



RADIO SERVICE NEWS

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NEW RK-40 ANTENNA READY

EASE OF INSTALLATION IS FEATURE OF NEW ANTENNA

Single Doublet and Factory Assembling Make Installations Easy—Features New Low Price

Now all service engineers may offer their customers a scientific all-wave antenna system that is easily erected in the most difficult location. A new RCA Antenna supplies the need for an antenna that works on all sets and can be installed at a cost sufficiently low to sell to all owners of all-wave receivers. Its efficient performance and wide pickup frequency range made it ideal for either short-wave or standard broadcast reception. The RK-40, as the new antenna is named, retails for \$5.50. The RCA stock number is 9631.

Uses Special Doublet

The RK-40 consists of a special doublet—one leg 19 feet and the other 49 feet, an antenna junction box, a 75-foot transmission



RCA RK-40 Antenna

line, and a receiver coupling unit. Additional material consists of two knob-type porcelain insulators, a wall entrance tube, a ground clamp and two connecting links. The transmission line, antenna junction box, antenna wire and strain insulators are factory assembled with all joints soldered, thus greatly re-

(Continued on Page 3, Column 5)

RCA SOUND IS NEW FEATURE IN "SCANDALS"

Natural Sound In All Seats Thrills Patrons Of New Musical Show

Elaborate RCA Photophone sound reinforcement apparatus which will provide "natural" sound for every seat in the house regardless of location, is an important feature of the newest edition of George White's Scandals which opened in New York Nov. 15.

Al Lee, General Manager of the

Scandalous



Two reasons for the popularity of the new George White's Scandals show now playing in New York are beautiful Ann Budick, shown above, and the RCA High Fidelity Sound Reinforcing System especially installed in the New Amsterdam Theatre for this show.

new "Scandals," believes that sound reinforcement of the high fidelity type has become an indispensable adjunct to stage shows. The public, he said, has been educated by the talkies to expect complete intelligibility of words and music throughout the house, and it will not be satisfied with less from the

legitimate theater. Lee is confident of a revival in road shows of successful plays, in which sound reinforcement will have to play an important part because it permits using larger capacity houses, for popular priced admissions, and helps to equalize varying acoustical conditions in different theaters.

The use of RCA equipment for sound reinforcing in the "Scandals" emphasizes the tremendous field for the sale of sound equipment.

RCA CRYSTAL CALIBRATOR CHECKS SETS

Guaranteed Accuracy Is Better Than 2 Parts In Million

Checking oscillators, receivers, or frequency meters to an accuracy better than two parts in a million is now possible to anyone with the new RCA Piezo-Electric Crystal Calibrator. This remarkable device, now being featured by RCA Parts distributors at the low net price of \$29.95 complete with acorn tube, power supply, and individual calibration, offers to service engineers for the first time a primary standard of frequency more accurate than that available in the vast majority of laboratories. It is also particularly adaptable for use by schools, universities and all physical and electronic laboratories.

Service associations, amateur clubs and progressive Parts Distributors are finding the RCA Crystal Calibrator an ideal piece of apparatus for club use.

Has Two Frequency Modes

The RCA Piezo-Electric Crystal Calibrator consists of an accurately ground piezo-electric crystal having two modes of operation, one at 100 k.c. and one at 1000 k.c. It is contained in a small bakelite case, complete with an RCA-955 acorn (Continued on Page 2, Column 1)

THERE ARE NUTS AND NUTS—An Editorial

By F. B. Ostman, Manager, RCA Service Division



F. B. Ostman

In the show business "the nut" is the fixed overhead; in the radio service business the nut is the fellow who does not know his fixed overhead.

He is the fellow who charges ridiculous prices for his services, who is forced to resort to parts and tubes of unknown quality in order to make a "profit," and who wonders why he does not get ahead.

* * * * *

He gets a call, travels 3 miles to the customer's home in his 18-miles-a-gallon car, does the job, returns, and then figures that since he has traveled six miles he has used one-third of a gallon of gas which cost him eighteen cents and that therefore his overhead on the call was six cents.

So he charges accordingly. Perhaps he congratulates himself on that phoney extra "profit" he thinks he made on the parts and tubes. He does not know that while the parts and tubes did not cost him much in money they are likely to cost him a customer's good will.

Some day he may wake up, but it is more likely that some day he will go broke.

* * * * *

At first glance, cost accounting seems far removed from radio servicing, but a simple form of cost accounting is not so far removed from successful radio servicing.

Call it cost accounting, or common sense, or what you will, the successful radio service engineer must know what it costs to spend a busy hour or, for that matter, what it costs to spend an idle hour.

Know your costs. And don't overlook the true cost of cheap parts and tubes.

A Universal Bridge



The new RCA Universal A.C. Bridge measures inductance, capacity and resistance over extremely wide ranges. It uses three tubes and has a self-contained power supply. Read the complete details on page 3.

Calibrator



Oscillators and receivers are checked with an accuracy of better than 2 parts in a million with the new RCA Crystal Calibrator. It may be seen at RCA Parts Distributors.

RCA CRYSTAL CALIBRATOR CHECKS SETS

(Continued from page 1, column 5)

tube and the necessary oscillatory circuits and power supply.

By having two fundamental frequency modes, the crystal provides 100 k.c. frequency steps from 100 k.c. to 20,000 k.c. and 1000 k.c. steps from 1000 k.c. to 50,000 k.c. The steps are strong harmonics of the fundamental frequency and are easily identified because of the ease with which the fundamental may be shifted from either 100 k.c. to 1000 k.c.

High Accuracy

The crystal is ground to an accuracy of .05 per cent of the stated fundamental frequencies. In addition, the individual frequency of each Calibrator is stated to an accuracy better than two parts in one million. Also, the temperature at which the check is made together with the temperature coefficient of the crystal is given, thus obtaining a high degree of accuracy at all times.

Operation

The RCA Piezo-Electric Crystal Calibrator is placed in operation by inserting the power plug into a 110-120 volt, 50-60 cycle A-C line. The Frequency Selector Switch is then set either at "Hi" or "Lo", depending on whether the fundamental frequency of 1000 k.c. or 100 k.c. is desired. The Calibrator should then be placed adjacent to the receiver which may be tuned for the desired harmonic.

On the higher harmonics of 100 k.c., the 1000 k.c. steps should be used as reference points. For example, a calibration point such as 15.5 megacycles is determined by first locating the 15 or 16 megacycle point and then counting forward or backward by 100 k.c. steps.

When calibrating test oscillators, harmonics of the lower oscillator frequencies should be used to beat against harmonics of the Calibrator. For example, the 10th harmonic of

LAUNCH BIG METAL TUBE AD CAMPAIGN

48 Leading Set Manufacturers Cooperating

A giant advertising and promotional campaign designed to further educate the public on the advantages of metal tubes has been launched by the RCA Radio Tube division with the cooperation of 48 of the leading radio set manufacturers who are using metal tubes in their new radio models.

Large newspaper space, ranging from full pages to 1000-line advertisements in over 100 newspapers in the principal cities; special metal tube newspaper sections with cooperative advertising, publicity stories and photographs; special window and store displays, and radio broadcasting are among the media being used in the campaign.

The first full-page advertisement has already begun to appear and is to be followed by similar ads in the intervening weeks to Christmas. Blazoned with a headline reading "48 RADIO MANUFACTURERS NOW USE METAL TUBES," the first ad lists these prominent set makers in alphabetical order at the top of the page to point out that the Radio Industry has enthusiastically adopted metal tubes by an overwhelming majority. "Metal tubes," the ad continues in a sub-head, "are the Sign of an Up-to-date Radio." "Be Modern—Get a Radio Set with Metal Tubes!" The copy then goes on to name the milestones

Show Features Oscillograph



The success of the Philadelphia Radio Service Men's Association's booth at the Radio and Electric Show, Oct. 7 to 12, in Philadelphia, Pa., was amply shown by the curious throng which wanted to find out just what was happening to the "light in the box."

The RCA Oscillograph pictured on the right was excited by the "mike" on the center table. The "mike" fed a phonograph oscillator hooked up to the set on the table on the right, the output of which fed the oscillograph on the same table. Thousands of people filed by—speaking, shouting, and whistling into the "mike" in order to "see" their voices in the oscillograph.

On the left side of the booth is displayed an "ideal" service shop, complete with analyzer, tube checker, oscillator, capacity, resistance and voltage measuring instruments. The purpose was to impress the public with the technical equipment needed to properly service radio receivers.

in radio progress, up to the advent of metal tubes, which are hailed as the greatest tube advance in 28 years. The illustrations consist of a number of metal tubes and a cut-away drawing of a metal tube showing its special features. Enclosed in a box is the following pungent paragraph:

"This is the age of steel and electricity. Metal tubes, designed by the famed General Electric laboratories, and made by RCA and other tube makers licensed under RCA patents, are manufactured with a precision that is possible only in

steel. Precision is the cause and measure of radio efficiency. Metal tubes give you more efficient reception. They are quieter, more stable, more enjoyable and especially superior in all-wave sets. Let any radio dealer prove this to you."

I. R. E. MEETING FEATURES TWO RCA ENGINEERS

Papers on European Radio And Volume Expansion Delivered at Philadelphia

A discussion of European radio technique in the design of vacuum tubes, receiving apparatus and allied radio equipment as compared with American methods was the principal feature of a meeting of the Institute of Radio Engineers in Philadelphia, Pa., November 7th. This highly entertaining lecture was delivered by Lewis M. Clement, RCA Victor Vice President in charge of Research and Engineering.

