A GERNSBACK PUBLICATION

RADIO'S LIVEST MAGAZINE

Special RADIO SHOW Number

Radio-Craft

HUGO GERNSBACK Editor

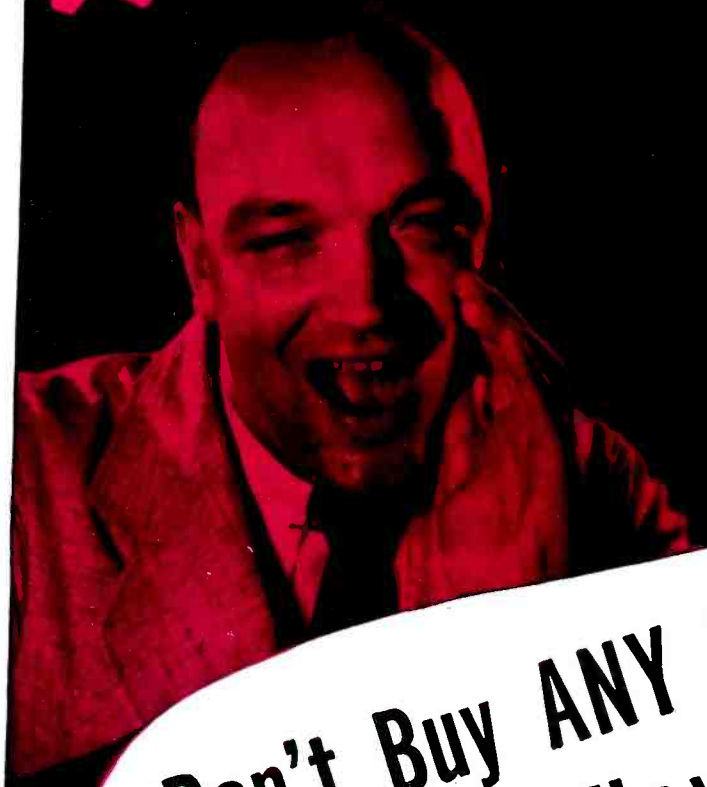
October
25 Cents
in Canada 30 Cents

THE NEW RADIO SETS—See Page 202

New Radio Sets — New Test Equipment — New P. A. Apparatus — 16 New Tubes!
How to Make a "Bass-Booster" — Beginner's Pocket Set — Q-Test Adapter.

OVER 175 ILLUSTRATIONS

Watch FOR NEW 1937 SUPREME TESTING EQUIPMENT!



"Don't Buy ANY Radio Test Equipment Until You Have Seen the NEW 1937 SUPREME LINE."

Your Parts Jobber

NEW INSTRUMENTS

NEW FEATURES

A NEW IDEA IN METERS

You can buy any SUPREME Instrument on S.I.C. easy terms!

SUPREME INSTRUMENTS CORP. GREENWOOD MISS., U. S. A.

EXPORT DEPT., ASSOCIATED EXPORTERS CO., 145 W. 45th STREET, NEW YORK, N. Y., CABLE ADDRESS: LOPREH, N. Y.

SEE THE NEW SUPREME MODELS ON DISPLAY AT THE IRSM SHOW IN NEW YORK CITY!

Radio-Craft
FOR THE SERVICE MAN · DEALER · RADIOTRICIAN

Special RADIO SHOW Number

CONTENTS - OCT., 1936, ISSUE

Volume VIII Number 4

SPECIAL RADIO VOCATION NUMBER

What are the possibilities of making a living in one of the diversified branches of radio or electronics? Is it advisable to try to break into radio, as a business, NOW? In what branches of radio are the probabilities for success best? These and many other vital questions are answered in November RADIO-CRAFT on the newsstands October first. Don't miss this issue!

HUGO GERNSBACK, President I. S. MANHEIMER, Secretary
Published by Continential Publications, Inc. Publication office: 29 Worthington Street, Springfield, Mass. 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.

European Agents:

London—Gorringe's American News Agency, 9A Green St., Leicester Square, London, W. C. 2.
Paris—Messageries Dawson, 4 Rue Faubourg, Poissonniére, Paris, France.
Australian Agent: McGill's Agency, 179 Elizabeth St., Melbourne.

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

I WILL TRAIN YOU TO START A SPARE TIME OR FULL TIME RADIO SERVICE BUSINESS WITHOUT CAPITAL

J. E. SMITH
President
National Radio Institute

The man who has directed the home study training of more men for the Radio Industry than any other man in America.

HERE ARE A FEW EXAMPLES OF THE KIND OF MONEY I TRAIN MY MEN TO MAKE

EARNED $50 FIRST MONTH IN SPARE TIME

"I knew nothing about Radio. After four lessons I began servicing Radios, earning $50 the first month. Last winter I made as high as $100 a month in spare time."—G. F. WALTON, 808 West Olney Road, Norfolk, Va.

OWN BUSINESS PAYS $300 A MONTH

"I now have my own Radio business which shows three hundred dollars a month profit—thanks again to National Radio."—FRANK T. REESE, 39 N. Felton St., Philadelphia, Penna.

CHIEF OPERATOR IN BROADCASTING STATION

"When I completed 20 lessons, I obtained my Radio Broadcast Operator's license and immediately joined Station WMPC, where I am now Chief Operator."—HOLLIS F. HAYES, 85 Madison St., Lapeer, Mich.

Get My LESSON on Radio Servicing Tips FREE

I'll prove that my Training gives practical, money-making information, that it is easy to understand—that it is just *what you need* to master Radio. My sample lesson text, "Radio Receiver Troubles—their Cause and Remedy," covers a long list of Radio receiver troubles in A.C., D.C., battery, universal, auto, T. R. F., super-heterodyne, all-wave, and other types of sets. And a cross reference system gives you the probable cause and a quick way to locate and remedy these set troubles. A special section is devoted to receiver check-up, alignment, balancing, neutralizing and testing. Get this lesson *Free.* No obligation.

MAIL COUPON NOW

The Tested WAY to BETTER PAY

Do you want to make more money? The world-wide use of Radio has made many opportunities for you to have a spare time or full time Radio service business of your own. Three out of every four homes in the United States have Radio sets which regularly require repairs, servicing, new tubes, etc. Many sets are old and will soon be replaced by new models. I will train you at home in your spare time to sell, install, service, all types of Radio sets—to start your own Radio business and build it up on money you make in your spare time while learning. Mail coupon for my 64-page book. It's Free—it shows what I have done for others.

Many Make $5, $10, $15 a Week Extra In Spare Time While Learning

Practically every neighborhood needs a good spare time serviceman. The day you enroll I start sending you Extra Money Job Sheets. They show you how to do Radio repair jobs that you can cash in on quickly. Throughout your training I send you plans and ideas that have made good spare time money—from $200 to $500 a year—for hundreds of fellows. My Training is famous as "the Course that pays for itself."

There's a Real Future in Radio for Well Trained Men

Radio already gives jobs to more than 300,000 people. In 1935 over $300,000,000 worth of sets, tubes and parts were sold—an increase of 20% over 1934! Over 1,100,000 auto Radios were sold in 1935, 25% more than in 1934! 22,000,000 homes are today equipped with Radios, and every year millions of these sets go out of date and are replaced with newer models. Millions more need servicing, new tubes, repairs, etc. Broadcasting stations pay their employees (exclusive of artists) more than $23,000,000 a year! And Radio is a new industry, still growing fast! A few hundred $30, $50, $75-a-week jobs have grown to thousands in less than 20 years.

Get Ready Now for Your Own Radio Business and for Jobs Like These

Radio broadcasting stations employ engineers, operators, station managers and pay up to $5,000 a year. Spare time Radio set servicing pays as much as $200 to $500 a year—full time jobs with Radio jobbers, manufacturers and dealers, as much as $30, $50, $75 a week. Many Radio Experts own and operate their own full time or part time Radio sales and service businesses. Radio manufacturers and jobbers employ testers, inspectors, foremen, engineers, servicemen, paying up to $6,000 a year. Radio operators on ships get good pay and see the world besides. Automobile, police, aviation, commercial Radio, and loud speaker systems are newer fields offering good opportunities now and for the future. Television promises to open many good jobs soon. Men I have trained are holding good jobs in these branches of Radio. Read their statements in my 64-page book. Mail the coupon.

I Send You Special Radio Equipment to Give You Practical Experience

My Course is not all book training. I send you special Radio equipment and show you how to conduct experiments and build circuits which illustrate important principles used in modern Radio receivers, broadcast stations and loud speaker installations. I show you how to build testing apparatus for use in spare time work from this equipment. You work out with your hands the things you read in the lesson books. My Free Book tells you about this 50-50 method of training—how it makes learning at home interesting, quick, fascinating, practical. Mail coupon.

Save Money—Learn At Home Money Back Agreement Protects You

I am so sure that I can train you at home successfully that I agree in writing to refund every penny you pay me if you are not satisfied with my Lessons and Instruction Service when you finish my Course. I'll send you a copy of this agreement with my Book.

Find Out What Radio Offers You Get My 64 Page Book Free Now

Act Today. Mail the coupon now for my Free Lesson and my book, "Rich Rewards in Radio." Both are free to anyone over 16 years old. My book describes Radio's spare time and full time opportunities and those coming in Television; tells about my Training in Radio and Television; shows you actual letters from men I have trained, telling what they are doing and earning. Find out what Radio offers YOU! MAIL THE COUPON in an envelope, or paste it on a penny post card—NOW!

J. E. SMITH, President
National Radio Institute
Dept. 6KX
Washington, D.C.

GOOD FOR BOTH 64 PAGE BOOK SAMPLE LESSON **FREE**

J. E. Smith, President, Dept. 6KX
National Radio Institute, Washington, D. C.

Dear Mr. Smith: Without obligation, send me the Sample Lesson and your free book about the spare time and full time Radio opportunities, and how I can train for them at home in spare time. (Please write plainly.)

Name ..... Age .....

Address .....

City ..... State 14x1

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

Editorial Offices: 99 Hudson St., New York, N. Y. HUGO GERNSBACK, Editor Vol. VIII, No. 4, Oct. 1936

MAN-MADE STATIC

An Editorial by HUGO GERNSBACK

THE PROBLEM of man-made static has assumed large proportions during the past twenty years and, as our machine and electrical age advances, artificial static is advancing at a terrific rate as well.

Almost any new electrical device is a potential static generator, in that it often sends out electromagnetic waves at a particular frequency or band of frequencies, which in turn create noises in radio sets in the home. And the more sensitive our radio sets become, the louder becomes the noise recreated through the loudspeaker.

The opening up of the short-wave bands and the development of all-wave receivers which operate from approximately 5 meters up to 600 meters, has brought a host of new problems. The man-made static in the lower wave bands frequently becomes so bad nowadays that it is almost impossible to tune in short waves because the program is so marred that it becomes necessary either to shut off the radio receiver or tune in on the broadcast band where conditions may not be so bad.

High-voltage transmission lines through leaking insulators and defective transformers are probably the most powerful source of man-made static. The same is true of electric trains and railways, due to the large power used. In or about buildings, we have literally thousands of potential noise creators, of which only a few are mentioned, such as, electric flashing signs, ignition systems of automobiles, busses; motors of all types, such as on elevators, refrigerators, air-conditioners, vacuum cleaners, hair dryers, etc. Even such innocent appearing objects as electric heating pads may disturb the entire neighborhood and have frequently done so due to the thermostatic contacting device. Defective wiring, defective electric sockets and, in fact, *any* electric appliance which has gone "bad" can, and often does, create a fearful amount of artificial static that may mar the programs of dozens of radio receivers in its direct vicinity.

Until very recently, we were willing to leave things as they were, and we took the disturbances philosophically. But, of late, the temper of the population is beginning to assert itself, because radio no longer is looked upon as a toy or a luxury, but has become a necessity. And, if enough people are annoyed, usually something comes of it.

A few years ago, the electric utility corporations paid little attention to the elimination of artificial static. Today, practically all of them with few exceptions are wide awake and alert, and do everything in their power to locate the source of disturbance. Indeed, many of the electric and power companies now have regular crews whose only duty is to hunt down noise-producing sources. In this, the electric corporations are motivated primarily by good business, because today radio receivers represent a large percentage of their income. It is, therefore, to their advantage to see to it that the radio set is turned on as long as possible.

Electric railways, street cars, etc., however, are not in this position, because they derive no income from radio sets, and up to now, they have been rather apathetic to remedying the situation. This, of course, is a foolish attitude, because, in the first place, self interest and good business on the part of the electric railway corporations should dictate a different course. If there is a leaking insulator on their main line, this insulator not only gives rise to static that may disturb hundreds of radio receivers within a certain radius, but, at the same time, valuable electric current is also dissipated for no good reason except that there is a bad insulator. During the course of a year, the loss in electric power through such a defective insulator will run into a sizable sum of money. Self interest, therefore, would indicate the replacing of such an insulator in short order. Slowly, the electric railway corporations may come to this view, too. In the meanwhile, there are many cases where such corporations are still so hide-bound that they pay little attention to the rights of others, and it is, therefore, interesting to note that in some parts of the country, people are beginning to use pressure on such organizations—often with telling results.

Recently, for instance, there was organized on Long Island, New York, the *National Committee for the Prevention of Radio Interference*. Frank L. Carter of East Rockaway, New York, an old radio amateur and service manager, found it necessary to do something about the nuisance. It seems that in the vicinity of Long Beach, New York, there existed a terrific amount of disturbance, created by one of the railroads which had "sizzling" insulators that disturbed literally thousands of radio sets, making it impossible even to hear such a powerful station as WABC, the key station of the Columbia Broadcast System. Letters were written to the railroad with little effect. Then Mr. Carter resorted to writing letters to the Long Island press, and a regular campaign was started. He even went as far as to bring the matter to the attention of the District Attorney. All of this had a telling effect so that now over 75 per cent of the interference has been eliminated in the East Rockaway, New York section, where the complaints were most frequent.

This entire man-made static condition is, of course, receiving a lot of national attention nowadays, and the question is also being considered by the Sectional Committee on Electrical Interference of the American Standards Association; of the International Special Committee on Radio Interference; and of many large radio-set manufacturers and radio-parts makers.

The Federal Communications Commission has had this matter under advisement for a long time, but, so far, there has not been any adequate law to really do much about it. It is to be hoped that the next Congress will pass adequate laws to prohibit anyone from creating a nuisance through the creation, wilful or otherwise, of man-made static. Inasmuch as radio is assuming more and more of a political character, politicians now realize the importance of radio. It should not, therefore, be so difficult to have them pass a law which will protect radio from all types of man-made static. Once such a law is passed, the Federal Communications Commission will find it comparatively easy to suppress the nuisance. It is not difficult nowadays to locate the source of a disturbance and, once located, the owners or those responsible for maintaining the nuisance can then be haled into court and fined, if there is no abatement of the noise-producing agencies.

Of course, the passing of such laws will immediately make it unlawful for electrical or other manufacturers to put upon the market appliances or devices which will create radio disturbances. This, however, presents no insurmountable difficulty, because it is only a matter of correct design and the application of certain safeguards (which any manufacturer can take) in order to make his product free from man-made static.

It is to be hoped that within the next few years with adequate laws, man-made static will have been eradicated.

THE RADIO MONTH

DOCTORS ASK RADIO CHANNEL

TAKING a cue from the police radio systems, a physician's paging service which has made a business of locating doctors for their patients for a number of years applied, last month, for a frequency in the ultra-short wave band between 30 and 50 megacycles. This frequency will be used, according to the application, for sending out calls for physicians en route to other calls.

According to the application, "Almost all doctors travel by private automobile and we frequently receive a call for a doctor five minutes after he has left his office and is perhaps traveling home to the suburbs 40 to 60 miles away. It may take him 2 hours to get home and 2 hours to come back and that 4 hours gained might frequently be the means of saving a patient's life."

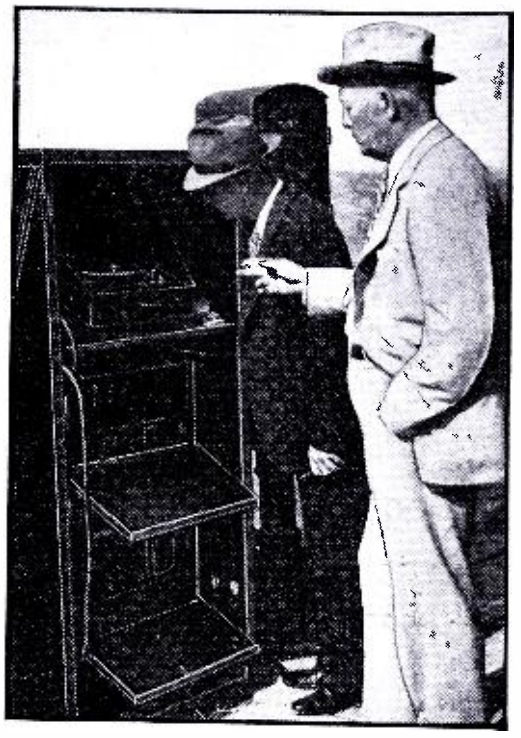
It is proposed to set up a NATIONAL NETWORK of such radio call stations. The doctors thus called would receive full instructions by wire telephone.

BOWDOIN SCIENTIFIC CRUISE

LAST month, the famous ship Bowdoin which has figured in several expeditions in the polar regions, started on an expedition in the Bay of Fundy to make studies of a meteorological, geological and biological character. Magnetic disturbances that have been reported near the Machias Seal Island will also be investigated.

The ship has been fully equipped with radio equipment to operate on 28 megacycles, and on the 75- and 20-meter phone bands. The station has Canadian call VE1IN and is the only American-operated Canadian amateur station, as far as known.

The radio equipment and operators on the Bowdoin, on her Kent's Island expedition.



TRAFFIC LESSONS BY LOUDSPEAKER

AN automatic phono.-amplifier was demonstrated, last month, in St. Louis, Mo., to educate pedestrians to use caution at a dangerous intersection.

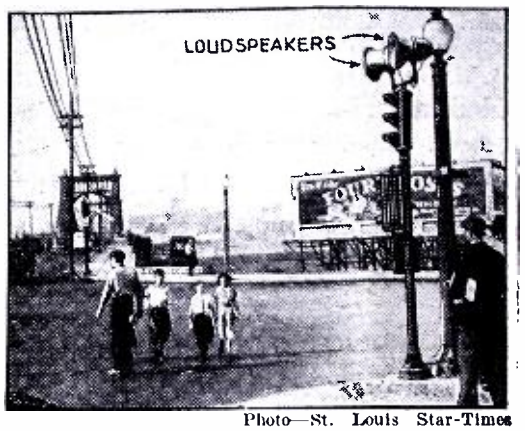
Every second time the light turned red in one direction, a voice, recorded on a phono. record, announced the following message: "Attention, pedestrians! This intersection is a transfer point between busses and street cars. Hundreds of pedestrians cross here daily, and several were seriously injured last year because they did not comply with the traffic signals. *Avoid accidents by starting at the instant the light flashes green.*"

The warning was audible above the noise of traffic at each corner of the traffic intersection. Such automatic signals should be of tremendous service in reducing traffic accidents.

MUTUAL— 3RD NATIONAL NET

COMPLETION of negotiations by which the Don Lee Network of California will become a member of the Mutual System was completed last month—thus making the Mutual Network the long-heralded third nation-wide hook-up.

The rise of the Mutual Network has been one of the sensations of the broadcast industry. Within two years the chain has advanced from the simple exchange of programs between three powerful stations, WOR, WGN, and WLW, to the "third Chain."



Photo—St. Louis Star-Times

Above, the speaker installation at a busy crossing in St. Louis, Mo.

Left, the amplifier and automatic recording device in its compact metal case.

PUBLIC UTILITIES ENTER RADIO SERVICE

OF interest to the Service Man is the pamphlet issued last month by a large utilities corporation supplying electric power to the Metropolitan area.

The folder advertised a radio check-up including inspecting and cleaning chassis; inspecting speaker and connections; checking all power connections; testing and labelling all tubes; cleaning interior of cabinet; checking aerial installation; inspecting aerial and ground connections; inspecting lightning arrester; and, *free estimate of any additional repairs.*

For this service, a standard charge of $1.50 is made.

This ad. threatens to start a new era in service work and rates, under the supervision of the public utilities. Just what effect this will have on the independent Service Man remains to be seen!

NAB ATTACKED

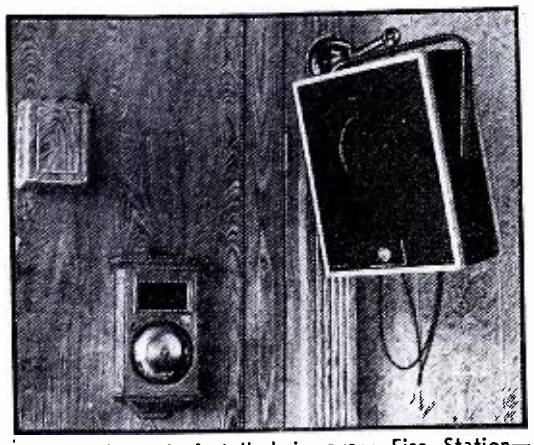
AN aftermath of the fight last December, regarding the music rights and the rates charged by music publishers to radio broadcasters, popped up last month when a member of the National Association of Broadcasters threatened to form a new broadcast station organization.

Assailing the NAB, chiefly about the difficulties over music rights, Isaac D. Levy of Philadelphia asserted that it will be "only a short time before the organization collapses if you run it this way."

The difficulties, incidentally, with Warner Brothers and the American Society of Composers, Authors and Publishers have never been settled, and stations were forced to make individual arrangements for the use of music.

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.



Above, the unit installed in every Fire Station—it consists of an alarm and an amplifier.

Right, the Central Headquarters amplifier.

P.A. AND THE FIRE ALARM

PUBLIC address entered the fire fighting business last month when a new system was demonstrated to insure the correct dispatching of fire fighting apparatus.

In the old system, a man on watch received the address and instructions when emergency calls were received, and he passed these instructions to the firemen who answered the call. In the case of similarly-sounding street names, such as Main and Wayne, the man on watch could very readily make a mistake, thus causing costly and dangerous delays.

With the new "Talkalarm" system, demonstrated in Bridgeport, Conn., the alarm and instructions are projected over a P.A. system so that every man in the fire station hears the instructions —which are sent from a central station to every fire house in the entire city. This method reduces to a negligible extent the chance of error. It also increases the speed of answering alarms.

Electronic apparatus has thus found another useful application in aiding firemen to uphold public safety.

TELEVISION TESTS STARTED

LAST month, amid much secrecy, the television experiments of RCA from the Empire State building were begun. A demonstration was given to RCA licensees showing what was being done —an announcement was made that no results could be expected from the experiments for some months—amateurs in the metropolitan area found that loud signals could be heard from the 10 kw. transmitter—and the No Admittance sign on the 85th floor of the Empire State building was found to mean what it read!

STARS CHARGE BOOTLEGGING

A SERIES of suits to prevent broadcast stations from transmitting recorded music classed as "bootlegged" entertainment, were started, last month.

Paul Whiteman brought suit against station WNEW; and individual suits were started by Lawrence Tibbett, Don Voorhees, Frank Crumit and Walter O'Keefe, against other stations.

These suits were brought against stations or recording companies for "capturing" programs which were subsequently cut down and sold.

It was stated by Mr. Voorhees that these—"bootleg recordings are modified and altered so as to contain advertising material and announcements of new sponsors who thus have the use of the talents of myself and other artists without payment of any compensation for them."

Tibbets reserved for himself all rights but "home" use of his recordings.

In reply to these charges, one of the defendants intimated that they understood that the music was public property once a record was purchased.

MOON TURNS ON EXPOSITION

IN keeping with the precedent set at recent scientific expositions, the opening of the Great Lakes Exposition, last month, was officially marked by having the lights turned-on by the illumination from an astronomical body.

In this case, a telescope in Cleveland was trained on the Moon and the first variation or "wink" automatically tripped a relay, operated from a photocell, throwing-on the lighting circuit.

A CATHODE-RAY DIRECTION FINDER

FAR-REACHING results were obtained, last month, in tests made by the Coast Guard of a new cathode-ray direction finder invented by Edward Hefele, who has developed other radio devices for flying.

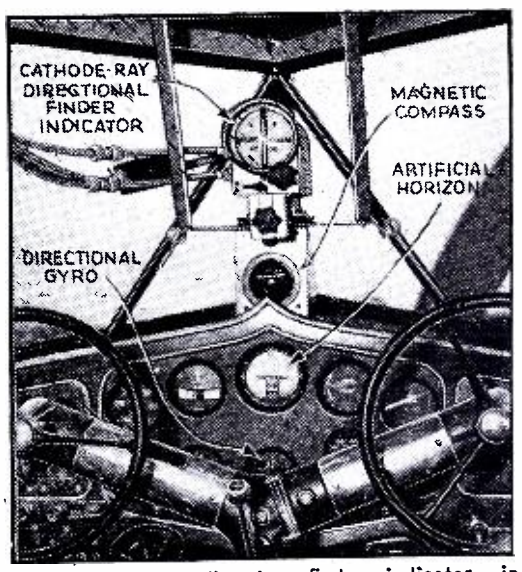
The tests of the Coast Guard were carried out over mountainous, flat, and rolling country, as well as over water, both in daytime and in darkness. It was found that reliable bearings could be obtained through heavy atmospheric disturbances as well as through interference from other radio signals on the same frequency as the observed station.

In operation, the cathode-ray pattern gradually opens from a vertical line into an ellipse on approaching a station, until finally, when directly over the radio station an almost perfectly circular pattern is obtained. The "directional sense" was found to be entirely automatic, the approach and departure from any broadcast or beacon station being at all times apparent. The "sensing" of the equipment installed in the Coast Guard test plane was designed so that when the device was arranged for homing purposes and approaching a station, the vertical beam would incline to the *left*, indicating that the plane was swinging to the *right* of the observed station.

In addition to functioning as a radio direction finder, homing device, right and left indicator, and non-directional receiver, the Hefele cathode-ray device was found to give a very accurate line of bearing and directional indications of electrical storms.

An outstanding advantage of this device is the ability to give accurate bearings on signals of comparatively low signal strength—say 50 microvolts-per-

(Continued on page 231)



The cathode-ray direction finder indicator, installed above the magnetic compass and artificial horizon in the Coast Guard plane.

ELECTRONIC CONTROL SYSTEM AT VASSAR COLLEGE

The first published description of a unique centralized control for reproduced musical entertainment.

ANDREW HALBRAN

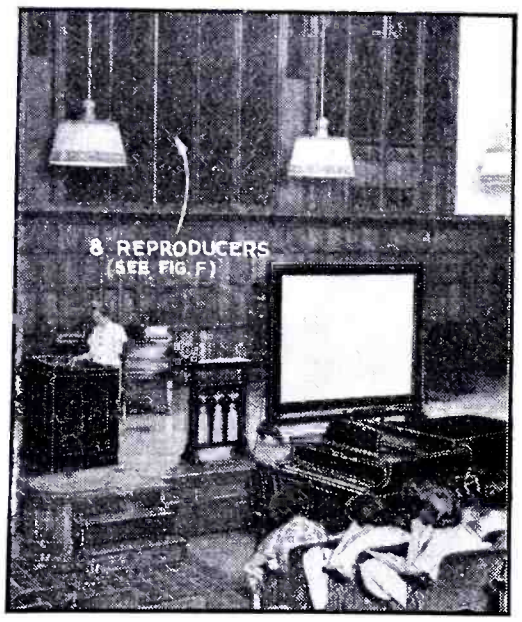


Fig. A. The set-up in Skinner Hall.

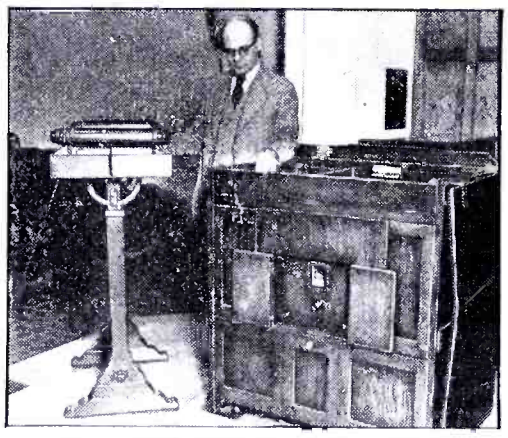


Fig. B. Prof. Dickinson at the controls.

WHAT IS claimed to be the most novel and original control system is now in operation in the Skinner Hall of Music at Vassar College (Poughkeepsie, N. Y.). Conceived by Professor George S. Dickinson of the Department of Music, this unique system permits the instructors to go through the entire lecture routine without moving a step away from the lecture table, meanwhile "cutting in" the large organ, the radio or phonograph, stereoptican, piano, etc. by merely pressing a button or closing a switch—*everything operating automatically!*

FOR THE FIRST TIME IN ANY RADIO PUBLICATION

Furthermore, the instructor can interrupt at any point to explain certain things in detail or he can repeat any part of, or all, of the previous routine at will. For instance, if one of Wagner's compositions is being played on the phonograph and has reached a point where some explanatory remarks are necessary, the instructor pushes a switch which automatically raises the reproducing arm and holds it poised at that exact point off the record, which continues to revolve. After the necessary comment, the instructor again throws the switch and the needle engages *at the same point on the record as it was before the interruption.* The same applies to the magnificent new pipe organ which, in addition to its regular keyboards, is also operated by music rolls as are also the grand pianos in the Hall of Music.

Operating a switch turns off the lights and starts the stereoptican which automatically projects and changes all or any part of 52 lantern slides.

Perhaps one of the most ingenious features of this novel system is the synthetic section of the pipe organ. Although of most modern design, the building would not accommodate the giant 32-ft. organ pipes needed for the characteristic deep bass organ tones.

(Continued on page 232)

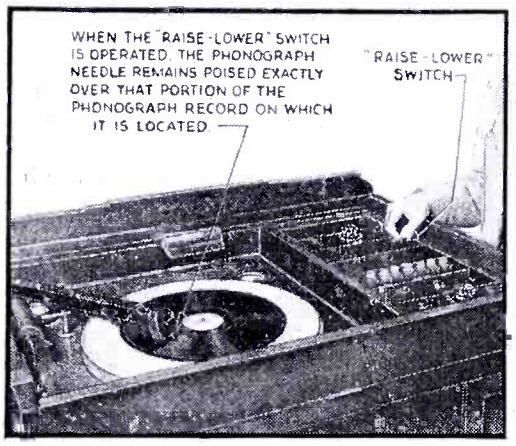


Fig. C. The control panel and phono. pickup.

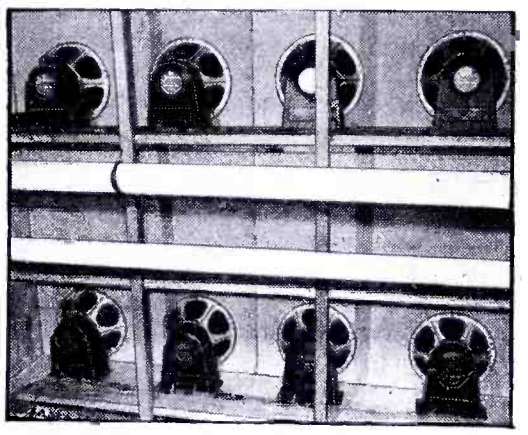


Fig. F. The speaker bank in the organ loft.

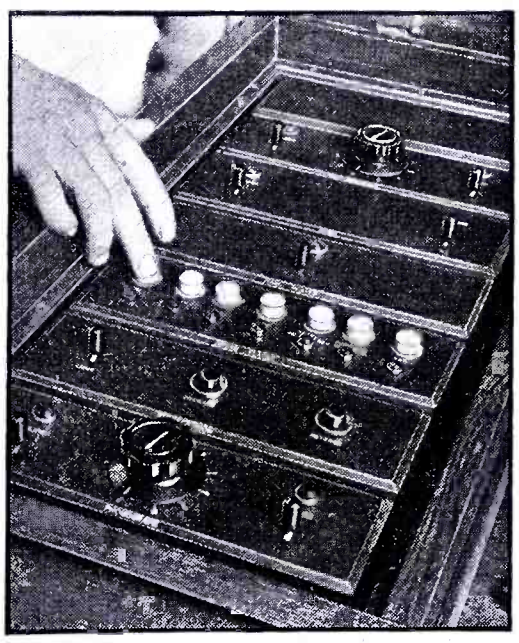


Fig. D. A close-up of the switch panel.

Fig. E. The compact 50-W. amplifier.

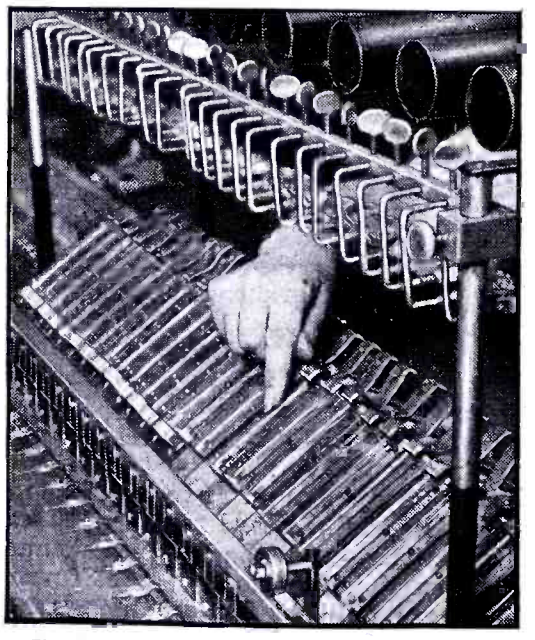


Fig. G. The reeds which replace large pipes.

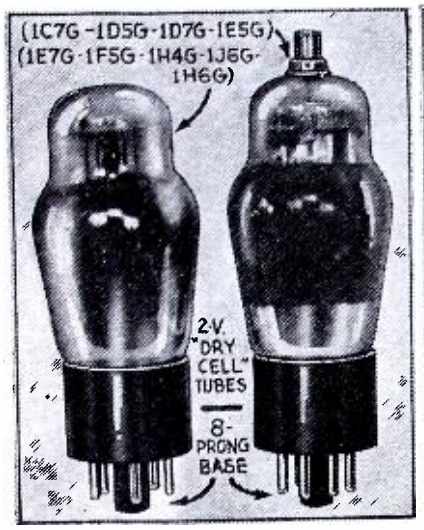


Fig. A. Octal-base 2-V. tubes.

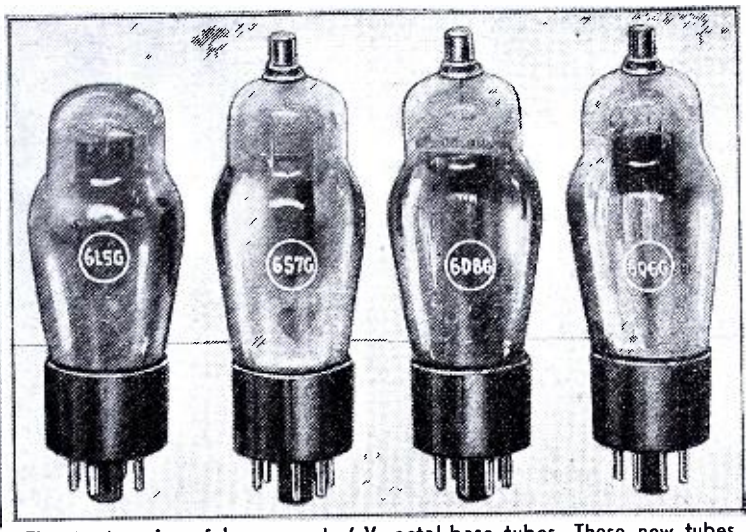


Fig. B. A series of low-current, 6-V. octal-base tubes. These new tubes mark an important advance in radio equipment for the car owner.

Fig. C. The 6N5 "eye."

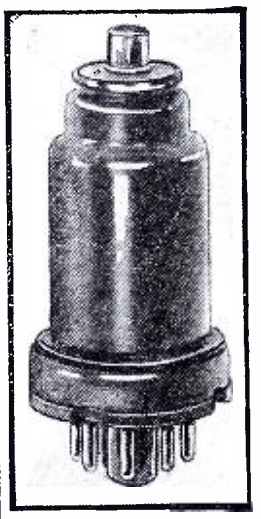


Fig. D. The 6B8 metal tube.

The development of the new receivers has necessitated new and different tubes—some of the most interesting of these are described, including a new car-radio series.

16 NEW TUBES!

J. H. GREEN

THE DEVELOPMENT of the new 1936-'37 line of radio receivers and the activities of engineers in the sundry laboratories throughout the country have resulted in the announcement of many new tubes, this month.

And since it is the duty of every radio man to keep up-to-date concerning new circuits, parts and devices, some of the most interesting of these new tubes are described below, together with comparisons with other existing tubes designed for the same purposes.

Of vital interest to the designers of automobile, universal-current and battery receivers is the introduction by National Union and Raytheon Prod. Corp. of a new series of 6.3 V. tubes which consume only 0.15-A. filament current as compared to 0.3-A. for previous 6.3 V. tubes. The resulting saving in battery drain in a car receiver can readily be appreciated when it is remembered that this means cutting the filament drain in half! *Tube engineers cannot be complimented too highly on this truly outstanding achievement!*

Five tubes have been announced, to date, in this line of low-current types. All 5 are housed in glass bulbs and with the exception of one, the 6N5 (a 6-prong indicator tube), they are equipped with octal (8-prong) bases and caps.

6D8G Characteristics

Heater voltage	6.3 V.	6.3 V.
Heater current	0.15 A.	0.15 A.
Plate voltage	135 V.	250 max. V.
Anode-grid voltage (grid No. 2)	135 V.	250 *max. V.
Screen-grid voltage (grids No. 3 & No. 5)	67.5 V.	100 max. V.
Control-grid voltage (grid No. 4)	—3.0 V.	—3.0 V.
Oscillator-grid resistor (grid No. 1)	50,000 ohms	50,000 ohms
Conversion conductance	325 mmhos	500 mmhos
Conversion Rp	0.40 meg.	0.32 meg.
Control-grid bias for conversion conductance = 10 mmhos.	—25 V.	—38.5 V.
Triode mutual conductance (Egl = 0)	1,150 mmhos	1,000 mmhos
Cathode current	8 ma.	13 ma.

*Through a 20,000-ohm dropping resistor.

Interelectrode Capacities (With form-fitting shield)

Oscillator input	6.0 mmf.
Oscillator output	5.5 mmf.
Oscillator-grid G_1 to Anode-grid G_2	1.0 mmf.
R.F. input	8.0 mmf.
Mixer output	11.0 mmf.
Grid G_4 to plate	0.3 mmf.

6D8G—Frequency Converter. This tube is a frequency converter type, similar in purpose to the 6A8 metal tube. The characteristics, with the exception of the filament current, are approximately the same as for the 6A8G. The conversion conductance is 500 micromhos.

6L5G—Triode Voltage Amplifier. This tube is a triode voltage-amplifier, suitable as an audio amplifier of medium gain, low distortion and high output. It is similar to the 6C5 metal triode, with the exception of a slightly lower amplification factor and lower filament current of 0.15-A.

This triode has the least distortion of any in the "octal" series.

6L5G Characteristics

Heater voltage	6.3 V.	6.3 V.
Heater current	0.15 A.	0.15 A.
Plate voltage	135	250 V. max.
Control-grid voltage	—5.0	—9.0
Plate current	3.5	8.0
Plate resistance	11,300 ohms	9,000 ohms
Amplification factor	17	17
Mutual conductance	1,500	1,900

Interelectrode Capacities (With form-fitting shield)

Grid-to-plate	2.7 mmf.
Grid-to-cathode	3.0 mmf.
Plate-to-cathode	5.0 mmf.

(Continued on page 234)

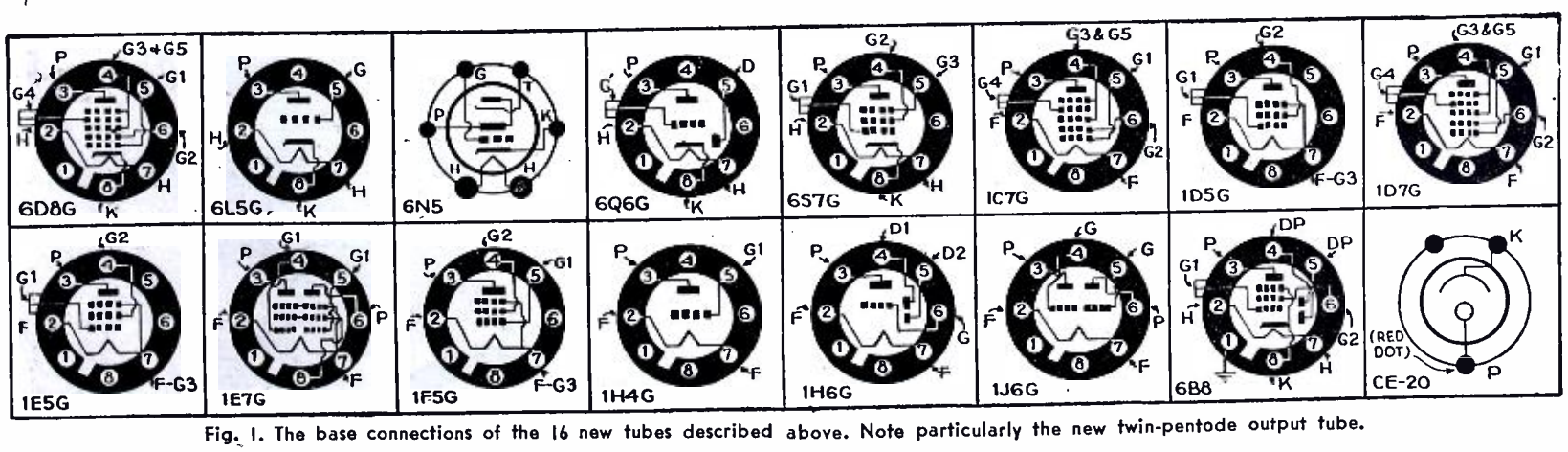
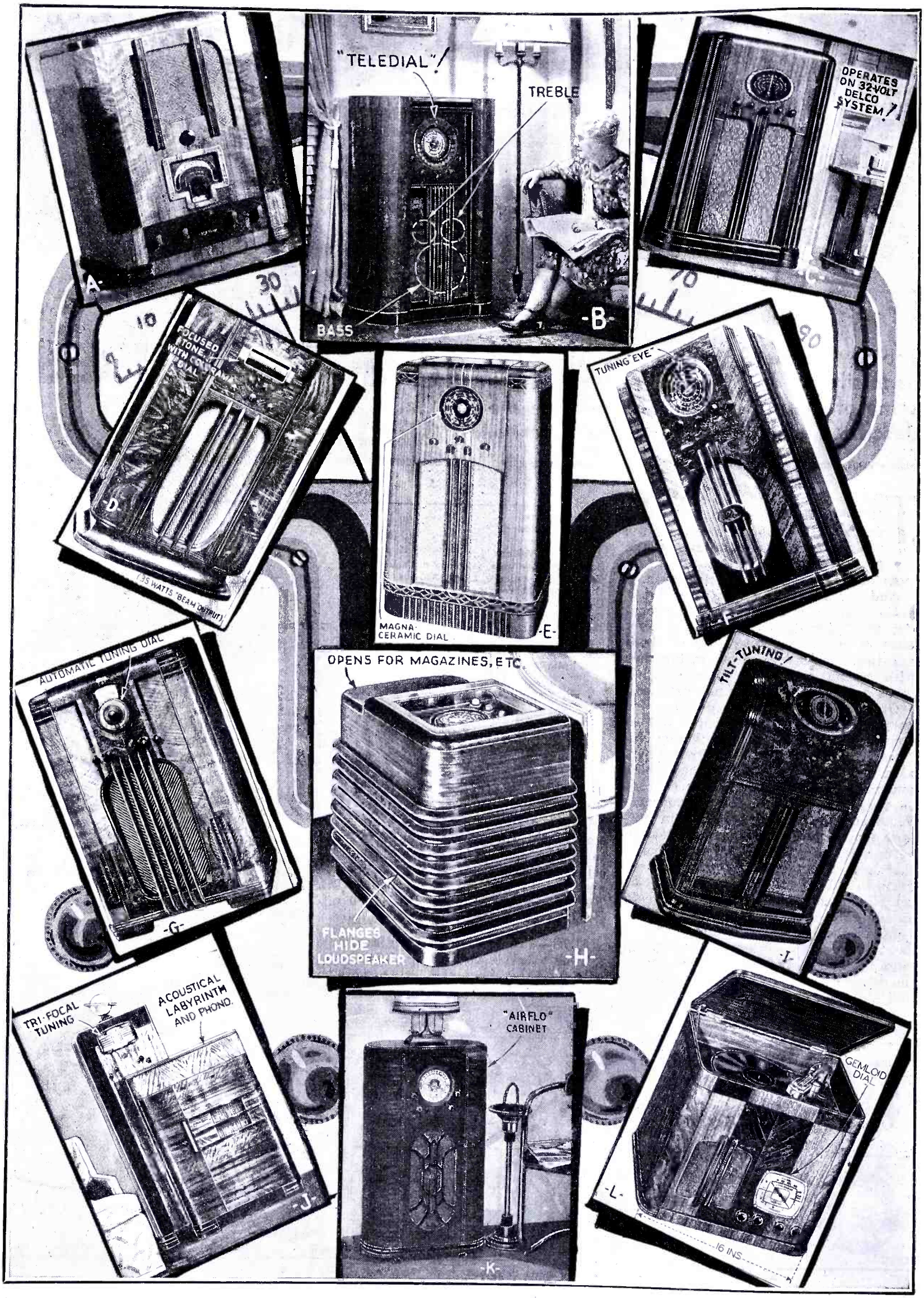


Fig. 1. The base connections of the 16 new tubes described above. Note particularly the new twin-pentode output tube.


A-
"TELEDIAL"!
TREBLE
BASS
-B-
OPERATES ON 32-VOLT DELCO SYSTEM!
FOCUSED TONE WITH COLOR-RAY DIAL
-D-
35 WATTS "BEAM OUTPUT"
MAGNA-CERAMIC DIAL
-E-
TUNING EYE
-F-
AUTOMATIC TUNING DIAL
-G-
OPENS FOR MAGAZINES, ETC.
FLANGES HIDE LOUDSPEAKER
-H-
TILT-TUNING!
-I-
TRI-FOCAL TUNING
ACOUSTICAL LABYRINTH AND PHONO.
-J-
"AIRFLO" CABINET
-K-
GEMLOID DIAL
-L-
16 INS.

SEE THESE NEW RECEIVERS AT THE RADIO SHOW

It is the duty of every professional radio man to keep informed of the technical developments that are taking place. A study of the new 1937 receivers will be of exceptional interest. Some of the outstanding features of these sets are discussed below.

A GLANCE into the kaleidoscope of radio development this year reveals many unusual and interesting new sets. The receivers this year are by far more attractive in their cabinet appearance than those of recent years. Increasing sales have encouraged manufacturers to make larger and more complete models, as demonstrated by the examples on the facing page at the left. The technical features of some of the most popular manufacturers are outlined on this page and in the two following pages. These models, in general, will be shown for the first time at the Radio and Electrical Show in New York, beginning September 9th.

(At the time of publication, schematic circuits were not available for these sets—they will be published in succeeding issues.—*Editor*)

RCA MFG. CO. (A)

Model 10-T. "Higher Fidelity" is provided by this all-wave receiver, which has an output of 9 W. from its beam-power tube. It uses the Magic Brain, the Magic Eye, and the Magic Voice! The tubes are 10 in number, and all-metal. The selector dial shows only the scale in use, so there can be no confusion as to the frequency tuned in. A separate, slow-motion dial makes for ease of logging. Air trimmers of the plunger type make the set impervious to heat and humidity, and ordinary mechanical strains; magnetite-core I.F. transformers also add to the permanence of alignment, as well as adding to selectivity and sensitivity. The frequency range is 150 to 60,000 kc.

