Everyman's Car - Radio Set — Public - Address and "Universal" Radio Tuner
Tube Characteristics with the "Ray" Tube — Service Man's Coil Tester

See Page 9
SENSATIONAL NEW
SUPREME
OSCILLOSCOPES
SET NEW
PERFORMANCE RECORDS!

Actual tests prove SUPREME 2" OSCILLOSCOPES
far superior, more accurate, have four times larger
screen area than the 1" kind!

MODEL 530—2" OSCILLOSCOPE
8 EXCLUSIVE features found in no other
instrument of similar price!
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2. Exclusive SELECTIVE RETURN SWEEP ELIMINATOR for inclusion or rejection of power supply frequency return sweep.
3. Exclusive UNI-CONTROL allows separate control of two potentiometers from one shaft protrusion on the panel.
4. Exclusive ANTIQUE BRONZE PANEL!
5. Exclusive LIGHT WEIGHT and SMALL SIZE!
6. Exclusive "POWER ON" INDICATOR lamp!
7. Exclusive MAXIMUM FUNCTIONS with MINIMUM number of PANEL KNOBS!
8. Exclusive FLEXIBILITY OF CONTROL FUNCTIONS!

MODEL 535—2" OSCILLOSCOPE
10 EXCLUSIVE features found in no other
instrument of similar price!
1. The only 2" Oscilloscope at this price!
2. Exclusive RETURN SWEEP ELIMINATOR for completely removing high frequency linear sweep return!
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4. Exclusive SNAP-LOCK SYNCHRONIZER for positive interlock between linear time base and incoming signal—Range 5 cycles to over 500 k.c.
5. Exclusive UNI-CONTROL allows separate control of two potentiometers from one shaft protrusion—Grouping of controls eliminates dropping for controls!
6. Exclusive ANTIQUE BRONZE PANEL!
7. Exclusive SMALL SIZE and LIGHT WEIGHT!
8. Exclusive MINIMUM number of PANEL KNOBS control MAXIMUM number of INSTRUMENT FUNCTIONS!
9. Exclusive "POWER ON" INDICATOR lamp!
10. Exclusive FLEXIBILITY OF CONTROL FUNCTIONS!

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GREENWOOD, MISSISSIPPI

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JUDGE THESE COMPARATIVE PHOTOGRAPHS YOURSELF!

This side-by-side comparison shows the same illustration reproduced both in 2" and 1" size. It portrays the demodulated output of the SUPREME Model 580 Signal Generator, obtained with a SUPREME 2" Oscilloscope which contains an actual 1" size tube (not a magnifying arrangement). Carrier frequency 600 kilocycles amplitude modulated at 12 cycles. Oscilloscope made with vertical plates connected across demodulator, static load resistor of superheterodyne receiver. Judge for yourself which is clearer, more distinct, and which will give a more accurate reading. You'll place your vote for the 2" size!
A FREE LESSON
SHOWED BILL HOW HE COULD
MAKE GOOD PAY
IN RADIO

I CAN'T FIND OUT
WHAT'S WRONG-
GUESS I'LL MAKE A
POOR FOOL
MYSELF
WITH MARY

HERE'S THE TROUBLE, BILL, IN THE
FIRST PLACE, I LEARNED THAT TEST EVEN BEFORE I
STARTED TAKING THE COURSE.
BILL, I'VE SEEN THEIR ADS.
I'VE SEENdeer-THAT TEST -- HEY, THAT
AD'S FREE, I CAN GET IT IN A
FREE LESSON WHICH THE NATIONAL RADIO
INSTITUTE SENDS YOU WHEN YOU MAIL A
COUPON FROM ONE OF THEIR ADS

HELLO BILL-- WHERE I've
BEEN LATELY--
AND WHERE DID YOU
LEARN ANYTHING
ABOUT RADIO?

HELLO JOE-- WHERE I've
BEN LEARNED--
AND WHERE DID YOU
LEARN ANYTHING
ABOUT RADIO?

I'VE BEEN STUDYING RADIO AT HOME, BILL...
WITH THE NATIONAL RADIO INSTITUTE.
YOU OUGHT TO TAKE THEIR COURSE.
I'VE GOT A GOOD RADIO JOB NOW. LET'S MAKE
A GREAT DISTURBANCE TEST-- STARTING WITH
THE AUDIO OUTPUT STAGE--
AND TESTING EVERY STAGE
RIGHT BACK TO THE
ANTENNA. LISTEN FOR
THE CLIMBS WHEN I
TAP THE GRID LEADS

BILL, YOU'RE ALWAYS
FOOLING WITH RADIO--
OUR SET WON'T
WORK-- WILL
YOU FIX IT?

I'LL TRY, MARY,
I'LL TAKE IT
HOME TONIGHT

YES, I WILL SEND YOU MY LESSON
ON RADIO SERVICING TIPS
FREE TO SHOW YOU HOW PRACTICAL
IT IS TO TRAIN AT HOME
FOR A GOOD RADIO JOB

I HAVE TRAINED MANY MEN TO START
A FULL TIME
RADIO SERVICE BUSINESS
WITHOUT CAPITAL.

Do you want to make some money in a hurry that is real money? It's possible for you to learn this business of making radio repair and service easily, quickly and profitably. A craftsman who can quickly make and fix good radios is worth his weight in gold. Wherever you go, you can increase your income and make real money. You can hear your wages on the radio circuit and the news media.

Many Radio Experts Make
$50. $100. $150 a Week
Radio broadcasting stations name numbers; operators, station managers and up to $2,000 a year. More than 2,000 full time Radio service jobs pay as much as $250 to $400 a week.
Full time Radio service jobs pay as much as $350 to $500 a week. Radio service jobs and operate their own full time or part time Radio repair and service business. Build many radios and install them in houses, there's no end to your earnings. After a few years of experience, you can make $1,000 to $2,000 a year. Build radios and operate own full time or part time Radio repair and service business. Build many radios and install them in houses, there's no end to your earnings. After a few years of experience, you can make $1,000 to $2,000 a year.

Many Make $5. $10. $15 a Week
Extra In Spare Time

Practically every telephone exchange needs a good spare time repair man.

Many make $5. $10. $15 a week extra to work on a free time basis.

You'll find that the business is very promising.

MAIL THIS NOW

J. E. SMITH, Pres., Nat'l Radio Institute
Dept. 76X
Washington, D. C.

J. E. SMITH, President
National Radio Institute

MAIL THIS NOW

J. E. SMITH, President
National Radio Institute

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

Name
Address
City
State
Zip

Please Say That You Saw It in Radio-Craft
HUGO GERNSBACK, Editor-in-Chief
C. W. PALMER C. P. MASON
Technical Editor Associate Editor
R. D. WASHBURN, Managing Editor

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THE AUGUST TELEVISION NUMBER

Whether or not you are interested in the newest television ideas here and abroad, we are sure you will want to read the many articles on radio reception, electronics and public address in August RADIO-CRAFT. Although this issue is our annual Television Number it also will contain articles on many other topics.

Read about—
A New Television Advertising Sign
A Cathode-Ray Aviation "Safety" Loop Antenna
A 2-Tube Carrier Interphone
—in August RADIO-CRAFT.

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OF VOLUME 7 OF THE OFFICIAL RADIO SERVICE MANUAL
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Here are the highlights of VOLUME 7
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The OFFICIAL RADIO SERVICE MANUAL (Volume 7) is being published in three installments—one installment being mailed every month to subscribers.

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This new Manual will be sold on the deferred payment plan. Complete details of this "as-you-compute-your-own-manual" plan appears in coupon.

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Is sent to you every month. Each installment will never be less than 150 throughout the year.

MANUAL OF OVER 1,800 PAGES
The total number of Service Data pages which you have received during the year exceeds any other service guide published.

CUMULATIVE INDEX EACH MONTH
The index accompanying the first installment lists all sets which appear in that section; the index mailed with the second installment lists both the first and second installments, and so on. You obtain the previous index and use the new index sent with each installment. With the final, twelfth installment, you will receive the complete index in the form of the Master Index which you receive will cover not only the set data you received during the entire year's monthly service (which constitutes Volume 7), but in addition, the sets listed in every GERNSBACK OFFICIAL RADIO SERVICE MANUAL since 1931.

OVER 3,000 ILLUSTRATIONS
The largest compilation of complete wiring diagrams, schematics and charts ever included in a single volume of an official service manual.

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Many wiring and schematic and other servicing diagrams will be included in Volume 7 than in any other Manual. At least 1,200 different models will be covered.

ALL FRESH MATERIALS—NO RENASH
And, most important, there will be no duplication of any material. In Volume 7 you will find material which has never appeared previously in the first six volumes.

MANY 1938 MODELS TO BE INCLUDED
At the end of Year's service 125 members, subscribers receive service data and diagrams on many advanced 1938 models. This material will be added at the back of this Edition of the MANUAL.

NEW SERVICE DATA EACH MONTH
This new plan requires you to buy your possession service data as released. Previously, the material was a one year or more, with most intervals data on older; receivers never before published in any other of the Gernsback Manuals, will be included in Volume 7.

COMPLETE SERVICE DATA
Data includes such valuable information as T. P. peaks, operating voltage, alignment procedure, trouble and tube tests, all sets, all parts; final highlights, all sets, all parts, and other really important service hints.

SERVICE DATA AND DIAGRAMS
NOT LISTED ELSEWHERE
A considerably large portion of the data appearing in the monthly installments will not be found in any other radio service Manual...at least not for some time to come. This is an outstanding advantage of this new plan.

SIMPLE TO INSERT EACH INSTALLMENT
You literally "plug" them in—an one installment on the first of the month, the second, and so on—presupposing the map numerically, alphabetically or otherwise. You receive the binder and with one simple motion, slip the entire group of pages over the binding mechanism. You do not remove the pages themselves, they stay in the binder for good. We've done all the filing work for you already. That's all the service data (for new installments) does the job. This index shows a glance where any required information can be found.

EQUIVALENT TO TWO REGULAR SERVICE MANUALS
Since the sets received are manufactured during the latter part of 1937, and early in 1938, the second year (starting April, 1938) of this monthly service will begin with sets manufactured during those years.

RADCRIFT PUBLICATIONS, INC., 99 HUDSON STREET, NEW YORK, N. Y.
WEN CLOCKS first were made, several centuries ago, they were constructed mainly of wood and most of the wheels as well as almost everything else connected with the clock, outside of the heavy lead weights, was also wooden. Such clocks had few parts and consequently any bright young man who knew something about mechanics had little trouble in repairing such clocks. But clocks kept on getting more and more complicated, at the same time becoming smaller in size; no ordinary watchmaker of olden times could possibly take such a watch apart and put it together again, much less repair it, intelligently. Finally, when we have as we do today a watch which is smaller than a dime and which the ladies wear on their finger rings, it is easy to understand that only an A-1 watchmaker could possibly service and repair such a timepiece where it takes a good magnifying glass to even see some of the exceedingly fine pieces of its mechanism.

This parallel can be used in good stead in the servicing industry today. There was a time when any bright youngster with a pair of pliers and a screwdriver could service a radio set because after all they were still rather crude. But radio sets, the same as fine watches, have traveled on a parallel course of evolution.

Thus we find that radio sets are becoming more complicated every month. If you look at the underside of a chassis of a 1937 model radio set, it immediately becomes apparent that the old-time repair man could no more service, intelligently, such a radio set than a blacksmith could repair a ladies' wristwatch. Every available fraction of an inch is literally crammed with radio parts which themselves are getting smaller as time goes on. There is a bewildering array of colors stamped into the radio parts and often an equally bewildering array of colored cabling of the connection wires. Variable condensers, potentiometers, and other moving parts are built in such a manner that it takes an expert mechanic to handle them. Then we have the new dials, fearfully complicated in many ways, not only as to mechanisms but they are lighted by means of various electric pilot lamps, further complicating the radio set. Other sets with remote control call for still greater mechanical ingenuity and for still greater precision in workmanship.

I could go on at length to mention all of the complications and the great complexity of the modern radio set, but it all brings us to the same conclusion, that is, the modern radio set can no longer be serviced by a novice or even by a second-grade Service Man. It takes more than an ordinary radio man to do the modern radio service. He must not only be an expert in radio, but he must be a good mechanic as well. He must know something about physics, and he must be a judge of the various materials which go into the manufacture of radio sets. And frequently, it happens that even a good Service Man must call in his specialist trying to properly and intelligently service a modern radio set. One may be an expert in radio, while the other may be a mechanical expert, and often both join in the labor when the set is in the shop, in order to properly service it.

And let no one think that radio sets are becoming less complicated. Neither watches, automobiles, nor typewriters became simplified as time went on, all became more complex, all more difficult in servicing, with each succeeding year. You may therefore expect radio sets to continue getting more complex as time goes on because more demands are made upon radio sets now than ever before. Only a few short years ago, people knew nothing about tone control, short waves, automatic tuning, finger-hole-dial tuning, etc., whereas most modern sets have these improvements and many others besides. The sets of tomorrow will be far more complex and even the best scientific prophet cannot foretell how far this development will go. Thus, for instance, one of the adjuncts which will surely be added in the near future to our radio sets will be the radio applause or radio voting feature, whereby it will be possible for station owners to know how many sets are either on the air tuned in to their station or how many are voting for a certain radio program.

What has all of this to do with servicing? Simply this, that as time goes on servicing will not be the cinch it was years ago. It will call for radio-mechanics of the highest order, and this also fortunately for the radio servicing industry spells the death knell of the radio "gyp artist, who could repair a set for fifty cents." Unless the modern radio Service Man is well-equipped with instruments, he will be afraid to service a complicated radio set for fear that he will not be able to repair it at all. Of course, it is possible that we will always have that type of petty-radio larceny man, who when called in to service a radio set finds that the aerial wire has been disconnected from the binding post of the set, and he charges two dollars for some imaginary trouble. Or his brother in petty crime, who tells his customer that all of the tubes are blown out, when as a matter of fact there is nothing the matter with them and perhaps only one of them has a bad contact.

I believe the time will come when no radio owner will be foolish enough to trust his set to any one unless he is generally known to be thoroughly reliable. Good Service Men will not be worried about the increasing complexity of radio sets because they have learned through long experience how to handle any situation that may arise. As for radio service gyps, we believe that their days are counted and it will not be long before they are automatically eliminated.
THE RADIO MONTH

MEMNOSCOPE—AN ELECTRICAL BRAIN

An oscilloscope, a camera (the two units combined constituting an oscillograph) and a peculiar motor-driven commutator having 147 separate segments each of which forms a tiny condenser were used, last month, to demonstrate the possibilities of making electrical devices “remember” electrical currents, in very much the same way as the human brain remembers.

The device, called the Memnoscope, was developed by the Westinghouse Research Labs, for recording trouble in Ignitron tubes which convert A.C. to D.C.

In action, the commutator of the Memnoscope is coupled by means of a coil to the circuits from the Ignitron. The commutator is revolved at a fast rate, and thus, each segment retains an image of a small portion of the current picked up in the coil, until it reaches a brush which draws off the charge. This charge is used to open the shutter of a camera focused on the end of a cathode-ray oscilloscope. Any failure of the Ignitron can thus be seen.

NAVY DEVELOPS “RADIO SPY”

In a request before a Congressional Committee for appropriations last month, the U.S. Navy disclosed the development of a “radio spy” by which enemy warships can be located or tracked over long distances at sea.

Rear Admiral Harold G. Bowen, engineer-in-chief of the Navy, declined to make public details of the equipment—but it is suspected that the system uses micro-waves which are reflected by the distant vessels.

Flash!—While on the subject of secret inventions, it has been learned from a reliable source that a certain West Point Cadet has invented a means by which the entire short-wave spectrum can be blanketed with interference during war times, to prevent the use of these waves by the enemy for communicating purposes. The system has been tried on a small scale at the West Point radio station with fine success!

THE RADIO REFRIGERATOR

A kink in merchandising was introduced, last month, with the introduction of a combined electric refrigerator and radio receiver, by Crosley.

The new unit contains the usual white refrigerator box, with all its gadgets and refinements—but the top, which is entirely separate and simply rests on the top of the refrigerator proper, is fitted with a 5-tube A.C. broadcast band receiver.

It has been said that 60 per cent of the housewife’s time is spent in the kitchen, and from this statement the power of this refrigerator-radio scheme as a sales argument can be realized!

BROADCASTING FLASHES

In a series of conferences with the Treasury department, a plan drafted by F.C.C.’s Commissioner George Payne to tax broadcasting stations on the basis of their power was “whipped into shape” for the House of Representatives.

Observations at the Mount Wilson Observatory indicate that the energy which causes fade-outs on the short-wave bands which has been attributed to Sun spots, comes from the Sun with the speed of light—or in other words, takes about 8 minutes to reach the earth.

The W.E. Co. placed a new program amplifier for radio stations on the market. The new unit features an automatic volume limiter (a type of reverse A.V.C.) which prevents over-modulation.

The Government of India, in installing new broadcasting stations in Calcutta, Delhi, Bombay and Madras decided to use 10 kw. short-wave transmitters because of the very bad static conditions on the broadcast band in that part of the world. To satisfy those few people using broadcast band sets, small 200 W. transmitters are re-broadcasting the short-wave signals—which is the reverse of the conditions in the U.S.

CRYSTAL MIKES CHECK VIBRATIONS

A new use for piezo crystals was announced last month by a well-known maker of these units. By mounting specially cut crystals on a propeller blade and using very fine leads with slip rings for connection, the torsional and bending strains due to vibration of the blade in motion can be detected.

Thus radio promotes airplane safety.

Above, piezo crystals record strains and torsions in airplane propellers. Left, the housewife will appreciate this addition, of a 5-tube radio receiver “section,” to the electric refrigerator.
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.

**TELEVISION IN THE NEWS**

CBS, not to be outdone by the efforts of NBC in the television field, made application to the F.C.C. last month, for permission to construct combined television and sound transmitters at the top of the CBS building in New York. The station will equal the power of the television station now being constructed in Paris—30,000 watts.

As a direct result of the decision to use the Marconi system exclusively, in England, the price of television sets has been reduced by 30 per cent, including free installation.

R. A. Watson Watt, head of the Bawdsey Research Station of the Air Ministry in England announced the discovery of a new set of reflecting layers over the earth which reflect ultra-high frequencies. These layers are responsible for the "ghost" images which have been seen as "echo" pictures in the television screens of experimenters.

American Air Lines announced the successful use of "facsimile" devices in their ships—predicted in these columns.

RCA started back on the air with improved 441 line images with a promise that the experiments would continue well into the summer—good news!

Berlin is now enjoying (7) television operas.

**AIR BEACON "MARKERS"**

As an added safety factor for pilots riding radio beams, the Bureau of Air Commerce began, last month, installing ultra-short wave "fan" type markers at certain distances from the major landing fields. These marker stations send out warning signals which tell the pilot how far he is from the landing field.

**PUBLIC ADDRESS IN SPAIN**

An interesting use to which a sound truck is being put in the bloody civil war in Spain was recounted in an issue of the New Masses last month.

The story tells of the Moors stationed behind a heavy stone barricade in the Reel lines hearing the voice of one of their fellow-tribesmen telling in stentorian tones how they had been deceived by their officers—how the money they had received was worthless and the promises of independence for Morocco, false.

The voice was heard from a giant sound truck back of the Loyalist lines, which picked up the transmissions of radio station EAQ some 5 miles back of the lines and made the voice audible to the soldiers in the Rebel ranks.

The transmissions of EAQ on 9.4 megacycles have been heard over the entire civilized world.

**TRUCK RADIO A PAYING LINE**

Although a few auto trucks were fitted with the usual type of automobile radio sets within the past few years, there has been a notable lack of interest in this source of sales.

Within the past month or so, truck makers—notably Reo—have become conscious of the possibilities of added income from the sales of radio sets with their trucks. As a result, an entire line of Reo-Philco truck radio sets and equipment have been introduced, including special aerials and remote control heads to fit the dash boards of the new lines of vehicles.

Radio Service Men should investigate this new source of installation and repair work.

(Continued on page 38)
A DELUXE SERVICE SHOP ON WHEELS

A fleet of special trucks in Switzerland handles the service and public-address needs of over 100,000 customers.

HERMANN STEINER, JR.

IN SWITZERLAND you meet everywhere, the blue Steiner-Service cars. They are the visible sign of a standard service organization which covers the whole country. These cars, one of which is shown here, pictorially, inside and out, are used by the Steiner service organizations, officially tested by experts, who check upon radio installation, deal with receiver breakdowns and give technical advice to the listeners. Besides that, this great organization maintains modern-equipped service workshops in every big town.

The number of clients of this organization now numbers about 100,000 of the 400,000 licensed listeners in Switzerland. This amazing result—which American technicians would do well to analyze—is due to an ingeniously operated subscription system for radio sets, including all servicing.

These new service cars are equipped as a mobile radio workshop, and in addition each one possesses a fine microphone and amplifier system for large P.A. work; a crowd of 100,000 and more persons easily may be covered. Every car has its own fixed district in which the clients are regularly visited—not only to effect repair but also, by periodical inspections, to avoid breakdowns.

At this “movable workshop” the clients' sets are thoroughly tested and cleaned. Tubes are tested under operating conditions and weak ones immediately replaced by new ones.

TECHNICAL DATA

The Steiner Service and Public Address Car presents a complete radio workshop.

The instrument which most attracts public attention is the tube tester. This tester is furnished with 80 tube bases on which we are able to test every tube today in use. The tubes are tested under the same conditions as they are in the factory. Shorts, loose contacts, low emission, etc., and other defects are discovered very easily.

To be independent of the daily broadcast hours, the car carries a small service oscillator which covers the entire wave range from 14 to 2,500 meters. With this instrument we test every set for sensitivity, selectivity, amplification and dial alignment.

The P.A. system, which has an undistorted output of 100 W., is placed at a 3rd table. Inside this table is an electric turntable with crystal pickup. Also on this table is a commercial Rex Medium receiving set for reception of every broadcast program. In a corner is the requisite assortment of phone records; and a crystal "Mike." Additional test equipment on the table includes a portable tube tester, a universal volt-ohm-ammeter, and a portable interference finder for checking-up reports of static and man-made noise.

On the car roof we use 4 heavy-duty 30-W. P.A. speakers. These reproducers may be turned in any desirable direction. On one of our tests we covered a distance of over 2½ miles; every word was perfectly understandable.

Each service car has its own small power plant. The current delivered, for the workshop and for illumination, is the same as that used in every town—220 V., 60 cycles A.C. Dual storage batteries, each rated at 200 A.H. at 24 V., are used to drive a 1.1 kw. rotary converter that delivers single-phase A.C. power at a potential of only 15 V. This voltage is stepped up by means of a transformer, to optional values of 110 to 220 V. To charge the storage batteries we

(Continued on page 11)

RADIO-CRAFT for JULY, 1937
THE SERVICE MAN TAKES A HOLIDAY

Lakes, rivers and ocean beaches may be profitably patrolled by Service Men with suitably equipped boats.

R. D. WASHBURN

Unlike the case celebre of the sailor on vacation who goes rowboating, the radio Service Man who, on his time off, undertakes to repair radio equipment at least has some monetary return to show for his industry.

But Radio-Craft goes a step further and makes the task really enjoyable in the suggestion, shown on the cover of this magazine and in the reproduction at upper-right, by combining the recreation of sojournng near summer resorts where boating is a feature, with the profitable service of extending to these boat owners the courtesy of radio repairs right at the respective private boat houses, yacht clubs, etc.; and, even out on the water if necessary.

Radio-Craft will be greatly interested to hear from Service Men who may wish to put into practice this idea for bolstering the old bankroll.

The radio technician who aspires to a profitable boat-radio repair service must be prepared not only to service innumerable types of radio receivers in all stages of repair and dis-repair but also should keep a weather eye open with a view to selling the boat owner on the idea of obtaining a more modern and effective radio set; and the possibility—or, in fact, probability—that his friends also will want to have a radio receiver installation.

The servicing tools required for a boat-radio repair service are identical to those required in servicing car-radio receivers.

However, the marine radio man will find that his average service charge will be greater than the customary level "on land" due to the fact that dampness raises havoc with radio equipment not specifically designed for marine use; and salt water in particular will exhibit pernicious effects that only the clever and painstaking radio man will be able to rectify.

NEW PROFITS FOR THE AUTO MECHANIC IN RADIO INSPECTION

Here is the other side of picture—"the auto mechanic should also be the radio mechanic"—for consideration.

A. R. PERONG

It is a warm spring evening. You're out driving and stop at the red light.

Listen! From almost every car comes music. The auto-radio is here—and here to stay. Every day sees more and more cars equipped with them.

These radio receivers need regular inspection and tune-up, just as much as any other part of the car's electrical equipment. From the moment of its installation—a fact which many automobile owners do not know—the auto-radio is inextricably tied up with the entire car. It is not a separate unit but an integral part of the car's electrical system, which should definitely be serviced along with the rest of the car by a man with experience in automotive ignition and electrical systems.

A garage today that features one-stop radio and ignition system service, by experienced, dependable men, will save the car owner time, expense, and build up a big new source of profit for the garage.

