not only upon the ratio of primary and secondary turns but also upon the primary current and the *number* of primary turns. However, too many primary turns reduces the maximum output because of the increased reactance in the primary circuit. On the other hand, for lower outputs, increasing the number of primary turns increases the efficiency.

(4) The vibrator should emit a fairly steady musical note of several hundred cycles per second. The weight on the vibrator tends to reduce the frequency but is essential for steadiness of operation.

(5) Increasing the number of turns on the vibrator reduces the maximum output, for the contacts then open at a lower value of primary current.

Other tubes besides the old battery tubes can be used as the rectifier. The old Raytheon BH rectifier tube gives a maximum of about 20 ma. at 110 volts. For this tube the plate is connected to the output filter circuit and *one* filament prong is connected to the positive end of the secondary winding. There are several tube types made especially for eliminator use, such as the BR Raytheon, which requires no filament winding. Mercury vapor tubes cannot be used.

Fig. 3 "B" unit assembly details.



THE DRAMA OF RADIO

(Continued from page 267)

mercial services and other lanes of communication meet with unexpected disaster.

It fell to the lot of a Canadian amateur, 1DD, to help a commercial transatlantic radio service in a tight spot that developed so suddenly one day ten years ago. At that time, in April, 1924 to be precise, several large American newspapers maintained an up-to-date receiving station at Dartmouth, Nova Scotia, a small town on the eastern shore of Halifax Harbor. Here the latest European news was received from foreign representatives via several powerful stations on the other side. It was the practice for the European stations to transmit on schedule, Dartmouth doing receiving only, resorting to the cable for special requests or when a repeat was desired, made necessary by interference or static.

On the evening of April 17 an important news item became garbled in transmission. Speedily the cable companies were called upon, but they were helpless to offer service. Two of the transatlantic cables had parted that same day and the other was so overloaded with urgent messages that delivery then was impossible. What to do?

The operator at Dartmouth, after casting about in a quandary for an hour for some solution of the dilemma, began to realize that the schedule was approaching "closing" time, and action was needed. Anxious and helpless, he suddenly thought of his friend, Major William C. Borrett—or, as he was known to the amateur radio fraternity, "Canadian 1DD."

On the telephone he told him in short order about the situation and the repeat that was required. 1DD, despite the urgency, used good judgment. Believing that several other transmitters added to his own station would aid in the endeavor to get the message across with more certainty, Borrett called on 1BQ, 1EB and 1DJ. These local Halifax amateurs already had to their credit the holding of two-way communication with British amateurs using size 50 to 100 watt tube sets on the (then new) 100 meter band. They first listened intently for a British signal to establish contact. No luck that night. They then decided to send the message broadcast in the hope that some alert Britisher, tuned to their channel, would pick it up and relay it to the foreign station. Fifteen minutes the QST (general call to all stations) signal flashed, then they listened for an answering signal, but none was heard. It looked doubtful that the experiment would succeed.

Again they started the broadcast signal when the telephone in the shack of station 1DD rang. The operator at Dartmouth conveyed the happy news—"thanks, you certainly put it over. We are now getting our repeat." And shortly thereafter British 2SZ, in communication with 1DD confirmed the fact that the message was picked up by himself and Britsh 5BV and forwarded.

Amateurs in name, but pioneers in spirit, and professionals in results! It seems heroes of the air are made by circumstance, not born.

●

CONVERTING OLD SETS

(Continued from page 284)

the one shown in Fig. 1. For example, a 10,000 or 15,000 ohm potentiometer may be used as an antenna or R.F. potentiometer. This results in a saving in the modernization expense as condensers C1, C2, C3 and C4, and resistors R1, R2, R4 may be dispensed with. However, from an operation standpoint this small saving is not believed to be justified. As no "C" bias would be used on the grids of the R.F. tubes, in this case, the plate current would be greatly increased, thereby nullifying the original economy. According to the RCA tube manual, the type 30 tube draws about 4 milliamperes with 67½ volts on the plate and no grid bias, and with 90 volts on the plate and no grid bias over 8 ma. is the plate current. With a plate voltage of 90 volts and a grid voltage of —4½ volts the plate current is only 2.5 ma. As the volume control used in Fig. 1 varies the grid voltage from —4½ to —12 volts it can readily be understood why this type of control effects a saving of at least 50% in the R.F. plate current. In terms of "B" battery life this reduction is important. A rather high-resistance potentiometer (R3) was used by the writer to remove the necessity of using a switch to break the "C" bias circuit.

Optional Detector and Amplifier

If an output greater than .185-W. is desired it is recommended that the circuit illustrated in Fig. 2 be employed. Besides permitting much greater output than obtained previously, this circuit offers the advantage of improved fidelity of tone. In modernizing a 6D circuit to conform with that of Fig. 2 proceed as follows:

As the radio frequency amplifier used with Fig. 2 is identical with that of Fig. 1 its modernization will not be repeated. Remove the two A.F. transformers, the .001-mf. R. F. bypass condenser and the grid leak mounting clips. Disconnect the grid condenser from the grid terminal of the detector socket and the grid lug of the adjacent coil. This condenser may now be used as C7 in Fig. 2. Connect the 67½ V. battery wire to the grid contact (to which the grid leak and condenser were attached) of the detector socket.

As a screen-grid, type 32 tube is used as a detector it is necessary that the grid terminal of the 4th R.F. transformer be connected to the control-grid of the tube by means of a flexible insulated wire terminated by a screen grid clip. Due to the fact that grid-bias detection is used it is necessary that the secondary of the 4th R.F. transformer be ungrounded, and connected to C5 and the junction of R9 and R10 as per the circuit diagram of Fig. 2.

Substitute a 5 prong tube socket for the original first A.F. tube socket. Mount the output transformer above the subpanel so as to "cover up" the 2nd A.F. tube socket which is not used. If desired a choke-and-condenser type of output coupling device may be substituted for the output transformer. Next complete the circuit alterations by connecting R11, R12, C6, etc., according to the circuit diagram of Fig. 2. Remember that resistor R5 must be adjusted as explained in the previous discussion and that it is often necessary to align the R.F. circuits (by means of trimmers on the gang condenser) to obtain maximum results.

When performance and economy of operation are considered, the modernized Kolster 6D is in the front ranks. In performance it compares favorably with many of the recently manufactured 2 V. sets. On an actual test it consistently brought in stations with plenty of volume that a certain well-known 5-tube screen-grid (2 volt) radio set would only barely "scratch". Due to the low current requirements all batteries will have a surprisingly long life. In fact an air cell will furnish about 1,400 hours of constant filament power if used with the circuit of Fig. 1, and 1,200 hours of service with Fig. 2.

List of Parts for Fig. 1

One I.R.C. resistor, 50,000 ohms, 0.5-W., R1;
One I.R.C. resistor, 150,000 ohms, 1W., R2;
One I.R.C. resistor, 350,000 ohms, 1W., R4;
One Electrad type A Truvolt resistor, 1 ohm, 10 W., R5;
One I.R.C. resistor, 1,500 to 2,500 ohms (as required), R6;
One I.R.C. potentiometer with switch, 250,000 ohms, R3 and Sw.;
Three cartridge condensers, .06-mf., C1, C2 and C3;
One cartridge condenser, .1-mf., C4;
Five type 30 tubes, V1, V2, V3, V4, and V5;
One type 31 tube, V6;
Three 45 volt "B" batteries;
One 22½ volt "C" battery;
One Air Cell "A" battery or a 2 V. storage cell.

List of (additional) Parts for Fig. 2

One radio frequency choke, 10 mh., R.F.C.;
One resistor, 50,000 ohms, 1 W., R7;
One resistor, 7500 ohms, 1 W., R9;
One resistor, 6000 ohms, 1 W., R10;
One resistor, 100,000 ohms, 1 W., R11;
One resistor, 500,000 ohms, 0.5-W., R12;
One potentiometer with D.P.S.T. switch, 100,000;
Ohms R8, S1 and S2;
One cartridge condenser, .06-mf., C5;
One coupling condenser, .05-mf., 600 V., C6;
One R. F. bypass condenser, 250 mmf., C7;
One output transformer, primary load impedance 7,000 ohms, T1;
One 5 prong socket and a screen-grid clip;
Three 4½ V. "C" batteries or one 13½ V. battery;
One type 33 tube;
One type 32 tube.

Note: the following parts of Fig. 1 are not used in Fig. 2: C4, R2, R3, R4, V4, V5, V6, and the 22½ V. "C" battery.

TUNED ALL-WAVE LINE-NOISE FILTER

(Continued from page 281)

When this filter was tried with various superheterodynes it was not as effective in reducing all the noises, and as the receivers were known to be in perfect condition it was apparent that another noise source was present that did not show itself when a regenerative receiver was used.

Associated with the new all-wave sensitive superheterodynes are the noises from tubes such as thermal agitation and other inherent tube noises. Not wishing to debate on this subject, it suffices to say that most of the noises present were not caused by any of the above effects, but from power line pick-up.

Figure 1B shows the circuit that was finally used for superheterodyne receivers. The only difference to the previous filter is the inclusion of an additional tuned trap circuit. When this trap was tuned to the same frequency as the receiver's intermediate frequency amplifiers, the noise was reduced sufficiently to warrant the above statement. This effect is logical when one considers that the I.F. stages of these sets are usually worked at a very high gain, and any noise pick-up on this frequency is enormously amplified.

Both circuits are sound in engineering practice and extremely simple, being devoid of any tricks or fancy frills, and may be used with A.C. or D.C.

The parts are mounted on an aluminum chassis and the entire unit is inclosed in a totally shielded aluminum box. A power line receptacle outlet socket for the receiver power plug is fastened to one of the sides of the filter shield can.

To further minimize in noise pick-up it is suggested that the power cord of the receiver be replaced with shielded cable. If this is not done the cord should be kept as short as possible, and if there is any slack it should be coiled to form a solenoid.

In conclusion it should be understood that this is not a cure-all for static elimination, but when used with a noise reducing antenna system placed out of interference fields with a thoroughly shielded receiver the overall effect will be a considerable reduction of man-made static.

List of Parts

One Amperite voltage regulator tube and socket, V1;
Two 25-80 mmfs. Hammarlund equalizing condensers, C3;
One set of coils from any I.F. transformer, L2;
Four Blan line filter chokes, L1;
Four Cornell-Dubilier .5-mf. filter condensers, C1, 400 V. rating;
Two .075-mf. bypass condensers, C2;
One chassis;
One shield can;
One fuse holder and fuse;
One receptacle socket;
One Blan power line cord and plug.

INFORMATION BUREAU

(Continued from page 290)

and Nelson seem to be common with several others that made up the unit, namely, difficulty in obtaining Sw. 3, and no meter deflection on either the M or H range of the tester.

In regard to the schematic diagram, Fig. 4, page 28, July, 1933 issue, there are no corrections to be made as this is correct. If all parts and values used are as stated and connected as shown, the unit will function exactly as explained in the article.

In reply to Mr. Nelson, switch Sw. 3 is a Carter Radio Company unit (H-3D5D). Resistor R3 is in the circuit only when using the M or Range No. 2 of unit as can be seen from the diagram.

Mr. Prosser's trouble of getting no meter deflection on either the M or H range is due to the fact he is using D.C. shunts. He may have ordered A.C. shunts and assumed they are, but what he got was D.C. shunts. This happened to several who experienced the same difficulty and wrote to the writer direct, the writer answering these. The resistance of these D.C. shunts being a fraction of an ohm and shunted across the A.C. side of the rectifier (see Fig. 4) shorts the rectifier and meter out of the circuit, consequently there is no meter deflection on either the M or the H range.

The resistance of the A.C. shunts being approximately 5 ohms for the 500 ma. shunt and 20 ohms for the 100 ma. shunt, anyone may make their own shunts by using wire-wound units of the above values. If one desires to do this, R6 may be removed from the circuit as this resistor was used to compensate for the M.V. drop of manufactured shunts.

The 5 and 20 ohm values are correct for use with a Weston model 301, 1 ma. meter and Taurex rectifier, with resistor R6 removed from the circuit. These values probably would vary slightly with meters of a different make. However, they are sufficiently close to give one an idea of the value to start with.