GENERAL HOUSEHOLD UTILITIES CO. (B)

Model 1541 Teledial Console. The most startling feature of this receiver is the Teledial, whereby the desired station is tuned-in by mere insertion of the finger, followed by a single pull of the dial. The station will be automatically tuned-in to perfect resonance. The reproduction is true high fidelity, and the speaker system is built with 3 separate units to cover the complete audio spectrum! The speakers are mounted on a special resonator to further enhance the tone quality. Manual tuning is made easy by the Colorflash dial, with 2 hands, so that dial settings may be read just like the hands of a clock. Tone compensation is provided for both bass and treble, each of which has a separate audio system. The receiver uses 15 metal tubes and tunes from 550 to 70,000 kc.

UNITED MOTORS SERVICE (C)

Delco Model 3209 32-V. receiver. The most surprising feature of this receiver is that it works on the 32 V. power lines, *with this voltage as the maximum in the receiver*. The power output is very high and a highly-efficient circuit assures maximum results. A control is provided to enable equivalent results to be obtained no matter if the line voltage varies between 26 and 40 V. Eight tubes are used and the output stage is push-pull parallel to assure sufficient power on the low voltage available.

GENERAL ELECTRIC CO. (D)

Model E-155. "Focused Tone" is a term used to indicate the automatic tuning used in this receiver. Even if the set is not tuned exactly to the incoming station, the circuit tunes itself so that perfect reception is assured. When this occurs, the dial illumination changes from red to green, and the station call lights up on the dial. The local station calls are on a strip which is inserted according to the geographic location of the receiver. This model covers from 140 to 70,000 kc., and has a power output of 35 W.—from beam-power tubes. There are 15 tubes used which serve to drive the 15-in. speaker to full power. A knob may be operated to silence the receiver when a station is being tuned in, then when the dial color changes, the knob is released and the station will be found perfectly tuned in!

CROSLEY RADIO CORP. (E)

Model 167 Console. The "Phantom Conductor" (volume expander) and base compensator, together with the special 15-in. speaker enable the full capabilities of the push-pull 6N6 "beam" output tubes to be realized. There are 13 tubes used, all metal except the "Phantom Conductor" tube. Tuning is especially easy with the so-called "Magna-Ceramic" dial, which is arranged to log stations by time instead of by wave or frequency if so desired. The "Cardiamatic" tuning unit is mounted on rubber and carries all R.F. coils and tubes together with the tuning condenser and band switch.

NOBLITT-SPARKS INDUSTRIES, INC. (F)

Rhythm King Model 1127. Eleven metal-glass tubes are used in this large console receiver which covers the full wave-range. A 12-in. speaker assures fullest tonal quality from the push-pull 6N6G output tubes. The electric-eye tube together with a traveling-spotlight station finder make for ease of tuning. The dial is dual-ratio drive and ball-bearing. An automatic built-in aerial tuning system assures maximum results on all wave bands.

PHILCO RADIO & TELEVISION CORP. (G)

Model 116X DeLuxe. Automatic tuning which is operated exactly like the familiar dial telephone (except that to tune in any station it is only necessary to operate the dial once) is offered in this large console. Magnetic tuning makes this possible, and also makes regular manual tuning much easier. The high-fidelity sound system has an undistorted output of 15 W. and is reproduced by the "cathedral" speaker with acoustic clarifiers and inclined sounding board. Two separate tone controls enable compensation of both treble and bass. The "spread-band" dial carries names and locations of foreign stations and spreads them 6 times farther than usual! The balanced superhet. circuit uses 15 high-efficiency tubes.

ZENITH RADIO CORP. (H)

Zephyr Model 7D-148. Modernistic design is shown in this unique A.C.-D.C. receiver, which uses 7 tubes in a superhet. circuit. The power output is 1.5 W. which feeds a 10-in. speaker. Three bands are covered by the receiver, which has a continuous tone control and a split-second station re-locator.

CONTINENTAL RADIO & TELEVISION CORP. (I)

Admiral Model AM 387. The "Tilt-Tuner" set allows the owner to tune in a station without the necessity of bending over, since the dial is at an angle that makes it easy to see from almost any position. In addition, the set features twin 12-in. speakers, automatic tone control, automatic bass compensation, and an undistorted power output of 30 W. The tuning range is from 16 to 2,000 meters, and 17 tubes are used. The 11-in. dial features "Finger-Flick" tuning and a visual station indicator.

STROMBERG-CARLSON TELEPHONE MFG. CO. (J)

Model 145-L. Phono. reproduction as well as radio may be had from this set. It will play and shift 15 records of any make and 10- or 12-in. size. The output is true high fidelity, made even better by the "acoustical labyrinth" and the beam-power tubes (which provide an output of 9 W.). "Tri-Focal Tuning" uses the 6E5 tube in a circuit that is effective at any signal strength. Tuning is further aided by the Deluxe Index Selectorlite dial, which has each range exactly spotted, and which illum-

(Continued on page 235)

The appearance of some of the smaller sets to be shown at the New York Radio Show can be seen at the right. Even the smaller sets are filled to capacity with new technical features which will be attractive to radio men. These sets are described below.

FREED MANUFACTURING CO. (1)

Model P-55. Here is a portable receiver in which 5 tubes are made to produce the results of 7. All batteries are self-contained in the fabrikoid covered case. A Perm-O-Flux permanent-magnet dynamic speaker assures a tone quality equal to that of small A.C. receivers. The superheterodyne circuit tunes from 540 to 1,700 kc.

PHILCO RADIO & TELEVISION CORP. (2)

Model 604. A new and novel design is originated in this A.C.-D.C. compact superhet. Five tubes are used ending in a pentode audio system. The 45-deg. dial may be seen equally well with the operator in either a standing or sitting position; all controls are mounted on top of the case to facilitate tuning. The dial has 2 speeds and a color station indicator which names and locates foreign stations, also a glowing-beam station locator. Fixed bass compensation assures proper bass response at low-volume levels. The cabinet is highly finished on all sides and has 2 speaker grilles, so that programs may be heard as well from either side.

INTERNATIONAL RADIO CORP. (3)

Kadette Model 400. This battery receiver has self-contained power supply and is furnished with a 6⅝-in. Perm-O-Flux (permanent-magnet) speaker. Four tubes are used, 2 of which are the double-purpose type. The superhet. circuit is designed to cover from 540 to 4,300 kc. A "battery saver" enables maximum service to be obtained from a set of "A" batteries.

FAIRBANKS, MORSE & CO. (4 and 9)

Model 91T4. This mantel type set has many features found only in the larger console types. For example, the 1st-detector is the 6L7, and a separate oscillator is used. Also the output stage is a 6L6 so-called beam-power tube. A cathode-ray tuning tube in connection with the "Semophore Dial" makes for ease of tuning. The chassis has a shield which completely covers the top and serves to exclude foreign noises and to keep out prying fingers

PIERCE-AIRO, INC. (5)

DeWald Model 618. Modernistic design is shown in this compact A.C.-D.C. receiver. It is beautifully finished and of such style that it will "fit" most anywhere in the home. Six tubes are used in the superheterodyne circuit. Only the dial scale in use lights up, and the figures are large and easily read. The receiver tunes in 3 bands, 18 to 52 kc., 60 to 190 kc., and 180 to 555 kc.

STEWART-WARNER CORP. (6)

Model 1641. Six of the newest type 2-V. tubes are used in a superhet. circuit in this receiver, the class AB output stage producing 1.5 W. undistorted power. The battery drain is 1.7 A. at 6 V., and no "B" battery is needed since the high voltage is supplied by a built-in unit using a split-reed rectifier. The frequency range is from 140 to 7,000 kc. in 3 bands. Delayed A.V.C. and full-variable tone control are other features.

WESTINGHOUSE ELECTRIC SUPPLY CO. (7)

Model WR-214. The "Spectrum Dial" of this receiver is especially interesting since it makes easy the identification of the various wave bands by application of the simple colors of the spectrum. The "Precision Eye" (a 6E5 tube) is used as an aid to tuning. Nine tubes are used in the superhet. circuit which includes push-pull output. The dial is dual ratio, 18 to 1 and 60 to 1. The precision tuner contains the high-frequency coils and tuning condenser in one central unit.

WILCOX-GAY CORP. (8)

Model A-17. Six tubes are used in an A.C.-D.C. circuit in this receiver. It is a superhet. with a 3-gang tuning condenser, and a ballast tube. Variable tone control and A.V.C. are also features. The 6½-in. dynamic speaker affords fine quality, due to the use of a large vent in the rear of the case. A phono. jack provides for this type of entertainment and the receiver is designed to cover 3 wave bands from 18 to 550 meters. The drum style case is 14½-ins. in diameter and 8 ins. deep.

UNITED AMERICAN BOSCH CORP. (10)

Model 640. The "Automatic Maestro" in these receivers is said to "act like an orchestra leader to coordinate the incoming music and to quiet discordant sounds." It also eliminates 100 soldered connections and 90 per cent of all wiring. The tuning range is from 540 to 16,500 kc. Noise suppression is included as well as a built-in wavetrap in all sets. The "Semaphore Tuning" aids in tuning a station in properly. This is a 7-tube receiver.

NATIONAL CO. (11)

Model NC-100 receiver. The most novel feature of this "communication" receiver is found in the tuning coil band-changing system. All high-frequency coils are mounted in a cast-metal case, and the whole case slides lengthwise of the chassis, connection being made by pins on the case which slide through clips mounted directly under the tuning condenser gang. The band-spread is continuous over the whole range of the receiver and is obtained mechanically by the special dial. Other features include a tuning "eye," A.V.C., beat oscillator, crystal filter, and push-pull output, in the circuit which uses 12 tubes.

PILOT RADIO CORP. (12)

Model 304. For A.C.-D.C. receivers, this set has exceptional output power. A double push-pull circuit is used to provide 4 W. undistorted output, which is more than many console sets can produce. The tuning range is 525 to 23,600 kc.; and the band switch controls colored lights to show up the band in use. The circuit employs 11 tubes, including the Tuning Beacon tube. An acoustic compensator in the 10-in. speaker provides adequate diffusion of sound. Double shielding of the chassis, plus the inclusion of a power line filter, insure quiet reception.

EMPIRE RADIO CORP. (13)

Model 207. Cathode-ray visual tuning is used in this compact receiver. It has a 6-tube superheterodyne circuit of the A.C.-D.C. type. The tuning range is 550 to 18,000 kc. in 3 bands. No aerial is needed as one is built-in. The dial is large and easy to read and is illuminated in 4 colors.

SIMPLEX RADIO CO. (14)

Sportsman Model AA. A new portable receiver, which may be operated anywhere, and includes all batteries and aerial in a case measuring 9¼ x 8⅜ x 4¼ ins. deep, with a total weight of only 5¼ lbs. The tuning range is from 540 to 1,750 kc., and the dial is so calibrated. Standard-size batteries are used, and the circuit includes A.V.C. The case is finished in waterproof material. Four tubes are used in a superheterodyne circuit.

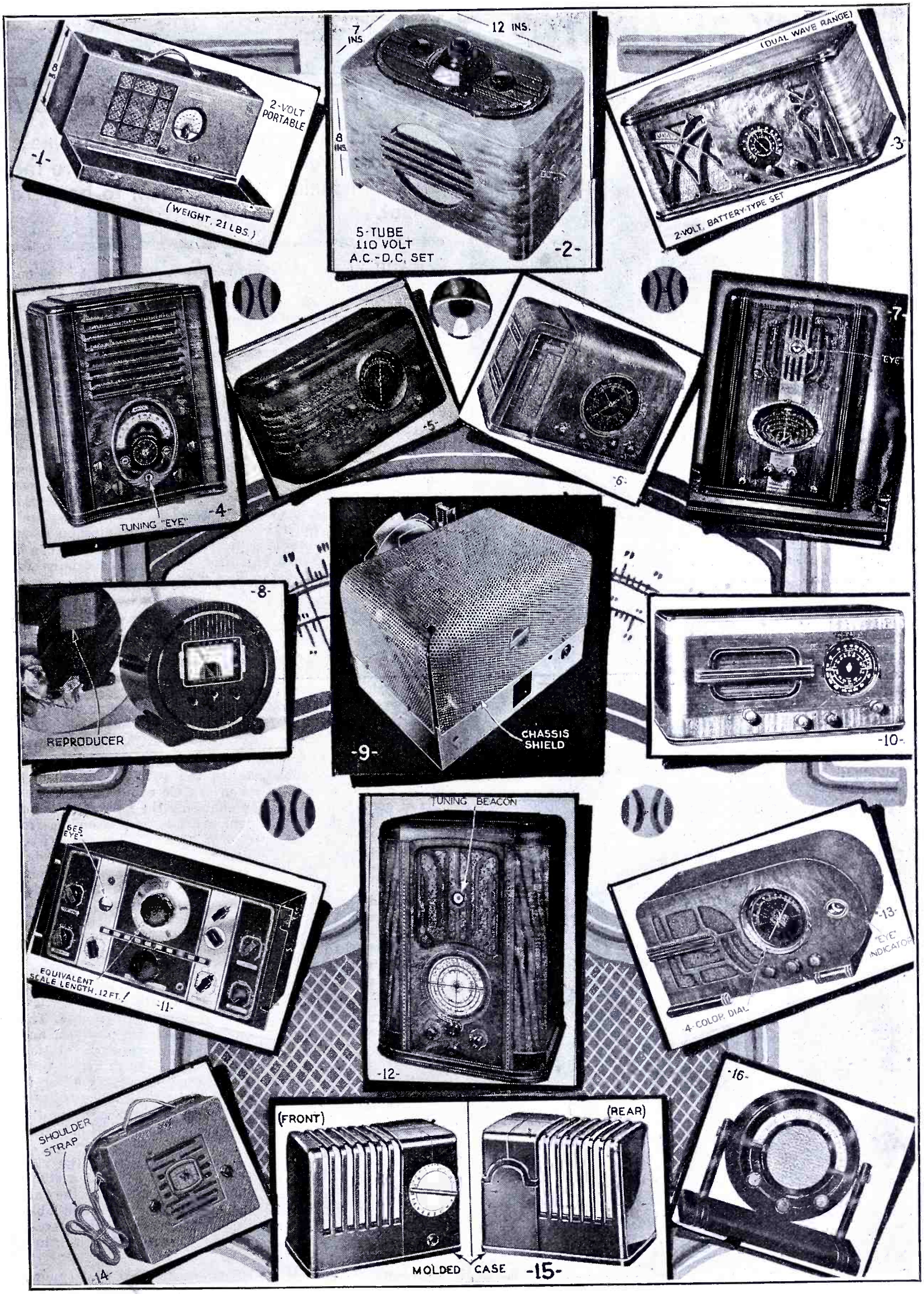
SEARS, ROEBUCK AND CO. (15)

Election Model. Made to sell at a low price, this "compact" offers many features. The cabinet is moulded in modern design and may be had in 3 color schemes. Five tubes are used and the speaker is of the dynamic type, enabling fine reproduction of the 2 W. of audio power. The dial is calibrated in kc. from 540 to 1,720; which is the tuning range of the receiver. An iron-core antenna coil assures high sensitivity from the T.R.F. circuit.

STEWART-WARNER-ALEMITE CORP., LTD. (16)

Good Companion receiver. Three finishes are offered for this novel set, all chrome, antique copper or black leatherette with chrome facing. The 4-tube superhet. circuit uses 3 double-purpose tubes in an A.C. connection. A wavetrap removes objectional code interference.

This set is 10 ins. high. The extremely novel design is Canada's contribution to unusual receiver design, for this set is a product of a *Canadian* radio receiver manufacturer. The set illustrates a successful attempt to break away from "traditional" radio receiver appearance.


-1-
2-VOLT PORTABLE
(WEIGHT, 21 LBS.)
7 INS.
12 INS.
8 INS.
5-TUBE
110 VOLT
A.C.-D.C. SET
-2-
(DUAL WAVE RANGE)
-3-
2-VOLT, BATTERY-TYPE SET
-4-
TUNING "EYE"
-5-
-6-
-7-
"EYE"
-8-
REPRODUCER
-9-
CHASSIS SHIELD
-10-
6E5 "EYE"
EQUIVALENT SCALE LENGTH, 12 FT.
-11-
TUNING BEACON
-12-
-13-
"EYE" INDICATOR
4-COLOR DIAL
-14-
SHOULDER STRAP
(FRONT)
(REAR)
MOLDED CASE
-15-
-16-

TECHNICAL FEATURES IN RADIO RECEIVERS FOR 1936-'37

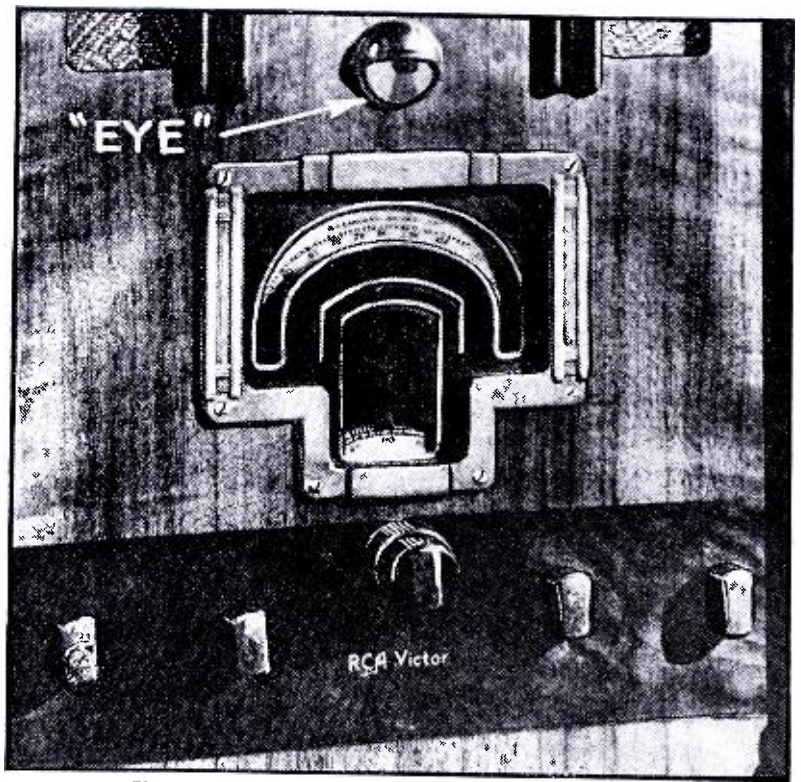


Fig. A. The Selector dial of the RCA Victor line.

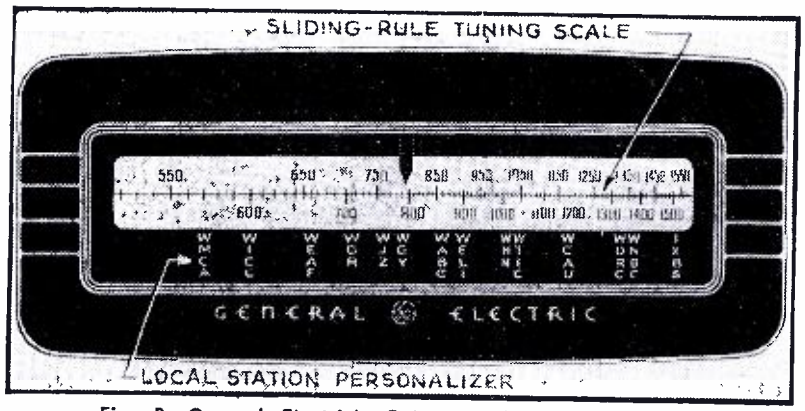


Fig. B. General Electric's Colorama dial changes color.

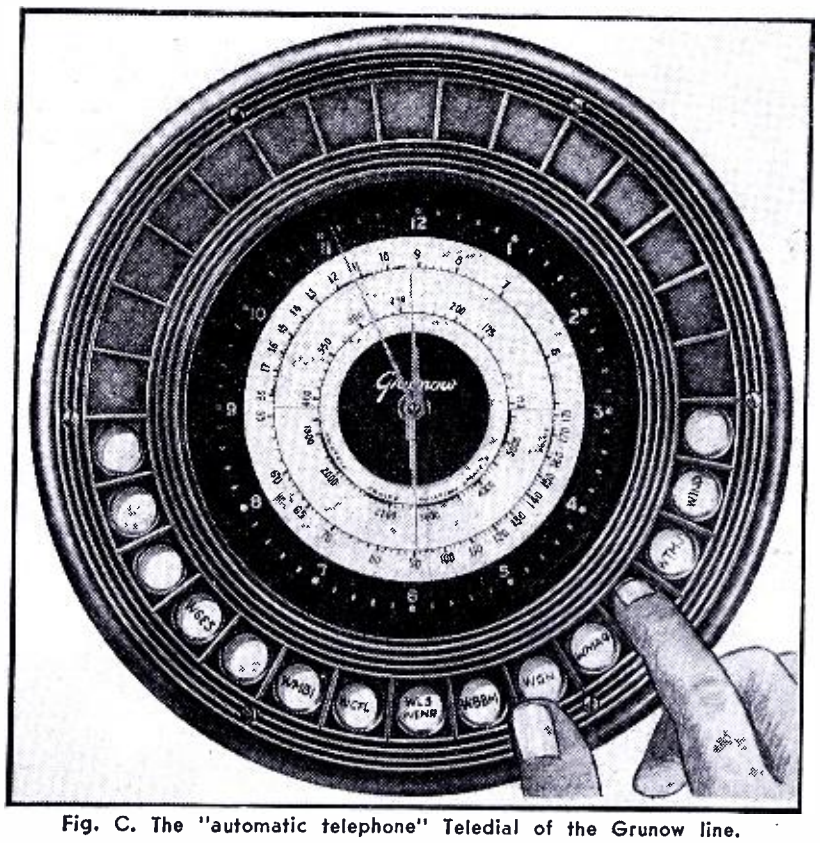


Fig. C. The "automatic telephone" Teledial of the Grunow line.

In examining the features of the 1937 line of radio receivers it is interesting to note that dials and tuning systems seem to be paramount.

EACH YEAR, the radio receivers presented by the outstanding manufacturers contain certain new features which the sets of the previous year did not contain—thus is progress attained!

The radio receivers soon to be shown at the Fall radio shows throughout the country have many outstanding new departures which will be attractive to the set user and the technician alike. A few of these technical features—the outstanding one—are described briefly below. (Additional details—service diagrams, etc.—as rapidly as they are released by the manufacturers will appear in subsequent issues of *Radio-Craft*.)

Selector Dial and Band-spreader. A feature of the new RCA Victor line is the dial, shown in Fig. A which is "edge lighted" for complete illumination. As the band switch is turned to shift from one wave band to another, the scale for each band moves into position in the semi-circular opening in the escutcheon. This permits only the scale in use to be seen which greatly facilitates tuning—especially for listeners who are not familiar with the technical side of radio.

Another part of the dial assembly is also worth noting. This is the "band spreader," which is a slow-motion mechanism which spaces out the crowded parts of short-wave bands. Part of this vernier action is the dial scale shown at the lower portion of the dial escutcheon in Fig. A. This dial moves with the vernier, thus providing an exact indication of the positions of the main dial and the vernier dial, for finding stations again after they have once been logged.

Magic Voice. This feature found in RCA Victor sets is designed to remove cabinet resonance—thus eliminating one of the outstanding obstacles in the path of high-fidelity reception from sets installed in console cabinets. The principle of operation depends on changing the normal resonant frequencies of the cabinet, which cause the "boom" to frequencies which are not audible or at which the normal response of the set is low by means of a group of metal tubes which are "tuned" to these resonant frequencies, thus helping to produce a "level" response. (The "resonant tube" idea has been discussed in past issues of *Radio-Craft*.) The speaker compartment of the set is sealed, instead of being open at the back in the usual manner, the only openings being through the tubes. The interior of the cabinet is shown in the cut-away view in Fig. D.

The Colorama Dial. One of General Electric's contributions to radio progress, as shown in their new model, consists of the Colorama dial which simplifies accurate tuning. The dial is illuminated with a red light, between stations, and when a station is incorrectly tuned, but as soon as the station is correctly tuned, the light changes from red to green, thus indicating visually when the position of best quality is achieved. See Fig. B. To aid this condition, an *automatic tuning or frequency control is included* which compensates for inaccurate tuning! Such systems were described in a past issue of *Radio-Craft*.

Local Station Personalizer. Another portion of the dial is the Local Station Personalizer which consists of a strip, mounted below the regular tuning scale, containing the call letters of a number of the local stations. (A strip is available for each of the big listening areas—New York, Chicago, etc.) As each of these stations is tuned in, the call letters are illuminated.

The Teledial. This new dial, a contribution of Grunow, combines the automatic telephone selector dial with which we

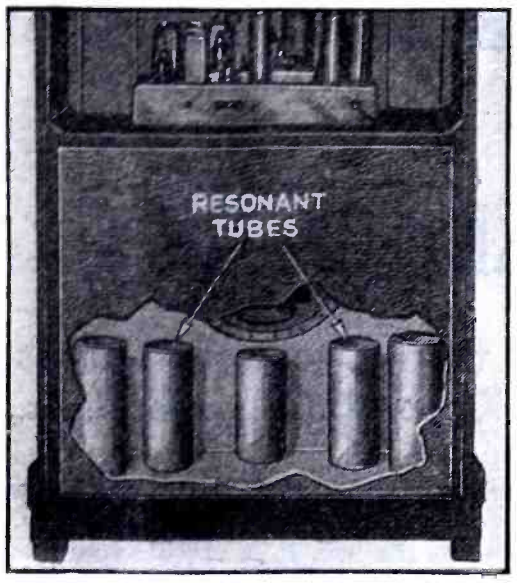


Fig. D. These resonant tubes eliminate "boom."

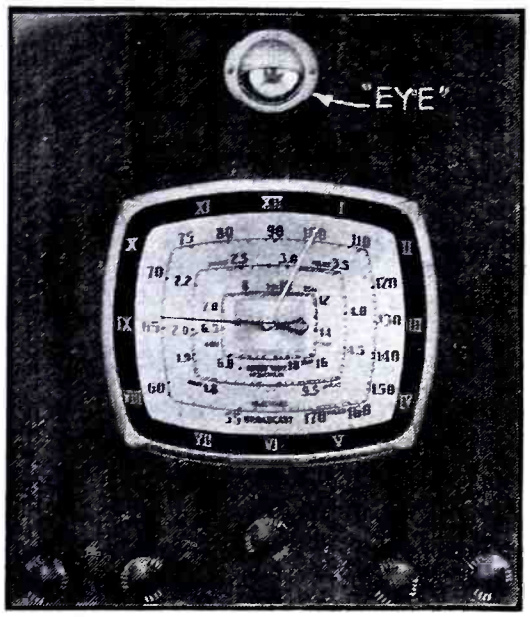


Fig. E. Emerson's Clock tuning dial.

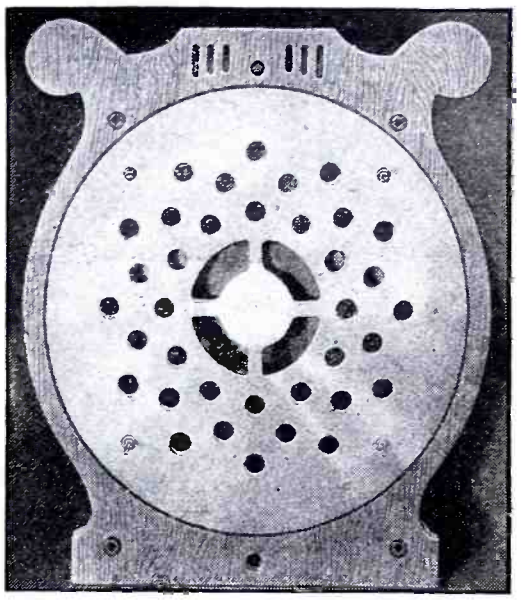


Fig. F. Crosley's Vibracoustic sounding board.

are familiar in the "dial telephone" system, with radio reception. (Dial operation of radio sets as practiced in Europe has been described in past issues of *Radio-Craft*.) As shown in Fig. C, the dial used in this make of set has an outside rim with holes containing the call letters of 15 favorite stations, which are tuned-in simply by inserting a finger in the hole and turning the disc until the desired hole is centered at the bottom. A system of automatic tuning control, which electrically adjusts the set to exact resonance with the station, makes this dial tuning possible. *Silent tuning* between stations on the Teledial is also used to make the system more attractive for the listener.

The dial enclosed by the automatic tuner, called the "Colorflash" airplane dial, is illuminated in only that portion of the scale (for the particular band) which is being used.

The Clock-Tuning Gemloid Dial. Logging stations on the new Emerson sets, especially on the short-wave bands, is simplified by the new-type dial used. As shown in Fig. E, this dial contains the usual airplane-type scales. But around the outside of the dial are 12 roman numerals *corresponding to the numbers on a clock face*. A vernier indicator needle (hand) is geared to rotate 12 times as fast as the main tuning indicator so that in logging a station all that the listener has to do is record the "time" indicated by the two hands, with the band in use!

The wave bands are individually illuminated as they are switched-in by the wave-change knob.

Vibracoustic Sounding Board. The Vibracoustic Sounding Board found in the 1937 line of Crosley sets has been de-

(Continued on page 233)

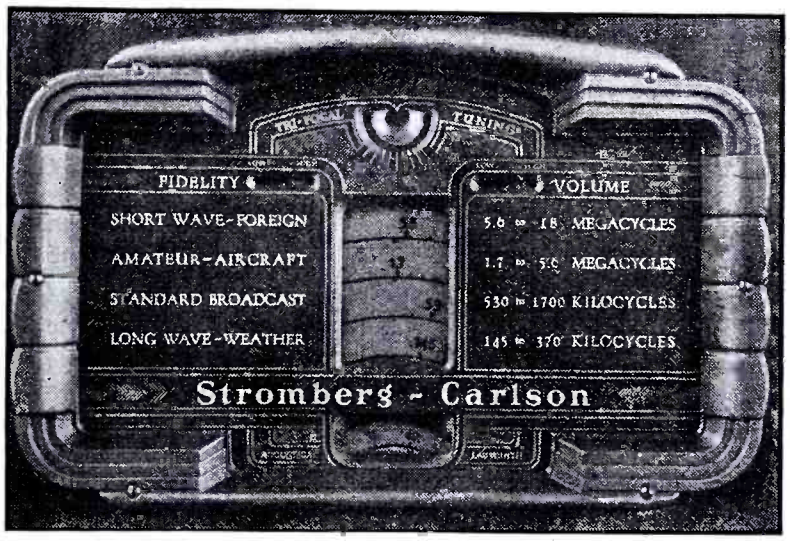


Fig. G. The Tri-Focal tuning system of the Stromberg sets.

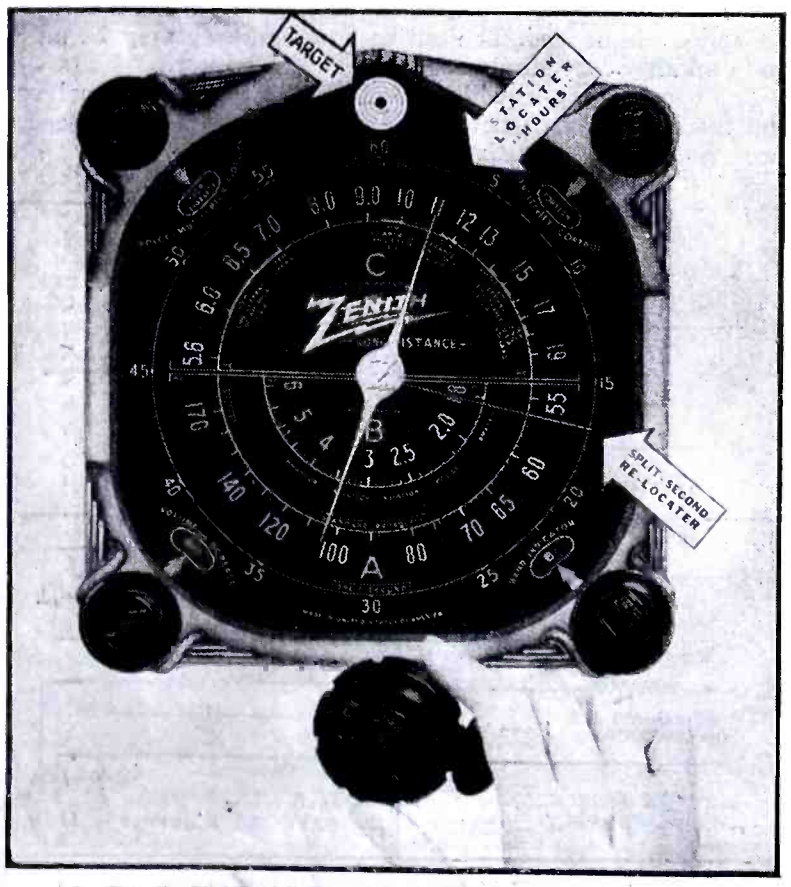


Fig. H. The Zenith Target tuning and station re-locator.

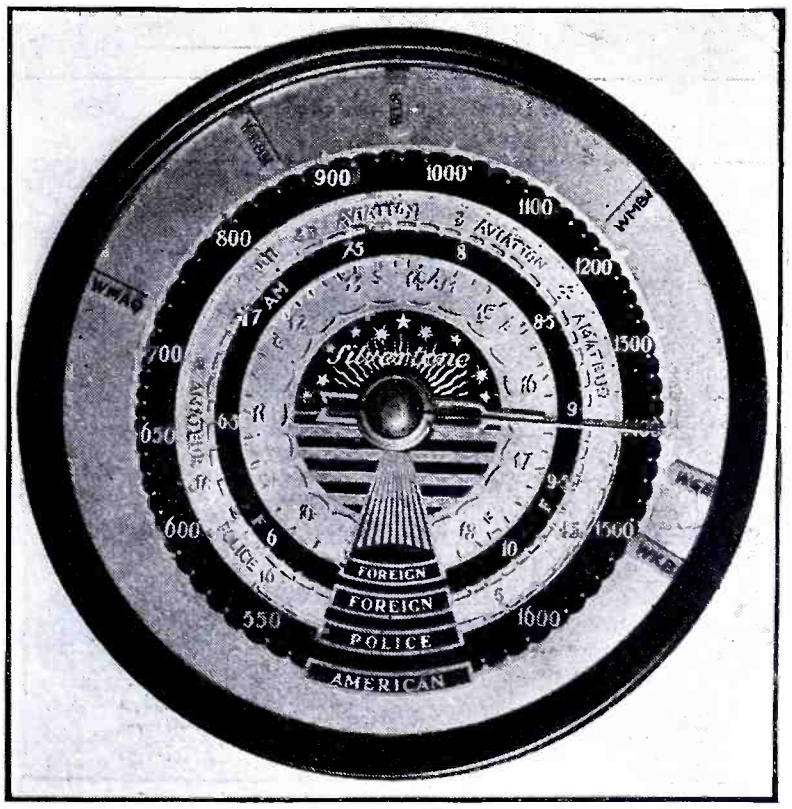


Fig. I. Sears' Automatic Flash Tuning control.

HOW TO MAKE A BEGINNER'S POCKET RADIO SET

This 1-tube set can be operated from any one of 3 sources of power — batteries, and A.C. or D.C. power lines.

H. G. CISIN

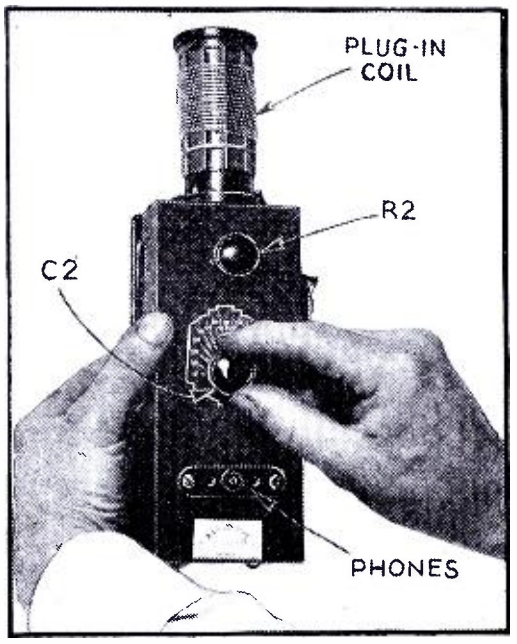


Fig. A. The appearance of the set when ready to operate. Note the plug-in coil on top.

DESIGNED especially for the beginner, this compact 1-tube (2 tubes, if A.C.-operated) receiver, shown complete in Fig. A, is truly "universal" in application, as it may be used with batteries or with any kind of commercial power supply.

For compactness and efficiency, the new type 6C5 is used as the regenerative detector; and all parts are contained in a small metal "cash box," measuring only 7 x 2¼ x 3 ins. wide. The plug-in coil socket is mounted on the top so as to be easily accessible, while the controls are on what would ordinarily be the bottom of the box. It is not necessary to open the case except to change tubes or make repairs.

The fundamental circuit is shown in Fig. 1, this same circuit being used no matter what type of power is available. The 3 connections to the power supply are made at the terminal board seen at the left of the case in Fig. B. This particular photo shows the power line cord connected in place for use of the receiver on a D.C. line, the connections for this being shown in Fig. 2B. The various power supplies illustrated in Fig. 2 are designed to take care of any possible operating conditions. If the receiver is to be used as a portable, it may be operated on batteries, as in A of Fig. 1. The use of dry cells is not recommended since the tube takes 0.3-A. heater current. The new type 6L5G (see pg. 201) may be used in place of the 6C5, although it is slightly larger in size, and the parts of the receiver will have to be rearranged to accommodate it. This tube has a heater current of only 0.15-A.; this makes it practical for use with dry cells, since the other characteristics are very similar to those of the 6C5. Although only a 90 V. "B" battery is shown in Fig. 2A, louder signals may be had by use of 135 V.

The power supplies shown in Figs. 2B and C are both for use with D.C. power lines of 110 V.—that in C having an additional filter to remove the ripple which is sometimes quite annoying on these lines. Figure 2D shows the same resistor cord used on a 110-V. A.C. line, with the high voltage coming from batteries. For complete A.C. operation, Fig. 3, it will be necessary to use another tube as a rectifier, a second 6C5 tube serving this purpose. The 350-ohm line cord resistor is again used, and in this case, the filter consisting of R4 and C6 is needed. The entire power supply may be built up in another case similar to that of the receiver.

The use of plug-in coils makes this an all-wave receiver, and the coils may be bought as a complete set or they may

(Continued on page 241)

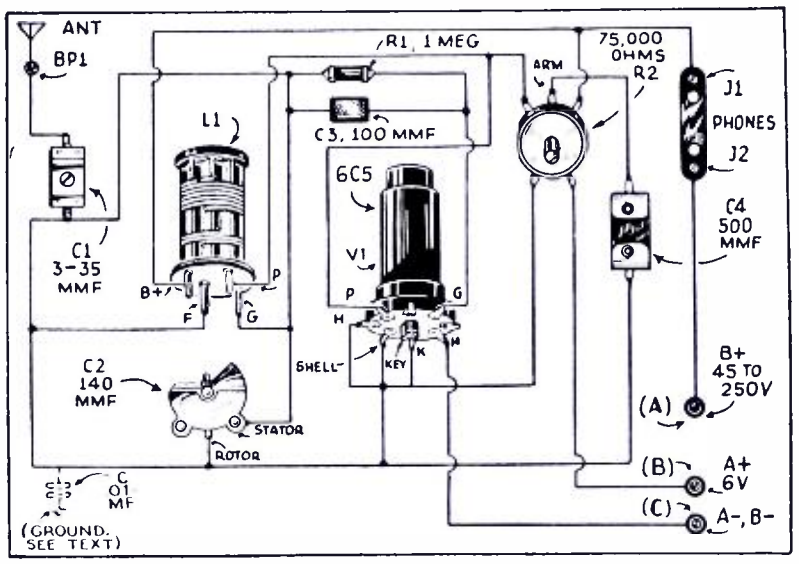


Fig. 1. The simplified pictorial circuit of the set.

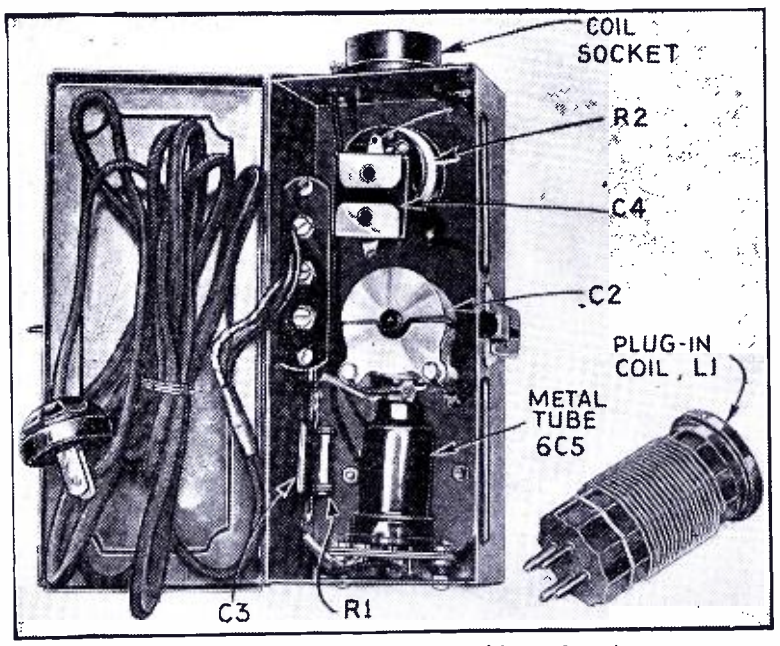


Fig. B. The interior, showing positions of parts.

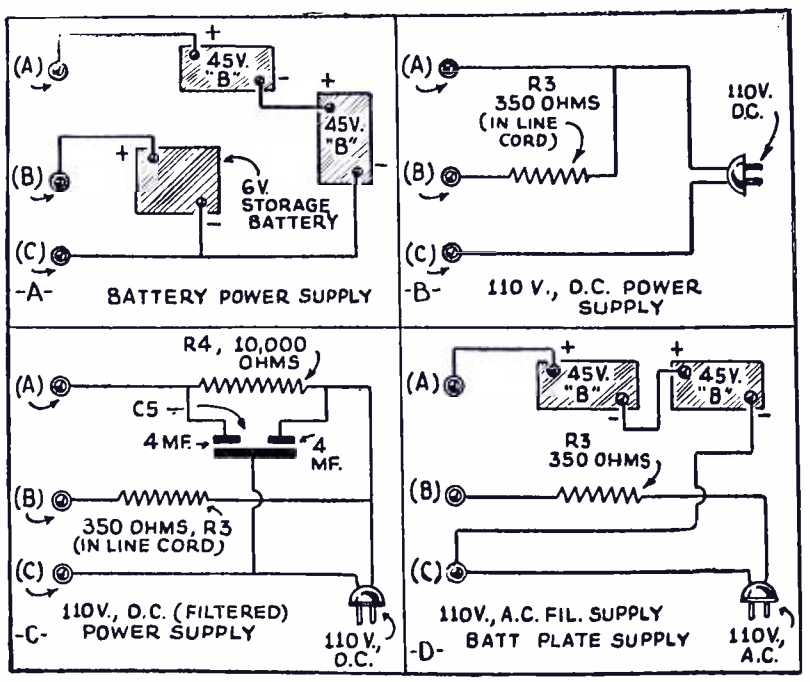


Fig. 2. Four power-supply circuits for the set.

ANALYSES of RADIO RECEIVER SYMPTOMS
OPERATING NOTES

Atwater Kent 165, 425, 665. These models have been serviced frequently for the complaint of circuit oscillation and hum. In almost all cases, the trouble has been traced to a loss in capacity of the second electrolytic filter condenser, an 8-mf. unit. In some few instances tone quality will be distorted and the hum condition may not be noted.

Where circuit oscillation is experienced and signal strength is decidedly weak most of the stations received being obtained at incorrect dial settings with cross-talk, look for an open-circuited type 57 1st detector-oscillator bias resistor R1. This is a wire-wound pigtail type unit connected as shown in Fig. 1A.

Atwater Kent 206, 376. Incorrect dial calibration at the low-frequency portion of the broadcast band is a common complaint with these models. To correct the condition, the broadcast oscillator padding condenser must be adjusted. The adjustment screw is located to the rear of the chassis and appears to be a mounting screw of some sort, set back slightly through an opening in the rear wall of the chassis.

Atwater Kent 310, 510. An inoperative receiver with the plates of the type 80 tube heating excessively may usually be traced to a grounded filter choke, the coil winding short-circuiting to the laminated core. In some cases an efficient repair may be effected by loosening the filter choke assembly and inserting a strip of insulating material between the unit and chassis. This can be accomplished only when the choke coil is fully insulated from the shield case by the impregnating compound. Should continuity be obtained between the laminated core and the shield, it is necessary to insulate the entire assembly from the chassis with insulating bushings and washers. Although the latter is not strictly intended as a permanent repair, it may be; providing the case is labeled "hot" to prevent possible "kicks" in the future, should one hand accidentally be placed upon the choke assembly, and the other on the chassis.

Where the *shadowgraph indicator* functions normally and the receiver is inoperative, look for an open-circuited R.F. choke in the diode circuit, the open-circuit being due to the pigtails of the choke. A voltage analysis with a set analyzer will not disclose this condition, although an ohmmeter connected between either plate or grid of the second-detector type 56 tube and chassis will readily point to the trouble. The correct reading to be obtained here is approximately 0.5-meg., the value of the volume control. The open-circuited choke is easily repaired.

The complaint of intermittent reception on these models has frequently been traced to poor internal contact of the .0014-mf. oscillator series condenser. As with a faulty wave-band switch, the condition may be reproduced by tapping the front of the cabinet. Replacement of the condenser is the only remedy.

Atwater Kent 318, 447, 557. These models have been serviced upon a number of occasions for the peculiar condition wherein stations at the extreme low-frequency portion of the broadcast band cannot be received. This symptom is not the result of short-circuiting tuning condenser plates as would be immediately suspected, but is due to a failure in the oscillator circuit of the broadcast band. The trouble is caused by poorly soldered connections at either the top terminal lug of the broadcast oscillator coil, to which the blue rubber-covered lead from a tap on the 3rd section of the wave-band switch is connected, or to the terminal lug adjacent to the unused lug on the coil. There are 2 oscillator coils located near the wave-band switch under the chassis. The one in question has an unused lug terminal. Fading and intermittent operation occurring at the low-frequency end of the broadcast band has also been found due to corroded or dirty contacts of the oscillator section of the wave-band switch:— clean with carbon tetrachloride.

Distorted, high-pitched and weak reception, with the additional circumstance of a narrowing shadowgraph indication, all of which may also be of an intermittent character, have been traced to the grounding of the cathode terminal of the type 55 tube socket by one of the self-threading screws used to hold the bottom shielding plate of the chassis. This screw projects just far enough within the chassis near the cathode terminal of the socket to make intermittent contact to the latter. The screw may be loosened or a shorter one installed, although the better practice is that of removing the chassis and bending the cathode terminal of the socket down to effect greater clearance. When these receivers are serviced for this condition, the lack of cathode voltage on the type 55 tube as disclosed with an analyzer, or an incorrect resistance indication obtained in a point-to-point analysis will show the trouble to be present at this point. It should be remembered, however, that when the bottom plate of the chassis is removed, the difficulty clears up.

Poorly soldered connections seem to be a frequent cause for intermittent reception on these models, for example, a poor connection of one side of the broadcast band oscillator series condenser, a 420 mmf. unit, to the frame of the wave-band switch. In earlier chassis of these models, the series condenser is a 360 mmf. unit. It is advisable when checking these receivers for this complaint to pull upon all connecting leads with some insulated instrument while the set is operating.

Fading or oscillator drift on the short-wave bands has been corrected upon several occasions by bonding the frame of the wave-band switch to the chassis with short lengths of phosphor bronze drive cable, and by cleaning the contacts of the switch with carbon tetrachloride. When performing this operation, the wires to the wave-band switch should not be disturbed too much or dial calibration will change, making re-alignment necessary.

When either the 1st and 3rd or the 2nd short-wave bands are found inoperative except for a hiss or rushing noise at the low-frequency ends of these bands, check the connections to the 2 coils located between the type 2A7 and R.F. type 58 sockets. These coils are partially held in position by screws passing through a riveted bar extending across openings in the chassis made for the coil lugs. One lug on each coil is grounded to a lug held in position by the coil mounting screw. The short leads between these lugs break either at the coil or grounding lug, producing the condition described. A check made between the control-grid of the type 2A7 and chassis with an ohmmeter or continuity device will point to the trouble.