The most persistent offenders against perfect radio performance are not in the radio set but in the car itself. They are various forms of mechanical vibration. Such things as loose brake rods, oil lines, gas lines, cabling to the engine compartment, loose body, chassis and engine mounting bolts are all contributors to noises and disturbances heard over the radio system. They are all faults that a radio service station could never find, much less correct.

The entire electrical system must be right, too, to insure good radio performance. Distributor rotor and contact points, generator brushes, spark plugs and all light wiring, starting motor cables, generator cables, dash wiring and stoplight switches must be checked and put in perfect condition. A search must be made for leaky high-tension cables and loose connections in the ignition system. An examination must be made to see whether paint or the like prevents good ground connections being made between the various parts of the automobile that form the ground connection. These poor connections will not be apparent in the operation of the car itself, as the voltage applied across the connection from the battery is enough to make sufficiently good contact for that purpose. However, when a radio receiver is installed in a

(Continued on page 39)
EVERYMAN'S
"SAFETY"
CAR-RADIO SET
FOR CUSTOM TRADE

A 6-tube auto set which consumes only 4 A.
from the battery and is "button" tuned! A
new series of low-drain tubes is used.

C. W. PALMER

A CAR-RADIO receiver for custom sales must have
everything that the usual commercial auto set has,
and yet have other characteristics or advantages
which make it attractive to the class of buyer who
wants something different.

For example, it must have all the sensitivity, volume and
quality that is expected from a good manufactured set with
other features such as delayed A.V.C. and so forth. Also, it
must be modern in appearance and be fitted with the latest
in tuning controls.

The set described here is designed with two major
thoughts in mind. The first is economy of battery current.
This is an important consideration if the set is to be used
much, especially in view of the heavy over-loading which the
car battery and generator are inflicted with in modern cars.

The second major consideration in the design of this set is
safety. The car set must not absorb the attention of the
driver. If it does, it is liable to become a menace to safe
driving, especially in traffic.

DESIGN CONSIDERATIONS

The factor of low battery consumption is answered by the
application of an entirely new series of 6.3 V, tubes not yet
used in any commercial car set and which require only
0.15-A. of filament current instead of the usual 0.3-A. In
addition, the battery supply utilizes a type of rectifier which
does not have a hot cathode, thus effecting another economy

Fig. A. The driver does not have to look at the set!

Fig. C. The front of the chassis showing parts layout.

Fig. 1. Complete schematic diagram of the set and the button tuner unit with the values of all parts indicated.
of battery drain. As a final blow to high current, a magnet (high-coercive permanent-magnet) speaker with a fixed field magnet is used. These features help cut the total battery drain from 7 or 8 amperes required for the usual 6-tube car set to slightly less than 4 amperes. And this economy is accomplished without affecting the tone quality, sensitivity or gain of the set in any way.

The factor of safety in driving is answered in a novel way, by the application of a new type of tuning control which permits tuning in 5 local stations by simply touching buttons on a small, neat unit which either straps onto the steering column or mounts on the underside of the dash. This button tuner relieves the driver of any necessity to look at a dial as the buttons can be picked out instantly by touching them. Also, since the circuits controlled by the buttons are carefully adjusted in the alignment procedure, when the set is installed, this button tuner provides a mechanical equivalent of automatic frequency control—without the necessity of adding any additional tubes or parts to the set itself.

You have only to press the button lettered (depending upon location), let us say, W.L.W., and presto, the Crosley program is heard!

An examination of the circuit in Fig. 1 will show the essential facts about the receiver. Tube V1 is an R.F. preselector stage using a type 6S7G tube—similar in characteristics to the 6K7G. This is coupled to the frequency converter—a 6DBG which is similar to the 6A8. The I.F. amplifier stage uses another 6S7G which is coupled both in input and output, with high-Q iron-core transformers, thus putting the major portion of the selectivity and gain in the I.F. amplifier where it belongs. A frequency of 175 kc. was chosen for this amplifier to further increase the I.F. amplification, and while the choice of this low frequency is attended with certain disadvantages, the resulting high gain and stability more than offset the disadvantages.

The I.F. amplifier is followed by a diode detector and high-mu triode A.F. amplifier—a 6T7G. This tube is similar to the type 7S tube, with the exception of a slight reduction in the triode gain, thus permitting a wider grid swing before grid current flows, with its accompanying distortion.

The 6T7G is followed by a 6AB6G direct-coupled triode which is similar to the 6B5 in design but having only 0.5-A. filament drain and an output of 3.5 W.

This completes the tube line-up with the exception of the power supply which is obtainable ready-to-install. This power supply uses a simple vibrator of the "parallel" type which has good life characteristics. A type 024 metal tube is used to rectify the high voltage from the rectifier. This tube is similar to the old Raytheon BH and BA cold-cathode rectifiers, requiring no filament current.

An "A" line filter is mounted in the set between the battery line and the filament and plate supply. This prevents ignition interference from entering the set through (Continued on page 44)

Fig. 2. Chassis and cabinet forming and drilling instructions. The drilling must be changed if the specified parts are not used.
ASSEMBLING A SIMPLE CRYSTAL SET

Beginners in radio will appreciate the simple and straightforward description of this radio set.

N. H. LESSEM

Once again it's the crystal set! Like a bobbing cork on a frothing, tumultuous sea, it persistently breaks through the turbulent waves of radio evolution to ride, mockingly, each crest. Multi-tube, complex radio receivers and the hundreds of modern new-fangled radio gadgets do not in the least detract from its popularity. In fact many old timers revert to it occasionally for sheer relaxation from the present furious gait of radio.

Yet, for more than any other reason, the crystal set owes its survival to the fresh class of beginners which crops up each year. For them it is the starting point in radio—the first stepping stone. To them it demonstrates, in a simple, easily-understood manner the fundamental theory of radio.

The crystal set described here is novel in that it is a modification of a simple, commercially-available unit—a "wavetrap." The beginner, therefore, for his first set at least, need not be bothered with the construction of the actual components. Besides the wavetrap, the only other parts necessary are: a 0.006-mf. for "0 point double-0 six" (Continued on page 36)

CORRECT PROCEDURE FOR THE SERVICING BEGINNER

Having been in a position to observe the professional actions of many Radio Service Men for a number of years, the writer believes that the following information will greatly benefit those who feel they are not reaping as much of the harvest as they deserve.

To the busy Service Man, doing the job correctly in the least possible time means money in his pocket. Putting in 2 hours on one job when it normally should be done in 30 minutes, most decidedly represents a cash loss. On the other hand, a completed job that is not 100 per cent correct may mean a dissatisfied customer and a future loss of business. It all adds up, so let's take a few jottings from our notebook and see if we can give some of you fellows a lift. Remember, if you only find one useful idea in this whole article, it will probably mean future dollars in your pocket.

ALIGNING PROCEDURE

First a word on aligning procedure. There is a right way and a wrong way and in case of doubt always use the set manufacturer's instructions—he designed the set and knows how it should be done. One thing many men do in— (Continued on page 48)

Fig. 1. A—picture diagram of the set; B—schematic circuit; and C—phantom view of the interior appearance and the crystal detector.

Fig. A. Two views of industrious students of radio servicing at work in the shops of a large radio school.

Radio-Craft for July, 1937
MAKING THE RADIO-CRAFT SIMPLIFIED CARRIER INTERPHONE

A carrier 'phone plugs into the electric outlet—requires no inter-station wiring!

PART II

In PART I the design of this unit was described in some detail—we will now proceed directly with the construction.

The chassis is made from a piece of aluminum or sheet steel 6½ x 8 ins., front and rear drops being folded down along the 8-in. length to raise the chassis 1½ ins. The ends remain open.

The cabinet is a standard job readily available to the trade. Both the cabinet and the chassis are first drilled and pierced to layout drawing specifications.

Mount the speaker, with its output transformer above it, in position on the front panel as shown. Mount T1 to the left, the phone jack to the right, the send-receive switch and volume control beneath the jack and T1 respectively. Below the switch and control mount the "send" and "receive" indicating pilot assemblies, positioning the latter so that the terminals extend out toward but do not touch the back-folding side lips of the panel. Secure 2 right-angle supports with 2 in. legs from the nearest "five and ten cent" store and fasten these to the panel so that the chassis, when bolted to the free legs, will just clear the bottom plate of the cabinet.

Mount the various other components on or below the chassis, with I.F.T.1 positioned so that it will be near the "send-receive" switch when the chassis and panel are bolted together by means of the angle supports. One R.F. choke will be above chassis, one below. The filter choke Ch. will be above chassis, one below. The filter choke Ch. will be above. Position sockets for short leads to associated components, secure them carefully with retainer rings, then fasten the chassis to the panel—remembering to keep a space of about 1 in. between the 2 metal units so that the pilot light sockets will have ample clearance and so that the microphone speaker "pot" will not extend too far back and prevent installation of the tubes which are to be positioned behind it.

Refer to the layout drawing for tube placement and then wire-in all parts. No hard and fast rules suggest themselves here. Just remember that the chassis is not tied directly to "B minus," that condensers and resistors should be tied-down carefully to prevent their moving about and making unwanted contact, that we haven't much room to "play around" in, that a lot of connections may be made right at the send-receive switch and thus do away with the necessity for some otherwise long leads, that both "B minus" and "B plus" should be bypassed to chassis, that leads to the volume control and the control-grid of the 6F5 voltage amplifier should be shielded.

TESTS AND ADJUSTMENTS

Switch to "receive" and turn on the A.C. line supply by means of the switch on the gain control, R6. The green pilot should indicate an OK filament continuity with tubes, of course, in place. Test for a "B" voltage of about 110 at the input to Ch. and a filtered supply of something less than 100 at all plate and screen-grids. Set up an external and modulated signal at the desired operating frequency and tune I.F.T.1 for maximum level as indicated by strongest speaker reproduction. The modulation should be clear and distinct pushing well out and above any super-regenerative background noise. If it does not come out clearly and if simply a carrier is heard, check for detector circuit oscillation by tapping the control-grid terminal of the detector or one lug of R.F.C.1. A loud "plunk" will indicate oscillation and

(Continued on page 39)
HOW TO MAKE A HI-FI P.A. AND "UNIVERSAL" RADIO TUNER

Many readers have requested this construction data on a tuner for P.A. work, etc.

THE TUNER we are about to describe was designed to be versatile in its applications. Some of the different classes of service in which it may be used are given in Table I.

A study of the schematic diagram, Fig. 1, will show some interesting details. The superhetredyne circuit is used, because of its well known advantages. Almost equally as well known is the fact that superhet. sets can give plenty of headaches to the home-constructors, if not properly designed and constructed.

However, another glance at Fig. 1 will show that our circuit was stripped to the bare essentials for simplicity and ease of wiring. The tuner is designed to cover only the full broadcast band, plus a small part of the police band. No short-wave, no A.V.C. (nor need for it on the hi-fi locals), no A.F.C. and no frills whatever were included.

THE SIGNAL SEQUENCE

For the sake of pointing out the circuit features and parts, let us trace the path of a signal throughout the system. Starting at the antenna post the signal is applied to the high-impedance antenna coil L1, and also to one side of the volume control potentiometer. The signal is then applied across the tuned circuit of the 6K7 and amplified through the R.F. transformer, L2. The voltage gain in this R.F. stage averages over 50.

The amplified signal is next applied to the top cap (1st-det. section) of the 6A8 converter. The oscillator tuning section of the 6A8 operates at a frequency which is always 466 kc. higher than the received signal. Both frequencies are mixed, and then applied to the plate of the 6A8, where the tuned primary of the high-gain, iron-core, I.F. transformer selectivity differentiates the beat intermediate frequency from the others. This transformer uses air-tuned trimmers. The gain is about 80 from the 6A8 plate to the 6J7 control-grid.

So far, it can be seen that the overall selectivity is good enough to separate most of the moderate-power stations, without attenuation of the higher frequencies. The signal is demodulated by the 6J7 biased 2nd-det., which has very desirable characteristics for this use. The constants chosen for the demodulator are such that they combine high sensitivity and high A.F. output for a given R.F. input. The demodulator stage gain is 110.

The plate circuit of the 6J7 has a shielded R.F. choke
to eliminate R.F. currents in the output. A tone control is placed in the 2nd-det, output to subdue static and vary the tone quality on certain types of music. The output tip-jacks are used either for headphones or connection to any audio amplifier.

As return for a moment to the volume control; the cathode of the 6K7 connects to one side of the potentiometer, R1, the center arm of which is grounded and the remaining arm connects to the antenna post as was mentioned above. This type of control is very effective because it takes the place of two separate controls, one in the cathode circuit and one across the antenna coil.

The power supply was especially designed for this unit. It consists of a small power transformer, which supplies 250 V. at 25 ma., a filter choke of 30 hy. at 25 ma. and 3 electrolytic condensers of the midget metal can type. The rectified A.C. is so effectively filtered that no sign of hum is present in the headphones.

An A.C. receptacle is placed across the power transformer winding for convenience. A dual line filter condenser is also connected across the A.C. line to reduce interference and noise. Connecting a single-pole, double-throw snap switch would enable the builder to use the A.C. line as an antenna or as a line filter, at his option.

Other circuit features are: the use of resistor condenser filters in the screen and “B plus” leads to prevent circuit coupling and insure stability and high gain.

The performance of this tuner is amazing, considering that only 4 tubes are used. For example, the A.F. output at the tip-jacks is usually high enough to drive a magnetic speaker at room-volume, from most of the local stations, here in New York City. As a further example, the detector output is sufficient to drive a single 6F6 to full output on all but the weakest signals.

It would be well to point out that there is a good possibility of overloading the first audio grid following the 2nd-detector when using any high gain amplifier with the tuner. This is so because of the fact that before the detector reaches its own overload point it is developing in the neighborhood of 17 V., A.P. This, obviously, is far too great a signal voltage to apply to a 6F6, for instance. The input circuit of the amplifier should therefore contain a variable gain control to regulate the input.

Hi-fidelity reception in our tuner is obtained in the simplest manner possible, without moving parts or switches. When properly aligned, the set just has enough selectivity to allow the side-band frequencies up to 6,000 cycles to get through. At the same time, however, the sensitivity is very good. The writer listened to KFI, Los Angeles (640 kc.), on headphones with a slight amount of interference from WSM, Nashville (680 kc.), on the adjacent channel. WEAF (660 kc.) interfered slightly with WSM. A total of 68 stations were tuned in during a 2-hour tryout, at night.

Fig. 2. The rear view of the chassis of the tuner.

Layout details

As can be seen from the photographs, the tuner is compact without being crowded. The parts were laid out so that all “hot” R.F. leads would be very short. For instance, the lead from 6A8 plate to “P” lug on the I.F.T. is barely 3/16 in. long. The 3 coils are mounted underneath the chassis for several good reasons. The most important being that they are, in effect, doubly shielded when mounted this way.

The blank chassis specified should be drilled according to layouts given in Figs. 2 and 3. An ideal tool for the home constructor is the socket punch and circle cutter recommended in the List of Parts. The writer used the 3/16 in. punch for several of the holes required. The larger size (1 3/16 in.) was used to punch out all the socket holes and also the openings for the filter choke and A.C. receptacle. The circle cutter is needed to cut out the 5 5/8 in. hole for the dial on the front panel. These tools are practically indispensable to the home constructor for this type of work. Check the accuracy of the holes you drill by trying each part for correct fit and position. A little care at this stage will insure a finished product of precision appearance.

The front panel should not be touched until all the parts

(Continued on page 42)
A UNIVERSAL-SERVICE TEST SPEAKER

The manager of a large radio service department tells Service Men how to make a new device that has many uses.

J. ABRAMS

A TEST unit that will be a valuable asset to any radio repair shop is here illustrated and described for the practical Service Man.

This unit is a real "universal" loudspeaker that will not become obsolete. It is inexpensive to construct and can be adapted to almost any radio receiver made—or to be made!—regardless of the type or number of speakers it uses (or will use). An interesting feature is the extreme simplicity and flexibility which allows it to be used for countless other testing procedures. It can be employed for testing speakers, leakage in electrolytic condensers, insulation breakdowns, defective windings in A.F. transformers and intermittent shorts in R.F. and I.F. transformers. Other tests that can be performed with this instrument will be described later in this article.

Loudspeakers are easily damaged. Ask any radio man. The usual sad story, accompanied with many tears, is that an unexpected bump in the road merely scrambled a few chassis and speakers. The result is a costly trip to the speaker repair department for new cones.

In my case as the manager of a large radio service department I needed some device to eliminate the necessity of bringing the speaker into the shop. The vision of 2 or 3 poor unprotected speakers sharing the rear seat of each service car with a few husky chassis reminded me that cones are still quite expensive.

One hole in the street or a short stop resulted in a very nice conglomeration of radio-parts hash.

Reproducer trouble being rarely encountered in ordinary service work we found that the following tests would check a loudspeaker and obviate the need of taking it out of the cabinet.

PRACTICAL TESTING

Using an ohmmeter, check the field-coil, voice-coil and output transformer for short- or open-circuits. Then, a carefully put, casual question to the customer will disclose if there was any complaint regarding any cone rattle. If the output transformer is mounted on the speaker there is no need to open the voice-coil connections to check for continuity. The application of the small voltage in the ohmmeter to the primary of the transformer will cause a click to be heard if the voice-coil is all right even if there is no field excitation. This test can be made in less than 3 minutes.

The saving of time is another valuable feature. The usual time required to remove and install a single reproducer from an ordinary cabinet is about a 1/2-hour of hard labor. Then imagine a dual-speaker receiver in one of these unraveled cabinets and throw the watch away and get a calendar.

To fully understand the method of (Continued on page 46)
REPAIR—OR, REPLACE THAT DEFECTIVE LOUDSPEAKER?

Service Men, today, to "get by" must know how to "cut corners"—financially speaking; loudspeakers afford a good example.

M. E. SWIFT

There are several good reasons why it is usually better for the Service Man to replace a defective loudspeaker with a new one, rather than attempt to repair it.

After a loudspeaker has been in service for some time and goes bad, the trouble is usually not of a superficial nature—metal chips or sand may be torn; in any case, it is often necessary to tear down and re-assemble the unit. The average Service Man has neither the time nor the tools to do this work. Replacement diaphragms, unless obtained from the manufacturer, are seldom exact duplicates of the original. They may result in performance which is far from satisfactory. Even minor repair jobs, done in the shop, such as patching a torn diaphragm with tape—seldom completely satisfy the customer; he is usually interested primarily in performance, and if shown the advantages of a new speaker over his old one, will almost always be willing to pay the difference in price.

NEW DEVELOPMENTS

Because of improvements in magnetic structure and reductions in production costs, the sales of sound equipment such as speakers are now available, at a reasonable price, that are far superior in performance to units of a season or two ago. Many fine reproducing units are constructed in such manner that the field coils can be changed without disturbing the alignment of the working parts. This results in a sizeable saving to the Service Man, since it reduces considerably the stock he must carry in order to cover the entire range of field resistances. When these speakers are purchased with universal output transformers, a further reduction in stock is realized. For most small shops 4 or 5 replacement speakers of this type will be sufficient; by having a couple of extra field coils for each on hand, almost any demand can be quickly and easily met.

When the Service Man is in a position to supply the

(Continued on page 45)

"THE CASE OF THE RESORT"—AND
OTHER SOUND STORIES

The author's Book of Experience contains valuable pages on public-address Morals.

H. M. BAYER

that little talk, and several others along the same line, we arrived at a definite, rock-ridden conclusion—The radio Service Man is extremely well aware of the fact that there is a tremendous field for the sale of sound equipment and its auxiliaries. As a matter of fact, he is tired of hearing this song played over and over again. But what he is willing to listen to, is the experiences of others—their sales and service problems and how they solved them.

The reason for this is very simple. He sells several receivers a week, and has been doing so for some considerable period (lucky boy) !; sales experience in this case came quickly and with sufficient variety to preclude the necessity for extensive external study.

However, sales of public-address installations are not made several times a week. (We speak for the average service shop.) This makes each sale a complete study in itself; only rarely can a P.A. contract be handled exactly like some other sale of the past. And so the Service Man does appreciate hearing of the experiences of others; the sales, installation, and service problems that arose and how they were solved.

(Continued on page 41)
AN EXCELLENT COIL-TESTING UNIT FOR THE SERVICE MAN

Here's a "Comparator" design, taken from practical factory data, that every radio man will find useful.

WALTER L. LYONS

The meter described in this article was intended to fulfill certain requirements in the production testing of a limited number of R.F. coils and condensers used in the radio receiver tuned circuit.

This "Comparator", as we call it in the plant, is particularly adapted to the checking of I.F. and R.F. transformers as they must operate under receiver conditions. This is accomplished by feeding an R.F. current through the coil primary which method takes into account the effect of primary impedance upon the effective inductance and relative gain, of the tuned secondary, at both ends of the frequency spectrum over which the coil must operate.

Such measurement of the R.F. coils to be used in the several stages of a receiver at the lowest operation frequency is a quick check on the tracking of these coils while the high-frequency test reveals the presence of high distributed capacity or reflected reactance which may often serve to render a coil, such as an oscillator, useless.

While "Q" and absolute gain are important items in coil design, it is often sufficient in production coil testing to obtain comparative gain readings with respect to R.F. coil standards. For this reason, the Comparator is calibrated in terms of per cent gain only. On inspecting the circuit, it will be apparent to the technician that features have been included in the design which make for the more accurate testing of antenna, R.F., oscillator and I.F. coils.

CONSTRUCTION

Figure 1 gives the placement of apparatus and important dimensions of the chassis which is constructed of cadmium-plated soft sheet iron. As Fig. 1A shows, the power transformer, supplying 6.3 V. to the tube filaments and high voltage to the 80 rectifier, is mounted on the rear of the chassis to save space and increase heat dissipation.

The oscillator utilizes a type 89 tube in a stable electron-coupled circuit comprised by C1, Cv and a universal-wound inductance L1, which has a tap for the cathode connection 100 microhm. from the ground (inside) end of the coil. These are all placed below the sub-panel in a well shielded compartment which also contains L3, a sectionized R.F. choke and C5, which serves to flatten out the high-frequency and harmonic-voltage output of the oscillator. Frequency calibration of the oscillator dial (placed on the left end of the chassis) is accomplished by beating appropriate oscillator harmonics against known broadcast frequencies, using preferably a sensitive tuned-R.F. receiver. During this calibration, the vernier, Cv, is kept at the one-half maximum capacity position, which point should be marked permanently on the chassis.

R.F. AMPLIFIER

A 6D6 is used in a standard R.F. amplifier circuit. Among other functions, it feeds the primary of R.F. or I.F. transformers under test. The voltage output of the 6D6 is jointly controlled by Pot. No. 2 and Pot. No. 4, which latter controls the oscillator screen-grid voltage.

THE DETECTOR CIRCUIT

The "heart" of the meter is the low-loss tuned circuit L2-C2-C3. This is coupled to the control-grid of the 76 tube which serves as a rugged V.T. voltmeter with a 0-1 ma. meter input.

(Continued on page 60)
HOW TO CHECK CONDENSERS WITH AN A.C. BRIDGE

A Bridge Analyzer quickly conveys to the Service Man important condenser information he must know.

GLEN H. BROWNING

All Service Men realize that a condenser fault is one of the most common and sometimes one of the most baffling sources of trouble in a radio receiver.

Intermittent open condensers have caused many Service Men to spend hours in trying to determine the reason for a sudden drop in volume. Many times, normal operation may be temporarily restored by switching “off” and “on” the receiver. While this trouble cannot always be laid to a faulty condenser it is safe to assume that in the majority of cases such is the case. As a consequence the Service Man finds it almost essential to have in his workshop apparatus that will quickly, completely and accurately check all types of defects in electrolytic, paper and mica condensers.

ELECTROLYTIC CONDENSERS

The defects commonly found in electrolytic condensers are:

1. High D.C. leakage at operating voltage.
2. High power factor, even though the D.C. leakage is normal.
3. Complete or intermittent open-circuits.
4. Electrolytic action where the lead is attached to the condenser, resulting in noise in the receiver.

(Continued on page 49)

TAMING MAN-MADE STATIC

The author answers questions, as to why? and how? of interference, in the minds of Service Men.

CHARLES GOLENPAUL

Radio Receivers, as with human beings, become more susceptible of ailments as they become more refined and therefore more sensitive. Early crystal-detector sets were so insensitive that direct electrical contact with a buzzer was usually required to test the setting of the “catwhisker.” Today, a buzzer a block away may cause a machine-gun rumble in a super-sensitive all-wave set! Hence the great problem of eliminating inductive interference at its source, if super-sensitive all-wave sets are to perform at their best.

CLASSIFICATIONS OF INTERFERENCE

There are 4 broad classifications into which interference normally falls, namely: (1) Natural static. (2) Interference originating in the receiver. (3) Interference from other stations or the neighbor’s receiver. (4) Interference caused by electrical machinery.