Mr. Clement is a widely known radio engineer whose experience dates back to the early beginnings of wireless telephony. He recently returned from an extended sojourn in the principal European capitals where he supervised the design and development of radio apparatus for factories located in South America and eight countries in the European Continent.

Demonstrates Amplifier

Another interesting feature of this meeting was the demonstration of the new RCA Dynamic "Volume Expander" Amplifier which automatically extends the volume range of recorded music so that it equals the original rendition. This interesting paper was presented by Chester M. Sinnett, of the RCA Victor research laboratories. Mr. Sinnett explained that when a large symphony orchestra makes a phonograph recording, it is necessary to keep the tonal volume within certain mechanical limitations of the record groove. The use of the "volume expander" system in a newly developed radio-phonograph instrument makes it possible to recreate the full orchestral richness of the music from the record.

Q R X — HAMS

A new series of RCA Service Meetings entitled "X-raying Amateur Rigs with the Cathode Ray Oscillograph" will start during December and continue into January. Many Amateur Radio Clubs are cooperating with RCA Parts Distributors in arranging these meetings at convenient times and places. Watch for the next issue of RCA Radio Service News for further details or keep in contact with your RCA Parts Distributor.

Eyes of the Navy



[Official photograph U. S. Navy]

Broadcasting from a squadron of naval fighting planes was a feature of the RCA Magic Key Navy Day Program. Other features of this program included a broadcast from a plane making a power dive and from a submarine going through underwater maneuvers. Featured every Sunday from 2 to 3 P.M., over a WJZ-NBC network, the RCA Magic Key brings unusual programs from all over the world.

360 k.c. on the oscillator to be calibrated will give a beat with the 3600 k.c. signal from the Calibrator; likewise, the 10th harmonic of 370 k.c. will give a beat with the 3700 k.c. Crystal Calibrator signal. Interpolation between the 360 and 370 k.c. points will give a 365 k.c. point on the oscillator to be cali-

brated if it is desired to calibrate closer than 10 k.c.

This same procedure will apply to other devices for which an accurate calibration is desired.

Specifications

Fundamental Frequencies—100 k.c. and 1000 k.c.

Accuracy of Calibration—±0.05%.

Temperature Coefficient—20 cycles per 1000 k.c. per °C.

Tube Used—One RCA-955 (Acorn Type).

Power Required—110-120-volt, 50-60 cycle A-C (90-135-volt D-C plate supply may be connected externally for unmodulated operation if desired).

Power Consumption—2 watts.

Controls—Hi-Lo Toggle Switch.

Size—5½" x 3⅞" x 2⅝".

Weight—1 lb. 3 oz.

DISTRIBUTORS' LIST

In the November issue of RCA Radio Service News several inaccuracies occurred in the distributor list on page 7. Sanford Samuels Corp. should be 136 Liberty St., New York City instead of 136 Cortland St. The new store of Wholesale Radio Service Co., at 911 W. Jackson Blvd., Chicago, was not mentioned.

SELLING IDEAS HELP SERVICE MEN'S PROFITS

Proven Sales Aids Promote Sale of Service and Parts

Selling Tips are our readers' contributions for selling their services or products. All readers of RCA Radio Service News are invited to submit their ideas for increasing business. All Selling Tips printed will win one of the new RCA Service Engineer's Pencils. They become the property of RCA to be used as they desire. Let's have yours.

An Ad That Works

Here is an advertisement, either for newspaper or house-to-house distribution that gets results, according to H. E. Ulmer of Altoona, Pa.

R epairing all makes of radios
A t reasonable prices and
D one with the
I ntention of making every cus-
tomer a friend,
O ur work will

S peak for itself! (Right out of
your loudspeaker!)

E very job is unconditionally
guaranteed.

R CA Tubes and the
V ery best parts will be used
I n replacements, when neces-
sary.

C all us NOW—your radio and
equipment thoroughly tested
and

E very minor repair made for
only ONE DOLLAR.

Everybody may not agree on the last line. The price can very easily be changed to suit the advertiser.

H. E. Ulmer,
Ulmer's Radio Service,
2421 Fifth Ave., Altoona, Pa.
Dial 8092.

Helps Sell Tubes

Do you have a file of the receivers your customers own? Yes? Well here's a scheme that usually brings in some tube business.

First, just dig up an old RCA Radiotron Socket Layout Guide and some antiquated tube price lists.

Have your stenographer, wife, girl friend, or what-have-you type up the following copy on a government postal card. Fill in the blanks pertaining to prices of your customers' old sets. The large reductions in tube prices will be emphasized in a manner that creates the urge to buy.

When you purchased your _____ receiver a complete set of tubes for it cost _____. Now, you can get a new set of improved RCA radio tubes for the same set for _____.

Although your set is still playing, it is very likely that soon you'll need one or more new tubes.

When you need new tubes, or service, call us. We'll give you prompt service.

Information



Mr. John Wilcox of Wholesale Radio Service Company, 100 Sixth Ave., New York City, answers scores of technical questions each day from his special information booth on the sales floor.

RCA Booth at I. R. S. M. Show

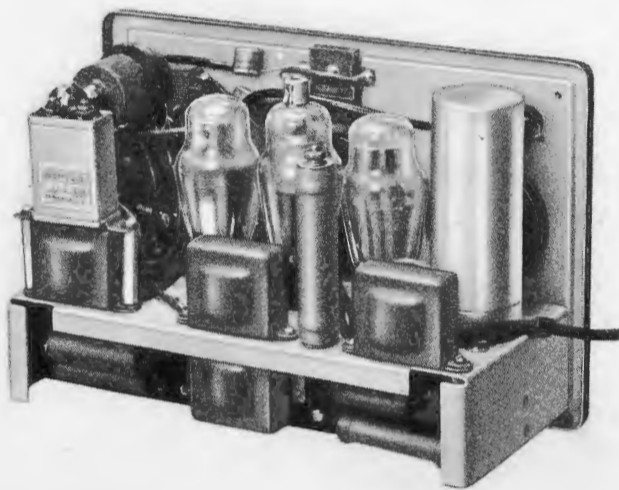


One of the most successful meetings of the year was the I.R.S.M. Second Regional Convention held at the Hotel Pennsylvania, N.Y.C., October 25-27 inclusive. The RCA Booth, which featured operating models of RCA Test Equipment, attracted hundreds of visitors every day of the Convention.

NEW RCA UNIVERSAL BRIDGE CHECKS WIDE RANGES OF LCR

Complete A-C Operation and Built-In Standards Feature Of New Service Instrument—Uses Single Linear Dial

Those low values of inductance, capacity and resistance, as well as the extremely high ones, may now be easily measured with the new RCA Universal Bridge, recently announced by the RCA Parts Division. This instrument, priced at only \$49.65 net, complete with all tubes and standards, has a single common linear dial, an exclusive RCA development. Such a dial facilitates the checking of all parts within its range as well as simplifying the operation of the bridge. The accuracy of 5 per cent overall at full scale places this instrument definitely in the laboratory class of apparatus, while its low net price is easily within the reach of all service engineers. The ranges are—Inductance, 100 microhenries to 10 henries; Capacity, 10 mmfds. to 10 mfd.; Resistance, 1 ohm to 1 megohm. The only additional equipment required is a null indicator which consists of an ordinary 2000-ohm, or greater, headphone.



Rear View of RCA Universal Bridge

Circuit Design

The RCA Universal Bridge consists of a variable-ratio-arm Wheatstone Bridge having three standards each for inductance, capacitance and resistance. A vacuum tube 1,000-cycle oscillator and a two-stage amplifier together with their power supply are built-in components. The only additional equipment required is a null indicator, for which purpose a single headphone of the high impedance type will serve. The usual 110-120-volt A.C. power supply furnishes all power required for the bridge, a cord and plug being supplied for inserting in a convenient outlet.

Assuming the proper selection of standards, the variable ratio arm makes possible the use of a single dial, with linear markings from 1 to 10, for all ranges of each type of measurement. Simplified operation and readings are the result.

A nine-position, four-gang selector switch permits choice of the proper scale for the particular unknown being measured. Two additional resistor phasing controls are provided so that the resistance in capacitors and inductors may be balanced out in order to secure a definite null point. Also, a variable capacitor for obtaining a null point on resistors above 100,000 ohms is provided.

Operation

Insert the power cord into a convenient outlet. Plug the head-phones into the jack and turn the operating switch "on." After a short interval, a 1000-cycle tone will be heard in the headphones.

To Measure Resistance. Connect resistor to be measured across binding posts and throw phasing toggle switch to "down" position. Set range switch and toggle switch "high-low" to approximate range of unknown. Adjust center dial until minimum tone is heard in phones. Dial reading for range used is resistance value of unknown resistor. If value of resistor is not known, all six ranges must be tried until null point is found.

To Measure Capacity. Connect capacitor across binding posts. Set range switch and toggle switch "high-low" to approximate range of unknown capacitor. Adjust cen-

ter dial until a minimum tone is heard in phones. Adjust phasing controls for minimum tone and readjust center dial for null indication. Dial reading for range used is value of unknown inductor.

To Measure Inductance. Connect inductor to be measured across binding posts. Set range switch and toggle switch "high-low" to approximate range of unknown inductor. Adjust center dial until a minimum tone is heard in phones. Adjust phasing controls for minimum tone and readjust center dial for null indication. Dial reading

RCA VICTOR TO SPONSOR TOUR OF ORCHESTRA

Philadelphia Orchestra With Dr. Stokowski To Conduct 36 Concerts

Final arrangements have been completed with Dr. Leopold Stokowski, famed conductor of the Philadelphia Orchestra, whereby RCA Victor will sponsor a five-week transcontinental tour of the noted symphony organization in the United States and Canada, starting next spring, according to an announcement by Mr. E. T. Cunningham, President of the RCA Manufacturing Company.