The volume control is occasionally the cause of the condition wherein the volume level abruptly lowers and suddenly recovers. Pushing or pulling upon the shaft discloses the source of trouble.

Atwater Kent 317, 337, 856, 976. Circuit oscillation experienced while tuning on short-wave bands for foreign stations may often be remedied by removing the "neutralizing" coil in the 2nd I.F. transformer from the screen-grid circuit of the 6K7 I.F. tube. The leads are colored yellow and white. Unsolder these leads from the I.F. transformer and connect them together, leaving the coil open-circuited. To secure the greatest possible gain from the I.F. stage, the manufacturer has introduced this "bucking" coil to overcome regeneration. However, oscillation as described on quite a few of these models was eliminated by eliminating the "neutralizing" coil.

Atwater Kent 328. Upon complaints of distortion with this model, check the bias on the type 6F5, which should be approximately 1½ to 2 V. A higher value will result in distortion and probably is due to an increase in value of the 22-ohm bias resistor (pigtail wire-wound unit, connected from high-voltage secondary center-tap to ground). A remedy is to cut the Wood's metal ends and solder the resistance wire directly to the terminals to which the resistor is connected.

Clarion 480, Camden 1480. When the condition of distortion and low-signal strength is encountered on this model, and the tunalite action is poor, look for a tunalite bulb with low gas content. The symptoms described are a result of excessive grid bias on the first audio type 56 tube, V2, whose grid is in the tunalite circuit as shown in Fig. 1B. This arrangement operates somewhat as an inter-station noise suppressor.

The complaint of intermittent reception has been traced to a number of causes on different occasions. The most frequent offenders are the 0.02-mf. grid filter condensers in the R.F., det. 1 and I.F. stages. These units open-circuit as a result of poor internal contact and produce the complaint stated. When the

(Continued on page 237)

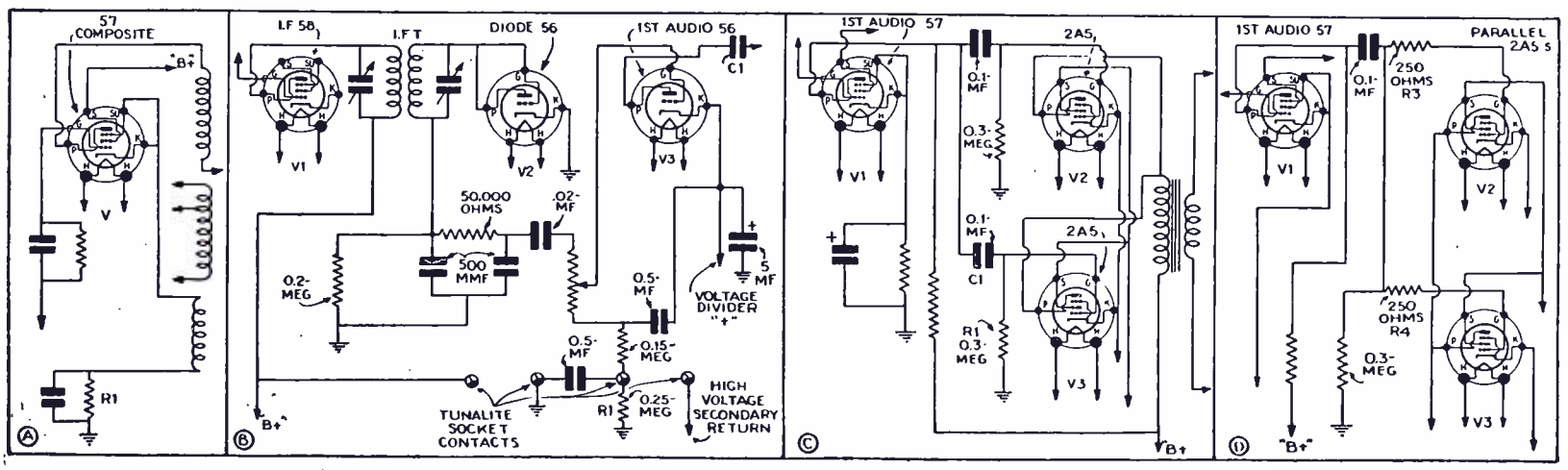


Fig. 1. Here are various circuit troubles easy to remedy. At C and D are shown 2 methods to remove distortion in sets employing parallel output tubes.

MAKING AN ALL-WAVE BOOSTER FOR DX-ERS

The serious DX-er will find in this unit the means for picking up those far-distant stations which can be heard faintly on his receiver.

J. B. CARTER

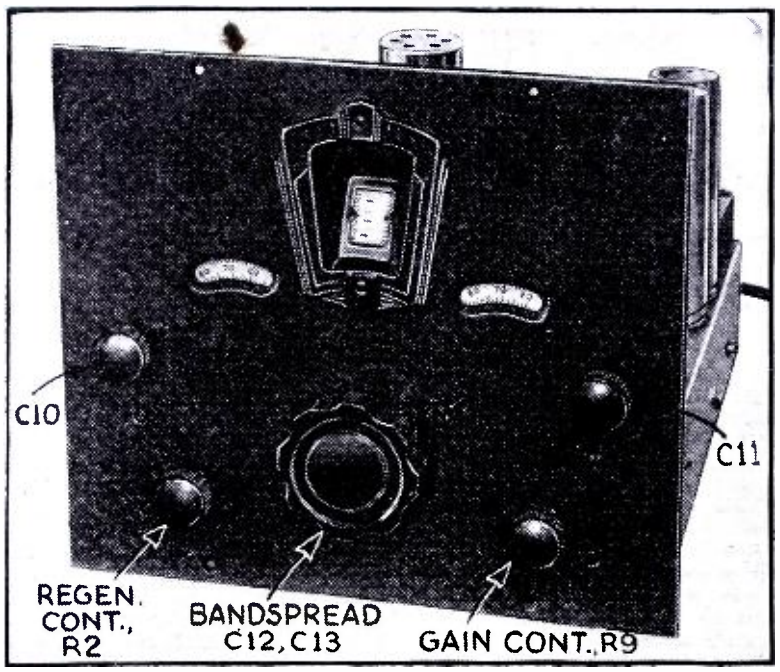


Fig. A. The front panel of the 3-stage pre-amplifier.

HAVING contended with the annoyances resulting from barely audible signals, image interference, the inability to separate stations on adequate channels, and a prodigious amount of background noise during a futile attempt to hear some European stations, the following question arose.

Why not build a radio frequency (or "R.F.") preamplifier as a separate unit, having sufficient sensitivity and selectivity that would remove these idiosyncrasies and yet involve no wiring changes in the receiver? Enwrapped in the first burst of enthusiasm, the preamplifier was visualized as a highly efficient *electrical apparatus criticus* in which the merit of simplicity of control would not be obtained at the expense of performance.

Naturally, there were fundamental decisions to be made. The booster would use A.C. tubes and have its own power supply, since taking power from the receiver might bring about further annoying complications due to the extra load imposed upon the power transformer and the general lowering of all voltages within the set.

DESIGN CONSIDERATIONS

The first real problem was a decision as to what type of R.F. amplification should be employed, regenerative or the straight T.R.F. It is a fact that the internal noises from irregularities in the electronic flow in the tubes is inversely proportional to the gain in the first tube, and that the noise produced in this tube represents a very large percentage of the total noise in the output of the receiver. Since the noise generated in the first tube is really the determining factor of noise, and the signal-to-noise ratio of the tube varies directly with the gain, it is readily apparent that for low noise level the first tube should be operated at as high a gain as possible.

Inasmuch as gain is essential, selectivity is obviously of paramount importance, too. As most forms of static appear simultaneously over a wide frequency range, it follows that the narrower the band of frequencies admitted, the lower the external noise level will be; therefore, the more selective the system is, the more effective will be its suppression of atmospheric disturbances. Selectivity however, is not a constant quantity in any circuit, but depends on the frequency. Since the selectivity is proportional to the inductive reactance, it would be directly proportional to frequency but for the fact that the resistance varies with frequency. The resistance increases more rapidly than the frequency, and for that reason, the selectivity decreases with frequency.

This decrease in the selectivity is unfortunate, because a higher selectivity is required as the frequency is increased. This follows from the facts that the separation of two stations depends on the ratio of their frequencies and also because stations are spaced in the frequency spectrum according to frequency differences. Therefore, on a ratio basis, the higher the frequencies, the closer are the stations, and thus a greater selectivity is required to separate them.

No single coil or condenser circuit is capable of yielding sufficient selectivity for modern needs. Using tuned circuits in tandem with amplifier tubes is the common method used in broadcast-band receivers, but for high-frequency receivers it is not practical due to the difficulties encountered in providing adequate shielding. Instead of using many tuners in tandem to obtain the necessary selectivity, regeneration may be used in a single tuned circuit. Regeneration has the effect of reducing the effective resistance in the tuned circuit and therefore of increasing the selectivity. Perhaps it should be said that the gain is due to regeneration, but it would be the same if the resistance in the circuit were as low as the effective resistance is in the regenerative circuit.

(Continued on page 236)

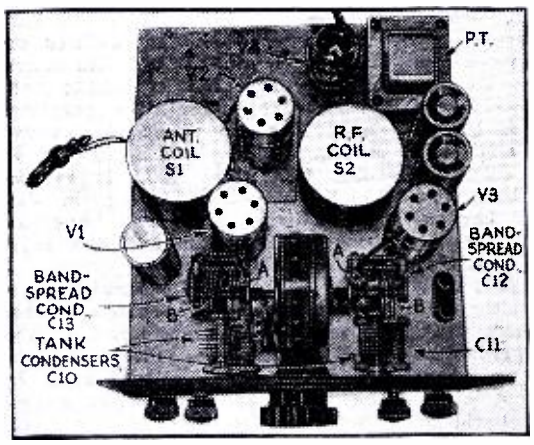


Fig. B. The interior showing the chassis top.

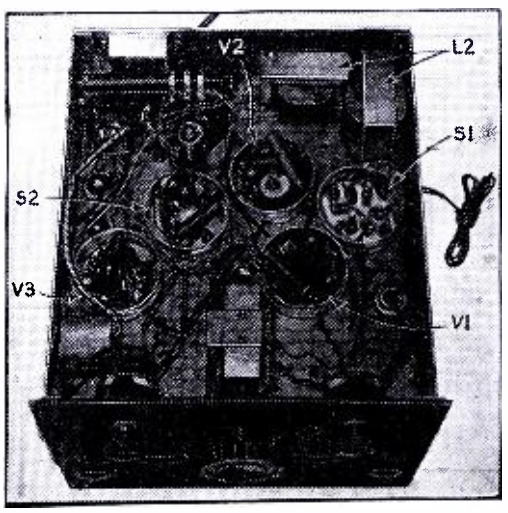


Fig. C. The under-chassis appearance.

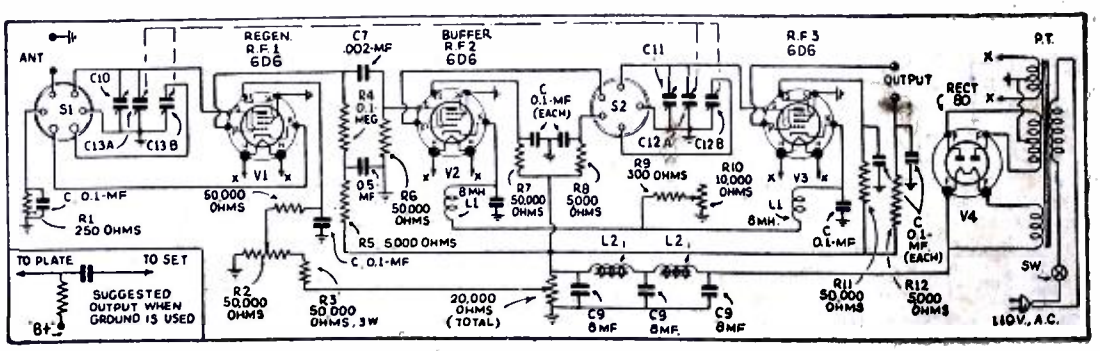


Fig. I. The circuit of the all-wave preamplifier. Band-spreading is used to simplify tuning.

HOW TO MAKE A DIRECT-IMPEDANCE BASS BOOSTER

The design of this add-on unit for increasing the fidelity of existing sets is described.

L. MITCHELL BARCUS

PART I

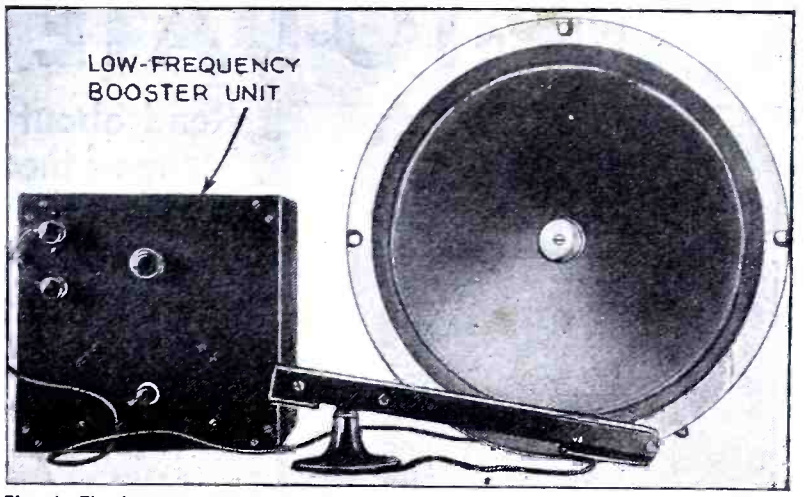


Fig. A. The booster with its low-frequency speaker and a crystal phono. pickup.

FOLLOWING the publication by the writer of articles in the October, 1935, and April and August, 1936, issues of *Radio-Craft*, describing several radio sets which incorporated a low-note amplifier, the interest of the technical world has been aroused to the exceptional possibilities of such systems. Unfortunately, these articles were of a nature which necessarily called for the construction of an entire amplifier of fairly high cost in order to derive the benefits possible from such a system.

Naturally those who already possess a first-class amplifier or a good radio receiver do not wish to undergo this heavy expense, but would far rather have a unit which could easily be attached to their present amplifiers. This has resulted in a world-wide demand for a simple low-frequency booster of easy adaptability. In other words, as put by Mr. E. G. White of Surrey, England, "I would like this network to be an addition rather than an alteration of the existing circuit."

Having had several years' experience with the problems to be met in bringing out a unit of this type which would perform satisfactorily, the writer realized that a number of factors would have to be overcome. While the construction of such an amplifier appears offhand to be rather simple, actual experience has shown that the most careful designing is required in order to meet the critical requirements. Inasmuch as the speaker is the most vital component when operating at these ultra-low frequencies, it had to be carefully selected from the many commercially available, *but mostly unsuitable for this work*, and the circuit held in line with the optimum requirements of the reproducer.

DEPTH

The most obvious and annoying shortcoming of contemporary amplifying systems is the almost total absence of "depth" (power) in the reproduced music. The reasons for this are manifold, and include such factors as: (1) speaker inefficiency in the lower regions; (2) lack of baffle area; (3) losses in the amplifier; and, (4) distortion in the "incoming signal"—whether it be microphone, phonograph or radio.

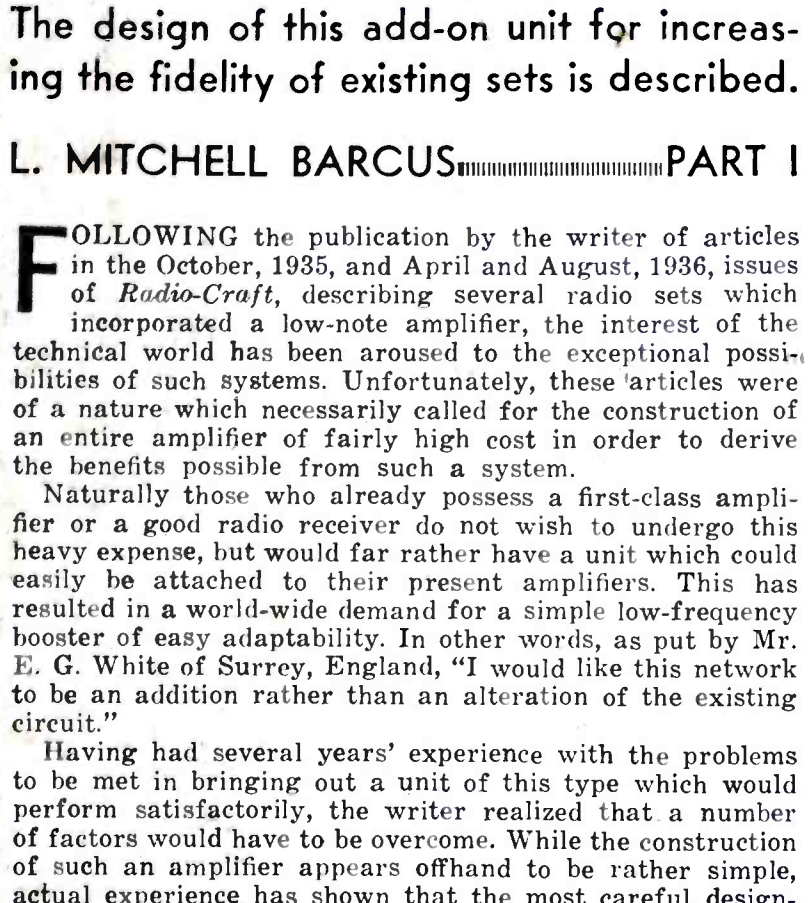


Fig. 1. At A, typical input to amplifier from a radio set; B, response of L.F. booster used as an amplifier; and C, response of booster connected to a radio set.

This fact has been recognized for a considerable while and, as a result, a number of compensating schemes have appeared, the first of which was the obsolete "tone control"—which was found to be utterly futile; and later on, the incorporation of "resonant traps," in the amplifiers, which to some extent would enhance certain frequencies. That such means of obtaining any degree of depth were unsatisfactory from the very first is most clearly shown by the heavy interest taken in the "L.F." (low-frequency) booster.

Despite a great deal of discussion on the subject, it is obvious to an observer that very little is really known by the general technical world about the matter or its importance. When the topic of low notes is brought up in relation to an amplifying system, the average technician will point to what he considers a good example of high fidelity, whether it be a commercial set or one constructed by himself, and reply that it *does* bring out the "lows."

FICTITIOUS "LOWS"

What he refers to are a few indefinable noises that do resemble low notes to a limited extent. They consist, for the most part, of harmonics with a very small percentage of the fundamentals. Enough of the lower frequencies are present to give an *illusion* that these notes are really heard when they are supplemented by the additional volume gained by the amount of fundamental sounds reconstructed aurally from the harmonics. (See, "How Do We Hear," Parts I and II, by N. H. Lessem, in, respectively, May and June, 1936, *Radio-Craft.—Editor*) This property of the ear which enables us to recreate a small part of a note when nothing but its harmonics are present accounts for more of the depth found in radio sets than some people imagine. However, these sounds are without "body," although production of this effect is by far the most important function of the low notes in establishing the sense of true *depth*.

Anyone listening to an orchestra from the outside of a building often finds that about the only portion of the music to filter through the walls consists of those notes which contain enough physical energy to vibrate the partitions and thus transmit themselves through the structure. These notes are in all instances of a very low frequency, usually below the range of a typical amplifying system. On the other hand, a radio set playing in the same room will either not be heard at all or, if loud enough, will be heard outside in the upper registers.

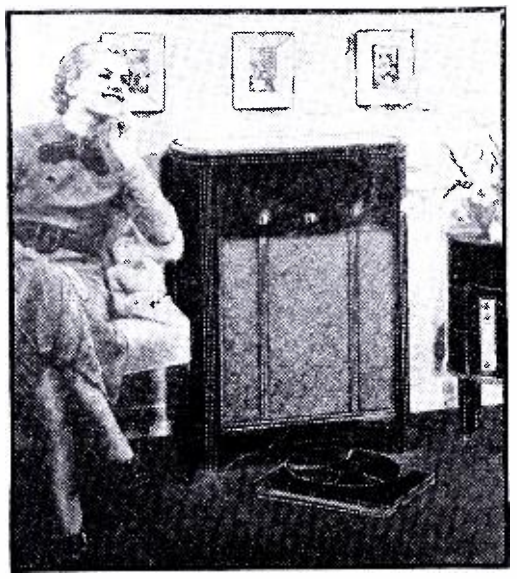
No radio receiver or amplifier can give the same sense of depth unless it, too, can bring out these low notes with the same *power* to actually vibrate heavier bodies, that the original instruments produce. *The lower notes must be FELT as well as* heard, and as the frequency lowers the former function becomes of greater importance until finally the threshold of hearing gives way to a soul-stirring feeling of power in the deep vibrations. Herein lies much of the majesty of an organ which is entirely lost in the feeble pipings of contemporary sound systems. *It requires POWER to produce a low note.*

This is readily shown by a comparison of the amounts of

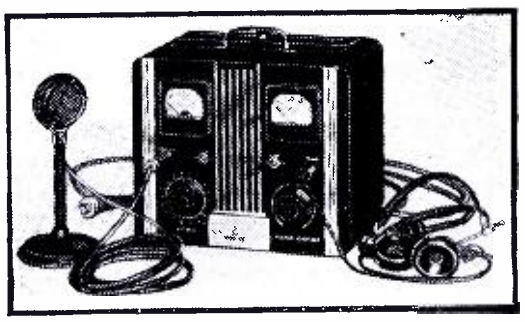
(Continued on page 238)

UP-TO-DATE EQUIPMENT FOR

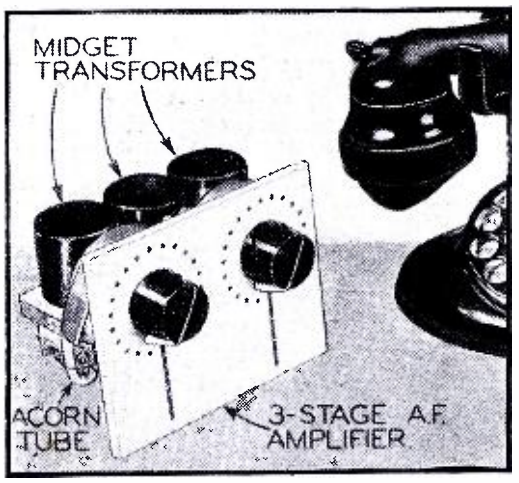
Read about these new devices for the sound technician. Many of these units, each of which is especially suited to a particular service, may be seen at New York's Radio Show.



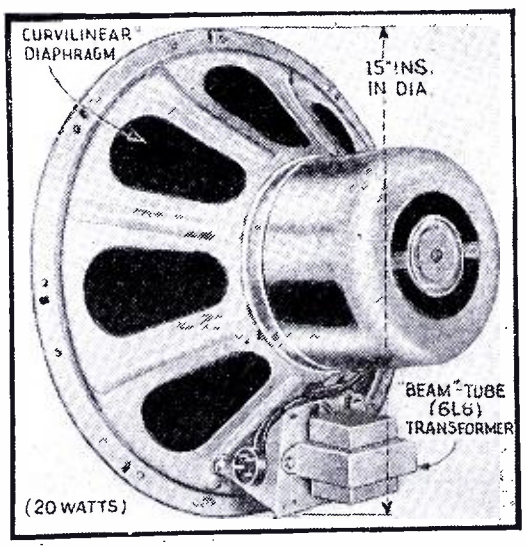
The P.A. specialist whose customers demand high-fidelity phono. reproduction will be interested in this item. (1159)



A modernistic sound-level indicator. (1160)



Using midget transformers. (1161)



Beam-tube reproducer. (1162)

HIGH-FIDELITY PHONOGRAPH (1159)

(RCA Mfg. Co., Inc.)

TRUE high-fidelity reproduction is assured with this instrument. It has a "dynamic amplifier," and an audio response from 50 to 7,200 cycles. Seven tubes are used and provide an output of 15 W. from the large 12-in. dynamic speaker. The improved pickup has a spring-balanced tone arm. A powerful synchronous motor drives the turntable which has an automatic stop and will carry 10- or 12-in. records. The cabinet of this model R-99 instrument is made of the finest woods.

For the P.A. specialist who wants a modern, grade A1 instrument for his customers, this unit fills the bill.

SOUND LEVEL INDICATOR OR "NOISE METER" (1160)

SIX major divisions make up this equipment. They are: a calibrated crystal microphone; a high-gain audio amplifier; a calibrated attenuator; an "ear weighing" filter; a calibrated output meter; a crystal headset. The filter is used so that the db. meter will respond to sounds as they actually appear to the human ear, as the ear is not equally sensitive to all sounds or all intensities. This filter may be cut out if desired. While the standard unit operates on 110 V. A.C., a model may be obtained that is operated by self-contained batteries. The range is from 0 db. to 120 db. A contact microphone may be used to measure vibration intensity.

TINY TRANSFORMERS IN PREAMPLIFIER ARE "FLAT" FROM 20 TO 20,000 CYCLES! (1161)

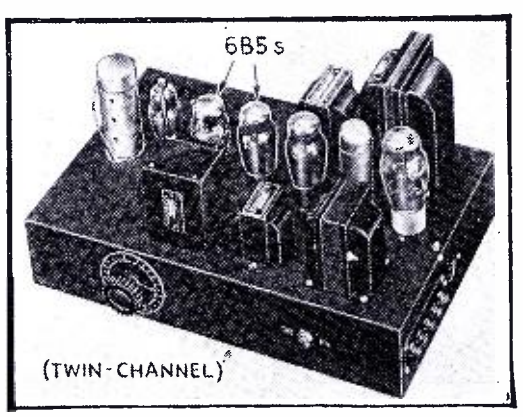
(American Transformer Co.)

THE USE of a newly-developed audio transformer of extremely small size makes possible the unit shown. This is a 3-stage amplifier with a 2-position mixer, with an overall gain of 90 db. and linear characteristics from 20 to 20,000 cycles! The size is 4¾ x 4¾ x 2½ ins. deep and the weight is less than 3 lbs! The transformers themselves measure only 1⅜ ins. in diam. and are but 1½ ins. high, and have a weight of about 3¼ ozs. They are made in a wide variety of types for any purpose.

(These transformers are here shown in a complete amplifier set-up utilizing "acorn"-type tubes, merely to illustrate the amazingly small dimensions of these high-fidelity transformers.)

"BEAM-TUBE" DYNAMIC SPEAKER (1162)

DEVELOPED especially to handle the output of the new beam-type power tubes, this speaker has a frequency range of from 40 to 6,000 cycles. Field excitation may be run between 10 and 18 W. Hum bucking coils may be had; and output transformers to match any of the standard power tubes are available. Power handling capacity is 20 W. average signal power, with sufficient reserve to handle normal peaks. The specially curved diaphragm minimizes cone distortion; and increased voice-coil travel allows the low frequencies to be reproduced with a minimum of harmonic distortion.



A 20-W. amplifier. (1163)

20-W. "6B5" AMPLIFIER KIT (1163)

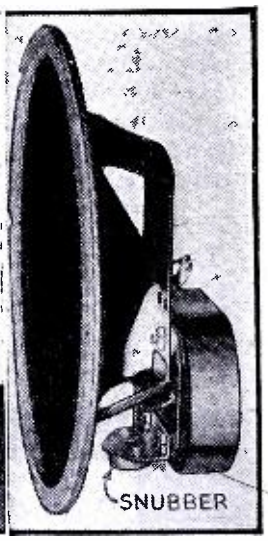
A SINGLE potentiometer controls the input of both channels of this amplifier, the gains being 98 and 138 db. The popular 6B5 output tubes insure high output and fine tonal quality. The frequency response is ±1 db. over a range of 40 to 12,000 cycles. This amplifier is available in the form of a kit of basic parts.

IMPROVED PHONO. PICKUP (1164)

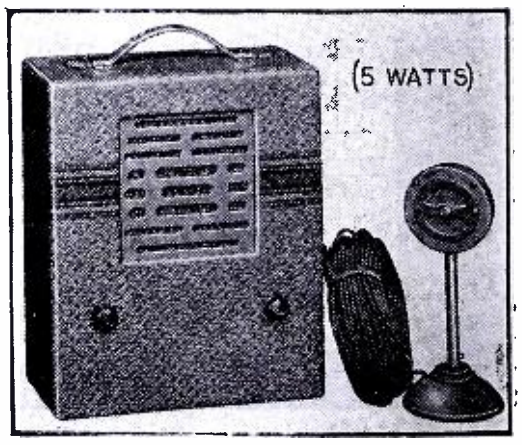
RATTLEPROOF construction is featured in this instrument. It is exceptionally light in weight, and the needle-point pressure is only 2½ ozs. The impedance is 10,000 ohms, although special impedances may be had on order. Finishes are black crackle, statuary bronze, or

A new phono. pickup. (1164)

A channel amplifier. (1165)



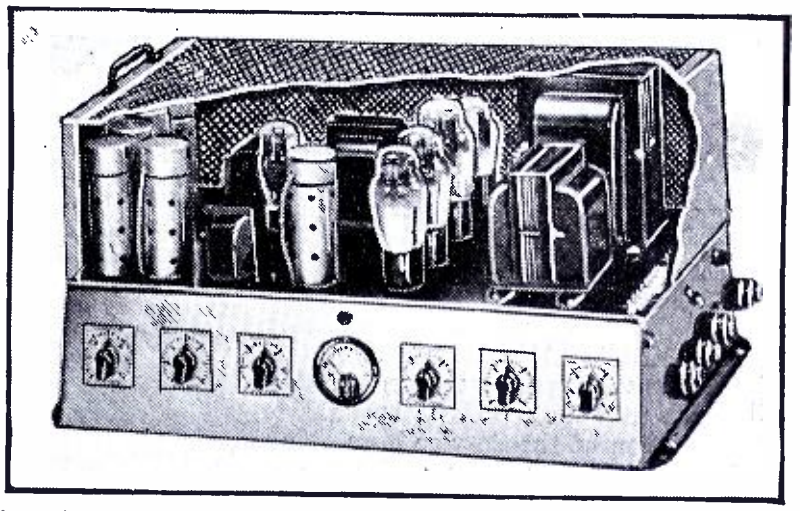
A "bass-note" magnetic. (1166)



This P.A. unit "looks" portable! (1167)

THE PUBLIC-ADDRESS SPECIALIST

Most radio men interested in public address do not realize the extent of this field, revealed by a study of the widely-diversified components here described.



Here is a "beam" amplifier that develops the full 60 W. capacity of the 6N6 tube. (1172)

polished aluminum. The frequency range is 100 to 4,500 cycles. A magnet of 17 per cent cobalt alloy is used.

Although the frequency range here given may at first glance appear to be somewhat low (as compared to ordinary "radio" reproduction), it must be remembered that commercial phonograph records *for home use* seldom exceed this range.

RACK-AND-PANEL 20-W. AMPLIFIER (1165)

A COMPLETE power amplifying system is mounted on this rack. It consists of a class AB amplifier with a gain of 82 db., a power output of 20 W., and the various mixing and speaker control panels mounted together with a phonograph reproducer. One panel carries the mixing controls, and meter for carbon-microphone current, and another contains complete switching for 3 dynamic speakers and 2 magnetic units. The tubes used are: 2—56s, 1—2A5, 2—2A3s, and 1—5Z3.

NEW WIDE-RANGE MAGNETIC LOUDSPEAKER (1166)

RATTLING on high-amplitude sounds is prevented by the design of this new magnetic speaker. A "snubber" of rubber holds a flat piece fastened to the armature. On low and medium-level signals the flat piece slides through the rubber, but at high amplitudes, the customary magnetic-speaker rattle is absent. It is said to have more sensitivity than the usual dynamic speaker, and much more volume than the usual magnetic speaker. A wide tonal range is reproduced, and the speaker is expected to find widespread use in small battery and midget sets.

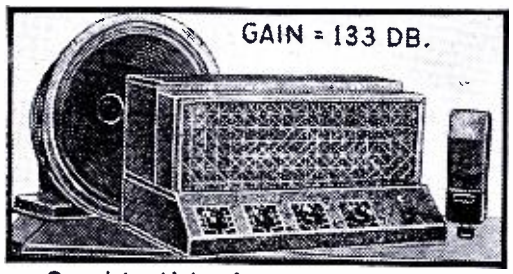
PORTABLE P.A. SYSTEM (1167)

A POWER output of 5 W. is available from this compact amplifier, and an extra speaker may be added if desired. The gain is 58 db. which is more than sufficient for the high-quality double-button microphone used. The latter is fitted with 25 ft. of cable. Both "mike" and cord fit into the case, making an extremely compact unit.

HIGH-GAIN AMPLIFIER (1168)

(Supreme Sound Labs.)

HIGH-FIDELITY output of 10 W. is produced by this amplifier. The response is essentially flat from 30 to well over 12,000 cycles. Seven tubes are used, and speaker field excitation of 18 W. is provided. The amplifier is designed to be used with a high-fidelity velocity mike. The coverage is about 5,000 people indoors, or about 15,000 sq. ft. outdoors. The gain of 133 db. makes it possible to have full output with the mike at a distance from the sound source.



Complete, high-gain P.A. system. (1168)

PHONO. ATTACHMENT (1169)

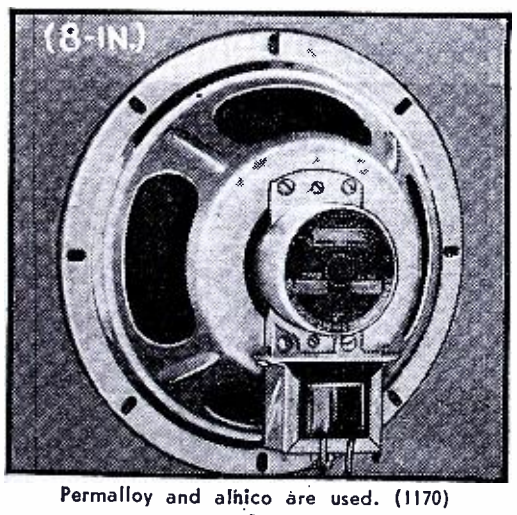
AN ORDINARY radio set may be converted into a high-class electric phonograph by use of this equipment. It consists of a constant-speed self-starting motor and a crystal pickup. The output is equipped with a volume control and may be quickly attached to most radio receivers. Models are made for straight A.C. operation and for universal operation. The reproduction is said to be of very high quality.

High-fidelity phono. adapter that connects to an existing set. (1169)

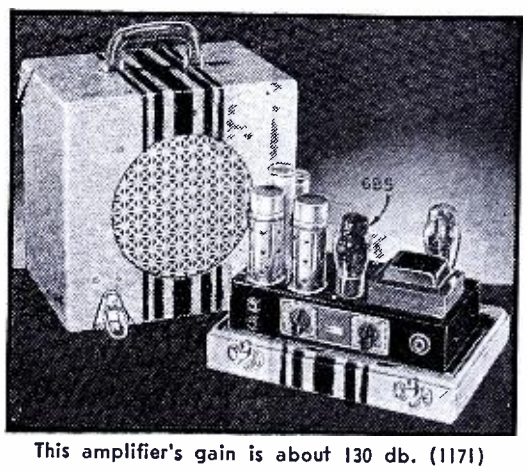
A NEW PERMANENT-MAGNET DYNAMIC REPRODUCER (1170)

THE SPECIAL spider arrangement, as used on this speaker is highly efficient and is very easy to center. Tests on one of these speakers show that the 8-in. type has a maximum of 10 W. and a peak of 20 W. Permalloy endplates together with an alnico magnet assure the most

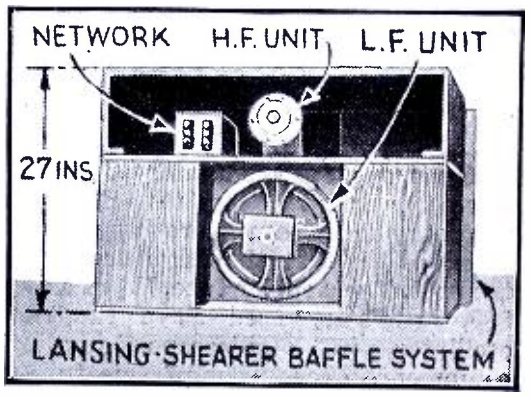
(Continued on page 239)



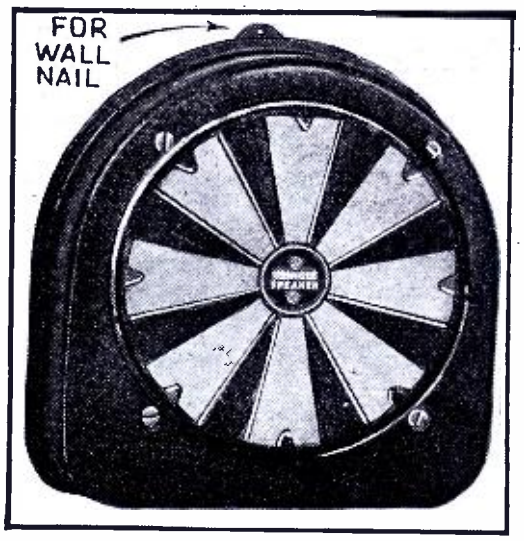
Permalloy and alnico are used. (1170)



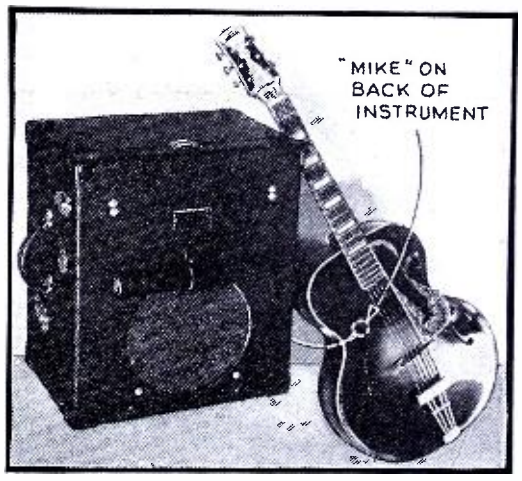
This amplifier's gain is about 130 db. (1171)



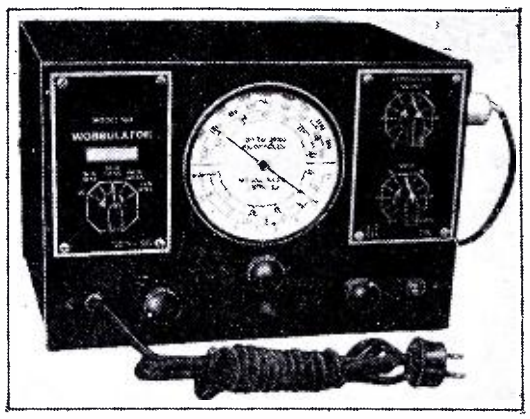
This unit incorporates "talkies" principles in its design. (1173)



Field current is not needed. (1174)



An instrument for musicians. (1175)



A NEW ELECTRONIC-TYPE OSCILLATOR-WOBBLER FOR OSCILLOSCOPE SERVICING

A frequency-modulated oscillator using a relaxation oscillator for "wobbling"—for visual set aligning.

E. J. DOYLE

THIS OUTSTANDING piece of test equipment has several novel features that may well be brought to the attention of the Service Man.

It is designed specifically for use in conjunction with an oscilloscope for service work, although it may of course be used with an output meter for the more usual type of set alignment. The oscilloscope application makes it imperative to incorporate a frequency modulator or "wobbulator" in the apparatus and it is here that the greatest novelty of this particular apparatus rests.

The frequency modulator is entirely *electronic* in operation, thus it is unnecessary to use any vibrating parts or motor as has been the usual practice in the past. The wobbler tube, V3, is a type 885, ordinarily used as a saw-tooth oscillator in oscilloscope auxiliary equipment. The output of this tube is coupled to the grid circuit of the fixed frequency oscillator, V5, so that the frequency of the latter is swept through a range of 30 kc. Since V5 is also the mixer, the beat produced between its oscillator section and the master oscillator, V1, will always be "wobbled" or varied regularly, back and forth, over a band of 30 kc., regardless of the output frequency. In connection with the wobbling circuit, the pattern on the oscilloscope screen will have on each

(Continued on page 238)

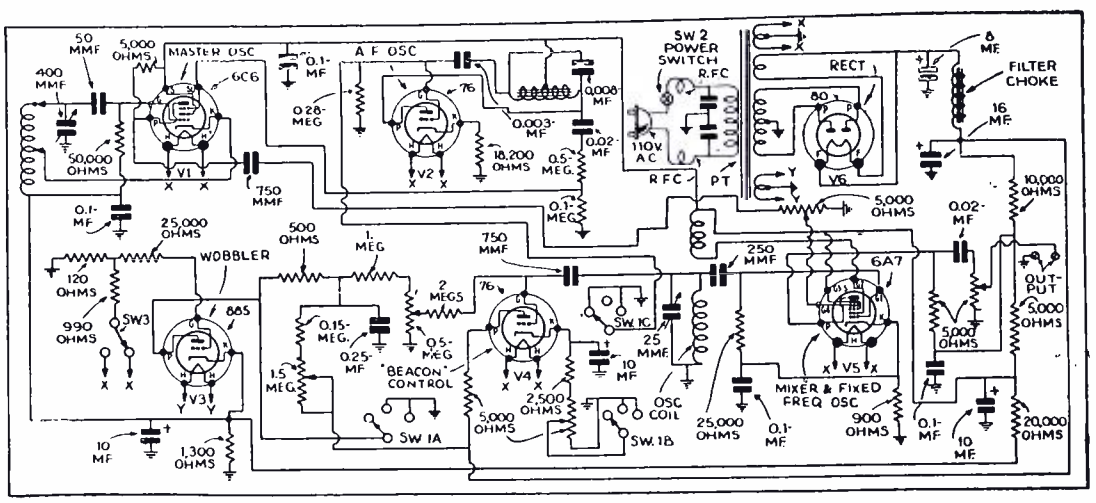


Fig. 1. The "wobbulator" circuit with values of parts, is here published for the first time.

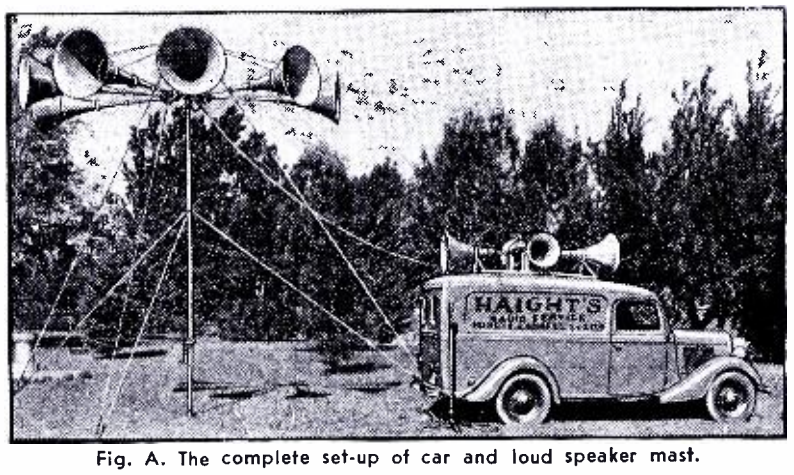


Fig. A. The complete set-up of car and loud speaker mast.

"A MODERN SOUND TRUCK AND P.A. SYSTEM"— AN OPEN LETTER

An interesting P.A. set-up which may be useful to other radio men in this lucrative field.

APOCATELLO, Idaho, service organization tells a well-known amplifier and transformer manufacturer just how his products are utilized in the field, for electioneering, ballyhoo work, etc.

Gentlemen:

We are forwarding to you some photographs of a sound truck and public-address or "P.A." system used for advertising both our retail and wholesale departments in this territory; and on some occasions the unit is rented by my son, who operates the retail department, for electioneering, and for rodeos and fairs, at a very nice profit.

We thought that you might use some or all of this material in your publicity for the purpose of stimulating P.A. and sound truck installations for the smaller dealers

(Continued on page 245)

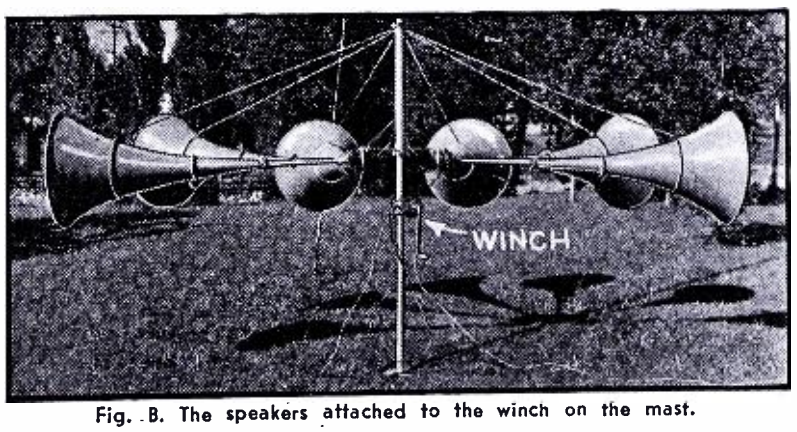


Fig. B. The speakers attached to the winch on the mast.

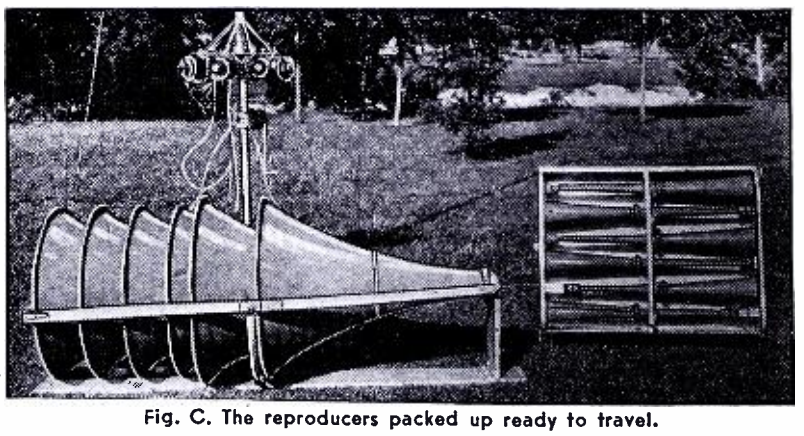


Fig. C. The reproducers packed up ready to travel.

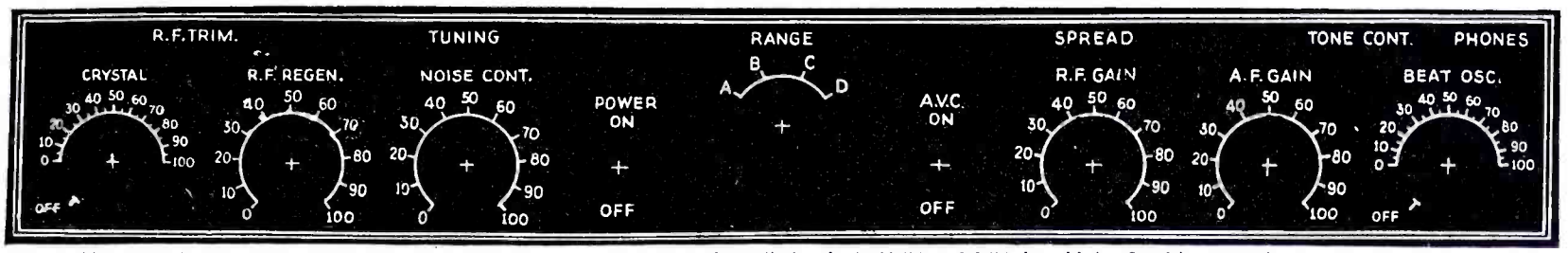


Fig. 4. The exact layout of the photostat which is fastened to the panel. Overall size is 17 11/16 x 2 9/16 ins. high. Outside controls are 1⅛ ins. in from each side; next 2 are 3 3/16 ins. in; next are 5 3/16 in. in, and switches are 7 ins. in from ends. They are all ⅞-in. up from bottom, except for center hole.