In calibrating these shunts for a meter other than Weston, the process is simple. Connect the above values in circuit as shown. To calibrate the 100 ma. shunt, throw Sw. 3 to the M position, connect the meter to I. HM pin jacks, close line switch Sw. 1 and adjust Sw. 2; now rotate the HM adjust rheostat and note the meter deflection. If the meter reads less than full-scale the resistance of the shunt is too low; if the meter goes off-scale, the resistance of the shunt is too high. The meter should read full-scale deflection when the resistance of the HM adjust rheostat is about half cut out. Thus by adding resistance or shorting out a few turns the proper value is easily found. The same procedure is used in calibrating the 500 ma. shunt, only Sw. 3 is thrown to the H position. Open Sw. 1, the line switch when making any adjustments. The reason for having half of the resistance of the HM adjust rheostat in circuit is that it allows sufficient wire to carry the load, this being important on the H range.

If resistor R2 heats up, the remedy is to use two 300 ohm, 20 W. units in parallel, giving 150 ohms rated at 40 W.

This high range is really not necessary, since A.C. is not recommended for testing electrolytic condensers, and the chances of ever having to test paper condensers above 4mf. being remote, this allows a simplified unit employing the L and M range of previous tester to be made up by any one so desiring, all charts and data given in previous articles holding good in regard to the L and M ranges.

Figure Q.297 shows such a unit covering a capacity range of 250 mmf. to 4 mf.

For Sw. 3 a D.P.D.T. toggle switch can be used, thus reducing the unit in depth by 1¼ ins., all other dimensions and appearance remaining the same.

To operate, the pin jacks of the unit marked "meter" connect to either the 1 V. A.C. or 1 ma. A.C. range of the universal meter. To test any condenser between 250 mmf. and 0.1-mf., switch Sw.3 is thrown to the L position. Now, connect the condenser of unknown capacity to the pin jacks, close switches Sw.1 and Sw.2, adjust the meter to full-scale deflection, open Sw.2 and the test is complete. Condensers from .1- to 4 mf. are tested by throwing Sw.3 to the M position, and proceeding as for the L range.

The 20 ohm shunt is across the A.C. side of the rectifier on the M range when Sw.3 is thrown to the M position. There is no danger of burning up any resistors on either of these ranges.

This unit has not been made up by the writer as the unit described in the July issue is still being used. It is merely sketched here to show a simple capacity tester, and simple switching arrangement.

Fig. Q. 296 B Underside view of decade box.

"A FUNDAMENTAL ANALYZER"

(297) Mr. J. R. Burns, Jr., Steubenville, Ohio.

(Q.) What are the values of the resistors shown on the back of the meter, in the article, "Fundamental Analyzer," in the May, 1934, issue of RADIO-CRAFT? Also, are resistors R5 to R in the correct positions? Is the value of resistor R7 0.505-ohm or 505 ohms? I am using a Triplett meter in my instrument.

(A.) The author advises as follows: Any inaccurate operation or inoperative condition of the "Fundamental Analyzer" can usually be traced to the use of incorrect resistors. The meter was built around a Weston model 301 "Universal" instrument, and any variation from this specification will require the use of resistors the value of which must be determined by experiment, in order to match the individual meter selected for the position. The resistor shown on the back of the meter is part of the meter, and is supplied with it. It is a shunt for the D.C. side of the meter and is only in use when the D.C. ranges are used, being disconnected from the circuit when the A.C. side of the meter is used. The value of R7 is 0.505-ohm.

The meter used in the original instrument has a built-in rectifier, 50 ohms internal resistance, 1 ma. to 50 millivolts D.C., 1 ma. and 5 V. A.C. full-scale.

(If the Triplett meter is a straight D.C., 0-1 ma. milliammeter, it can be used with a separate rectifier; if of the "universal" type, other values of resistors will be required unless the internal resistance of the meter is 50 ohms.)

Yaxley Replacement Volume Control Manual

This booklet is a valuable aid for the Service Man. It is a complete manual containing technical data and circuits of volume, tone, suppressor, filament, and hum controls. Considerable information is included on "control" circuits with detailed explanations of each type. An invaluable compilation of various manufactured receivers, classified alphabetically so that reference can be made quickly, with a description of the various controls employed in each type, and resistance values are included. It is a handy reference book every Service Man can use. Includes the list price for the manufacturer's specific type of control which is chosen for replacement, and will facilitate estimating a repair job where the volume control is involved. Write to Radio-Craft for item No. 578.

A SERVICEMAN'S ALL-WAVE OSCILLATOR

(Continued from page 282)

fundamental R.F. signal generated by the 30 tube remains unaffected by variations in attenuation in the output circuit.

When the test cord (which is supplied with the instrument) is attached directly to the R.F. pin jacks, the instrument will supply a 1000 cycle modulated R.F. signal at a frequency corresponding to setting of the dial and the position of the band switch. Markings "A" and "G" on the R.F. pin jacks which correspond to the antenna and ground posts respectively. Do not attempt to obtain an R.F. signal without the use of the connecting test cords as the oscillator is thoroughly shielded at all frequencies.

When the test cord (supplied with the instrument) is connected to the audio tip jacks, the instrument will supply an audio frequency of 1000 cycles. The circuit impedance at the audio tip jacks is extremely high; it should be fed directly to the grid of the tube of the circuit under test. (Marking "G" indicates the ground post of the audio circuit.)

When it is desired to obtain an audio signal from the radio frequency tip jacks, it may be of interest to note that the signal will be approximately one twentieth (1/20) of one volt at the full scale setting of the R.F. attenuator, and may be attenuated by means of the R.F. attenuator control. The impedance of the circuit is very low (in and out, 100 ohms) and it can be connected to any type of circuit without altering its frequency characteristics.

The entire power is furnished by means of two batteries which are mounted directly within the unit, as shown in Fig. A. Note that the "B minus" post of the "B" battery is connected directly to the ground by means of the supporting bracket frame which holds it in place. Also note the position of the "C" battery which supplies the filament current for the types 1A6 and 30 tubes of the oscillator. As can be seen, it is very easy to replace batteries.

In Fig. 1, condenser C1 has a value of 350 mmf.; C2, .01-mf.; "B" bypass, .006-mf.; type 30 tube grid leak and condenser, 0.1 meg. and 250 mmf., respectively; type 1A6 tube grid leak and condenser, 20,000 ohms and 250 mmf., respectively.

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INTERNATIONAL RADIO REVIEW

(Continued from page 277)

well with a "B" potential of only 36 V. (24 cells of 1.5 V., each, connected in series).

A ground connection is not required with this set, but may be used to advantage if available. The antenna may consist of a short length of wire raised as high above the ground as possible. For instance, a wire (of any convenient size, and either covered or bare) about 10 ft. long may be stretched out to reach a fence; or, increased signal strength may be obtained if the far end is raised by supporting it on the limb of a tree.

A TILTING DIAL RADIO SET

A RECEIVER design that will attract the attention of the most blase radio man is illustrated in Fig. G. A July issue of THE BROADCASTER AND WIRELESS RETAILER, an English weekly, tells us that this table model receiver not only incorporates a chassis of high efficiency but also features for artistic purposes a diagonally located reproducer and, for more practical purposes, a tilting dial.

This dial is a rectangular, full-vision scale hinged at the ends of its longest axis. When a person using the set stands near it the scale may be twirled around the horizontal plane to prevent the user having to stoop.

The receiver circuit incorporates tone control, A.V.C., a built-in aerial, Q.A.V.C., and 9 kc. selectivity. The latest tubes are used, including an electron-coupled oscillator. It is interesting to note that connections are provided not only for a phonograph pickup but also for extension speakers. The latter feature some time ago was one of the subjects of a plea in an editorial by Hugo Gernsback ("The Decline of Radio Sets," RADIO-CRAFT, November 1932).

THE TRIPLE-DIODE-TRIODE

ACCORDING to a recent issue of the French magazine TOUTE LA RADIO, the Ediswan Co. of England has developed a tube containing a triode and 3 diodes in one envelope. This goes the American diode-triode one better. (The new tube carries the coded designation, AC/HLDDD.)

As the schematic circuit of this tube indicates, Fig. 2, increased circuit performance may be obtained without recourse to an additional tube. As ordinarily connected, the third diode element is used to obtain interstation noise control ("quiet" or "Q.A.V.C.").

In the circuit shown, diode No. 1 functions in a superheterodyne circuit as the second-detector, the A.F. output of which is fed to the control-grid of the triode section, which functions as an A.F. amplifier. Diode No. 3 is the A.V.C. rectifier, and is biased negatively, as a result of the drop across resistors R8, R9, and R10, to a Q.A.V.C. value of about 40 V.

Diode No. 2 acts as the Q.A.V.C. rectifier, the D.C. output of which is fed to the control-grid of the triode section.

When a broadcast signal is received, Q.A.V.C. diode No. 2 starts to operate, developing a D.C. voltage on the control-grid of the triode section that causes a decrease in the triode-section plate current. The resulting drop in voltage across resistors R8 and R9 cancels the Q.A.V.C. voltage and diodes Nos. 1 and 3 then begin to operate.

A relatively high plate voltage is required to compensate the drop across resistors R8 and R9. To reduce this plate voltage requirement to the minimum a portion of the filter circuit is utilized comprising unit R10, which is a field coil. The filter choke is inserted at X; its value forms part of R9.

A comprehensive resistance-capacity filter system is utilized to prevent parasitic circuit oscillation at A.F.

The characteristics of the tube are as follows: Filament, 4 V., 1. A.; plate, 250 V.; amplification factor (plate, 100 V.), 35; plate impedance, 13,000 ohms. The interelectrode capacities, in mmf., are as follows: control-grid to plate, 2; control-grid to cathode, 3.75; plate to cathode, 6.25; diode No. 1 to cathode, 3.25; diode No. 2 to cathode, 3.75; diode No. 1 to diode No. 2, 0.5; diodes Nos. 1 and 2 to control-grid, .09.

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OPERATING NOTES

(Continued from page 288)

no contact was made there, whereupon the locals roared in with plenty volume to spare. Finally, the condensers were lined up and distant stations then came through. The customer was well pleased, saying it never played like that before.

ANSCO

WE HAD an Ansco in the shop; the trouble was reported as "no reception." The set was found to have a gassy 80 tube which acted as practically a dead short across the power supply. A new tube was put in but still no reception. A further check of the tubes unearthed a burned out 27 tube in the set.

This receiver utilizes a 24 first R.F. or preselector tube, 2 stages of T.R.F. using 27s, a 27 detector, a 27 first audio, and push-pull 45s. (This seems to be an "orphan" set. It was manufactured in this city by a private concern.) The 27 was replaced with a new one; still no music! The voltages were checked, and it was found that the tubes were getting either a little or no voltage.

Tracing the leads led to a green resistor which was in the can, on the rear of the chassis, which houses the power pack. The negative end of this resistor was found to connect to a bolt which held the terminal resistor strip. The bolt, in turn, connected to the chassis. The chassis, of course, was grounded, but the bolt itself was loose. Tightening the bolt made a good connection for the resistor, and that cleared all the trouble. (The imperfect contact had a resistance of sufficient value to develop a drop of 50 V. across it; this drop of course was in series with the normal, rated drop of 50 V., and the total voltage when applied to the grid of the tube greatly reduced its amplification factor.)

LEONARD SMITH

A DIRECT-READING 1. OHM TO 5 MEG. OHMMETER

Louis B. Sklar

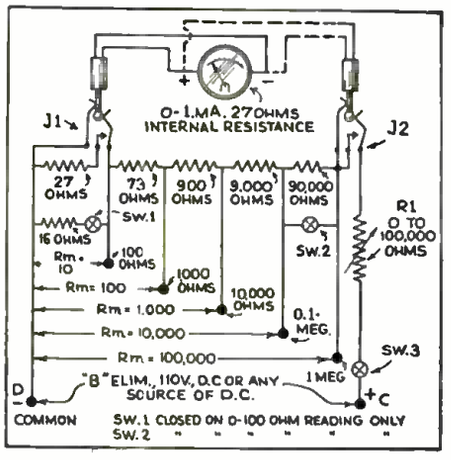
WITHIN the last few months there came out of the laboratories of individual radio-experimenters, as well as from commercial radio houses, a number of new-type ohmmeters. These meters (See numerous issues of RADIO-CRAFT) do not embody any new principle except that the shunt rather than the series method of measuring resistance is used.