The first classification is one over which we have a minimum amount of control. However, it is a matter of proportion. When our broadcast transmitters were rated at a few watts, the signals could not vie with Nature’s own broadcasting efforts. The steady increase of transmitting power, together with the limitation of service areas, has resulted in a satisfactory balance between signal and static throughout the year. It is rare that radio reception is impossible. Listeners located close to broadcast transmitters can operate even when lightning flashes are visible on the horizon.

When it comes to the second classification, it is for the set designer, builder and Service Man to guard against causes of noise. A faulty condenser can give rise to no end of noise which will be blamed on static, neighbors and everything else in creation except the real cause. Likewise (Continued on page 52)

RADIO-CRAFT for JULY, 1937
OF ALL the interesting and ingenious uses to which the cathode-ray oscilloscope has been put in the last few years, none offers more room for investigation than the cathode-ray tube tester. This latter use of the cathode-ray tube shows its usefulness in characteristics on the fluorescent screen just as though they had been plotted from data taken in the most thorough fashion. Furthermore, and for more important, the actual dynamic characteristics are obtained.

**DYNAMIC VS. STATIC TUBE TESTS**

The difference between the "static" tube characteristics which represent the tube itself and the "dynamic" tube characteristics which represent its operation in a particular circuit can easily be seen by considering the effect of a grid voltage change on the plate current (or circuit characteristics) of a triode.

Increasing the grid voltage in the positive direction increases the plate current, but if the plate circuit contains a resistance load, this in turn lowers the plate voltage, which in turn tends to decrease the plate current. Thus, in general, less plate-current change will occur and the curve will be separated in 2 paths, one of increasing plate current and the return path of decreasing plate current. In a linear amplifier these 2 paths will form a perfect ellipse. Inasmuch as we are interested mainly in resistive loads, the curves shown here were all taken with a pure resistance as the plate load. In this case, a linear amplifier gives a straight line, the return path coinciding with the grid-voltage—plate-current curve.

**WAVEFORMS OF A TYPE 6CS TUBE**

Figure A1 shows a 6C5 operated as a grid-bias detector with a -6 V. bias and a 90 V. plate potential. For a reasonably large swing, the plate current is proportional to the control-grid voltage as shown by the straight portion of the curve marked X. The plate current cutoff is shown at Y, and the rectifying portion of the curve is shown at Z. For small signals in the region of Z, considerable amplitude distortion will result since the plate current is not proportional to the grid voltage over this part of the curve.

Figure A2 shows the same tube operated at -1.5 V. bias. This should have represented a class A or linear amplifier but as can be seen, only a small section of the center of the curve fulfills these requirements. Plate current cutoff is still evident at the lower-left, and plate saturation is seen at the upper-right. It is evident that for faithful reproduction of A.F. signals, both these extremes must be avoided and the control-grid swing confined to the center or straight portion of the curve.

**DATA ON A 6L6 BEAM TUBE**

Figure A7 shows the result of operating a 6L6 beam-power amplifier into a 1,000-ohm load that is slightly inductive. Changing the output transformer matching to the speaker made the load practically non-inductive as is shown in Fig. A3, but this further lowered the load resistance causing the curved characteristic as shown. This condition would result in considerable 2nd-harmonic distortion which is quite disagreeable to the ear. It is largely eliminated in Fig. A4 by raising the load value to 5,000 ohms. The improvement is evident.

If the load-voltage plate-current characteristics are to be investigated, Sw.1 is thrown to position B and the plate voltage swing adjusted by applying 60 cycles at Ep. An interesting comparison has been made in Figs. A5 and A6. In the first, the dynatron characteristics of the type 36 screen-grid R.F. amplifier are shown. The (Continued on page 40)

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**Fig. A. Contact photos of V.T. characteristics on a C-R. tube.**

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A 60-cycle grid voltage is applied at Eg and R1 is adjusted to give a good vertical deflection with the vertical amplifier in the oscilloscope set at maximum. This will make use of as low a value of R1 as is possible, which will not materially affect the operation of the circuit.

Since the vertical deflections are proportional to the plate current and the horizontal deflections are proportional to the grid voltage, the cathode-ray beam will trace out the grid-voltage plate-current relationship curve on the fluorescent screen. And since this occurs over and over again at 60 times per second, it appears to be stationary on the screen.

The frequency of the grid voltage has no effect on the size or shape of the curve unless the plate load is inductive, in which case phase displacement will occur and the curve will be separated in 2 paths, one of increasing plate current and the return path of decreasing plate current. In a linear amplifier these 2 paths will form a perfect ellipse. Inasmuch as we are interested mainly in resistive loads, the curves shown here were all taken with a pure resistance as the plate load. In this case, a linear amplifier gives a straight line, the return path coinciding with the grid-voltage—plate-current curve.

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**Fig. 1. The tube tester circuit with a triode type tube connected for characteristic test.**
SERVICING BY SIGHT AND SOUND

PART 1 — SPOT AMPLIFIER RESPONSE CURVES

A factory technician gives the Service Man practical information on newest cathode-ray servicing procedure.

M. M. BRISBIN

During a recent series of factory lectures, entitled "Training the Ear for Radio Servicing," the effect of changing circuit components in an A.F. amplifier was demonstrated. In order that the response curves of the amplifier could be noted by the audience, a demonstration device was used which would maintain the amplifier response curve on the screen of a cathode-ray oscilloscope. An outline of the operation of this device has been published but in response to requests for further information concerning its operation, it has been considered advisable to go more into detail.

Figure A shows the large demonstration board with the auxiliary apparatus connected in place. The amplifier under test is mounted on the rear of this board and its schematic diagram is on the front of the board. In this schematic diagram are various switches for changing the circuit. These switches are connected to the amplifier on the rear of the board and actually make the changes indicated on the schematic diagram.

(Continued on page 51)

AN EASILY-MADE ADD-ON VOLUME EXPANDER

A new, NON-DISTORTING "bridge" design permits obtaining any desired degree of A.F. volume expansion or compression.

L. A. DE ROSA

Recently, two systems of expanding the signal in the audio channels of the receiver have appeared. Both systems were tested out in the factory laboratory with which the writer is connected and were found to be unsatisfactory in many respects.

Months of experimentation with all kinds of devices and systems, however, has resulted in a modification—of one of the methods—which permits expanding the output of an amplifier as much as is desired with a minimum of power loss and at the same time introducing but a NEGligible amount of distortion (as will be shown). PLEASE NOTE THE CAPITALIZED WORD—

(Continued on page 54)

RADIO-CRAFT for JULY, 1937
BUILDING AN INTERFERENCE ELIMINATION BUSINESS

An "Interference Analyzer" will speed the servicing of man-made radio interference. HARRY KALKER, P.A. MAN

Man had to connect one condenser and choke after another into the circuit until he found the right one. The Interference Analyzer now lends wings to this work by means of the following simple procedure:

1. Plug in clip lead adapter (a length of 2-conductor cord), with male plug at one end and a clip on either lead at the other end in "A" socket of Analyzer.

2. Connect clip leads of adapter to terminals of electrical appliance.

(Continued on page 50)

Variations of the hook-up shown in Fig. 2A should be tried on more troublesome cases of noise.

Fig. A. Exterior of the Interference Analyzer.

Fig. B. Interior of the Interference unit.

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.
USEFUL RADIO CIRCUITS

Experimenters: Here is your Opportunity to win a prize for your pet circuit idea, if it is new, novel, and useful.

AWARDS IN THE CONTEST
FIRST PRIZE... $10.00
SECOND PRIZE... 5.00
THIRD PRIZE... 5.00
Honorable Mention

FIRST PRIZE—$10.00
Home-Made Photo-Voltaic Cell. My construction is a homemade photo-voltaic cell for the experimenter. This cell changes varying light intensity into electrical impulses by varying the potential between the electrodes of a primary cell. The solution is made by adding 1 oz. of lead nitrate crystals to 1 gill of distilled water (4 gills = 1 pt). An ordinary pickle bottle is used for a container. See diagram A. The electrodes used are a lead strip ½ by 6 ins. and a copper plate 1 by 4 ins. Heat the copper plate in a flame until the entire surface is coated with a black flaky substance called cupric oxide. (Use a blue flame instead of a yellow one, to avoid a deposit of soot.—Editor) Now wash the plate in a weak solution of ammonia water to dissolve the cupric oxide. This leaves a golden brown coating of cuprous oxide, which is light sensitive. The back half of the pickle bottle and the back side of the copper plate should be painted with black lacquer. 

DONALD ROBERTS

SECOND PRIZE—$5.00
Simple Method of Protecting Filter Condensers. It is probable that at some time or other almost every radio experimenter has absent-mindedly plugged the speaker plug out of a receiver and has consequently burned out or melted all the ways out of a set of filter condensers. The idea shown in diagram D does away with this possibility entirely. It will be noted that the speaker plug and socket have 2 extra connections. On the socket one terminal is grounded and the other is run to the center-tap of the power transformer, while on the plug the two extra terminals are merely connected together. When the speaker plug is pulled out, the center-tap of the power transformer is left ungrounded, so there are no abnormal high voltages produced across the filter condensers to burn them out.

HAR AL ANDERSON

THIRD PRIZE—$5
Novel Frequency-Doubling Idea. Here is a frequency-doubling idea which I have found useful when a relatively small amount of power is required at a frequency higher than that of the available supply voltage. The circuit shown in diagram C, was used when a frequency of 120 cycles was required to drive a small vibrator of a polarized type. The arrangement shown in diagram D is a variation which more readily adapts itself to multi-stage doubling but requires the addition of a power amplifier of some sort if other than a few milliwatts of power output is desired. The doubling arrangement is nothing more than a full-wave rectifier with output filter purposely omitted and a suitable A.C. output coupling device substituted in its place. A suggestion to observe in the use of the circuit in diagram C is to be sure that condenser C is of the highest quality insulator as any high-resistance leak in the material will nullify results. 

L. H. C. SMITH
Calcutta, New South Wales

HONORABLE MENTION
Simple Code-Practice Set. Two people may practice code in the same room using a single buzzer and 2 separate telegraph keys. No outside wires are required. An ordinary bell-ringing transformer is employed. When one party is sending, the other party must throw his switch in order to short out his key, and ring the buzzer. Works from the voltage rating. For 60 cycle house lighting circuits. See diagram F.

RICHARD GREY
(Continued on page 35)

RADIO-CRAFT for JULY, 1937

www.americanradiohistory.com
OPERATING NOTES

ANALYSES of RADIO RECEIVER SYMPTOMS

Fedal Flashagraph 42. Oscillation and motor-boating between stations can always be eliminated by inserting a 0.01-mf. condenser between the 110-V. line and chassis—Fig. 1A. Pading on this model is usually traced to the coupling condensers of which there are two; for permanent repair both units must be replaced. Pading on this model is also traced to the R.F. plate bypass condenser as in Fig. 1A. It is located in the long-condenser housing. The one with the red lead going to the R.F. coil is usually the defective one.

Zenith 79. When this set complaint is distortion on low-volume setting the usual cause is leaky coupling condenser between the detector plate and first audio grid. The best method to check for this trouble is to connect the meter from the control-grid of the first audio to chassis. If there is a reading it indicates the coupling condenser is leaky. If there is no reading the coupling condenser is good. Use only a high-resistance meter when making this test.

U.S. Radio & Television, No. 499. Chassis. Here is an inherent fault in the circuit of the Gloritone model 24 (No. 499 chassis) that causes difficulties and is easily corrected. This circuit uses a 97 tube as a composite 1st-det. oscillator in which the tuned circuits of the oscillator is comprised through the 8-mf. electrolytic filter condenser (C14) and a 4-mf. 20-V. electrolytic (C16). The trouble evidence from the negatice of the oscillator on the lower frequencies and severe audio frequency regeneration when the circuit breaks in or out of oscillation. This occurs until the set has thoroughly warmed up and may require more than an hour's time.

The difficulty is localized in the 4-mf. 20-V. electrolytic (C16), this condenser having a sufficiently high R.F. resistance at low temperatures to stop oscillation over part of the band. A 0.1-mf. tubular condenser, connected from the low-external end of the oscillator to chassis, was found to be the smallest that would secure the desired results. This is illustrated by the dotted connections in the diagram. See Fig. 1C.

Increased selectivity is also a noticeable result of this change. Experience has demonstrated that the filter condensers should be replaced if a complete reconditioning is desired. It is advisable, at least, to check them, preferably by measuring their power factor; although several of these chassis have operated satisfactorily many months after the proper bypass was provided.

Stromberg-Carlson 160-L Circuit. Variations in new 6J7 tubes have occasionally caused distortion in the automatic tone control circuit of the 160-L receiver, as first released. These tubes function correctly after "aging" a few hours. Also it has been found possible to eliminate this possibility of distortion with new or aged tubes by adding a wire, as shown in the illustration, to stabilise the screen-grid voltage. See Fig. 1D.

This modification was in effect at the factory in all 160-P and 160-L receivers, and in all 160-L produced after October 23, 1936.

Stromberg-Carlson No. 160 Receiver. Variations in characteristics of the 6X7 tube cause some tubes to draw excessive grid current, which may lead to (1) noisy volume control action as the volume knob is rotated; (2) low signals to (3) overloading; and (2) excessive bass compensation at low volumes.

To prevent this, circuit changes are being incorporated in all of these receivers manufactured on or after October 23, 1936, and the same changes should be made in receivers in the field, where noisy volume control action is observed. To make the circuit and the necessary resistors will be supplied without charge.

Two changes are made (see Fig. 1E): (a) Replace the 1,000-ohm bias resistor with Part No. P-26338 (2,700 ohms) for increased bias. (b) Connect Part No. P-26345 (10,000-ohm) resistor across the bass compensating condenser, for smoother bass at low volumes. This connection is made from the volume control to a terminal nearby.

Stromberg-Carlson "SOLDIER NAGHIN"

Crosley No. 102. Set dead, draws excessive current from "A" battery, and the volume knobs are erratic. Cables between both vibrato leads were breakers. These are accessible by removing side cover of vibrato housing, condensers connected across secondary of power transformer. Replace with 0.02-mf. 1,000-V. tubular condenser. This is a common trouble with this set.

Fig. 1. Sketches of the circuit details discussed in the Operating Notes described on this page.
Radial Model 48. A common fault with this model is erratic cutting off at half-volume and back. The plates of the variable condensers in this model are made of a magnetic metal and iron filings from the bearings cling to the plates, shorting them at times. These small particles can only be seen with the aid of a strong light.

The best way to remove these filings is to blow them out with about 200 lbs. of air.

Majestic Model 50. A very common fault with this model is the bypassing or open circuiting of the volume. This is usually caused by one or more of the bypass condensers by-passing the R.F. and detector circuits. These condensers are all in metal cases, riveted to the inside of the chassis, making it impossible to detect these condensers in the case of volume and closing since any kind of connections with the normal operational condition for a short time. The only sure way to correct this trouble is to replace all 3 condensers with 0.65-mf. types, or to short one and as sure as you replace one and leave the other two in, you will be called a fender bender and have a nasty time explaining to the customer.

Richard Owen

RCA Victor Model 119-211. Set had barely reached volume when to play on local stations. A thorough check on all voltages, currents and insulations showed nothing unusual. The V.C. voltage was normal, but a suspected and an inspection of the schematic disclosed two likely places in the form of by-pass condensers and a grid and screen net-work to ground. A resistance check failed to show a shorted condenser, so the sublubration method was used. It was found that the 0.05-mf. condenser (C5) bypassing the last-det. grid, was the culprits from the audible volume control to ground was open. It was also found that this was an intermittent condenser (1.6k 460 kc).

Philco 640, 645. When the low-frequency band is found inoperative or weak with accompanying hiss, check the R.F. choke mounted upon the front wave-band switch section shield for an open-circuit condition. In every case, the open-circuit condition was found in the grounds, which is easily repaired.

Before repairing a shorted tuning meter which is burnt out or open-circuited, the 0.05-mf. tubular condenser connected after the meter should be checked, as this condenser is rated for either a leaky or short-circuited condition. A defective condenser at this point will burn out the new short condenser unit because this condenser is not grounded, unless placed. The condenser is located near the front of the chassis, behind the metal finish.

Very highly distorted, muffled or choked re-production at any volume level is a complaint common with these models. By removing the grid bias from the 75 tube, which may be done by shorting out the 16-ohm section of the secondary circuit, this condition may be cleared to a great extent but the volume control will have negligible effect. The trouble is due to a leaky blocking or coupling condenser between the plate of the 75 tube and the grid of type 42 driver.

This is a 0.05-mf. black enamel condenser located near the type 42 driver tube socket. Since these condensers are connected in the terminal bracket portion, unless a duplicate condenser is installed, it may be best to disconnect one side of the condenser and add a replacement unit.

Benjamin M. Fink

Majestic 500. Sets of this model that refuse to operate over the entire dial can usually be remedied by replacing the small 50-mfd. oscillator grid leak connected from oscillator-grid to cathode of the 75 tube. This resistor often increases in value several times.

Majestic 90, Weak reception on Majestics 90s, when all voltages and tubes check OK, can be caused by open-circuited 0.5-mf. by-pass condenser.

The two condensers used are located on the side of the partition shield opposite the R.F. tubes. (Looking at the bottom.) Sometimes the grounds of these condensers, which are soldered to the side of the can, snap, open-circuiting the condensers. The remedy is replacement or re-soldering.

Zenith 70S, 75S, A common trouble in Zenith Model 70S, 75S, and other similar models is their failure to operate below 1,000 kc. This trouble will only be noticed when opening the antenna coil. When this coil is open there is no sufficient inductance from the low end of the coil. This coil usually opens at the connecting lugs and is easily re-soldered.

United Motors 4037. On United Motors model 4037, when the set is dead or very weak and the ammeter shows a drain of from 10 to 20 mA., with the tubes, condensers, and vibrator checking OK, the trouble will often be traced to shorted turns on the primary of the vibrator transformer. The primary on these transformers consists of several layers of heavy wire and can be rewound quite easily. First make sure that the secondary is not shorted or grounded.

RCA Victor Model 120. When the circuit of this set model motorhome continuously, with no other signal present, check for an opencircuited condenser in the Selective electrolytic block at the right of the chassis. The trouble is usually the screened-grid supply by-pass. To prevent a comeback the entire block should be replaced.

Alwaire Kent 155, Weak, distorted signals after Kent models had been turned off to the 42 sidetube-return. This resistor is a small 0.5-mf. condenser at 0.75 peak, at the grid terminal on the 42 socket.

Silverstone Model 1592, Intermittent distortion fault. The tubes are set to a shorting speaker field. This trouble was located by placing a low-range voltmeter across the field. When it shorted the voltmeter would drop to almost zero.

Conner H. Blackerne

RADIO-CRAFT for JULY, 1937

Service Men may write, requesting answers to specific service questions, Address inquiries to Service Editor. For answers powered by mail, a service fee of 25c per question must be remitted.

MOTOR BOATING

(7) Richard Straus, N. Y. City. I have a Ford model 65 receiver, which intermittently, motor-boats. Please advise the reason and remedy.

A. Motor-boat in this receiver can usually be traced to an open screen-grid bypass condenser. See Fig. 1A. We recommend replacing the defective unit with a 0.65-mf. 600 V. unit.

RESONANCE LIGHTS NOT FUNCTIONING

(8) Martin Block, Reading, Pa. About a month ago I purchased a G.E. model 115 receiver and was very pleased with it. Lately I have noticed that the focus lights which change color to indicate tuning, are always illuminated. How can this trouble be corrected?

A. In order to correct this trouble, it is advisable to check all the tubes first, paying particular attention to the 6K7 R.F. tube. It has been our experience that this complaint was always corrected by replacing the 6K7 R.F. tube.

CODE INTERFERENCE

(9) James Riley, Lansing, Mich. I have recently purchased a Grunion model 1150 receiver and am troubled, great deal by code, riding in on 710 to 750 kc. What can I do to correct this annoyance?

A. By purchasing a wavetrap tuned to 610 kc. and connecting it in series with the aerial post on your set, this code interference will be greatly reduced. See Fig. 11.

SET MASKS

(10) Arthur Hall, N. Y. City. About 6 months ago I purchased a G.E. E55 receiver, and a week ago found it very satisfactory. I wanted to hear about the wave band about a week ago and turned the switch on, and it immediately started to emit a distinct projector transformer. I immediately shut it off. What should I do to prevent this trouble?

A. The first thing to do is to check the 524 rectifier tube, in all probability this will discover this to be the chief cause. If the set was turned off immediately, the transformer will not be installed and will not need changing.

"MAGIC EYE" DULL

(11) Frank DeSantis, N. Y. N. Y. E55 tube twice. What I would like to know is whether I will have to keep on replacing it every few weeks as to the past.

A. We are informed that the E55 "Magic Eye" is constantly being improved, therefore in our opinion it is not necessary to change it so frequently in the future.

DISTORTION

(12) Edward Smith, Hartford, Conn. I've been told me the reason for distortion after (confined on page 35).

0.05 MF

0.05 MF

STOP

OPEN SCREEN-GRID BIASING CAUSES MOTOR-BOATING

Fig. 1. Condenser defect; wavetrap connection.

www.americanradiohistory.com
THE LATEST RADIO EQUIPMENT

This department brings to you each month the newest developments in electronic, radio and public-address equipment. Aggressive technicians use this department to keep posted on the newer and better ways of doing things.

HIFI PORTABLE RECORDING AMPLIFIER (1389)  
(Universal Microphone Co.)  
DESIGNED primarily for use in schools, etc., for the recording of exercises and lessons in languages, expression, pronunciation, etc., this high-sensitivity, high-resistance-capacitance coupled speech recording amplifier has been developed with the added convenience of portability. Supplied complete with collapsible microphone stand, amplifier, velocity head, neon jacks; 1,720 ohm cutting head; neon volume indicator; calibrated volume control. Hum-free, A.C. operation; spot playback if desired.

SELECTIVE INTER-OFFICE COMMUNICATOR (1390)  
(Operadio Mfg. Co.)  
UNLIKE the model of the same make described last month in Radio-Craft this new model includes a control strip along the base that permits any one of 10 stations to be individually contacted. Once a particular station has been signaled, and contact established, conversation may be conducted in absolute privacy—more so as loudspeaker operation permits. A feature of this system, over those which do not require station-to-station wiring, is that high-quality voice reproduction may be obtained—a desirable characteristic where the interphone is to be used over extended periods.

NEW LOW-PRICED 3-IN. OSCILLOSCOPE (1391)  
A type 34-X3, 3-in. tube is used in this new oscilloscope—which has been designed to sell for under $50.

Although designed especially for the service engineer to be used in conjunction with any standard frequency-modulator oscillograph or with any of the new designs of frequency-modulated oscillators, this instrument will serve the many purposes of a really efficient portable oscilloscope as well. It has a variety of vertically and horizontally controlled horizontal and vertical high-voltage amplifiers, flat from 30 to 30,000 cycles; internal or external positive synchronization; high- and low-voltage power supplies insuring brilliant pattern and no intereference of control.

LOW-PRICED NFC (1391)  
New R.F. and I.F. wavetrap. (1394)

LOW-LOSS, RUGGED SWITCH (1395)  
(Shallcross Mfg. Co.)  
STYLISH, heavy-duty features characterize a new switch designed to meet the most exacting demands in output meters, tube checkers, decade boxes, thermocouples.

COMBINED B.C. AND I.F. WAVETRAP (1394)  
(Meissner Mfg. Co.)  
A FERROCART (high-frequency iron) core is utilized in this newest wavetrap. It has two sections. One section (knob adjustment) resonates over the range of 1,720 to 7,000 kHz; the other section (time adjustment) covers a range of 400 to 700 kHz, and thus will eliminate interference in the lower portion of the broadcast range. The two sections may be utilized simultaneously or for different purposes, as mentioned above; or, these two sections may be connected in series to obtain resonance at any frequency between the extremes of 400 and 1,720 kHz.

Service Men will be glad to know that a well-made device of this kind is now available.

NOISE FILTER FOR ELECTRIC RAZORS (1393)  
(Solar Mfg. Corp.)  
A NOISE-FILTER of the inductance-capacitance type has been developed to eliminate the interference to radio reception caused by operation of electric razors. It takes only a second to plug the unit into circuit, between the razor’s cord and the wall receptacle. This low-priced, neatly-finished device should be an easy fit for the Service Man to sell to his customers; a demonstration is all that’s necessary to close the deal.

LOW-LOSS, RUGGED SWITCH (1395)  
(Shallcross Mfg. Co.)  
STYLISH, heavy-duty features characterize a new switch designed to meet the most exacting demands in output meters, tube checkers, decade boxes, thermocouples.

(Continued on page 56)
A COMBINATION (AND SLIDE-BACK) V.-T. AND PEAK VOLTOMETER

The functions, and what is probably the first published diagram with parts values, of a new test instrument.

S. MINSKER

Long recognized as an indispensable laboratory instrument, the vacuum-tube voltometer has now become a frequent service instrument for measuring C-bias, A.V.C., A.F.C., R.F. voltage, etc., where ordinary voltmeters of even the highest sensitivity will draw current and upset circuit conditions. This has been clearly shown in recent, detailed articles in Radio-Craft on the use of this type of test equipment.