HOW TO MAKE AN ULTRA-DX 12-TUBE ALL-WAVE SET

Herewith is presented all data necessary to construct and set into operation the all-wave receiver treated theoretically in the last issue. A list of parts was given in Part I.

H. G. McENTEE ..... PART II

SINCE ALL theoretical considerations were covered in the first part of this article, we shall now launch directly into the construction of the receiver.

To begin with, it must be assumed here, of course, that all holes are cut out as shown on the accompanying layout diagrams, Fig. 3. It may be mentioned now that it will be necessary to have a strip of 1/16-in. thick aluminum between the panel and chassis, and extending from the top of the chassis down about 2¼ ins. This is needed because the base of the metal cabinet is bent upward about ½-in. all around the edges, and this bent portion is slipped between the panel and chassis.

The black plate on the lower part of the front panel (Fig. 4) is what is commercially called a "glossy photostat." The first step in preparing this is to draw to exact size on regular white drawing paper an exact facsimile of the desired plate. This is then inked with regular india drawing ink. The *glossy photostat* is made from this and has a fine shiny finish that looks excellent and wears very well. It is fastened to the front panel with a good grade of rubber cement, although other adhesives might be employed. It is best to wait until

(Continued on page 242)

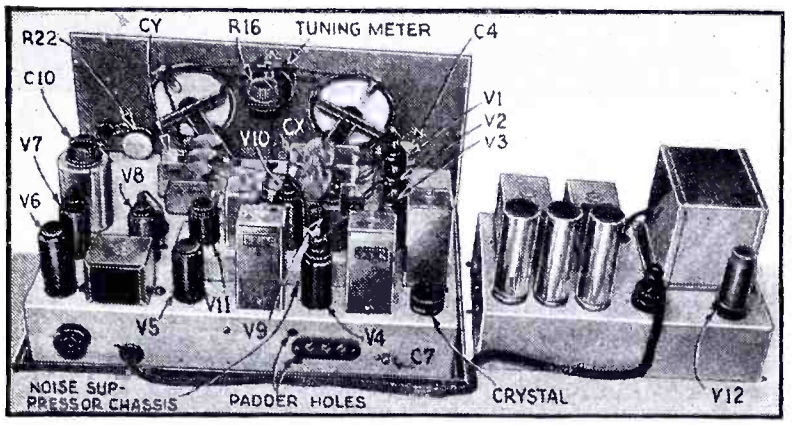


Fig. B. Rear view of receiver and power supply. Note angle of dials.

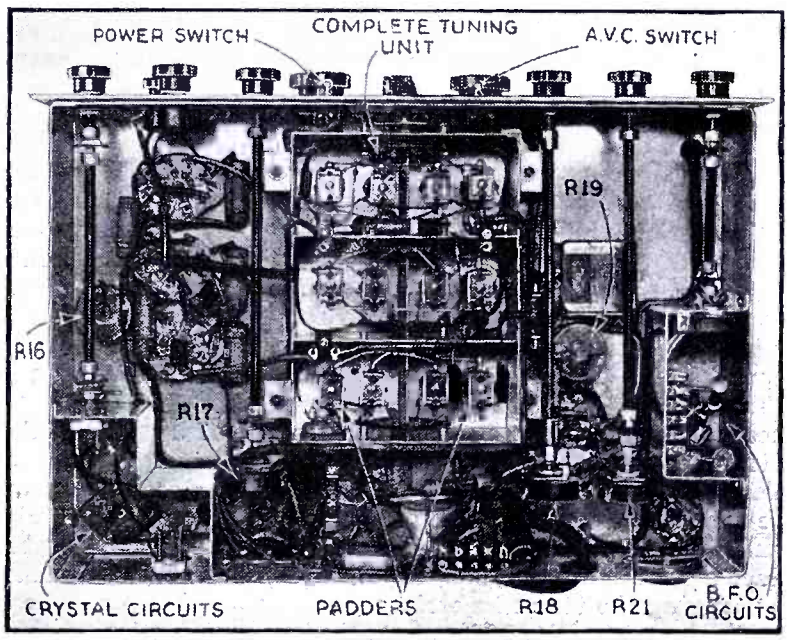


Fig. C. All parts are grouped around the all-wave tuning unit in center.

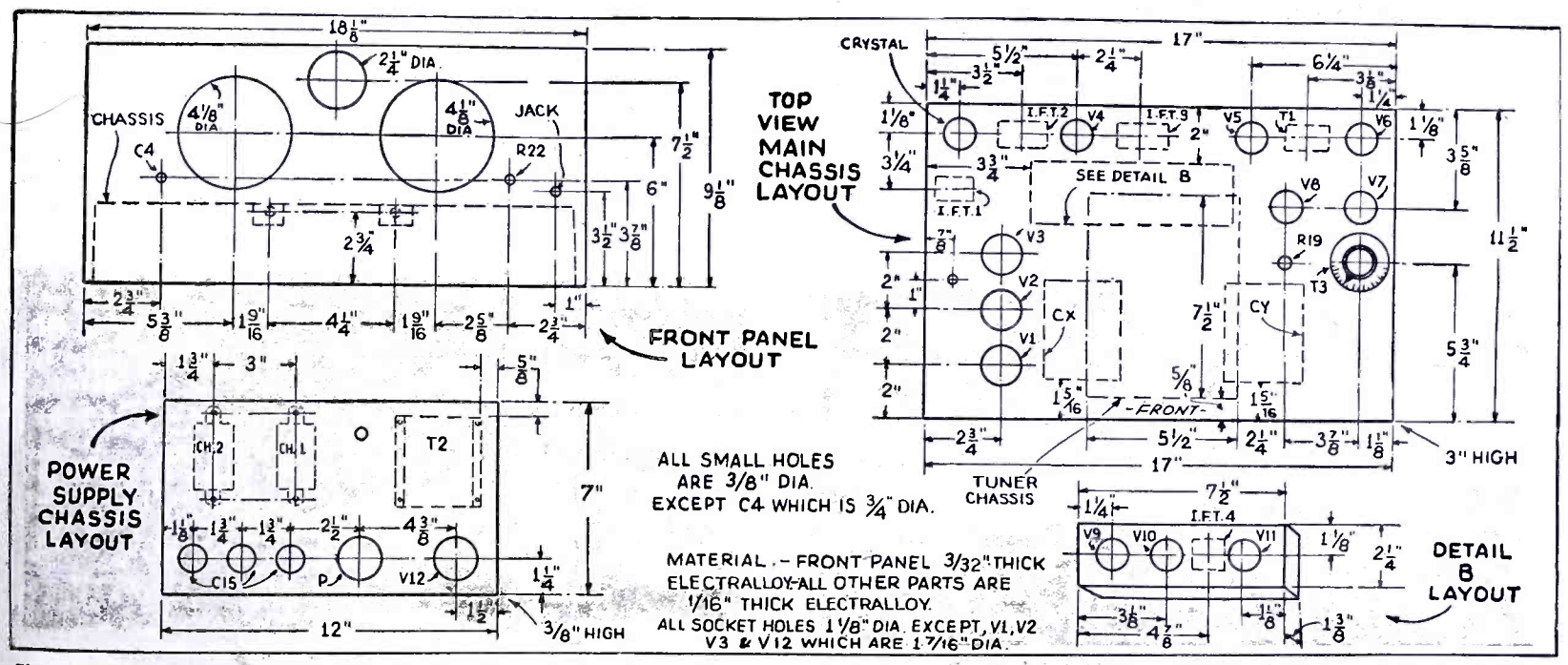


Fig. 3. Simplified layout drawing of the chassis and panel, of receiver and power supply. Parts are not to exact scale since substitutions may be made by the builder.

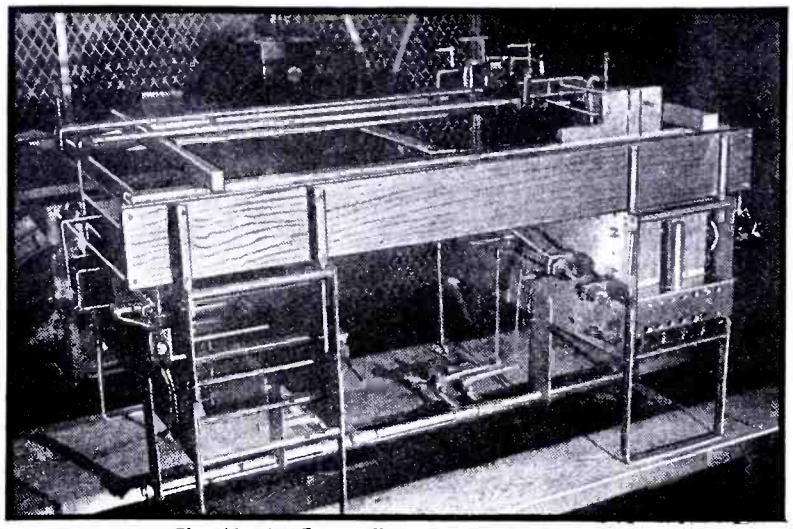


Fig. H. The Eremeeff film organ in the Lab.

ELECTRONIC MUSIC FUNDAMENTALS

This is the concluding part of this very complete survey of the electronic music field in which film-type instruments are described. Photos are included for those interested.

EDWARD KASSEL

Part V

IN THIS concluding part of the series a general description of several types of film-type musical instruments is given. These instruments provide extremely flexible operating characteristics, which may be altered to suit individual needs.

Figure 14 represents a diagram of a number of frequencies synthetically combined into a complex waveform. The lower portion of the diagram represents the same frequencies, changed in amplitude and combined into a complex waveform. This diagram illustrates that, for synthesis, it is important that the number of partials be combined, and also their amplitudes which govern the wave form of the resultant wave.

Figure 15A illustrates a diagram of an electronic musical instrument consisting of a moving pitch film and preadjustable quality film. A light source at times is thrown through predetermined apertures (when shutters are open) into a photoelectric element. The shutters are operated by flexible connections from keys, also connected and disconnected by a spring action to the slowly-moving diminishing roller, which permits the automatic closing of manually-opened shutters in order to produce a diminishing of tone, for example, prolonging the tone of a string.

The insert in Fig. 15A is a close view of the moving-pitch film and stationary quality film. The quality film consists of a number of sections, each section having rows of patterns of its own individual shape.

Figure 15B illustrates an electronic musical instrument employing only one preadjustable quality film. A multisided scanning mirror revolved by a synchronous motor continuously scans patterns on the film with the aid of objective lenses which focus sharply, a single filament light source on predetermined selected portion of the quality film. Graduated transparency discs, inserted in the path of light for increasing and decreasing the intensity of the light, serve as volume control and tremolo action. A vertical set of shutters, pressed on 2 rollers driven by the motor, is connected to the keys with suitable ribbons, so that when the shutter is being lifted, the light portion of the filament shines through a slit of the mask and is focused by objective lenses on a corresponding track. Of course, the revolving mirror focuses the light image to scan that particular track in one direction.

Figures E, F, and G show sample films of various sizes, used in the photoelectric production of music with the aid of the film.

Photo H represents the Eremeeff film organ which utilizes film, shutters, light sources, optical system for the production of electronic music. The production of electronic music, by using wave patterns, holds a promising future for musical instrument builders, and amateurs, due to unlimited possibilities of tone colors and due to the inexpensive process of duplication of films and the absence of intricate wiring circuits.

This concludes the series of five articles in which an attempt was made to cover all the important developments in electronic music. A supplementary Part VI will discuss questions by *Radio-Craft* readers in connection with the many different instruments mentioned.

(Continued on page 241)

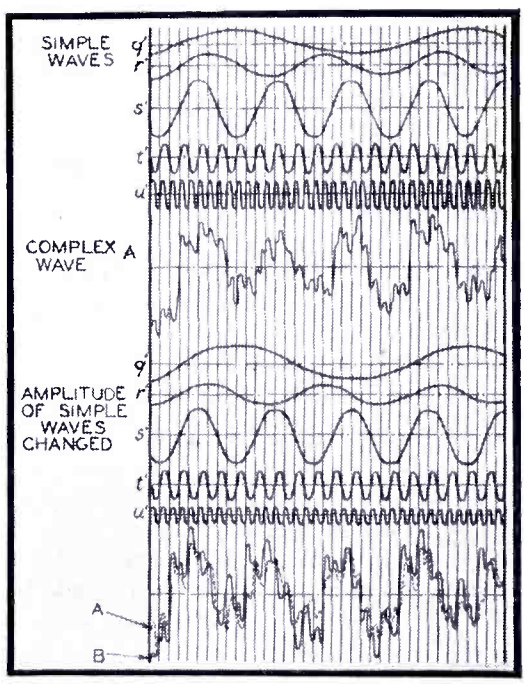
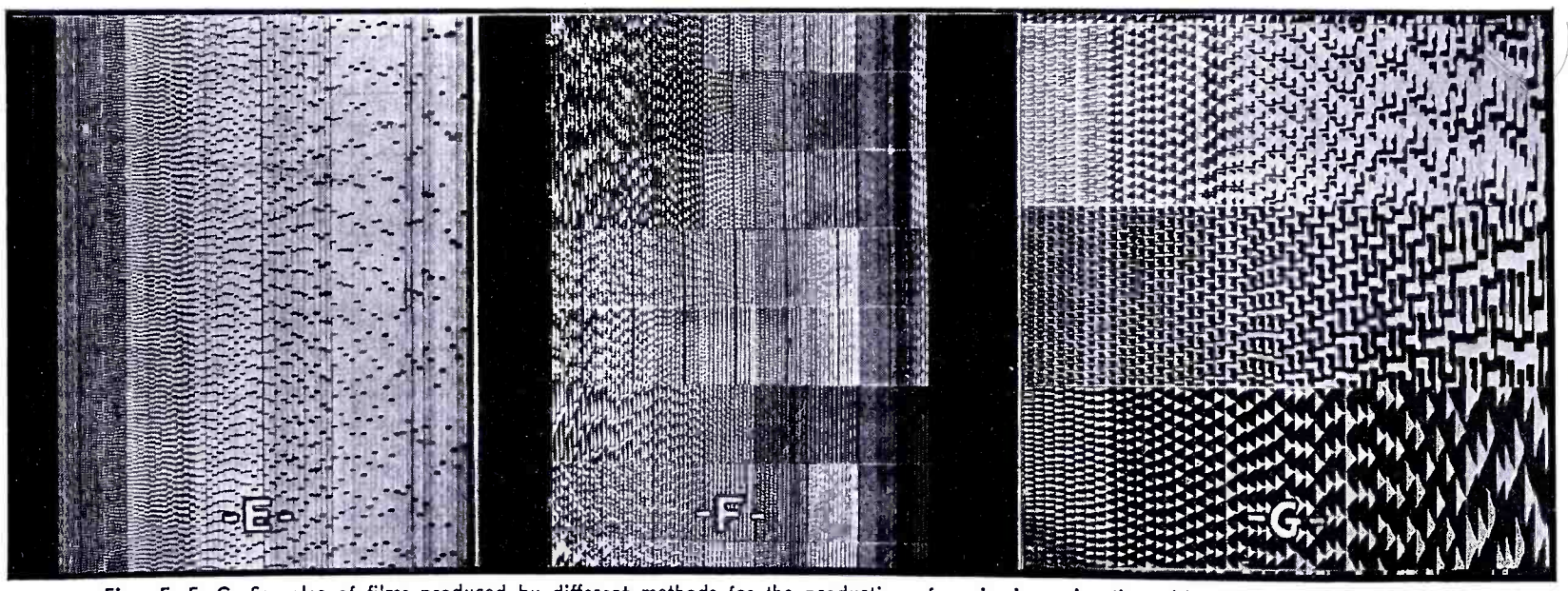


Fig. 14. A synthetically-formed waveform.



Figs. E. F. G. Samples of films produced by different methods for the production of music, in conjunction with a PE. cell and amplifier.

RADIO-CRAFT readers are invited to "speak their piece" on any subject in the entire radio field. Open forum comments such as these are of mutual benefit.

READERS' DEPARTMENT

MORE ABOUT "TRAVELING SOUND TRUCK"

Washington, D. C.:

I WAS very much surprised to see the picture of my sound truck and myself in your September issue. I want to thank you very much.

There is one correction, however—my equipment is not ordinarily used for ballyhoo purposes in and around Annapolis. *I travel all over the United States.* My work to date has been more on the line of a public service, and not for the gain of any one individual; and I have been called upon to render many "out of the ordinary" services.

I would like to tell you a little about my equipment. It is mounted on a 1935 V8 Ford, dual-wheel, panel truck (the wheelbase of which is 131 ins.). I carry at all times the following amplifiers: one 12-W. class A, one 15-W. class AB, one 20-W. class B, and one 30-W. class AB. I use an RCA phono. pickup and ribbon mikes. The equipment is powered by a Kato gasoline motor-generator. The amplifiers are all flat up to 10,000 cycles. I use both trumpets and dynamic-cone type horns to compensate for the frequency response in the output. I mix radio, phono., and microphone at will. All equipment is controlled from the driver's seat.

R. D. WAGNER

The original photograph of Mr. Wagner's truck appears on page 134 of the September, 1935, issue. We are sure other P.A. men will be interested in the above account of the equipment used, as it is certainly complete and up to the minute.

The illustration, Fig. 1, shows a blotter which was enclosed in the letter; a means of advertising that others might employ to advantage.

MODERNIZING AN OLDTIMER

Maynard, Ark.:

I am enclosing a diagram of a Crosley 6-tube battery receiver that I changed to 2-V. operation. I do not know the model number of the set, nor can I find any serial number.

It offered no great difficulty except that the detector tube circuit had a tendency to howl. I tried a gridleak, resistance-coupled detector, and also a grid-bias arrangement, but the howl persisted. I finally put a 10 mh. choke in the detector grid circuit and the results were excellent. I placed the choke on top of the original coupling choke, making an untuned R.F. transformer.

The selectivity is far better than with the old tubes and I have never seen a set, old or new, that will pick up more stations than this one. It overloads the 31 tube, so I expect to try a 33, and also push-pull output.

W. E. THROGMORTON

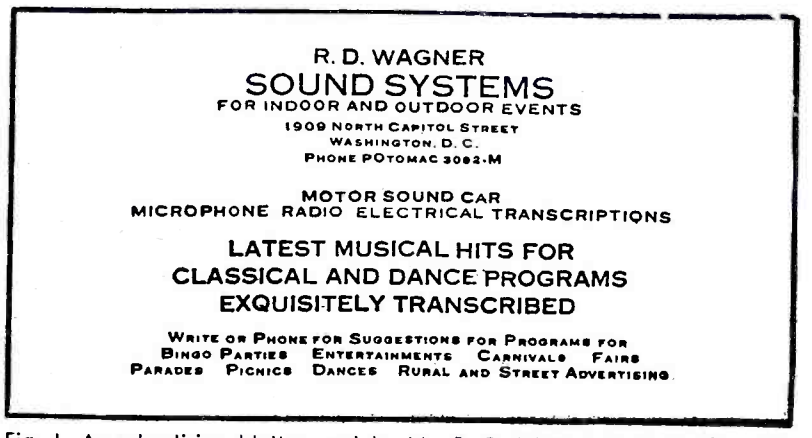


Fig. 1. An advertising blotter used by Mr. R. D. Wagner in connection with his sound system service. A good idea for Service Men.

ARTICLE WORTH SEVERAL YEARS' SUBSCRIPTION! USEFUL ADDITION

E. McKeesport, Pa.:

Habitually a reader of RADIO-CRAFT I have many times found answers to unvoiced questions that were, literally speaking, worth their weight in gold. *Mr. Van Leuven's article in a recent issue was worth more to me than the price of a number of years subscription!*

Believing in saving money by the process of consolidation, I am offering this little addition to Mr. E. M. Shiepe's oscillator which undoubtedly many of the boys will build.

The condenser tester is very useful and saves the price of a box to house it separately, as well as using the 37 tube for more than one function. I believe the diagram, Fig. 3, is self-explanatory, and it will be noticed that the complete drawing of the oscillator is omitted as that can be obtained from RADIO-CRAFT for March, 1935. Only the meat of the matter is presented.

Wishing you continued success for a well-edited and constructive magazine I remain, *a constant reader,*

A. C. CLARK.

This addition will add to the utility of the instrument. It may be seen that the switch changes the 37 tube from an oscillator to a simple half-wave rectifier for condenser testing. Thanks for the compliments.

GRACIAS!

Guayaquil, Ecuador:

I have been reading your review for 8 months and every issue is better than the previous one.

I am very much pleased because in each number I get some circuits of new-model radio sets, which is very im-

(Continued on page 240)

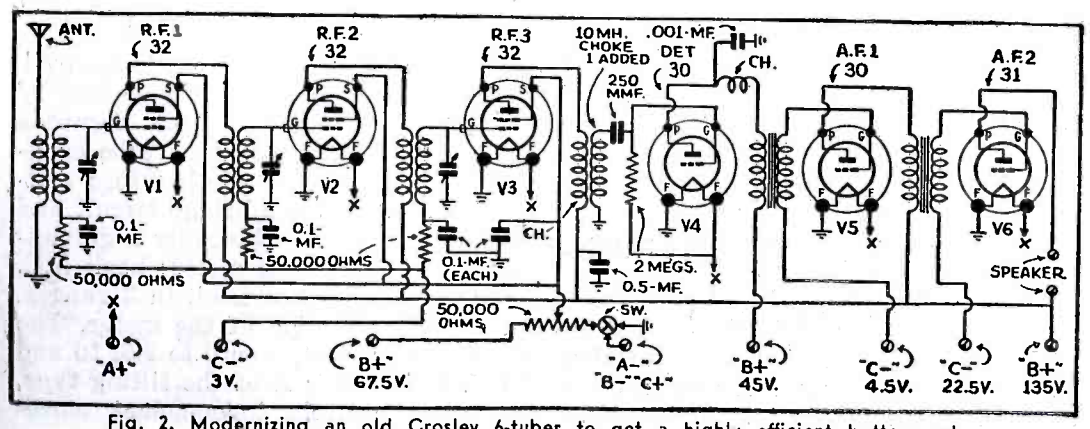


Fig. 2. Modernizing an old Crosley 6-tuber to get a highly efficient battery set.

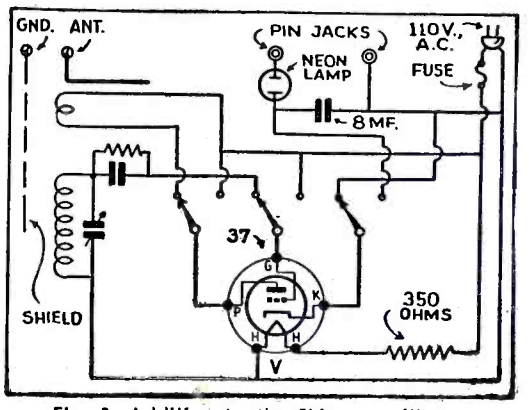
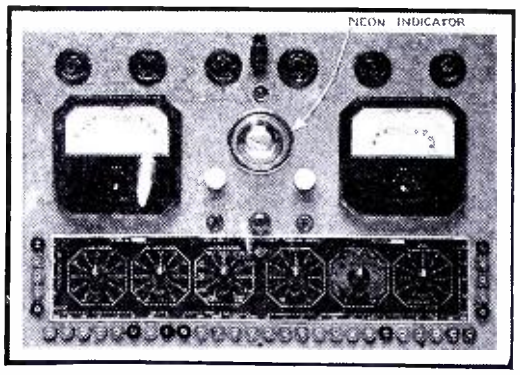
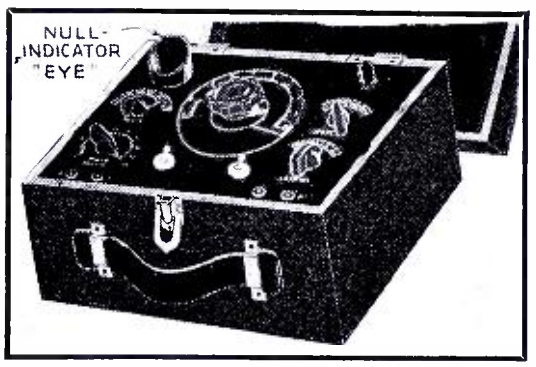


Fig. 3. Addition to the Shiepe oscillator.

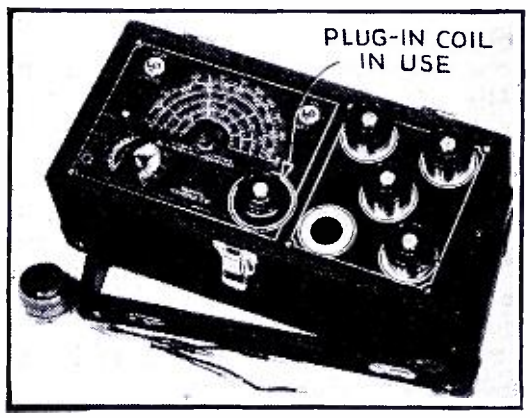
NEW TESTING APPARATUS FOR



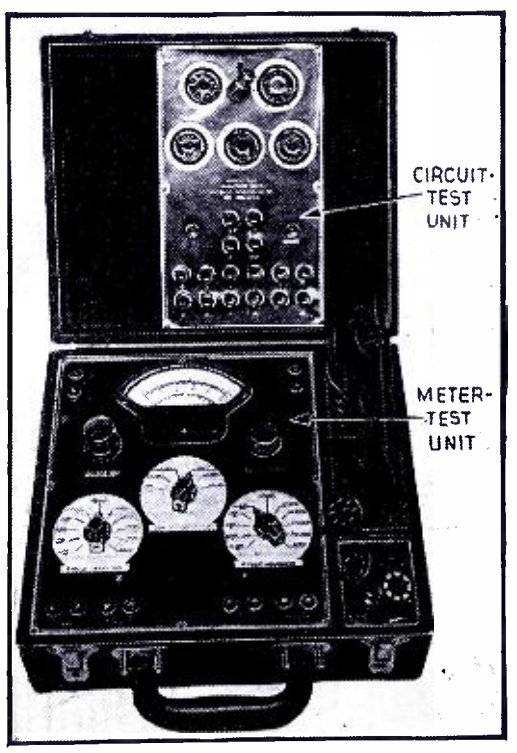
A comprehensive tube tester is included in this set tester. (1122)



An A.C. bridge that may be used as condenser tester. (1123)



Compact test oscillator with calibrated plug-in coils. (1124)



This instrument affords a sensitivity of 2,000 ohms-per-volt. Spare terminals are available for the future. (1125)

Many new developments in testing equipment for the laboratory worker and Service Man are here illustrated and described. A tendency toward versatility of application, and to the use of extended ranges, will be noted.

A VERSATILE "SERVICER" (1122)

THE TUBE tester of the fine-appearing instrument here illustrated operates each tube under its own proper load conditions. A special test analyzes each tube element, and this together with the "hot" neon short-test detects all noisy and shorted tubes, as well as "faders." The selector switch has positions to provide for tubes of 8, 10, and 11 prongs when they are introduced! The 2 meters have 4½-in. scales, and knife-edge pointers. All meter shunts and series resistors, of which there are 35, are of the precision wire-wound type. Ranges are as follows: D.C. voltmeter, 5 steps, 0 to 10, 0 to 1,000; A.C. voltmeter, 5 steps, 0 to 10, 0 to 1,000; D.C. ma., 6 steps, 0 to 2.5, 0 to 1,000; D.C. ammeter, 0 to 10 A.; low-range ohmmeter, 0 to 300 ohms, mid-scale reading of 7 ohms; high-range ohmmeter, 4 steps, 0 to 30,000 ohms, 0 to 30 megs.; complete condenser analyzer.

The condenser analyzer tests all electrolytic, paper, oil and mica condensers for capacity on a 3-range (0-0.4; 0-4, 0-40 mf.) direct-reading meter. Electrolytic condensers are tested for quality while polarized by practically the operating voltages (35, 100 and 350). The condition of the condenser is indicated on a BAD—?—GOOD meter scale. Non-electrolytic condensers are tested for shorts, leakage and "opens" in a highly-sensitive circuit with a large neon lamp used as the indicator.

NEW A.C. BRIDGE (1123)

(Tobe Deutschmann Corp.)

IN ADDITION to its service as an A.C. bridge this apparatus may be used as a resistance and condenser bridge. Besides the more usual dynamic tests for shorts, opens and "intermittent" condenser conditions, power factor may be read directly, and capacities measured with greater precision than on ordinary capacity meters. A neon tube, a 6E5, and an 01A are the tubes used. The range of the resistance bridge is 1 ohm to 1 meg. The capacity range is 10 mmf. to 100 mmf.

Note the hood for convenience in quickly securing a "reading" on the cathode-ray tube "eye."

SERVICE OSCILLATOR WITH PLUG-IN COILS (1124)

(Readrite Meter Works)

INDIVIDUALLY-calibrated coils which have built-in trimmer condensers are used in this instrument. The over-all accuracy of calibration is guaranteed by the manufacturers at 1 per cent for the broadcast band and 3 per cent for short waves. The frequency range is from 100 kc. to 18 mc., *all in fundamentals*. The dial scale is direct-reading. Complete shielding, both static and magnetic add to the stability. Strong signals, both modulated and unmodulated, are furnished.

The design here utilized permits the construction of an effective instrument for the low-price field.

MASTER ANALYZER (1125)

(Radio City Products Co.)

ALL THE features of a multitester and a selective analyzer are combined in this instrument. The metering system (see main case of instrument) is entirely independent from the circuit testing unit (in cover). A 10-wire analyzer cable with bakelite plug enables readings to be made at receiver sockets. (Free point and free reference system of analysis.) A spare wire is included in the cable and a spare terminal on the panel will enable future developments to be taken care of. A 5-in. fan-type meter allows a sensitivity of 2,000 ohms-per-volt on D.C. and 1,800 ohms-per-volt on A.C. Scales are as follows: voltage—5 to 1,000 A.C. and D.C., in 5 ranges; current—500 microamperes, A.C. and D.C.; 59 to 250 ma. A.C. and D.C.; 2.5 A., A.C. and D.C.; resistance —1,000 ohms to 40 megs., in 6 ranges; capacity—0.03– to 300 mf., in 5 ranges; decibels— –15 to +40 db., in 5 ranges; inductance—0.25– to 10,000 hy., in 4 ranges, and 25 and 1,000 millihys. The instrument is sold complete with adapters, cables, etc.

This is said to be the only analyzer to date measuring both A.C. and D.C. *microamperes*, milliamperes and amperes.

V.-T. VOLTMETER "BRIDGE" (1126)

(Triplett Electrical Inst. Co.)

ACCURACY of calibration is assured in this instrument, *independent of changing tube values*, since a circuit is used that is independent of tube emission values, and this is therefore self-calibrating. This is a bridge circuit and is shown to be in balance by a galvanometer section of the meter; peak A.C. or D.C. voltages are read, in 3 ranges, on the other section of the meter. The linear scales read from 0 to 2.5, 10 and 50 V. This meter is of the tilting type, with two entirely independent move-

THE "LAB." AND SERVICE MAN

Manufacturers have found the new cathode-ray tuning tube to be an important adjunct where facile operation is of importance; and that multiple scales and high-resistance meters afford requisite precision. Testing apparatus for 1936-'37 make an almost irresistible appeal to far-sighted technicians who must keep pace with rapidly increasing demands.

ments, as described.

The bridge instrument is extremely valuable in measuring low A.C. or D.C. voltages with negligible current drain. This new instrument brings to the technician the invaluable features of extremely precise measuring equipment, with the ruggedness that characterizes modern equipment design. Note that these advantages are available in portable service; the meter being pivoted along its front edge swings into the main case. The angular position of the meter may be adjusted for any convenient angle between the position illustrated, and the flat position for portability.

"UNIVISUAL" INDICATOR (1127)

A NOVEL new instrument which may be used for checking noisy volume controls with accuracy is here shown. The device is also useful for testing noisy resistors, condensers, and other such equipment. The indicator is the 6E5 cathode-ray tube; and a built-in audio amplifier, which may be used separately, provides ample gain for all tests. Tests leakages as high as 5 megs. An integral power supply assures proper operation from 110 V. A.C. power lines.

This instrument, utilizing a cathode-ray indicating tube, is said by the manufacturers to be "far more" sensitive than preceding types that are dependent upon a neon tube as the indicating element. Note the convenient viewing angle of the 6E5 tube. The apparatus measures only 6⅞ x 9½ x 4½ ins.

The audio amplifier used in this instrument has a gain of 32 db. It utilizes a 6B5 tube, resistance-capacity coupled to the remainder of the equipment.

COMBINED SET AND TUBE ANALYZER (1128)

A COMPLETE analyzing equipment —a "service estimator," the manufacturer calls it—as here shown is housed in a case only a foot square. The tube tester has a BAD-GOOD scale, and each tube element is tested separately, by means of a neon tube, for "hot" tests of elements for inter-element leakage or shorts. The set analyzer has a large, long-scale meter of 1,000 ohms-per-volt rating. A high-ohm scale of 500 ohms to 2 megs. is powered by an internal rectifier (that operates from a 110 V. A.C. power line). The other 2 ranges of ½- to 2,000 ohms, and 50 ohms to 0.2-meg. are powered by a small 4½ V. battery in the case. A condenser leakage tester covers all electrolytic, paper and mica condensers. The voltmeter has ranges of 0-5-250-1,000 V.; milliammeter ranges are 0-5-250.

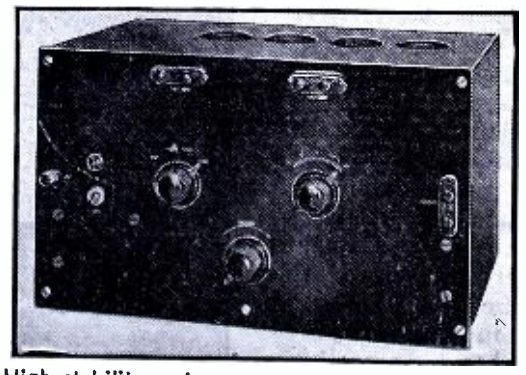
This instrument is quite heavy—11 lbs.—but the manufacturers have outdone themselves in producing a unit that incorporates all the features mentioned above, yet measures only 12 x 12 x 5 ins. deep. (The meter around which this equipment has been designed is of the new "modernistic-appearing" type.)

A HIGH-STABILITY 4-TUBE AUDIO OSCILLATOR (1129)

A MANUFACTURER who has gained an enviable international reputation for producing test equipment that establish standards for precision, has just developed an audio-frequency oscillator of the tube-operated type that probably will soon be an important unit in every well-equipped laboratory, in place of older, less suitable tuning-fork types—or, as a flexible adjunct to precision tuning-fork oscillators.

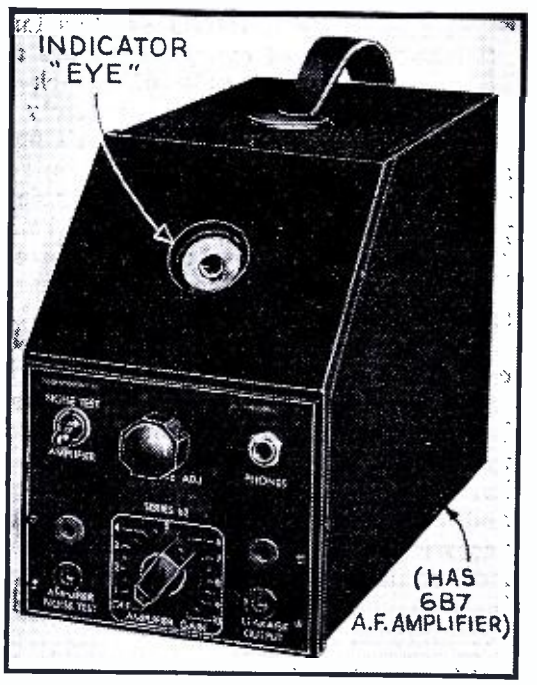
High stability of frequency and waveform is assured with this 4-tube oscillator, regardless of the load being supplied. Values of 500, 1,000 and 2,000 cycles may be secured directly from the instrument (with an accuracy of approximately ±7 per cent in frequency from scale zero), while values from 500 to 10,000 cycles may be had by proper use of external resistors and condensers. The output is 1 W. or more when connected to a load of 2,000 ohms resistance at any frequency between 500 and 10,000 cycles. The circuit consists of a triode oscillator whose output is amplified by push-pull tetrodes. A high-voltage power supply, operating on 110 V., A.C., is built-in.

This instrument is a suitable source of energy for supplying various types of bridges (most of which have been described in past issues of *Radio-Craft*); and for making numerous repeat tests of various components, at commercial test frequencies.

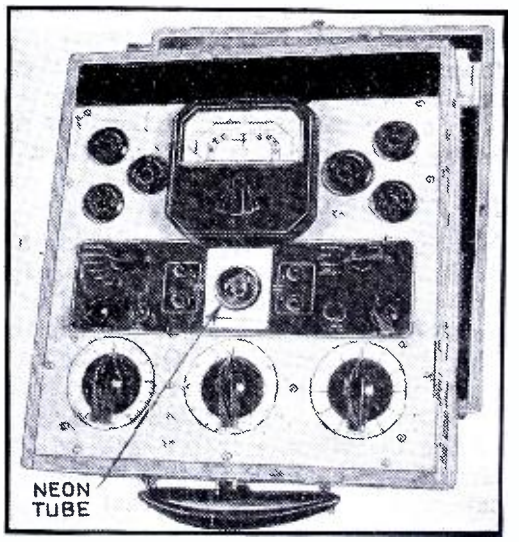


High stability and accuracy are assured for audio tests. (1129)

This V.-T. voltmeter has linear scale readings. It is the first instrument of its kind to bring to the technician the precision facilities of both the bridge-type galvanometer and the peak voltmeter, in a test unit rugged enough for use in portable service. Note that the meter needles indicate vertically. (1126)



Here is a compact unit suitable for either shop or use on outside calls for making those elusive "noise" tests that ordinarily defy detection. Erratic flashing of the cathode-ray tube "eye" gives instant visual indication that a condenser, resistor or tube is developing "noise" characteristics. Note that this instrument also introduces the feature of mounting the "eye"-tube indicator at an angle for more convenient observation. (1127)



An analyzer and tube tester are in this one case. (1128)

MAKING A Q-TEST ADAPTER

In Part I of this article, a description of a really new test instrument for the Service Man and Experimenter is given—don't miss it! Your service oscillator is utilized.

C. W. PALMER

PART I

Photo—Boonton Radio Corp.

Fig. A. The appearance of a commercially available Q Meter. This instrument is complete, having an oscillator, thermal galvanometer, standard condenser and V.-T. voltmeter.

THE RADIO ENGINEER has long used a measure of the "merit" of coils, condensers and other reactive circuits, which, because of a lack of suitable meters or testing units has been entirely neglected by Service Men and radio experimenters. This figure of merit is known as the "Q" or the "ratio of a given reactance to its (R.F.) resistance." By means of a suitable Q-testing unit, it is possible to (1) determine the best coil for a given purpose; (2) match coils for a set; (3) measure R.F. inductance; and, (4) to measure the capacity and resistance of coils, condensers, resistors, insulating materials, switches, etc.

In other words, the "Q meter" as the testing instrument is called, is a most useful measuring device for any radio man. Unfortunately, this instrument has been exclusively a laboratory and factory-production unit, up to now, due to the high cost of available commercial units; the careful handling necessary due to the delicate instruments used and the precision calibration of the various components, necessitated by its absolute calibration; and the fear which most radio men display towards any complicated or precision instrument, especially if mathematical computations may be necessary in some applications.

The purpose of this article is to describe an adapter which may be attached to the all-wave service oscillator (such as the one described, by the writer, in the January, 1936, issue of *Radio-Craft*, page 414) and which may be used to give comparative indications of the Q factor, without necessitating direct calibration, unless desired.

This comparative meter, of course, is limited to some extent when compared to commercial units—which are precise to the Nth degree—but for the Service Man and radio experimenter it is a more rugged instrument which will be found to be invaluable in the design and repair of radio receivers, amplifiers, etc.

In order to understand how the Q-Test Adapter works, let us delve into this factor, "Q", a little more deeply.

THE FACTOR OF "Q"

In a simple resonant circuit (such as a parallel coil and condenser) with a series impressed voltage, the ratio between the voltage across the coil or condenser, to the impressed voltage (in other words, the voltage step-up) is directly proportional to Q. In the case of more complicated circuits the performance also depends upon Q, but not so directly. However, the higher the Q of the reactive elements of the circuit, the better will be the performance of the circuit. An example of this is found in the case of a band tuner, where it is known that a high Q in the reactances improves the transmission in the pass band as well as making the cut-off slope more steep.

THE METHOD OF MEASUREMENT

The method used in the Q-Test Adapter can be understood by an examination of the theoretical circuit in Fig. 1. The oscillator, which is any calibrated all-wave service oscillator with a sufficiently high output, is fed into a very small resistance, R. The value of this resistance will be negligible when compared to the other resistances of the circuit, being only 0.04-ohm. The output of the oscillator is adjusted by means of a vacuum-tube voltmeter, to a predetermined value. A known voltage V1 is thus introduced into the series circuit comprising the condenser C1 (shunted by trimmer C2) and the coil to be measured, L1 (connected across terminals X, X, and adjusted to resonance with the oscillator). The voltage V2 measured across the condenser C1 by the V.-T. voltmeter thus permits the ratio of V1 and V2 to be made and the following relation holds:

$$\frac{V2}{V1} = Q\ (app.) = \frac{1}{2\pi F C_1 R\ (eff.)}$$

And, the reactance of the condenser at resonance is equal to the reactance of the coil, or

$$\frac{1}{2\pi F\ C_1} = 2\pi FL\ (app.)$$

For this reason, $\frac{V2}{V1} = \frac{2\pi FL\ (app.)}{R\ (eff.)} = Q\ (app.)$

Where Q(app.) is the apparent Q; R(eff.) is the effective R.-F. resistance; L(app.) is the apparent inductance; F is the frequency; and C is the capacity in mmf.

The effective Q differs somewhat from the true Q ($2\pi FL/R$) and investigation shows that the difference is due to the distributed capacity of the coil. The difference between true and effective Q is of little importance, however, since in practically every tuned circuit encountered in practice a condenser having a capacity of 10 to 20 times the distributed capacity is connected in shunt to the coil, so that the effective Q is only 5 to 10 per cent removed from the true

(Continued on page 248)

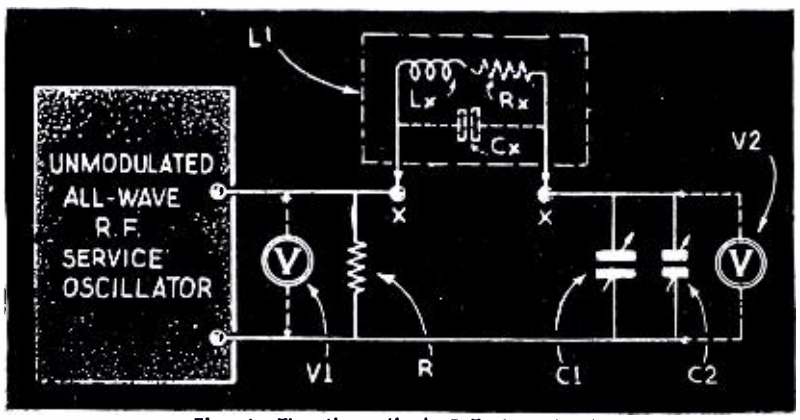


Fig. 1. The theoretical Q-Tester circuit.

NEW DEVELOPMENTS IN WIDE-RANGE SPEAKER DESIGN

Some factors involved in the design of high-coercive magnet speakers for high fidelity.

HALTON H. FRIEND

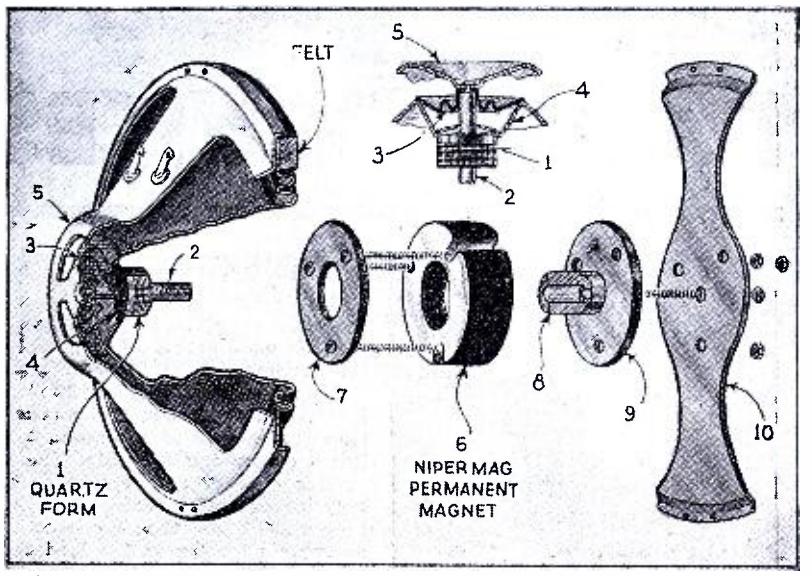


Fig. A. A break-down of the speaker showing the essential parts and their relation.

FOR THE first time since the inception of dynamic cone speakers a combination of new materials and methods for all of the component parts, giving fidelity of tone and quality in reproduction heretofore thought impossible has been developed. The feature points incorporated in one commercial model of this reproducer are shown in the "break-down" illustration, Fig. A; numbers identify the various composite elements.

The "heart" of a speaker is its voice coil. It must faithfully transform a complex electrical impulse into mechanical motion, "including all its complex variations," without distortion and with a minimum of loss. It is well known that the voice coils now in use fall short of these requirements. To overcome such imperfections, a special *quartz silicate ribbon* has been developed. Quartz, being extremely dense and non-elastic, when formed into a voice coil (1, in Fig. A) having a wall thickness of approximately 0.002-in. and an overall thickness, including voice coil, of only 0.006-in., weighs but a fraction of the conventional type voice coil!

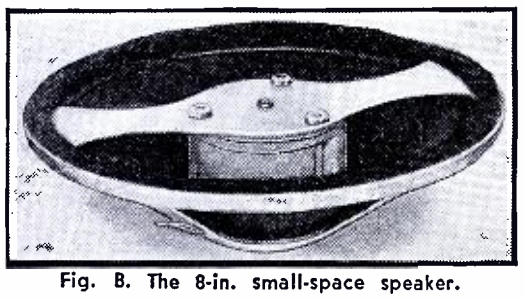


Fig. B. The 8-in. small-space speaker.

The ring of quartz silicate being absolutely non-elastic, and firmly anchored to the diaphragm (4), must, of neces-

(Continued on page 243)

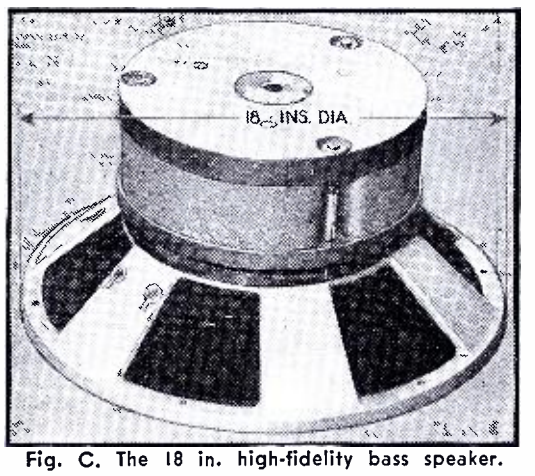


Fig. C. The 18 in. high-fidelity bass speaker.

HOW TO INSTALL A WIRED AUDIO P.A. SYSTEM

The importance of using A.V.C. and automatic expansion in wired-audio P.A. is outlined here.