The purpose of the tour, Mr. Cunningham said, is to take the entire orchestra, one of the most famous in the world, to music centers which have known this great symphony orchestra only through broadcasts and recorded music. In this way music lovers will have an opportunity to hear and see the orchestra in the intimate, advantageous setting of local concert halls.

Will Conduct 25 Concerts

Thirty-six concerts will be given in more than a score of cities, of which Dr. Stokowski will conduct 25, and announcement will be made later of the conductors for the remainder. The entire personnel of 100 musicians, with ten members of the managerial staff and stage hands, will make the trip in a special air conditioned train, which will be used as permanent living quarters.

"The signs are unmistakable," said Mr. Cunningham, "That this country is awakening to a greater appreciation of good music than ever before in our cultural history. Radio and modern recorded music are, of course, doing much to stimulate and satisfy this widespread and growing interest, but it has been the privilege of a comparatively few to hear an organization of the calibre of the Philadelphia Orchestra in their own local concert halls. In sponsoring this tour, RCA Victor feels it is making a valuable contribution to the spread and appreciation of good music, a mission it has assumed since the birth of the first phonograph and the advent of radio."

for range used is value of unknown inductor.

Specifications

Circuit—Variable-Ratio-Arm A. C. Wheatstone Type Bridge.
Tubes—1 RCA-25Z5, 1 RCA-76, 1 RCA-6F7.
Weight—5½ lbs.
Power Consumption—40 watts.

Stokowski Signs RCA Contract



Charles L. Wagner and George Engles, Vice-Presidents of NBC (at left) who will manage the tour of Dr. Stokowski (seated). E. T. Cunningham, President of RCA Manufacturing Co., is at the extreme right.

An Earful, Too



Edythe Wright, soloist with Tommy Dorsey's Victor-Recording Orchestra, is heard over the CBS network. Miss Wright is another reason for the popularity of this orchestra and another reason for the "Tune-Up" Campaign to keep all radios in top condition, which is benefiting service engineers throughout the country.

NEW ELECTRON TUBE SHOWN AT I.R.E. MEETING

High Amplification and High Output Features of New Device

A small radio tube, which catches an energizing light or radio impulse and multiplies it millions of times was described and demonstrated before the Institute of Radio Engineers at 330 West 42nd Street, New York, on Oct. 12, 1935, by Dr. V. K. Zworykin, Dr. George A. Morton and Mr. Louis Malter of the RCA Laboratories.

Tests made indicate application of the tube to any problem of electrical amplification requiring exceedingly high "gain" at noise levels far below the present types of amplifying tubes, including television scanning.

The device is suitable for amplifying either direct current, or alternating current of any frequency, and the circuit in which it operates is one of extreme simplicity. The tube marks a distinct advance in the utilization of what technicians refer to as "secondary emission," a principle by which the impact of electrons emitted by a cathode release other electrons from a series of succeeding electrodes in ever increasing volume.

Has 3-Watts Output

The new tube may be provided with either a photo-electric cathode or the usual thermionic cathode, such as that used in the radio tubes of home receivers. In a demonstration of the new device, the RCA scientists employed a tube with photoelectric cathode. The energizing impulses were provided by a neon glow tube, connected to the magnetic pick-up of an electric phonograph. The dull light thus generated, fluctuating in accordance with the music of the record, was focused on the photoelectric element of the new tube, which converted it into electrical energy and amplified it enormously. It produced an output of two to three watts for the direct operation of a loudspeaker, through which the recorded music was reproduced.

Development of remarkable electronic device is another instance of RCA pioneering in all fields.

NEW ANTENNA MAKES EASY INSTALLATION

(Continued from page 1, column 1) during the time and labor necessary for installations.

Weather-Proof Line

The transmission line is specially impregnated to avoid losses in efficiency due to the deteriorating effects of the weather. The antenna junction box is hermetically sealed so that losses due to soot and dirt on cross-over eliminators are avoided. At the point of connection to the receiver, an easily attached receiver coupling unit complete with screw terminals and connecting links make connection easy.

Ground Clamp

The ground clamp is of the screw type, with a point for making contact through paint or corrosion on the pipe. In the event a lightning arrester is desired, two will be necessary, connected to each transmission line. When selecting lightning arresters, those having low internal capacity should be used, as otherwise some of the signal voltage may be by-passed to ground.

Service engineers who have tested the new RCA RK-40 Antenna are enthusiastic about the ease of installation and neat appearance of the finished job and report good signal pickup. RCA parts distributors are now featuring this antenna.

New Tube



Dr. V. K. Zworykin examining the new electron multiplier tube which has wide application in all types of amplification circuits.

HIGHER VALUES MEASURED WITH RCA OSCILLATOR

Range Extended From 250 mmfd. to 2000 mmfd.

By T. Y. FLYTHE
RCA Service Engineer

The great versatility of the RCA Test Oscillators is again demonstrated by the following article in which a simple method is given for measuring small capacitors. This article is a continuation of that published in the September issue of RCA Radio Service News in which Mr. Flythe described a method of measuring capacitors from 2 to 250 mmfd.

A simple method for using the RCA Test Oscillators for checking the capacity of condensers from 250 to 2,000



T. Y. Flythe

mmfd. is to place a 250 mmfd. condenser in series with the condenser to be measured and checking the dial readings against the chart shown. This method has the merit of high accuracy and easy operation. Also, the fact that it requires a minimum of additional equipment is of great help to the service engineer.

Calibration of Standard Condenser

An accurate condenser of 250 mmfd. is required as a standard for the series condenser. If an accurate 250 mmfd. fixed condenser is not available, a conventional variable condenser may be used for this purpose. Most variable condensers used in receivers have a maximum capacity higher than 250 mmfd. and it is easy to set them at 250 mmfd.

To avoid hand capacity from affecting the value of the external condensers, it is advisable to use a shielded cable—single wire—the wire acting as one lead and the shield as the other lead, for connecting the unknown capacitors to the oscillator. This may be any suitable length, preferably 12 inches to 18 inches long. Leave about three inches at the free end. Clips attached to the end of the lead and the end of the shield will provide ready means for connection to the capacitors. The other end should be connected to a phone plug by connecting the shield to the body of the plug and the lead to the tip.

Checking Standard

Place the oscillator in operation with the plug of the shielded cable inserted in the left (sweep) jack of the oscillator. Set the oscillator dial to a reading of 3,000 kc. (band 6).



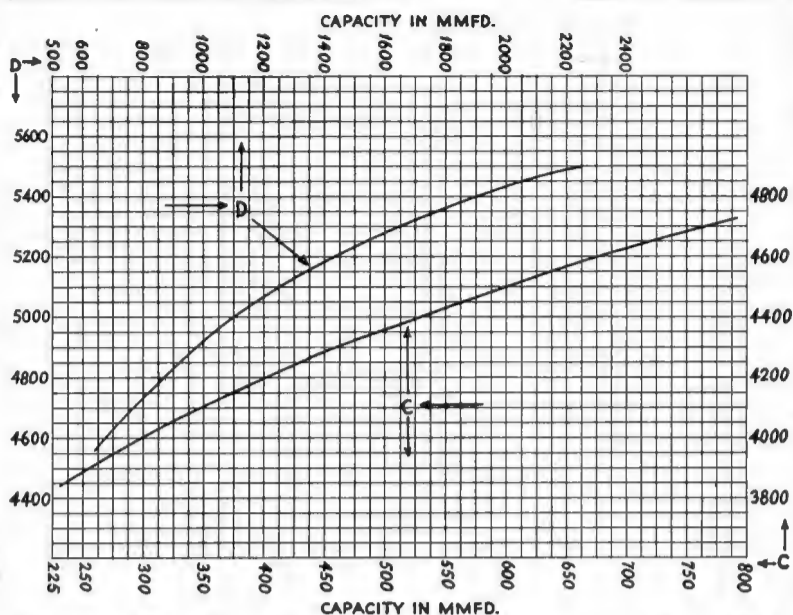
RCA Oscillator Type, TMV-97-C

Set oscillator range switch to its 800-1,500 kc. position. The frequency of the generated signal will then be approximately 774 kc. Tune this signal in on a convenient broadcast receiver. Leave the receiver setting at this position for all tests. Retune the oscillator until the dial reading is 6,250 kc. (band 6). Connect the external variable condenser across the free ends of the cable. Tune the external variable condenser used as a standard until the signal is again properly tuned to the receiver. The capacity of the external variable condenser will then be 250 mmfd., the value required for the standard capacity. Leave the external condenser set to this position for all other tests.

Checking Values From 250-700 Mmfd.

Connect the condenser to be measured in series with the external standard variable condenser. Connect one lead of the cable to the free end of the external standard variable condenser and connect the

Increases Range of Oscillator



Calibration chart showing curves for measuring capacitors from 250 to 2000 mmfd. with the RCA Test Oscillator.

other free end of the cable to the free terminal of the condenser to be measured. The series jumper between the two condensers should be very short to obtain minimum disturbance of the circuit from the capacity effect of surrounding objects. Likewise the condensers should not be placed near metal objects. Adjust the oscillator dial until the signal is tuned to the receiver. Read the dial and compare its reading to the chart above, following across the chart until the lower curve is reached. Follow the chart downward to the lower line which is calibrated in capacity. Example: Os-

cillator dial at 3,000 kc. Place external standard in series with condenser to be measured. New dial reading 4,400. Consult chart. Capacity of unknown condenser, 531 mmfd.