A V.-T. AND "SLIDE-BACK" PEAK METER

An actual vacuum-tube voltometer of the very latest type is here shown by photograph and diagram. It is a precision V.-T. voltometer of improved practicability and ease of operation combined with a peak voltmeter of the slide-back type operating from an internal balancing voltage.

This instrument is offered to meet the wide range of applications not satisfactorily filled by a vacuum-tube voltmeter, of the usual design, limited to the reading of root-mean-square potentials.

(Continued on page 61)

Fig. 1. This is believed to be the first published schematic circuit of the new meter to include electrical parts values.

A 20,000 OHMS/VOLT ANALYZER KIT

The new trend in servicing instruments is definitely in the direction of higher sensitivity.

Fig. 7. Two models, the D.C. type is shown by diagram, above, left; Fig. 7, above, right, diagrams the A.C.-D.C. Tester-Analyzer.

The jump from low resistance to 1,000 ohms-per-volt, to 2,000 and now 20,000 ohms-per-volt instruments shows the service instrument manufacturers reply to the Service Men's demand for sensitivity. But the rise of highly sensitive meters was not purely impulsive on the part of the Service Men, it resulted from the development of new radio receiver circuits calling for more accurate adjustments and forbidding any excessive current drain during the tests.

Test operation under the above-mentioned conditions of 20,000 ohms/volt sensitivity has been made available in

(Continued on page 63)
BUILD THE RADIO-CRAFT 1937 CAR-RADIO RECEIVER

Enjoy the pleasures of all-wave reception and automatic frequency control, in 1937.

PART II

AFTER THE constructor has decided, from the detailed descriptions given in Part I, just which types of power supply will be used and whether automatic frequency control, noise suppression, and a beat-frequency oscillator will be included in his set, the actual construction work can be started.

Incidentally, a complete description of the A.F.C., with the diagram of this part of the set will appear in Part III, in a forthcoming issue.

The construction of the "front end"—a complete R.F. coil assembly—will call for some exceptionally careful work and perhaps much more time than the reader might think.

THE INPUT "END"

First, the 3-gang switch must be taken apart, the spacers cut in two, the shield partitions formed and drilled and then installed between the switch sections, and the side piece bolted in to complete the job thus far. Next, the various coils must be wired in—self-supported from the switch sections. It would take a complete story to give all details as to proper placement, and we must simply refer you to the detail drawings on construction and layout and advise you to "hang up" the coils with solid No. 14 or 12 wire, keep the leads short, and place the higher-frequency windings as far as possible away from the shield partitions.

Wire in the trimmers on all but the ultra-high frequency coils, placing them wherever convenient and as close as possible to the inductances which they are to tune. Remember that they must be adjustable with the R.F. shield compartment in place under the chassis. Therefore they must be placed vertically, with the screw caps accessible from below the chassis. Connect the cap leads to the A.V.C. or paddler connection coil terminals and the bottom lugs to coil grid terminals.

Wire from coil to coil in each stage for "B plus," A.V.C., and other common coil leads, bringing the final leads out through the side wall of the assembly or leaving them inside if they are to be connected to R.F. or mixer tube sockets. (These sockets will be inside the shield box when the assembly has been installed under the chassis.) In the R.F. and mixer compartments, wire-in R.F. coupling condensers (0.05-mfd.) from common A.V.C. bus lines for each stage to some convenient point on the shield partitions and then solder leads to the partitions for connection up through the chassis to the variable condenser rotors. Connect leads for variable condenser rotors (grid terminals) to the switch gangs, making the leads rather long so that they may be pulled up through the chassis later and before the assembly is fixed in position. Remember that it will be difficult to make changes and connections with the assembly installed, as coils and trimmers take up too much room. Do all this work in the very first place and test for continuity, etc.

(Continued on page 58)

Fig. D. This under-chassis view shows the coil and switch mounting.

Fig. C. The completed set with accessories and vibrator "B" unit.

Fig. 1. Chassis, coil shield and metal container drilling and forming details. The band switch is taken apart and re-assembled as shown at 8.

Radio-Craft for July, 1937

www.americanradiohistory.com
A brief review of a few new test instruments selected at random reveals that the trend continues toward precision and versatility.

TEST EQUIPMENT FOR THE SERVICE MAN

A.C.-D.C. OSCILLATOR. External tests may be made. (1397)

New wide-range oscilloscope. (1398)

Bevel gears link the multi-point switch to the 12-scale mechanism. (1399)

View of the complete set analyzer, details of the 12-scale mechanism of which are shown in the companion illustration at left. (1399)

A.F. OSCILLATOR FOR CHECKING AMPLIFIERS. A suf- ficiently strong signal is supplied by this A.C.-operated audio oscillator to permit checking weak amplifiers. Attenuation for the measurement of gain percentage is said to be extremely accurate and impedance matching is variable. A pure sine wave, without harmonics or other waveform distortion, is generated.

Frequencies: 100-250-500-1,000-2,000-3,000-4,000-5,000-7,500-10,000 cycles. Measures about 8 x 6 1/2 x 4 1/2 ins. deep; thus, it matches a companion series of units made by the same manufacturer.

Triplet Electrical Instrument Co. (1400)

A.C.-D.C. MULTI-METER. SERVICE MEN, and even the general technician, will appreciate the exceptional convenience afforded in this new 12-scale multi-range meter—it's so compact it will slip into a pocket. Measures only 3 1/4 x 1 5/16 ins. deep. Previous instruments, by the same manufacturer, having the same general appearance lacked the built-in rectifier in this new model which permits A.C. measurements to be made to a good degree of accuracy. Ranges: High Range—to 1 meg. with self-contained battery; Low weight only 27 oz.

View of the complete set analyzer, details of the 12-scale mechanism of which are shown in the companion illustration at left. (1399)

A.F. OSCILLATOR (1400) 10,000 cycles, pure sine wave; amplifiers, (1400)

Pocket A.C.-D.C. meter. (1401)

Pocket A.C.-D.C. meter. (1401)

A.C. SCALES ON TOP ELECTRIC METER IS BUILT-IN, (1401)

CATHODE-RAY OSCILLOSCOPE

A 2-unit servicing "kit." (1402)

TEST OSCILLATOR

A 2-unit servicing "kit." (1402)

RADIO-CRAFT for JULY, 1937
STROMBERG-CARLSON No. 127, A.C.-D.C. CHASSIS (SET MODELS 127-H AND 127-M)

A 9-Tube Superheterodyne, Metal Tubes, 3-Band (540 - 1,500 kc., 1,450 - 3,500 kc., 5.6 - 18 mc.) A.V.C., "Tri-Focal" (Cathode-Ray) Tuning. Permanent-Magnet Dynamic Loud Speaker.

This is a universal A.C.-D.C. circuit. Note chassis is not the negative from which voltages are to be measured. Sensitivity control to be adjusted by Service Man for location. Tuning indicator is connected by plug at back of chassis. The "Tri-Focal" tuning indicator, V9, makes plug-in connection to the chassis.

**Alignments of R.F. circuits are to be made at following frequencies, in this order of trimming: "C" band, 17 mc.; C9, C6, C3; "B" band, 3.4 mc.; C8, C5, C2; "A" band, 1.4 mc. (1,400 kc.) C7, C4, C1. Then at 6.6 mc. (600 kc.) oscillator series aligner C41; at 1.4 mc. again, C7, C4, C1. Align I.F. amplifier at 465 kc., in this order, C13, C12, C11, C10.

The range switch connects in series, 2 dial lamps at a time for proper illumination. Sensitivity control, at rear of chassis, is adjusted to give minimum reading from strongest nearby station. It is cut out on short-wave ("B", "C") range switch settings.

Voltage readings of set, with 120 V. on A.C. line (1,000 ohm/voltmeter) to heavy bus wire (negative grid-plate)—not channels
—are as follows:

<table>
<thead>
<tr>
<th>Tube</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>33</td>
<td>88</td>
<td>0</td>
<td>0</td>
<td>*24</td>
</tr>
<tr>
<td>V2</td>
<td>95</td>
<td>69</td>
<td>-7</td>
<td>95</td>
<td>*12</td>
</tr>
<tr>
<td>V3</td>
<td>99</td>
<td>83</td>
<td>2</td>
<td>96</td>
<td>*28</td>
</tr>
<tr>
<td>V4</td>
<td>150</td>
<td>0</td>
<td>0</td>
<td>88</td>
<td>*6</td>
</tr>
</tbody>
</table>

*A.C. voltage: on D.C. power line, lower D.C. reading will be had.

Use 1,000-V. scale of meter.

<table>
<thead>
<tr>
<th>Tube</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>V5</td>
<td>61</td>
<td>106</td>
<td>106</td>
<td>0</td>
<td>17</td>
<td>*31</td>
</tr>
<tr>
<td>V6</td>
<td>0</td>
<td>106</td>
<td>106</td>
<td>0</td>
<td>17</td>
<td>*30</td>
</tr>
<tr>
<td>V9</td>
<td>0</td>
<td>150</td>
<td>150</td>
<td>0</td>
<td>116</td>
<td>0</td>
</tr>
<tr>
<td>V8</td>
<td>0</td>
<td>150</td>
<td>116</td>
<td>116</td>
<td>*116</td>
<td>0</td>
</tr>
<tr>
<td>V9</td>
<td>61</td>
<td>150</td>
<td>499</td>
<td>25</td>
<td>67</td>
<td></td>
</tr>
</tbody>
</table>

*A.C. voltages on D.C. power, lower. Receiver tuned to 1,000 kc.: no signal.

GENERAL ELECTRIC MODEL E-51 RECEIVER

A 4-tube, A.C.-D.C. superheterodyne; dual band, broadcast range, 540-1,740 kc., short-wave range, 2,2-7.0 mc.; 6½-in. dynamic speaker; power consumption, 45-W.; undistorted output, 0.3-W.; maximum output, 0.7-W.; intermediate frequency, 465 kc.; tone control.

The functions of the various tubes in the General Electric Model E-51 receiver are as follows: 6AK, oscillator and Int. Det.; 6K7, I.F. amplifier; 6Q7, 2nd Int. Det., A.V.C. and first A.F. amplifier; 25A6, audio power amplifier; 25Z6, rectifier with each section functioning as half-wave rectifier.

The pilot light is a Mazda No. 46.

The alignment frequencies for the General Electric Model E-51 are 465 kc. for the I.F. and 1,500 kc. for the broadcast band. In order to properly align the receiver, it will be necessary to have the following service tools:

1. Test oscillator capable of producing the above alignment frequencies;
2. Non-metallic alignment screwdriver;
3. Output meter;
4. Service set; and
5. Socket voltages of 115V.

Throughout all adjustments the output should be maintained at a low level by decreasing the test oscillator output as the various stages are brought in line. After these adjustments have been made, the same procedure should be repeated as a final check. The I.F. alignment will then be complete.

The R.F. and oscillator transformers are aligned at 500 and 1,500 kc.

Aligning the Broadcast Band: With the band switch in the short-wave position, set the tuning dial to 1,500 kc. Set the test oscillator at 1,500 kc. and adjust the oscillator trimmer for maximum output. Next, adjust the R.F. trimmer for maximum output, taking care that the output from the test oscillator is not high enough to overload any part of the set. After these adjustments, tune the set and the test oscillator to 500 kc. Adjust the broadcast padding condenser C1, for maximum output while rocking the tuning condenser back and forth until maximum output is obtained. The dial setting after this adjustment may not agree exactly with the reference frequency, but this is not important. To complete the broadcast band line-up, repeat the adjustment at 1,500 kc. as before.

Aligning the Short-Wave—22-7.0 mc. (2,200-7,000 kc.)—Band: No separate short-wave trimmers are provided on this receiver. The correct adjustment of the broadcast band automatically aligns the short-wave band.
NUMEROUS interesting devices do not fall into the ordinary categories of general radio equipment, testing apparatus, etc., are now available either as direct purchase or as premiums of some sort in connection with the purchase of radio equipment. Some of the more unusual of these devices which have made their appearance in the past are here shown for such interest as they may hold for the radio man. Names and addresses of manufacturers represented will be sent upon receipt of a stamped and self-addressed envelope. Kindly give (number) in the following descriptions.

A "Metal-Tube" Lighter. A new, novel "clumsy" lighter is made in the form of an octal-base tube of the screen-grid type. The lighter is made available by removing the shell of the "tube." (1386) RCA Manufacturing Co., Inc.

Color-Coded Service Pencil. More than ordinary utility is enjoyed in a new Service Man's pencil which incorporates (1) colored and numbered bands that rotate and may be aligned, as illustrated, to determine the electrical values of components in accordance with R.M.A. color codes; and, (2) a bakedine neutralizing tool that reseizes into the pencil and is available by removing the exterior wrap, which reseizes a metal tube (removing only the shell of this "tube" reveals an eraser underneath, which are contained replacement leads). (1384)

A Musical Pillow. Service Men should have no difficulty during a nice sideline business wiring-in to existing radio sets the new type of radio pillow here illustrated; hospital, institutional, the hard-of-hearing and other markets for this pillow will be interested in the item because of its small size and low cost, and the individualized program-reception it affords. The pillow contains a small reproducer unit which radiates sound to the surface of the pillow, through a resilient material containing hundreds of tiny passages. (1382) Eastern Radio and Television Co.

Radio Symbol Guide. Most radio men will welcome the new transparent celluloid gadget here illustrated. Its various outlines make the drawing of radio symbols a pleasure in more ways than one. (1384) Hygrade Sylvania Corp.

Flashlight Screwdriver. Here is a clever tool that combines an insulated metal blade set in a heavy glass base, with a flashligh whose tips are focused at the point of the blade. Clips into your pocket. Great for working in dark corners. (1384) Hygrade Sylvania Corp.

Circular Slide-Rule. Technicians who know enough arithmetic to work out an Ohm's law formula will want to own this new pocket slide-rule. Its effective length is 20 in. Permits quickly making all the calculations, in multiplication, division, proportion, reciprocals, squares, and square roots, that are the indispensable elements in constructing and servicing radio equipment of all types. (1386) Tavella Sales Co.

Radio-Set Tone Tester. The portion of this applicator that extends from the knob to its tip may be rotated. This controls circuits, shown by diagram, that permit demonstrating, in 6 steps, the point difference in tone quality between types of radio receivers typical of the years 1927 to 1937. Colorama simultaneously illustrate these respective types of sets. (1386) General Electric Co.

World-Wide Radio Station Index. Known as "Directory of World Stations." This thumb-operated device lists over 1,600 long- and short-wave stations —tells you instantly at any point on the globe. Stations are listed by call letters, and by frequency and wave-length. Swivel for checking station logs on dials, etc. (1386A)

"Pindex" lists tube prongs. (1386A)

Write in the dark. (1387)

DISTRIBUTOR "SUPPRESSOR"

Illuminated Pencil. Ever had a yen to possess a pencil, that could be used in the dark, which would illuminate only the immediate area in which you were writing? Here tis. Fine for sewing in the dark, or as a guide outline of a radio outline. The

(Continued on page 64)
USEFUL TOOLS FOR RADIO SERVICING

The clever technician, in order to save him a few minutes here and a few minutes there, keeps himself well-posted on new tools. Many interesting ones are here described for the Service Man.

Perhaps not all these tools will interest all radio men, but, some of them will interest some members of the craft. Names and addresses of manufacturers represented will be sent upon receipt of a self-addressed, stamped envelope. Kindly give (number) in the following descriptions.

RADIO-SET BLOWER (1368)

Service men now have available a radio blower that quickly chases dust and dirt—and thus, often, static—from the most inaccessible places in the radio receiver.

LIGHT-DUTY HAND-DRILL (1369)

Here is an A.C.-D.C. hand-drill with trigger-type switch and continuous-operation lock, priced low enough to attract almost every radio set builder, Service Man and experimenter. The no-load speed of this 7/8 in. drill is 2,000 r.p.m.

SERVICING CHASSIS CRADLE (1370)

Any make or model of radio chassis may be held in any desired position for testing, aligning, repairing, replacing parts, etc., if the steel chassis cradle here shown is used.

BULLDOG-GRIP ELECTRIC PLUGS (1371)

Service men will want to replace their regular terminal plug with the special type here shown. A plunger causes the prongs to expand tightly against the receptacle. Prevents the soldering iron becoming disconnected in the middle of an important job—due to a wall plate in the customer's home that does not tightly fit the plug.

CIRCUIT BREAKER SUBSTITUTES FOR FUSE (1373)

No need for delay repairs, in the service shop, to replace a fuse blown by a defective instrument. Install a magnetic circuit breaker in a convenient spot. Available in instantaneous trip and time-delay action. Available types: drop on 50 ma. to 35 A.; time delay of 5 secs. to 8 mins.

WRINKLE-FINISH VARNISH (1374)

Giving a commercial appearance to home-built equipment (amplifiers, test equipment, parts, chassis, etc.) is no longer a problem to the custom constructor. A new "assist" in this direction for the technician is a varnish, available in black and colors, which wrinkles without requiring baking. Easily applied by brush or spray.

SERVICING GRAPHITE-LUBRICANT (1375)

If that condenser shaft becomes a little tight give it a dose of finely-powdered graphite as here illustrated. The compressible celluloid tube is capped with a tiny nozzle.

WATER-PROOF INERTIA FLASHLIGHT (1376)

A battery-operated flashlight that does not use the usual type of off-on switch is now on the market. This flashlight is so completely water-proofed it may be submerged in water more than 24 hours without in the least affecting its operation. It is turned either on or off by a sharp snap of the wrist which operates a built-in switch utilizing principles of inertia.

SERVICING CHASSIS AND MALLET (1377)

A fixed-angle chassis made of heavy steel which may be used not only for bench work but also in connection with displays is here shown holding a radio set in position. A wooden mallet (insert), cushioned on both ends with rubber (Continued on page 63)
This model C-516 Crosley radio set is a 6-tube superheterodyne designed for operation on a 110 to 120 V. power supply, either A.C. or D.C. The tuning range of the receiver is approximately from 540 to 1,725 kilocycles (555 to 173 meters). Uses a 6A7 as oscillator and 1st-det.; 470 as A.V.C., 2nd-det. and A.F. amplifier; a 43 as power output; a 5Z3S rectifier. Utilizes a 5-in. dynamic speaker.

Tubes and Voltage Limits: The table shown below gives the functions of the tubes used, together with the voltage readings between the tube socket contacts and "ground". Voltages readings should be taken with a 1,000-ohm-per-volt, 250-V., voltmeter (except filaments) with volume control full on and no signal input.

Alignment Procedure: The chassis of this receiver is connected through a resistor to one side of the power supply and for this reason all test equipment should be thoroughly isolated in order that the power supply will not be short-circuited while attempting to align the receiver.

Connect one terminal of the output meter to the plate and the other terminal to the screen-grid of the 43 output tube. Be sure the meter is protected from D.C. by connecting a condenser (0.1-mf. or larger—not electrolytic) in series with one of the leads.

Tuning R.F. Amplifier to 450 kc.: (a) Connect the output of the signal generator through a 0.02-mf. condenser to the top cap of the 6A7 Oscillator—1st-det. tube, V1, leaving the tube's grid clip in place. Connect the ground lead from the signal generator direct to the receiver chassis but do not run a wire direct to ground. Keep the generator leads as far as possible from the grid leads of the other screen-grid tubes. (b) Set the station selector so that the plates of the condenser gang are completely out of mesh and turn the volume control to the right (G2). (c) Set the signal generator to 450 kc. (d) Adjust the I.F. trimmer condensers for maximum reading on the output meter. Always use the lowest signal generator output that will give a reasonable output meter reading.

Aligning R.F. Amplifiers: (a) Connect the output lead from the signal generator to the 250 mmf. condenser to the antenna lead on the chassis. (b) Set the signal generator to 1,400 kc. (c) Adjust the station selector to 140 on the dial. (d) Adjust the trimmer located on the "OSC." section of the condenser gang for maximum output. (e) Adjust the trimmer located on the "ANT." section of the condenser gang for maximum output. (f) Readjust the station selector slightly for maximum output. (g) Repeat operation (e) for more accurate adjustment.

TUBE SOCKET VOLTAGE READINGS

<table>
<thead>
<tr>
<th>Tube</th>
<th>Function</th>
<th>H</th>
<th>P</th>
<th>S</th>
<th>K</th>
<th>G2</th>
<th>G1</th>
<th>G4</th>
</tr>
</thead>
<tbody>
<tr>
<td>6A7 (V1)</td>
<td>Oscillator 1st-Det.</td>
<td>6.5</td>
<td>100</td>
<td>40</td>
<td>1</td>
<td>0-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7S (V2)</td>
<td>2nd-Det. &amp; A.F. Amp.</td>
<td>6.5</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43 (V3)</td>
<td>Output</td>
<td>25.0</td>
<td>95</td>
<td>100</td>
<td>0</td>
<td></td>
<td></td>
<td>-20</td>
</tr>
</tbody>
</table>

Power output approximately 1 W.; power consumption approximately 50 W.; voltage drop across speaker 120 V.; all readings taken on 117.5 V. A.C. power supply; all readings except filaments will be approximately 15 per cent lower on 117.5 V. D.C.

Chassis layout of Crosley Model C-516 showing location of tubes and major components.
This receiver is designed for Chrysler C14, C15, C16; DeSoto S-3; Dodge D-5, D-6, D-7; Plymouth P-5, P-6 models. The cars are also constructed to receive antennas, control panels, and additional speakers.

On models P-3, P-4, D-2, D-7, there is a connection of the "A" lead to the back of the ignition switch, on which there is a "Gm. Rad." terminal. When the motor is not running, turning the switch key to the extreme left permits the operation of the receiver. For other models, a break switch, preventing unauthorized operation of the set, is an extra.

The set is normally furnished with the "Roadway" antenna, with which the pickup is beneath the running boards. On the left side of the receiver housing is an antenna connector; if the "Skyway" antenna (installed on the roof, and running from windshield to below rear window) is used, two screws are taken out of the antenna connector and it is turned halfway round (Fig. F). The screws are replaced; a snap button cover taken off the antenna selector switch (Sw. 1). The receiver is then mounted on its bracket; dash seal screw is taken from behind the swivel bracket (at bottom of receiver) and bracket secured to the dash. Antenna lead is then connected to conductor.

The control unit, installed from the rear of the panel, carries three control shafts, connected to the side of the receiver housing, as shown in "A." Each runs from the upper left side of the housing to the "A" lead on the end of the receiver. The battery lead, from the center of the housing below the window, is cut to the proper length, and connected to the discharge side of the ammeter.

When the control knobs have been tightened on the shafts, and the shafts centered, it is necessary to turn the seat to its forward position, and then back all the way in the opposite direction. Check against a station of known frequency; hold the dial at that frequency (with a rubber on the tip of a pencil) and tune exactly to the station.

To suppress ignition interference: screw the bakelite suppressor (interference condenser part 30-4407) on the distributor end of the generator condenser lead shaft; plug the distributor into the distributor cap. Install the generator condenser (part 30-4406) on the back of the motor. It is in full view under the ground wire screw (center) and connected to the "A" terminal (thus putting it across the "A" supply) at the left. Do not connect to the other screw (right).

In case of special trouble, ground the ammeter cable, oil line and temperature indicator tubes, where they enter the dash. No. 14 bare stranded wire is passed around the three tubes and grounded under one of the condenser cap screws. (Remove the paint from under the screw head.) It may also be helpful to connect a 0.5-mfd. condenser to either the ignition switch or the ammeter (wherever it does most good), mounting the condenser on the flange of the instrument board.

In noisy locations, it is best to turn the middle knob (time control) clockwise to less noise position, cutting down the high notes. Static, whether atmospheric or manmade, is amplified with the signal and near electric power lines, or car lines, it may be difficult to bring in any but powerful locals. Since these require less amplification, the automatic volume control reduces amplification, and with it the undesirable noise. Caution must be used to turn off the set completely, or the battery will discharge.

There are two models of vibrator: 41-3195-3 (Fig. B) and 41-3170-2 (Fig. D), connections of which are shown.

A 250-mfd. condenser has been added to this receiver, in later models, as indicated in dotted lines, between filament of V1 and ground.

As a recommended accessory, the "Comfortone" speaker box has been designed. The back of the front seat, in all car models, is pierced to facilitate its installation. It therefore does full volume to passengers in rear seats, without increasing it to inconvenience the occupants of front seats. It is connected (as shown in Fig. E) to a socket at the side of the receiver housing. Its connections are shown in Fig. C.

To install this speaker it is necessary to reach the speaker cut-out by removing the retaining bracket nuts, the front seat rear-cushion, and peeling down the insulating material. (Continued below.)

Using a sharp knife, cut through seat-back trim; use as guide; outside diameter of the cut-out.

Speaker cable threads, from receiver, under floor carpet, to left side of floor tunnel to front seat and through hole in front seat center brace channel to 1/8-in. hole (to be drilled); photo shows wiring upward from this point.
HOW TO SOLDER

Tyro and expert technicians, alike, will appreciate the fundamental information on an important subject this article contains.