E. A. DENNIS — PART III

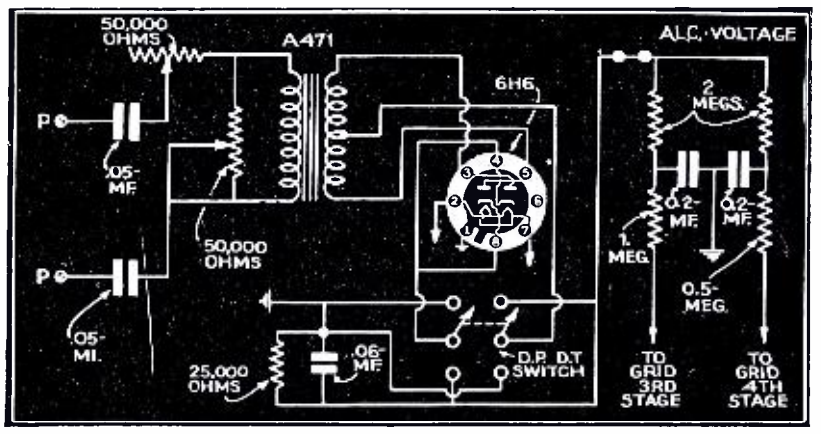


Fig. 4. The circuit of the expander attachment.

AUTOMATIC volume control for public address; automatic expansion for playing phonograph records and transcriptions: it sounds complicated doesn't it? Well take a good look at Fig. 4.

The circuit consists of a transformer, with a primary impedance of 40 to 50 thousand ohms, a turns ratio one-to-one, center-tapped, feeding into a 6H6 full-wave rectifier. (Both cathodes should be tied together at the tube socket.) The output of the rectifier is fed through a D.P.D.T. switch, so that the bias voltage may be reversed in applying to the grid (or grids) of the amplifying tube (or tubes). This voltage should be applied to the first stage of the amplifier in its phono. position. (The writer prefers to apply a smaller voltage to both the first and second stages.) The tubes used in these stages should preferably be of the remote cut-off type, such as the 78, 6K7, 6A8. In the latter case the bias voltage may be applied to grids other than the control-grid.

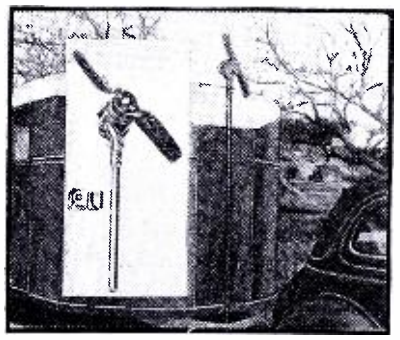
The 25,000-ohm resistor, together with the 0.06-mf. condenser, will give voltage hold-over (leveling of signal voltage) of approximately 0.48-sec., with a pickup of about 1/20,000-sec. The hold-over voltage is arranged at this point, so that when the circuit is used with a microphone, with a speaker addressing an audience, the voltage will have control to hold over from word to word. However by reducing the size of the 0.06-mf condenser, the action may be made as fast as desired. Also, by increasing the capacity, the (leveling) time may be slowed down.

The speed of the pick-up time may be increased or decreased by changing the values of the 2-meg. filter resistors. (To speed up the action, make these values about 1 meg. with a 0.06 or 0.1-mf. condenser.) Remember that these filter resistors and condensers are the heart of the circuit insofar as stability is concerned, and that if these values are not correct, degeneration of the frequency being amplified will take place and will be out of phase by 180, 270 or 360 deg. (depending upon the number of stages after A.V.C. action).

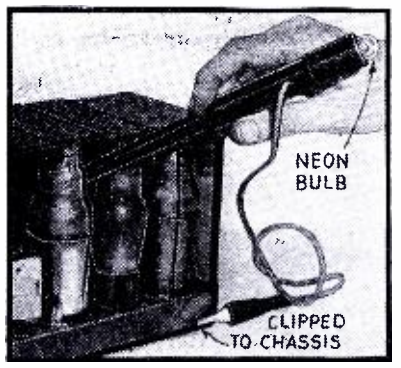
It may be necessary in rare cases to install an additional switch to change (or cut out) the bias on the tubes under A.V.C. control. In such cases, the bias should be about twice normal value for use as an *expansion* circuit. In this case increased amplification is desired with increased signal input, so a positive voltage is applied to the grids in direct proportion to the signal. The opposite

(Continued on page 236)

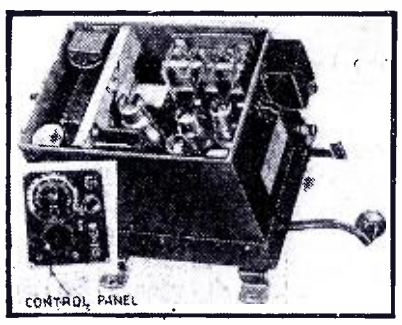
NEW RADIO DEVICES



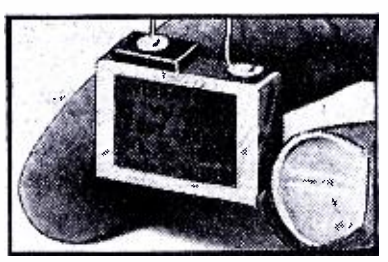
Auto trailer battery charger. (1130)



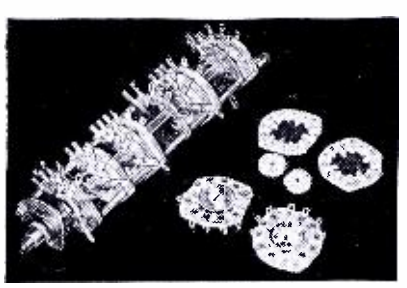
Many-purpose test prod. (1131)



Lightweight airplane receiver. (1132)



Ultra-compact buffer condenser. (1133)



Ceramic insulated switch. (1134)

Deluxe antenna kit. (1135)

TRAILER CHARGER (1130)

FORWARD movement of the trailer operates this charger, so that no additional load is placed on the generator of the tractor motor.

Charging starts at about 22 m.p.h. in still air, and reaches its maximum rate at about 40 to 45 m.p.h., a 3rd brush controlling the rate. The use of this charger and a storage battery in the trailer makes it entirely independent of the car electrical system, and removes the load from the latter. A control panel with ammeter and relay (and suitable mounting brackets) is furnished with the charger.

This unit meets the demand for low-cost current supply equipment in mobile services.

IMPROVED "INDICATING" TEST PROD (1131)

MANY tests on radio and electrical apparatus may be made with this handy, extremely versatile probe.

It consists of an insulating handle which has a socket in one end and a metal contact point in the other. The circuit is returned through the flexible lead with the clip. It also has in the handle a condenser with variable dielectric constant, and a voltage rating of 2,000 V. D.C., this condenser being connected directly across the contact points, as is the tube socket. The neon lamp in the socket may be replaced by a low-voltage lamp for certain tests, or for using the instrument to illuminate dark corners.

NEW AIRCRAFT SET (1132)
(RCA Mfg. Co.)

A BUILT-IN power unit is featured in this compact receiver. The current drain is only 1.4 A. from a 12 V. source, yet the high-efficiency circuit permits exceptional results. The tubes used are: 6D6, 6A7, 6B7, 6F7 (one each). A "static limiter" that tends to bypass excessive voltages, as for instance lightning impulses, may be switched in when needed. Two models are made, one of which tunes from 200 to 400 kc., and from 550 to 1,500 kc.; the other tunes from 200 to 400 kc., and 2,200 to 6,700 kc. The models are otherwise identical. Total weight including control unit and all excessories is only 17 lbs., and the size of the receiver case has been reduced to the small dimensions of 8¼ x 6¾ x 10¾ ins. long.

BUFFER CONDENSER (1133)
(Cornell-Dubilier Corp.)

SMALL size and high rating are features of this tiny unit. It is only ⅝ x ⅞ x 9/32-in. deep. The case is of metal and the unit is of the oil-filled type. One terminal is grounded to the case, and the other is brought out through a bakelite insulator. The working voltage is 1,000 and the capacity value of this unit is 0.007-mf., although capacities as high as 0.03-mf. are obtainable. The exceptionally small size makes replacement very easy. Set builders probably will be pleased to learn about this unit.

CERAMIC BAND SWITCH (1134)
(Centralab)

WAX-IMPREGNATED isolantite is used for insulation in this low-loss switch. The units are made in a variety of different contact and section arrangements. The contacts are of the lowest possible resistance and of non-rocking construction. Just the thing for that "5-meter" rig.

DELUXE ANTENNA KIT (1135)

AN AUTOMATIC circuit arrangement which permits maximum efficiency on either broadcast or short-wave bands without manual switching is the outstanding feature of this system. Another valuable feature is that the twisted antenna wire is wound on a core of high tensile strength, so that it may be pulled taut, and will withstand the weight of winter sleet without stretching or breaking.

TINY VARIABLE CONTROL (1136)

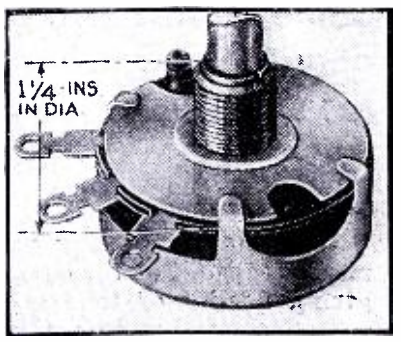
A METALLIZED element is used in this volume control, giving it the ability to withstand very high humidity and even immersion in water with very little change in resistance value! This especially recommends the unit for inclusion in equipment intended for use in humid climates. The terminal contact is made by means of a 5-finger contactor, the points of which are silver plated. Provision is made for 2 taps which may be brought out from any point on the resistance element and which in no way disturbs the variable contact. Switches may be fitted on if desired.

NOVEL AIRPLANE RECEIVER (1137)

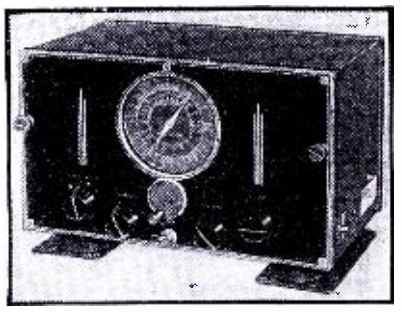
EITHER direct or remote control may be used with this compact superheterodyne receiver. It is designed to cover 4 bands, 200 to 400 kc., 550 to 1,500 kc., 1,500 to 4,000 kc., and 4,000 to 10,000 kc. The power output is 700 milliwatts, which is sufficient to operate as many as 6 pairs of headphones in parallel. A device called the "varistor" eliminates loud static crashes by bypassing excessive voltages (lightning discharges, etc.); and A.V.C. is available if desired. Crystal-controlled reception may be used on either of the high-frequency bands. The size is 9 x 14⅝ x 8¾ ins. deep; and the total weight is 14¾ lbs.

IRON-CORE TRANSFORMERS (1138)

COMPACTNESS and efficiency are outstanding features of these I.F. transformers. The units may be had in all standard frequencies and are also available with air-dielectric trimmers. The cores are of "ferrocart"—very finely powdered iron held in a binder.

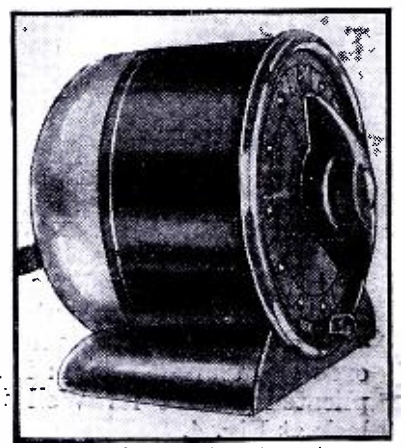


New, compact variable resistor with provision for 2 taps. (1136)

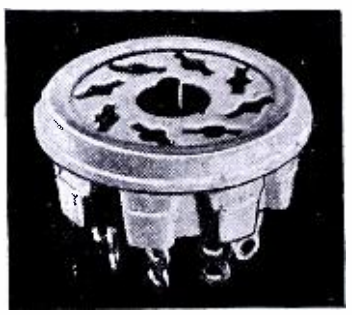


Airplane receiver which provides for the use of crystal filters. (1137)

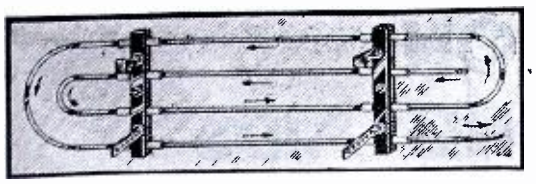
Compact iron-core transformers, available in many types. (1138)



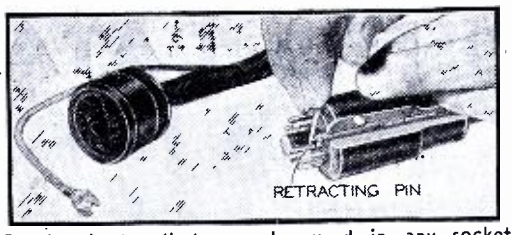
Portable time switch will turn equipment on or off. (1139)



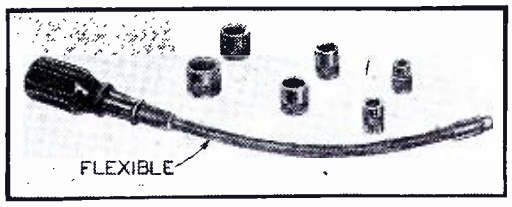
Steatite insulated socket, for subpanel mounting use. (1140)



The rods of this under-car antenna are arranged so that the pick-up of ignition noise is as low as possible. (1141)



Octal adapter that may be used in any socket. (1142)



Flexible shaft hex-socket wrench. (1143)

PORTABLE TIME SWITCH OF NEW DESIGN (1139)

RADIO receivers or any other electrical equipment may be turned on or off automatically at any time within 12 hours, by means of this unit. The dial is direct reading and no calculations are necessary. The instrument has a switch which is used to turn the electrical apparatus on or off manually. No current is consumed by the time switch, which is operated by a high-grade spring movement, and is wound automatically when the switch is set.

LOW-LOSS STEATITE SOCKET (1140)

THE HIGHEST possible insulation value is provided in this ceramic socket. It may be mounted directly in the chassis or by means of a metal plate, the latter providing a mounting that is virtually breakproof. The sockets are made for all tubes including the new octal-base types. The surface of the socket is highly glazed, thus contributing to maximum efficiency in use on ultra-short wave equipment. This socket also is "swell" for use in cathode-ray oscilloscopes.

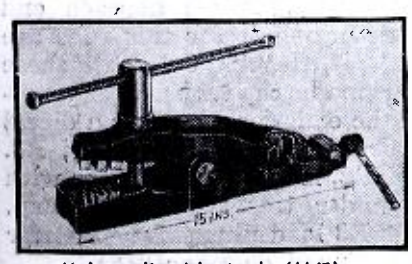
"STREAMLINE" AUTO ANTENNA (1141)

DESIGNED for mounting under the running board, the use of this new antenna is said to result in greatly improved results. It comes complete with all hardware and the necessary adjustable mounting brackets. The parts are weatherproof, being finished in either cadmium plate or galvanized. For even higher pick-up, 2 of the units may be used, one under either running board.

OCTAL ADAPTER (1142)

UNIVERSAL use is possible with this new adapter; which permits test of sets incorporating sockets that are not blanked-out for all 8 prongs. It is designed to fit any octal-base tube, and the plug end will fit any octal-base socket, regardless of whether it has all the pin holes punched or not. A unique spring arrangement on each pin enables it to slide up into the body if unpunched holes are encountered, yet the pins will stay in place and make contact even *if the clips in the socket are very stiff*.

Highly-sensitive galvanometer. (1144)



Universal cable tool. (1145)

FLEXIBLE SOCKET WRENCH (1143)

(Commonwealth Products Co.)

THE SHAFT of this handy tool will actually bend at right-angles to reach hard-to-get-at nuts. The shaft is made of many strands of flexible, steel wire wrapped in such a way that it is very flexible but will not twist. The interchangeable hex sockets snap onto the square end and are held firmly in place by a ball-bearing lock.

This tool is an excellent companion to the flexible screwdriver shown in June 1936 *Radio-Craft*, page 734 (item No. 1016).

PORTABLE GALVANOMETER (1144)

THIS instrument is intended for portable use and requires no special care in leveling. The scale length is 60 mm., and this particular type may be had in sensitivity of 0.125-micro-A. per division. The scale is set at 45 deg. so that it may be read from almost any position. The instruments are more rugged and less susceptible to damage than jewel-bearing types of equivalent sensitivity.

CABLE REPLACER (1145)

AUTO-RADIO Service Men should have one of these tools in their shops. It will do any type of work required on remote-control cables, such as swaging, cutting, replacing fittings, etc. It is especially handy since all parts are in one unit.

The versatility of this tool is amazing, and quite compensates for the very high cost of this device as a high-quality product.

ALL-WAVE ANTENNA TRANSFORMER (1146)

(Philco Radio & Television Corp.)

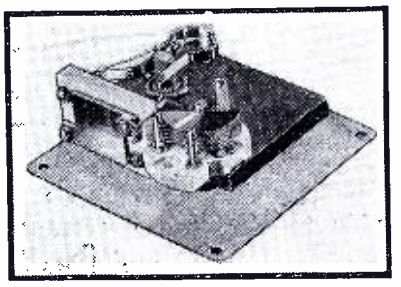
ACCOMPANYING an assembled all-wave antenna kit, this transformer is said to be much more efficient than that of previous types of similar make. The antenna kit may he used with any set, but those that have no built-in set transformer, will need an extra companion unit. The entire outfit gives maximum noise elimination and efficiency on all waves.

The completely weatherproof construction of the unit permits it to be mounted outdoors, right at the junction of the two conductors of the dipole antenna system. The complete antenna kit is available all soldered, ready to string up.

CRYSTAL FILTER UNIT FOR SUPERSELECTIVITY (1147)

(Hammarlund Mfg. Co.)

THIS crystal unit is designed to be used on the famous Super-Pro receiver. It is fitted with a control switch which is used to vary the selectivity band at will. The crystal holder is of accurately ground isolantite with lapped plates. A transformer with air-dielectric condensers and 2 matched windings, between which the crystal is connected assures the highest efficiency.

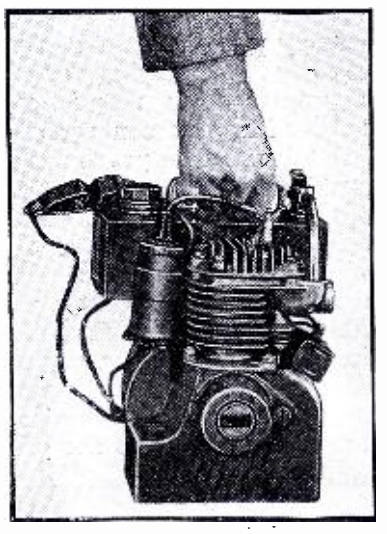


Crystal holder and filter unit for communication receiver. (1147)

A 6-V. (or 12-V.) GAS-DRIVEN GENERATOR (1148)

COMPACTNESS and portability are the most apparent features of this efficient little unit. The overall size including base is only 11½ x 15 x 12¾ ins. high and the weight is only 44 lbs. Its D.C. output charges a storage battery.

It is designed to be used in conjunction with a 6-V. battery and may be used to supply power for any need within its power rating, which is 150 W. Any good gasoline may be used for operation. Battery ignition is used and the 6 V. storage battery together with the generator act as a starting medium to set the plant into motion. The single-cylinder air-cooled motor has only a single oil point and is supplied with a muffler. A 12-V. model with the same characteristics and watts rating is also made.

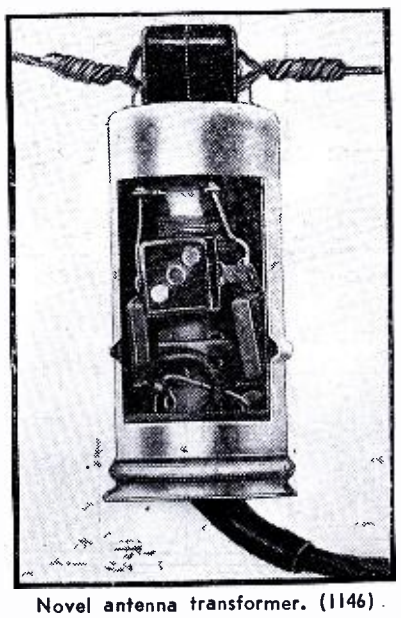


Compact gas-driven power supply which is self-starting. (1148)

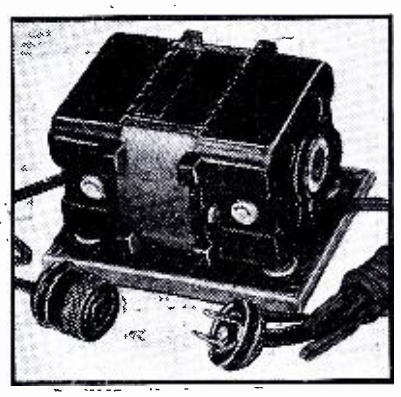
A D.C. TO A.C. CONVERTER (1149)

AN OUTPUT of 40 W. may be had from this compact unit! It is made in types to convert 6, 12, 32, or 110 V. D.C. into 110 V., 60 cycle A.C. It is designed for continuous operation and has a case with cooling vents. The bearings are of the oilless type and the unit is insulated from the base by rubber, to eliminate noise. The size is 4 x 5 x 2⅞ ins. high, and the weight, 6¼ lbs.

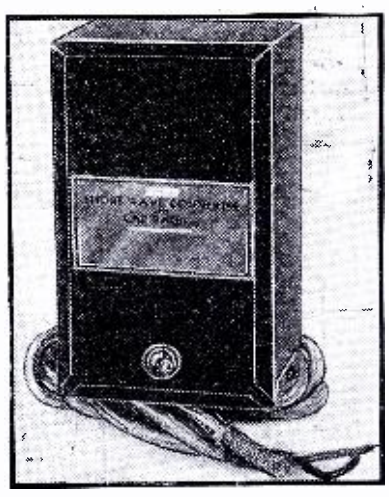
(Continued on page 244)



Novel antenna transformer. (1146)



An output of 40 W. is obtainable from this small converter. (1149)



An attachment for police use to pick up police broadcasts. (1150)

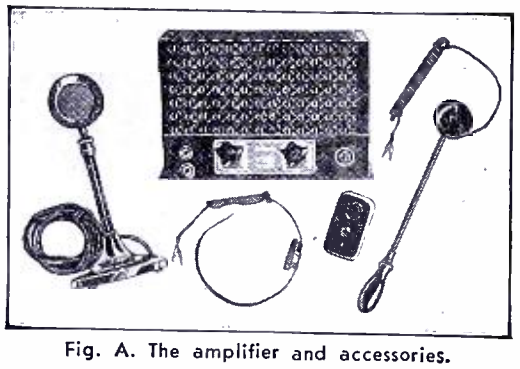


Fig. A. The amplifier and accessories.

USEFUL DATA ON CHURCH HEARING AIDS

The business of installing hearing amplifiers and accessories in churches is one which is not overcrowded!

HUBERT L. SHORTT

COMPARATIVELY unexplored, not yet subject to intense competition, the business of providing hearing aids to churches presents a most attractive field to any Service Man.

Churches are vitally interested in such equipment, more so than any other institution devoted to public gatherings. The most devout and "important" members of any congregation are apt to be elderly persons, and therefore hard-of-hearing. Increasing age lessens the acuteness of hearing in everyone. In a rather large percentage of persons who are advanced in years the condition approaches a state of partial deafness. Church officials, themselves often past middle age, are aware of the desirability of hearing aids to reenforce the sacred services for those who need such aids. They seldom find much difficulty in raising funds for a purpose of that kind. In many if not most cases *it is only necessary to convince them that the equipment, and the person offering it, are reliable.*

INHERENT ADVANTAGES

Hearing-aid installation work is free from one of the large "headaches" of ordinary public address (P.A.)—feedback. Since headsets alone are used, and loudspeakers omitted, the microphones are not subjected to interference, and the process of installation is a straight wiring job, with satisfaction assured if only reasonable care is taken in the selection of apparatus. In some cases, of course, a church hearing-aid installation may be combined with a P.A.

(Continued on page 249)

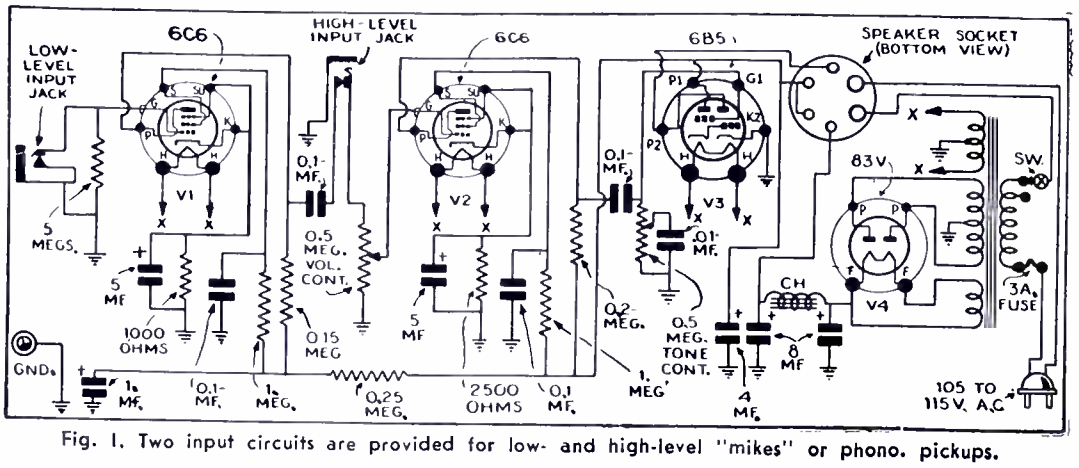


Fig. 1. Two input circuits are provided for low- and high-level "mikes" or phono. pickups.

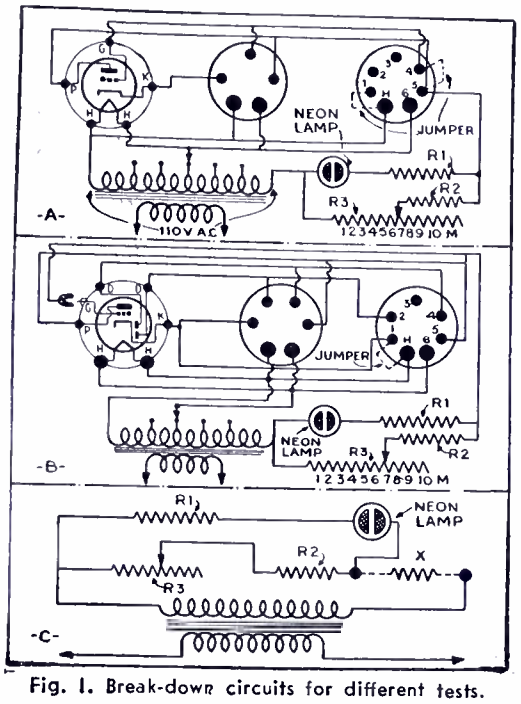


Fig. 1. Break-down circuits for different tests.

HOW TO USE A "PATCH"-TYPE COMBINATION TESTER

Additional detailed instructions for operating the Combination Tester described in October 1935 RADIO-CRAFT.

JOHN W. MILLION, JR.

SINCE THE introduction several months ago of the "Combination Tester," there have been many questions asked indicating that the original article in the October, 1935, issue of *Radio-Craft* describing this tester did not go into sufficient detail in explaining the different tests; and the use of *patch cords* for making circuit changes. It is the purpose of this article to clear up these points.

TESTING PROCEDURE

In Fig. 1A is detailed the manner in which the average test for emission is made; the principle is readily seen. Only that part of the circuit in operation is shown. The tube under test, a 76 type, has its elements shown connected to the contacts of the 5-prong socket. The connections to the *patch socket* and the *patches* (cords, provided at each end with contacting tips) for this tube are shown; that is, H-1 and 5-4. With these connections made, the tube acts as a rectifier and the emission produces a direct current through the load resistor, R3. A resistor, R2, is inserted in series with the tube under test. The neon lamp, across this R3 load plus safety resistor

(Continued on page 246)

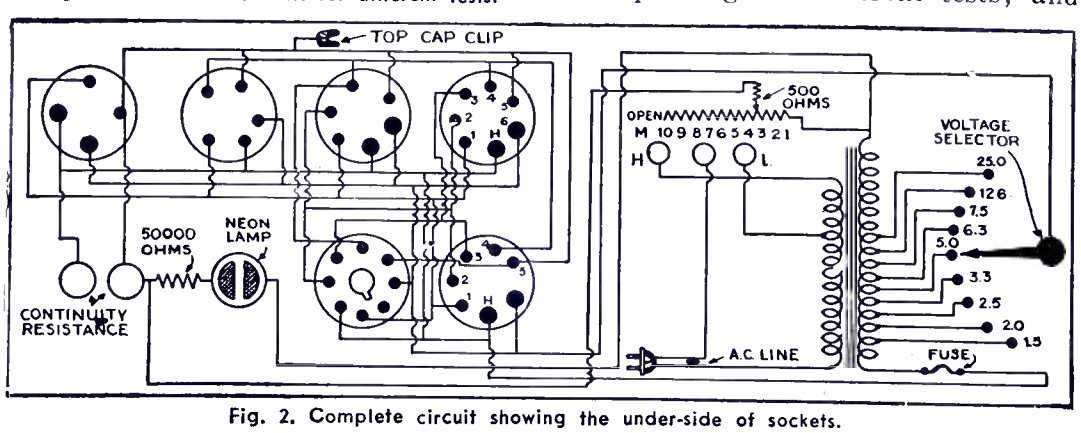


Fig. 2. Complete circuit showing the under-side of sockets.

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

INTERNATIONAL RADIO REVIEW

A FRENCH TELEVISION SET

A PRACTICAL example of commercial television receivers as manufactured in France was described in the latest issue of *Documentez-Vous* (Paris). This set consists of a cathode-ray tube with the associated receiving set, power supply and sweep oscillators.

This set is made in two parts. The first contains the tuning and framing controls, as well as the receiver, power supply and oscillators. The second contains the viewing tube, itself. Thus, the actual viewing unit need not be complicated by the many knobs, dials, etc., which appear on the front of the second cabinet. The latter can be enclosed in a decorative case, thus hiding the controls.

The editor of *Documentez-Vous* was very flattering in his praise of the operation of this set on present transmissions.

EUROPEAN RADIO CABINET FEATURES

IN THE recent issues of all the popular European radio magazines, many unusual and attractive cabinets have been shown, with descriptions of the new sets and their many features.

These sets and their novel cabinets will interest American radio fans, by contrast with the new American sets and cabinets.

First, in Fig. B, we see the new Cossor "Super-Ferrodyne" 3-tube receiver described in the latest *Practical and Amateur Wireless* (London). The appearance of this table model cabinet is certainly unusual, if only for the odd, unsymmetrical layout of speaker grille and dial. The circuit of this set oddly enough is not a superhet. but follows the old T.R.F. principle. The necessary selectivity and sensitivity are obtained by the use of "super-selective iron-cored coils and high-efficiency R.F. pentodes." The set is operated from the A.C. lines.

The second set, we see (Fig. C) is also an English one, being an Alba "Radiogram," or as we would describe it a radio-phono. combination. The simplicity of its cabinet and control panel is a relief from some of the complicated and elaborate ones found in European radio-phono. units. The set is a 5-tube superhet., and the phono. unit can be obtained with either manual or automatic record changer. This set was shown in *Wireless Retailer and Broadcaster*, (London) an English trade magazine.

Next is a portable set—the Ever-Ready which appeared in *Wireless World* (London). This set has an odd mounting for the speaker, so that when the lid is raised the panel on which the speaker is mounted, tilts upward so that the face of the reproducer points toward the listener. This set contains 3 tubes, an R.F. pentode, a screen-grid detector, and a pentode A.F. tube. The speaker is a permanent-magnet unit using one of the recently developed, high-coercive magnets, the power supply is batteries, and the aerial is a loop in the lid of the case.

(Continued on page 251)

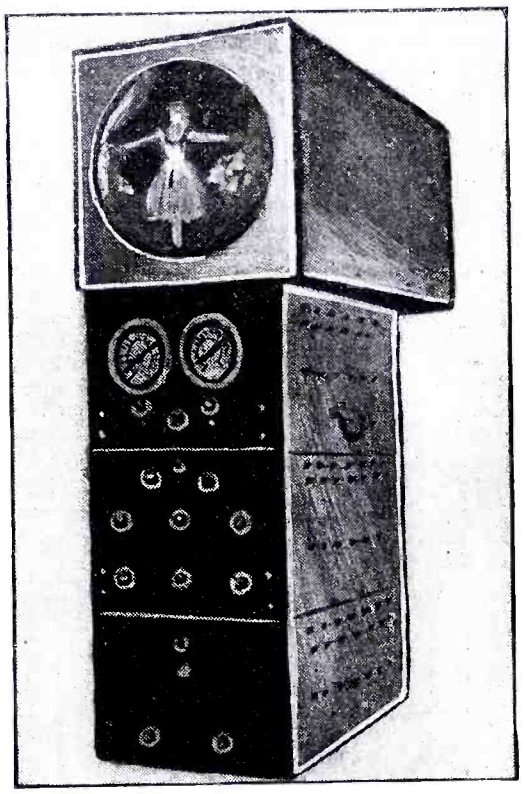


Fig. A. A new French television set.

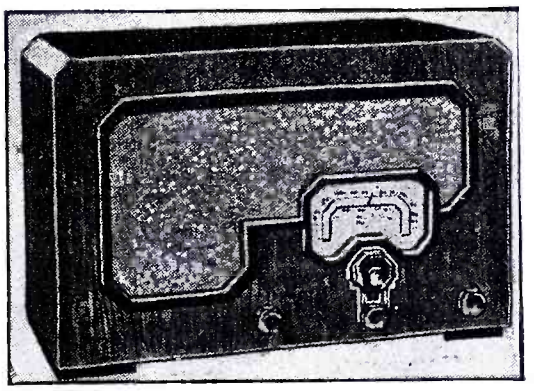


Fig. B. A table model of odd appearance.

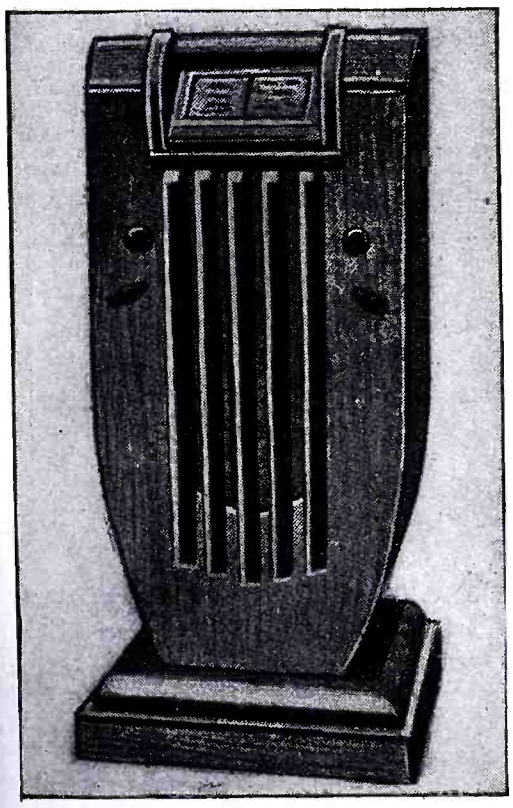


Fig. E. An oddly-shaped French receiver.

Fig. F. A German auto-"B" power supply.

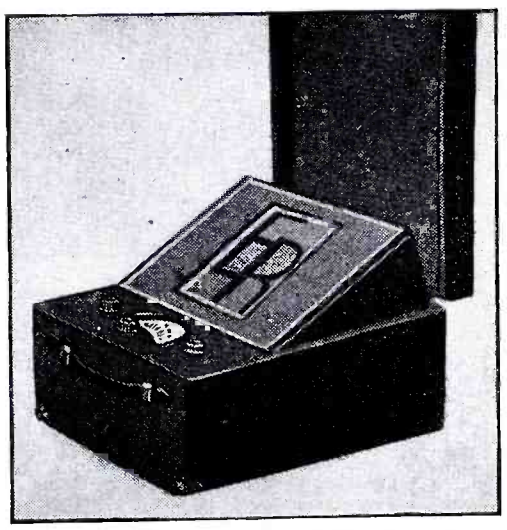


Fig. D. The speaker panel tips forward.

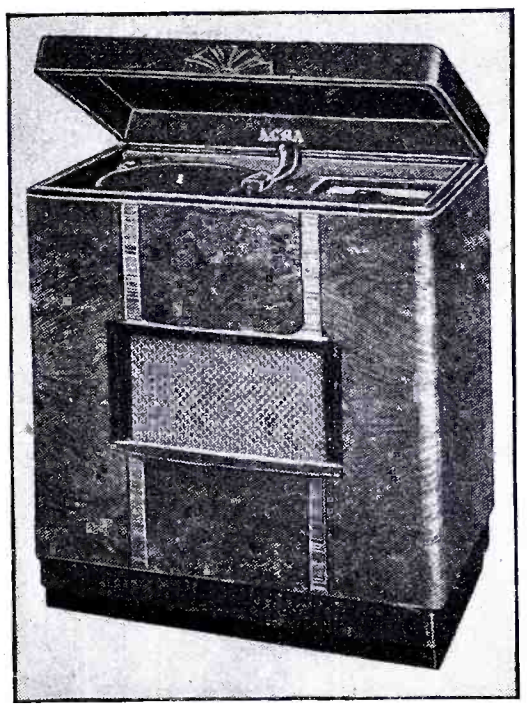
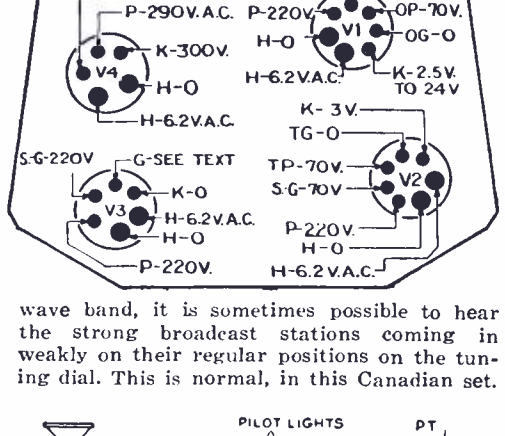


Fig. C. A radio-phono. set of English origin.

STEWART-WARNER-ALEMITE "GOOD COMPANION" R-192, 4-TUBE A.C. COMPACT RECEIVER

(Features: 6-tube performance; antenna wavetrap; superhet. circuit; dynamic speaker; hum-bucking coil.)

Multi-purpose tubes are used in this novel design of receiver to give performance equal to that from 6 tubes. The operating voltages are shown on the small detail. The C.-G. bias voltage of V3 must be measured across the resistor of 350 ohms from the center-tap of the power transformer high-voltage secondary to ground, and should be—14 V. The bias on the C.-G. of the pentode section of V2 is measured across the 500-ohm resistor in the cathode circuit, and should be 2V. The wave-trap in the antenna circuit is designed to cut out interference in the vicinity of the I.F. and is adjustable by means of the 20 to 120 mmf. padding condenser. It should be adjusted each time the receiver is attached to a new antenna, since the change in antenna is apt to detune the trap sufficiently to make it ineffective. Although this receiver is capable of reception on 2 wave-bands no adjustment is needed on the short-wave band, since the switch merely shorts a part of the mixer grid coil. (The receiver is made in several finishes, including all-chrome with silver grille, antique copper, and black leatherette with chrome facing.) The whole chassis and speaker tilt to any desired angle so that the sound may be directed to any part of the room. Alignment of the I.F. is made with a 0.25-mf. condenser in series with the test oscillator lead and the cap of V1. The gang condenser should read 530 at full-mesh. Adjust the test oscillator to 1,400 kc., and with a 250 mmf. condenser in series with the output lead, turn the dial to this position and adjust the trimmers on the gang condenser for highest output. The one nearest the front of the cabinet, which is the oscillator trimmer, should be adjusted first. When tuning the receiver on the short-wave band, it is sometimes possible to hear the strong broadcast stations coming in weakly on their regular positions on the tuning dial. This is normal, in this Canadian set.



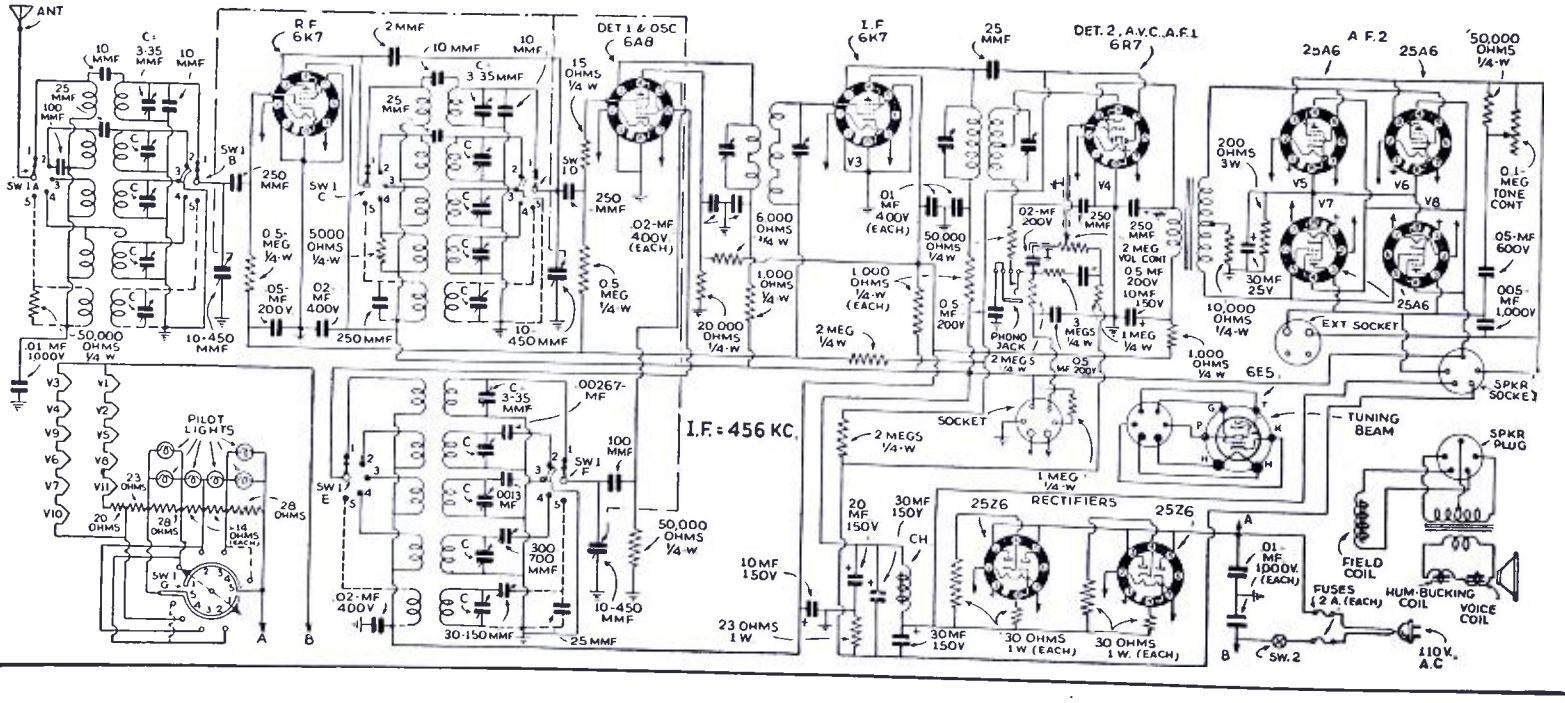
PILOT MODELS 304 AND 305 ALL-WAVE 11-TUBE A.C.-D.C. SUPERHETERODYNE

(Features: range, 12.7 to 2,150 meters; tuning beam; push-pull parallel output; dual rectifiers; extra speaker socket.)

The operating voltages of this receiver are as follows:

Tube	Plate	S.-G.	Cathode	Heater
V1	91	91	0	6.3
V2**	88	49	0	6.5
V3	83	80	0	6.3
V4	73	—	0	6.3
V5-V8	80	90	12.5	26
V9	6*	—	0	6.3
V10, V11	A.C.	—	99	26

*Measured through a 1-meg. plate resistor. **Oscillator plate, 80 V. All voltages measured with a 1,000 ohms-per-volt meter. The target of V9 runs at 90 V. and the speaker field at 99 V. The undistorted power output is 4 W. The model 304 has 4 tuning bands and covers from 12.7 to 570 meters, while the model 305 has 5 bands and covers from 12.7 to 2,150 meters with a skip from 570 to 740 meters. (This latter model is sold only outside the U.S.A.) A jack is provided on the rear of the cabinets for the use of a high-impedance phono. pickup. Also provided is a socket for the use of an extra speaker, which should preferably be a permanent-magnet dynamic type of 10,000 ohms. When aligning the I.F. amplifier, the tuning condenser should be at maximum and the band switch at the broadcast position. The test oscillator lead should be connected to the cap of V3 through a 0.1-mf. condenser and then to the cap of V2 and each I.F. transformer adjusted to resonance. Then connect the test oscillator leads to antenna and ground of the receiver, the antenna lead going through a 200-mmf. condenser. Leave the switch in the broadcast position and place the tuning dial at 1,500 kc., and with the test oscillator at 1,500 kc. align the oscillator trimmer; then the detector; and, finally, the antenna trimmer. Next, set the test oscillator to 600 kc. and turn the receiver dial to the same position. Adjust the series padder to resonance, while rocking the receiver dial back and forth slightly to get the proper position. Band 3 is aligned at 4,300 kc., band 2 at 11,000 kc., and band 1 at 22,000 kc. Band 1 is aligned somewhat differently from the others in that the R.F. and 1st-detector circuits resonate at the high-frequency side of the oscillator. The other bands are resonated at the low-frequency side of the oscillator. Alignment of the long-wave band is similar to band 4, the frequencies being 375 and 150 kc.



Radio Service Data Sheet

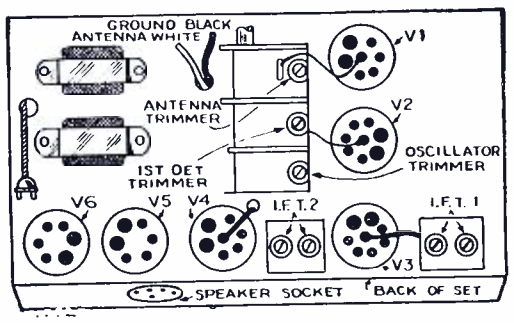
WARD'S MODEL 62-229 6-TUBE 32 V. RECEIVER

(Features: no power supply used; dynamic speaker; class B output; tone control; antenna trap.)