While these methods of measuring resistances from a fraction of an ohm to several megohms are a greater convenience to the man in the radio or electrical laboratory, the ideal condition, however, has not as yet been reached; for the simple reason that in almost every case *the readings are not direct* for all resistance values within the range of the meters. In some cases, several curves have to be drawn or calculations and substitutions in mathematical formulas have to be used in order to arrive at the final results.

An ohmmeter having a range from 0 to 1 megohm, and possible 5 megohms, which will give all answers direct and accurate and without any calculations, has long been the goal of radio and electrical engineers.

With this view in mind the writer devised a new type of ohmmeter that overcomes these objections. There is really nothing radically new in the method used for measuring resistance values except that the different shunts used for the measurement of values from a fraction of an ohm to 1 megohm are so arranged that 1 curve, Fig. 3, is used for all readings. It is also seen from Fig. 3 that each value, whether it is 6 ohms or 600,000 ohms can be determined with the same percentage of accuracy. Anyone familiar with other type of ohmmeters will appreciate this feature.

Figure 1 shows the schematic layout of the ohmmeter and the parts required. The 0-to-1



Above, Fig. 1
Schematic circuit of ohmmeter.

Below, Fig. A
Exterior view of completed instrument.

ma. meter does not necessarily have to be part of the equipment. (The writer used a Weston 0-1. ma. meter which is part of a set analyzer.) All parts are assembled on a small box, as shown in Fig. A.

The D.C. source may be a "B" eliminator, three 45 V. "B" batteries, or anything which will give about 110 V. D.C. Since this D.C. does not have to be filtered, a type 71A tube rectifier can be used, as shown in Fig. 2, and as the equipment for this type of rectifier is very inexpensive it can be permanently incorporated in the circuit.

When all the wiring is completed, check it carefully; if everything is O.K., you may connect the D.C. source to the terminals marked D and C. You are now ready to plug the meter into jack J1. At any time, before the meter is plugged into the circuit, *make sure* that rheostat R1 is at maximum resistance. When the meter is in the circuit, adjust R1 until the meter shows full-scale deflection. The ohmmeter is now ready for operation.

To measure resistance values from ½-ohm to 100 ohms, close switches Sw.1 and Sw. 2, and adjust R1 until the meter shows full-scale deflection. When the resistor to be tested is inserted between terminals D and 100 the meter will indicate a current flow of less than 1 ma.—let us say, .45-ma. From the curve, Fig. 3, we see that the corresponding resistance is 8 ohms. The reason for using the 16 ohm shunt resistor and S, will be explained later, under, "The Theory of the Circuit."

Measurements of resistance values ranging between 100 and 1,000, and between 1,000 and 10,000 are the same as explained for testing values between ½-ohm to 100 ohms, except that switches Sw. 1 and Sw. 2 remain open.

When resistance values higher than 10,000 ohms are to be tested, the procedure is as follows: first, place the unit of unknown resistance value between the correct terminals. Remove the meter from J1 and insert it in J2. Adjust R1 until the meter shows full-scale deflection. It will be observed that when the meter is inserted in J2, a resistance equal to the internal resistance of the meter is automatically replaced in J1. This provides greater accuracy in the final reading. Remove the meter from J2 and reinsert it in J1. The new reading on the meter is the one used for finding the unknown resistance value on the graph.

The purpose of placing the meter in J2 before the reading is taken, is to make sure that the total current in this circuit is not more than 1. ma. This procedure is very important when high-range resistors are being tested, as the current through the circuit is being appreciably affected by the different values of the resistors to be tested. In the lower ranges, up to 1,000 ohms, the change in current can be considered negligible for all practical purposes.

All parts used are of standard make and in most cases will be found in the junk heap. The odd-value resistors, such as 16 ohms, 27 ohms, etc., can be easily constructed by unwinding any old wire resistors, until there remains just the right value.

The graphs, Figs. 3 and 4, may be pasted on a piece of cardboard and hung up at a convenient place in the laboratory or workshop; or, they may be pasted on the resistance box.

The Theory of the Circuit

We know that when a resistor is placed across the terminals of an ammeter or milliammeter the current which was originally flowing in the meter is now divided between the internal resistance of the meter and the shunt resistance. Mathematically it is expressed as follows: $\frac{Rm}{Rs} = \frac{Is}{Im}$ where Rm = internal resistance of the meter, Rs = shunt resistance, Is = current through the shunt, and Im = current through the meter.

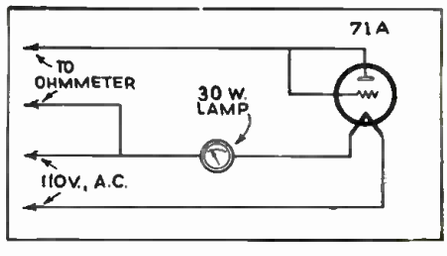
When the full-scale deflection of the meter is 1. ma., as it is the case here, this formula can be changed to $\frac{Rm}{Rs} = \frac{1-Im}{Im}$ and $RmIm = Rs-Rs\,Im$, and finally we get $Im = \frac{Rs}{Rm+Rs}$

In this last equation we have two unknowns: Im and Rs; Rm is unknown because it is equal to the internal resistance of the meter *plus* the external series or shunt resistance. We can now plot a graph giving values of current vs. values of resistance, and this graph is shown as Fig. 3.

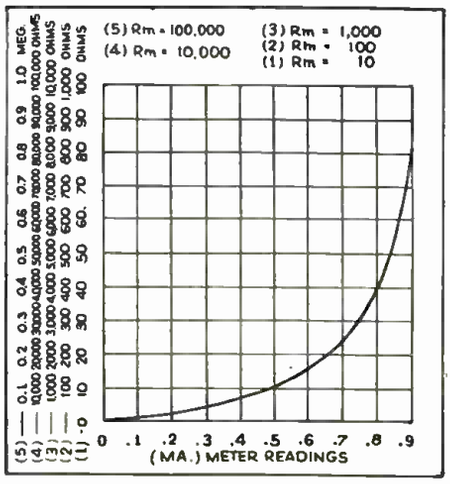
For the purpose of simplicity and convenience the writer has chosen Rm to be equal to 10 for values of Rs from .5- to 100. Any value below .5- or above 100 makes the readings either of the current on the meter or the resistance values on the graph inadequate for all practical purposes. However, if we multiply the numerator and denominator of the right member of the last equation by 10, the values of Im will remain the same for a new set of values ranging from 10 to 1,000. In order to accomplish this, all we have to do is increase the "internal" resistance of the meter to 100 and multiply the resistance units to be tested by 10. The equation then becomes: $Im = \frac{10Rs}{10Rm + 10Rs}$, which can also be translated as $Im = \frac{Rs10}{10Rm + Rs10}$, where Im will remain the same between the values of zero and 100 when Rs *and* Rm are multiplied *simultaneously* by 10. You can therefore readily see that there is no limit to how far we can go with this procedure, if it were not for the limiting factor Rm. Because when Rm is increased above 100,000 the voltage required would have to be very high in order to get 1 ma. through the circuit. For all practical purposes the ranges shown in Fig. 3 are sufficient. It is possible, however, to measure resistance values up to 5 megohms by using Rm = 100,000, and the graph shown in Fig. 4.

The milliammeter used, as stated before, has a 0 to 1 ma. range. The internal resistance of this meter is 27 ohms. In order to obtain a resistance Rm of 10 ohms it is necessary to shunt the 27 ohms with a 16 ohm resistance.

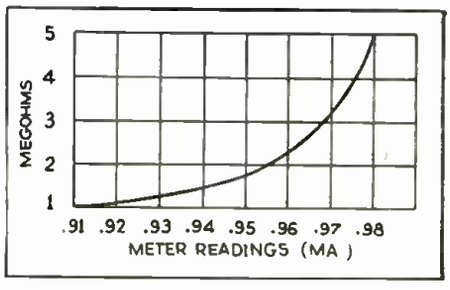
Right, Fig. 2
The D. C. supply for Fig. 1



Below, Fig. 3
Graph; range: 1 ohm to 1 meg.



Below, Fig. 4
Graph; range: 1 to 5 megohms.



The two resistances in parallel are equivalent to 10 ohms and the results obtained are the same as if the internal resistance of the meter was 10 ohms. It is therefore necessary to close Sw.1 when resistors of less than 10 ohms are to be tested. It can also be seen that by shunting the internal resistance of the meter and still keeping the current in the meter at full-scale deflection, the current through the entire circuit will be approximately 2.7 ma. This will require about 300 V. of D.C. instead of a little over 100 V. In order to avoid the necessity of using a higher voltage the 90,000 ohm resistor may be short-circuited by Sw. when the 16 ohm shunt is being used.

Of course if anyone has a meter the internal resistance of which is 10 ohms or less, switches Sw. 1 and Sw. 2 can be eliminated. According to the writer's information, however, no such meter is listed in any of the manufacturers' catalogs.

There may arise in some reader's mind a doubt as to whether the scheme used for obtaining Rm = 10 ohms is mathematically correct—it is! The writer has worked it out mathematically; and for the purpose used, it is exactly the same as if the internal resistance was 10 ohms. The mathematics involved are a little bit complicated. To work it out would require a lot of figuring which is beyond the scope of this article. Any radio enthusiast who would like to work this out for himself, can spend a few interesting minutes in solving this problem.

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A.F. AMPLIFIERS FOR HIGH FIDELITY

Nick Bensussen

AN AUDIO amplifier for the amplification of frequencies up to 10,000 or 15,000 cycles must be much more faithful in frequency response than those designed for 5,000 to 7,000 cycles, which is the usual broadcast range. The question then arises, "How can one design and build an audio amplifier that will be suitable for exceptionally high quality?" There are a number of ways in which high quality may be achieved in an amplifier, and a discussion of the factors involved will be of value, even though the information may not be put to immediate use.

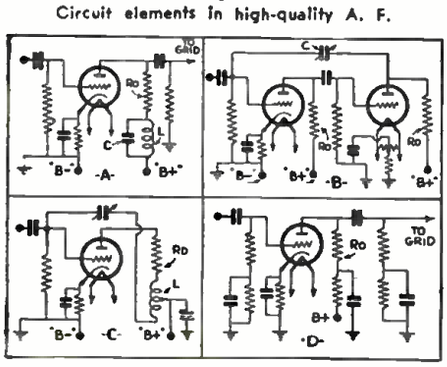
First of all, if flat frequency response is to be had, gain per stage must be sacrificed. It is logical to say that if a tube is to be overloaded or over worked so that it will give its maximum possible gain, it cannot faithfully reproduce all frequencies equally. The first requirement, then, is low gain per stage. This stipulation will require the use of a small load resistance on the tube.

The second requirement is that one must use a small input resistance and a tube that has a small input resistance. This requirement is made so as to bring up the response at the low frequencies.

The high-frequency response is limited by the input or grid-to-cathode capacity of the tube. Therefore, in choosing a tube for the amplifier one must see that it has a small input capacity. Almost all triodes satisfy this second requirement, among which 01A, 37, 56 and the 30 are the most suitable.

The third requirement is the use of a suitable type of amplifier to meet these requirements. Due to the fact that transformer-and-impe-

Fig. 1
Circuit elements in high-quality A. F.



dance coupled amplifiers have bad inductive qualities which prohibit flat frequency response, except where exceptionally high-priced units are used, they are at once eliminated. Direct-coupled amplifiers cannot very well be used because of their instability during operation over a long period of time. The last resort is the resistance-capacity coupled amplifier. This type of amplifier has been very extensively used by many experimenters and found to be the most faithful in the way of frequency response and stability.

Looking at A in Fig. 1, one can see that if L and C are resonated or tuned to either the high or the low frequencies the gain can be raised wherever needed. This is true because when a parallel inductance-capacity circuit is at resonance it offers the greatest impedance to the resonant frequency. Therefore, if L-C is resonated at either the high or low frequencies, there will be the greatest voltage drop across L. This voltage drop will add to that of the drop across R and the gain will therefore be raised.