J. L. BROTHERS

SOLDERING is not difficult when certain facts are known. There is only one method of making a perfect, soldered joint. The pieces of metal to be soldered must be raised to the melting temperature of the solder used. It is most important to keep the soldering iron (Here's one of radio's paradoxes—the soldering "iron" is not an iron but a copper!—Editor) at the correct temperature. An "iron" too cold or too hot will not solder properly—if at all.

Temperature. The correct temperature of the copper tip is indicated by the condition of the tinning. An experienced solderer knows by the appearance of the iron and by the "zip" it makes when brought into contact with the soldering flux and solder, just when the right temperature is reached. Only a little practice is needed to acquire this knowledge. If the tip is overheating, there will be a tendency for the tin to burn off. That is, instead of the tinning on the copper tip remaining bright, it will become discolored and burn away permitting the bare copper to oxidize and consequently form a heat-insulating crust. The heat is thus prevented from melting the solder and raising the parts to the soldering temperature. Overheating can be prevented by disconnecting the iron from time to time as required.

Clean Metal. The metals to be soldered must be bright and clean, free from grease, dirt or oxide and preferably tinned (coated with pure tin or solder). Nickel-plated parts are very difficult to solder because nickel does not readily enter into solution with the solder, or "alloy" with it. Electro-plated tin parts are not so satisfactory as those that have been hot dip-tinned because the solder tends to alloy only with the plating which frequently flakes off. There (Continued on page 61)

DIRECT-COUPLING IN A 30-W. BEAM TUBE AMPLIFIER

This hi-fi amplifier matches a specific microphone. Part II appeared in April issue.

A. C. SHANEY

PART III

AFTER having carefully checked the "perfect and ideal" high-fidelity amplifier described in Parts I and II, the P.A. technician might say to the engineer, "So what?" And the engineer would probably reply, "With the advent of a true straight-line frequency, non-reactive amplifier, it becomes a relatively simple matter to design a real straight-line frequency response P.A. system by simply correlating the design of the microphone and loudspeaker in such a way that the frequency response of these 2 units complement each other to provide, when connected to the amplifier, uniform pick-up and reproducing characteristics for the entire audio spectrum."

IMPORTANCE OF THE MICROPHONE

Naturally, the microphone is one of the very important determining factors in such a system, and any discrepancy in its transducing ability would be exaggerated by the amplifier. The ideal microphone is capable of converting all audio frequencies into corresponding electrical impulses of equivalent amplitudes without waveform distortion. To accomplish this result, a new streamlined Bullet Micro-(Continued on page 62)
ENJOY NEW RADIO THRILL!

Thousands Getting New Pleasure from Radio that's RCA All The Way!

The air is full of thrills! Every hour of every day finds colorful, exciting programs being broadcast for you to hear—enjoy!

As fine as these programs are—it’s up to you to get the thrill of radio that’s RCA All The Way—perfect performance beginning with the RCA microphone in the studio and coming to you with equal perfection from your RCA Victor receiver. Only by owning an RCA Victor radio can you get this thrill.

They Cost as Little as $20

You can enjoy radio that’s RCA All The Way at low cost with one of RCA Victor’s new 1937 models! They are now on display at your RCA Victor dealer's store. Designed for every purse they cost as little as $20. Among the many models priced below $100 are several with RCA Victor’s Magic Brain, Magic Eye, Metal Tubing. Every chassis is housed in a beautiful cabinet—and there is a large variety of cabinet styles—one of which is sure to catch your eye. At slightly higher prices are the fine models which feature RCA Victor’s latest triumph—the Magic Voice.

But visit your dealer. See and hear these superb radios. Take particular notice of their thrilling performance. Then match them against any other radios of equal price—and RCA will win you!

RCA Radiotron Check-up Restores Radio’s Pep and Power

Radios, like anything else that’s constantly in use, eventually tire and lose the efficiency which gave you outstanding performance when the set was new. You can restore your radio’s original pep and power—give it new life and “new set” tone by having your radio service man administer the cure-all of an RCA Radiotron check-up.

This check-up consists of 10 testing, cleaning and adjusting steps which cost you only $1.50.

Get More Service Jobs—Push the Check-Up

If you’re a service man you will discover, as hundreds of other men in your business have, that the RCA Radiotron Check-up Plan not only gives you additional service jobs but in addition, helps you sell parts, new sets and other appliances that you have for sale.

You will find the RCA check-up an easy service to sell. Because there’s nothing unusual about check-ups in American life. People are accustomed to check-ups of all sorts. They know the value of check-ups. Therefore, a radio check-up is quite acceptable.

You get selling help, too, direct from RCA Radiotron. For full column adver-tisements are running in the Saturday Evening Post and Collier’s every other week...newspaper ads are appearing in over 100 cities...the check-up is being featured with commercial announcements on a full hour Sunday radio program. And in every one of these advertising efforts RCA Radiotron is featuring you as the man to perform this check-up service. In addition, RCA Radiotron also offers you mailing pieces for your own use—mailing pieces that will include your own name and address and which will bring you directly to the attention of all your prospects. Secure yours today. Use them. Get behind this check-up service—and profit! You can get full details from your jobber, who will also be glad to tell you about the new RCA Radiotron Auto Radio Check-up.

This is P. A. Time—The Time to Cash In!

Warm weather and bright sunshine are here. And that means it’s P. A. time—and the time for you to cash in on installations of public address systems.

Your prospects? There are many. This season of the year is ideal for outdoor installations such as in amusement parks, athletic fields, camps, resorts, swimming pools and “garden” night clubs.

The best way for you to get your share of this P. A. business is to offer prospects RCA equipment. Public address systems bearing the RCA trademark provide real quality. And that’s only natural. For behind them are the years of experience RCA has gained as the world’s leading maker of sound products.

RCA offers these portable P. A. models that will cover all your needs for the type of equipment. Both give you the sales advantage of the RCA name. All are literally packed with performance features that help make them easy to sell. All sell at modest cost—yet assure you good profits.

Get after the P. A. market today. Get your share of the profits that are in it. Push the RCA public address systems shown here—and win many installation jobs! Write us for free details.

New Tube Manual!
The RC-13 Manual on RCA Radiotubes gives service men complete information on all receiving tube types including Metal and G-Series tubes. Get your copy from your RCA tube distributor.

Please Say That You Saw It in RADIO-CRAFT
THE RADIO MONTH IN REVIEW
(Continued from page 1)

The system is extremely flexible in that the energy released by interfering with any beam can be used for various purposes, such as sounding an outside bell or siren. The type of installation made at the demonstration was unique and presaged more modern and effective methods. It automatically cleared a telephone line, dialed police headquarter, and transmitted a spoken message summoning aid. After this message had been repeated for a minute and a half, the device "hung up" and then called the telephone company, repeating its message for the same period as a check upon the first call. Having done this, it once more cleared the line and automatically placed the telephone back in service.

Previous protective systems relying on the phototube have had to depend on a visible white beam for reliable transmission of any consider-
able distance, even by more than a few mirrors. The 32-candlepower lamp em-
ployed in this demonstration was placed in a projector fitted with a special filter which transmitted only invisible rays of the infra-red band. The invisible beam was focused on the phototube through a special lens and holer connected to an amplifier using standard metal radio tubes. Be-
cause of its design, the system is responsive to minute current values set up in the phototube, making it possible to employ the beam over long distances, and to reflect it from mirror to mirror and effectively homuncle a space with unseen "fences" of electricity.

Radio is making it harder and harder for lawbreakers to get away with anything.

---

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RADIO CIRCULAR CO., INC.
DEPARTMENT RC-7
915 Broadway
New York, N. Y.

THE SERVICE MAN TAKES A HOLIDAY
(Continued from page 9)

overnight. It may in fact be 2 or 3 seasons before the Service Man has succeeded in storming the citadels of the bootleggers who own radio-equipped boats or who plan to equip their boats with radio receivers. Unlike the car-radio owner who has only to drive into a car-service station, the boat-radio owner finds it inconvenient to bring his problems to the Service Man. There-
fore it is up to the boating technician to capitalize on this fact by having instantly available a fully-equipped radio service boat to answer a radio repair 806.

Please Say That You Saw It in RADIO-CRAFT
car, it is desirable to maintain the metal parts of the unit and maintain ground potential so that, for instance, no radiation of the spark interference will flow from the unit to the dash, thereby improving the service of the car. In order to reach the lowest ground potential. A good electrical connection is as important as a good mechanical mounting.

All these things, of course, can be done easily with the aid of instruments designed for these purposes by leading automotive engineers. It only remains to add those equally important instruments specially built for radio service which will soon be the necessary equipment in every progressive shop.

An amateur who knows ignition systems can pick up auto-radio service in a very short time. It is based on the same fundamental facts as the ignition system. Even the terms are those with which he is in daily contact—ohms, amperes, volts. So are capacity and inductance, the first being used in the designation of sizes of condensers used across the breaker points of the ignition system, the second being associated with the ignition coil. He will have no trouble at all in learning the ins and outs of auto-radio service.

Stress the fact to every owner of an auto-radio receiver that he has to service his radio set is the man who services his car. For one is so inter-dependent upon the other, that unaccustomed ban on the service of the best radio receiver in the world will prove a dud. This one-stop service will please him, save him time and money, and improve his big and increasing source of profit to the garage.

Our Information Bureau will gladly supply manufacturers’ names and addresses of any item mentioned in RADIO-CRAFT. Please enclose a stamped and self-addressed envelope.

**MAKING THE RADIO-CRAFT SIMPLIFIED**

(Caution: Do not use the word “circuit” in more than one sentence.)*

Show that the circuit is not super-regenerating, perhaps by reason of improper values for R2 and C2. Remember that we don’t want oscillation, under ANY CIRCUMSTANCES. We don’t even want super-regeneration if we’re going to have trouble with it. If you can’t get the set to regenerate properly without oscillation, the R and C from the R.C.F.C. switch section to R5 and discard C5 and R9. Plate voltage will be quite low, but the detector will still work effectively.

Switch to “send”. Here the red pilot should light up. Test for plate voltage. If this is as low as 20 and circuit correctness do not appreciably increase it, the 25A6 transmitting signal generator must be discarded and a 6J7 or 6C5 substituted. R.C.F.C., whatever the type of oscillator-circuit tube, must be effective at operating frequency and prevent any R.F. from wandering out of home pastures. Now connect a speaker voice coil to the secondary of Cb. If the latter is equipped with a winding for any voice-coil impedance match. Test for audio reproduction of speaker and voice impulses by speaking into the “transducer” with the gain control at various positions. Clear articulation at all levels should indicate evidence of hum, audio feedback, or R.F. mush. If speech sounds boomy and R9 and C6 are in use, decrease the value of C6 until low-frequency muffle response is attenuated to the desired degree.

Know the external speaker. If “sings” at high audio levels—gain control level with a., without impressed speech—(1) either R.F. and regenerative feedback are present; (2) the circuit is picking up in the receiving tubes, or (3) the signal generator may not be oscillating and the load presented to the 25A6 modulator may be insufficient. Keep “playing around” until the generator is oscillating strongly and the audio system is entirely clear of undesirable effects. Set up a small receiver not usable to operating frequency and loosely coupled together in circuit and variable. If voice modulation can be distinctly and cleanly heard, we’re ready to tie C7 to point Y and build up a second communication unit.

---

**CUT RATE OUTLETS**

... are places where National Radio Tubes AIN’T!

A nice comfortable feeling! We mean that secure, clean cut feeling a National Union Service Specialist has when he installs N.U. tubes. He knows he’s gotten a fair price for premium quality merchandise. He’s rendered a genuine service to a set owner and he’s not going to be embarrassed by having his customer see N.U. tubes advertised in some gyp joint down the street as a loss leader.

No, Sir! National Union has kept the market clean for you. National Union tubes are not listed in cut price mail order catalogs. You won’t find them in price slashing chain stores or department stores.

Your profit margin is reasonable when you sell at established list prices and National Union has always felt that you were entitled to protection on it. Remember these facts... the boys who are selling N. U. tubes are selling them with complete confidence... they’re not running a chance of customer ill-will... because the set owner will never see N. U. tubes offered for sale with the heart cut out of the price! This business of keeping the market clean for the Service Industry is only one of the reasons that N. U. is such an overwhelming favorite in the service field... Have you ever heard the entire National Union sales story? It will pay you handsome dividends to be tied up with N. U. Find out why... send the coupon below... NOW.

---

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**CLIP!...MAIL!**

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**RADIO SPECIALISTS NEEDED**

Modern receivers with their complicated circuit systems have knocked out the old-time cut-and-dry radio fixer. Trained men with up-to-the-minute knowledge are needed to service these new sets.

---

**HERE IS YOUR OPPORTUNITY**

Your possibilities of making money and getting ahead are limited only by your ability and skill—but you must know more than the other fellow. You must be a radio service specialist, as R.T.A. can train you.

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To start you making money without delay we include a useful booklet on how to deal with your Coraline Automatic Parts for Radio Repair. For students only.

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**WHAT R.T.A. STUDENTS SAY**

Newark, New Jersey: I have completed with R.T.A. I am now a Radio Service Manager and wish to extend thanks for your help.

Joseph Ruppin, Jr.

Yorkville, Ohio: I received 103 radios and set up 92 articles, which is very good for part-time work while studying.

Chas. Koelter.

---

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ASK YOUR JOBBER

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TECHNICIANS' DATA SERVICE
JOSEPH CALCATERA
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 by us.

1. HAMMARLUND Catalog. Contains complete specifications, illustrations and prices on the Hammarlund line of variable and adjustable condensers; intermediate frequency transformers, coils and coil forms; sockets; shields; chokes and miscellaneous parts for broadcast, short wave and television, and ultra-short wave reception and transmission. Also contains description and prices of the Hammarlund line of "Comet Pro" and "Super Pro" receivers.

2. ELECTRA 1936 Volume Control and Receiver Catalog. Contains 12 pages of data on Electroac standard and replacement volume controls. Tru-val adjustable resistors, vitreous wire-wound fixed and adjustable resistors and voltage dividers, precision wire-wound non-inductive resistors, center-tapped transformers, high-quality attenuators, power (50- and 150-watt) rheostats and other electroacitor specialties.

3. THE KEY TO SERVICE. Four different types of combinations of courses on Radio Servicing, Public Address Work, and Television, developed by the Radio Service Institute, are described in this 24-page booklet. Complete information, testing, outlines of courses and costs, is given. Two of the courses are designed for the more advanced and more ambitious Service Men who are anxious to get to the top of their profession. The other two courses are for less-experienced Service Men who want to advance or work rapidly in the Radio Servicing Field. Please do not ask for this booklet unless you're really interested in taking a course in these subjects.

4. POLYMOR COIL DATA SHEET 536. This folder contains complete data on all types of coils, their specifications, prices, performance curves and circuits showing applications of the complete line of Polymor coil components made by the Aladdin Radio Industries, Inc.

5. RIBON 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.

6. THE 1937 LINE OF SUPRAVAC TUBES. A description and specifications of each of the tubes included in the Sprague Condenser Catalog. This is the only complete list of all Sprague Tubes, and is designed for the Radio Servicer. This booklet also contains the complete list of Sprague Tubes, which explains the characteristics of each of the Sprague tubes. Also contains prices of the Sprague Tube Line for 1937.

7. 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.

8. SPRAGUE 1936 ELEKTROYLIC AND PAPER CONDENSER CATALOG. Gives specifications, with list and prices on a complete line of wet and dry electrolytic, and paper condensers made by Sprague. Also contains information on the various types of condensers desired by 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.

9. CONDENSER TUB-UP. A 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 sensitive tests to be made to determine the efficiency and suitability of given condenser to provide maximum filtering and safety in operation.

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 delay.

VACUUM-TUBE CHARACTERISTICS WITH THE C.R. TUBE

(Continued from page 20)

When the study aims at elimination of distortion, the use of the actual characteristics of a vacuum tube is essential, even if the particular circuit cannot be recommended too highly.

Not only can the cathode-ray tube testing equipment be used for a particular circuit, with small variations can be applied to the routine checking of tubes in production lines. By use of a special type of synchronous switch perfected by the author and described in ELECTRONIC DEVICES (February, 1936) such checks can be made in the ° typical manner. This will allow much more rapid and comprehensive testing of all tubes than has been possible because of the time involved.

Please Say That You Saw It in Radio-Craft
"THE CASE OF THE RESORT"—AND OTHER STORIES

(Continued from page 12)

FRIGE and tradition in mind the countermen caused him to attempt to sabotage the system: 
he insulted anything "hamand" to the kitchen as if you instead of into the mise— 
but that's another story.

The catastrophe that started up the scenes in this case occurred after aucher rush when two men simultaneously shouted their orders into the mikes. The chef's resultant of this is老百姓 ordered to find no words. True 2 parallel mikos did reduce the efficiency of output considerably, but each tricked out of the speaker to bring about an inane incoherent message that almost caused an analyzer to jump off a test bench and gallop down to Ye Eate Shoppe unaided.

A bevy of technicians took to horse and made for the restaurant. When they arrived they found calm had descended again, albeit with mild complications. A system had been devised that served for the time being, but could not endure. Each man looked up and down the counter before about his order. At the time the technicians arrived, business had slowed down but the heads of two of the countermen continued to glow white by glare.

The mix switches were changed to incorporate another throw. When a man pressed his button a pilot light on each mike flashed, indicating that the system was in use. An independent circuit using a simple bell-ringing transformer for energy didn't do the trick.

MORAL: Design your system for worst possible conditions.

THE CASE OF TOO MUCH SOUND

This case involved a tuner at the trailer park, family amplifier for entertainment there; the mine line ran back to the office. The system was to be used in the social hall for entertainment that evening. A mine line run from the social hall to the tent, and the speakers were carried the ambushed business back from office to stage reproducers.

And this was to be carried to the dining hall and the social hall for use with the mine line either place. Field and voice for all speakers followed the 3-wire cable line, with field supplies at the amplifier in the office. Other features of this system were that at the trailer rack, spare amplifier for emergency and a portable record reproducing unit for unit-record mixing facilities.

The set-up looked awed on paper and so was OK'd for installation. Two weeks later the empy sky was punctuated by the telephone office staff walking around training for the first time.

Two times a day a harried technician haggled the mixer up to the dining hall for use there. In a formal version there was for the trailer rack in the social hall, or backstage for sound effects. Another man had to sit in the office to control the things at the amplifier.

Then, something was happening to quality—the long mine lines from the theatre and dining hall 'way over to the empy sky and amusement were suspected. The ground on the mine cable shield at the trailer park was mounted on an insulating wrapping. The social and musical director made their hair at the inflexibility of the system for the trailer. The office manager shivered at the monitor on the office rack—the wiring was in bad shape.

It came sooner than was expected. The explosion rocked the windows at the P.A. establishment. The health officers ran running up for another week's vacation with pay, but here is the solution. It should have been done in the first place; it would have meant a bigger sale in dollars and made every one happy.

The outdoor calling speakers were left in position, but a separate amplifier was used at the office for calling. Another amplifier was set up in the social hall; this unit mounted its own controls and served for the orchestra and stage.

The dining hall, likewise, was equipped with an amplifier and the hall's normal equipped with its own mixing panel—most amplifiers are so equipped anyway. Incidentally, here's a good tip; a simple fact had been overlooked in the original specifications—the enormous noise level of 700 dishes and metal edging testifying at the same time almost unbalanced the amplifier and the installation engineer. And, 1th yes, the thing wound down.

MORAL: The simplest way is generally the best way.

THE CASE OF THE KITCHEN CALL SYSTEM

This one is really too simple, but it did create a situation that will doubtless be of interest to all sound men. The locale of this plot took place in a restaurant. Specifications carried into effect indicated a signal from a microphone in the kitchen and 4 microphones spaced evenly along the back counter so that 4 cooks could work efficiently. The signal on each mike did the trick of throwing it into the circuit. Filaments and plates were on at all times.

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Please Say That You Saw It in RADIO-CRAFT

The Magazine for \"ALL AMATEURS and PROFESSIONALS\"
HOW TO MAKE A HI-FI P.A. AND "UNIVERSAL" RADIO TUNER

(Continued from page 15)

have been assembled on the chassis. The height of the 3 protruding tubes (volume, tone and dial) should be measured from their centers to the bottom edge. If all is correct, then the front panel markings may be measured off on the smooth back. Cut the large circle first, then drill the 3 shaft holes. Inasmuch as the front panel is 1 in. higher than we need, it is best to have a tin snip cut off the excess on a power shears machine. At the same time, have him mount the tuning knob to the top of the photograph. The finished panel will then be approximately 9 ins. high and 11 ins. wide. The tone and volume indicating plates are mounted by means of small sheetcrown pins.

WIRING AND TESTING

The wiring comes next. A good method to follow is to wire one element of each tube at a time. For instance, wire all the shell pros of the metal tubes to ground. Next, connect all cathodes, and anodes. This method eliminates a lot of checking and jabbing back and forth. The author never takes it for granted that a part is OK merely because it is new. So, if an indicator is available, check the following items before mounting them on the chassis.

D.C. RESISTANCE

1.1 Primary 20 ohms; Secondary 6.5 ohms.
L2. Primary 65 ohms; Secondary 6.5 ohms.
L3. Primary 2 ohms; Secondary 3.2 ohms.
L4. Primary 8 ohms; Secondary 5.6 ohms.
Ch. 170 ohms.
F1. Primary 22 ohms. High-voltage secondary, 1,100 ohms, plate to plate.
F2. Winding 0.5-ohm, 0.6-ohm.
F3. Winding 0.6-ohm, 1.0 ohm.
Check all resistors and diodes that are 20 per cent off their rated value. Also check the bypass condensers for shorts or leaks. Check the tubes.

When all wiring is complete, follow out the circuit for wrong connections and continuity. Turn the set on, do not use an antenna, tune dial to 1,700 kc. and volume on full, then check the oscillator to the top of the photograph. If everything is in order, insert the tubes, set the variable condenser section nearest the panel. This is the item, marked "wire capacitor," shown in Fig. 1, which is connected to condenser C and Ca. Note that although the other side of this "wire capacitor" is shown grounded, this is only a fictitious or effective ground and DIRECT CONNECTION TO GROUND MUST NOT BE MADE.

The low-frequency oscillator should first be screwed up tight and adjusted for maximum response at 600 kc. Rock the dial counter slowly up and down while adjusting for the best peak. You will find that the high-frequency end may have shifted 10 or 20 kc., so go over the 3 trimmers again and then check 600 kc. again. All this may sound hard but it really isn't. Our unit was all peaked in 15 minutes and rarin' to go.

Disconnect the test equipment and use either headphones or an amplifier for the air tryout. Connect antenna not longer than 75 ft. to the set. As a rule, no ground wire is needed.

LIST OF PARTS

One Meissen antenna coil, No. 6642, L1;
One Meissen R.F. coil, No. 6644, L2;
One Meissen oscillator, No. 6645, L3;
One Meissen ferrocast I.F. transformer, No. 6645, 456 kc., L1;
One Meissen shielded R.F. choke, No. 5552, 20 mh., L5;
One Meissen 8-plate variable condenser, No. 15122, 365 mmf.;
One Meissen 6-in. dial, 12A-301;
One Meissen paddler trimmer, No. D2500, 500 mmf., C10;
One Kenyon power transformer, No. T249, F1;
One Kenyon filter choke, No. T156, 20 by, C10;
Seven Aerovox tubular bypass condensers, type 454, 0.1-mf., 400 V., C1, C2, C3, C6, C7, C8, C9;
Three Aerovox tubular bypass condensers, type 454, 0.01-mf., 400 V., C1, C11, C12;
Two Aerovox tubular bypass condensers, type 454, 0.01-mf., 400 V., C4, C15.

Now we come to the subject of alignment. The I.F.T. should be accurately peaked at 456 kc. Upon this adjustment alone do you get a maximum of the sensitivity and selectivity of the set as a whole. If you haven't the equipment to do this job right, then by all means have it done by a competent technician.

If you have the equipment, the procedure is as follows: Turn the set off, then turn the dial all the way off the 6AV and connect your oscillator to the top cap. The ground lead of the test oscillator should be connected to the tuner chassis. Connect an output meter or oscilloscope to the output jack at the rear of the set. The R.F. oscillator should be accurately set at 456 kc. and the attenuator set for 1/3-decibel on the output meter. Peak the 2 air trimmers for maximum response, alternating the test signal if the meter goes off scale.

Next, set the test oscillator to 1,600 kc., replace the 6AV grid clip. Feed the test signal through a small micro condenser (100 mmf.) to the antenna pot. The tuner dial should be set at 1,600 kc. and the 3 trimmers on the variable condenser should be adjusted to get the best response all the way. The antenna and R.F. trimmers should be unscrewed a little bit for maximum signal. It may be necessary to use additional capacity across the oscillator trimmer to bring the pointer to the exact line on the dial. The writer added about 5 mmf. by soldering a 4-in. piece of hookup wire to oscillator plate and wrapping 2 turns around the spacer bar. This wire may be seen in Fig. 1, upon which is shown the variable condenser section nearest the panel. This is the item, marked "wire capacitor," shown in Fig. 1, which is connected to condenser C and Ca. Note that although the other side of this "wire capacitor" is shown grounded, this is only a fictitious or effective ground and DIRECT CONNECTION TO GROUND MUST NOT BE MADE.