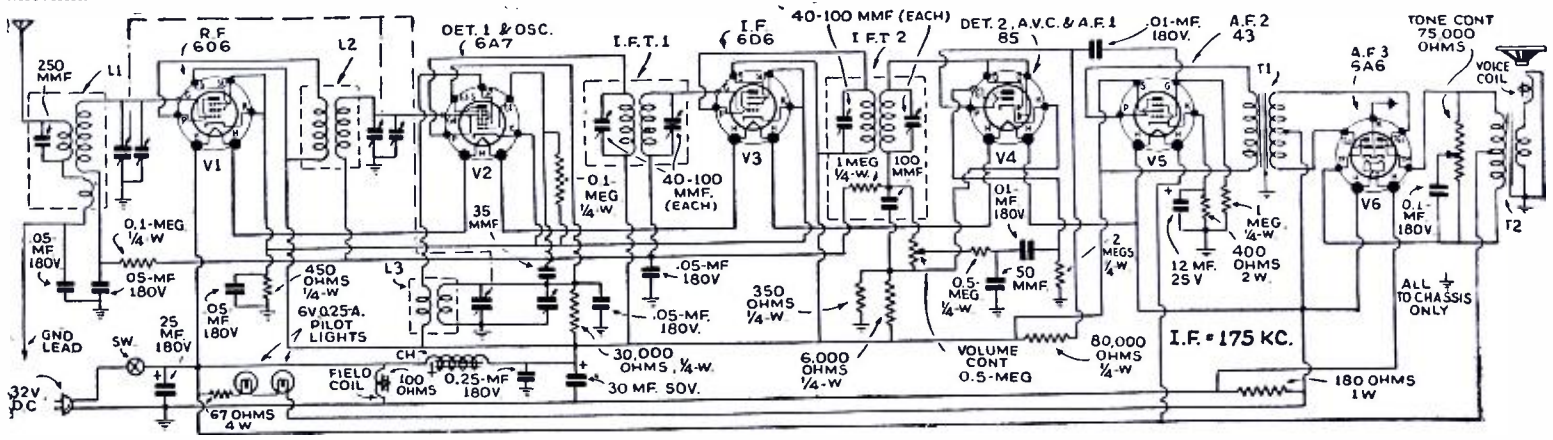
This unusual receiver has no power supply, the high voltage being obtained directly from the 32 V. line. The line voltage must be kept within 25 to 42 V. for satisfactory operation. The polarity of the line plug *must* be observed, although no harm will be done if the plug is inserted the wrong way. *Do not* ground the receiver at any point, except the ground lead. Operating voltages are as in this table:

Tube	Plate	S.-G.	Cathode	Plate ma.
V1	205	A.C.-plate to plate, 450 V.		
V2*	31	18	2	0.2
V3	31	31	2	1.5
V4	12.5	—	1.8	0.2
V5	28	31	3.5	7.0
V6	31	—	0	22 total

*Anode grid, 31 V., 0.65-ma. These values taken with volume control at maximum and antenna lead connected to ground. Alignment of the I.F. stages is made with the lead of the signal generator connected through a 0.1-mf. condenser to the grid cap of V2. Turn the rotor of the receiver tuning condenser to full-open, which should be at 1,750 kc. on the dial. Next, connect the lead from the signal generator through a 200 mmf. condenser to the receiver antenna lead and with the volume control at maximum, adjust the oscillator trimmer for best response, the generator having been previously set to 1,750 kc. Then shift the generator to 1,500 kc., and adjust the other 2 trimmers on the gang condenser to maximum response, without changing the setting of the oscillator trimmer. This completes the aligning procedure. The filament circuit of the receiver is of the series-parallel type, the same as used in some A.C.-D.C. receivers, and should be quite easy to trace. Note that *all* tubes and pilot lamps must be in their sockets before an attempt is made to operate the receiver.



(The designation given on data sheet No. 162, of Ward's receiver, series ODM is incorrect, and should be changed. This chassis is used in Ward receivers with the following model numbers: 179, 194, 206, 216, and 218. This correction should be made on the above-mentioned data sheet.)



ATWATER KENT MODEL 416 6-TUBE AUTO RECEIVER (ALSO, MODELS 126, 136 AND 446)

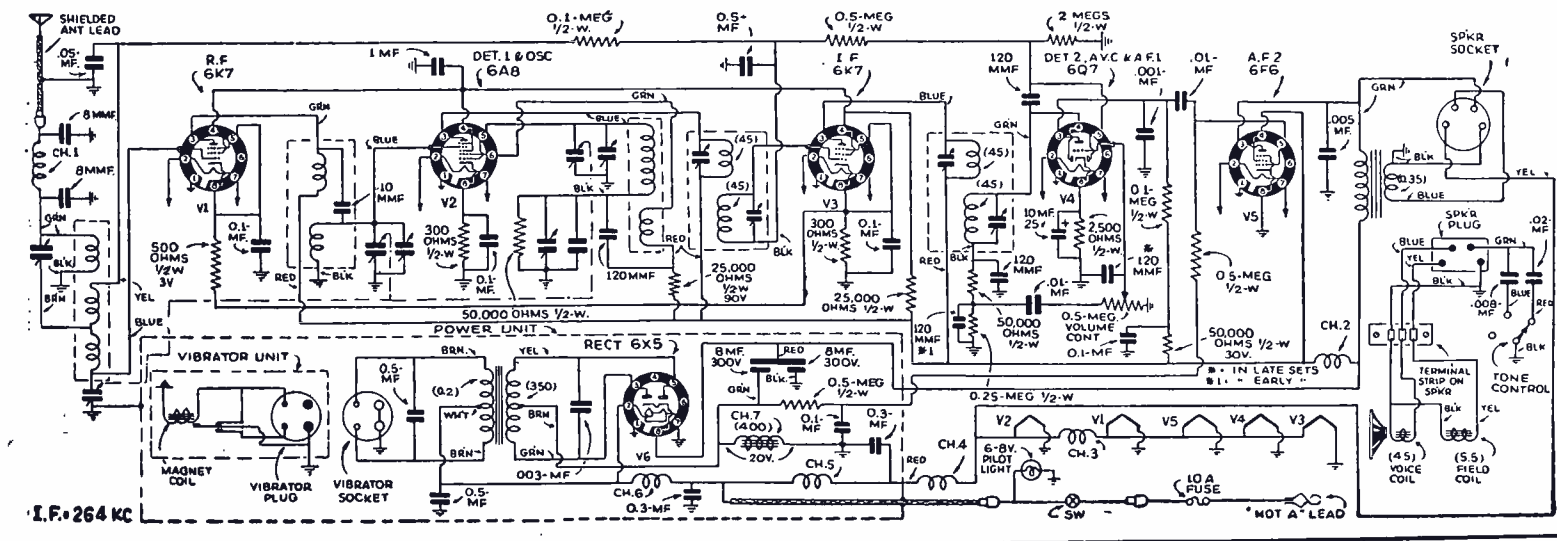
(Features: complete input filtering; metal tubes; 3-position tone control; dual-speaker provision; suppressorless operation.)

The operating voltages of this receiver are as follows:

Tube	Plate	C.-G.	S.-G.	Cathode
V1	225	1	80	5
V2*	225	4	80	4
V3	225	1	80	2
V4	125	1	—	1
V5	215	5	225	0
V6	A.C.	—	—	240

*Anode grid of V2, 130 V. The circuits of the models 126, 136 and 446 are similar to that of the 416, the 126 having glass tubes and enclosed speaker, the 136 glass tubes and separate speaker, and the 446 metal tubes and separate speaker. The model 556 has a similar circuit, with the following exceptions: an 0.01-mf. condenser is connected from each plate of V6 to chassis in place of the single 0.003-mf. unit shown; the audio filter choke is in the positive side of the "B" supply and the dual electrolytic condenser has a common negative instead of a common positive lead. Tube V5 has a 500-ohm cathode resistor, shunted by a 10-mf. electrolytic condenser, and the 0.5-meg. grid-leak is returned directly to chassis. There is no tone control and the 50,000-ohm resistor with its bypass condenser in the plate circuit of V4 is omitted. The "B" voltages of the model 556 are about 10 per cent lower than in the 416. There is no connection from the plate of V5 to the speaker socket.

After the receiver has been installed, the antenna matching condenser should be adjusted for best reception on a weak station near the high-frequency end of the band. The dial indicating arrow is adjustable by means of a screw reached by removing the dial-light assembly.



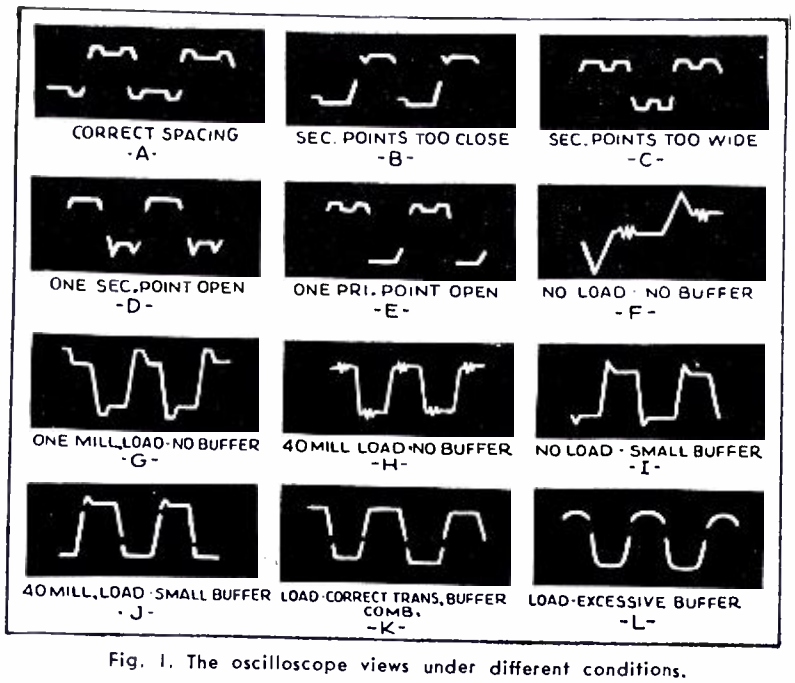


Fig. 1. The oscilloscope views under different conditions.

THE OSCILLOSCOPE IN VIBRATOR SERVICING

Correct adjustment of vibrators is simplified by the use of precise "visual" analysis.

ALLEN S. NACE

THE OSCILLOSCOPE has been of invaluable aid to the vibrator engineer in the recent progress made in development of vibrators as a method of converting low-voltage D.C. into A.C. and stepping it up through a transformer to furnish the high voltage necessary for a radio receiver plate supply. It has eliminated a considerable amount of guesswork in design, both mechanical and electrical, and enabled him to build a background of definite knowledge concerning vibrator applications that was not possible before.

The oscilloscope has been particularly helpful in the study of two of the most important considerations in vibrator practice—(1) point spacing and (2) transformer-buffer combinations.

PRACTICAL POINT SPACING

The most practical point spacing of a synchronous vibrator from the standpoint of life and satisfactory performance is to have the secondary points spaced somewhat wider than the primary. This condition is shown by Fig. 1A, which is an oscillogram taken across the primary of the vibrator transformer. The open spaces are caused by a change in voltage so rapid that the cathode-ray beam does not have time to register. The change is virtually instantaneous. The peaks at each side of the crest of this wave show the primary voltage when the secondary points are still open. When the secondary points close, the vibrator is loaded, and the primary voltage accordingly drops slightly. Because it is undesirable for the primary to open under load, the secondary opens first and the primary voltage rises again.

Figure 1B shows the same vibrator with its secondary points too close. A shift in phase between the primary circuit and the secondary may be observed as well as the voltage drop due to the primary points opening under load. Arcing is apt to occur with this adjustment.

When the secondary points are too wide, the waveform is like the one in Fig. 1C. The secondary is now closed for only a small percentage of the time, and the efficiency and output of the vibrator are very low.

Figures 1D and E show faulty vibrators; Fig. 1D showing

(Continued on page 250)

OFFICIAL RADIO SERVICE MEN'S ASSOCIATION, INC.

MEMBERS' FORUM

A department devoted to members and those interested in the Official Radio Service Men's Association. For mutual benefit, contribute *your* kinks, gossip and notes of interest to Service Men, or others interested in servicing.

AMPLIFIER CIRCUIT

RADIO-CRAFT, ORSMA *Dept.:*

As a member of ORSMA and a reader of your magazine for some time I wonder if you could send me a circuit diagram of the interesting amplifier, No. 1070, illustrated and described on page 29 of the July 1936 issue of *Radio-Craft*.

I am in the market for such equipment, but would like to see the circuit arrangement before deciding.

HARRY L. JACKSON,
Providence, R. I.

Since the circuit in question has several novel features, we are reproducing it herewith in Fig. 1. It will undoubtedly be found of interest by many other readers.

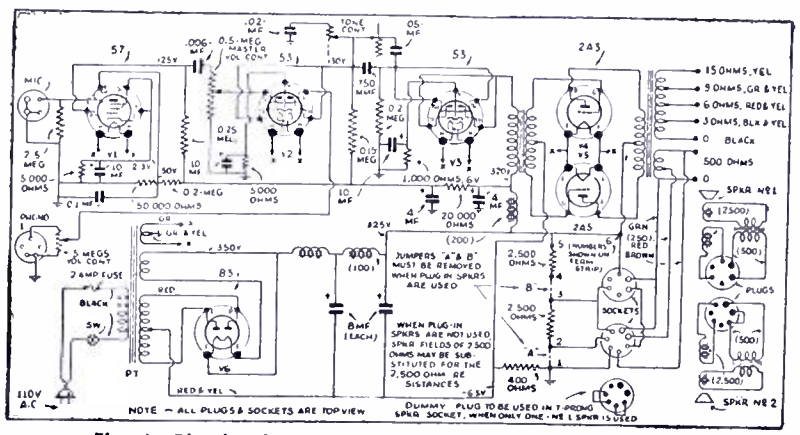


Fig. 1. Circuit of a commercial high-gain amplifier. (1070)

CORRESPONDENTS WANTED

RADIO-CRAFT, ORSMA *Dept.:*

May I offer a few words of appreciation for *Radio-Craft?* I have been a constant reader for some time and its hints and tips have saved me a headache times without number, more so since it is difficult to get service sheets in this country.

I would like to become a member of ORSMA, as I see it is an international organization, and would like to exchange news and views on the latest radio activities with any members who would like to correspond with me.

I wonder if any of your readers could supply me with a service sheet for the Halson AW-770?; I find that 2 of the short-wave bands have not been wired up. I have been informed by the makers that the service sheets on this model are out of print.

I have built quite a few sets from circuits I found in *Radio-Craft*, and have found them to be up-to-the-minute in design. As a matter of fact I am listening to W2XAF at the present moment on one of "your" sets!

WM. T. JONES,
Cheshire, England.

We are glad to learn that *Radio-Craft* is so useful. What ORSMA member knows the answer to the "AW-770" problem?

BUSINESS AS USUAL

RADIO-CRAFT, ORSMA *Dept.:*

I was quite interested in the remarks of Mr. Lanning in July 1936 *Radio-Craft* regarding the radio servicing business.

In part I agree with Mr. Lanning that radio servicing should be a better-paying business than it is at present. But, having been in the game for several years myself, I certainly can see that conditions are improving, and that the good Service Man is gradually gaining the position to which he is entitled.

Naturally, as in any business, there will always be a few "quacks" who will stumble along at the game, and because they have little else invested except time and a screwdriver, will tackle a job at such low prices that the real Service Man is out of the picture. But keep track of these fellows and you will be surprised how fast they pass out. Their customers are

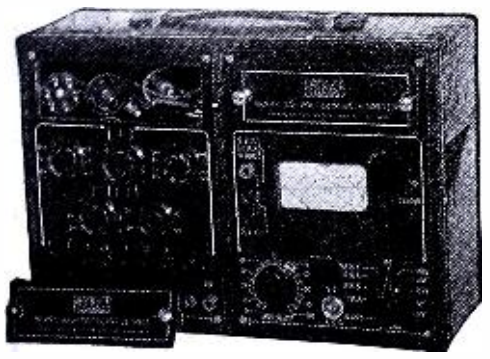
(Continued on page 247)

QUALITY COMBINATIONS FOR RADIO SERVICING

THE NEW RANGER EXAMINER LINE

Complete for Shop or Field

COMBINATION FREE POINT TESTER AND MULTIMETER MODEL 640-740



Model 640 Free Point Tester has 5 sockets. Panel includes eight automatic switch type and ten single action jacks.

Model 740 Volt-Ohm-Milliammeter Unit has a Triplett Precision instrument scale reading 10-50-250-500-1000 A.C. and D.C. volts at 1000 ohms per volt. 1-10-50-250-M.A.; low ohms 0-300; high ohms to 250,000 at 1.5 volts. Rheostat adjustment.

Case is same as for Model described opposite. **Dealer Price ... $27.00**

COMBINATION TUBE TESTER AND SIGNAL GENERATOR 440-540

Model 440 Tube Tester checks all glass, metal and glass-metal tubes. Condition of tubes read directly on GOOD-BAD instrument scale while load values are applied. Circuit designed to indicate inter element shorts and leakages. Illuminated dial A.C. instrument for line volts adjustment. Shows when tester is connected to power supply. Individually calibrated plug-in type coils in Signal Generator Model 540 set new standard for obtaining laboratory accuracy at low cost. See description for Model 557 Signal Generator.

The sturdy case is metal with built-in compartments having snap-on covers for accessories, finished in electro black baked enamel, panels in silver and black.

Complete with all batteries and two type 30 tubes and necessary accessories. **Dealer Price $33.60**

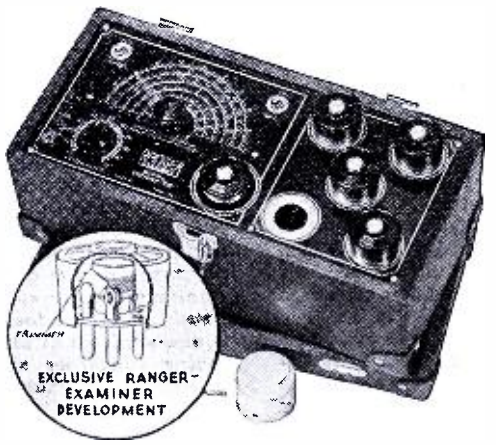
SENSATIONAL DEVELOPMENTS AT SENSATIONAL PRICES

DIRECT READING SIGNAL GENERATOR MODEL 557

The direct reading Signal Generator Model 557 has plug-in type coils. Five frequency bands from 110 to 20,000 Kc. All fundamentals. Each coil is individually calibrated by peaking with trimmer condensers. Accuracy less than 1% on all bands. Completely shielded. Attenuation and stability are outstanding features.

Supplied in black leatherette case. Silver and black panel. **Dealer Price $18.00**

Model 554-A—same as Model 557 but not direct reading. Calibrated graphs included for accuracies under 1% on any band. **Dealer Price $14.40**



D.C. POCKET VOLT-OHM-MILLIAMMETER MODEL 735

Contained in sturdy black molded case with silver and black panel, rounded corners. Ranges are 15-150-750 volts; 1.5-15-150 M.A.; ½-1,000 low ohms; 0-100,000 high ohms at 1.5 volts. External batteries may be used for higher resistance measurements.

Has Triplett D'Arsonval precision instrument accurate to 2%. Selector switch for all ranges. Provides for all D.C. measurement requirements of the serviceman. Size is 3x5⅞x2½" thick—is easily carried in the pocket, and handy for the laboratory. **Dealer Price $10.80**

ADDITIONAL RANGER COMBINATIONS

Model 540-740 Signal Generator and Multimeter. **Dealer Price $36.00**

Model 440-740 Tube Tester and Multimeter. **Dealer Price $37.50**

The new Ranger-Examiner line of radio test instruments is precision built throughout. All instruments have been designed and constructed for the utmost in compactness, accuracy and durability.

Compare these test instruments . . . Check their accuracy, note ease of operation and speed with which they can be used . . . See how light they are in weight . . . And then note the price.

Ask your jobber to show you the Ranger-Examiner line. Write for more complete information.

RANGER EXAMINER

READRITE METER WORKS
1016 College St., Bluffton, Ohio.

☐ Please send Ranger-Examiner catalogue.
☐ I am interested in more information on Model .....

Name .....

Address .....

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

KARADIO MODEL 57-B SHERIFF 7-TUBE AUTO SUPERHETERODYNE

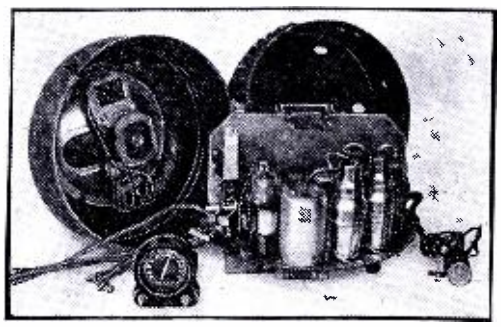
(Features: police-band reception; push-pull output; low noise level; single unit construction; motor-noise trap.)

This receiver is designed to be used by government officials, since it is made to cover the police bands, as well as the general broadcast band. The operating voltages are as follows:

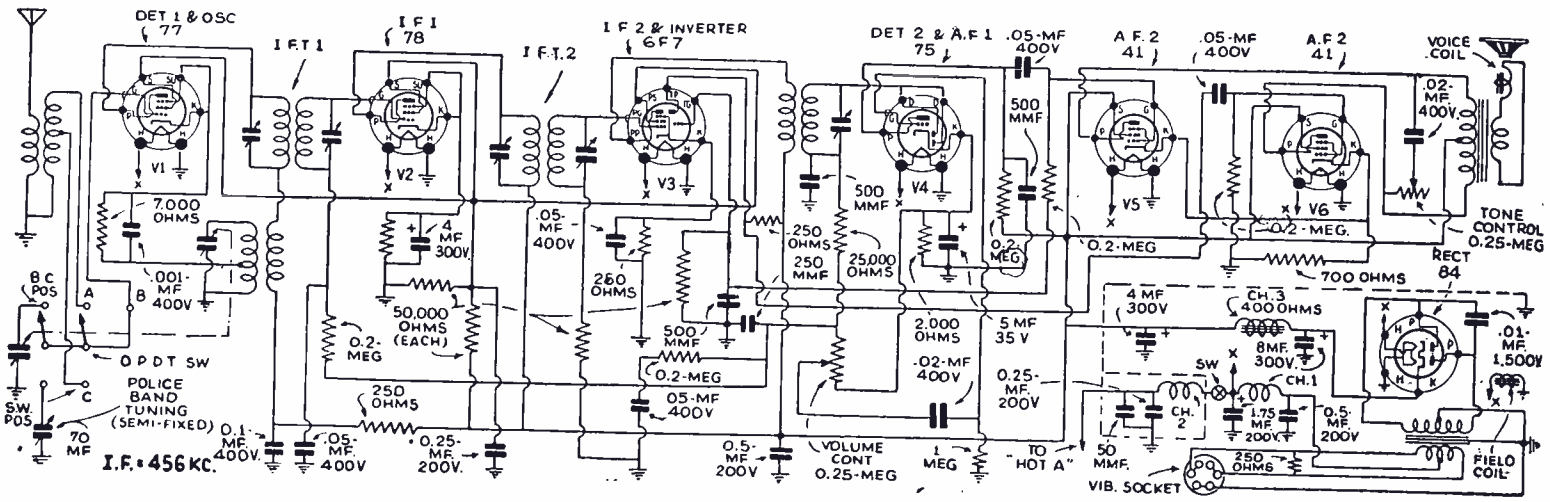
Tube	Cathode	S.-G.	Plate
V1	3	60	205
V2	2	60	205
V3*	1.5	60	205
V4	1	—	105
V5	17	205	205
V6	17	205	205
V7	205	A.C.-plate to plate, 450 V.	

*Triode plate of V3, 40 V.

The type 77 used as det. 1 and oscillator was found to have a much lower noise level. Tube V3 functions as a combination I.F. amplifier and as a phase inverter tube to allow the use of push-pull output. The short-wave band is picked up by operating the D.P.D.T. toggle switch, which cuts out the first section of the tuning condenser gang, and connects in its place a 70 mmf. trimmer condenser which is adjusted through a hole in the case adjacent to the switch handle. The trimmer is adjusted to whatever police station the particular installation calls for. The receiver is designed to have the lowest possible battery drain and it may be used, in most cases, without sparkplug suppressors. Since it is unlawful in most states to have in a car a receiver that is capable of reception of police calls, these receivers will be found mainly in cars of police and city officials, detectives, Federal operatives and other law enforcement agents. The speaker in the cover of the receiver has a plug fitting, so that the cover may be completely removed to do service work. A variety of dial plates are made to fit a large number of auto dash-



boards, or the control head may be mounted on the steering column, this latter type of control being shown in the accompanying photo. The photo also shows the location of the police-band adjustment condenser and the switch.



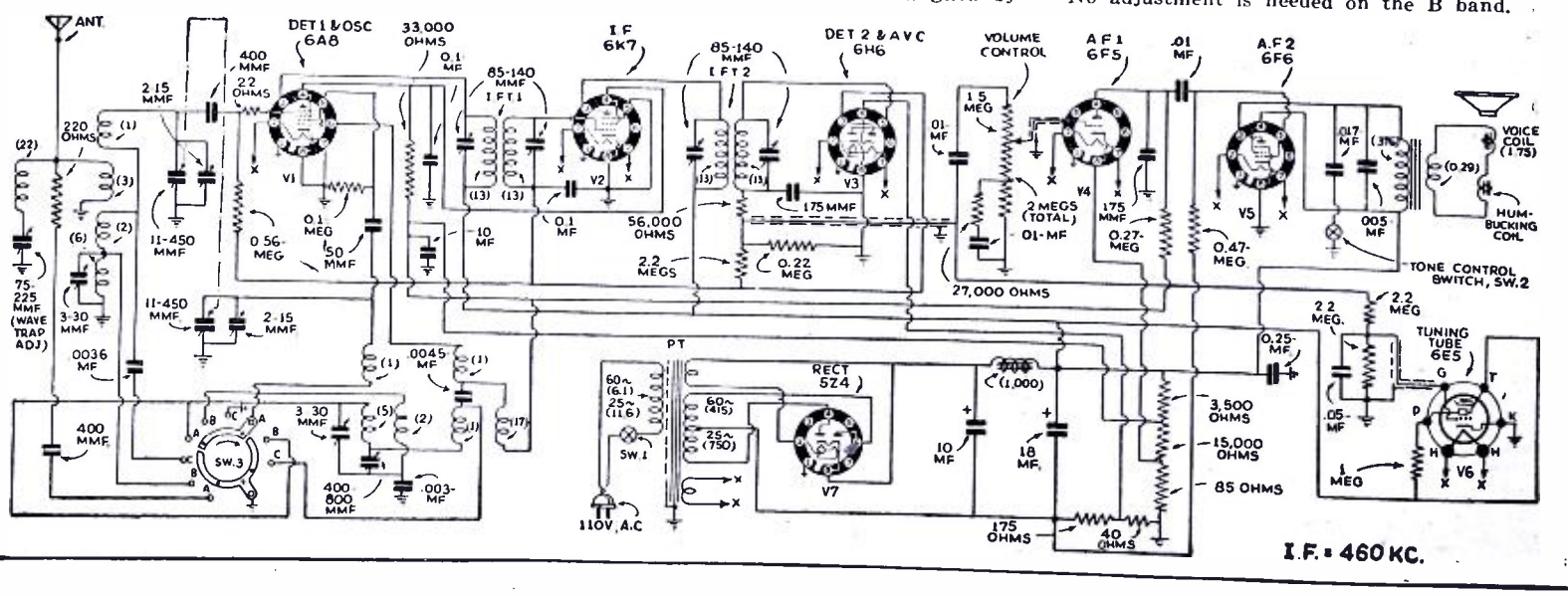
RCA VICTOR MODELS T7-12 AND C7-14 7-TUBE 3-BAND RECEIVER

(Features: "magic eye"; 4.5 W. output; range, 540 to 18,000 kc.; metal tubes; adjustable wavetrap.)

The socket voltages of this receiver are as given in this table and should be correct within about ±20 per cent.

Tube	Plate	S.-G.	C.-G.	Cathode
V1	263	103	3.2	0
V2	263	103	3.2	0
V3	—3.2 (on section 2)			
V4	117	—	0	1.1
V5	252	263	—16	0
V6	(target, 263 V.)		0	0
V7	370 A.C.	—	—	342

The anode grid of V1 runs at 170 V. The above conditions hold true when there is no signal input. This receiver circuit is essentially the same as that of the RCA Victor models T 6-1 and C 6-2, except for the addition of the "magic eye" and the use of a 5Z4 rectifier tube. The maximum audio output is 4.5 W. and the undistorted output is 2 W. An antenna wavetrap is provided, which may be adjusted to the I.F. of the receiver and will then cut out or greatly attenuate any interference which is near 460 kc. The adjustment of this trap is located near the 1st I.F. transformer. A universal transformer may be had for operation on 100 to 250 V., and 40 to 60 cycles. This transformer has a 110-V. tap for connection of a phonograph motor. The I.F. stage is aligned by attaching the test oscillator between chassis and grid cap of V1, and adjusting all 4 I.F. trimmers for highest output. With the tuning condenser at full-mesh position, the dial pointer should be at 530 kc. First R.F. alignment is made at 18,000 kc. The point of resonance on the oscillator trimmer which is maximum is the correct one to use in case 2 such points are found. The antenna trimmer is also adjusted at 18,000 kc., and the receiver tuning condenser should be rocked slightly to get the optimum setting. Then shift the band switch to band A and adjust for resonance first at 1,400 kc., then at 600 kc. No adjustment is needed on the B band.



THE RADIO MONTH IN REVIEW

(Continued from page 199)

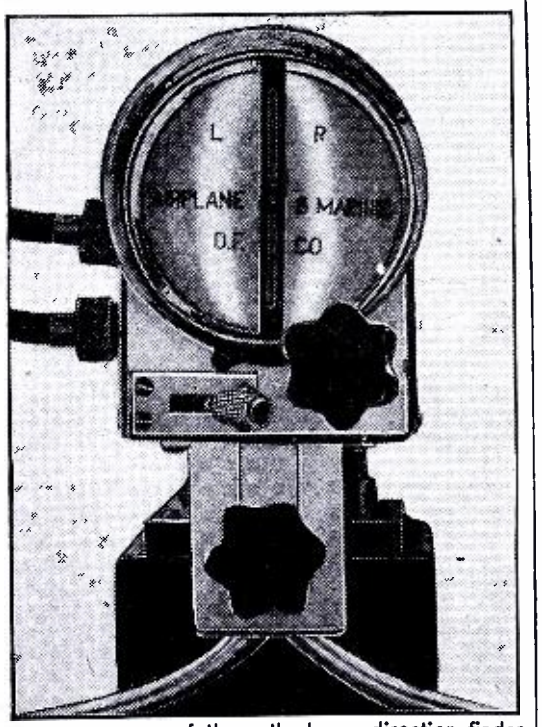
meter—through intermittent electrical disturbances having the field strengths of 2 or 3 volts-per-meter!

The equipment employs two separate amplifying channels, one utilizing the energy from a simple vertical antenna and the other amplifying the signals from a rotatable loop. The visual indication is a "resultant" of the two signals —one of which is fed to the vertical pair of deflector plates, and the other to the horizontal pair.

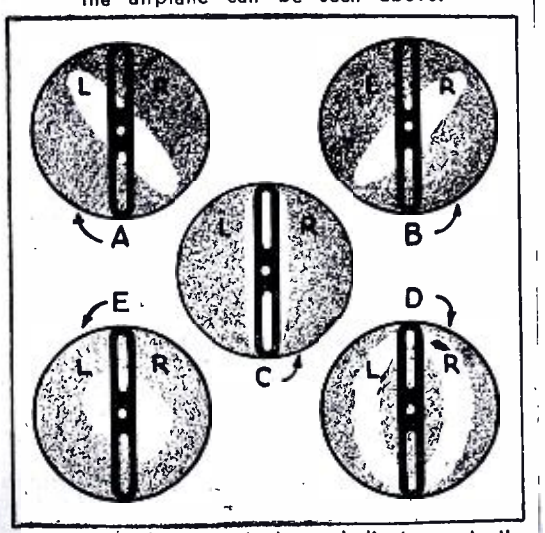
It was reported by the Coast Guard that the Hefele direction finder, in conjunction with a directional gyro (standard equipment on most planes), magnetic compass, and artificial horizon, provided an excellent means of constantly checking the drift of the plane due to wind—which is another very important application of this versatile device.

The commercial airlines probably will soon add cathode-ray equipment of this general type as "standard equipment," thus making more business for radio manufacturers, installers, operators and Service Men.

For 12 years the Coast Guard has applied direction finding equipment on ships; and for 5 years this branch of the government service has utilized such apparatus on airplanes, states Chief Radio Electrician C. T. Solt, of Coast Guard Headquarters, Washington, D. C. However, the new cathode-ray equipment is said to be one of the most important and versatile contributions to safety in air travel.



The appearance of the cathode-ray direction finder which is mounted above the instrument panel of the airplane can be seen above.



Five changes in the cathode-ray indicator:— A, the indicator shows that the plane is at the left of course; B, is at the right of course. When the ship is right on beam, C is seen, changing into D, when plane approaches the station. When the plane is directly over station, circular pattern at E can be seen.

TECHNICIANS' DATA SERVICE

JOSEPH CALCATERRA — DIRECTOR

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

2. HAMMARLUND 1936 CATALOG. Contains 12 pages of specifications, illustrations and prices on the new line of Hammarlund variable, midget band-spread and adjustable condensers; trimming and padding condensers; R.F. and I.F. transformers, coils and coil forms; sockets, shields, chokes and miscellaneous parts of ultra-short-wave, short wave and broadcast operation.

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

5. ELECTRAD 1936 VOLUME CONTROL AND RESISTOR CATALOG. Contains 12 pages of data on Electrad standard and replacement volume controls. Truvolt adjustable resistors, vitreous wire-wound fixed and adjustable resistors and voltage dividers, precision wire-wound non inductive resistors, center-tapped filament resistors, high-quality attenuators, power (50- and 150-watt) rheostats and other Electrad resistor specialties.

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

59. THE EVOLUTION OF TUBE TESTING. This interesting booklet, published by the Supreme Instruments Corp., traces the development of tube testing equipment and gives a complete technical description, with wiring diagram and discussion of the technical points involved in the design and use of the Model 89 Supreme Radio Tester for testing all tubes, and also paper and electrolytic capacitors.

65. NEW 1936 LINE OF SUPREME TESTING INSTRUMENTS. This 16-page catalog gives complete information on the entire Supreme line of testing instruments, including the Model 385 Automatic Tube Tester and Analyzer, the Model 339 DeLuxe and Standard Analyzers, and other standard Tube Testers, Set and P.A. Analyzers and Signal Generators. Complete details of the Supreme Easy Payment Plan for purchasing testing equipment on the instalment plan are given.

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

69. YOUR FUTURE IN RADIO. With the development of Radio into many specialized fields, it has become increasingly important for anyone considering radio as a lifework, to investigate the opportunities offered in the various fields for a man of his particular qualifications. These opportunities are described in an interesting 32-page book, "Your Future in Radio" published by the Sprayberry Academy of Radio. It also gives complete information on the new Sprayberry Course in Radio Service Engineering which includes all standard equipment and supplies for the practical work required in mastering the course and going into business.

73. HOW TO ELIMINATE RADIO INTERFERENCE. A handy folder which gives very complete information on how to determine and locate the sources of radio noise by means of the Sprague Interference Analyzer. A description of the analyzer and method of using it is included, together with data on how to eliminate interference of various kinds once the source is located.

74. SPRAGUE 1936 ELECTROLYTIC AND PAPER CONDENSER CATALOG. Gives specifications, with list and net prices on a complete line of wet and dry electrolytic, and paper condensers made by the Sprague Products Co. for radio Service Men, set builders, experimenters and engineers. Information on the Sprague Capacity Indicator, for making capacity tests on condensers and in servicing receivers, is included.

75. SPRAGUE TEL-U-HOW CONDENSER GUIDE. A valuable chart, compiled by the Sprague Products Co. which tells the proper types, capacity values and voltages of condensers required in the various circuits of radio receivers and amplifiers, and how to locate radio troubles due to defective condensers. Includes data on condenser calculations.

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

Radio-Craft Technicians' Data Service
99 Hudson Street,
New York City, N. Y. RC-1036

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

2 4 5 57 59 62 65 67
69 73 74 75 76

My radio connection is checked below:

( ) Service Man operating own business.
( ) Service Man for manufacturer.
( ) Service Man for jobber.
( ) Service Man for dealer.
( ) Service Man for servicing company.
( ) Dealer.
( ) Jobber.
( ) Experimenter.
( ) Professional Set Builder.
( ) Amateur Set Builder.
( ) Short Wave Work.
( ) Licensed Amateur.
( ) Station Operator.
( ) Radio Engineer.
( ) Laboratory Technician.
( ) Public Address Worker.
( ) Manufacturer's Executive.
( ) Student.
( ) .....

I am a:

( ) Subscriber ( ) Newsstand reader

I buy approximately .....of radio material a month. (Please answer without exaggeration or not at all.)

Name .....

Address .....

City ..... State.....
(Please print name and address)

Avoid delay. The catalogs and booklets listed are now in stock and will be sent promptly as long as the supply lasts. Please use this coupon in ordering. The use of a letter causes confusion and delay.

ELECTRONIC CONTROL SYSTEM AT VASSAR COLLEGE

(Continued from page 200)

Vibrating reeds and vacuum tube oscillators completely solved this problem.

The reeds which are 12 in number are chromium plated, and are vibrated continuously by a blast of air from the organ. Each reed is fitted with an electrostatic pickup which feeds into a vacuum-tube oscillator. The reeds keep the V.-T. oscillators exactly in step, so that the tones, *which go down as far as 16 1/3 cycles*, are absolutely true.

The output of the organ tone oscillators as well as the phonograph, radio and piano music is amplified by a compact, 50-W. vacuum-tube amplifier and 8 dynamic speakers located in the organ loft, immediately behind the grille work shown in Fig. A.

The flexibility and dependability of this control system have revolutionized the art of teaching music and allied subjects at Vassar, as well as making the task of the professors much less difficult.

TECHNICAL FEATURES IN RADIO RECEIVERS FOR 1936-37

(Continued from page 207)

signed to accomplish 3 purposes. First, being supported entirely on rubber cushions, it tends to prevent vibrations of the speaker unit from being transmitted to the cabinet, thus reducing the tendency toward cabinet resonance and boom. Second, because of the resistance offered by the solid portions of the sounding board to air motion, it prevents small portions of the cone from vibrating independently from the entire cone (which produces fuzziness in the response). Third, Fig. F, by proper positioning of the holes in the sound board high notes are deflected instead of traveling in narrow "beams."

Tri-Focal Tuning. In the Stromberg line of sets, a new system of tuning known as Tri-Focal Tuning is employed. The feature of this is a combination of 3 factors which tell a complete story of the tuning conditions:— (1) A cathode-ray tuning tube indicates when a station is accurately adjusted to resonance; (2) a 4-band scale indicates what can be heard and the limits of each particular frequency band (only one scale is illuminated at one time); (3) a vernier scale permits accurate logging of short-wave stations so that they can be picked up again without difficulty.

Figure G shows the escutcheon of this new line of sets; note the ray-tube "eye" at top, and the "full-vision" arrangement of the scale.

Target Tuning and Split-Second Re-Locator. One of the outstanding features of the 1937 Zenith receivers is the tuning control used. This consists of an airplane dial calibrated in kc. for each band. A vernier indicator revolves around an outside scale which is calibrated from zero to 60. This is the split-second control, for a station is calibrated in kc. plus the position of the vernier dial, thus permitting accurate logging. The tuning knob is fitted with a fly-wheel so that if the dial twister wishes to run slowly over a given band, a twist of the knob starts the dial in motion. The fly-wheel then keeps it moving without the necessity of the usual laborious knob turning.

The tuning indicator used by Zenith is also interesting. It is in the form of a bulls-eye having a meter type movement with an aluminum disc at the end of the meter needle. This moves over a target and for local stations, the station is accurately tuned when the disc covers the bulls-eye of the target. The positions of all controls, such as *band, volume, fidelity* and *sensitivity* are indicated on separate scales on the main tuning dial; Fig. H shows its appearance.

Automatic Flash Tuning. Sears, Roebuck's new sets are equipped with the "Automatic Flash Tuner" which consists of an automatic frequency control to insure correct tuning of stations and a multi-contact switch which is rotated by the variable condenser. When the condenser passes a given point, a circuit is closed, which lights up a bulb and thus illuminates the call letters of the local station operating at that particular frequency. The appearance of these illuminated call letters on the dial is shown in Fig. I.

The automatic frequency control—or "A.F.C."—is of the conventional type consisting of a "discriminator" tube in the I.F. amplifier which rectifies part of the signal current and produces a positive or negative voltage, depending on whether the station frequency is higher or lower than the tuning in the set. A control tube in the oscillator circuit shifts the tuning of that circuit to compensate for the off-tuning. (Various A.F.C. systems have been described in *Radio-Craft.*)

CONCLUSION

In the above description of the outstanding features of the 1937 sets, it is obvious that in practically every case some form of tuning system or dial is predominant. These new dials and tuning systems seem to be the key-note of the coming season!

While no startling developments have been incorporated in these new sets, the ease of operation, appearance, and quality of reproduction, in general, are better than in the sets of previous years. This is a healthy condition for the industry as it tends toward a stabilization of sales, over each season.

It is possible that next year's receivers might include new developments as sensational as the metal tube last year. We shall patiently wait!

16 NEW TUBES!

(Continued from page 201)

6N5—Cathode-Ray, Tuning Indicator. The cathode-ray tuning indicator of the 6E5, *sharp* cut-off triode type has also been duplicated in the low-filament current tubes and is known as the 6N5. This tube has a wider operating range between zero shadow and 90 deg. shadow than the 6E5, requiring 12 V. to produce the change, instead of the 8 V. required for the 6E5 type. This increased range will permit the tube to be connected directly to the A.V.C. line in some sets, thus simplifying connections.

6N5 Characteristics

Heater voltage	6.3 V.
Heater current	0.15-A.
Plate supply voltage	135 max. V.
Target voltage	135 max. V.
Triode-plate series resistor	0.25-meg.
Triode-plate current for grid voltage = 0	0.5-ma.
Triode-grid voltage to give 0° shadow	—12 approx. V.
Triode-grid voltage to give 90° shadow	0 approx. V.

6Q6G—Diode-Triode. The fourth of the series of 5 low-filament current tubes is a diode, high-mu triode tube similar to the 6Q7 metal tube, but having only 1 diode. This tube has a somewhat lower mutual conductance than its metal cousin, however, being rated at 1,050 mmhos. in place of 1,200 mmhos.

6Q6G Characteristics

Heater voltage	6.3 V.	6.3 V.
Heater current	0.15 A.	0.15 A.
Plate voltage	135 V.	250 max. V.
Control-grid voltage	—1.5 V.	—3.0 V.
Plate current	0.9 ma.	1.2 ma.
Amplification factor	65	65
Mutual conductance	1,000	1,050

6S7G—Variable-Mu Pentode R.F. Amplifier. The last of the 5 tubes is a variable-mu R.F. amplifier similar to the type 78 metal tube, though having a higher mutual conductance and amplification factor than the latter. Because of the economical filament requirements of this tube it will find many applications besides its intended purpose of R.F. and A.F. amplifier.

6S7G Characteristics

Heater voltage	6.3 V.	6.3 V.
Heater current	0.15-A.	0.15 A.
Plate voltage	135 V.	250 max. V.
Screen-grid voltage	67.5 V.	100 max. V.
Control-grid voltage	—3.0 V.	—3.0 V.
Suppressor voltage	(Connected to cathode at socket.)	
Plate current	3.7 ma.	8.5 ma.
Screen-grid current	0.9 ma.	2.0 ma.
Amplification factor	850	1,100
Mutual conductance	1,250	1,750
Control-grid voltage for mutual conductance = 10	—25 V.	—38.5 V.

Interelectrode Capacities (With form-fitting shield)

Grid-to-plate	0.007 mmf. max.
Input	4.6 mmf.
Output	7.8 mmf.

"METAL" 2-V. TUBES

In addition to the above interesting series of tubes, another group has just been announced, which will be of equal interest to a different group of radio men. This is a series of 9 tubes of the 2-V. battery type, having octal (8-prong or so-called "metal") bases, though they are enclosed in glass bulbs.

1C7G—Pentode Converter. This tube has identical characteristics to the 1C6 pentagrid converter, with the exception of the base—which fits the octal sockets. The tube is a fine one for frequency conversion in all-wave battery superheterodynes, because of its high triode (oscillator) mutual conductance.

1D5G—Variable-Mu Pentode R.F. Amplifier. The characteristics of this variable-mu R.F. pentode, of the direct-filament type, are very similar to those of the 1A4—*With the exception of the added suppressor-grid element. The tubes, thus, may not operate the same in certain circuits—for example, in dynatron oscillators. (Late production on the 1A4 also includes the suppressor-grid!)*

1D5G Characteristics

Plate	90	180 max. V.
Screen-grid	67.5	67.5 max. V.
Control-grid	—3	—3 min. V.
Amplification factor	350	705
Plate resistance	560,000	1,050,000 ohms
Mutual conductance	700	750 mmhos
Plate current	2.2	2.3 ma.
Screen-grid current	.9	.8 ma.
Mutual conductance at —15 V. control-grid	15	15 mmhos

Interelectrode Capacities (with shield)

Cglp	.007 max. mmf.
Cgl (K plus G2)	4.8 mmf.
Cp (K plus G2)	11.5 mmf.

6D7G—Pentagrid Converter. This tube is identical in its characteristics to the 1A6 pentagrid converter tube. It is fitted with the octal base and is enclosed in a glass bulb.

1E5G—Sharp Cut-off R.F. Pentode. The characteristics of this tube exactly duplicate those of the 951 and the 1B4 tubes, being a sharp cut-off R.F. pentode. *The tube has one element more than the 1B4—a suppressor-grid making it a pentode.* This may change the operation in some special cases such as in dynatron circuits, depending on secondary emission from the plate which is reduced by the suppressor. *(Late production on the 1B4 also includes the suppressor-grid!)*

1E7G—Dual-Pentode Output Tube. THIS IS AN UNUSUAL TUBE, BEING THE FIRST DUAL-PENTODE OUTPUT TUBE TO BE INTRODUCED. The characteristics are identical to the 1F4, with the exception that 2 tubes are included in the same envelope with a single set of filament connections and screen-grid connections being brought out to the base prongs. Thus, separate plate and control-grid prongs are provided, making the tube useful for push-pull circuits. (It's an "old-timer" in Europe.—*Editor*)

1F5G—Output Pentode. The characteristics of this tube are identical with those published for the 1F4. It is similar to one-half of the above-mentioned 1E7G, and may be used for single-ended output circuits in battery receivers and amplifiers.

1H4G—General-Purpose Triode. The 1H4G is similar in its characteristics to the type 30, being a triode of the 2-V. filament type. However, it has been especially designed to provide operation as a low-current class B output tube and when used in push-pull, (2 tubes) a power output of over 2 W. can be obtained without introducing noticeable distortion! It is fitted with an octal base.

1H4G Characteristics

Amplifier Class A
(Operating conditions and characteristics)

Plate	90	135	180	V.
Control-grid	—4.5	—9.0	—13.5	V.
Amp. factor	9.3	9.3	9.3	
Plate resis.	11,000	10,300	10,300	ohms
Plate cur.	2.5	3.0	3.1	ma.
Mut. cond.	850	900	900	mmhos

Amplifier Class B

Plate voltage	180 max. V.
Peak plate current	50 max. ma.
Zero signal pl. cur. (per tube)	1.5 max. ma.

Typical Operation (2 tubes)

Plate	157.5 V.
Control-grid	—15 V.
Zero sig. plate cur. (per tube)	0.5 ma.
Load resistance (per tube)	2000 ohms
Effective Load res. (pl. to pl.)	8000 ohms
Max. sig. driving power	260 milli-W.
Power output (2 tubes)	2.1 W.

Detector
(Operating conditions as biased detector)

Plate	90	135	180 max. V.
Control-grid (approx.)	—9.0	—13.5	—18.0 V.

Plate current adjusted to 0.2-ma. with no signal. With normal signal the average D.C. plate current should be limited to 2.0 ma.

1H6G—Duodiode-Triode. The eighth of the

series of nine 2-V., octal-base glass tubes is a double-diode triode which has characteristics identical with the 1B5 and 25S glass tubes. The only difference in characteristics is in the use of the octal base.

1J6G—Twin-Triode Power Amplifier. The last of this series of 2-V., octal-based tubes is identical with the type 19, being a twin-triode power amplifier. Since the characteristics of the 19 are well known, the figures are not repeated here.

This completes the short descriptions and characteristic data for the two new series of tubes which have been developed in connection with the new lines of 1936-'37 radio receivers.

In addition to these tubes, several other new tubes of interest were placed on the market, last month.

6B8—Duodiode-Pentode. The first of these, which is designated 6B8, a new metal tube* of the dual-purpose type, includes a pentode and two diodes in the same metal container. Thus it may be used similarly to the 6B7 as I.F. amplifier or A.F. amplifier, as well as diode detector and A.V.C. rectifier, in superhet. receivers.

6B8 Characteristics

Amplifier operation (R.F. or I.F.) pentode section			
Plate voltage	250	Max.	V.
Screen-grid voltage	125	Max.	V.
Control-grid voltage	—3		V.
Plate current	10:0		ma.
Screen-grid current	2.3		ma.
Plate resistance	0.6	approx.	meg.
Amplification factor	800	approx.	
Mutual conductance	1325		micromhos
*Control-grid voltage	—21	approx.	V.

*Voltage for cathode current cut-off.