One can also raise the overall gain of the amplifier by the use of regeneration. Looking at B in Fig. 1, one can see how this is done. Condenser C is used to produce regeneration. The capacity is usually pretty small. Feeding part of the output into the input without causing oscillation naturally will increase the overall gain.

Another idea is to neutralize the grid-to-plate capacity of the tube as shown in Fig. 1C. Eliminating this interelectrode capacity prevents a shunting effect at the high frequencies. The inductance L must be small and have no appreciable capacity effects at the frequencies to be amplified. If the grid-to-plate capacity is eliminated the gain at the high frequency end of the range will be raised.

Every good amplifier should provide a low-impedance path to ground for the signal, in order to raise the response at the low frequencies and prevent "motorboating." The use of bypass condensers for this purpose is illustrated in Fig. 1D.

If these steps are faithfully followed there is no question but that one will have a good audio amplifier in both stability and frequency response because each of these recommendations has been tried and found to be successful in eliminating faults in the construction of high-fidelity amplifiers.

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A TEST KIT FOR ANTENNA SYSTEMS

Roy E. Jessup

THE RADIO Service Man needs a system in his set tester to quickly determine which is the aerial and ground. Something quicker than tracing out long, hidden, and many times twisted leads of the same color. Something quicker than running another, and sometimes long wire to a ground to determine by battery testing, which is the aerial and ground.

I originated my own set tester and installed the A. C. continuity tester illustrated at A in

Fig. 1
Schematic circuits of a novel test unit.

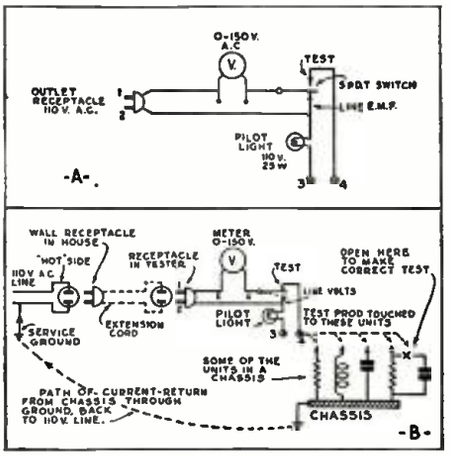


Fig. 1. Terminals 1 and 2 were installed as a small 110 V. outlet receptacle (erroneously shown in the figure as a plug). The meter as I have it, has a 0 to 150 V. A. C. scale. The switch is any S. P. D. T. type. The indicating light is an ordinary 10c, 110 V., low-watt light and is installed under the instrument panel, where its reflections will be seen through jack holes. The test prods are connected to terminals 3 and 4.

Operation of Circuit

In practice the circuit performs as follows: a 110 V. line is plugged into the receptacle represented by the terminals 1 and 2. When the switch is switched to "line E. M. F." the line voltage is read; when the switch is thrown up to test, the meter and light are both in series with the test prods inserted in 3 and 4. In determining the aerial and ground wires, the ground wire is to be tested for. Disconnect the aerial and ground and, taking one of these wires in each hand, touch each of the test prods, one at a time, to it. If there is neither a deflection of the meter, nor a lighting of the light, then try the other wire. If the ground is good, there will be either a deflection of the meter, or a light from the 110 V. lamp. This, then, is the ground wire, and the other is the aerial wire. If the meter gives the ground reading, then the lamp may be made to light by taking out the plug at the receptacle, and turning it over, and reinserting, which reverses the connections. The lamp will then light if the other test prod is used.

The successful practice of the circuit depends, and operates on the ground connection of the lighting system. A meter, or lamp with one side connected to the "hot," or ungrounded wire of the system, will either deflect, or light up, when the other side is connected to ground.

The circuit is not limited to identification of aerial and ground, but has a number of other important functions, if used intelligently.

Additional Uses

Since the meter indicates nearly full-scale when the prods are touched together, and the switch is thrown to "test" position, when continuity testing, rough resistance measurement can be made. When the meter is used to indicate ground, the continuity of coils and resistors connected to ground in the radio chassis, may be determined by placing the prod on the opposite terminal of any unit connected to ground in a chassis, as for example the units represented in the lower right of Fig. 1B. The prod is placed on the upper terminals of the units and a steady deflection will result if the continuity is there. Thus, transformer secondaries, antenna coils, resistors, circuit voltage dividers, and bleeder resistors, that have one side connected to ground, can be tested.

The technician must fully realize that another unit connected in parallel with the unit under test, will give a misleading test. Units which shunt the one under test must have at least one wire disconnected. Resistors, which are bypassed by condensers cannot be accurately tested by this method unless the condenser is disconnected at one end. Condensers of large capacity will give a steady deflection under test on A. C. only, which is a good test to determine whether the condenser is open-circuited. This method cannot be used to check for condenser short-circuit, since a D.C. test is required. However, small capacities can be tested for short-circuit, such as tuning condensers, grid condensers, and others, which do not deflect the voltmeter much when they are not short-circuited. A short-circuit in one of these will give full-scale deflection. The tester must of course disconnect the secondary of the transformer if he tests a tuning condenser; he should observe the same precautions in other instances.

Antenna Tests

The aerial and ground may be tested for short-circuit by placing the test prod on the disconnected aerial wire. A shorted lightning protector, or other shorts, will cause a deflection. The 0 to 150 A. C. meter is sensitive, and a leak from the aerial to ground through the branches of green trees can be detected, as can a leak to ground due to moisture. An open-circuit can be detected in an aerial system, by grounding the far end of the aerial and placing the prod on the aerial wire in the house. Aerial continuity, and short-circuit testing should be made with the aerial disconnected from the set, or a false reading of the meter, through the antenna coil, will result.

HINTS AND KINKS

J. Pilling

PRESSED wood is now available which makes a fine substitute for bakelite. It has a smooth finish, is easily machined, and when ducoed rivals bakelite for appearance.

THE mixture used on the tops of "B" batteries can be dissolved with common duco thinner.

AMATEURS who want the best possible finish for their equipment panels should find the following kink useful. Mount all parts on the panel with countersunk screws, then cover the whole panel with thin tin, such as is used in making furnace pipes and is obtainable at all plumbing shops. Bind it around the corners after cutting through any necessary holes for controls. Duco in black. This leaves the panel free from unsightly bolt heads, and is similar to the method used by Western Electric in their "relay rack" panels.

SOME degree of tone compensation may be had by connecting a suitable resistor from grid to ground of one tube of the push-pull stage in an amplifier. The lower register is reinforced, while one side of the push-pull circuit carries the treble.

EXPERIMENTERS having trouble with condenser mikes should note that the back-plate design has a profound effect on quality. Separation between the plate and diaphragm, holes in the back plate, their number and size and relation to one another, all govern the quality.

LITTLE black wooden plugs such as are used by the telephone companies to plug unused jacks may be used to improve the appearance of that panel which is the worse for rebuilding. They are about right to fit half-inch holes, which is a common size on much-used panels.

OLD telephone fuses make fine insulated bushings and washers.

DULL-FINISH duco paint will give a good finish when applied with a brush. Glossy finish will not.

"SYNTHETIC ECHO" STUDIO

(Continued from page 269)

sound. The crash, rumble, or echo effect has been previously artificially produced by either the orchestra or sound-effect experts. But, heretofore the quality of the program indicated that realism was lacking, unless the broadcast took place from a location with proper surroundings. Now, independent of location, the proper sound effects can be readily and accurately simulated.

Be sure to read the announcement on page 291 . . . it gives complete details about the OFFICIAL AIR CONDITIONING SERVICE MANUAL which is now ready for distribution.

BE sure to turn to page 291 of this issue and get complete details about the OFFICIAL AIR CONDITIONING SERVICE MANUAL which is NOW ready for distribution. It is a book that will add many extra dollars to the pockets of ambitious radio men.

BUILD THIS ALL-WAVE RADIO SET

(Continued from page 299)

List of Parts

One Gen-Ral coil and switch assembly;

Two Gen-Ral 456 kc. high-gain I.F. transformers;

One 3-gang 370 mmf. variable condenser unit (trimming condensers are not necessary);

One 7 x 18 x 3 ins. high sub-base. (preferably aluminum);

Four I.C.A. wafer sockets, 1-6D6, 1-6A7, 1-6F7, 1-41;

One 5 prong socket, for speaker outlet;

One Electrad volume control, 5,000 ohms, with 300 ohm stop;

One Electrad tone control, .5-meg., with switch;

Two Cornell-Dubilier tubular condensers, .01-mf., 600 V. type;

Eight Cornell-Dubilier tubular condensers, .1-mf., 600 V. type;

One Cornell-Dubilier .5-mf. bypass condenser;

One I.R.C. 1 W., 700 ohm resistor;

One I.R.C. 1 W., 3,000 ohm resistor;

One I.R.C. 1 W., 300 ohm resistor;

One I.R.C., 1 W., 250,000 ohm resistor;

One I.R.C. 1 W., 30,000 ohm resistor;

Three I.R.C. 1 W., 100,000 ohm resistors;

One I.R.C. 1 W., 9,000 ohm resistor;

One I.R.C. 1 W., 50,000 ohm resistor;

Two I.R.C. 2 W., 10,000 ohm resistors;

One I.R.C. ½ W., 25,000 ohm resistor;

One I.R.C. ½ W., .5 megohm resistor;

One Jensen dynamic speaker, field 1,800 ohms, tapped at 300 ohms, with matching transformer for 41 tube;

One .0001 mf. bypass condenser (bakelite type);

One .005 mf. bypass condenser (bakelite type);

One antenna and ground binding post assembly;

One D.P.D.T. toggle switch;

Three National Union "skin-tight" tube shields.

Parts for Power Supply

One General Transformer auto "B" supply—vibrator type, using 84 tube, (make a few slight necessary changes, as indicated by comparison of Fig. 1, with the connections of the power supply unit as purchased);

One step-down 110 V. to 6.3 V. transformer, secondary output must be rated *at least* 7.5 A., continuous operation;

Two Cornell-Dubilier 8 mf. (electrolytic) condensers, 600 V. type.

●

"CONVERTING SETS —ECHOPHONE 'C'"

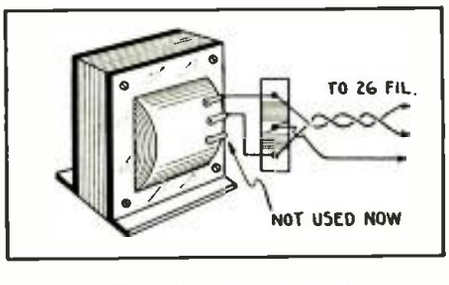
Editor, RADIO-CRAFT:

In the October, 1934 issue of RADIO-CRAFT, pg. 243, is an article by James K. Coates, entitled, "Improving Echophone Model C." This article calls for a schematic diagram referred to in the article as "figure 3," but there was no diagram to be found in the magazine. I would greatly appreciate it if you can supply me with the diagram in the following issue or by separate mail.

I have such a radio set and would like to convert it as described in the article.

VERNON R. HORN.

We apologize to Mr. Horn and to other readers of RADIO-CRAFT who may have been interested in this item. The circuit, accidentally left out of the issue, is shown below.



BOOK REVIEW

LOUD SPEAKERS, by N. W. McLachlan. Published by The Oxford University Press, London, England. Size 6½ x 9½ ins., 385 pages, cloth covers. Price, $13.50.

A highly technical book, well sprayed with involved mathematical formulas for the engineer. It deals exclusively on the subject of loudspeakers.

The first part deals with an analysis of the theoretical problems of design, including the effect of fluid inertia, vibration, the moving coil system, electrostatic loudspeakers, and horns.

In the second part of the book the theory is applied practically to the design and testing of loudspeakers.

While printed in England the book completely covers in the treatment of the subject most of the information published on loudspeakers in America and other countries.

There are 20 chapters, each dealing with various phases of loudspeaker design, testing, and measurement work; a few are as follows: Principles of Sound Propagation, Acoustic Power Radiated from Vibrating Surfaces, Moving Coil Speakers, Electrostatic Speakers, Driving Mechanisms, Magnets, Electrical Impedance Measurements, Response Curves, and Design Considerations in Hornless Moving Coil Speakers.