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Disconnect the test equipment and use either headphones or an amplifier for the air tryout. Connect antenna not longer than 75 ft. to the set. As a rule, no ground wire is needed.
TRY TO MATCH THIS
12-WATT SOUND SYSTEM

Among new designs of moderate power, Model PA-712 ranks the
hull. It will handle audiences up to
30 people, is suitable for
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D. C. TESTING

• Model 735 has a Triplet D'Arsonval
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  readable scales. Ranges are 15-150-750
  volts at 1000 ohms per volt; 1/2-15-
  150 M.A.; 1/2-1000 low ohms; 0-100-
  000 high ohms at 1/2 volts. Provisions
  for external batteries for higher resistance
  measurements. Has selector switch for all ranges
  and individual zero adjustment for resistance measurements.

ASK YOUR JOBBER—
WRITE FOR CATALOG

Fig. 3. Details of panel supports and coil rack.

Please Say That You Saw It in Radio-Craft
MILLION
AC-DC VOLTMETER
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OMHS PER VOLT
AC-DC Volts 0 to 3-30-300-900. 0ms 0-10,000-30-
Milliamperes 0-60-300. 0ms 0-30-0. 30-0-
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Radio is too important an unabridged information—freely, by experienced men
of the industry, the practical, the
merit—so that no one may be
There are several types of radio

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Please Say That You Saw It in RADIO-CRAFT
when the button tuner is in use, but the same
station are free from this interference when
tuned by hand on the dial. It may be neces-
sary to add an additional shielded knob over
the cable between the button tuner and tuner
control box. It may also be necessary to ground the
tuner control knob with a heavy twisted equal-
strip to the battery cable shield in order to
reduce this interference. The shield strip
should be tied as a final resort, if one full
grounding to the tuner control box fails to
remove the ignition noises.

The unusual character of this receiver, plus
the ease of tuning-in local stations without
turning the dial, and the extremely low batter
charge should make it a good seller for those
radio men who specialize in selling custom
sets for discriminating customers.

LIST OF PARTS
One Meissner high-gain aerial coil, type 6621,
L1.
One Meissner high-gain R.F. coil, type 6641, L2.
One Meissner oscillator coil, type 4424, L3.
One Meissner condenser 175 kc, I.F. Transformer,
type 5728, T1-1.
One Meissner Ferricat 175 kc, I.F. transformer,
type 5728, T1-2.
One Meissner 65 mmf., 3-section tuning con-
denser, 6.1 trim (for use with L1). C1, C2, C3.
One Meissner Ferricat 90 mmf. choke, RFC1.
One Meissner 500-12,500 mmf. padding con-
denser, type 15247, C14.
Six Aerovox 0.01-mf. condensers, type 444, C4,
C5, C520, C521.
Eleven Aerovox 0.1-mf. condensers, type 444, C5,
C6, C7, C9, C10, C11, C13, C16, C17, C18, C28.
One Aerovox condenser, 255 mmf. type 1660,
C12.
Two Aerovox mic condensers, 100 mmf., type
146C, C19, C22.
One Aerovox 500 mmf. mic condenser, type
1464, C21.
One Aerovox electrolytic condenser 25 mf. 50 V.,
type P230, C24.
Four Continental Carbon 0.25-meg. L-W. re-
sistors, R1, R4, R5, R16.
Two Continental Carbon 1/2-W. resistors, 250
ohms, R8, R9.
One Continental 1/2-W. resistor, 200 ohms, R5.
Three Continental Carbon 1/2-W. resistors, 10,000
ohms, R3, R6, R18.
One Continental Carbon 1-W. resistor, 50,000
ohms, R7.
Two Continental Carbon 0.5-meg. 1/2-W. resistors,
R11, R14.
One Continental Carbon 1 meg. 1/2-W. resistor,
R13, R17.
One Continental Carbon 1-W. resistor, 10,000
ohms, R12.
One Elytral Daisy-castor with switch 0.5-meg.,
type 303, U12.
One 6E8-type metal "ult." W, unit, 250 V., 50 ma.,
One "A" filter, type 4155.
Two National type STG tubes, V1, V3; (the Nat-
ional type XTM tubes, V3; One National Union type
6TG tube, V5; type 6AGJ type tube, V6.
One Raytheon type 6B1 tube, V7.
One remote tuner (with correct ratio to suit
amplifier tuning condenser: One touch-base mutual tuner
One +, minus, magnet-magnet speaker with universal
transformer.
One five octal sockets, type 1121.
One cradle finish steel box, 8 x 10 x 7 ins.,
type 3922.
One interference control, type 4541.
One 9 x 11 in. sheet of aluminum for chassis:
Foil fl. large shielded horn for aerial lead and
control-grid shielding.
One battery cable No. 12 wire, shielded, with fuse
retainer.
One double tip jack for extra speaker:
One single tip jack for yield light connection:
One bayonet aerial connector:
As needed, metal-cased condensers for ignition
by-passing, etc.
One battery fuse 5 A.: One 1/2 in. bolt for set mounting;
Hookup wire, screws, rubber, crimp rubber, lock
washers, etc.
Names, manufacturers will be supplied upon
receipt of a stamped and self-addressed envelope.

ORSMA MEMBERS' FORUM
(Continued from page 22)

Well, enough of this amplifier talk for the
present, and now let's get down to business.

Firstly, kindly forward me as many "Answer
Adv. post cards" as possible as I do not want
to damage my Radio-Craft by cutting the ads,
out. I'll let you know later.

Secondly, will you please attend to the clips
engaged, and do me a favor, as you should
have access to them.

In conclusion, may I wish you further success in
the sale of this set. Here's hoping you won't make
any improvements to the Amplifier, as I'd hate
not to have to tear it down.

Hamid N. Khoi,
Fairview, N.S.W., Australia.

Thanks very much for your very kind words.
It's nice to know that our carefully-prepared
technical articles are of such international
interest—and assistance.

A LOW-COST P.A. AMPLIFIER
Radio-Craft, Oct. 21. - As a member of the OHGMA, I feel that it is
about time that I passed along a little of the information that I have
learned in the past 5 years of trying to do a good job in a short
time and still be quite a distance from a quick source of supply.

I would like to offer the first suggestion to
those engineers and service engineers who have occasion to require a cheap P.A. amplifier on
short notice. Apart from that work is done nicely.
Well, if you have an old Zenith No. 52 or any other make of similar layout and tube com-
binations, do follow:

Remove the grid wire from the type 21 detector tube.
On top of the tin cover for the tuning condenser, mount "metal mike" transformer.
Gander a wire to one side of the secondary and mount it to the chassis of the set, and
to the other side of the secondary solder a short shielded wire with a grid clip on it to reach
the top of the detector tube. (If the transformer is placed right, this wire will not have to be over
3/4" in. long.) Now mount beside the trans-
former a 4-prong socket and 2 binding posts, wire the 2 outside wires of the primary to the
2 filament prongs of the socket. The primary of the transformer is grounded by
mounting the act of the chassis, now also ground one of the binding posts to the chassis and
run a wire from the other post to the grid and on across to the plate line (tying them together) of the socket.

Now connect a 2-button "mike" to a 4-prong
plug with a button to each large prong and the
mike frame to either of the small prongs; and
3 V. of battery to the binding posts. If every-
thing is in good condition you will have a better
amplifier than can be bought for many times
the small cost of the "mike," stand, transformer, etc. You can save by cheapening the plate and the
 necessitated price.

1. Cos. (The items mentioned above cost me $8.50, and
$3.00 for the set.)

1 used this amplifier in a theater of 600-person
capacity for amateur night and with only one
speaker was able to get a good coverage at
3 ft. from the mike with it turning full on. And
the best part of it is that it is always a good
idea to have a radio receiver merely by chang-
ing the grid cap on the detector tube.

PHILIP HUECKER,
Fitchburg, N. Y.

REPAIR—OR REPLACE THAT DEFECTIVE LOUDSPEAKER
(Continued from page 15)

To customer a better speaker without delay at a reasonable price, he is rendering a service that will gain him a reputation for efficiency that will be reflected in increased business. Your information will gladly supply manufacturers' names and addresses of any items mentioned in RADIO-CRAFT. Please enclose a stamped and self-addressed envelope.

Please Say That You Saw It in RADIO-CRAFT
New ELGIN A.C.-D.C. Volt-Ohm MilliOhmeter
A compact tester that accurately tests A.C. voltages, D.C. voltages, D.C. Mills, and resistance.

Reads obtainable: 0-50-500-1000 volts D.C., 0-5/5/50/500/1000 volts A.C., 0-5/5/50/500/1000 ohms D.C. resistance. The unit can easily be adapted for use with oscillators as an output meter. SHOULD BE A MUST OF EVERY SERVICEMAN'S AND EXPERIMENTER'S TEST KIT.

Net Price to Dealers, serviceman, and Dealers ———- $11.95
Net Price to Retailers ———- $13.95

TRY-MO RADIO PRODUCTS CO., 85 Cortlandt St., New York City

BURIED TREASURE! Find it with the New GOLDAK RADIOSCOPE

Money Back Guarantee! Locates any metal enclosed lead and silver plated in glass. Guaranteed to detect disorder than any other device, regardless of price. Most advanced scientific device. No batteries required. Invented by Chilson, writer almost universally considered one of the most successful mineral detectors for locating treasure.

THE GOLDKAM CO.
1931 Booth Broadway Dept.
R.C. Los Angeles, Calif.

I REGULAR recomends
WET-DRY MICA CAPSULES & FILM

WHY PAY MORE... when Radio City Products Co. offers you better testing equipment at far lower cost?

WRITE TO DEPT. C FOR CATALOG

Radio Courier for July, 1937

SMALL ADJUSTMENT

The radio dealer had just succeeded in selling the most expensive all-valve radio equipment in his shop and was mentally spending the commission on the sale when his customer’s voice brought him back to earth.

“Jim, pal, how about the small adjustment?”

“Just a few minutes,” the dealer said. “I’ll be right out.”

“Would you give me a ride, Jim?” the customer asked.

“Yes, madam.”

“When we drive, I’ll have to use an electric seat.”

“We do not have electric service,” she told him. “Will you have it converted, please, for gas?”

—from New Outlook

REX 6L6 UNIVERSAL AMPLIFIERS

INCORPORATE HIGHEST STANDARDS OF ELECTRICAL AND MECHANICAL EFFICIENCY. PROVEN RELIABILITY. ONLY $5.75!!

Engaged Construction (a radically new departure) provides far more satisfactory performance than usual. Tested upright, or mounted on a wall. Models available producing 14, 32, 60, 64, 96, 100, 150, 200, 250 watts audio output, with only 255 Harmonic Content. (Illustrated.)

NEW REX "LOUD-PHONE" INTER-OFFICE AMPLIFIER SYSTEMS FOR $75.75

WRITE FOR OUR FREE CATALOG.

REX AMPLIFIER SYSTEMS CO.
14-156 West 23rd St., New York City

SMALL ADJUSTMENT

The radio dealer had just succeeded in selling the most expensive all-valve radio equipment in his shop and was mentally spending the commission on the sale when his customer’s voice brought him back to earth.

“Jim, pal, how about the small adjustment?”

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“When we drive, I’ll have to use an electric seat.”

“We do not have electric service,” she told him. “Will you have it converted, please, for gas?”

—from New Outlook

A UNIVERSAL-SERVICE TEST SPEAKER

(Continued from page 16)

A small untangle switch turns on the 110 V. A.C. line where the unit is plugged. The milliammeter is any type, accuracy and calibration is not important. The volume is raised and kept at 500 V. so it must not be more than 50 ma.

Carefully that the meter is connected in series with the field coil only. The reason for this is that if the filter condenser shorts or any heavy current is taken from the pin jacks marked “Positive, Negative 300 Volts” the current through the meter, instead of increasing, will decrease and thereby prevent meter burn-outs and allow us to use a smaller range than we would otherwise be able to do.

Now that we have duplicated the speaker unit of any radio set we should also be able to duplicate the connector systems of the different sets.

LOUDSPEAKER CONNECTION SYSTEMS

After a careful survey of the methods used for the link between the receiver and the reproducing unit we find that the following cables provided a speedy and simple means of connection.

For those sets having a female socket utilizing 4, 5, or 6 prongs, we use 3 separate cables with 4-, 5-, and 6-prong male plugs with the wires cut short and plugged in pin plugs for connection to the speaker test panel.

For arrangements where there is just a speaker cable from the set to the speaker such as the Zenith 444, the cable from the set is connected to an isolated block which is in turn connected to which a 7-wire cable is connected. This cable also terminates in pin jacks for connection to the speaker panel.

For sets that have binding posts to which the speaker cable is connected, we use the 76, we have a 4-wire cable with speaker leads on one end and pin plugs on the other.

For sets utilizing single binding posts we use a 2-wire cable with pin plugs on both ends. Occasionally we come across a set where the ohmmeter sweep on one end of the cable terminating in pin plugs. Now it is a simple matter to merely push the pin plugs into the speaker terminals.

Please Say That You Saw It in Radio-Craft
end comes in handy. All the cables are shown in Fig. 2A.

A few tips on the construction of these cables will not go unheeded here. Use a good insulated wire with a good amount of flexibility, devise a color system so that you will be able to use the cables quickly and easily any time it is needed. The color system I use is simple and fast.

For the 4-prong plug cable I use a red wire for the plate, yellow wire for the grid, black with red tracer wires for the filament plus, and blue with red tracer wire for the filament minus on the side of the plate. Painted into one jack, I merely solder a blue wire for the cathode plus leaving the colors for the other prongs the same. For the 6-prong cable I use a blue wire to run wire for the suppressor-grid pin. By this color system it is easy to identify the wires as they come out of the plug.

These cables are connected to the speaker panel. Selection of the proper colors are simply made by plugging into the proper pin jacks.

The idea of using a speaker switch arrangement was discarded. The possibility of insulation breakdowns in selector switches because of their high voltages in the a.c. voltage losses reduces the complex speaker connection. The most economical, most flexible, easiest operation and best of all cost less. Another advantage of pin jacks is the number of connections per part of the test panel may be used separately for other purposes. In some speakers there is an internal connection between the field circuit and a wire from the set is connected to this connection. To meet this condition we use this simple method of connecting a single wire to two parts of the test panel. There are two sets of 2 pin jacks connected to each other as two triacs. These are used as junction connectors so that a single wire from a cable can be unplugged from one jack to the 2,000-ohm jack. Short jumper leads with pin plugs on both ends can be brought out of the same wire by inserting them into the 2 remaining pins of the triac. Two of these junction connectors are used in the pins and have proven sufficient for all needs. Four plugs and three of the length of the panel, are used with the blocks.

HOW TO USE THE TEST SPEAKER

As an example of the operation of the un-iversal speaker, we will use it to replace the twin speakers of a Zenith model 444 radio set. The entire system has been well explained before. The circuit diagram is in Fig. 2B.

The study of this complex speaker connection shows that a simple wire A which goes to 1 speaker can be connected. The first thing to do is to remove the single wire from the chassis to the binding post strip of our Twelve wire. As soon as the colors through the pin A, B, C, and D. Following the yellow wires go to the 2 jack marked "P" and "P" on the output transformer. The red wire goes to one junction block and the jumpers coming out go to the "C" jack on the transformer and to the 2,000-ohm jack on the top row of the choke and resistor circuit. The brown wire goes to the 2,000-ohm jack and the black wire goes to the 0-ohm jack of the same row. The field of speaker No. 2 goes to the second row. The black and yellow tracer wire goes to the 0-ohm jack and the white and blue go to the 2,000-ohm jack. If you turn on the field supply and switch in the voice coil, you will have the two jack switches and you are all set to go. The entire operation is done very quickly, and with very little practice in less than 1 minute.

One of the other uses of the test set is shown in Fig. 2C. Using the same connector only we get the 3 wires from the set as follows: The black wire goes to the jack marked "VC." The yellow wire goes to the junction block from which one wire goes to the second "VC" jack and the other wire goes to the 0-ohm resistor jack marked 1,000 ohms. The red wire goes to the 2,000-ohm jack. Tarn on the field supply and open the voice coil switches to the transformer which is not being used. This circuit is shown to be about 30 seconds.

A small card index system will prove a great help for some of the odd circuits such as the Majestic model 360 which has a 4-prong plug in 2,000-ohm jack so as to open the 110 A.C. line to the set if the speaker plug is accidentally removed and so prevent damaging the filter condenser. The circuit of the repro-}

Are you one of the thousands of service men getting help from the new Sylvania Technical Manual? Get on the "band wagon" now!

If you knew how many thousands of service men are using this new Sylvania Technical Manual on almost every job you'd realize what a value of a thing it is for 15c!

This handy pocket manual contains 184 pages listing 193 tube types with important circuit application information on each—all about glass, metal and "G" tube types as well as those for Majestic receivers... and full information on Sylvania "Ballast Tubes." Don't be without it! It's one of the handiest tools you could carry! Send the coupon and 15c—we'll do the rest.

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Set-Tested Radio Tubes

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Please Say That You Saw It in RADIO-CRAFT
Correct Procedure for the Servicing Newcomer

(Continued from page 12)

VARIABLE speed induc- tion CONDENSER

Winding: 110 coils. 25 to 80 turns. A.F. with

Shipping Weight 18 lbs.

WELLWORTH TRADING CO.


All merchandise in original packages—

never used. Money-back guarantee.

We will forward Shipments by Express Collect if sufficient postage is included.

Correct Procedure for the Servicing Newcomer

(Continued from page 12)

G.E. PHONOGRAPH MOTOR

Formerly sold for $15.00

Correctly is to align the I.F. in the wrong

sequence. Always start with the I.F. trans- 

former next to the generator and align the

condensers, in order, back toward the signal. 

And always work with the weakest possible 

output from a signal generator. This is the key 

to the secret of a sensitive and selective aligning job. 

(A few manufacturers specify procedure that 

differs from above.)

Those sets using tertiary (a third) windings 

on the I.F. transformers are usually designed 

to be aligned to the “normal” position. In 

the “normal” position. The response curve is 

then broadened the proper amount on switching 

to the high-direct position to eliminate 

feedback. In aligning some I.F. transformers, try 

shortly cutting out the oscillator section of the 

gain condenser. Many times reaction between the 

set oscillator and the generator (that is, service oscillator) 

signal puts you on the wrong track and you 

may be aligning the I.F. to some beat note 

harmonic.

A word now to you news men—all troubles 

in a set cannot be found by analyzing, although a 

much good can be. The trouble must be such that 

a loose wire might give you trouble. Watch the 

readings normally take. If it doesn’t, our voltages won’t 

show where the trouble lies. For example: an 

open antenna coil may cause weak reception, but 

it will not affect any of the set’s voltages. Or 

perhaps we have an open A.C. or D.C. source, 

no voltage will show. If, however, the test is 

“dead.” Many more examples could be given, but I 

believe you understand the point.

Always check the tubes before you start look- 

ing for trouble in the set itself. Quite a large 

percentage of troubles is caused by running 

defective tubes. Present-day tubes require a 

pretty good tester if all the bad tubes are to be 

weeded out. A good tester will catch most of them, 

but to get the real stubborn one, use a power output type checker. This 

magazine some time ago, published an article 

describing how to construct a tube tester using 

an oscillator and the strength of oscillation 

indicating a tube’s worth. This should catch 

most any faulty tube and personally we’d like 

to see another good deal of real tube testers 

now, all with pre-calibrated sets. (How about it, 

fellow, how did you like that article, “The 

Microphone and Receiver” in the January 1933 

issue—Editor)?

A.V.C. Circuits

Those A.V.C. circuits seem to be one big 

stumbling block for many men, when it comes 

to checking the action other than by a listening 

test. Since the circuit is generally controlled or varied by the A.V.C. voltage, a 

check of the plate current of one of these tubes 

will give you an idea of the amount of A.V.C. action. Normal plate current will 

exist with no signal, so if the plate current drops past any reasonable 

amount, you know there is trouble. If you do not wish to use a meter 

for checking, an alternate method is to hook-in 

“em” in the plate circuit. “Tuning the tickers” in fact many factory 

“eyes” can be purchased complete with socket 

and leads ready to connect to any set having 

A.V.C. simple directions for attaching this 

unit being provided. If the set already has some 

form of tuning indicator, this will give us 

direct check on the A.V.C. action. Many 

cases of failure can be traced to defective bypass 

condensers to this section of the set, giving 

them a thorough check, especially for leakage.

Additional Tests

A good condenser tester, one using a sensitive 

meter for the various readings, is a very good investment 

for any Service Man. Coupling condensers should 

always be checked if the set seems 

sensitive than normal, assuming everything 

else to be OK. Be as fuzzy as Aunt Matilda 

when testing the vacuum tube power supply for 

weakness, as the least bit can upset a circuit 

and prevent normal action. Do not rely too much 

on the manufacturer’s ratings when testing 

these capacities.

How many of you fellows have a good pair of 

headphones? They don’t have to be expensive, 

as the ordinary 2,000 ohms-per-pair type con- 

stitute a very good sensitive detector or 

inductor indicator for testing. For aligning 

sets, using a weak signal from the test-signal generator, 

they are invaluable. There is nothing more 

annoying than a set that has a good signal 

in one end and is unanswerable in the 

other.

Please Say That You Saw It in Radio-Craft
HOW TO CHECK CONDENsERS WITH AN A.C. BRIDGE

(Continued from page 19)

Leakage. High D.C. leakage under actual operation condition in usually the result of an electrical failure of the film which makes up the dielectric of the electrolytic condenser. This results in practically a short-circuited condenser and is readily determined by a D.C. test. However, this D.C. test should be made at or near the operating voltage, for the writer has known of cases, even in electrolytic condensers, where the film would withstand a low voltage such as would be impressed by an ohmmeter, yet would break down under the voltage applied to the filter circuit of the radio receiver.

Power Factor. Power-factor measurements on an electrolytic condenser give a very good idea of its condition. Power factors of greater than 20 per cent indicate that the filtering efficiency of the condenser is materially lowered. This is produced by a change in the structure of the paste or electrolyte which is the negative terminal of the condenser, for any current flowing in or out of the electrolytic condenser must pass through the above material and if its resistance is higher than normal there is a resultant loss in voltage which may be represented by a resistance in series with a perfect capacity. This dissipation of electrical energy causes the condenser to be less efficient in its filtering.

The power factor of a condenser is the resistance divided by its impedance.

Therefore, if R is the equivalent series resistance in ohms, C the capacity of the perfect condenser in farads, and f the frequency, the power factor equals

\[ \frac{R}{\sqrt{R^2 + (2\pi fC)^2}} \]

If the power factor of the condenser is less than 10 per cent the power factor reduces to 2\pi fCR. In other words, if the power factor is low there may be no relationship to D.C. Leakage. Of course, if the D.C. leakage is high, the power factor is also high. However, if the D.C. leakage is low, the power factor may or may not be normal.

Those interested in actually experimenting with different power factors in condensers used in filter circuits can, by adding a series resistance, make the power factor of the condenser any desired amount; for instance, to raise the power factor to 10 per cent at a frequency of 120 cycles, a series resistance of 16.6 ohms should be added. Proportionately larger resistance increases the power factor a proportional amount.

Open-Circuits. Complete or intermittent open are one of the most difficult of the condenser faults to determine. The only satisfactory method is to check the movement on the emulator of the condenser and then manipulate the leads or any the condenser to determine whether or not its capacity changes under those conditions.

Electrolytic Action. Electrolytic action between the condenser leads and the condenser proper may be determined by bridge measurements. The ordinary procedure is to set an exact balance on the bridge, both in regard to the capacity of the condenser and its power factor. The electrolytic action developed between the leads and the condenser proper will tend to change this balance either in regard to power factor or to capacity or both with time. Consequently, it is only necessary to observe the visual balance in the bridge Analyzer to be described to determine this condition.

Fig. 1. Interior of the A.C. bridge unit.

Fig. 2. Theoretical circuit of the capacity-resistance bridge.

Please Say That You Saw It in Radio-Craft

PAPER CONDENSERS
(AND "DIELECTRIC HYSTERESIS")

The common faults in paper condensers are:

1. Electrical failures due to a breakdown of the proper insulating paper.
2. Complete or intermittent open-circuits.
3. Higher than normal power factors.

Breakdown. Even though the condenser has failed, this breakdown cannot always be determined except near the operating voltage, for in some cases the original breakdown does not carbonize the paper used as the dielectric of the condenser sufficiently so that it will be indicated as substantially a short-circuit when tested at low voltages. However, at higher voltages carbonization takes place and the condenser shows a very low resistance.

Open-Circuits. The open-circuits, intermittent or otherwise, may be determined in a similar manner as that described under ELECTROLYTIC CONDENSERS.