Values from 700-2,000 Mmfd.

Set the oscillator to 3,000 kc. as before. Tune receiver to this signal. Connect standard condenser in series with unknown condenser and connect across free end of cable. Retune oscillator until signal is again in tune on receiver. Example: New oscillator dial reading 5,250 kc. Check chart. Capacity, 1,540 mmfd.

MAGIC EYE IS BIG HELP TO SERVICE MEN

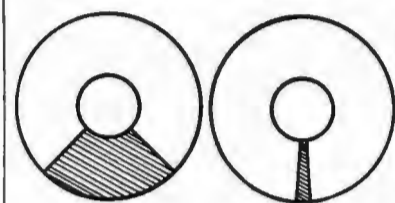
Speeds Up Servicing Of Sets By Showing Location Of Trouble

According to A. W. Panke of Smith Distributing Co., Louisville, Ky., the new Magic Eye of the 1936 RCA Victor Instruments is a great help for the service engineer diagnosing trouble. While the Magic Eye is an ideal cathode ray tuning tube, it is also so located in the circuit that variations in its operation are a positive means of tracing trouble to certain parts of the receiver. While, of course, the Magic Eye does not eliminate the need for other test equipment, it nevertheless is a big help, Panke stated in a letter to the NEWS.

No Plate Voltage

"Assuming the tuning tube is O K., when the filament is burning and

Functioning of Magic Eye



Out of Tune In Tune

there is no green glow, it can be readily assumed that there is no

plate voltage in the chassis," the letter states.

"When the tube tunes to the station and yet the receiver is silent, the audio tubes had better be checked as far as the 6H6. If the tuning tube tunes raggedly and the signal is distorted, the 6H6 should be tested. If no variation in the tube can be seen, it can readily be traced to the tubes or trouble in the r-f or i-f section of the receiver which can then be checked in the usual manner.

"Possibly by the end of 1935 we will be able to tell exactly what the trouble is by watching the effect of the Magic Eye."

(The editor would be glad to have any additional suggestions of this type.)

CONNECTING RCA PHONOGRAPH OSC. TO METAL TUBES

The connecting lugs of the RCA Phonograph Oscillator were designed, of course, to fit the base pins of glass tubes. With the introduction of RCA All-Metal Tubes, and receivers using them, the present lugs on the connecting leads of the RK-24 will, of course, not fit the smaller base pins of the metal tubes without modification. All that is necessary is to slip back the spaghetti and carefully pinch the split lug together with pliers. When the spaghetti is slipped back in place there is sufficient clearance and the lugs make a firm and good electrical connection. Since all of the new metal tubes except the rectifier are standardized to a heater voltage of 6.3 volts, the RCA-6A7 is the correct tube to be used with the RK-24 Oscillator.

Another new leader! RCA UNIVERSAL A.C. BRIDGE



NET PRICE \$49.65
Stock No. 9600

Complete with tubes and standards. Nothing else needed except a high-impedance headphone as null indicator.

Now You Can QUICKLY, ACCURATELY MEASURE

- INDUCTANCE—100 Microhenries to 10 Henries
- CAPACITY—10 Micro-microfarads to 10 Microfarads
- RESISTANCE—1 Ohm to 1 Megohm
- ACCURACY—5% overall at full scale



HERE is the newest piece of RCA Test Equipment for speeding up service and laboratory work. It gives a quick and accurate check of inductance, capacity and resistance over unusually wide ranges, including the low values that ordinary resistance and capacity meters cannot check. Measurements are made at 1000 cycles per second, and the Bridge includes not only a 1000-cycle oscillator, but also a 2-stage amplifier tuned to 1000 cycles, in order to assure adequate voltage for making any balance required. Service work requires measurement of inductance, capacity and resistance many times daily, and this compact, self-contained Universal A. C. Bridge not only lessens the work of such measurement but greatly increases its accuracy. See it at your RCA Parts distributor.

SERVICE TIPS

Now you can win your choice of a handsome pigskin wallet or an RCA Service Engineer's Pencil by sending tips to RCA Radio Service News, Camden, New Jersey. . . . If you send only one tip, and it is accepted, you will receive the pigskin wallet. If you send three tips all of which are acceptable to the Technical Editor, you may have your choice of the Pencil or the Wallet. Be sure to specify which you want. . . . All tips become the property of RCA to be used as they see fit. . . . Service Tips are our reader's ideas, not ours. While RCA Radio Service News believes they are worthwhile, we cannot be responsible in any way for results obtained.

RCA Cathode Ray Oscillograph

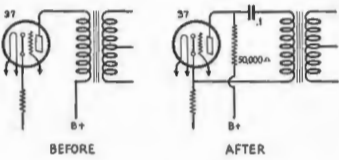
Permanent references of various tuning curves and other characteristics may be made by photographing the image on the cathode ray oscillograph when it is connected to a receiver in known operating condition. These photographs should be enlarged and placed on a large loose-leaf page entering their Service Notes and filed away for a permanent record.

It should be noted that it is necessary to use a very rapid lens and film in order to get a perfectly sharp and undistorted picture. The camera that I used has an F 4.5 lens and we use Pancromatic film.

Arthur W. Greathead,
Johannesburg,
South Africa.

Stromberg-Carlson Model 60

A common complaint received for this receiver is internal noise. It has always been traced to the primary of the audio input trans-



former. However, instead of replacing this transformer, we eliminate the noise by using a parallel-feed consisting of a 50,000-ohm resistor and a .1 mfd capacitor connected as shown.

Monroe M. Freedman,
635 East 228th St.,
New York City, N. Y.

Auto Antenna

A piece of copper screen about 2 1/2 x 3 1/2 feet placed on the underside of the work bench makes a good antenna for testing auto radios. It makes possible the alignment of the trimmer capacitor before placing the set back in the car.

Jack W. Lee,
Box 99,
Oatman, Arizona.

Bonding Auto Radio Units

When bonding auto radio units with soldered connections, always remember the rules of good soldering. Be sure to clean the surfaces bright, and have sufficient heat to melt the solder and bring the surface to the solder melting point. Due to the large radiating surfaces of the automobile, it requires a 200 watt iron to make the surface hot enough to melt solder. Any lower wattage will result in a flux joint.

Roy E. Weddle,
Funkstown, Maryland.

Neutralizing

In neutralizing some of the old sets, a good tube from which one filament pin has been cut off is often used. However, due to the fact that tubes vary in their internal capacity, this does not always work. A better way is to use the tube that is to be used in the stage under test by slipping a short length of drinking straw over the filament pin. This never fails to work and permits a more accurate neutralization job that avoids possible oscillation.

Buhl Buckingham,
S-O-S Radio Service,
2817 Lyndale Ave., South,
Minneapolis, Minn.

Emergency Reception

On some superheterodynes, emergency reception may be provided by connecting the grids of the first and second detectors together, thereby eliminating a defective oscillator or IF amplifier, and making the receiver work as a tuned radio frequency job.

E. W. Caldwell,
954 Scotland Avenue,
Chambersburg, Pa.

Output Transformer

I have found it very useful to carry one of the RCA Universal Power Transformers with me on all outside jobs. In addition to its function as a power transformer, it also serves very well as an emergency output transformer repair. As a matter of fact, in some cases the tone quality has been superior to that obtained when the regular output transformer for the particular set was used, and the customer preferred to pay the higher price. The high voltage winding is used as the primary, and various combinations of the filament or primary winding are then tried, to secure the best results.

J. Kelly,
25 Vermilyea Ave.,
New York City.

Editor's Note: The RCA Universal Output Transformer of course is better as an output transformer, although it does not have the flexibility of use as a power transformer also.

Midget Speakers

When you have a midget speaker on the bench that is hard to center, just hook the field coil and output transformer in series and connect it to the 110 volt AC line. Proper centering is indicated when you will hear nothing at two feet from the speaker. However, if the cone is rubbing, the sound will be very bad.

Melvin Mattox,
3524 Cerritos,
Long Beach, Calif.

Editor's Note: This method of cone centering applies to all receivers and has distinct merit.

Metal Tube Receivers

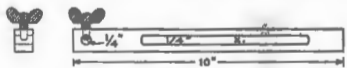
A condition that I have found in metal tube sets, and which cannot be located during the regular tube and chassis tests, is a poor connection between the metal shell of the tube and the tube shell pin. This defect usually manifests itself as severe oscillation. An examination will show measurable resistance between the points mentioned. In one case the resistance was as low as 2 ohms. If no new tube is readily available, a quick temporary repair can be made by soldering an external ground to the shell of the tube.

Fred J. Elser,
Carlsbad, California.

Dial Cable Helper

I have found the following tool to be indispensable when working around dial cables, dial controls and the like.

The Slot X is slipped over the



nearest shaft. By means of the wing-headed screw, the dial shaft can be slipped or held rigid.

Reginald Watts,
20 South Granada Ave.,
Alhambra, Calif.

Dirt Blower

I secured a small tank such as is used in some pressure-gasoline stove systems. On this I installed a gauge and a valve stem from an automobile tire. I also made up a short rubber tubing with a fitting which, when attached to the valve stem, opens it (I obtained the fitting and hose from an old "Touch Up" sprayer). I then took the tank to a "free air" station, and put about 60 lbs. of air in it (be sure your tank will hold). I take it with me on service calls and, by attaching the hose to the tank, I can properly clean any radio or refrigerator much better than by any other method I know of. It is good policy to take the set outside before you start blowing, because of the dirt that will be blown out.