GATEWAY TO RADIO, by Major Ivan Firth and Gladys Shaw Erskine. Published by The Macaulay Company. Size 5½ x 8 ins., 319 pages, cloth covers. Price, $2.50.

This book is intended for those interested in commercial radio—that is, the entertainment and advertising phases. Anyone associated with the industry, or interested in it will find this book of intense interest and great value.

Chapter headings include: Writing on the Air, Entertainment and Advertising, How Music Aids the Writer, Radio Drama, The Radio Market, Program Building, Recorded Programs and Spot Broadcasting, Radio Studio Production, British Production Methods, The Announcer, The Actor in Radio, Children and Radio, The Engineer, Press Relations, Sales Department, The Sponsor, To the Radio Audience, and finally, The Future of Radio.

SIGNALS AND SPEECH IN ELECTRICAL COMMUNICATION, by John Mills. Published by Harcourt, Brace and Company. Size 5 x 7½ ins., 281 pages, cloth covers. Price, $2.00.

This book is written for non-technical readers interested in the mysteries and complexities of electrical communication. It contains 16 short chapters, entirely free from mathematics and diagrams, which present interesting explanations of various methods of communication. This not only involves radio by telephone, but also includes sound pictures, television and stereophonic reproduction. (Written by the same author is an extremely popular book, "Letters of a Radio Engineer to His Son.")

APPLIED ACOUSTICS, by Harry F. Olson and Frank Massa. Published by P. Blakiston's Son & Company, Inc. Size 6 x 8½ ins., 430 pages, 228 illustrations, cloth covers. Price, $4.50.

This book is an excellent treatise for the sound technician or for the practical physics student who is interested in sound and acoustic engineering. It deals essentially with the design, construction, operation, and analysis of modern acoustical and electro-acoustic apparatus, data and procedure for analyses of rooms, studios and theatres, and the operation of amplifier systems and associated equipment. Information on the latter will particularly appeal to radio men. Individual chapters are devoted to the following radio subjects: microphones (electrical engineering characteristics of each type), loudspeakers (both horn and baffle types), testing of loudspeakers, and electro-acoustic musical instruments.

SOUND—ITS FUNDAMENTALS AND METHODS OF APPLICATION. Published by the Lafayette Radio Manufacturing Co., size 9 x 12 ins., 59 pages, profusely illustrated, paper cover. Price $.50.

Contains considerable fundamental and theoretical information on amplifiers and public address systems. While by no means a comprehensive treatise, the data consists of just the right amount pertaining to various phases of public address work to inform the radio man on that subject.

It is extremely well layed out, printed on excellent coated paper, clear-cut and defined illustrations. Includes a complete description of the numerous amplifiers manufactured by the company publishing the book.

THE INDUCTANCE AUTHORITY. Published by Herman Bernard, New York City. Size 9 x 12 ins., 51 pages, innumerable charts, tables, and illustrative diagrams, leatherette binder. Price, $2.00.

A comprehensive treatise dealing with the subject of inductances. All salient information relative to coil design, calculation, curves; also contains other pertinent data. Excellently written, for the layman and constructor as well as for the more advanced technician. Very handy as a reference book, inasmuch as the numerous charts and curves will permit rapidly determining turns, dimensions, inductance value, or any other characteristic of coils that may be desired, quickly.

(Continued on page 317)

QUALITY FACTORS IN THE MODERN RADIO SET

Roy Manson*

There is so little mechanical wear in a radio set that at first glance one would say, "There is nothing to wear out except the vacuum tubes." This is true of the finer receivers, employing high-quality materials in their construction; unfortunately though the same doesn't hold true for every receiver of the many on the market today.

IN CHOOSING a radio receiver the purchaser's selection is generally based largely upon the appearance, tone and price. Yet there are other factors to consider, hidden in the workmanship and choice of materials, that may not appear in a single listening test—that may not even become apparent until the receiver has been in operation for several months.

Nor does the selection of high-quality parts constitute the final step in the construction of a quality receiver, though there seems to be a common belief that anyone can haphazardly assemble the component parts in a standard circuit and, so long as the parts are expensive, designed to have the lowest losses, etc., the result will be a radio receiver that can be branded as "high quality."

In actual practice so many factors enter into the construction of a genuine "quality" receiver that to go into detail regarding the engineering practices involved in such construction would take a complete volume. In the space allotted for this article only the major points can be covered, and these only in the briefest detail.

While, in the development of a new radio receiver, the cabinet design usually follows actual construction of the receiver chassis, in this article cabinet construction is discussed first—because it is usually the first item taken into consideration by the radio purchaser and because its construction has such a vital influence on tone quality and performance.

Factors in Good Cabinet Design

Faithfulness of tonal reproduction and the response of the speaker to the various tones and overtones of the human voice and of the various instruments used in orchestral work depends to a great extent upon cabinet size. While a small cabinet, such as is used for table model receivers, in many cases reproduces the high notes of the musical scale with excellent fidelity it falls down badly on notes below approximately 200 cycles unless some form of special bass compensation is incorporated into the circuit which will, to some extent, re-enforce the bass response. Obtaining a good balance of bass to treble in this manner is a delicate operation that can quite easily be carried too far, unless complicated and costly measuring instruments are used.

For the finest tone obtainable a large cabinet is far superior and much more satisfactory than the smaller cabinets. A large cabinet is needed as a wall or barrier surrounding the speaker, to prevent the air pushed by the speaker from simply slipping around the edge and coming to rest again. This is especially important for reproducing low bass notes and, within reason, the larger the cabinet the lower the fundamental tones that its speaker can reproduce.

Adequate size alone though is not enough for good tonal balance, to bring out the various harmonics of instruments or the human voice in proper proportion to the fundamental notes. Shape, also, is important to tone. The proper shape for any given speaker or receiver cannot be determined, unfortunately, by any mathematical formula, but requires expensive acoustic laboratory equipment, trained engineers and technique to make over-all "sound pressure" measurements of the tone quality of the chassis and speaker when installed in the cabinet.

Sound pressure measurements, as they are made in the laboratories of one radio receiver manufacturer, furnish an extremely interesting procedure. The audio output power is given in "decibels." (This unit of audio power has been discussed at length in Part I of the [three part] article, "The Theory and Construction of Volume Controls, Line Filters, and Matching Transformers," in the May, 1932, issue of RADIO-CRAFT.)

How Loudspeaker Performance is Checked—Indoors

The loudspeaker, which in first tests is mounted on a large and heavy baffle, and later in the receiver cabinet, is driven by an oscillator of

* Chief Engineer, Stromberg-Carlson Tel. Mfg. Co.

suitable output power capacity. A calibrated condenser microphone is used for picking up the sound.

The greatest acoustic difficulty encountered in making indoor speaker measurements is caused by the reflection of sound from the surfaces of the room. The disturbing effect of this is the formation of a "sound pattern" which shifts about in a complicated manner as the frequency is changed. Thus, a microphone placed in a fixed position would register large changes of sound pressure with frequency "even though the loud speaker were capable of generating a uniform sound pressure over the frequency range in free space." Even in a large room lined with sound absorbing material, one inch thick felt, it is still present at a normal listening distance from the speaker. Low-frequency reflections are particularly difficult to eliminate because of the inefficiency of the best sound absorption materials in this range.

Of course a number of observations could be taken in various parts of the room at each frequency and the results averaged. This, however, would be a slow and tiresome procedure. In the laboratories previously mentioned the equivalent is accomplished by mounting the microphone on a large rotating arm inclined to the axis of the speaker. As the arm rotates the microphone is constantly turned so that it always faces the plane of the speaker. A slow-acting thermocouple meter registers the output of the microphone and because of its relatively slow action gives a fairly steady average reading as the microphone sweeps through the varying sound pressures.

This system is unusually stable in the results it gives which may be repeated over long periods of time with an average deviation of only plus or minus one decibel. The result of speaker and cabinet design changes may thus be accurately studied and recorded.

However, outdoor measurements made under certain conditions give the most accurate results, particularly at the lower frequencies. In order to obtain measurements of high accuracy, acoustical engineers have arranged an interesting outdoor set-up.

Reproduction Tests—Outdoors

In an open field at the rear of the factory, two pairs of tall poles are erected and their tops connected by tightly stretched steel cables. The cables are clamped together in the center of the span where they intersect and from this point the loudspeaker or radio receiver is suspended with the axis of the speaker horizontal and about 35 feet above the ground. The microphone also is suspended from one of the cables at a suitable location with respect to the loudspeaker.

The distance of the loudspeaker from the ground and from buildings is such that errors due to reflection are quite negligible.

To prevent natural resonance of the cabinet from distorting the reception, cabinets of "quality" receivers are of non-resonant constructions, because *in no case is the cabinet supposed to act as a "sounding board" but simply as a barrier around the speaker.* In certain models (as best determined by sound pressure measurements) the bottom as well as the back should be open or vented, to prevent drum-like "cavity resonances." This requires that a sturdy, rigid frame be used, as it eliminates the usual stiffening effect of the cabinet bottom.

Loud speaker efficiency also requires that air be allowed to circulate freely at both the front and back of the speaker unit.

Thus the back should be open or vented, or covered with cloth. Sound absorbent material, if used, should be compensated by other tone characteristics of the cabinet, speaker or chassis, because of the non-uniform effect of all sound absorbent materials to different musical tones.

Still other factors enter into the construction of fine cabinets that, although they have little effect on tone quality and performance, are important because, as a fine piece of furniture, the radio in the American home today is generally the center around which the rest of the living room furniture is grouped.

For instance, one manufacturer devotes a month or more to the construction of each cabinet, the time being consumed principally by a thorough kiln drying of the wood. Ample time is also allowed to permit the glue to completely dry and set while the cabinet is clamped in presses. This procedure eliminates any possibility of warped lids or doors, or checks and cracks such as might develop in poorly seasoned wood.

Fine radio cabinets are finished with a water

stain that soaks deep into the pores of the wood, thoroughly dried before protecting with several coats of lacquer or varnish, and hand-rubbed with pumice stone to a dull gloss finish. This type of finish does not "bloom" (stain does not work its way through the outer lacquer to dry in the air) nor does it flake off.

Having disposed of the cabinet the next item to be considered will naturally be the chassis.

The How and Why of Good Chassis Design

In this unit are found the tuning and amplifying units, the elements which make it possible to pick the voice of a speaker or the tunes of an orchestra playing 3,000 or more miles away from the air—an infinitesimal spark of energy—and amplify it without distortion into a current strong enough to actuate a speaker sufficiently to fill a large auditorium.

Why Copper-Plated Steel is Best

The chassis base of the make of receiver for which the above-described cabinets were designed is rigidly constructed of heavy sheet steel, and heavily copper-plated as a protection against rusting—and to insure good "ground" contacts, as well as good surface conductivity for shielding purposes. After the copper plating process comes a coat of crystalline enamel improving the appearance of the finished set and as further insurance against corrosion which might give rise to parasitic noise producing currents.

This steel base is so rigidly constructed that it is practically impossible to distort its shape or warp it in any manner, through heat dissipated by the transformers or by mechanical jars. Delicately aligned instruments, when mounted upon such a base, will retain their original characteristics indefinitely. Copper-plated steel, aside from its mechanical strength, provides the best shielding material possible to use in a radio receiver as its shielding properties are both *electro-static* and *electro-magnetic*.

Components That May "Age" Quickly

Because a good radio receiver is an expensive instrument it must be so constructed that it will retain its original operating characteristics for years if need be. The tone quality, sensitivity and selectivity should measure up to the same standards after a long period of operation as they did in the final factory test. If cheap or poorly constructed parts are used this cannot be so. From the first day the set is placed in operation, they will begin to deteriorate, due to the effect of heat, chemical change or mechanical wear. This applies not only to filter condensers, but to the voltage dividers, fixed resistors, by-pass condensers, transformers and many small parts. Mechanical wear is also a factor in the design of switches, volume controls, means for turning the tuning dial and the visual tuning indicators.

Sample tests are continually conducted in the laboratories to select or develop reliable parts. This testing is conducted by experienced engineers. When the most efficient type of part has been chosen—and these tests are carried on continually in an effort to improve existing apparatus as well as for the selection of parts for new receivers—each individual unit is again tested before being included in a receiver.