Power Factor. The power factor of a paper condenser is usually very low, normally ranging from about 1 per cent to less than 0.2 per cent. A paper condenser seldom has a power factor in excess of 20 per cent as failure practically always takes place before the condenser reaches this stage.

However, higher than normal power factors are a forerunner to electrical failure. When a paper condenser has a power factor of several per cent it is a definite indication that deterioration has taken place. Usually this deterioration is due to moisture. However, it may be due to carbonization of the paper caused by ionization in the voids of the dielectric.

If the high moisture content is due to moisture this moisture has probably entered at the condenser ends. It is perfectly possible for one or the other layers of paper used in the condenser to have its edges frayed a considerable amount more than the others. As a consequence, moisture may be taken up by this paper and transmitted into the condenser laterally. The transmission of this moisture between papers takes a very much longer period than the lateral transmission of moisture. As a result, one of the papers may be electrically damp, while the other papers are substantially dry. The result of a D.C. test on such a condenser would indicate substantially a normal D.C. leakage resistance. However, a power factor test would indicate that the power factor was considerably higher than normal, the reason for this being that only one paper is wet and there is practically no D.C. leakage through the other papers. The heat in the condenser upon the application of alternating current would be considerably higher than normal due to what might be termed "dielectric hysteresis."

THE BRIDGE ANALYZER

The Bridge Analyzer was designed after a study of the above common defects in condensers. (Continued on page 33)

Instruments by

...A Guarantee of Precision and Reliability

MODEL 521 . . . 5" . . . Volt-Ohm-Milliammeter . . . One of Triplet's large line of electrical measuring instruments. Others available in 2 and 3 inch round and 3 and 4 inch square sizes. All standard ranges. Economically priced.

The new Triplet factory has day-light construction, it is air-conditioned throughout with temperature and humidity controlled. Especial measures have been taken to keep out dust, lint and microscopic particles . . . the enemies of precision accuracy.

The latest equipment makes possible the most modern processes for aging, relieving strains and stresses of materials and making the fine adjustments so absolutely necessary for producing precision instruments.

No wonder . . . "Instruments by Triplet"—is a guarantee of precision and reliability.

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The Triplet Electrical Instrument Co.
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Please send me more complete information on Triplet Model 521. I am also interested in:

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Address ____________________________________

City __________________ State ____________

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PHILCO SIGNAL GENERATOR
LIST PRICE $22.50

A neat, brand new compact and economical portable signal generator. Complete with standard adjustable standard broadcast and radio sets. Can be bought on the market at this type unit. Complete self-contained; carries its own battery; (1)-Dry battery extra. Includes light and 110 volt A.C. transformer for building projects. Covers a range of 1550 to 6000 kc. built-in battery testing condenser makes for quick accurate operation.

MAIL ORDERS PROMPTLY FILLED
OUR PRICE $4.95

EXTRA SPECIAL!
Genuine Astatic 5-8 $4.95
Crystal Pickup .

THOR RADIO, Inc., New York City

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HAMMARLUND 25th YEAR RADIO CATALOG
The most complete catalog ever published with special illustrations, drawings, curves and a complete description of the famous TH tube "Super-Pro." Write Dept. R.C7-37.

HAMMARLUND MFG. CO., INC.
424-438 West 33rd Street, New York

BUILDING AN INTERFERENCE ELIMINATION BUSINESS

(Continued from page 22)

(3) — Connect ground clip to Analyzer and to appliance frame.
(4) — If you cannot get to terminals of the appliance, cut into the supply lead so that the clip leads will be connected just as close to the device as possible.
(5) — Start the appliance operating. Then turn the Analyzer Selector Knob to Position No. 1. Listen on the customer's radio set (or your own portable radio receiver) to see whether this eliminates the noise. If not, then turn the Selector Knob to Position No. 2, and so on until you determine the filter arrangement that eliminates ALL of the noise. In checking for noise, it is important that the Analyzer be connected directly to the terminals of the appliance (motor, vibrator, etc.) if at all possible. Otherwise there is apt to be a certain amount of interference radiated over the interfering line. If you cannot get to the terminals, cut into the supply line within a few inches of the terminals—just as close as you can get. Filter condensers should be installed at this same place in the line.

The type of interference analyzer here illustrated includes over 16 different filter combinations covering every type of filter circuit used in eliminating radio noise. By disconnecting the ground connections it is possible to obtain 0.5-mf. from dual condensers C1; 0.6-mf. from dual C2; and 0.4-mf. from dual C3. See Fig. 1. Selector Knob Positions Nos. 1, 2 and 3 on the Analyzer include combinations to be obtained by the use of filter condensers only.

Selector Knob Positions Nos. 4, 5 and 6 give a variety of combinations which use both condensers and chokes of various sizes.

For instance, Positions Nos. 4 and 5 use 1 R.F. choke coil and Position Nos. 6 uses 2 R.F. chokes. Positions Nos. 4 and 5 are the same, except that the R.F. choke is in one side of the power supply line for Position No. 4 and in the other side of the line for Position No. 5. In connecting a filter to the appliance for permanent installation according to Position Nos. 4 or 5, the R.F. choke should be tried on both sides of the line to determine which is best.

In some instances better results are obtained by placing the R.F. chokes between the power supply line and the condenser. This is done by connecting the offending appliance into the Analyzer "B" socket and the supply line into the "A" socket.

USE OF LINE FILTERS

Occasionally a line filter will prove beneficial, especially where the radio set antenna has a shielded lead-in and has been proved to be free of interference. In this case, simply treat the radio receiver as though it were a household appliance. Connect the Analyzer just as you would connect it to an appliance. Then determine the proper filter to use by rotating the selector knob until the noise is eliminated. Connect the ground wire of the filter to the receiver chassis or the receiver ground, as circumstances dictate.

Heavy-Duty Equipment. Where the interference is very low, it often draws more current from the circuit. In such cases, filter condensers must be interconnected to complete the job. Simply connect the Analyzer as you would for a straight capacity filter. Cut the wire to the appliance (motor, etc.) and connect the heavy-duty chokes into the circuit in series. Then try Selector Knob Positions Nos. 1, 2 and 3 to see which produces best results.

Heavy-duty chokes have not been incorporated into the Analyzer as they would add materially to its cost and the few jobs where they may be required can be handled satisfactorily and inexpensively in the foregoing manner.

Housing. Special boxes of sturdy metal construction to contain filter condensers and chokes are used on interference elimination jobs are obtainable. These are marked and drilled for easy installation and insure a neat, efficient job. We strongly recommend their use. In some cases they are necessary to meet Underwriters' regulations.

Always remember to connect the filter devices as close to the offending appliance (motor, etc.) as possible. If you can attach them to the terminals or even inside of the frame of the appliance so much the better. In any event, use a long lead to the filters. Every superfluous inch of lead wire may add to your troubles by causing radiation of interference even after the filters have been installed.

This article has been prepared from data supplied bycourtesy of Sprague Products Co.

Fig. 2. Different types of interference filters attached to electrical appliances.

Please Say That You Saw It in RADIO-CRAFT
SERVICING BY SIGHT AND SOUND

(Continued from page 21)

The input to the amplifier is on the left and the output is on the right. In order that the operation of this equipment may be more clearly understood, refer to Fig. 1 which is a block diagram of the auxiliary apparatus.

In the lower-left corner of the diagram (and of the demonstration board) is a switch which, when turned, is used to change the input to the amplifier so that it may be applied to a beat-frequency oscillator or a phonograph pickup. The output of the amplifier connects to a rectifier and filter (not shown) and to a detector (not shown) which applies to the cathode-ray oscilloscope either the direct or the rectified output of the amplifier. The units at the lower right of the diagram marked "Var. F. O."—"Fixed F. O., Rectifier," and "Detector" are units incorporated in a standard beat-frequency oscillator.

A beat-frequency oscillator operates by combining the output of two R.F. oscillators so that their difference in frequency will be the audio frequency and will be the frequency delivered to the amplifier under test. This audio frequency can be varied by varying the frequency of one of the R.F. oscillators.

AMPLIFIER TESTING PROCEDURE

To determine the characteristic of an A.F. amplifier at constant audio voltages, audio frequencies are applied to the amplifier and the variation of output at various frequencies is noted.

 oscillator board is shown to put the characteristic curve of the amplifier on the cathode-ray oscilloscope requires that this be done rapidly. In order to produce rapid variations of the audio frequencies, there is in parallel with the testing condenser on one of the R.F. oscillators, a variable condenser which is so arranged that it can be rotated by a motor. This makes it possible to change the frequency to suit the particular amplifier under test. When the frequency is increased, the position shown in Fig. 1 is at minimum capacity. When the motor turns the shaft the variable condenser moves and the frequency is decreased. The frequency of the frequency of the R.F. oscillator varies from a low audio frequency to a high audio frequency and then back again. This rapidly varying output is applied to the amplifier under test and the output of the amplifier is applied to the cathode-ray oscilloscope.

The timing of the oscilloscope is adjusted so that the image will sweep across the screen within a few cycles varying from its lowest point to its highest point. In order to hold the oscilloscope chart the frequency the oscilloscope requires that this be done rapidly. In order to produce rapid variations of the audio frequencies, there is in parallel with the testing condenser on one of the R.F. oscillators, a variable condenser which is so arranged that it can be rotated by a motor. This makes it possible to change the frequency to suit the particular amplifier under test. When the frequency is increased, the position shown in Fig. 1 is at minimum capacity. When the motor turns the shaft the variable condenser moves and the frequency is decreased. The frequency of the frequency of the R.F. oscillator varies from a low audio frequency to a high audio frequency and then back again. This rapidly varying output is applied to the amplifier under test and the output of the amplifier is applied to the cathode-ray oscilloscope.

SEQUENCE CHART

This chart may look a little complex but if followed carefully from the top down, its purpose may be realized.

The first part of the chart is divided into 4 equal sections. The width of those 4 vertical columns denotes the time required for the oscilloscope image to move across the screen. Inasmuch as the other operations are accurately timed to correspond to this sweeping impulse generator on the right-hand end of the motor shaft that is connected to the synchronizing terminals of the oscilloscope. This produces a stationary image. In order that you Service Men may understand exactly what takes place, Fig. 2 gives a clearer idea of the sequence of operations.

For the first sweep the pattern will be shown on the screen but during the next sweep which is the reverse of the first, it will be short-circuited and only a straight line will appear on the screen. The 3rd sweep will be the same as the 1st and superimposed on top of it. The 2nd will be abbreviated making a straight line again. So, when all are put together they will coincide and give the characteristic curve of the amplifier with the zero line drawn, at the bottom, as "Complete Image." This is the familiar type of curve which manufacturers publish in data books giving the performance characteristics of their amplifiers.

Analyzing this chart, it may be pointed out that the chart has been done to cover 4 successive sweeps. However, this only covers 2 complete reversals of the motordriven condenser mechanism. The complete image is what is shown at the top of Fig. 2. It is the type of view that appears on the screen of the cathode-ray oscilloscope. At the meeting where this instrument was demonstrated the characteristics were shown both visually and audibly. Visually on the screen of the cathode-ray oscilloscope and audibly through reproduction. (Service organizations interested in group-instruction of this nature are interested to contact the author either directly or through Radio-Craft.—Editor)

This article has been prepared from data supplied by courtesy of RCA Manufacturing Co., Inc.

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TRANSMISSION OF INTERFERENCE.

There are 4 ways for the inductive interference to reach the receiver, namely: (1) It may be radiated directly into space, especially if the source is quite powerful. (2) It may be conducted along power wires and reach the receiver that way. (3) It may be conducted along the power wires and radiated by them to the aerial. (4) It can be re-radiated by another conductor nearby.

Directly-radiated interference reaches the receiver by way of the antenna. It is, therefore, encountered with all transmitters as well as line-operated sets. Such interference should be suppressed at the source; but, failing that, it is possible to overcome it by using a special antenna situated away from the interference source and supplied with a noise-cancelling lead-in.

Inductive interference usually does not extend more than 50 ft. from the source, the aerial can be swiveled so as to cover the building, while the special lead-in passing through the noise zone will cancel out any pick-up of its own.

Conducted interference can usually be reduced by means of a line filter. This is simply a pair of condensers connected in series across the line and center-tapped for a ground connection. Suppression at the source, of course, is a better procedure, for some of the interference may be radiated by the line and thus reach the set through the antenna, which gives us the 3rd variation. If the interference hinders off the wire into space, then we have plenty of trouble.

The fourth classification relates to a nearby aerial or wire which has picked up interference elsewhere and is re-radiating it. This becomes shifting the nearby aerial or wire with relation to the set aerial, if unable to kill the trouble at its source.

NOISE-DETECTION PROCEDURE.

Begin with the receiver. Make sure it is not guilty. It may be receiving a static noise. Defective tubes may cause intermittent buzzing. These are often difficult to locate. The old test of disconnecting aerial and ground is not always reliable because some noises occur only when a signal is coming. Tapping various parts of the set may locate poor connections or faulty components. If possible, another receiver should be tried in exactly the same location.

Assuming that the receiver is blameless, disconnect aerial and ground, and short-circuit the aerial and ground binding posts with a short piece of wire. If the noise remains equally strong, it is of the second or conducted kind.

If a battery-operated receiver is available, it serves to check interference caused by direct radiation or indirect radiation through power wires or adjacent aerials or wires. Interference radiated by the power line can usually be identified by tuning through the dial and down to the short waves. If the trouble becomes worse on the short waves, it is usually due to direct radiation and the source is probably within 50 ft. If the interference is worse on the long waves, the interference is probably carried along the power line and radiated by it. The source may then be several blocks away.

Again we repeat: the best cure is suppression at the source. But if that is impractical, then there are several things to do at the set end.

NOISE SUPPRESSION.

If line noise originates outside the building, they may be kept out of the house wiring by the line-noise filter shown in Fig. 1A. Two paper condensers of 1 or 2 mf. each, rated at 600 V., are connected as shown, close to the point where the power line enters the building. Fuses should be inserted as an added protection. On A.C., the filter may be placed between the transformer and the grounded. An alternative circuit is indicated in Fig. 1B, but there is little danger of shock if the transformer is grounded. The ground first when installing the filter. It may be necessary to try several grounds. In any event, the ground wire must be kept as short as possible and should not be the same as that used for the receiver.

Where simple filters fail to turn the trick, a more elaborate arrangement such as shown in Fig. 1C becomes necessary. More than one section can be employed with different-size coils.
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so as to bring maximum attenuation in the correct bands. Inductor values ranging from 0.1 to 1 millihenry have been employed for the broadcast band with condensers of 0.1- to 0.5-mfd. This will not be necessary if a complete shield is employed to shield the filter. Carefully. Mounting the coil in inductive relation to each other helps the effectiveness of the filter. The 3rd measure the set owner can take is to employ a special n o t e - r e d u c i n g antenna system. A typical layout of this general type is shown in Fig. 1b. In this case the aerial does all the work of picking up signals. The lead-in or downward is an active pickup, its sole function being that of a transmission line between aerial and set.

In the final analysis, however, suppression at the source is the best way out. In Figs. 2a, B and C are shown various types of filters for electric motor hum suppression. Electric motors of the series type, both A.C. and D.C., may be shielded from the circuit of 2a to this extent by impressing upon the field serve as a choke. The center-tapped condensers are connected across the brushes—not across the line. If the frame of the motor is grounded the center-tap of the 2 condensers can return directly to the motor frame. When this is possible, the noise is reduced by the additional condenser 0.01-mfd. Though the total circuit and the condenser are nothing but switches and can be treated the same, the diagram that proves effective for flasher sights is shown in Figs. 2e.

Neon signs are notorious offenders in the motor hum region. The large signal which can be excited by high-voltage A.C. condensers can be fitted across the primary as in Fig. 2f. It is also effective to include a choke, properly insulated, in between the letters of the sign. If necessary, the winding on a narrow metal band around the glass tube near the middle of the sign, this band to be grounded.

Diathermy machines, X-rays, violet rays and so on are not only radio transmitters and cause severe interference. The power line should be grounded at the source of interference by a similar method to that shown in Fig. 1c. The directly radiated interference can only be stopped by a complete shielding of the room and filtering all wires passing through the shield. If a power line filter is used at the machine, however, the special aerial will probably take care of the direct radiation.

The chokes should have a maximum of impedance over the tuning range of the receiver. In general, the larger the choke the better—if it does not have too much distributed capacity. Economic considerations however, usually fix the size of the choke. Standard sizes for chokes have been anywhere between 100 and 1,000 microhenries.

In designing a choke the current carrying capacity of the wire should be taken in consideration. Since heavy wire means an expensive and large choke, the filter is often designed to carry no more than the current for a good-size receiver and care should be taken not to overload it. Table 1 shows the current-carrying capacity of several wire sizes, as given by the National Board of Fire Underwriters, together with the maximum allowable number of watts on a 110 V. R.M.S. line. The impedance of a multi-layer coil of square cross-section, Fig. 2g, is given by the equation:

\[ L = \frac{6 + 9e - 10b}{N^2} \]  

Where \( N \) is the number of turns and all dimensions are in inches. The most efficient coil is one when both factors are distributed in such a way that they can be canceled in the above equation and after some mathematical juggling be put in the following form:

\[ a = \frac{52.6}{\sqrt{d}} \]  
\[ b = -0.46d \]

where \( d \) is the number of turns per inch and can also be found in Table 1.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>B.S. Safe current on Turns-per-in.</td>
</tr>
<tr>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>18</td>
<td>8</td>
</tr>
</tbody>
</table>

This article has been prepared from data supplied by courtesy of Arrowz Corporation.

How to Check Condensers with an A.C. Bridge

(Continued from page 49)

The function of this bridge is to determine the condition of electrolytic paper condensers both in regard to D.C. leakage values and power factor.

The bridge consists of a network so designed as to measure capacity from 10 microfarads to 100 microfarads; power factors from 0 to 50 percent; D.C. resistance values from 1 ohm to 1 megohm; and D.C. leakage of electrolytic and paper condensers under actual voltage operating conditions. The D.C. voltage impressed on the condenser for leakage tests may be varied by the operator from 0 to 150 volts. D.C. leakage of electrolytic condensers may be measured as well as D.C. leakages of paper and mica condensers.

The diagrammatic schematic circuit of the Bridge Analyzer and a simplified diagram of the bridge network, used, is given in the main body. This main circuit has a scale of \( 1 \frac{1}{2} \) ins. so that the values of capacity and resistance may be accurately determined.

A 655 electronic visual-indicator tube is used as a null indicator instead of the customary headphones, making the test simple, quick and accurate.

The Service Man and experimenter, it is believed, will appreciate this device which enables him to accurately determine the condition of all condensers in a radio receiver.

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Another advantage of this modified system is the fact that if a load of resistance is increased to such a degree that it will operate on the "A" portion of its plate characteristic except for changing its plate current, it will be found that the plate current will remain substantially constant, thus keeping the harmonic distortion to a negligible value at ordinary volumes.

Like its premier predecessor in one make of present-day commercial radio receiver, its fundamental operation is based on the change of resistance in an expansion filament as its temperature is raised by the passage of a large current. Two bulbs are connected in a Wheatstone bridge arrangement as shown by heavy lines in Fig. 1. (A complete 36-W. amplifier is shown for the purpose of demonstrating clearly how the new modified expander connects into a practical amplifier circuit.) When the voltage across points A and C is increased, the current in both sides of the bridge is increased and more heat is evolved in the lamp filament causing a rise in temperature, and, because of the high temperature coefficient of this wire, an unbalance current of considerable flow between the B and D terminals of the bridge.

THE NEW MODIFICATION

The modified expander circuit differs from the commercial type in that the former circuit is always operated near the balance point. This is accomplished by inserting the expander proper after the first tube of the amplifier. With this modification, it is possible to add a slight or no change in the output stage, if a voice coil were connected across points B and C as is done in some commercial systems now in use, in order to obtain a somewhat lower degree of expansion. The advantage of this is that no loss may be expected across the elements of the Wheatstone bridge. This fact alone places a practical limit on the degree of expansion possible. Should the Wheatstone bridge be operated with a large unbalance, two opposite resistance arms must be increased or decreased in value before the change is appreciable in the unbalance current. A bridge operated near its balance point, however, requires but a small change in resistance of two diametrically opposite arms to cause a large increase in output current. Since the change in resistance of a bulb filament is limited by its temperature coefficient, then, in order to secure a large increase in unbalance current by a minimum increase in input voltage, the bridge should be operated at a point very close to balance. In fact, if the bridge is balanced and the slightest unbalance occurs, the ratio of increase will be very small. It is also original with this circuit to use the filament current, and the resultant value no matter how small, when divided by zero, results in infinity. Another advantage in operation is that the balance near the balance is an increase in time lag which is desirable. Therefore, the bridge will run V7, used as an output transformer of a VHT which is, in turn, feeds a pair of 6L6s arranged to operate as a push-pull class A amplifier and capable of driving 35 to 50 W. E. A speaker if the power supply is well regulated. The construction details are quite simple and should be easily gleaned by studying the schematic shown by heavy lines in Fig. 1. Two transformers are usually used in this circuit, one for each branch of the Wheatstone bridge proper, and the bulbs are always operated at 6608, 6609 and 6609 in the reverberation. For T2, the transformer used was one made to match a voice coil impedance. Should a push-pull grid be used as an output transformer of the type made to work with 35 to 50 W. E. A speaker, a great deal of improvement is made.

If a driver stage is used to swing the grids of the output stage, then the bridge, with its associated step-down and step-up transformers, is used to drive any receiver. The equipment is made available by courtesy of Wholesale Radio Service Company.

If a driver stage is used to swing the grids of the output stage, then the bridge, with its associated step-down and step-up transformers, is used to drive any receiver. The equipment is made available by courtesy of Wholesale Radio Service Company.

LIST OF PARTS

One universal-type output transformer, high plate impedance to 1.5- to 2.0-ohm secondary load, T1;
One universal-type output transformer (functions as a coupling transformer) and 2 push-pull grids unit, if operated reversely, T2;
One output transformer (for 6L6s in class A), tuned to speaker, T3;
Two automobile headlight bulbs, 3 candlepower, 6 V, V6, V7, V5, V3, and the bulb resistance.
One Electrode tandem control, No. 6608, 5 ohms (individual 10-ohm rheostats, part No. 204-W, may be used instead of rheostats), R32-R69;
Two Electrode resistors, 3 ohms, 2 W, R13, R14;
One Wholesale Radio Service Co. metal cabinet, 6 x 5 x 2 in. deep, D.P.D.T. switch, etc.,
One Wholesale Radio Service Co. Lot of miscellaneous items included are: jack plugs, escutcheon, knob, D.P.D.T. snap switch, etc.,

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

Please Say That You Saw Us in Radio-Craft
USEFUL RADIO CIRCUITS

(Continued from page 23)

HONORABLE MENTION

How to Obtain High Voltage from Several Hundred Volt Receivers-Type Transformers. "Name" and experimenters often want high voltages for D.C. voltages. This can be supplied by using ordinary broadcast receiver power transformers, wired in a bridge circuit which, in conjunction with a 38 or some other mercury-vapor rectifier tube, allow a D.C. output nearly equal to the A.C. voltage of the power transformer. See diagram G. Now to further increase the voltage, wire another mercury filament of the same rectifier to center-tap of next power transformer. Then will have the voltage of No. 2 added to No. 1. You can make two bridge circuits like No. 1 and get still higher voltages, wiring them in series, of course. All filament windings to rectifiers must be separate. They can be part of the same power transformer, but separate filament transformers would be less likely to have any breakdown trouble. By these circuits the voltages are raised but the transformers are not overloaded.

HUBERT BISSARD

HONORABLE MENTION

A Home-Made Output Meter. A good output and A.C. meter can be made from a taping meter which can be picked up for about $25, taken from a Majestic 69-A receiver. The rectifier is an Eikon type, cut down to set a more sensitive rectifier. For A.C. readings, an old output transformer is used and the meter is then calibrated against a standard model. It may also be used as an output meter to keep up I.P. and R.K. stages, etc. The A.C. side of the rectifier is connected directly to the voltage. See diagram H.

FRANK KOLLATT

HONORABLE MENTION

Good Home-Made Condenser Tester. After experimenting for the last couple of weeks, I have found a circuit which tests condensers from 10 mfd. to 100 mfd. and gives a fairly accurate test. I used an old filament transformer from a Majestic "B" eliminator, a 2 W. neon lamp, a 0.25-mfd. 400 V. bypass condenser, a 400 ohm choke, and a type 61A tube as a rectifier. In addition to testing condensers, this unit can also be used as a continuity tester. See diagram I.