Interelectrode Capacities

$G_1 - P$	0.005 mmf. max.
$G_1 - (K + G_2 + G_3)$	6.0 mmf.
$P - (K + G_2 + G_3)$	9.0 mmf.

CE-20—16-MM. "Talkies" PE. Cell. This tube is a new photoelectric cell* designed primarily for use with 16 MM. film projectors and other applications where a small but efficient photocell is required.

The tube is a caesium-argon type having the standard 3-prong PE. cell film projector base. The tube is 2 ins. high and 11/16-in. in dia. Among other advantages claimed for it are high sensitivity, non-microphonic characteristics and compact envelope.

**The names and addresses of manufacturers will be sent upon receipt of a stamped and self addressed envelope.*

(Continued on page 248)

SEE THESE NEW RECEIVERS AT THE RADIO SHOW

(Continued from page 203)

inates only the range in use. All control knobs are marked as to use. The 4 wave ranges go up to 65,000 kc., starting at 145 kc. The exact position of every tuning and control knob may be seen at a glance. Ten tubes are used in the superhet. circuit.

DETROLA RADIO CORP. (K)

Model 102-C. This receiver is contained in a 2-tone cabinet of novel design. It is a 7-tube A.C.-D.C. superheterodyne with a tuning range from 540 to 15,750 kc. A voltage-doubler circuit assures high output on A.C. lines. An I.F. wave-trap eliminates code interference, and an anti-absorption type band-selector eliminates dead spots on the short-wave band.

EMERSON RADIO AND PHONOGRAPH CORP. (L)

Model L-143 Phono-Radio Combination. A new material called "Gemloid" is used for the dial of this receiver. The diffused light that illuminates this dial is supplied by edge-lighting bulbs. The 5-tube superheterodyne circuit supplies a power output of 3 W., and this power is also available when playing records. The turntable will accommodate either 10- or 12-in. records and the same volume control is used for both phonograph and radio. Quiet reception is assured by a line noise filter and an antenna filter. Two tuning bands are covered, 540 to 1,750 kc. and 2,200 to 7,500 kc.

MAKING AN ALL-WAVE BOOSTER FOR DX-ERS

(Continued from page 210)

It makes no practical difference whether the regeneration is viewed as a reamplification of a given signal voltage, or as a reduction in the resistance in the resonant circuit, as the results in both cases are the same.

The ease with which a high degree of sensitivity and selectivity can be obtained by the use of regeneration, merited its inclusion for the first tube in the booster.

Having chosen "regenerative R.F." (radio frequency) amplification for the first tube it is important to include a buffer stage to prevent interlocking of the circuits. For this stage resistance-capacity coupling was chosen, using metalized carbon non-inductive resistors in preference to chokes as all chokes have a resonant frequency. (If this resonant frequency happened to coincide with the frequency of the station being received interlocking would prevail when the first tube approached the state of regeneration.)

Using reams of paper and plenty of ink, various circuits were designed that were the "last word" in preamplification design. After building 4 of these wonderful-on-paper circuits, they were discarded as being totally inadequate for various reasons. On the fifth attempt the circuit shown in the schematic diagram proved on test to fulfil all expectations.

CIRCUIT DETAILS

The tubes and their functions are as follows: V1 is the regenerative 1st R.F. amplifier, resistance-capacity coupled to buffer V2; tube V3 is another stage of tuned R.F. amplification.

This additional high-gain stage was included in the design because it materially increases the overall selectivity, which is important if image interference is to be entirely suppressed. The popular 6D6 tubes are used in each stage because of their desirable characteristics for this type of service. The rectifier V4 is an 80-type tube and is used in the conventional power supply circuit. Band-spread tuning was incorporated because the tuning would be quite critical due to the high gain. The band-spread system chosen has been used very successfully for the past two years by one of the most prominent manufacturers of custom-built professional short-wave receivers.

The electrical design of the output as shown in Fig. 1 is such that it may only be coupled to a receiver that has provisions for a doublet antenna system; that is, *the primary of the receiver's input coil must not be grounded.* If this coil is grounded, shunt a 0.1-meg. carbon resistor across the output of the amplifier; one side of a small condenser should be attached to the plate of the output tube, the other connection of the condenser is then used for the output.

MECHANICAL PROCEDURE

For the benefit of those who may contemplate building this amplifier, some of the mechanical construction will be described. The aluminum chassis measures 12 x 10½ ins. After it is drilled commence the assembly by attaching the tube and coil sockets. The 3 amplifier tubes and the coils are shielded above and beneath the chassis. This is important if high gain is to be realized, as without the shields interlocking will result and the gain control will have to be decreased. In mounting the parts on the chassis use lock washers to prevent loosening at a later date which no doubt would be cause for plenty of grief. Two sets of standard 6-prong regenerative coils and 5-prong R.F. coils that will cover the various frequency bands may be utilized for this amplifier. As will be noted from the band-spread diagram, Fig. 2, the ground connection of the primary is unsoldered and connected to the ground connection of the secondary. This change releases a spare prong which is required to provide a jumper for the broadcast and 160-meter coil that automatically brings condensers C13B and C12B into the circuit. The actual connections of the coil terminals to the form prongs—and thus to the terminals of sockets S1 and S2—are readily determined by reference to the respective portions of the circuit, in Figs. 1 and 2. It is suggested for the broadcast band that the regeneration coil be discarded and straight tuned R.F. be employed. If this is not done, the first tube in the receiver will be severely overloaded on strong signals.

In conclusion it can be stated that this amplifier has been *thoroughly tested* in a well-known radio laboratory in New York City and their findings were highly complimentary. Not being entirely satisfied with only a laboratory report the amplifier was lent to several amateurs whose opinions were known to be quite critical. The only adverse criticism that was heard from this source was the hams bemoaning the departure of the booster.

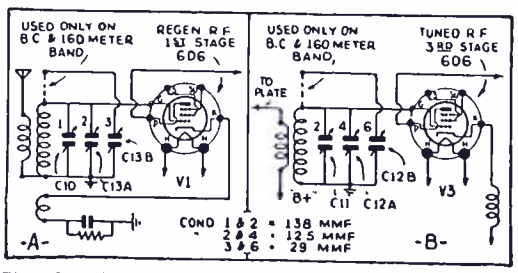


Fig. 2. Circuit showing the band-spread arrangement used in the booster.

LIST OF PARTS

Two Hammarlund sets of 5- and 6-prong plug-in coils;
Two Hammarlund 5- and 6-prong isolantite sockets, S1, S2;
Two Hammarlund R.F. chokes, 10 mhy., L1;
Two Hammarlund double band-spread condensers, C12, C13;
Two Hammarlund tank condensers, C10, C11;
Two Hammarlund tuning dials;
One Hammarlund band-spread tuning dial;
One Hammarlund panel;
Three Hammarlund tube shields;
Three Hammarlund base socket shields;
One resistor, 250 ohms, 1 W., R1;
One resistor, 50,000 ohms, 3 W., R3;
One resistor, 0.1-meg., ½-W., R4;
Three resistors, 5,000 ohms, ½-W., R5, R8, R12;
Three resistors, 50,000 ohms, ½-W., R6, R7, R11;
One resistor, 300 ohms, 1 W., R9;
One Aerovox cartridge condenser, 0.1-mf., C;
One Aerovox mica condenser, 0.002-mf., C7;
Three Aerovox filter condensers, 8mf., C9;
One Electrad variable resistor, 50,000 ohms, R2;
One Electrad variable resistor (with switch Sw.), 10,000 ohms, R10;
One Electrad bleeder resistor, 20,000 ohms, 50 W., R13;
One United Transformer Co. power transformer, type UH-1, T1;
Two United Transformer Co. filter chokes, type UC2, L2;
One Blan aluminum drilled chassis.

HOW TO INSTALL A WIRED AUDIO P.A. SYSTEM

(Continued from page 221)

is desired for *contraction* circuits, as in this case decreased amplification is desired with increased signal. If all bias is removed from the tubes under A.V.C., then the circuit will act as an expansion circuit up to the point where normal bias is obtained, and will act as a contraction circuit from that point upward.

Last an L-type control is placed in the primary of transformer A471, to control the amount of contraction or expansion. This control could have been a straight potentiometer of 50,000 ohms; in this case, it would have replaced the 25,000 ohm resistor and the 0.06-mf. condenser value would be changed to 0.03-mf. and an additional condenser 0.04 mmf. would be connected from the arm to the common side.

This concludes the series on wired audio P.A. installation. The writer will answer any and all questions relating to the construction and operation of the above-described circuit.

In the near future additional articles will appear in RADIO-CRAFT, by the same author, treating the installation of wired audio public address systems.

This article has been prepared from data supplied by courtesy of Dencose, Inc.

OPERATING NOTES

(Continued from page 209)

open-circuit occurs, volume level will drop abruptly, resonance hiss will be experienced, and the action of the tunalite will be poor. When the tunalite operates normally but the receiver becomes inoperative intermittently, check the 0.1-mf. A.F. coupling condenser, C1, connected between the plate of the first audio 56 type, V2, and the control-grid of the type 59 driver stage for an open-circuiting condition. Poor contact between the base pins of the neon bulb and its socket is also a frequent source of trouble. The pins should be cleaned and the socket contacts squeezed slightly to increase their tension, to remedy the difficulty.

When servicing this model for the complaint of choked and weak reception, look for a broken pigtail lead to the 0.25-meg. carbon resistor, R1, mounted on the tunalite socket assembly. One end of the resistor is grounded to the frame.

Lyric SA-91, SA-99, 900. Where the symptoms of weak and distorted reception are encountered and the receiver operates only with the noise suppressor control turned completely clockwise, change the type 55 tube (which may test perfectly in a tube checker!).

Distorted reproduction at low volume is almost invariably caused by an improperly centered voice coil of the dynamic reproducer. Where the complaint is distortion at medium- or high-volume with the tone control in treble position, the trouble has been traced to audio oscillation. Two remedies are suggested to correct this condition. The first is to isolate each control-grid of the parallelled type 2A5 tubes, V2, V3. The only required parts are a 0.3-meg. carbon resistor, R1, and a 0.1-mf. condenser, C1, connected as shown in Fig. 1C. The second method requires only two 250-ohm resistors, R3, R4, connected as shown in Fig. 1D. Although the second method is satisfactory, isolating each control-grid of the type 2A5 tubes is by far the better way. High-pitched reproduction, distortion, and the attendant symptom of the type 2A5 S.-G. glowing red has been traced to a leaky type 2A5 cathode bypass condenser, a 10 mf. unit, and to a leaky 0.05-mf. condenser connected in series with a 3,000-ohm carbon resistor from plate to screen-grid of the type 2A5 tubes.

Emerson D-S5. Intermittent and noisy reception wherein the signal level lowers abruptly, accompanied by rasping noises, is usually caused by poor contact within the dual volume control, the section being used in the A.F. circuit of the reflexed type 6B7 tube causing the most trouble. Where reception suddenly cuts off entirely, check the 0.05- and 0.02-mf. audio coupling condensers for an open-circuited condition.

Should the condition of distorted reproduction be observed with the symptom of unusually high control-grid bias, usually more than twice its normal value, impressed upon the type 47 output tube, the trouble may be traced to an open-circuited 0.25-meg. carbon resistor, one of two resistors connected in series across the field coil dividing the voltage drop across the field to obtain the correct control-grid bias for the output tube. When the complaint of distortion is received and a voltage analysis discloses a very low grid-bias voltage on the type 47 tube, and the grids of the type 47 glow red, look for a leaky 0.5-mf. grid filter condenser in the grid circuit of this stage.

Emerson 102, 104. Upon a number of occasions, these models were serviced for the complaint of very weak reception. With volume control turned full-on, the usual audio gain was found lacking, although R.F. gain was normal in all respects on broadcast and short-wave bands. When this condition is encountered, check the phonograph pickup tip-jack. The shorting member shifts and produces the difficulty.

Weak, distorted reception is usually caused by a leaky coupling condenser between the plate and grid of the type 75 and one of the type 6F6 tubes, respectively. This condenser is one of a block located upon the side wall of the chassis. Where the coupling condenser described and that connected between the type 6C5 plate and the grid of the second type 6F6 are found intact, check the reproducer for a grounded and partially shorted voice coil.

BERTRAM M. FREED

HOW TO MAKE A DIRECT-IMPEDANCE BASS BOOSTER

(Continued from page 211)

air required by organ pipes at opposite ends of the musical scale, or by considering the comparatively little amount of exertion required to play a fife when compared with the lusty blows dealt a bass drum.

THE L.F. CURVE

Perhaps the most critical factor in a low-frequency booster is the overall shape of the response curve. Upon it depends the amount of possible gain we may give the low notes without excessive boominess or distortion of the voice, and whatever the conditions which tend to reduce the sharpness of the cut-off, the response *above 70 cycles* must be kept at an absolute minimum.

While the previous circuits presented by the writer made use of a standard low-pass filter, advantage has been taken in the present instance to derive the filtering from a resistance-capacity circuit which produces a sharper cut-off than a single low-pass filter. This is of a decided advantage, since we are seeking to have as little of those notes above 70 cycles as possible. The ideal arrangement would be one in which the higher frequencies would be entirely eliminated, including the harmonics generated by the speaker.

In a scheme of this sort, we are battling against counteracting forces at all points. Chief of these is the effect of insufficient baffle area in all ordinary installations, which results in a loss of acoustic efficiency below the effective area. Should the baffle have a cut-off at 50 cycles, for instance, the output of the L.F. booster will be altered from the rising characteristic shown in Figs. 1B and C, and will have a tendency to flatten out below this point. Fortunately, this is overcome to a certain extent by an inherent action of the speaker in having a much greater cone excursion, with a correspondingly greater sound production, due to the lack of air damping. Thus by forcing enough power into the speaker at the lower frequencies, a very satisfactory sound output is obtained.

Care must also be taken to use a speaker which has a very low harmonic content in the range under consideration. In the event that the reproducer should be one in which the output of the amplifier is converted largely into 2nd, and higher harmonics—it must be admitted that most commercial loudspeakers are defective on this score—the characteristics of the amplifier are practically destroyed, and but a limited number of the desired notes can be obtained without serious distortion of voice frequencies. While an actual listening test of this unit with a poor speaker might give a greater "apparent" loudness, close investigation will reveal that the output consists almost entirely of 2nd, and higher, harmonics.

The "amplitude distortion" of the speaker chosen for this purpose by the writer is very low and the cleanness of the low notes is striking. This is due largely to the use of a thick and comparatively soft cone which can be driven to a wide excursion without break-up and consequent harmonic distortion. This desirable trait enables the shape of the L.F. curves, Figs. 1B and C, to be maintained almost intact, with scarcely discernible flattening.

Inasmuch as the frequency discrimination of the speaker and of the human ear become more pronounced at low volume, it has become the policy to make provision for additional attenuation of the middle musical range at low-volume levels. This has usually been aimed-at by means of a tap on the volume control from which the higher frequencies are shunted off through a tone control condenser when the volume control is at a low setting. With the L.F. booster, the same object is attained by increasing the "gain" (amplification) of this supplementary amplifier.

CIRCUIT REQUIREMENTS

If, beginning at the microphone and ending with the speaker, every component of the electrical reproducing system were absolutely linear; and sufficient power output were available, no bass boosting would be required. In practice, however, such rigid ideals cannot at the present time be met and we find frequency discrimination at every turn. Usually this is in the lower end of the audio scale.

Not only do we find losses to be prevalent in the actual amplifier, but even more so in the associated apparatus. It is true that our aural perception is insensitive to the loss of a decibel or two, but in the writer's opinion a *trained* individual can actually *feel* a power loss of an even less amount in the *lower register*.

It so happens that the cone reproducer of today has a decided tendency towards discrimination against the lower notes. Therefore this characteristic must be counteracted by increased gain in the amplifier in the corresponding regions. Accordingly, an amplifier having perfectly linear (uniform, or "flat") response over the entire scale *would still not produce the desired results.*

Figure 1A shows a typical voltage input response curve to a radio amplifier, and approximately the output from the usual phonograph record. Many microphones in general use have a response quite like this. While this curve cannot be taken as true in all instances, it does give a fairly accurate picture of the conditions which must be met. It may be seen that we are concerned from the beginning with a considerable loss in the lower regions. When added to the losses encountered in the speaker network, it becomes clear that the additional amplification given by the L.F. booster must be high, regardless of the fidelity of the amplifier itself.

The author has often found it necessary to use the full output of 2 high-gain stages following the "normal" power stage of an amplifier in order to properly bring up the level of the low notes! This gain is achieved in the present instance by the use of a 6J7 and a 6F6 in cascade arrangement.

Part II will describe the construction, adjustment and operation of this L.F. Booster Unit.

A NEW ELECTRONIC-TYPE OSCILLATOR-WOBBLER FOR OSCILLOSCOPE SERVICING

(Continued from page 214)

side, an upturned end which acts as a "beacon" in the circuit alignment. This action is shown in Fig. 1A, while at Fig. 1B is the usual pattern, with the ends of the pattern fading out. The advantages of pattern A are thus visualized. Tube V4 controls this beacon action.

The circuits of the oscillator section of V5 are so proportioned that the oscillator operates at a fixed frequency of 840 kc., while the master oscillator is varied, by shifting coils and by adjustment of the main tuning condenser, C1.

The frequency range is from 100 kc. to 30 mc., covered in 5 bands, and the more popular alignment frequencies are spotted on the airplane dial.

Switch 1 in the left position provides for visual modulation; in the center position, a 400-cycle audio modulation is produced by V2, and electronically coupled to V1 by the latter's suppressor-grid; while in the right-hand position of the switch, the R.F. output is unmodulated.

A dual attenuator with 2 panel controls affords very wide latitude in control of the R.F. output.

The complete apparatus is contained in a metal case 11½ x 8 x 8½ ins. deep; the total weight is 14½ lbs.

Our Information Bureau will gladly supply manufacturers' names and addresses of any items mentioned in Radio-Craft. Please enclose stamped return envelope.

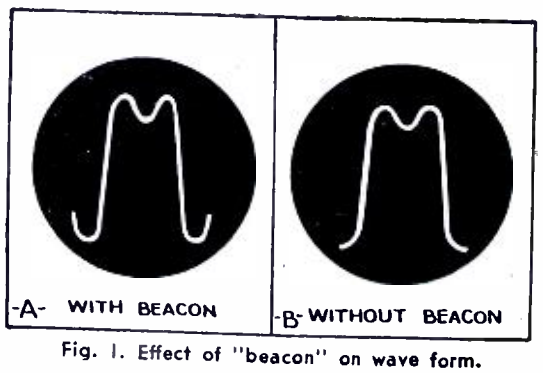


Fig. 1. Effect of "beacon" on wave form.

UP-TO-DATE EQUIPMENT FOR THE PUBLIC-ADDRESS SPECIALIST

(Continued from page 213)

efficient possible magnetic circuit. The units are entirely dustproof and weigh less than regular electro-dynamic speakers. Speakers may be obtained in 5-in., 6-in., and 8-in. diam. sizes.

A P.A. SYSTEM FOR ELECTIONEERING (1171)

(Wholesale Radio Service Co., Inc.)

ALTHOUGH designed particularly for the needs of the coming political campaign, this compact outfit may be used for many other purposes. With its output of 5 W. it is ideal for the average street corner gatherings. Flexible input channels permit simultaneous connection of several mikes or mixing of music and speech. The gain is sufficiently high (131 db., at 5 megs. input) to allow the use of either the directional velocity mike or the sound-cell type. The case measures 9 x 13 x 14⅜ ins. high; the weight is about 40 lbs.

HIGH-POWER AMPLIFIER (1172)

(Radolek Co.)

BEAM power tubes produce the high power output of 60 W. from this amplifier with a usable gain of 135 db. The peak gain is 75 W., and the response curve is flat within 1 db. from 40 to 9,000 cycles. There are 4 separate input channels for high-impedance mikes and a channel for phono. or radio, each channel having its own volume control. All connections are made by means of plugs. There is provision for 4 speaker fields of 1,000 ohms each. The meter on the control panel is an output level indicator. Output impedance is variable from 2 ohms to 1,000 ohms.

HIGH-FIDELITY MONITOR (1173)

(Lansing Mfg. Co.)

THOUGH the overall size is only 50 x 27 x 27 ins. deep, the response curve of this speaker system is flat over a range of 50 to 8,000 cycles. It is a development of a type of speaker system used mainly in theatre work, and may be used as a monitor for high-quality speech reenforcement, or for radio receiver use. The system consists of a 15-in. dynamic low-frequency speaker, a moving-coil high-frequency speaker, a filter network, and the baffle system.

NOKOIL-MAGNET DYNAMIC EXTENSION SPEAKER (1174)

(Wright-De Coster, Inc.)

AN URGENT demand for a speaker that can be operated at a distance from an auto-radio or any other receiver is answered in this compact extension speaker. The steel case is strong enough to stand a great deal of abuse, but is light and affords adequate baffle area for the speaker. The 8-in. speaker unit requires no field current and is equipped with a universal transformer which matches all output tubes, either single or push-pull. The speaker magnet is of the new type alloy which will withstand much abuse without losing its magnetism.

A fine item for use in hotels, schools and restaurants, and in inter-office communication systems.

MUSICIANS' AMPLIFIER (1175)

(Amplifier Co. of America)

THIS very novel development is designed especially for use of musicians. It is capable of an output of 32 W. with less than 1 per cent total distortion. Inputs are provided for from 1 to 6 instruments. and voice may be blended with any of these. Provision is also made for reproduction of recorded music with automatic volume level expansion.

Circuit features include tone compensated volume controls, electronic mixing, high- and low-frequency gain controls, and harmonic-content control. The portable case measures 21 x 19 x 12 ins. deep. Standard equipment includes one 12-in. speaker, but 2 of these may be used if desired.

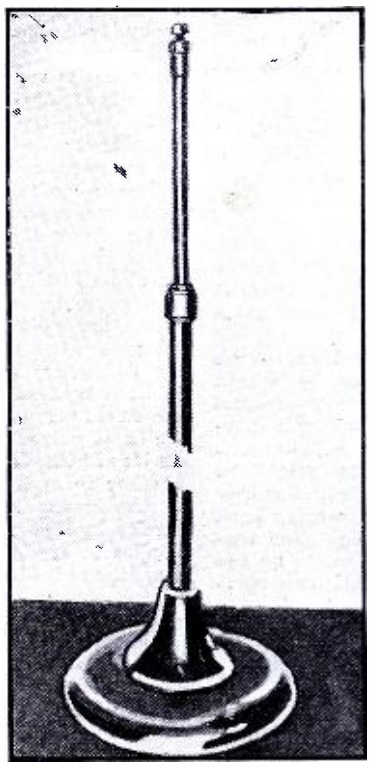
Up-to-date musicians everywhere are using this sort of equipment for enhancing the effectiveness of both solo and orchestral performances.

60-80 WATT P.A. AMPLIFIER (1177)

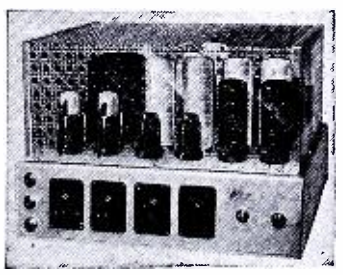
(Amplitone Products Co.)

THE construction of this amplifier is in line with newest refinements in the public address field. Outward appearance is extremely attractive, and all tubes and other components are well protected from external interference due to a perforated screen-type cover. Ventilation and shielding is thus unimpaired. Heavy cadmium plated finish on chassis and top cover. Etched black control dials contrast sharply against the cadmium background. The circuit employs some new highly developed innovations which result in improved efficiency and consistent stable operation. A calibrated feedback suppressor arrangement tends to minimize troublesome operating noises commonly encountered with amplifiers.

The three position electronic mixer circuit permits mixing and fading of any or all separate inputs. Jacks permit rapid connection to three separate-input channels. 2 high-gain and 1 medium gain (for crystal, ribbon mike or phono. inputs). Output impedances. 2-4-8-15-500 ohms. Tubes employed: 2-6J7, 4-6C5, 2-6L6, 1-83, 1-82. With this tube complement, an overall gain of 115 db. is obtained, and a full 60 W. of power with a possible peak rating of 80 W. Careful measurements indicate that the hum level of this amplifier is 55 db. below the output level, and that the frequency response is within plus or minus 2 db. from 40 to 10,000 cycles, thus making it a high-fidelity unit.



New microphone stands with many outstanding advantages over the ordinary "garden variety." (1176)



A 60-80 W. amplifier using the "beam power" tubes and supplying a gain of 115 db. (1177)

IMPROVED MICROPHONE STANDS (1176)

(Atlas Sound Corp.)

A NEW "Velvet Action" that prevents any scratching or noise from being conducted to the microphone is the outstanding feature of this new line of microphone stands. This easy sliding action also prevents the running tube from being dropped suddenly, and causing damage.

The friction clutch on the stands can be adjusted according to the weight of the microphone and the microphone can be raised and lowered without further adjusting of the clutch. This clutch can also be locked at any height if desired.

The rubber cushion mounting on the bases of two of the models, absorbs any floor vibration; prevents marring of the floor; and improves the stability of the stand.

THE NEXT ISSUE —

Is the annual Radio Vocation number in which a wealth of information on the numerous side lines of "Radio" will be found. Every professional radio man, regardless of his specialty will find information in this number which will help him "make a go of it." Don't miss the November issue on the newsstands October first!

READERS' DEPARTMENT

(Continued from page 217)

portant for my work in this country.

I write this letter (that you will excuse, because I write very bad English) because I want to offer my very little voice for a good radio review.

J. GALO VELARDE R.
Guayaquil, Ecuador

We reproduce the above letter exactly as received. Mr. Galo has done a lot better with our language than we could with his! We hope that future issues of *Radio-Craft* will hold equal interest for Mr. Galo.

A MANUFACTURER'S VIEWPOINT ON "VIBRATOR ADJUSTMENTS"

Cleveland, Ohio:

Mr. O. E. Payne of Columbus, Ohio, in your August, 1935, issue, pg. 99, objects strenuously to the vibrator manufacturer's caution, "Don't try to adjust this vibrator yourself."

Mr. Payne states that he has successfully serviced hundreds of vibrators, and finds nothing complicated about cleaning the points and adjusting a vibrator.

The Radiart Corporation doesn't have any doubt that Mr. Payne does an excellent job on servicing vibrators, and we feel certain that there are hundreds of other Service Men who are doing or might do likewise. However, we also are confident that for every Service Man who can successfully service vibrators in the field, there are nine of perhaps equal technical ability who cannot, and the caution "Don't try to adjust this vibrator" is directed at the field as a whole and not to the exception.

Where adjustments are as critical as in the case of vibrator points which must be within one or two thousandths, *feeler gauges* are not efficient unless the Service Man has the particular "feel" or touch for vibrator adjustments. The average first-class Service Man might be able to adjust 3 out of 4 vibrators satisfactorily and guarantee them, but the fourth coming back to him would mean a loss in prestige—and corresponding dollars and cents—that would by far offset the advantage of his doing his own servicing.

If the vibrator points are improperly adjusted, return the vibrator to the manufacturer and place the blame where it belongs, relieving the Service Man of responsibility that should not be his.

We might say that in order to insure uniformity on point adjustment, no Radiart engineer would attempt to adjust vibrator points without the aid of a series of complicated lenses that magnify the vibrator points many times.

In the matter of cleaning points, a surer and safer method than the use of emery paper, is to run the vibrator for a few moments at 10 V.

One vibrator manufacturer at one time recommended that the Service Man service vibrators in the field and went so far as to publish a vibrator service manual and list replacement parts. But after a year's trial in the field, this was found to be entirely unsatisfactory, both from the factory and Service Man's viewpoint, and we understand that the parts listing has been discontinued and the recommendation reversed.

THE RADIART CORPORATION

This comment, coming as it does, from one of the large vibrator makers, gives a very interesting viewpoint, and also several hints, on the subject of vibrator repair by the Service Man.

SUPPRESSORS, AGAIN!

St. Joseph, Mo.:

In response to your request for information gained through actual experience with noise suppressors, I wish to say that Mr. H. E. Anderson's article (" 'Who's Wrong?' or, 'Why Suppressors are Wrong,' " pg. 158) in the September, 1935, issue of *Radio-Craft* confirms in a thorough and concise manner, based upon departmental research work through practical experimentation, exactly what I have learned from several hundred cases of car-radio installation and subsequent car operation.

You spoke of the reduction of power available at the spark plugs, caused by the suppressors, as hardly detectable. Under some conditions, this seems true, but when analyzed and when tests are made over a variety of operating conditions the effect is very noticeable, and agrees with Mr. Anderson's statement.

The conditions under which an aeroplane motor must operate are considerably different than for an automobile engine.

The use of suppressors revolves around cost, their use resulting in lower initial outlay, this being secured with a reduction in efficiency. What car owner is willing to spend even $50, let alone $200 for an elaborate ignition-shielding system, so he can use a car radio?

Another point not clear in your comment is that the series use of suppressors did not reduce the power available at the spark plugs, whereas a shunt connection would. Aren't you confusing the terms voltage and current with their product, which is power? The way I understand it, any device which transforms electrical energy into another form is a power generator. Hence, due to the suppressor being a high resistance, it results in a loss in the form of heat, and this applies to any circuit having this characteristic, regardless of whether it is series or parallel connected. Series connection reduces voltage and shunt connection reduces current, and neither voltage nor current is power; their product is power. The suppressors reduce the voltage, not current, and this reduction lowers the intensity of the spark, which gives a lower percentage of combustion.

There are so many factors involved in this matter that to arrive at a true perspective of the facts requires the services of men like Mr. Anderson, who know the aviation as well as the automotive field.

Congratulations, Mr. Anderson and I hope we shall again have the pleasure of reading another of your excellent comments.

RUDOLPH POLTKAMP

This subject has had so many comments made about it, on both sides, that we print the above letter in the hope that it may help some who are in doubt. After all, the Service Man is interested in actual results obtained in practice, not in theory, so Mr. Poltkamp's statement that he has considered this problem in the light of experience obtained from several hundred cases will be of great interest.

ELECTRONIC MUSIC FUNDAMENTALS

(Continued from page 216)

Due to the wide scope of the subject matter, it was impossible to give constructional information on many of the different types. The author is quite willing to assist wherever possible in supplying details on individual instruments. Address inquiries to the author in care of *Radio-Craft* and enclose a stamped and self-addressed envelope.

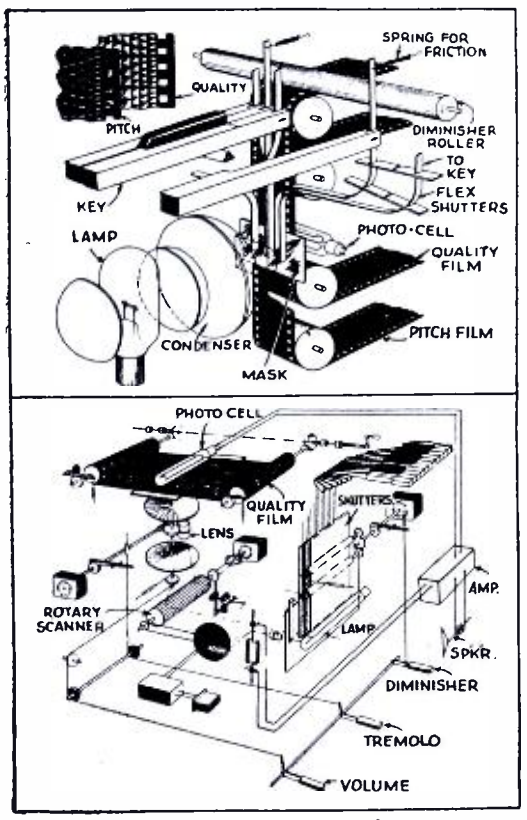


Fig. 15. Details of composite instruments.

HOW TO MAKE A BEGINNER'S POCKET RADIO SET

(Continued from page 208)

be wound by hand. Table I gives complete specifications for the coils. When winding the coils and connecting them to the base prongs, make certain that the top of the larger winding, or secondary, goes to the grid condenser, and that the bottom of the smaller winding or tickler connects to the plate. Otherwise it may be impossible to secure regeneration or oscillation. (Reverse the connections to the plate coil, if "beeps" are not heard as station carriers are tuned-in.)

When wiring the set, make certain that no metal parts or wires touch the case. Condenser C2, which is mounted on the case by a single nut on the center bearing, should be insulated from the case by means of bakelite washers. Condenser C, which is shown dotted, may be used when a ground is connected to the circuit. Never connect a ground directly to the receiver if it is being operated on the power lines, unless this condenser is used. Otherwise it is quite probable that a fuse will be blown or other more serious damage be done.

The construction cost of this little set is so slight, and the design so simple, that every beginner in radio should find it "apple pie" to build this receiver. If you hit a snag, just drop the writer a line—*and enclose a stamped, return-addressed envelope.*

TABLE I

Coil Specifications

Wave (Meters)	Tickler Turns*	Second Turns**	Turns Spacing†
17-41	4	5	4
33-75	7	15	3
66-150	7	35	2
140-270	16	75	1
250-560	28	114	none

*All wound with No. 32 wire. **First 3 wound with No. 24, next with No. 30, last with No. 36 wire. †Spacing is in thickness of wire used. Space between windings is ⅛-in. on all coils; enameled wire used throughout.

LIST OF PARTS

One Hammarlund trimmer condenser, 3-to-35 mmf., C1;
One Hammarlund "Star" variable condenser, 140 mmf., C2;
One Solar mica condenser, 100 mmf., C3;
One Solar 500 mmf. mica condenser, C4;
One Solar dual 4 mf. filter condenser, 200 V., C5;
One Solar dual 8 mf. filter condenser, 200 V., C6;
One resistor, 1 meg., ¼-W. R1;
One Electrad 75,000-ohm potentiometer with switch, R2-Sw. 1;
One 350-ohm power cord resistor, R3;
One wire-wound resistor, 10,000 ohms, 10 W., R4;
One twin tip-jack strip, J1;
One Hammarlund all-wave coil set, L1;
Two 4-prong wafer sockets;
Two metal cash boxes;
One RCA type 6C5 tube, V1 (on A.C., a second 6C5, V2, is required for use as a rectifier, as per text);
One bakelite 3-terminal connection strip;
Knobs, wire, hardware, etc.

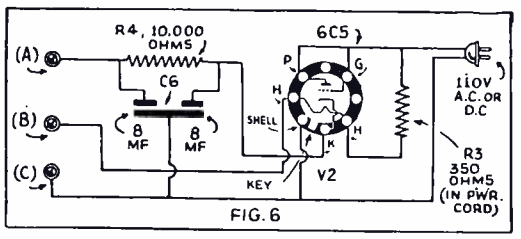


Fig. 6. An A.C.-D.C. type power supply for the pocket set. A, B and C connect to set.

"APEX STATIONS"

It is interesting to note that the ultra-high-frequency broadcast transmitters which are being licensed by the F.C.C., four of which are low in operation, are being officially called "apex stations." These four existing stations are all working on frequencies above 30 megacycles and it is understood that there are many applications on file in the F.C.C. offices for other broadcasters in these new wavebands.

HOW TO MAKE AN ULTRA-DX 12-TUBE ALL-WAVE SET

(Continued from page 215)

all holes are cut and *all* parts fitted in place before fastening the black piece on the panel. In this way, it will not be scratched or marred.

SLIGHT ALTERATIONS ARE ESSENTIAL

There are many parts that need slight alterations to be usable for our purpose and these changes will be taken up now.

The most important is the tuner-unit change. Here we remove the tuning condenser from the tuner chassis, leaving all leads connected to the precision components of the tuner as it originally comes. The condenser is mounted flat on the receiver chassis by means of 3 small brackets.

The band-spread condenser is cut down from a standard 3-gang unit of 140 mmf. capacity, leaving only 1 rotor and 1 stator plate in each section. This condenser is also mounted flat, but by means of screws run into tapped holes already in the frame.

The tuner chassis is mounted in place on bushings so that its switch shaft comes at the proper level to pass through the front panel.

The beat oscillator tuning inductance, T3, comes equipped with a mica compression-type trimmer. This must be removed and a 100-mmf. air trimmer, C10, installed in its place. All components of this beat oscillator circuit under the chassis are contained in a shield can as shown in Fig. C, the front end of which serves to hold C9 and the beat oscillator switch. The latter is operated by a pin projecting from the rear flexible coupling of the panel control of C9, the pin engaging in a slot in the switch knob when the control is turned fully counterclockwise.

The "noise-silencer" transformer, I.F.T.4, needs a slight change, as the coupling has to be increased as much as possible. This is done by disassembling the unit and removing the coil unit. Cut the cardboard tube on which the coils are mounted and bring them next to each other, holding the two portions with a wood dowel which fits tightly into both. Then assemble as before.

The tuning meter in the original receiver is illuminated and this is easy to do by cutting a slot about ¼- x ½-in. long in the top of the bakelite case. Cement a strip of celluloid over this hole to keep out dust. The variable shunt resistor, R20, is mounted directly on the meter.

A shield is built around the under-chassis components of the crystal-filter circuit, the part toward the front panel carrying the condenser, C8, and the filter switch, the latter being operated in exactly the same manner as the beat oscillator switch.

All variable resistors controlled from the front panel, with the exception of R15, are mounted on aluminum brackets, and controlled by bakelite rods.

The remainder of the construction and assembly, including wiring, is essentially straightforward and will not be gone into here.

ALIGNING THE SET

After a thorough checking of the wiring, alignment is the next process. The first step is to make sure the voltage from the power supply is correct. This should be about 250 from chassis to "B+", and 100 from chassis to "B−".

With the beat oscillator, the crystal filter and the A.V.C. switches off, a rough alignment of the I.F. transformers may be tried, starting with I.F.T.3, then I.F.T.2, and finally I.F.T.1. Coupling condenser C7 should be set at about ½-full capacity. If the circuits seem to line up properly, the I.F. amplifier may be aligned to the crystal frequency. To do this, set up a simple crystal oscillator using any handy tube such as a 30, 99, 01A, 27, etc., and about 45 V., plate supply. The plate inductance may be the secondary of an I.F. transformer. This crystal-controlled oscillator is used exactly as was the original test oscillator to line up the I.F. amplifier circuits from V2 to V4. Care must be taken to insure accuracy.

When this alignment is finished, the beat oscillator is tested, and with C9 set at about mid-scale, C10 is turned until a loud whistle shows that this circuit is producing a beat with the incoming crystal-oscillator signal.

Now the R.F. end of the receiver must be aligned and this process is too well known to require description. Proper tracking over the 2 lower frequency bands is secured by their respective variable padding condensers, while the remaining bands have fixed padders.

The job of aligning the set cannot be carried out with too much care. It is advisable to repeat the various operations in their correct sequence in order to be sure that the best sensitivity, and frequency response are being obtained. This is especially true of the I.F. adjustments, for the greatest portion of the gain in the set is in this intermediate amplifier and the success or failure of the set depends to a great extent on the care with which the aligning is done.

By this time it should be possible to receive stations on any band, and the A.V.C. control, R19, should be adjusted with the A.V.C. switch on, until all stations are held to the desired level as indicated on the tuning meter.

NOISE SUPPRESSOR ADJUSTMENTS

The noise-suppression circuit requires adjustment only of the trimmers in I.F.T.4. Turn control R17 to the ground end, then start a vacuum cleaner or other such appliance, and adjust these trimmers until the noise is at its lowest. As resonance is reached, the control will have to be advanced to prevent cut off of V4. In operation, R17 is turned as far as possible towards the ground end, while retaining the desired signal. When R17 is turned too far, the signal will start to cut off.

This completes the adjusting procedure, and reception of any type of radio transmission within its range will be handled with ease by the receiver.

By now it will be seen that there are no startling innovations, all the circuits and construction being more or less orthodox, yet everything is provided that will enable the dyed-in-the-wool DX-er to attain the maximum of performance.

Set-builders, who still find themselves in the "amateur" class, should be fairly successful in building this 12-tube receiver. If care is exercised in construction, its performance should be as near perfect as though made by a "professional."

(It has been decided to provide to those wishing them, reproductions of the front panel control plate, all ready for trimming and mounting, and made from the same drawing as was the plate on the original receiver, for $1.00.)

NEW DEVELOPMENTS IN WIDE-RANGE SPEAKER DESIGN

(Continued from page 221)

sity, transmit the most minute oscillations of the voice coil through the diaphragm to the air column, without any deviations or losses. The average cone diaphragm fails in this respect. At certain frequencies it will fail to produce audible sounds entirely, while at other frequencies it will become overactive, creating too much sound. And, then again, it may oscillate in such a manner as to produce spurious tones.

To overcome these defects, a new diaphragm (4) has been developed. This cone diaphragm has no voice-coil orifice, thereby preventing air circulation or "breathing" around the voice coil at low notes, and also improving its efficiency at both the extreme high and low frequencies. It also prevents the infiltration of dirt around moving parts. The voice coil fits snugly into a special recess on the cone, which allows for maximum coupling area. This special method of connecting the coil with the cone, heretofore found unattainable, permits the efficient operation of the speaker at frequencies *above* 6,000 cycles per second.

The contour of the cone surface is an ever-changing plane, made to conform to an exponential curve. This form contributes greatly toward the prevention of parasitic vibrations. The character of the conventional cone material was found to cause much of the loss in tonal fidelity. Therefore, a new combination of materials has been developed. These "polyfibrous" materials *control the relative loudness of one frequency to another*, making possible a frequency response that is practically uniform throughout. Furthermore, it is possible to attain various frequency characteristics with the use of these new materials. It also increases the range of amplitude and frequency response obtainable in cone speakers.

REPRODUCING LOW NOTES

To make a very low note audible an appreciable amount of air must be displaced by the diaphragm. This is accomplished by the two dimensions, area of the diaphragm surface, and the length of axial travel. When the diaphragm is only 12 ins. in diameter, considerable travel, or distance-of-motion must be realized if an extremely low note is to be audible. To make such motion possible, an improved type of suspension was developed. This suspension allows the diaphragm to float freely as well as keeping the voice coil in perfect alignment.

A centering spider that is too heavy and too stiff fails to give the required freedom. It is resonant to certain vibrations, and by transmitting the specific vibrations back into the diaphragm, it creates distortion. By the development of an *interlaced centering net* (3) the above conditions have been overcome. This centering device makes contact with the cone at a fixed distance from the voice coil, throughout the circumference at that point. A radial thrust in any direction is effectively opposed, while perfect freedom in the axial direction is assured. This centering device with its extreme axial flexibility, makes a really low note attainable.

PERMANENT-MAGNET FIELD

Quality and efficiency are dependent on a strong magnetic field (6). To achieve it with the minimum of size, weight, and cost is most desirable. In addition, it is desirable to obtain this strong magnetic field with little or no electrical excitation. High magnetic densities, with small light-weight field structures are now attained with the permanent magnet alloy "Nipermag." (See "A New Alloy for Permanent Magnets," September 1936 *Radio-Craft—Editor*) "Nipermag" excitation is a marvelous contribution to the science of sound reproduction, and completely eliminates the consumption of rectified electricity in the speaker field. This results in a decided saving in current consumed, as well as eliminating the cost of the rectifying equipment. This means smoother, quieter operation of the radio set, as the "hum" from the power pack cannot reach the speaker field of a "Nipermag"-excited reproducer. (In Fig. A, brass rod 2, riveted to frame 5 centers the iron polepiece 8, as it is slid into voice coil form 1. Polepiece 8 fits tightly into iron endplate 9.; endplate 7 also is iron—the 3 long screws are bronze. The entire assembly is held by a single long screw through spanning plate 10. The usual felt ring is provided.)

The flux densities of nipermag vary with each speaker size. The 8-in. model (Figs. A and B) has a flux density of 7,000 lines of force per square centimeter; and, for the 18-in. reproducer (Fig. C; shown without "infinite baffle" housing), 13,000 lines of force per square centimeter. Use of either an acoustic chamber or an infinite baffle is *imperative*, due to the reproductive power of the 18-in. model. The amazing frequency—30 to 10,000 cycles—is shown by graph in Fig. 1.

THE "INFINITE BAFFLE"

This speaker has another outstanding feature to offer, which has a great influence on its purity of tone as well as the reproduction of the low notes. This feature is its adaptability to use in an Infinite Baffle. See "Facts About the Infinite Baffle," May 1935 *Radio-Craft.—Editor*) All cone loudspeakers require a baffle of one kind or another if the low notes are to be made audible. In the "home radio," the cabinet must serve as the baffle. Because of its small size it is very unsatisfactory, failing to make the low fundamental notes audible.

Another great drawback is the radiation of sound from the back of the radio cabinet. The sound emanating from the rear of the speaker strikes the wall and is reflected. These reflected frequencies or sound waves are ofttimes out of phase with those being produced by the front of the cone, neutralizing some, and distorting others. This distortion is never the same, varying according to the location of the set. It is the chief cause of the artificial booming sound, so common in the reproduction of men's voices. This sort of distortion again varies with the type of radio cabinet one chooses. All of these above points are overcome with the infinite baffle, which is a special type of housing, so designed and built as to have a definite relation with the diaphragm of the reproducer. This housing is air tight, stopping all rear radiation and automatically preventing distortion caused by this radiation. Since it is an *infinite baffle* no low note can circulate from the front of the diaphragm to the rear, and neutralize itself. A structure of this type is ideal for public address work, as no other baffle is needed. If a flat baffle board were provided large enough to equal infinite baffle, it necessarily would be over 10 ft. square! This is usually impossible in churches, auditoriums, theaters—and radio cabinets.

With the infinite baffle the speaker-type here illustrated and described can be mounted on the side of a wall, in the corner or slipped into a hole in the wall. It can be mounted in a radio cabinet and the acoustic character remains unchanged.

In listening to this speaker, one can readily distinguish the fine tonal characteristics of the instruments that are being reproduced, throughout the entire audible frequency range. There is no impression of unpleasant loudness; there is no painful hardness to the tones, caused by frequency doubling and resonance. This is all replaced by the true overtones or harmonics that portray the genuine character of the musical instruments, as well as the deep, rumbling fundamentals that are so pleasing to hear, so much more satisfying.

This article has been prepared from data supplied by courtesy of Cinaudagraph Corp.

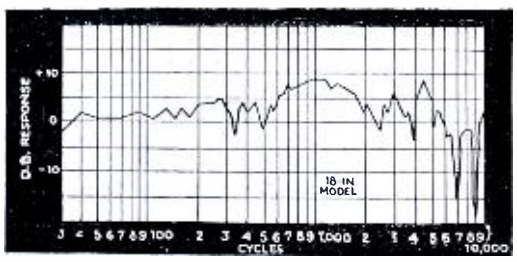


Fig. 1. The unusually flat response curve of the 18 inch. model speaker. This new speaker designed particularly for high-fidelity public address work has an output capacity in watts of 30.

A new lathe—fine for radio work. (1157)

NEW RADIO DEVICES

(Continued from page 223)

FIXED-WAVELENGTH HIGH-FREQUENCY CONVERTER (1150)

(ABC Radio Labs.)

WHILE designed expressly for police and government use, this converter also covers the 5- and 10-meter amateur bands. The converter uses a single type 6A7 tube and is tuned by a single condenser. The tuning is fixed and pre-set. Connection is made to the regular broadcast receiver, and a switch on the converter cuts it in or out as desired. Since there is no tuning control, it may be installed in almost any space available.

CONDENSER KIT (1151)

INDIVIDUALLY boxed units in this kit insure clean merchandise no matter how long they are kept in stock. There are 40 units in a metal case, *the values being selected from those most often used.* The sizes range from 0.001-mf. to 0.5-mf., and include units of 400- and 600-V. ratings.

CONDENSER REPLACEMENT UNITS (1152)

(Sprague Products Co.)

UNIVERSAL mounting is the feature of these units, as they are all of one size, and will readily fit the standard mounting strap. With these units it is possible to build up a *condenser replacement* of any odd value which will be in most cases smaller than the original, and often much lower in cost. They are made in both 450- and 600-V. lines.

CATHODE-RAY TUNING UNIT (1153)

A CONVENIENCE supplied on many of the latest receivers may now be had at small expense, for attachment to any set having A.V.C. This adapter is furnished with connecting cable and panel escutcheon. Only 2 screws are required for mounting this 6E5-tube holder.