There are so many factors which might contribute to the poor operation of a radio receiver that it is obviously impossible to enumerate them all in this article. Some of them would be almost impossible to locate by any ordinary testing method, and when, after a long period of operation, they became evident by tonal distortion, noise or some other fault would still be extremely difficult to track down.

Transformer Temperature-Rise Limits

For instance, a vital factor in the continued good performance of a radio is *heat*. The Underwriter's laboratories will pass a receiver, the transformers of which do not heat up to more than 55 degrees Centigrade (131° F.). The conservative radio design engineers, though, must specify a heat that does not exceed 50 degrees Centigrade (122° F.), even when the receiver is operated continuously for 24 hours. The reason for this is important.

At a higher temperature, the wax which ordinarily is used to seal transformers and to assist in the rapid dissemination of heat would melt and eventually leak away and, as the wax became less, the heat would increase until it would only be a matter of time until the transformer windings burnt out. Deterioration of insulation,

both in the transformer itself and in any apparatus near enough to be affected, would also result. The effects of the eventual breakdown of this insulation need hardly be recited here.

Moisture-Proofing Essential

A little known requirement of *much importance*, if the radio receiver is to give reliable service, is the moisture proofing of its parts to preserve its sensitivity and selectivity characteristics during weather conditions of fog or high relative humidity, as well as for protection against corrosion and rust.

Many very sensitive receivers that are made without adequate treatment against moisture absorption become practically useless after 2 or 3 days of wet weather. Their sensitive coils and condensers and wires absorb so much moisture from the air as to cause detuning or loss of resonance in the critical circuits, or even temporary short-circuits. Moreover, the sensitivity is likely to stay poor for several days, even after conditions have changed to warm dry weather, until this moisture has thoroughly dried out. In some cases the damage done to the receiver permanently affects its operation.

In the case of good radio receivers, both for the home and auto, the following provisions must be made against moisture absorption.

The treatment of the steel chassis base has been described previously. In this same factory, after the paper filter condensers have been wound all air and moisture is drawn from them in a vacuum chamber, following which they are impregnated and permanently sealed with hot wax. The wire used for connecting the various parts is purchased bare and insulated in the plant. After the silk and cotton has been applied, it is thoroughly waxed. The wires that connect the chassis parts are assembled underneath the base of the chassis into a braided cable. This practice is important for continued stability of the receiver.

Chassis Design vs. Loudspeaker Tone Quality

The tone quality of the radio chassis is important as regards the frequency range of the music reproduced, and many receivers have been improved within the last year by better—"high fidelity"—amplification of the low and high tones to extend the musical range of the instrument. This improvement is especially noticeable in the reproduction of phonograph records, in a combination instrument or in an electric phonograph connected to the phonograph jack of one of these receivers. This extension of the musical range is effective on radio programs as well. As for the flatness or smoothness of the amplification of different tones, this is meaningless as represented in the usual chassis fidelity curve unless the tone quality characteristics of the speaker unit and cabinet are known. Equipment to measure, electrically, the fidelity curve of a chassis can be purchased for a few hundred dollars, but a completely equipped acoustical laboratory, with equipment for making sound pressure or *acoustic* measurements as described previously, is necessary if the actual tonal performance of a receiver is to be known.

The Aligning Procedure Determines Loudspeaker Quality

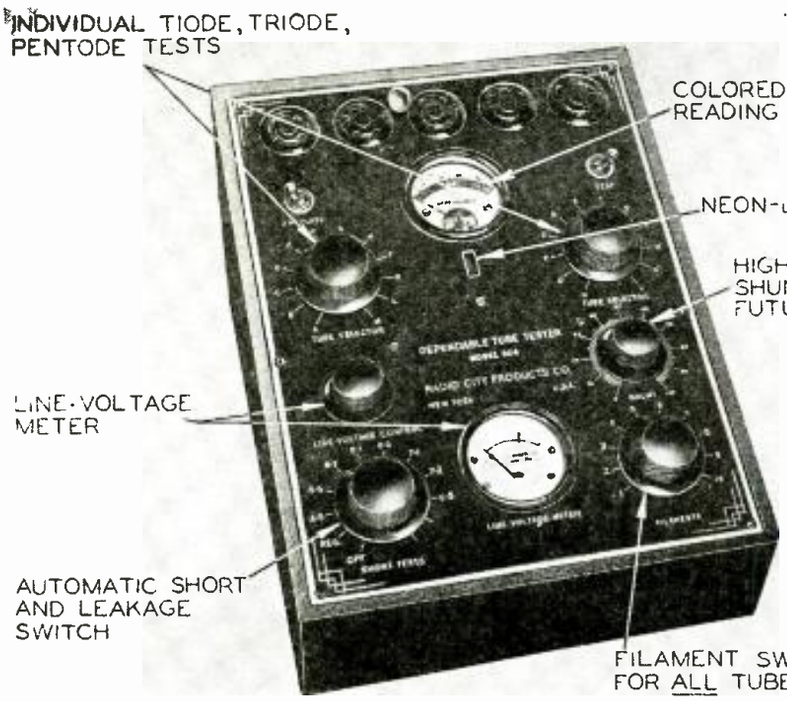
Selectivity, the ability to separate broadcasting stations into their respective channels, is an important characteristic of any receiver, and so deserves some mention. Good selectivity is required to receive clearly a station on the desired channel with its full tone range, and yet to eliminate all interference from stations on adjacent channels.

Absolute 10 kc. selectivity, while it is not difficult to obtain when the adjacent stations on the dial are distant ones with a weak signal is next to impossible to attain when these stations are powerful locals, although claims of such selectivity are sometimes made. The only means of approaching this ideal is by judicious use of individual tuned circuits, each circuit having a rounded selectivity curve. When a number of these are added together algebraically, with their peaks tuned or aligned to the same frequency—the usual manner of aligning with simple oscillators—it results in a highly "peaked" selectivity curve with too sharp selectivity near the peak, impairing the tone, and too broad selectivity at the "tails," allowing powerful stations on adjacent channels to interfere.

The method of alignment used by a few radio manufacturers to overcome this effect results in a curve, that more nearly approaches the ideal. This requires expensive "oscillograph" in-

(Continued on page 317)

- - *ahead of others*
in TUBE TESTER Value



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10 - **ACCURATE D'Arsonval moving-coil meter, guaranteed 2% accuracy.**

11 - **NO ADAPTERS of any kind necessary.**

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The new, Model 304, Dependable Tube Tester establishes a new "high" in test equipment to meet all modern requirements in testing. Simplicity in design and operation permit even the average consumer, who knows very little about radio technicalities, to follow the testing procedure, and to accept without further question the "good" or "bad" evaluation of every tube in the set.

Dependable Model 304—100-135 volts; 50-60 cycles
NET TO DEALERS $19.95
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There is an important economy factor in purchasing a Model 304 Dependable Tube Tester. The instrument is capable of making all essential tests, and, because it is portable, may be taken from store or laboratory and used on outside service calls. In addition it has a handy compartment for small tools.

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A high-quality test instrument. The moving-coil instrument sensitivity is 2,000 ohms per volt. This instrument meets 4 major specifications. Ohm-meter range: ¼-ohm to 2 megs.; individual range: 0-2,000 (ohms)—0.2 (-meg.) -2 (megs.), (batteries, self-contained). Voltmeter range: 0-5-50-250-750 V. Milliammeter ranges: 0-50 ma. Microampere range: 0-500. The automatic selector switch connects the meter only to the desired circuit and range.

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(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.)

QUALITY FACTORS IN MODERN SETS

(Continued from page 315)

struments and trained operators, but the results are noticeably superior, in both tone and selectivity. The resulting curve has a broad top, retaining fine tone, and steep sides indicating better overall selectivity, and can only be accomplished with visual oscillograph instruments.

It is difficult to prescribe accurate earmarks or tests for distinguishing efficient from inefficient types of speaker units because it has been shown of late that the size of the cone and the size of the magnet structure are likely to deceive.

For instance, a large magnet does not necessarily mean a strong magnetic field in the air gap in which the moving coil travels, which is the only place where the magnetic field does any useful work. Measurements taken recently on two speaker units, one of which had twice as much iron and copper in the magnetic structure as the other, showed that the smaller one had 20 per cent more magnetic field strength in the air gap than the larger one! This was simply due to efficient design and prevention of magnetic leakage.

As for the moving cone, the best speakers have cone shaped diaphragms which are 7 in. or more in diameter across the opening, and which are suspended either on embossed creases at the rim of the cone itself (which must be made of grainless paper in this case) or which are suspended on a good grade of flexible bellows leather. Other types of suspension using cheap leather or cloth impregnated with "dope," may harden and crack under the tremendous stress of vibration that speaker units are subjected to, or may become flabby with age. By taking sound pressure measurements on every individual reproducer before it leaves the factory, all these faults in construction show up at once, whereas, in sets made to the low standards of "cut price" merchandise, only inadequate tests can be made, and the faulty set quickly gets into the hands of the consumer.

From this analysis we see that a tremendous amount of money is spent on radio sets of *good* manufacture, with most of this expenditure being invisible to the consumer. Only Father Time can prove that "cheap" sets are expensive!

●

BOOK REVIEW

(Continued from page 311)

HANDBOOK OF TECHNICAL INSTRUCTION FOR WIRELESS TELEGRAPHISTS (Fifth Edition), by H. M. Dowsett, published by Iliffe & Sons, London, England. Size 5 x 8½ ins., 572 pages, profusely illustrated, stiff paper binding. Price approximately $3.75.

While the book was written essentially for radio enthusiasts in England who desire to become commercial operators, nevertheless the information contained within it will be found to be extremely helpful to the American amateur whose tendencies are similarly inclined.

New chapters, which have been added to this revised edition, concern improvements and more up-to-date equipment, such as, constant frequency oscillators, echo oscillators, and data concerning short-wave marine transmission and reception.

PRINCIPLES OF PUBLIC ADDRESS SYSTEMS, by M. N. Beitman. Published by Supreme Publications, Chicago, Illinois. 8 x 11 ins., 16 pages, few illustrations (diagrams), paper cover. Price $.50.

While the book contains some highly informative data for P.A. men, nevertheless the information is compiled mostly from manufacturers' pamphlets that may be obtained free of charge by anyone writing direct for them. This fact coupled with the exceedingly few pages contained within the book seems to indicate that the price is much too high for a compilation of that sort. It is this magazine's belief that the subject of public address systems is of such a nature as to warrant considerable more data than can be included within 16 pages, if it is to be covered thoroughly. Evidently the book was written with a view towards publicising an associated sound company.

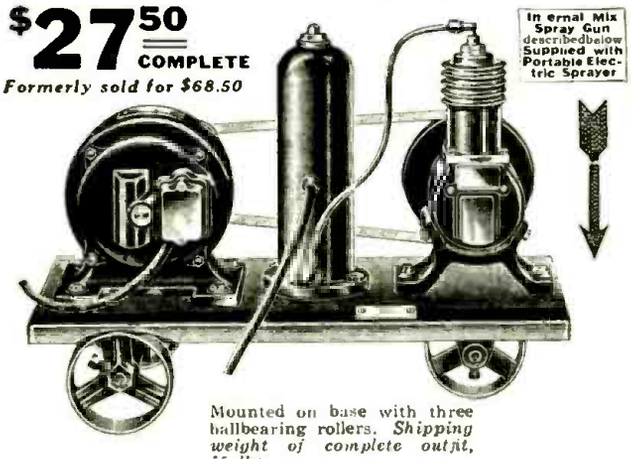
BARGAINS

All Merchandise Offered On Page Is Absolutely New And Unused

Electrical Portable Sprayer Outfit

$27.50 COMPLETE

Formerly sold for $68.50



Mounted on base with three ballbearing rollers. *Shipping weight of complete outfit, 55 lbs.*

This is the ideal outfit for all-around spraying work wherever current is available. With this electric sprayer you can spray paint, varnish, duco, enamel, lacquer, insecticides, etc., with speed. You can move it from one room to another with ease. Simply insert plug into electric socket and this marvelous machine is ready to do a man-size job—and do it efficiently.

This electric portable sprayer saves its cost over and over again on your own work. It will make money for you doing jobs for others.