June L. Lehnher,
Towanda, Kansas.

Gulbransen End Table Model

The power line, ground and aerial lead-in wires are in the same cable. Any noise that is being made by the power line will be picked up by the aerial lead-in in the cable, regardless of whether the aerial is connected or not. To eliminate this noise, cut the aerial lead-in wire at the antenna coil, and bring it out in a separate wire from that point to the aerial.

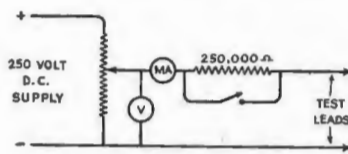
Triangle Radio Co.,
2904 Archer Ave.,
Chicago, Illinois.

Editor's Note: This of course applies to any receiver in which the antenna and power lines are closely associated.

No Current Volt Meter

I have found the circuit shown below to be invaluable for measuring voltage in circuits having high resistance.

In practice the test-leads are connected to the unknown voltage and the potentiometer arm is adjusted



for zero current in the milliammeter. Then the voltage is read directly on the voltmeter. The 25,000 ohm resistor is used to protect the milliammeter during preliminary adjustments. This instrument reads actual voltage as it draws no current from the circuit being measured.

B. H. Swaney,
937 East 8th St.,
Erie, Pa.

Output Tube Failure

An unusual fault that I found on several sets was the grounding of the pilot lamp socket. The customer when replacing the pilot lamp has unknowingly forced one of the light socket lugs to ground. This shorts the bias resistor of the output tube, thereby causing excessive current, distortion and extremely low output tube life. Very often this trouble is difficult to find, as it is not in the chassis proper.

Herbert Varney,
3024 Cherokee St.,
St. Louis, Mo.

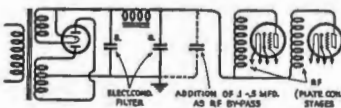
Ford V-8 Motor Noise

Stubborn cases of motor noise in the Ford V-8 may often be remedied by winding a 30 turn coil of No. 14 enamel wire on a 1/2 inch insulated form. Cover this with tape, and then hook in series with the low-tension lead next to the spark coil of the distributor assembly.

Earl Ehling,
Mogle Radio Co.,
108 E. Ninth Ave.,
Winfield, Kansas.

Oscillation in Midget Receivers

Oscillation in most present-day midget receivers often becomes quite a problem to cure. I have found that some dry-electrolytic condensers are not effective as a radio-frequency by-pass, due to the high radio-frequency resistance.



While such an electrolytic serves as a filter, it performs as a filter only, and ceases to function as an RF by-pass. The result is oscillation. This condition is cured by shunting the offending electrolytic with a 0.1 or a 0.5 mfd. fixed capacitor as shown in the illustration.

Leon J. Fox,
Radio-Electric Engineering Co.,
9 West Chippewa St.,
Buffalo, N. Y.

Another Dumas



There'll be another famous Dumas if present indications mean anything. Lovely Helene Dumas (no relative to the great Alexandre of literary fame) currently heard in the House of Glass over an NBC-WJZ network each Wednesday at 8.30 p. m., E. S. T., is steadily rising to the height of popularity.

EASY TO ATTACH RECORD PLAYER TO 1936 RADIOS

Metal Tubes Give Improved Results With Record Player

Every purchaser of a new 1936 RCA Victor Radio is a good prospect for the sale of the unique RCA Victor Record Player, according to G. P. Allen of the RCA Parts Division. This small and compact instrument retails for only \$16.50 and enables anyone to play either ten- or twelve-inch standard records through their radio with tone quality equal to a local station. Many dealers and service engineers are now cashing in on this extra-profit item which also leads to additional business in records.

For the service engineer however the problem of connection must be solved and sometimes it is a very real problem. Many of the RCA Victor Service Notes for the new RCA Victor receivers contain a diagram and instructions as to proper connections of the Record Player. Examples are the C-15-3 and C-13-2 Service Notes. See page 13.

For other receivers of the 1936 RCA Victor line, or receivers of other manufacture, the connections should be made as outlined below.

See Service Notes

1. For receivers not using the new RCA-6H6 Twin Diode as a second detector, connections can be made as described in the Record Player Service Notes and Instruction Sheets.

2. For receivers using the new RCA-6H6 Twin Diode as a second detector and with the first A.F. stage SIGNAL-BIASED, the Record Player connections should be made by breaking the control-grid lead of the first A.F. tube (usually an RCA-6C5) which follows the RCA-6H6 in the circuit, and following the diagram and instructions of the C-15-3 Service Notes. At this writing, the C-15-3 is the only receiver of the new RCA line that has the first A.F. stage signal-biased.

Sets with RCA-6H6

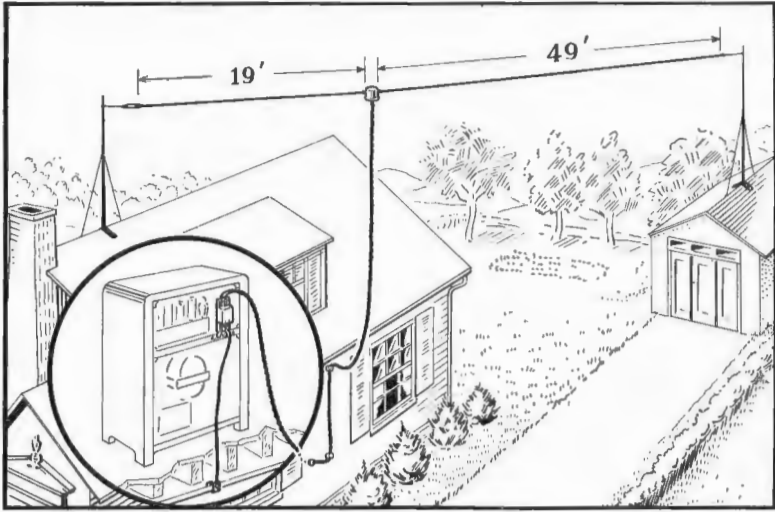
3. For receivers using the new RCA-6H6 Twin Diode as a second detector and with the first A.F. stage SELF BIASED, the Record Player connections should be made by breaking the control-grid lead of the first A.F. tube (usually an RCA-6C5), which follows the RCA-6H6 in the circuit, and following the diagram and instructions of the C-13-2 Service Notes. All of the new 1936 RCA Victor line such as the C-13-2, C-11-1, C-9-4, C-8-15, T-10-1, T-8-14, etc., except the C-15-3, have the first stage self biased. With the connections made as described in the C-13-2 Service Notes, page 13, there may be cases where the radio signal or noise is not entirely suppressed. In such cases, connect the blue and red leads in series with the cathode of an I.F. amplifying stage only.

75,000 Amps. for 1/30 of a Second



Development of power welding apparatus, controlled to split-second accuracy by thyatron control tubes, was an important factor in making possible the new improved RCA Metal Tubes which are a feature of the new 1936 RCA Victor Receivers.

Easy To Install



Factory assembling including soldering and a weather-proof junction box, make the RCA RK-40 one of the most easily installed of all antennas. Simply fasten each end to a support, connect the coupling unit to the receiver and an efficient scientific antenna system is bringing in more stations for your customers' enjoyment.

NEW TUITION METHODS HELP SERVICE MEN

RCA Institute Courses Divided Into "Groups" for Study

The aid which service men derive from current magazines and technical publications, especially those of the manufacturers, is so much taken for granted that its extent is easily overlooked. "But," says W. F. Aufenanger, Superintendent of RCA Institutes, "there are many men in the field who do not obtain a full measure of help from those sources simply because they cannot comprehend the contents, not having had fundamental training in the applications of radio principles."

"Generally we have found that, while many of the men are considered fairly good technicians, they, themselves, realize the handicap in their lack of theoretical instruction. They would jump at a chance to attend a technical radio school, but for financial or other reasons are prevented from doing so. That is why RCA Institutes maintain Extension Radio Courses for Home Study."

The home study courses of which Mr. Aufenanger speaks have an especial appeal to employees of RCA Victor, RCA Radiotron and RCA Parts merchandising outlets, for such employees are given the same discount of 25 per cent from the tuition as enjoyed by employees of RCA, and have the further privilege of taking only such portion of a course as needed by them. Independent service engineers may obtain this discount by having their RCA Parts Distributors endorse their application.

Arranged in Groups

For instance, the home study Service Course is arranged in sections or "groups" of lessons. There are nine groups in the course but a student with a background of practical experience, or one with previous training, may eliminate groups with which he is familiar. The tuition is \$9 a group, with no additional expense except for the postage in mailing examination papers and queries to the technical consultants. The home study course in Sound also should be considered by service men. The groups of that course, which embrace applications of sound amplification, are \$11.

Service engineers or others interested in these courses should write to RCA Institutes, Inc., 75 Varick St., New York City, for further information in regard to these courses.

TUNE-UP GIVES PROFITS TO ALL PARTICIPATING

Thousands of New Parts and Tubes Sold in Campaign

Eighteen calls, with a net profit of over \$40.00 on calls amounting to over \$1.50, were obtained by Geo. S. Hards Co., of Pittsburgh, Pa., during the first few days of the sensational RCA Tune-Up Campaign. To quote Mr. Hards: "We received eighteen calls resulting in seven \$1.50 Tune-Up jobs. Our net profit on calls amounting to over \$1.50, was approximately \$40.00."