E. O. COLE

HONORABLE MENTION

Versatile Vacuum-Tube Voltmeter. I wish to present an A.C.-operated, flexible, vacuum-tube volt meter of entirely original design, simplicity and precision. I built this meter in my work, and it was used as an output meter "on the line" in one of the local radio manufacturing companies. Comparison with similar equipment used for this purpose. The 6J7 meter tube is used because the response is linear in a range of 0 to 1000 volts. Some of the uses of this meter are: for measuring A.C. voltages from transformers, A.C./V.C. voltages, and on audio tubes at the grid, and when tapped high-resistance voltage dividers are used: output meter on plate of core voice coil: gain in final stages of receiver: etc. In some cases an A.C.-operated V.T. volt meter will give a more accurate measurement when A.C./V.C. voltages are being measured. There are a number of things one can do to improve the meter: (1) change the power transformer of the V.T. volt meter (which may have leakage or too high a capacity) for primary and secondary, etc.; (2) add a ground from chassis, including insulated mounting of the filter condenser; (3) insert a regulated-plate and capacity filter in the grid lead of the D.C. plate of the V.T. meter (see diagram J): (4) reverse line plug: (5) replace peripheral ground from receiver and line bypass condenser (if there is one).

WILLARD CHANEY

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THERE is no electrolytic replacement required for the servicing of the modern A.C.-D.C. receiver that cannot be successfully accommodated by either the types KR or JR dry electrolytic capacitors. The type KR series is enclosed in a round aluminum container with convenient wire terminals and stud and bolt mounting, for sub-panel wiring. The type JR is assembled in a handsome silver container and provided with convenient leads and mounting feet. Both the KR and JR series is available in single, dual and multiple capacity combinations.

For a neat, profitable job and complete customer satisfaction standardize on C-D Electrolytics. Complete catalog free on request.

WORLD’S LARGEST MANUFACTURER OF CONDENSERS

FREE: New 1937 Catalogue of Short-Wave Radio Receivers, Transmitters, 5 meter receivers, and summer portable sets; send stamp to cover mailing costs.

NOTE: Kits are factory assembled by us and are ready to work without a single diagram. No tube to drift or burn out. 20% discount required on C.O.D.'s.

EILEN RADIO LABORATORIES

ON THE BOARDWALK ATLANTIC CITY

HOTEL KNICKERBOCKER

IN THE HEART OF ALL RESORT ACTIVITY

FIREPROOF CONSTRUCTION AMERICAN PLAN SALT WATER BATHS

ROOM AND BATH FROM $3.50 AMERICAN PLAN FROM $6.00

C. HENRY LARROW, Manager

TWO WAY COMMUNICATION

Interphones, offices to office, factory, shipping depot, garage and hundreds of other uses. Positive in operation. Simple to install. Modern in appearance. Any number of phones to same line.

(Dealers and jobbers write for discount)

HAVE YOU SOME SPARE ROOM

A basement or garage where you can do light work? We can offer you a profitable proposition earning 5 and 10¢ per hour. Astras, Ply Automobiles, etc. We will purchase them from any man and will pay the best possible price. Expect to pay from 5¢ to 10¢ per car, depending upon the condition. All you do is to clean and polish the car. May be run as a side line business or as a regular business for the repair of old cars. Write us for details. Ask for the "26-10¢ deal." The AS-Manufacturing associates, 111 W. 34 St., New York City, N.Y.

Vest Pocket Adding Machine


TAYLOR SALES CO., 27 West Broadway, New York, N. Y.

Vest Pocket Adding Machine

Free Trial $2.50

Please Say That You Saw It in Radio-Craft.
THE LATEST RADIO EQUIPMENT
(Continued from page 25)

NEW NEON TEST LAMPS (1396)
[Sundf Engineering Co.]

CLASSIFIED as electroscopes and current-measuring types, two new groups of neon lamps have made their advent on the market. Various designs of each are illustrated. They are identified, as to voltage to glow on A.C., as follows: No. 5179, electro-deglass, 200 V.; No. 5171, electro=glass, 520 V.; No. 5172, electro-deglass, 1,000 V.; No. 5173, test probe, 1,000 V.; No. 3146, tuning wand, 110 V.

The electro-deglass tubes operate on the same principle as a condenser. Electrons flow between the 2 metallic caps deposited on the outside tips of the tubes, with the neon gas acting as a conductor between the 2 metallic caps. In normal practice, the current/bright relation is very high, especially when the frequency is about 5,000 cycles; current drain rarely exceeds 4 micro A.

The high impedance, these tubes may be operated in circuits of very high voltages and low currents without causing any appreciable change in the normal operation of the circuit. Many important applications for this type of tube are slather-heat output indicators, transmitter and R.F. pilot lights, insulation and condenser testing, and automobile ignition testing.

The current-measuring type is of the internal-electrode glow-tube type. The length of glow along the 6-in. electrode is a measure of the current passing through the tube. For this reason, it may not only be used for D.C. measurements, but also for indicating the relative current in R.F. circuits. The intensity of the current will cause a bright glow to creep up within the tube along the electrode. In direct-dial circuit work, however, the current passing through the tube must be limited to less than 10 ma. This may be accomplished by use of the proper shunts and series resistors. Many important applications for this type of tube include transmitter adjustments, R.F. measurements, current readings, and radio-receiver output meters.

MIKE STAND (1404)
[Amperite Corp.]

THIS MIKE stand merits special attention in view of its radical departure from previous designs. Placing a microphone horizontally lowers the center of gravity and thus makes the stand unusually stable. The leaf spring suspension act as an excellent shock absorber. The microphone may be rotated in practically any position; horizontally for pulpit, desk and foot-light installations.

SOUND-CELL MIKE (1405)
[The Brush Development Co.]

BY TIPPING at about a 45-deg. angle the "cue ball" sound-cell assembly shown in phantom view in May 1936 RADIO-CRAFT, page 675, important advantages are obtained. In addition, the sound cell itself has been improved so that the output (40 db.) is the highest of any sound cell so far produced. Available with line matching transformer.

DYNAMIC MIKE (1406)
[American Microphone Co.]

A PRESSURE-TYPE dynamic microphone suitable for either close or distant pick-up, in indoor or outdoor installations. Measures only 3 1/2 x 2 3/4 in. dia.; wide frequency response; high- and low-impedance matching; semi-directional.

VARI-VOLT TRANSFORMER (1407)
[General Electric Co.]

THIS TRANSFORMER will supply the service bench with an output of 210 W. max.; toggle switches control the output voltage ranges of 0 to 100, 200, and 300 V. D.C.

RADIO-CRAFT for JULY, 1937

THE LATEST RADIO EQUIPMENT
(Continued from page 25)

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[General Electric Co.]

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NEW INTERPHONE ([145])

Both a model A, shown at left, and a deluxe type shown at right are available from a well-known manufacturer of sound equipment. The model A system utilizes a common amplifier and a push-button on the top-right surface of the desk unit. The deluxe job is provided with a secrecy earphone and up to 6 sub-stations and control switching system.

A NEW BOOKLET

Of interest to the technician and the radio short-wave enthusiast is the new folder describing the new Super-Pro just published by The Hammarlund Manufacturing Co., Inc. This folder contains valuable technical data concerning this new "communication type" receiver which is of general interest to radio technicians and aside from the particular receiver described. Write to Radio-Craft for your copy of this folder—ask for No. 1403.

CORRECTION ITEMS

May Radio-Craft, pg. 675, contained a slight discrepancy concerning the crystal microphone, Item No. 1328, that has been called to the attention of Radio-Craft by The Brush Development Co. Item C in the illustration referred to as cellophone instead is specially-prepared paper.

June Radio-Craft, pg. 716, carried a most regrettable trinity of errors—a transposition of credits which was not caught in time to make correction. Correction credits are: B. & O. radio installation, Crosby Radio Corp.; Evanston, Ill., police ambulance radio installation, General Electric Co.; meteorograph radio balloon, National Carbon Co.

"CELL" OR "BATTERIES"?

In order to get a check-up from an authoritative source concerning the proper use of the terms cell and battery—which are used indiscriminately by most radio men (a single No. 6 drycell usually being called a "dorcell battery")—Radio-Craft requested from National Carbon Co. a comment in this connection. The reply, from their Mr. L. B. Fox, follows:

"Definitions from Webster's New International Dictionary:

"Cell—a cup, jar or other vessel containing electrodes and an electrolyte for generating electricity."

"Battery apparatus for generating voltaic electricity, consisting of one or more cells."

"Thus, a single cell may be called a 'battery' correctly. However, the definition commonly used in the battery-manufacturing industry is that a battery consists of TWO or MORE cells! It is recommended that a single unit be termed a cell and a combination of two or more cells be called a battery."

A well-designed interphone system. ([142])

A NEW HIGH QUALITY SWITCH

The Shallcross Rotary Instrument Switches are designed for high voltage, high frequency and high insulation applications.

These switches can be made with any number of contact points up to fifteen, shorting or non-shorting, can be furnished with suitable insulation for metal panels, ganged in two or more decks, A- shaft, single hole mounting. Ideally suited for band switching, high resistance voltometers, multi-range instruments, etc.

Send for Bulletin 530-P for details.
NEW—JUST OUT!

before installing.

Train and set the chassis. Then install and wire in all components except the R.F. assembly. Put the variable condenser and the oscillator paddles in place, at least, as these items cannot be installed after the coil assembly has been bolted-in. Wind up both R.F. and mixer sockets completely, too, as it will be almost impossible to do so with the coil assembly present, allowing accessibility of terminals. Do not elevate the tuning condenser more than 1/3-in. above the chassis, as it will touch the top of the cabinet. Rubber faucet washers will lift the condenser just about the right amount and will be quite advisable as a means of taking up shock and preventing condenser plate vibration and microphony.

Install both the specified dial (if it is desired) and the gear reduction unit for the remote control on the condenser's 3/4-in. shaft—making sure that both are of 6-1 ratio. Place the front panel in proper line and secure it to the chassis by means of the audio volume control shaft nut and a couple of machine screws. Bolt the generator (or the substituted vibrator power supply assembly) securely inside the cabinet and to the left, leaving enough connections from the sockets and male receptacle on the front panel. Proper hookup data for socket, chassis, and power supply of either type are given in one of the accompanying diagrams.

The VIBRATOR POWER SUPPLY

It might be noted that complete vibrator-type power supply assemblies are available which will supply 6.3 V. A.C. and may be substituted for the generator specified if the choice is made. The vibrator generator and the vibrator units will afford excellent service if well made and adequately rated.

To those builders who will be using a single pentode audio stage and a vibrator job affording the required power for the complete receiver and the necessary voltage (about 60 V. for normal conditions), some of them may find the vibrator data will be welcome. One such vibrator is pictured, and a table taken from it is given now to relate to that particular job as shown.

Figure 6 gives the circuit and component values. This is a self-rectifying type, is compact, exceptionally efficient, and affords long vibrator life. It will supply approximately 250 V. at 60 ma. of filtered D.C. power when connected to a storage battery delivering 6.3 V. at the center-tap of the transformer primary. If a somewhat higher voltage is required, it is considerably lower current it will simply be necessary to adjust the conditions of the receiver so that lower current would be drawn from the pack. (The most advisable thing to do is to reduce the current drain of the 6F6 pentode.) If, on the other hand, a higher current on the order of 60 or 70 ma., the power source current will be of a system to which the usual filter condensers at the coil and ammeter, etc., and all the other more or less customary items may be added. The table and additional items are a dome light filter and filters in both the antenna and power output stages.

Building this receiver is going to be quite a job. But don't let that scare you. It will work with surprising efficiency when in operation and will be well worth the business of constructing it. Further, we can guarantee it to meet every requirement of that exacting customer who wants "the best of the best," as Ben Bernie would have it.

STATIC SUPPRESSION IN ALL-WAVE CAR RADIO SERVICE

One of the first tasks that interference met with in auto-radio service—three of which become of increasing seriousness as the receiver is extended to and through the higher frequencies.

The first one is that caused by high-tension spark discharge, generator commutator arcing, low-tension breaker point noise, domelight radiation, and static from wind-shield wipers, clocks, heaters, fans, and various motor-driven and electrical-powered items factory-installed or optionally used in the car. The usual spark suppressors, distributor suppressor, coil, and other high- and low-frequency suppressors, and domelight filter which are customary to the average good B.C.L. band set installation will, if they are at all effective, be well regarded for the frequencies to which an all-wave job tunes. Proper shielding of antenna leads and nearly any low-loss wire helps here.

(2) The second is metal-to-metal noise caused by poor connections throughout the auto chassis and body and calling for extra-careful attention where switch and wiring are installed and designed to meet the high-sensitivity receiver such as this Radio-Craft 1937 Car-Radio Receiver. The shielding and grounding which assure the last traces of ignition interference will help in suppressing this type of noise. As we have just stated, unusual care must be exercised to insure against any possibility of both ground-to-ground arcing and the difference of potential between various metal parts. Flexible bonding from bulkhead to motor block and drive-shaft torques through the frame to radio-set mounting bolt, and from all free metal parts to a common ground point may be required. A very careful with bonding, and if

Please Say That You Saw It in RADIO-CRAFT
good ignition noise suppression has been achieved and the antenna is properly shielded, no more so-called "buzz" was found than that brought in at the average home receiver.

3) The third is static interference made apparent only when the car is in motion, which is caused by road-surface, tire, and friction-electricity discharge, and to a lesser degree by water in the tires, makes one sit up and take notice during short-wave reception. This type of noise makes itself felt in the tubes and muffler tail pipe ground, which will be imperative here, as well as some sort of effective means of grounding the transmission. Wheelbase suppressors, installed in all 4 wheels as shown in Fig. 4A mounted on standard dust caps within the regular hub caps, will eliminate static and other interference.

4) The fourth is interference in the form of power-supply buzz which will really "hassle." Some of this type of noise may be eliminated by increasing the size or number of audio filter components in the "B plus" lead from power pack to receiver. Such increase is not always effective, however, as is the case when using any conventional audio filter chokes may be for that matter inapplicable with heavy "B" current drains and because of increased voltage drop across them and lower "B" output, and it is therefore advisable to secure or build a power supply which in itself is very carefully filtered, especially to give proper service with 5-meter receivers. Most of the noise is more apparent than actual (so far as its source at the distributor or eliminator is concerned), and is really set up by radio-frequency disturbances which get into the 6.3 V input and "B plus" leads to the receiver, nothing under the sun but R.F. chokes will help here, and it is suggested that one be placed in the "B plus" wire from the power unit to the short-wave receiver, with an additional 6.3 or 12 V filter capacity directly across the supply output. Such a filter in any convenient item of guaranteed effectiveness at all voltages to which the receiver is to tune and of current-carrying capacity sufficient to prevent full receiver drain at full output. Radio-frequency interference in both "A" and "B" battery leads to the power unit may ultimately, each built to carry 10 A or so and effective at least on the short-waves. Where R.F. interference is found to be of high order in sum total effect, see Fig. 4G. However, there is no reason on earth why an all-wave, high-gain receiver, connected to a suitable antenna, will not give excellent performance in automobile service provided the suggested precautions are taken to eliminate static and other interference.

With the antenna grounded, the set should run perfectly quiet. With the antenna connected properly, noise would be found (that picked up from other than strictly local sources) and may be suppressed by trimming the antenna circuit to resonance somewhere in the noisiest short-wave band (say the regular short-wave band) and by careful alignment of the tuned circuits on A.L.I. bands. Peak efficiency in the R.F. stage will always bring up the signal-to-noise ratio, of course, and it might be advisable in some instances to remove the A.V.C. from this stage so that the tube used with it will operate at all times at full conductance. The use of a simple noise suppressor circuit in the receiver might be a very desirable added refinement. Figure 4C shows such a circuit—adapted to the Radio-Craft 1937 Car-Radio Receiver.

LOCAL REGULATIONS

Some city or state ordinances prohibit the operation of car radio receivers in certain portions of the frequency spectrum of the broadcast band—that used or reserved for police mobile communications in particular. It will be wise for the builder of an all-wave automobile radio to make sure of local regulations—of, of course, state laws—before connecting his receiver, and to then eliminate such coils as would tune to the prohibited bands, or to make such changes as would prevent these coils from tuning to the "taboo" points. As the most interesting is regular short-wave, tuning from 19 to 50 meters approximately, and as this band would handle noise (make sure of it, however), we can still have our all-wave receiver and do away with the intermediate band entirely. It is true that the user of an all-wave car radio set play around with the short-waves on such bands only when the car is not in motion—or where circumstances are such as to permit his giving entire attention to the wheel and the road. "Fishing" for DX while driving is a dangerous and altogether improper business, and the writer of this article wants to go definitely on record as to the great importance of that fact. "Safety of the road"—for the driver and for the "other fellow"—must command even attention, recognition, and respect.

TEST EQUIPMENT FOR THE SERVICE MAN

(Tubed from page 25)

TUBE TESTER

Employs an English-reading fan type meter which is direct reading. This unit which is light and compact for shop or field use, checks all 4.5, 6, 7 small and large, and most transmitting tubes with an emission test. A neon short test is included.

Low cost, yet consistent with dependable operation is the feature of this instrument.

(Superior Instrument Co.)

5,000 OHMS VOLT METER

A high-resistance A.C. and D.C. meter having scales of 0-5-30-300-3000 V. A.C., 0-3-30-300-3000 V. D.C., 0-300 microamperes, 0-3-30-300-600 ma. D.C., 0.1 microampere, direct reading, 0-10,000 ohms, 0-10 mg. ohmmeter, all housed in a handy case 5 x 3 x 3½ in. deep and

having a special high-torque movement and built-in test leads. A handy unit for the Service Unit of local P.A. dealers.

(Million Radio & Television Labs.)

A.C.-D.C. SERVICE OSCILLATOR

A 6-band signal generator covering the frequencies from 20 kel. to 31 megacycles. The tubes are external to the case and the line-droping resistor is in the line cord so that the interior of the case is not heated by those units. This increases the stability of the instrument over other makes which have the tubes and resistor near the coils where they can be raised in temperature. A separate 600-cycle oscillator provides modulation.

(Elta Radio Co.)

COMPREHENSIVE PRINTS (FREE)

The kit includes circuits for the most recently released tubes, and devices on older types of tubes that you probably have in your shack. The new Stancor "59-C" Kit contains all the parts you need for every circuit—less cruts, all photo-forms.

COMPLETE SCHEMATIC BLUE PRINTS INK WITH EVERY KIT

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850 BLACKHAWK STREET CHICAGO

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BOOK REVIEWS

RADIO SERVICING, by M. N. Beitsman. Published by Supreme Publications. Size, 8 1/2 x 11 ins., 17 pages, Price, 50c.

This book contains shortcuts and money-making ideas and undoubtedly will interest many beginners in radio servicing. This publication is of little interest to experienced Service Men as the chapter headings indicate: 100 Common Radio Faults; Tuning Mechanism Out of Order; Condenser Replacement; Power Transformers; Alignment Adjustment; Money in Modernization; Extra Speakers;市ai Money-Saving Possibilities; Public Address Offers Real Profits to Service Men; Tube Testers.

RADIO SERVICE BUSINESS METHODS, by John F. Rider and J. Van Newhizen. Published by RCA Manufacturing Co., Inc. Size, 6 x 9 ins., 218 pages.

Here is the first authoritative volume to analyze and explain the best known present-day methods and procedure of conducting a radio service business. Primarily the authors seek to help the radio service engineer, unfamiliar with bookkeeping, maintain an orderly accounting system which will keep him constantly informed of his financial progress with the minimum of time and effort. This book was originally offered as one of the units of the Point Service System Plan which was designed to help the radio Service Man get more business, simplify his handling of it and organise his procedure. Undoubtedly, for many this book will mean the difference between failure or success in independent radio servicing.

Part I, by John F. Rider, contains 6 chapters discussing practical aspects of managing a service business. Part II, by John Van Newhizen, contains a foreword and 9 chapters on accounting procedure. A 5-page index of Part II is included. The author of Part I is a well-known technician. The author of Part II is an accountant and auditor of long experience in the radio field.


Although this volume is by an English writer the radio man will have no difficulty in "translating" the text into the language of "America can in which "value" becomes vacuum tube, etc. Of special interest to our review editor was the considerable amount of information the author has been able to compress into the limited number of pages in discussing the design factors involved in radio receiver design. Anyone adding this book to his technical library will be well rewarded with a reference which contains all the fundamental information necessary to the proper design of efficient radio receiving equipment.

The table of contents is much too extensive for reproductions but, the book contains a complete chapter of which the first three pages are given below:

The Superheterodyne and Its Frequency-Changer: Need for Selectivity: Principle of Superhet; Principle of Frequency-Changer; Two-Valve Frequency-Changer: Single-Valve Frequency-Changer: Conversion Conduction; Oscillator Ganging; Whistles.

This book is a little too technical for the rank-and-file beginner insomuch as the authorcredits the reader with at least a nodding acquaintance with technicalities. The book has appeal mainly as general reading and reference for the technician who has graduated from the kindergarden stage, and its author's use of corollaries is most intriguing.

NOVEL RADIO ITEMS

(Continued from page 32)

flashlight portion uses 2 cells. The pencil-end switch will lock closed. (1387).

Distributor-Suppressor Lighter. Any radio man would be foolish not to appear wearing this, seemingly, distributor-type "interference suppressor." Remove the top-half shell, and after you have flipped it back onto the receiver. (1383)

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(While every precaution is taken to assure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.)
NOW IS THE TIME TO CASH IN ON THE MOST SENSATIONAL HOME TRAINING PLAN IN THE HISTORY OF RADIO

Make Me Prove that YOU Can Make Good in RADIO

MY TRAINING ACTUALLY SETS YOU UP FOR BUSINESS

RIGHT NOW..... Is the Time to Get Started in an Industry That is Making Fortunes for Live, Wide Awake Men.

THIS new and different kind of Training does more than teach you about all branches of Radio. It teaches you Radio business methods—it sets you up ready for an actual start in business—and it backs up every step of your training with REAL PROFESSIONAL RADIO EQUIPMENT!

No matter what kind of Radio Training you take, it is absolutely necessary that you have equipment of this kind BEFORE you are ready to start making real money.

Sprayberry Training brings it to you almost at the start—teaches you just how to use it under actual working conditions. Upon completion you have COMPLETE business and technical training PLUS the needed equipment to enter business at once for full or part time profits—or to start off on a career in any one of Radio's specialized fields such as Public Address, Auto Radio, Commercial Radio, Broadcasting, etc.

ACT TODAY
Get Into Radio — An Industry That Shows a Profit NOW!
Radio is going ahead by leaps and bounds. And now TELEVISION is on its way!

Today is the time to get started—and Sprayberry Training will start you right. Investigate at once! I will show you how an investment of only 17¢ a day—just about the cost of a pack of cigarettes—can mean a real future for you in one of the fastest-growing professions in the world.

EARN UP TO $25 A WEEK WHILE LEARNING—READ WHAT THESE MEN SAY

A. K. LANE, Nashville, Tenn., writes: "Your name is so thoroughly good and trusted, I am sure to look at your catalog and think that Sprayberry is the man. I have always had this wish for the last forty-six years; sending you a little envelope with the money to start the training for my son. You deserve all the credit, and I can't tell you how much I appreciate your course."

EDWIN & GRODUCTION. Arizona: "I can't believe your course, is the best I've heard of, and I can't wait to start it. Yours is the best training they have ever had for men who are coming to be trained in any kind of Radio, and all the training you have shown me has been successful. You deserve all the credit, and I can't tell you how much I appreciate your course."

WALTER DAVIS. Baltimore, Md., writes: "Your training is the best one I have ever had in Radio, and you have trained men in the field for years. I have always heard of Sprayberry, and I can't wait to start it. Yours is the best training they have ever had for men who are coming to be trained in any kind of Radio. You deserve all the credit, and I can't tell you how much I appreciate your course."

NOW SEND FOR FREE BOOK!

My free book has started hundreds of men on the road to success in Radio and happiness in life. It's crammed with facts you can't afford to miss—filled with TRUE STORIES of men that I put in to Radio. Get this book and read it. If others can succeed in Radio, so can you—it's all in getting started right. Get the right start TODAY—mail this coupon for YOUR copy of this great FREE BOOK!

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Please send me, without obligation, "More Money in Radio" and complimentary facts about your new type of training.

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THE NEW
MODEL 775
WESTON
SERVISET

...Combining the Model 772 ANALYZER and the new, matched Model 773 TUBE CHECKER!

Features:

1. Complete, modern servicing combination in a solid, polished-wood case of finest construction! Real luggage handles.

2. Contains the famed Model 772 and the new, matched Model 773 Tube Checker.

3. Model 773 perfected emission type tester...tests tubes under standardized load resistance...big, sensitive meter.

4. Improved noise test...all electrodes. Neon short check...while tubes are hot. Cathode leakage test.

5. Wired for rotating filaments...spare socket...obsolescence forestalled!


7. Model 772 has big WESTON Meter...sensitivity 20,000 ohms-per-volt...resistance ranges up to 30 megohms...current as low as ½ microampere. Wide range of usefulness...including all receivers, P. A. systems, television, sound movies, photo-cell circuits, etc.

A New CONCEPTION IN COUNTER TUBE SELLERS!

Entirely different! Commands instant attention in this striking, polished solid-wood case. Conveys to customers the impression of true, scientific accuracy. Instrument also fits the single and combination carrying cases. Quickly interchangeable. Note the new Weston rotator-type tube chart. You 'spot' your tube instantly. Charts easily replaceable.

WESTON Instruments can be purchased under the WESTON deferred INVESTMENT PLAN!