Outfit equipped complete with Internal Mix Spray Gun, with quart aluminum cup, which enables you to obtain round or fan spray, ¼ H.P. heavy duty motor, 110-volt, 60-cycle AC, air filter, safety valve, Kellogg Air-Cooled Compressor, 1¾x1¾, 15 feet of hose, cord and plug.

Price of complete outfit with gun, $27.50

Price of outfit without motor, $20.00

Internal Mix Spray Gun

This Pressure Type Internal Mix Spray Gun Is the Finest Value on the Market. It Embodies the Seven Following Outstanding Features

1. Hardened steel paint valve needle and nozzles, to resist the cutting action of abrasives in paint.
2. Quart capacity aluminum cup with concave bottom to resist high pressures—very light and durable.
3. Air control (shown on top of gun, just back of the nozzle) gives instantaneous control over the "wetness" of spray.
4. Positive material control (shown at back of gun, above handle).
5. New type construction of cup cover allows instant removal for cleaning or for attaching a paint hose to the gun.
6. Latest type handle—"fits the hand."
7. Two-finger trigger.

In this gun the material is forced up to the nozzle under pressure, properly mixed within the nozzle and discharged, perfectly atomized, in a fan-shaped spray 6 to 12 inches wide. One hardened steel nozzle for round spray also furnished with gun.

Shipping Wt. 3 lbs.

$7.50

Filter Tank $4.25

Complete with tank, gauge and 60 lb. safety valve

Compressed air filter and expansion tank, equipped with gauge and safety valve. Has standard taps in tank and base ready to install. Eliminates oil and moisture.

Same as illustrated in Electric Portable Sprayer Outfit shown above.

Shipping weight 8 lbs.

Kellogg Air-Cooled Compressors

Same as Illustrated in Electric Portable Sprayer Outfit shown above.

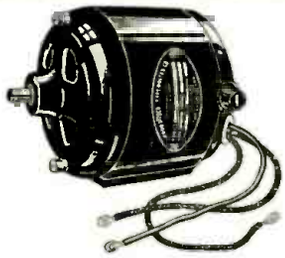
Size	Maximum Pressure	Speed	Motor Required	Price
1¾ x 1¾	75 lbs.	600	¼ H.P.	$7.50
1⅞ x 2	100 lbs.	600	¼ H.P.	9.00
2 x 2	125 lbs.	600	1/3 H.P.	10.50
2¼ x 2	175 lbs.	500	1/3 H.P.	12.50

Shipping weight, 12, 13, 14, and 18 lbs.

G. E. MOTORS

These Motors were manufactured by the General Electric Company and originally intended for use by a large manufacturing company.

Here are the specifications: 1/30 h.p.—4800 R.P.M. Universal A.C. and D.C. 110 volts instant reverse. Size: Diameter 3 inch, length 5 inch. **Shipping weight, 3 lbs. Add 25c for special packing and mailing anywhere in U.S.A.**



$2.45 EACH

WHILE THEY LAST.

Original Price $12.00

HEAVY DUTY Electric Drill 3/8 in.

$14.95

Shipping weight, 7 lbs.

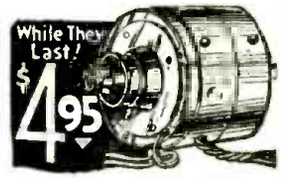
SPECIFICATIONS

WEIGHT—6 pounds, perfect balance.
CAPACITY—⅜ inch.
MOTOR—Westinghouse Universal, specially constructed for this drill, 110 volts, DC, or 60 cycle, AC.
BODY—Aluminum.
FREE SPEED—2,000 revolutions per minute. Full load speed, 850 RPM.
GEAR REDUCTION—7⅔ to 1.
BUSHINGS—Special high-grade bronze.
GEARS—Nickel alloy steel and high-grade bronze.
VENTILATION—Forced, around field and armature.
SWITCH—Normally open, quick break. Designed for this drill. Approved by Underwriters.
CHUCK—⅜ inch—keyless.
LENGTH—Over all, 12 inches. All parts interchangeable.
Equipment complete with chuck, 7-foot rubber-covered cord and steel-armored, unbreakable attachment plug.

Westinghouse Power Generator

Manufactured by Westinghouse for U. S. Signal Corps.

Built-in commutator takes off the generated D. C. Three leads extend through the casing to permit a 4½ V. flashlight-type battery to be switched into circuit for starting, and to control the A.C. output. Rotated at its normal speed of 4,500 r.p.m., the output is 200 W., at 115 to 125 V. (on open circuit), 900 cycles. The rotor turns in ball bearings. Shaft length (driving end), 2 ins.; diameter 9/16-in.; the end is threaded for a distance of ⅝ in. Base dimensions exclusive of the shaft, 4½ x 6¼ in. in diameter. Guaranteed new and perfect.



Shipping weight, 13 lbs.

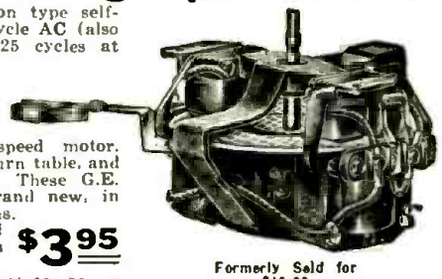
Here is what one of our customers writes:

"These generators are being used in a small fishing village, where the only current is supplied from a 2K.W.-D.C. generator.

"As it was impossible to use A.C. sets and especially my short wave transmitter using two 45 tubes, one of the generators is used to supply my two A.C. receivers and the other to supply power for the transmitter. Both generators are run by a ¾-horsepower motor. These generators perform perfectly and have been absolutely trouble free. The voltage and current regulation is remarkably stable, taking a considerable overload."—(Name supplied on request.)

G. E. Phonograph Motor

Varinble speed induction type self-starting, 110 volt, 60 cycle AC (also furnished in 50 and 25 cycles at same price) with lever control. Speed range from 5 to 200 RPM. Can be installed in place of old-fashioned, hand-winding speed motor. Also ideal for display turn table, and a hundred other uses. These G.E. Electric Motors are brand new, in original factory cartons. Complete with speed regulator (not shown in above picture).



$3.95

Formerly Sold for $15.00

When ordering state if 60, 50, or 25 cycles.

Shipping weight, 11 lbs.

WELLWORTH TRADING CO. RC—1134
560 West Washington St., Chicago, Ill.

I enclose $..... for which please send me the following:

.....

.....

Name .....

Address..... City..... State.....

ORDER FROM THIS PAGE

Since We Do Not Publish Any Catalog

Remit by check or money order for full amount of each item—shipped by express collect, if no money for P.P. enclosed. No C.O.D. order accepted. Money refunded if not satisfied. Be sure to state shipping point if express or freight office is not in your town.

WELLWORTH TRADING CO.

560 West Washington St. Chicago, Ill.

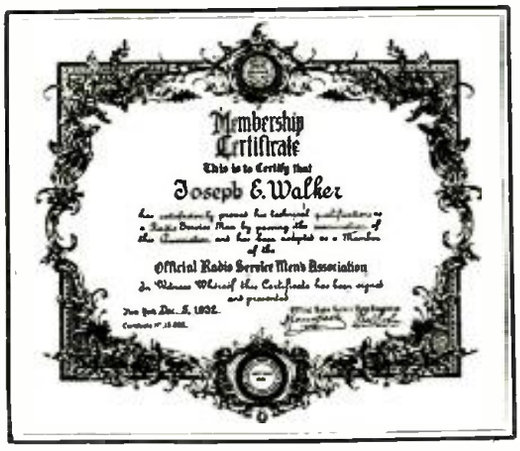
SERVICE MEN'S ESSENTIALS FOR ALL MEMBERS OF THE ORSMA

WHAT ARE THE SERVICE MEN'S ESSENTIALS?

THE OFFICIAL RADIO SERVICE MEN'S ASSOCIATION has arranged to supply a number of "Service Men's essentials" for its members and associate members only.

These essentials are priced at cost, plus a small additional fee which is the only source of income that the Association has. No one obtains any profit or benefit, except the Association itself. Whatever profit accrues, is reinvested for the furtherance and enlargement of the Association.

By using the letterheads, billheads, etc., you present the business-like appearance to your customers. In addition, the Association has made arrangements with most of the prominent manufacturers to allow special discounts to members, providing ORSMA letterheads are used when ordering.



No. 14—50c each
(Plus 10c for Postage)

No. 1 ORSMA LETTERHEADS

These letterheads, shown on the right, are furnished with your name, address and telephone number. Printed on excellent paper. They are sold in lots of 100 or multiples thereof, with a distinct saving for single orders of 1,000 or more. Per 100, 60c; per 1000, $3.00.

No. 2 ORSMA ENVELOPES

These are furnished to match the letterheads, printed with your name and address and seal of the Association. They go hand in hand with the letterheads and are usually ordered in the same quantity. Per 100, 60c; per 1000, $3.00.

No. 3 ORSMA SERVICE RECORD CARDS

These serve a double purpose; whenever you complete a job you fill out the report-bill and hand it to the customer; this is the "psychological moment" to collect. By the use of carbon paper a permanent record is kept. Furnished with name, address and telephone number. Per pad of 50, 60c; per 10 pads, each of 50, $3.00.

No. 4 ORSMA INSPECTION LABELS

The label is to be filled in with the proper dates, and pasted inside the set or cabinet where the customer will see it. It is a continuous reminder to him that when service is needed, he can call you again. The advantage is apparent. Per 100, 60c; per 1000, $3.00.

No. 5 ORSMA LAPEL BUTTON

At the suggestion of many members a handsome lapel button bearing the name and emblem of the Association has been designed. It signifies that you belong to the ORSMA; and in addition it gives your customers a better appreciation of the professional nature of your work. 50c each.

No. 6 ORSMA BUSINESS CARDS

These are furnished on a fine grade of paper in two colors with a blotter back. Thus they present an incentive to customers to keep them in a prominent place. They are printed with your name, address and telephone and bear the official seal of the Association. Per 100, 75c; per 1000, $4.00.

No. 5—50c each

Nos. 9 & 10 ORSMA EMBLEM CUTS

These cuts for printing, advertising, etc., are furnished in two styles and sizes. They may be used for newspaper or telephone-book advertisements or for printing of any kind. Large size, 1¾ x 1¾ in., $1.35 each; small size, ¾ x ¾ in., $1.20 each.

No. 11 MEMBERSHIP SIGN

A set of three signs, printed on heavy cards, and having holes punched in order to hang in office or store. These are sold to members and associate members. Large enough to be quite prominent and the two tone effect makes them attractive. Set of three, 50c

No. 12 ORSMA ADVERTISING DISPLAY SIGN

A two color sign printed in large letters with your name, address and telephone, with the seal of the Association. This sign is sold in quantities of 25 or more and is ideal for hanging in stores, offices, etc., for advertising purposes. Set of 25 cards, $3.00.

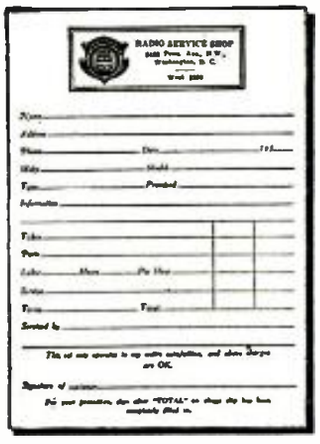
No. 13 RADIO SERVICE MEN'S ASSORTMENT PACKAGE

This includes one gold filled lapel button, 100 letterheads, 100 envelopes, 50 service record cards, and 100 labels printed with your name and address as described above. The whole assortment costs only—$3.00—a worth-while saving. Complete, $3.00.

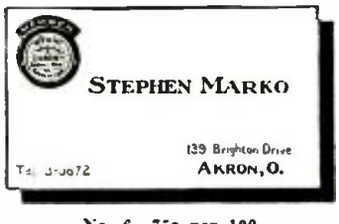
No. 14 ORSMA MEMBER CERTIFICATE

A handsome diploma-like certificate engraved on stiff vellum-bond. The certificate is personally signed by the President and Executive Secretary and the corporation stamp of the Association is impressed on a red seal attached to it. Your name, certificate number and date of registration are lettered by hand and the Certificate is mailed in a card-board tube to insure safe delivery. Each 50c, plus 10c for postage.