"In my personal opinion, the results of this campaign were very gratifying, and I believe the idea of such Tune-Up Campaigns a very good and worthwhile one."

Mr. Hards is just one of the thousands of dealers who are finding the RCA Tune-Up Campaign a short-cut to more business. A backing of national advertising featuring full page ads in the Saturday Evening Post, tie-in newspaper ads in 39 cities and direct mail postcards supplied at a nominal cost to service engineers and dealers, are making everyone conscious of the RCA Tune-Up Campaign.

RCA Radiotron Distributors are offering dealers and service engineers special inducements to participate in the RCA Tune-Up Campaign. See yours at once for details or, if not convenient, order the Tune-Up cards shown in the November issue of RCA Radio Service News, direct from Camden, N. J.

Photophone To Distribute New Sonotone Aid

Theater Installations to Benefit Hard-of-Hearing

Exclusive distribution for all group installations in the commercial field of the famous Sonotone hearing aids for the hard-of-hearing has been obtained by RCA Photophone, according to E. M. Hartley, manager of RCA Photophone Division. When it is realized that there are 10 million persons who are unable fully to enjoy talking motion pictures, the added business that Sonotone-equipped theaters can obtain is at once obvious.

To Sell All Theaters

Under the new set-up, RCA Photophone will sell and install the new RCA-Sonotone Oscillator in theaters, regardless of the make of sound reproducer with which they may be equipped. When Sonotone is used in connection with Photophone equipment the installation consists of a special amplifier, connected across the output of the main reproducing amplifier, and double audio outlets placed beneath the arm of the chairs. With other theater sound systems, the addition of a microphone, to be placed directly in front of the loudspeaker, is required.

Most Advanced Hearing Technique

The RCA Sonotone Oscillator is a tiny, smooth, flat unit, about half the size of a domino, which rests coolly and comfortably behind either ear of the listener. It operates on the bone conduction method of hearing. Sound is brought through the auditory organs via the bones of the head rather than the ear.

The instrument is requested at the box office by the patron, who is provided with either a lorgnette-handle or a head-band type of instrument. The theater usually makes no extra charge for the use of the device, since the added patronage of the hard-of-hearing will more than repay the cost of installation.

Leading theaters are installing Sonotone. For example, provision for fifty of the new RCA-Sonotone

Hearing Aid



Merely hold the comfortable Sonotone Unit either behind or in front of the ear to hear the programs perfectly in Sonotone equipped theaters.

INTERMITTENT CAUSES EASY TO CLASSIFY

Engineer Finds Tabulation of Great Value

A new attack on the old intermittent reception problem which so often stops even the best of engineers, is suggested by Mr. Frank Photiades of 1251 1/2 Gerald St., Highland Park, Mich. His idea is to keep an accurate record of all such troubles and then see which is the most likely cause of this trouble. To quote Mr. Photiades:

"By keeping a careful record of service calls made by myself and a few other service men, we have obtained the following record of causes of intermittent operation:

- 40 to 45% are caused by defective by-pass capacitor used for plate, screen and cathode.
- 35% are caused by defective resistors.
- 7% are caused by defective tubes.
- 6% are caused by defective coupling condensers.
- 5% are caused by defective RF, IF, or audio transformers.
- 3% are caused by defective speakers.
- 2% are caused by mechanical defects.

WESTMINSTER CHIMES WORK LOUDSPEAKER

1 to 49 Notes Are Electrically Reproduced at Any Volume

Electric chimes, of correct pitch and of any desired intensity, are now supplied by RCA for churches, stores, banks and other institutions that use or need chimes. These chimes, which may be played either manually or automatically, are reproduced electrically by amplifiers and loudspeakers. This greatly reduces the cost of a chimes installation together with providing great flexibility for future increases of notes and power.

An RCA Westminster Chimes consists of the chimes actuating unit, which may have either 1, 5, 13, 25 or 49 notes, depending upon the type of installation desired, the amplifier, the loudspeakers, the chimes control unit and the master clock unit. While the units mentioned are required for a complete installation, only the units desired may be used.



Five Note Chime Unit.

In addition to complete equipment, just the chime striking equipment may be used with any standard Public Address and Commercial Sound System which has sufficient gain to operate from a standard phonograph pickup. The striking mechanism requires 12 volts d.c. for field exciting power.

2% are caused by electrical defects other than those stated."

December Tune-Up Ad

Final Pre-Holiday Offer!

COMPLETE RADIO TUNE-UP

only \$1.50

10 FOR THE PRICE OF 1

- 1 Inspect and clean chassis.
- 2 Check speaker and connections.
- 3 Check all power connections.
- 4 Test and label all tubes.
- 5 Clean interior of cabinet.
- 6 Check aerial installation.
- 7 Inspect aerial and ground connections.
- 8 Inspect lightning arrester.
- 9 Clean radio set.
- 10 Free estimate of any additional repairs.

Your last chance at this rock-bottom price!

Yes, sir, the holiday programs this year will far surpass anything you have ever heard before. Literally the best in the world, from all the world. Don't let anything spoil your enjoyment. Make your set play like new, NOW before it is too late. Dirt, loose connections, corrosion, worn parts, weak tubes gradually rob your radio of its original pep and power. This final Radio Tune-Up offer is the surest and least expensive way to put your set in fine condition. You actually get ten jobs for the price of one! See list. Of course, any tubes or materials required will be extra.



Remember the holidays with their marvelous programs coming from all the world. Don't miss a single note of the great Christmas season!

Phone any RCA Radio Tube Dealer Listed Below

The third of the tune-up newspaper ads will appear in 68 newspapers located in 39 cities. RCA Radiotron Distributors are arranging tie-ups with all progressive dealers and service engineers. Service engineers are reporting highly satisfactory returns from the tie-up and postcards.

Know Your Tubes



Evidence that RCA fulfils the responsibilities of leadership in the radio industry is found in the many authoritative technical publications RCA issues. In the illustration are shown six RCA publications that are invaluable to radio engineers, radio technicians and others.

Copies may be obtained through your distributor or by writing to the RCA Radiotron Division, Camden, N. J.

RC-12—Cunningham-Radiotron Manual	Price	All-Metal Radio Tube Manual	Price
Handbook Series	.25	464S—Supplement to Bulletin 464	.10
*HB1—Receiving Tube Handbook		1275—Wall Chart included in RC-12 Manual	.15
*HB2—Transmitting and Special Purpose Tube Handbook		*Note: The HB Series of Handbooks are highly technical books suitable for the more advanced engineer and are available on a subscription basis only. Write to Commercial Engineering Section, Harrison, N. J., for details.	
*HB3—All Types Handbook			
TS2—Cathode Ray Tube Manual	.25		
464—Amateur Transmitting Types	.15		

hearing aids, of the bone conduction type, has been made in the Warner Brothers Hollywood Theater which has reopened.

DYNAMIC AMPLIFIER HELPS TONE QUALITY, SAYS ENGINEER

Volume Range Extended 20 Db. With Unique Variable Gain Amplifier—Has 25 Watts Output

The following article by Mr. C. M. Sinnett of the RCA Engineering Dept. explains the principles upon which the dynamic amplifier of the new RCA Victor Radio-Phonograph D22-1 operates. The sensational performance of this instrument is making history as one of the greatest advances in musical reproduction since the dynamic loudspeaker. This article by Mr. Sinnett will help service engineers to properly understand the functioning of this remarkable device.

The design of equipment for reproducing music for entertainment in the home and in auditoriums has always met with serious problems dealing with limitations in dynamic range as well as frequency range. The limitation in frequency range has been somewhat overcome in the past few years.

To date, however, no equipment for home use has succeeded in reproducing the dynamic range of a large symphony orchestra.

We learn from our study of music that a wide range of frequencies is often encountered in the rendition of a musical selection; the lowest note of an organ being as low as 16 cycles per second, and the highest overtone of an oboe being approximately 16,000 cycles per second. This range in frequency is much wider than that reproduced by the best grade of modern radio receivers, since in most receivers the range extends from about 60 cycles to 4500 cycles. Modern electric phonographs cover a little more frequency range particularly at the higher frequencies.

Listening Tests Used

Results of listening tests, attended by famed musicians, indicate that for practical purposes this range meets present day requirements. In dynamic range, however, both the radio and the phonograph have definite limits falling far short of that which is encountered in a large symphony orchestra. The change in volume may extend over a range of 70 db from a pianissimo violin solo to a fortissimo ensemble. This dynamic range is much greater than that which can be satisfactorily reproduced by present day radios and phonographs. Such factors as noise in studio lines, tube noise in both

but due to the fact that they required a change in recording technique and a completely new library of records they have been discarded. The system about to be described depends for its action upon the variation in amplitude of recording, and gives a new sense of realism on any type of recorded symphonic music. In the development of a volume expander suitable for use in a commercial radio phonograph combination, several factors have to be considered such as cost, reliability, flexibility in production, and freedom from close limits on the components.