SMALL CABLE CONNECTOR (1154)

HERE is a small, all-metal coupling unit which permits connection of 2 single conductor shielded cables. The unit is ¾-in. in dia. and 1½ ins. long, and is finished in gunmetal. Cables up to 5/16-in. may be accommodated.

GAS-TYPE FIRE FIGHTER (1155)

(Walter Kidde & Co., Inc.)

THE USE of an extinguisher of this type in electrical and radio laboratories, small radio manufacturing plants, broadcast stations, etc., is to be especially recommended, since it is harmless to any material it may touch, due to the fact that the gas is dry, and it makes no mess.

The unit may be kept indefinitely before use without deterioration and will not freeze. The gas is absolutely non-corrosive and thus will not harm delicate wiring or any sensitive apparatus it may have to be used upon.

5-IN-1 PUNCH (1156)

(Livermore 5-in-1 Punch Co.)

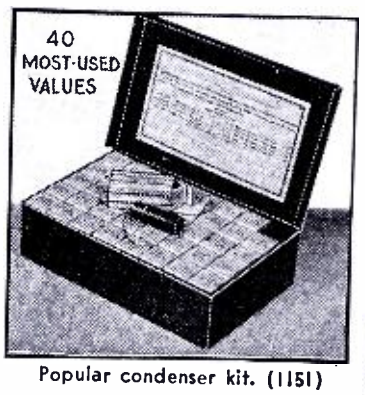
HOLES of ½-in., ¾-in., 15/16-in., 1 3/16 in., and 1 7/16 in. may be cut in sheet metal up to 16 gauge with this combination punch. It is very simple to center the hole and only a 2 lb. hammer is sufficient to do the work. The parts are of heat-treated steel of a special grade and will wear well.

(The earlier type described in a past issue of *Radio-Craft* did not have as wide a range of sizes.)

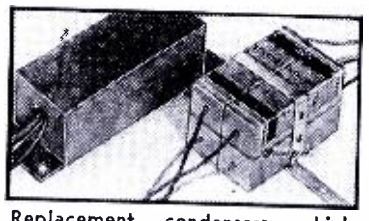
WORKSHOP LATHE (1157)

(South Bend Lathe Works)

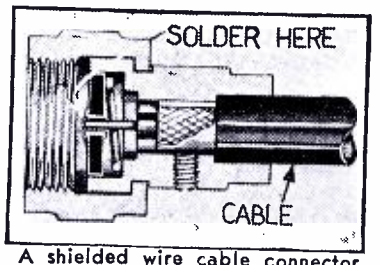
ALL THE care which is put into the manufacture of large commercial lathes is expended in producing these "home lab." lathes. They have an extra strong bed which may be had in 4 sizes, 3 ft., 3¼ ft., 4 ft., and 4¼ ft. There are 8 different types, including those for bench and for floor mounting. New features include: simplified twin reverse for cutting right- and left-hand threads of 4 to 40 per in., several



Popular condenser kit. (1151)

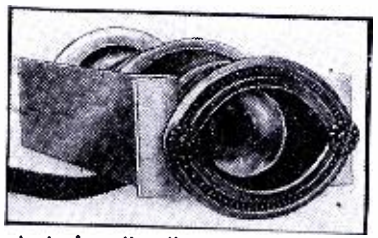


Replacement condensers which feature universal mounting. Provided with mounting strap. (1152)

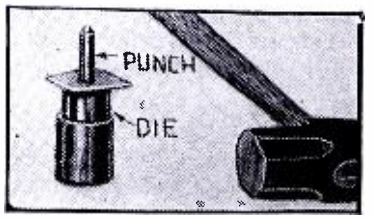


A shielded wire cable connector. (1154)

High voltage buffer. (1158)



A tuning "eye" adapter for insertion in existing sets. It is easy to install. (1153)



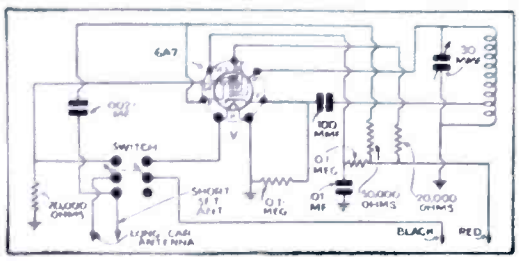
A punch set for cutting holes in sheet metal. (1156)

types of countershafts, improved back-geared headstock, new ball-bearing thrust collar on the spindle, etc. All kinds of metal can be machined with equal facility.

The increasing complexity of radio and allied equipment make such a device a profitable adjunct to any well-equipped shop that specializes in repairs of all kinds.

HIGH-VOLTAGE BUFFER CONDENSER (1158)

OIL-IMPREGNATION assures the maximum performance from these units. They are made in all standard sizes to fit various models of radio power supplies. The flash test is 3,600 V., and the A.C. working voltage, 800 V.



The circuit of the fixed frequency converter for police and government use. (1150)

An essential in the shop or laboratory is a safe fire extinguisher. (1155)

"A MODERN SOUND TRUCK AND P.A. SYSTEM"— AN OPEN LETTER

(Continued from page 214)

In connection with your "Sentorian" line of units. There is no doubt that this is the finest form and also the most profitable type of "advertising" for a small dealer.

Incorporated in this unit very extensively are products of your firm and I might add further that a number of special transformers of other manufacturers have been tried from time to time but just do not hold up. Practically all transformers both audio and power are of your make.

Following are a few words of explanation with reference to the photos.:

Figure A shows the truck and mast in position for operation; this mast can be erected by one man and the speakers attached and focused on the ground as shown in Fig. B; then, by use of the small crank and winch they can be raised to the top of the mast as shown in Fig. A. The transportation of this unit is accomplished as shown in Fig. C with the three 7-ft. lengths of the mast loading on the floor of the truck (not shown). The equipment consists of 20-W., 30-W., and 50-W. amplifiers with the associated preamplifiers, turntables, etc.

Figure D shows at the right the 18-V. D.C. and 120-V. A.C. 350-W. converter, mounted in a cushion frame. Supplanting the original car generator is a special compound-wound D.C. job supplying a maximum of 19 A. when charging on the car battery (6 V.), and a maximum of 45 A. when charging the 18-V. converter battery. Both of these charging rates are adjustable by virtue of a rheostat mounted in the driver's compartment. This generator-converter arrangement permits the operation of the equipment while the truck is in motion on the street, or in localities that do not have the usual light-circuit facilities. By permitting the engine to run at idling speed the battery is "floated" and thus the converter will operate indefinitely.

The complete arrangement can be unloaded, and the mast and the six 6-ft. trumpets erected by one man in approximately 45 minutes; however for street "ballyhoo" work two men are required, one to drive, the other to change records and announce.

Hoping that this bit of information and pictures can be used by your organization to further interest in the public address field, we are

Yours truly,

H. HAIGHT,
Haight's Radio Service.

Our Information Bureau will gladly supply manufacturers' names and addresses of any items mentioned in Radio-Craft. Please enclose stamped return envelope.

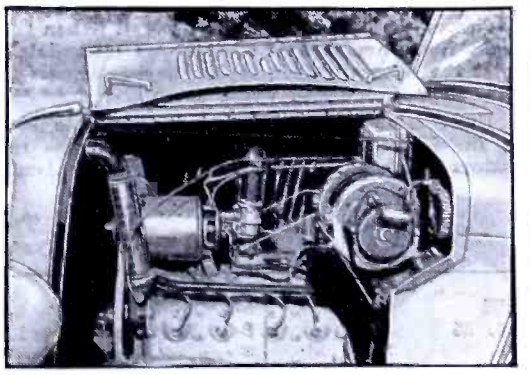


Fig. D. The generator mounted on rubber cushions which supplies 18 V. and 120 V. for operation of the P.A. system, phono. motor, radio tuner, etc.

THE SMALLEST TUBE

What is claimed to be the smallest radio tube ever to be made was constructed a short time ago by Chao-Ying Meng a research worker at California Institute of Technology. The tube has a plate about 0.5 mm. in diameter and works on the retarded field system of oscillation with the plate at zero or a slight negative potential while the grid is at a high positive potential.

The wavelength of the waves generated by this tube are extremely high in frequency, being about 1 centimeter long.

In size, the tube is about the same as an average man's thumb nail. It generates sufficient power to send consistently over the "optical range."

HOW TO USE A "PATCH"-TYPE COMBINATION TESTER

(Continued from page 224)

R2, is protected by resistor R1. This lamp lights at a given voltage and it is readily seen that a tube having a high emission will send enough current through the load to produce the voltage required to light the neon with a small value of R3 in the circuit. As the testers are calibrated the load value of 2 is the dividing line between passable tubes and weak tubes for the average heater tube. When new these tubes will have sufficient emission to light the neon as far as 1 on the load resistor.

In Fig. 1B the circuit shows the same triode elements but this time with 2 diodes—as found in the 85. This tube plugs into the 6-prong socket and its connections to the 7-prong patch socket are shown. Here, because the control-grid cap on the tester is connected to the No. 5 line, the only patch required is the H-1 patch that connects the heater and cathode. The triode section tests the same as for a 76 with the same limits. To test the diodes the control-grid cap is removed and then the No. 5 line must be connected to the diodes in turn for the tests. Set the load at the correct value for diodes (10) and make the patch connections first from 5 to 2 and then from 5 to 4. The neon tube will light in each case if the diode has sufficient emission (which it will unless the diodes are "bad").

CONTINUITY TESTS

Figure 1C shows the connections of the *continuity test*. The principle of this test is that the A.C. voltage of the supply divides between the resistor under test and the load variable. Setting the load by just lighting the neon tube gives the reading on the load scale of the resistor. Here enters the test for bypass condensers in and out of sets.

On A.C., the impedance of the bypass condenser is the same as the measurement of a D.C. resistance value;—that is, any bypass condenser has so many ohms impedance at 60 cycles. It will test across the continuity terminals as that many ohms. This makes the scale of adjustment vary from about 0.15-mf. up in size. This means that a 0.1-mf. condenser will light the neon tube only at M and the latter will "go out" at 10 or when the resistor R3 starts to enter the circuit (M indicates the "open" position of R3). When the light is extinguished at 10 it shows immediately that the bypass condenser is not shorted. (If it was shorted, the load would go to zero.)

Even more important than this simple test is the facility to check, in a set, the bias resistors which are bypassed with 0.05- or 0.1-mf. or larger bypass condensers; and which are only a few thousand ohms resistance. Here the combination tester comes into its own as the continuity test is A.C. and if the bypass is across a 2,000-ohm or 5,000-ohm resistor the reading of the resistor will be lowered a definite amount if the bypass is not open and of course will read zero if shorted. It is the open bypass that is hardest to find and for which this tester answers the Service Man's prayer. It saves lots of time to be able to test without unsoldering connections.

"SHORT" TESTING

The most important short or leakage test is made between cathode and heater. To make this test check the emission of the tube and with the neon tube lighted turn the load control to M. Remove the cathode-heater patch (green patch from H to 1, 2, 3, 4). The neon tube light will go out if there is no short or leakage.

In rejecting a tube for cathode-heater leakage compare the leakage light with that for 1 meg. and use that as a test limit for tubes other than rectifiers and output tubes. On rectifiers and output tubes use the light given by a 0.1-meg. resistor as the test limit. You will find it easy to tell the light corresponding to these two resistance values.

The next most important leakage test is that between screen-plate. This is important only in high-frequency amplifiers where the impedance of the output circuit may be of the order of a megohm. To test this in tubes such as the 6D6, remove the control-grid cap, turn the load control to M and remove the connection to the screen-grid by removing patch 5-4. If there is leakage between the screen-grid and plate there will show a light of the neon tube corresponding to the value of the leakage. Leakage to the control-grid will show in the same way but is almost unheard-of in glass tubes and while present in a few metal tubes is now a thing of the past.

Shorts other than the above can be checked by turning the filament voltage to zero and connecting all other elements to H and the one under test to 5.

ALIGNMENT METER

Greater sensitivity may be obtained in some cases by placing a "C" battery in series with the control-grid of the tube with the negative terminal connected to the control-grid and the value adjusted so the neon tube does not light without a signal.

TABLE II
Diode Types (Load 10-M)

Type	Diode No. 1	Diode No. 2	Amplifier
25S	5-4	5-2	5-1
55, 85	5-2, H-1 (control-grid cap off.)	5-4, H-1 (control-grid cap off.)	H-1 (control-grid cap on.)
2B7, 6B7	5-2, H-1 (control-grid cap off.)	5-3, H-1 (control-grid cap off.)	H-1 (control-grid cap on.)
6H6	H-4 only	H-1, 53	

SECOND-PLATE AND MULTIPLE-PURPOSE TUBE TESTS

Many tubes have two plates (rectifiers) and many have more than one set of elements. These will be divided according to the method of testing.

Full-wave rectifiers. Tube types 80, 81, 82, 83, are all full-wave rectifiers having a 4-pin base. To test the second plate make the regular test with only one plate and then patch 5-1 adding the second plate. The load range for an 80 then becomes 1-4 instead of 2-5.

The 84 and 6Z4 are the same tube and the 4-5 patch connects the second-plate and the same change in the load range applies when both plates are connected.

The 25Z5 has independent cathodes and tests with H-2 5-1 for one rectifier and H-4 only for the other. (The load range as given is for one side.)

For 5Z4 tests patch 5-4 for one plate and 5-2 for second-plate.

In testing the 6Y5, patch H-2, 5-4 for one plate, H-2, 5-1 for second-plate.

TABLE I

Multiple-Purpose Tubes

Type	First-Section	Second-Section
19	5-4	5-2
53, 6A6	5-4, H-3	5-2, H-3
79	H-2 only control-grid cap on	H-2, 5-4 control-grid cap off
6F7, 2F7	H-1, 5-2 (load 5-8 control-grid cap off)	H-1, (control-grid cap on

Load ranges given in the October 1935 article are for one side (1 plate) and are reduced by one when two sides are tested at the same time, but otherwise apply the same to each side except in the case of the 6B7 and diodes (in which cases the special load value is given above).

In closing these additional instructions let me remind you that questions are always appreciated and will receive prompt attention.

This article has been prepared from data supplied by courtesy of Million Radio and Television Labs.

ORSMA MEMBERS' FORUM

(Continued from page 228)

only "one timers," and anyone who repeatedly goes back to them after getting one hooking, is not wanted as a customer by a good Service Man anyway!

I have come to look upon these "quacks" as good boosters or advertisers of legitimate servicers. Nine times in ten you will get the job to straighten out after the "quack" is through; and customers don't forget you, and their friends and relatives generally hear about it, too.

Now, to disagree with Mr. Lanning. I see no reason at all why any Service Man is entitled to charge for service on an hourly basis. That's a fine way to tear down your business, and it puts you in the same class as the "quacks," guessers, and the rest of their ilk.

If a Service Man gets stuck and as Mr. Lanning says, spends hours finding the trouble, that's his own fault, and when the trouble is finally found, he generally kicks himself, at its simplicity, or his own ignorance. Anyway, the next job will in all likelihood be a push-over, and thus you make up for the bad one.

I'm strong for "flat rate" charges on all jobs. One flat rate for locating trouble, one rate for replacement labor, one rate for pick-up and delivery, and so-on, to cover all phases of the business.

This question of time spent checking over a job and locating the trouble is a popular one everywhere, and in my city I made complaining Service Men this proposition: that they bring all their jobs to my shop (and it's one of the best) and for a flat rate I do all the trouble shooting, leaving nothing but the actual replacement of parts, etc., for them to do. This was flat rate regardless of size, type or anything else, and the price was *right*, and did they take me up? No, but they shut up about hourly charges!

And about this "$1.00 charge before even looking over a prospective job;" that's ridiculous, and if a Service Man; after getting into the home, isn't salesman enough to sell that customer on the idea of a first-class job, at a price that is fair to both, then he doesn't belong in this game, and really should pay that customer a dollar for out-talking him.

Real Service Men should get together, establish flat rates for certain jobs, stick to them, forget the "quacks," and all fight this thing out together, to the point where Service Men get better prices, and are better thought of. But the idea that any one should get out of the business until the rest of us fellows have smoothed the way and got going good, only to have the slackers then jump in and take their part of the gravy, is darn rotten.

I am a *Radio-Craft* booster, and would like to hear more readers' ideas on this subject.

F. CLAUDE MOORE,
Pekin, Ill.

There you are, fellows—what say? Mr. "*Radio-Craft* booster" seems to be quite certain as to just where he stands.

WIRED RADIO USED FOR FINANCIAL NEWS SERVICE

Radio is supplanting the ticker and bulletin systems of the Dow-Jones & Co. financial service. Audio signals over telephone wires send the quotations and news items from a central news office to the amplifier and speaker installations of subscribers.

It is claimed that the announcement possibilities and facilities provided for calling attention to special items in the new system make it vastly superior to the old ticker method.

This new, improved system of dispatching quotations should certainly speed up buying and selling activities at the great financial trading centers.

MAKING A Q-TEST ADAPTER

(Continued from page 220)

factor in these cases.

In the Q-Test Adapter, the meter of the V.-T. voltmeter is calibrated in volts, according to a method to be described in Part II of this article. The scale in Q is not calibrated, unless the constructor wishes to calculate it (the method will be described) as the meter will be used almost exclusively as a comparative meter.

For example, suppose the experimenter is making a new receiver and wants to know which coil of the available types and makes will be best for his purpose. The actual Q is not important, it is the *comparison* which is the important fact. Or, suppose a Service Man wishes to check a coil in a set which he suspects of having short-circuited turns, the comparative reading on the Q-Test Adapter will tell him if the *relative* Q is much below normal—thus indicating a short or a leaky insulation.

The condenser C1 is incorporated in the Test Adapter. This condenser is actually 2 condensers in parallel. One is a *straight-line capacity* unit of 500 mmf. maximum capacity and 30 mmf. minimum. The other is a 4 mmf. unit used as a vernier. The scale of this condenser is calibrated directly in micro-microfarads from plus 2 mmf. to minus 2 mmf., taking the mid-capacity point as zero. This vernier serves three purposes; (1) it permits fine adjustment of the condenser in tuning the reactive circuit to resonance with the oscillator; (2) it permits measurement of small values of capacity; and, (3) it permits accurate matching of coils or condensers. When the main condenser is set at 100 mmf. the vernier may be used to read directly the percentage change in total capacity.

The V.-T. voltmeter used with the Q-Test Adapter is especially designed to maintain accurate calibration over a wide range of frequencies. The tube used is an "acorn" type 954 pentode connected as a triode. The filament is supplied from a filament transformer to prevent line changes from affecting calibration. The plate supply is obtained from a rectifier tube directly fed from the power line. This voltmeter is calibrated in A.C. volts on a low-frequency line and is so designed that the calibration is constant to very high frequencies. The low input capacity of the 954 makes it an ideal tube, especially if short-wave coils and circuits are to be measured.

In Part II of this article, the actual construction of the Q-Test Adapter will be described. In addition, details for calibrating the V.-T. voltmeter in volts and Q will be given. In Part III details for operating the unit, especially for the more unusual measurements of impedance; power factor; phase angle; insulation and dielectric constant; capacity, inductance and reactance of resistors; etc., will be given.

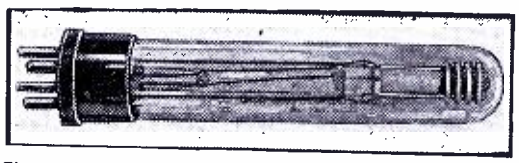
Credit is given here to the *Radio Review of Australia* for some of the information contained in this descriptive article.

16 NEW TUBES!

(Continued from page 235)

X-9—Super-Cineglow Recording Lamp

This tube, made by Blue Seal Sound Devices, Inc., is an improved glow-lamp having three elements (compared to the usual two-anode and cathode). It contains a cathode and two anodes. One anode is modulated and the other anode is used as a bias or pilot which keeps the gas in the tube ionized. A two element tube when over-modulated would extinguish as the ignition voltage is much higher than the extinguishing voltage which would cause "blasting" or unexposed areas of the sound track. The addition of the pilot anode rectifies this condition. The X-9 is extremely uniform in manufacture.



The appearance of the sound-on-film recording lamp.

USEFUL DATA ON CHURCH HEARING AIDS

(Continued from page 224)

system, both loudspeakers and headsets operating from the same amplifier. In such instances the hearing-aid portion of the system constitutes a source of extra profit, with comparatively very little increase in labor time or trouble.

Many churches use more than one microphone for hearing-aid work. The minister is provided with one—or with 2 if there is an altar as well as a pulpit. Additional microphones are often added for the choir, and sometimes for the organ.

The beginner in such work who is otherwise experienced in radio and P.A. technique will encounter only one problem with which he is not wholly familiar. Churches are very likely to specify that they want so-and-so many hearing aid sets, with provision for adding more later, thus raising the question: How can the headset wiring be laid out to match the impedance of the amplifier, *and stay matched after additional units have been added* in the future? One simple method is to install, as part of the original job, additional *station boxes*, with their *volume-control potentiometers* and phone jacks, selling the church the additional headsets at a later time, as called for. However, if the amplifier offers a choice of output impedances even this procedure is often unnecessary, since the makers of hearing-aid headsets will furnish their units in any impedance desired, and in consequence additional units can often be added merely by specifying suitable impedances, and changing the output connection to the amplifier.

Impedance match, moreover, is not too critically observed in work of this kind, since loss of volume is of minor importance. Except for unusually deaf persons 1/100-W. per unit will often prove adequate power.

A.C. hum and other extraneous noises are also less important than they appear to be at first glance, in spite of the fact that headsets are used. Such disturbances are not as troublesome to the hard-of-hearing as they are to more normal ears. Interference that would be intolerable to the average individual is often not heard at all. Excessive hum, of course, is objectionable.

Hearing aid units are of two general kinds—(1) earphones and (2) bone-conduction "oscillators." The latter are laid against one of the bones of the skull, usually the bone behind the ear, and *in certain types of deafness* give better results than phones.

Either type of unit may be had with headband or lorgnette handle, as preferred. The ladies usually ask for the latter, as less likely to disturb their hair.

Figure A illustrates the essential components of a church hearing aid system developed by the writer. Lorgnette-type and single-unit headphones are shown, as well as a hearing-aid station control box, with its potentiometer and jack, and a crystal microphone.

The amplifier is diagrammed in Fig. 1. It is a commercial 4-stage amplifier, using two 6C6s as pentodes and a 6B5 cascade-conduction in the output. Low-gain and high-gain input jacks, tone control and volume control, are included.

(The harmonic content of this amplifier is 6 per cent and the frequency response flat within 2 db. from 100 to 10,000 cycles; within 4 db. from 50 to 10,000. Gain of 116 db. permits direct operation with a velocity microphone. Power output is 5 W.)

The drawing does not include an output transformer; one is added in accordance with the requirements of each individual installation. Speaker field power (6 W.) is supplied, in case a loudspeaker is to be included in the system. otherwise the speaker field line is closed by a resistor (which also is not shown in the drawing), rated at 1,000 ohms and 20 W.

The power output is adequate to any reasonable number of hearing-aid stations, even if a moderate-volume loudspeaker is used in addition. The hum level of —51 db. makes this amplifier particularly advantageous for hearing-aid work.

This article has been prepared from data supplied by courtesy of Lafayette Mfg. Co.

THE OSCILLOSCOPE IN VIBRATOR SERVICING

(Continued from page 228)

the effect when one of the *secondary* points is entirely open, and Fig. 1E when one of the *primary* points is open.

TRANSFORMER-BUFFER PRACTICE

Current passing through a transformer tends to build up and store energy in direct proportion to the inductance of the transformer. Breaking the circuit by the opening of the vibrator points results in the collapse of the flux of the transformer, tending to feed this stored energy back into the circuit, which in an attempt to continue its flow across the opening in the circuit reaches very high voltage peaks, which are limited only by circuit conditions. On an ordinary vibrator transformer delivering 300 V. normal output, this inductive voltage may reach 5,000 V. This is the working principle of the automotive spark coil where this great surge of voltage is utilized to produce a spark.

This same effect is found in the *vibrator-transformer* combination. When contact at the vibrator points is broken, halting the flow of current, the result is a great voltage surge and a buffer condenser is employed to absorb and reduce such voltage peaks. The lower the frequency of the vibrator and the higher the frequency for which the transformer was designed, the more troublesome are these voltage peaks.

In the matter of efficiency, the frequency of the vibrator should match that of the transformer as closely as possible. In laboratory practice, at least, it would be possible to combine a high-frequency vibrator with a low-frequency transformer and so reduce the voltage peaks as to make a buffer condenser unnecessary. Because of the loss in efficiency, however, this is not practical either from a manufacturing standpoint, or in field operation. Neither does this action conform exactly with theory, probably due to the tendency toward absorption of such voltage peaks by the greater distributed capacity of the transformer secondary designed for low frequency applications.

Therefore the best accepted practice is to use a well matched vibrator and transformer with sufficient buffer capacity to effect a satisfactory balance.

The greater the voltage peaks (which we have seen are increased by an improper vibrator transformer combination), the larger the buffer necessary.

Sufficient capacity must be used until all "spark coil effect" in the combination is eliminated. Should this spark coil effect be retained, the current stream across the open points will cause them to burn and materially reduce the life of the vibrator as well as possibly damage the transformer. It is desirable, however, to use no more capacity in the buffer than is necessary, as the larger the buffer, the less the efficiency of the power supply. In other words, the larger the buffer, the more current it will draw and the less will be available for the operation of the receiver.

OSCILLOGRAMS VISUALIZE ACTIONS

Figures 1F to L inclusive represent an oscilloscope study of vibrator-transformer-buffer combinations which should be more or less self-explanatory. The vibrator used in this case was of a somewhat higher frequency than the transformer was designed for (the average condition that is found in the modern, well-designed power supply systems).

Figure 1F outlines the curve of the vibrator transformer operating under no-load and with no buffer condenser. The result is a series of high peaks that are certain not only to damage the vibrator but also burn out the transformer!

Figure 1G shows the same combination operating under a 1 ma. load with no buffer. Here we see that the peak has flattened to a certain extent because of the presence of a load. It will be observed that the peak comes immediately after the contact at the vibrator points is broken.

The result of placing a 40-ma. load on the vibrator transformer is outlined in Fig. 1H. Here the contact point break is followed by a flutter but the load is sufficient to keep the voltage from rising.

The combination operating under no-load with a small buffer is represented in Fig. 1I. This would represent the condition at starting the power supply while the tubes were warming up. Here the peak is pronounced.

Continuing with Fig. 1J, we have the combination of a 40-ma. load with a small buffer. The peak has been so reduced that it would seem negligible, but still represents a condition that could shorten the life of the vibrator.

Figure 1K shows the ideal combination, vibrator, transformer and proper condenser. There is no discernible peak, and the break comes very close to midway on the zero line.

Now we go past the ideal combination to show the result of a buffer with excessive capacity under load in Fig. 1L. The waveform, especially with certain types of transformers, approaches a sine curve which would be desirable except for the fact that the losses are excessive as shown by the rounded corners.

A careful view of this oscilloscope study should prove of considerable benefit in striving for a clear understanding of buffer condenser application in auto-radio power-supply design.

Our Information Bureau will gladly supply manufacturers' name and address of any items mentioned in RADIO-CRAFT. *Please enclose stamped return envelope.*

INTERNATIONAL RADIO REVIEW

(Continued from page 225)

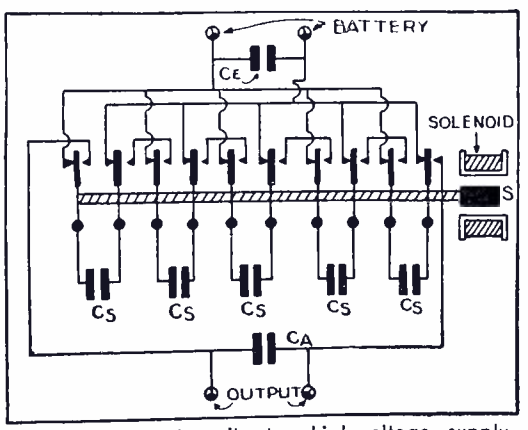
A very novel receiver cabinet is shown in Fig. E. This is the new Radialva receiver described in the latest issue of *Toute la Radio* (Paris) and shows the trend in French cabinets. The dial is placed at the optimum angle and is large enough to make tuning easy. The set has 2 speakers, one for high and the other for low frequencies. The circuit used is a superhet. having all the standard features of A.V.C., tone control, and variable selectivity.

MULTI-VIBRATOR "B" SUPPLY

A RECENT issue of *Funk Technische Monatshefte* (Berlin) contained the description of a new type of power unit operating from a storage battery, and supplying high voltage without the use of the usual step-up transformer, rectifier and other devices found in auto or vibrator type "B" units.

It operates on the principle of condenser discharge, the condensers being charged in parallel from the storage battery; and, by means of a switching system, they are discharged in series, so that the voltage of discharge is high compared to the supply voltage. This is accomplished by a multiple vibrator, in which the condensers are normally connected across the battery, in parallel. As shown in Fig. 1, as soon as current flows through the solenoid S, the contacts are shifted to the second position which connects them in series to the output capacity, Ca.

The resulting pulsating D.C. voltage is then filtered in the usual way. A view of the new type high-voltage supply is shown in Fig. F. The output voltage depends on the number of condensers and vibrator contacts used, while the current depends on the size of the individual capacities.



The circuit of the vibrator high-voltage supply. In the vibrator position shown, the condensers are in parallel across the battery. When the vibrator shifts, they are in series.

BOOK REVIEWS

THE FOURTH ESTATE AND RADIO AND OTHER ADDRESSES, by George Henry Payne. Published by The Microphone Press, 1936. Size 6 x 8 ins., 111 pages. Price, $1.00.

The contents of this work are lectures and addresses delivered by the author on different occasions, in all cases before college audiences. Five of the 8 addresses are on the subject of radio, mainly on the relation of radio to the public, a connection upon which the author is well versed through his service on the Federal Communications Commission.

There were so many requests for copies of the speeches that it was decided to publish them in compact and collected form.

CASE RECORDS OF BROADCAST RECEIVER REPAIRS by H. K. Bradford. Published by Capitol Radio Research Lab., Inc., 1936, Size, 9½ x 11½ ins., 238 pages. Price, $4.75.

A loose leaf compilation of actual cases of trouble in receivers, each of which has occurred at least twice. Besides records of 1,500 cases, there are included many items of general interest that might apply to any receiver, such as, "Gas in radio tubes," "Electrolytic condensers," and others of equal interest.

Supplements will be issued quarterly, and may be easily inserted in the loose-leaf binder.

GALVANOMETERS AND DYNAMOMETERS

A new and very comprehensive catalog on equipment for delicate electrical measurements, consisting mainly of galvanometers and dynamometers and associated equipment has just been published. This catalog is thoroughly illustrated. Write to *Radio-Craft* for your copy of No. 1178.

RADIO SERVICE INSTITUTE

INCREASING complexity in the servicing of new and constantly changing radio receivers and public-address systems, is throwing a growing burden on radio technicians and Service Men, that is rapidly forcing the technically unequipped men into the background.

For a number of years the Capitol Radio Engineering Institute has been training professional radiomen. Among their students and graduates are many men outstanding in the field of radio service. Still the large proportion of radio Service Men do not want to become radio engineers or to study general radio engineering. They want to become better Service Men and to take specialized advanced training in this work only.

Recognizing the needs of these men, this school has been working on this problem for several years. A year ago a special course arrangement was announced for Service Men and the results have been carefully observed. Their success in training professional Service Men on a comparatively small scale along with general radio engineering students convinced the directors of the school that this field is worthy of a special course handled by a separate organization. Therefore the Radio Service Institute has been organized as a subsidiary of the older school. We might add that this was at the suggestion of one of the most prominent authorities in the radio service industry.

In the development of the Radio Service Institute course, years of teaching experience were available. This course from beginning to end is prepared specifically for the professional radio Service Man. In addition to their educational background, the directors of Radio Service Institute have a background of successful organization and profitable operation of what became one of the country's largest radio service organizations handling both retail and wholesale radio service, and employing dozens of radio Service Men. We believe this is the only school in America whose directors have had personal radio service experience of anywhere near this degree.

The new courses available will include an advance course for those Service Men who by experience and prior study are well equipped in the fundamentals of their profession. For those men whose experience is limited or who have been away from their studies for a number of years, a complete course is available. In the complete course, the student first takes an introductory course which gives him a good review of fundamentals before getting into the more advanced work.

The new specialized course includes not only technical instruction but also special instruction in the business end of radio servicing, prepared by men who have actually been successful in this field, who have had to make such a business pay and who have had to meet payrolls every week.

Radio Service Institute is organized specifically to efficiently meet the needs of the professional Service Men who recognize the need for further training in their highly competitive field. It is not organized with the idea of bringing more men into an already overcrowded profession.

PHILCO'S NEW TELEVISION DEVELOPMENTS

KEEN INTEREST IN PHILCO'S PROGRESS

Week after week important new advancements are made in the Television experimental field.

Most recent developments have been conducted at the Philco research laboratories. Closely watched are the results of their experiments.

COMPLETE DETAIL IN NOVEMBER RADIO-CRAFT

In November *Radio-Craft* will be found an interesting article which gives the highlights of Philco's recent television experiments.

These recent achievements will be described by *Radio-Craft* in their usual interesting and authentic manner. Don't fail to get the November issue!

Index to Advertisers

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

"PEANUT" AND "THE ELEPHANT" TALK IT OVER

An illuminating conversation on the subject of purchasing new equipment.

"HI! TOOTS!"

Peanut, a slightly-built chap, heard the familiar greeting of the Elephant, his corpulent friend and fellow Service Man, as they were both headed towards their local radio jobber's.

"Hi, yourself," Peanut retorted. "And what brings *you* to this part of town?"

"Thinking about buying a new analyzer," the Elephant puffed. "Thought I'd look 'em over and see what I could get as a trade-in on my old one."

"Sounds like a good idea if you can work it," Peanut replied as he held the store door open for the Elephant. "Boy, oh boy, if you get any fatter they'll have to either widen these doors or move the store out to the sidewalk."

"Say," Peanut broke off the conversation, "isn't that your friend Ed, the Instrument Manufacturer's representative by the Parts Counter?"

"Hello, Ed!" the Elephant cried, lumbering over to shake the representative's hand.

"What are you boys doing down here?" Ed asked after being introduced to Peanut. "Looking for a pan to catch the Grid Leak?"

"No, Ed. I thought I'd look over the test instrument field," rejoined the Elephant as he idly turned the pages of a parts catalog. "These new analyzers look pretty good to me so I thought I might get a manufacturer's trade-in on my old one against the purchase of a new unit."

Ed looked up quickly. "How long have you owned your present analyzer and what did you pay for it?"

"Oh, a little over 3 years—cost me about $50 and works just as good as the day I got it."

"Then why buy a new one?" Ed asked.

The Elephant scratched his head. "Well, it can't test the new tubes without using adapters and it hasn't a lot of the features on the newer jobs, and—it *is* a bit worn. But," he added quickly, "it sure has given good service."

Ed finally interjected, "if that's the case, you should be willing to throw it up in the air and walk away, as it has returned its initial cost to you time and again. Do you keep books and allow for instrument depreciation?" the representative asked.

"I do," Peanut spoke up. "All the equipment in my shop has a definite value placed on it and I allow so much a year for depreciation with a reserve fund set up for replacement instruments."

"Good boy!" Ed exclaimed. "All Service Men should do the same thing, then they would be on the right track to owning a business that *grows* instead of exists.

"By the way," he continued, "what would the manufacturer do with your old instrument if he did allow you a trade-in?"

"Probably junk it," Peanut spoke up.

"Why couldn't he use some of the parts if they were applicable in new models?" asked the Elephant, perching himself on a counter.

"Would you want to buy a new tester with old parts?" retorted Peanut.

"Peanut is right," the representative assented. "That wouldn't be fair practice. You see, the manufacturer would have to either destroy your old instrument or sell it for a few cents to some 'distress merchandise' firm. Why, the instrument is really worth more to you if in an operating condition as an emergency tester than any trade-in you might get on it even from your jobber. If a manufacturer or jobber were to offer you a trade-in, the amount allowed represents a total loss to him unless he has some way of getting his money back. So—what is more simple than to boost his selling price and delude the Service Man into thinking he was getting something for nothing."

"Sounds like the old army game to me," interjected the Elephant.

"Don't mistake me," added Ed, "some jobbers as an accommodation to their customers take trade-ins on which they have a definite re-sale, but beware the instrument against which a *high* trade-in can be applied. If the traded-in instrument isn't re-sold at the trade-in price, someone is taking a loss which usually can be traced to an unjustified middleman's profit."

"Think I'll hold on to my old analyzer rather than trade it in," decided the Elephant. "Me too," concluded Peanut.

This article has been prepared from data supplied by courtesy of Supreme Instruments Corp.

New 1937 ADDITIONS TO POPULAR TRIPLETT MASTER SERIES

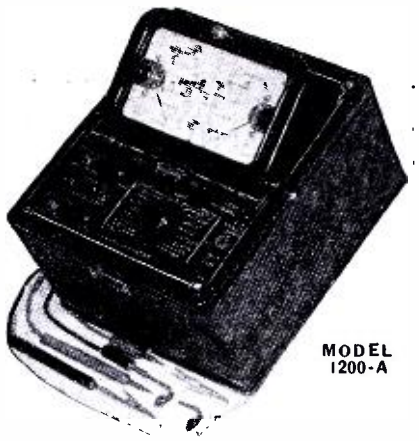
FEATURES

- MAXIMUM PROTECTION AGAINST OBSOLESCENCE. All designs carefully considered from a viewpoint of possible obsolescence. Being single purpose instruments in itself is great protection. Damage to one unit makes repairs single and does not tie up other instruments.
- Units are interchangeable in carrying case, inasmuch as they are contained in metal cases of one size.
- PORTABILITY. Unit size is small, compact, hence light in weight and practical for the best results.
- SOLID CONSTRUCTION. The internal construction of all Master Units is designed so all parts are rigidly supported. Will stand up under hard usage and give service.
- PRECISION BUILT. Every test will show Master Units are outstanding in quality. Every effort made to maintain accuracy throughout. Represent the most up-to-date engineering practice in every detail.

Here are new units for owners of Triplett Master Unit Test Sets. The metal cases are the same size as used in previous models. Select your requirements now. Those and other future models will always keep your Master Units out in front—with a minimum outlay. You can always buy such additional units as your needs demand.

For those not owning Master Unit Test Sets, here is additional evidence of Master Unit advantages. A co-related line of equipment fulfilling the needs of the radio service dealer and insuring the greatest return per dollar invested. Ask others. Try one now and you will find yourself standardizing your Service Test Equipment with Triplett Master Unit Models.

SEE THEM AT YOUR JOBBERS. MAIL COUPON FOR MORE INFORMATION



MODEL 1200-A

VOLT-OHM-MILLIAMMETER

Low ohm scale reading ½-500 ohms with 15 ohms center scale reading. Reads D.C. 10-50-250-500-1000 volts at 2,000 ohms per volt. A.C. 10-50-250-500-1000 volts. 1-10-50-250 D.C. Milliamperes; 1500 Ohms; 1.5 and 3 Megohms, back up low Ohms Scale ½-500. Dealer Price **$21.67**

Model 1200-B Similar to Model 1200-A but with copper oxide A.C. Dealer Price..... **$26.67**

CONDENSER TESTER

MODEL 1240

Checks all types condensers, Paper, Mica or Electrolytic from .0001 to 10 microfarads. Detects internal shorts, opens or high resistance leakages. A.C. and D.C. voltages for breakdown tests available in steps to 1,000 volts. Easily read meter scale. Dealer Price..... **$24.83**

VACUUM TUBE VOLTMETER

MODEL 1250

For the first time, accuracy independent of changing tube values. Self calibrated. Operation is extremely simple and fast. Reading all direct on a linear scale instrument. Dealer Price. **$33.34**

AUDIO OSCILLATOR

MODEL 1260

Generates pure sound wave without distortion or harmonics. Laboratory accuracy. Wide frequency range. Signal strong and impedance matching is variable, permitting matching with low, medium or high impedance input of amplifier or P.A. systems. A.C. operated. Dealer Price..... **$28.34**

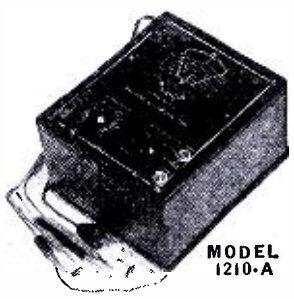
MODULATION MONITOR

MODEL 1295

Indicates actual modulation percentage of radio transmitters on direct reading scale. Factory calibrated and no further calibration needed. Complete with all necessary accessories. Dealer Price **$24.83**

OTHER MASTER MODELS

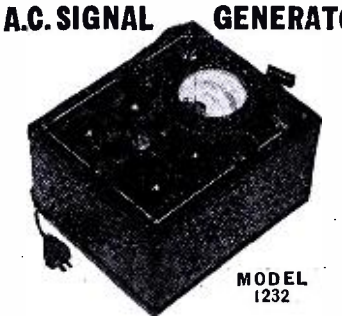
TUBE TESTER



MODEL 1210-A

Tests all types of tubes, metal, glass, G-type, under R.M.A. load conditions. Direct reading colored GOOD-BAD scale. Large meter. R.M.A. circuit used. Dealer Price **$20.00**

A.C. SIGNAL GENERATOR

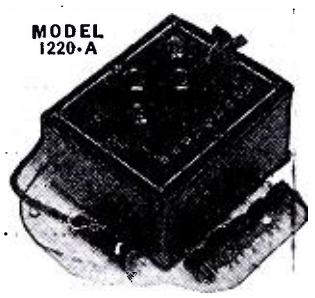


MODEL 1232

Large 12" direct reading dial, 6 bands from 100 to 30,000 Kc., fundamentals. Perfect attenuation. 400 Cycle Audio note. Now with peaked calibrated coils. Broadcast and intermediate bands less than 1%; short wave bands 3% accuracy. Dealer Price **$25.00**

Model 1231 D.C. Similar to Model 1232 but self-contained battery operation. Dealer Price **$23.33**

FREE POINT TESTER



MODEL 1220-A

Used with Volt-Ohm-Milliammeter for set testing. Makes all series and parallel instrument connections through five sockets with standard R.M.A. markings. Has plug and cord with all adapters. Dealer Price **$10.00**

THE TRIPLETT ELECTRICAL INSTRUMENT CO.
1610 Harmon Dr., Bluffton, Ohio

☐ Please send complete Catalogue.
☐ I am interested in more information on Model———.

Name .....

Address .....

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

TRIPLETT *Precision* ELECTRICAL INSTRUMENTS

Here's the important catalog news you've been waiting for...

Actually the First RADIO BLUE RIBBON *Catalog and it's* FREE!

HEAD-AND-SHOULDERS AHEAD OF THE FIELD IN EVERY DEPARTMENT

RADIO MARCHES ON! Modern science knows no resting place. New ideas—new designs—new improvements in sets, parts, amateur and public address equipment—these are all part of radio for 1937.

Wholesale Radio Service Co., Inc., sets the pace! For 1937 it presents the first BLUE RIBBON Radio Catalog—a book *designed to give you positive "purchase-insurance"!*

Yes, this is truly a "different" radio catalog. Every single radio item listed in this great new bargain book has been checked and approved in our huge Testing Laboratories and has been awarded "THE BLUE RIBBON SEAL"—a seal that certifies unquestioned value and mechanical excellence—*your assurance of quality!* Only those items which met the rigid standards of our Testing Laboratories were included in this great new catalog—a catalog destined to become a world-wide guide to radio quality.

When You See a Product Listed in this Great New Radio Catalog . . *You Know*

1. That every radio item has been checked and approved by the Testing Laboratories of Wholesale Radio Service Co., Inc.—*the largest radio supply house in the world.*
2. That it has been awarded the Blue Ribbon Seal—*your assurance of quality and value.*
3. That you can buy with confidence! *Lowest prices, fastest service and a liberal guarantee!*

WHOLESALE RADIO SEAL OF Blue Ribbon APPROVAL SERVICE COMPANY INC.

5 Huge Convenient Branches Brought to You in the Pages of the Largest Catalog in All Radio

In order to give you the fastest, most complete service in the radio field, Wholesale Radio Service Co., Inc., maintains 5 great branches in New York, Chicago, Atlanta, Newark and the Bronx. The huge stocks, the friendly co-operation, the ability to give you prompt, reliable service are all brought to you in the pages of this new blue-ribbon edition.

Send for this book of a thousand bargains *today.* It's FREE! See what Wholesale Radio Service Co., Inc., has to offer you! A brilliant array of NEW RECEIVERS, from 4 to 24 tubes, with surprise features for 1937. Special FARM RECEIVERS with new improvements; special RECEIVERS for European reception; BATTERY SETS—32 Volt SETS—AUTO SETS. A great selection of REPLACEMENT PARTS—TUBES—KITS—AERIALS. Latest SHORT-WAVE and HAM equipment; PUBLIC ADDRESS AMPLIFIERS, SYSTEMS and ACCESSORIES. Everything in *Quality* Radio at lowest "Wholesale" Prices. Use the convenient coupon—it will bring you the first BLUE RIBBON RADIO CATALOG ever issued —FREE!

MAIL COUPON FOR FREE CATALOG

WHOLESALE RADIO SERVICE CO. INC.

CHICAGO, ILL. 901 W. JACKSON BLVD. • NEW YORK, N.Y. 100 SIXTH AVENUE • ATLANTA, GA. 430 W. PEACHTREE ST., N.W.

BRONX, N.Y. 542 E. FORDHAM RD. • NEWARK, N.J. 219 CENTRAL AVE.

WHOLESALE RADIO SERVICE CO., Inc.
Dept. K-3
100 Sixth Avenue, New York, N. Y.

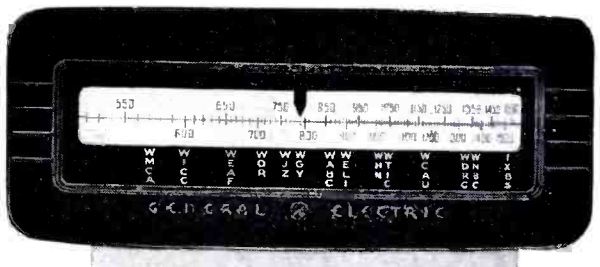
Please rush FREE BLUE RIBBON Catalog No. 65.

Name_____

Address _____

Town_____

State_____



At Last . . . A RADIO THAT REVOLUTIONIZES TUNING . . . AUTOMATICALLY ASSURES PERFECT TONE

If you should unknowingly tune-in a station the slightest bit off-tune — *and nine out of ten people do* — instantly, the new G-E Focused Tone Radio corrects your error and shifts itself into hair-line tuning for perfect reception. Immediately, the new G-E COLORAMA DIAL changes from red to green to tell you "your station is perfectly tuned." The call letters flash on to announce the local station tuned in. This G-E "custom-tailored" PERSONALIZER scale puts an end to hunting up the kilocycle numbers of your favorite stations. It's done like magic and just as silently too, for the G-E SILENT TUNING CONTROL silences all noise as you switch from one program to another.

HOW GENERAL ELECTRIC FOCUSED TONE RADIO AUTOMATICALLY AND INSTANTLY SHIFTS ITSELF INTO HAIR-LINE TUNING

G-E *Focused Tone* combines all the revolutionary new features described above, plus these new General Electric Radio inventions and developments — G-E METAL TUBES, G-E SENTRY BOX, G-E STABILIZED DYNAMIC SPEAKER, G-E SLIDING-RULE TUNING SCALE and G-E "V-doublet" ALL-WAVE ANTENNA SYSTEM.

Only the New

GENERAL ELECTRIC

AUTOMATICALLY

RADIO GIVES IT TO YOU

VISIBLY . . . INSTANTLY

The new G-E Focused Tone Radio brings you every radio service on the air . . Standard Broadcasts; Foreign Reception; Police Calls; Amateurs; Aviation; Ultra Short-wave; Experimental Broadcasts. General Electric Radio comes in 26 handsome models, priced from $29.95 to $750.00 (Eastern list) - Slightly higher in West and South.

GENERAL ELECTRIC

Focused Tone Radio

YOU'LL ALWAYS BE GLAD YOU BOUGHT A G-E