No. 1—60c per 100
$3.00 per 1000

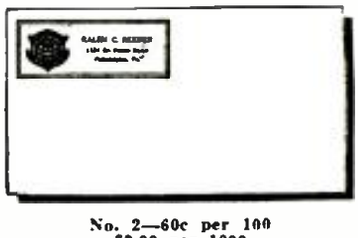


No. 3—60c per pad of 50
$3.00 per ten pads, each of 50



No. 6—75c per 100
$4.00 per 1000

No. 4—60c per 100
$3.00 per 1000



No. 2—60c per 100
$3.00 per 1000

Application for Membership in ORSMA

Executive Secretary, ORSMA
99 Hudson Street, New York, N. Y.

Kindly send an application blank for
☐ Full Membership
☐ Associate Membership

Name .....

Street or Box .....

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

RC-1134

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION

RC-1134

99 Hudson Street, New York, N. Y.

Please send me the following RADIO SERVICE MEN'S ESSENTIALS which I have selected from this advertisement. My remittance for $..... is enclosed. *Send remittance in form of check or money order. Register letter if it contains cash, currency or unused U. S. Postage Stamps.*

.....

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Name ..... ORSMA No. .....

Address ..... City and State .....

RTC's Big November SPECIALS

YOUR DOLLAR— IS WORTH MORE

When You Buy From Us

Is the dollar inflated? These days everybody is speaking of inflation, but why worry about it, whether the dollar is inflated or not it is worth more when you buy from us. **The prices shown on this page are so radically low that no one can possibly undersell them.** Our consistent advertisements present to you each month, on this page, certain **STAR (*)** items which are not listed in our regular catalog. These are all specials of which the small quantity on hand does not permit us to catalog them. **ONCE SOLD OUT NO MORE CAN BE HAD AT ANY PRICE. ORDER TODAY—NOW.** Order direct from this page and save money. 100% satisfaction guaranteed on every transaction.

We are a wholesale house and cannot accept orders for less than $3.00. If C.O.D. shipment is desired, please remit 20% of the total amount of your order. Balance will go forward C.O.D.

If full cash accompanies your order deduct 2% discount. Send money order, certified check or U. S. stamps.

Be sure to include sufficient extra remittance if order is to be shipped via parcel-post; any excess will be refunded.

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RADIO and Short Wave TREATISE

—

108 Pages 1500 Illus.

Completely revised and enlarged, this new 1934 edition contains 108 solid pages of useful radio information, diagrams, illustrations, radio kinks and real live radio merchandise. It contains more valuable radio information—**more real live "meat"**—than many text books on the subject. **PARTIAL LIST OF CONTENTS:** Fundamental Principles of Radio for the Beginner. Chapter 2—Fundamental Circuits and Uses of New Tubes—Revamping Six-Volt Battery Sets for Two-Volt Tubes—Public Address Systems—How to Build Short-Wave Transmitters and Receivers—Up-to-Date Tube Chart and Socket Connections, etc., etc. WRITE TODAY—Enclose five cents (coin) for postage. Treatise sent by return mail. Print name and address clearly on request.

BIG 8-TUBE SET BARGAIN

★*Complete with 11" Dynamic Speaker*

NEW FULL-VISION AIRPLANE DIAL

Limited Supply

only **$15.95**

Not a Midget!- but a full-sized **CONSOLE CHASSIS**

"THE GREATEST SET BUY IN AMERICA" is by all means a mild description of the value which we are offering here. This very same 8-tube receiver as recent as eight months ago, sold for more than $95.00, yet now, because of the advent of even later type tubes, you can purchase this receiver for only a small fraction of that price. The tubes employed in this set are still comparatively new; and not only that, but all modern features such as 2A5 parallel output, tone control, phonograph attachment provisions, full dynamic speaker, etc., are incorporated.

The selectivity and sensitivity of this 8-tube receiver, due to its **4 tuned stages**, are just as sharp as those of an 11-tube superheterodyne. The construction of the set is best described as "standard," for its circuit is none other than the "good old stand-by" T.R.F. type modified and improved to use these later type tubes. It incorporates 3 stages of tuned R.F. amplification, using type 58 triple grid tubes; followed by a 56 detector. From there the signal is amplified by a type 56 first audio tube, and from there still further amplified by the powerful push-pull 2A5 power output tubes. By the time the signal comes out of these tubes, it is **strong enough to operate 4 or 5 dynamic speakers very easily, and many** times that number magnetic speakers. A type 80 full-wave rectifier is employed. All provisions for supplying field power to the 11" genuine Oxford dynamic speaker, is incorporated.

Tuning is extremely simple and very sharp, being comparable to the tuning of a superheterodyne receiver. A new type full-vision airplane dial is employed. The three controls on the front of the chassis consist of tuning knob, tone control knob and volume control, respectively. The chassis itself is made of heavy steel, beautifully black enameled. All tuned circuits are thoroughly shielded, including the tubes and condensers. This prevents feedback, whistling and howling. The use of 4 tuned circuits employing the new triple grid, screen grid tubes and high gain R.F. transformers, together with careful wiring and by-passing, results in extremely high sensitivity. Many of our satisfied customers inform us that a good variety of distant stations come in regularly like locals. And why shouldn't they, for 4 tuned stages is more than what even more recent sets are employing, and everyone knows that the more tuned stages you have the greater is the sensitivity and particularly the selectivity of a receiver. Tone quality, too, is extremely fine and can be controlled to suit the individual, from very high treble down to deep bass.

Here is an opportunity for wide-awake servicemen to "clean up." **There are little more than 150 of these excellent chassis available, hence "first come, first served."** Judging by the rapidity with which our "Peerless" receivers sold a few months back, when we had a sale on them, the supply of these considerably superior receivers will not hold out very long. The moral is, "Don't delay, order today." Overall size of chassis, 15½" x 11" x 8½". Shipping weight, 40 lbs.

List Price $95.00

No. 2000N—8-Tube T.R.F. Receiver, Including Dynamic Speaker But Less Tubes YOUR PRICE $15.95

TUBES: 3 58's, 2 56's, 2 2A5's, 1 80.....$6.30

FAMOUS "19" TWINPLEX KIT

For Short-Wave Foreign Reception

15-550 Meters

Economical 2-VOLT OPERATION

ONLY $4.90 with Earphone and Two Plug-in Coils Less Tube

The TWINPLEX is **ACTUALLY A TWO-TUBE SET;** yes, we repeat, A FULL-FLEDGED TWO-TUBE SET AT THE PRICE OF A ONE-TUBE SET.

JUST IMAGINE, TWO TUBES IN ONE GLASS ENVELOPE. That is the story of the new "19" tube. It is a 2-volt tube, which has a **DOUBLE SET OF ELEMENTS.** The "19" TWINPLEX is available **ONLY** in kit form. Shipping weight 5 pounds.

No. SW-306 Famous Twinplex Short-Wave Receiver Kit with all parts **INCLUDING SINGLE HEADPHONE AND BAND**—But no tube **YOUR PRICE $4.90**

No. SW-309 Complete Accessories for TWINPLEX Receiver, Comprising 1 Type "19" Tube, 2 No. 6 Dry Cells, 2 45-volt "B" Batteries. Shipping weight 20 pounds. **YOUR PRICE $3.50**

Additional Plug-in Coils for the 20, 80 and 160 meter bands—45c each.

PHOTOPHONE-TYPE Theatre Dynamic

ONLY $17.90

15" Cone—18 Watts

A photophone-type dynamic speaker capable of handling up to 18 watts, undistorted, and having a top "push" test of 25 watts. Ruggedly constructed, with chamois-floated, 15" corrugated cone and Granoflex three-point outside spider. The **heavy duty** field alone weighs 8½ lbs. The entire net weight of speaker is 35 lbs. The speaker reproduces all audio frequencies without discrimination. This is the first time that a photophone-type dynamic reproducer is being offered for less than $15.00. Its original list was $100.00. The speaker is available with any desired field specifications including the 6-volt type. Does not include output transformer. Shipping weight 40 lbs.

No. L-1 Photophone-Type Dynamic Speaker **YOUR PRICE $17.90**

3-STAGE 20-WATT CLASS "B" KIT

★

Save $8.00 Assemble It Yourself

No. 46K Kit less tubes **$29.90**

No. 46W Wired, less tubes **$37.90**

Here is a splendid opportunity to buy a real, professional amplifier at a substantial saving. There are only 20 of these fine public address units available—all in kit form. Assembly, with the aid of simple instructions, is a simple matter. However, we'll build it for you, if you wish, at charge of $8.00. You save that amount if you assemble it yourself.

The amplifier uses 1-57, 3-46's and an 82 rectifier. Input to grid of 57; output impedance 4000 ohms. Ship. wt. 45 lbs. **For 110 volts A.C.**

RADIO TRADING COMPANY, 97 Hudson Street, N.Y.C.

FREE

THE BIGGEST-LATEST-MOST COMPLETE 1935 RADIO CATALOG

192 PAGES of RADIO BARGAINS

OVER 50,000 ITEMS

B·I·G S.W. SECTION

GREAT P.A. DEPARTMENT

NEW REFRIGERATION DEPARTMENT

ALL NATIONALLY KNOWN LINES

A Bargain Book of 192 Pages that will SAVE YOU MONEY

THIS amazing new 1935 Radio Catalog is the last word . . . the greatest Bargain Book of Radio ever published by us or any other company. There are more pages, more items listed, more nationally known lines, more Specialized Departments. Over 50,000 items have been assembled in this great 192 page book to make it the outstanding book of the Radio Industry.

There is a Special Department on the latest Broadcast and All Wave Receivers from 2 to 10 tubes. You'll find an entirely new Department on REFRIGERATION PARTS and accessories . . . a new money-making field for Servicemen. A whole section on PUBLIC ADDRESS is the most complete and all-inclusive thing of its kind.

Then there is our matchless SPECIALIZED SHORT WAVE DEPARTMENT which in itself is a complete catalog listing everything the Ham, Brasspounder and Experimenter will ever need. Sets, Kits, Transceivers, Pre-selectors, Converters, as well as other Short Wave parts and accessories. Practically every nationally known manufacturer is listed here. The complete list reads like a Who's Who of Radio . . . and everything is at LOWEST WHOLESALE PRICES!

For 13 years the "WHOLESALE" catalog has been the Serviceman's "Bible." Today the greatest Radio Catalog ever printed — backed by the resources of the greatest organization of its kind in the world — is yours for the asking. *Get yours today!*

ALL-STAR S.W. Kit

ALL-WAVE Superheterodyne

Build it yourself! This revolutionary sensation in the Short Wave Field was designed by 8 leading manufacturers. All of their experience in designing and manufacturing has gone to make this a Superhet that outperforms anything of its kind! Features that guarantee good foreign reception include: Continuous Band Spread, 10 to 500 Meter Tuning Range, 6 tubes, Pre-adjusted Coils, etc.

Be sure to write for complete circuit diagrams, parts list and data sheet . . . FREE!

Lafayette "19" Transceiver for 5 m. communication

A new Transceiver that really gets out and lets you do things. One of the most powerful portable units ever offered in this class. Using a type 19 tube in a p.p. oscillator, it has a power output of approx. 2 watts (about 10 times the power of units in this class). More than enough output is obtained for speaker operation if desired.

The Lafayette "30" is similar to above, except that it uses a type 30 tube as the oscillator for transmitting with type 33 pentode as modulator providing a strong signal that is clearly understood.

Both models were developed after research in both laboratory and field. Entirely self-contained. Weight but 26 lbs. complete with batteries. Write for complete information.

WHOLESALE RADIO SERVICE CO. INC.

Main Office and Warehouse

100 SIXTH AVENUE • NEW YORK, N.Y.

Serving the South and Southwest
430 W. PEACHTREE ST. N.W. • ATLANTA, GA.

Serving Northern New Jersey
219 CENTRAL AVE. • NEWARK, N.J.

WHOLESALE RADIO SERVICE CO.
100 Sixth Ave., Dept. C-114
New York, N. Y.

- ☐ Send me your new 1935 Catalog No. 56.
- ☐ Send me free data on the All-Star Kits.
- ☐ Send me free details on the Lafayette Transceiver.

Name .....

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