Three Tubes Used

Figure 1 is a schematic diagram of the volume expander used in RCA Victor Model D-22-1. Three of the new metal tubes are employed in this circuit. VT-1 is the RCA-6L7 hexode-pentagrid converter employed as a variable-gain voltage amplifier, VT-2 and VT-3 are RCA-6C5 triodes. VT-2 is resistance coupled to VT-3, and acts as a voltage amplifier and buffer tube between input transformer T-1 and VT-3. VT-3 is connected as a rectifier, and serves to furnish a bucking voltage for the bias appearing on No. 3 grid of the RCA-6L7. In operation, the circuit functions essentially as follows:

Voltage from the electro-magnetic pick-up appearing across the primary of the 1:80 step-up transformer T-1 is impressed on an aurally compensated volume control VC-1, and by means of coupling capacitor C-5, on the degree of expansion control R-6. It will be noted that the voltage delivered to expansion control R-6 is taken off ahead of the signal volume control VC-1. This was considered desirable since it allowed any degree of expansion, which would be independent of any setting of volume control VC-1. The variable-gain characteristics of the No. 3 grid of the 6L7 permits the use of this tube for volume expansion. The signal is impressed on No. 1 grid which is operating at a fixed bias

has been chosen as .5 mfd in order to permit some degeneration to take place and thus reduce the low frequency response of this portion of the circuit. Curve A in Figure 2 shows the frequency characteristic of the phonograph amplifier, Curve B shows the frequency characteristic of the dynamic amplifier alone. This characteristic has been used in order that low-frequency signals will not cause unnatural expansion such as would occur with normal frequency response characteristics in this type of an amplifier when base drum, tympani or bass viol music were being reproduced. VT-3 acts as a simple diode rectifier and has a 220,000 ohm resistor in its cathode circuit. Voltage appearing across resistor R-8 is thus rectified and appears across resistor R-9 as direct current. Condenser C-8 of .5 mfd capacity serves as a filter to smooth out pulsations in this rectified voltage. Resistor R-9 is connected in series with the bias supply to the No. 3 grid of the RCA-6L7.

A bias of approximately 18 volts negative is taken from resistor R-10 which is adjustable. It is desirable to have this bias adjustable, because of the variations in tubes; optimum results are obtained when, with a screen voltage of 100 and a bias of 10 volts negative on No. 1 grid of the RCA-6L7, a plate current of .10 to .13 mls is obtained. This bias to the No. 3 grid also passes through the time delay and filter circuit composed of R-2 and C-2 having the values shown. The time delay circuit is necessary in order that the operation of the expander may take place smoothly. If zero time delay were used then low frequency responses would gurgle and cause unnatural reproduction since the rectified impulses would bring about rapid changes in bias and correspondingly jerky performance. On the other hand too long a time delay would result in a smoothing out of staccato passages, and the overall effect of the expander would be nearly lost. The values of R-2 and C-2, as shown in the time delay circuit in Fig. 1, were selected as a result of a great number of listen-

22 Tubes—25 Watts Output



RCA Victor model D22-1—the Rolls Royce of Radio. This remarkable instrument not only reproduces radio programs on all wave bands up to 60 megacycles but also provides electrical reproduction of records through the automatic variable gain RCA Dynamic Amplifier.

volume level of pianissimo passages to be a little above room level.

Output Curves

Figure 3 shows curves of output versus input—expanded and normal. As can be seen from the curve, the amount of expansion at very low levels is practically zero. With increases in input level, however, the amount of expansion increases until at maximum level a total expansion of approximately 20 db over the original is realized. This is within 5 db of that required to

output stage will be driven to overload. Of course, a third demonstration in which the average level of reproduction is fairly high, with occasional passages at extremely low or high levels, will prove very interesting. In this particular case a change of plus or minus 10 db over the normal phonograph can be obtained by proper manipulation of the volume and expander controls before the test.

Figure 4 (page 8) shows the overall curve from record to loudspeaker output on Model D22-1. In taking this curve, a variable frequency record covering from 30 cycles to 10,000 cycles was used. This record, a special recording for this purpose, was recorded with constant voltage on the cutter network, and is representative of the type of characteristic employed during the actual recording of an orchestra. From 800 cycles up, the record has been cut at essentially constant velocity; from 800 cycles down to 30 cycles, the recording has been made at constant amplitude. This method of recording results in an attenuation of output, when played, of approximately 15 db at 60 cycles. In order to compensate for this attenuation, the fixed compensation across the secondary of transformer T₁ has been designed for the particular pick-up and transformer used in the D22-1.

The curve shown in Figure 4 was obtained by rotating a microphone at a given distance from the two 12-inch speakers of the D22-1. It indicates a response flat within plus or minus 5 db from 55 to 5200 cycles. The response curve of course trails off to lower and higher frequencies than those actually shown on the curve.

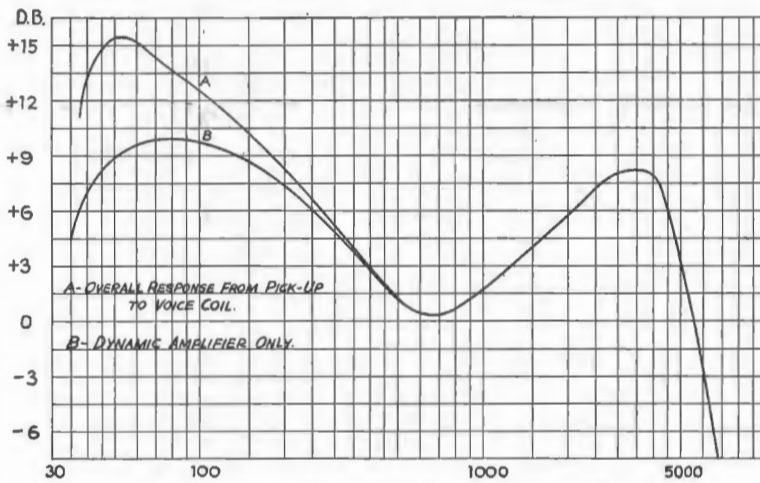


Figure 2—Frequency characteristic of phonograph amplifier

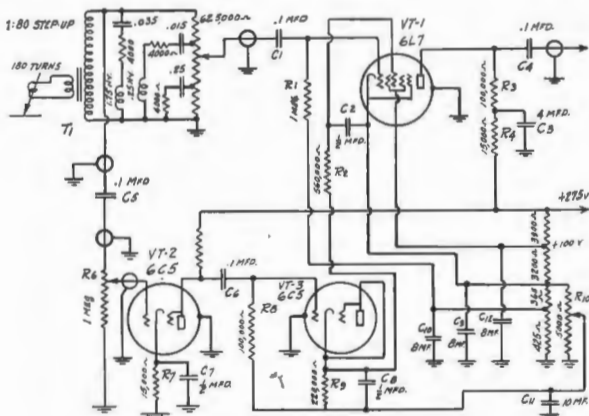


Figure 1—Schematic Circuit Diagram

transmitter and receiver, and distortion at high volume levels limit the dynamic range of a radio to about 55 db.

In the case of the phonograph, this range is reduced to a maximum of 45 db, because of the danger of overcutting the wax during recording and the presence of surface noise during reproduction. If it were possible to restore this loss of dynamic range, then a reproduction more nearly like the original would result. With the above limitations in mind, considerable development work has been carried on to increase the dynamic range of the phonograph.

Adaptable to Old Records

Many systems which restore this dynamic range have been developed,

of approximately minus 10 volts, obtained from the voltage drop across the 365 ohm section of the bleeder resistor.

Fixed Bias

This method is to be preferred over self-bias, since self-biasing of this type tube would result in unstable action during volume expansion, and would cause the bias to vary greatly with different tubes.

Voltage impressed across the degree of expansion control R-6 is fed to the grid of VT-2 which has its plate circuit resistance coupled to VT-3 which acts as a rectifier. A 100,000 ohm plate resistor is used in the plate circuit of VT-2 in order that nearly maximum gain can be realized from this tube. The value of cathode by-pass condenser C-7

ing tests conducted during the development of the device. If it is desired that the time delay be a variable then R-2 should be made a variable resistor of approximately 1 megohm total resistance.

Avoids "Hash"

This will permit variation of the time delay over wide limits. The time delay circuit also prevents rectified "hash" from appearing in the main audio channel of the RCA-6L7.

The volume expander circuit shown can be duplicated quite easily. A hum-free voltage of approximately 275 volts across the bleeder will give the required voltages and by means of variable resistor R-10 the plate current of the 6L7 can be adjusted to the required value. Output from the pick-up and transformer assembly should be of the order of 1.00 to 1.25 volts at 1000 cycles for normal operation. The compensation of the input system will of course vary with different input transformers and pick-ups. Values shown are only for the particular instrument being described. It is evident from the diagram that the output of the RCA-6L7 is fed to the grid of the next audio stage.

For best performance, this stage should have a fixed gain of about 15, and should be coupled through a 1 to 3 ratio transformer to an output stage capable of at least 10 watts undistorted output. With the amount of expansion afforded in this particular amplifier, this power output is about the minimum permissible. It enables the reproduction of distortionless expanded fortissimo passages, and allows the

produce the dynamic range of a full orchestra, and is generally more than sufficient to produce a new sense of realism at normal output levels such as those used in the average home. Possibly a curve having a slightly different shape, particularly since records are manually monitored, would be nearer correct from a theoretical standpoint. Tests in the laboratory indicate that the advantages of a curve nearer the theoretically correct one are somewhat lost due to the variations in monitoring, and as a result the one shown has proven to be very satisfactory.

In demonstrating the expander, two strikingly different effects can be shown. If the maximum levels with and without the expander are adjusted to be the same, then the use of the expander will result in a material reduction of surface noise during low level passages. In other words, the low level passages are reduced about 20 db below the level which would be reproduced under normal conditions. This reduction in level, while it does not actually change the signal to surface noise ratio, gives the impression that there has been a definite change in this ratio, and the result is pleasing.

Without Expansion

The other demonstration is equally effective, and consists of adjusting the low level passages to the same output with and without expansion. The high level passages will then increase to 20 db over the normal high level passages, and result in a much more realistic reproduction. Care must be taken with this particular demonstration, or the

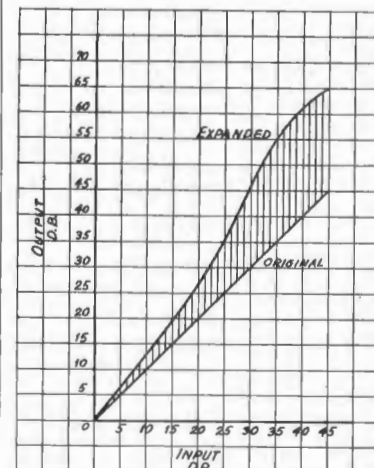


Figure 3—Output increase due to expansion

Gives Greater Dynamic Range

Model D22-1 for the first time makes available to the public a phonograph having a greater dynamic range than any other radio or phonograph which has been manufactured to date. To realize the greatest amount of benefit from the expander, the recording technique should be investigated with (Continued on page 8, column 3)

RCA OSCILLATOR HELPS PICK UP WEAK SIGNALS

Short Wave Signals Easily Detected With "Birdie" Method Of Tuning

The following article by Mr. M. L. Muhleman is reprinted from the November, 1935 issue of Scientific American. It suggests a tuning method, long known to radio engineers, that is particularly applicable to receiving short-wave stations.



RCA Beat Oscillator

When you are cruising through the numerous wave channels in search of new stations, or merely seeking a desired short-wave broadcaster, there is no assurance that you will hear each and every station tuned in. The stations are there, but a number of them may escape your notice.

This inability to spot all short-wave broadcasters on the air within the range of the receiver is no reflection on your technique of tuning, nor on the qualities of the radio set. The apparent absence of stations at their proper dial-scale settings is due to other causes.

Short-wave signals are subject to rather severe fading at times. Therefore, though the receiver may be tuned to the proper frequency for a given station, the signals may be so weak that they are lost in the background noise. Yet a few minutes later signals from the very same station may roar in.

Leave Carrier On

The condition of fading is further aggravated by the fact that foreign short-wave broadcast stations are more often than not run for extended periods with an unmodulated carrier; that is, the signal carrier is left "on the air" minus a program transmission. So long as a station carrier is unmodulated there is nothing to be heard except possibly a gentle hissing sound. If the carrier is passing through a period of fading while unmodulated, there certainly will not be any evidence of its presence at the receiver.

Since the carrier wave of any radio transmitter has a frequency far beyond the audibility of the ear, it cannot be heard through the medium of the radio receiver, unless it is modulated by an audible frequency. Consequently, a listener may readily skip by numerous short-wave broadcast stations without realization, or assume that a desired broadcaster has failed to maintain its program schedule.

Simple Solution

Happily there is a simple solution to this problem; one may attach to his all-wave receiver a small device, known as a "beat-frequency oscillator," that will make each and every station carrier distinctly audible, irrespective of whether or not the carrier is modulated. Several radio manufacturers market this device in unit form so that it may be employed as an auxiliary tuning contrivance or "station finder." These units can be used only with receivers of the superheterodyne type.

The beat-frequency oscillator generates electrical oscillations which are, like a broadcast-station carrier, above audibility. The oscillations are injected into the receiver circuit and made to "beat" with the station carrier in a manner such that the resultant frequency is audible in the loud speaker. The following explanation will provide a better understanding of just what takes place:

With Super-Heterodynes

In a superheterodyne receiver all signals received are converted to some lower, intermediate frequency, before they are actually detected and made audible. If the intermediate frequency of the receiver is 456 kilocycles—and this is a frequency commonly used—then all signals tuned in are converted to this frequency. Now, if a beat-frequency oscillator is attached to the receiver and its frequency adjusted to, say, 454 kilocycles, there

will be three rather than two frequencies in the detector circuit—the original 456-kilocycle frequency of the signal, the 454-kilocycle frequency of the beat-frequency oscillator, and a "beat frequency" of two kilocycles, which is the difference between the first two frequencies.

Now the beat frequency of two kilocycles is audible. A kilocycle is 1000 cycles; therefore two kilocycles is 2000 cycles—well within the range of the ear.

If the beat-frequency oscillator were to be set at 452 kilocycles, rather than 454 kilocycles, the resultant beat would still be audible. The beat frequency in this case would be four kilocycles, or 4000 cycles. The beat-frequency oscillator is provided with a small adjusting knob so that the listener may select the most desirable beat frequency. Once this adjustment has been made, it need not be touched again when tuning.

Whistle Heard

In operation, the beat-frequency oscillator is turned on and the receiver tuned in the usual manner. Each time the receiver dial pointer reaches the setting for a broadcast station which is on the air, an audible whistle is heard in the loud speaker. The beat-frequency oscillator is then turned off, at which time, of course, the whistle ceases, and in its place will be heard the program—or possibly nothing at all if the carrier is unmodulated or passing through a fading cycle.

The question may arise as to why even a whistle can be heard, when using a beat-frequency oscillator, under conditions of maximum signal fading. This is due to the fact that detection of a signal carrier by the beat-frequency method is many times more sensitive than the usual rectification means of reception. It cannot be used for the detection of broadcast programs because of the interfering whistle.

Sound Pressure Curve

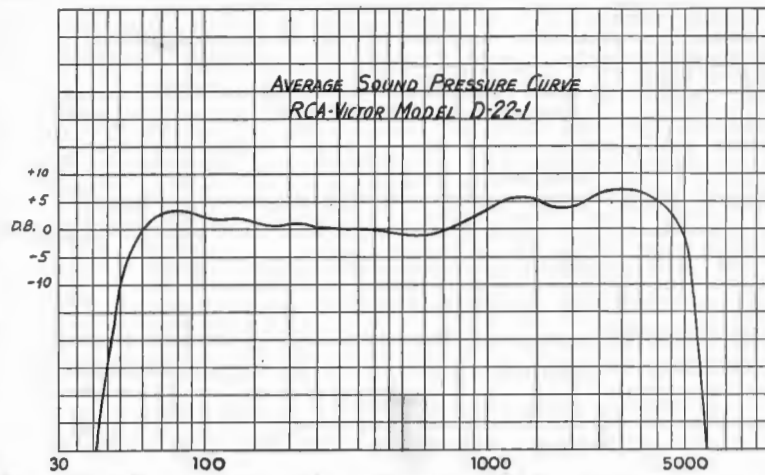


Figure 4—The unusually high quality and wide frequency range of the RCA D22-1, pictured on page 7, is graphically shown on the above curve. This curve shows the overall response from a-f input to sound output.

EXPANDER GIVES BETTER QUALITY, SAYS ENGINEER

(Continued from page 7, column 5)

the idea of possibly incorporating some form of automatic compression. This compression would serve to hold the dynamic range during recording to within the required 45 db. An expander having a curve the reciprocal of the compressor could easily be made, and the result to the ear would be very close to the original. It is doubtful whether such a compressor device would in any way result in an inferior recording when played on a standard

phonograph. On the contrary, if the compressor were properly designed, there is every reason to believe the result would be more pleasing, because the monitoring would be smoother, and there would be no danger of over-cutting on the highest levels. When reproduced on a phonograph having an expander of the proper type, the resulting reproduction, as far as dynamic range is concerned, would be exactly the same as the original.

TOO LATE—TOO BAD

More than 40,000 spare tube clips were distributed free to readers of RCA Radio Service News who accepted the RCA Radiotron Division's offer in the last issue. Dozens of requests were received after the stock was exhausted. RCA sincerely wishes them better luck next time.



Check FREQUENCY with ACCURACY of 2 parts in a million

New RCA Piezo-Electric Calibrator, Stock No. 9572, \$29.95 net, complete with crystal, tube, power supply.

Ideal for individuals, service associations, laboratories, schools, factory test rooms.

NEW precision is brought within the reach of any radio worker by the new RCA Piezo-Electric Calibrator. With it you can check frequencies from 100 kc. to 20,000 kc. in 100 kc. steps, and from 1000 kc. to 50,000 kc. in 1000 kc. steps. Calibrator provides two fundamentals, 100 and 1000 kc., and a series of strong harmonics. A properly-ground and accurately-calibrated crystal maintains its frequency more

accurately than any other known device. Each calibrator is supplied with individual crystal calibration showing temperature at which made. This makes possible the most accurate work in radio service, testing and design work. Service associations and parts distributors should be particularly interested in this instrument, which could be made available to individuals as needed. Write for descriptive folder.



About Books

RADIO PHYSICS COURSE

By A. Ghirardi

Reviewed By J. K. Whitteker
Chief Instructor, RCA Institutes
75 Varick St., N. Y. C.

A truly remarkable book, not only from the standpoint of the wealth of material covered, but also in its modern method of treatment.

Beginning with a well-written section on acoustics and physics of sound, the student is led in logical sequence through unusually thorough and comprehensive chapters on the electron theory, Ohm's Law, batteries, magnetism, inductance, and capacitance, alternating current, electric filters, and measuring instruments. Since 381 pages are devoted to these subjects, it is evident that they come in for more than a brief mention.

The vacuum tube is exceptionally well covered in four chapters.

Covers All Subjects

The balance of the book (418 pages) is devoted to radio and audio frequency amplification, superheterodynes, loud speakers, power supplies, etc. The chapter on automobile and aircraft radio testing and servicing, and sound motion pictures, while incomplete, have considerable value from the viewpoint of general information.

The book is a valuable addition to the library of any radio service engineer and is equally valuable to the person just beginning the study of radio subjects. It is written from a qualitative rather than a quantitative viewpoint.