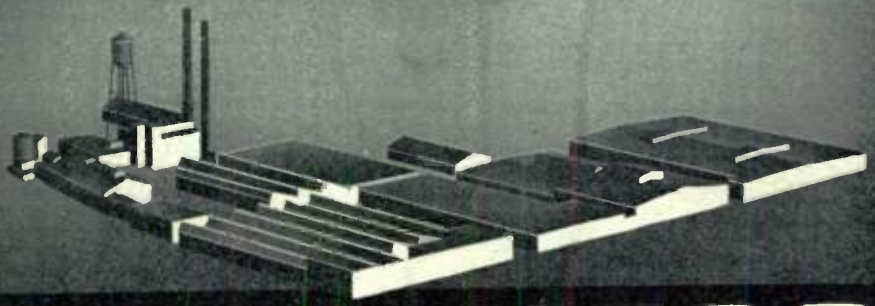
THE C-D CAPACITOR



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RADIO SERVICE HINTS

Practical Suggestions on Solution of Radio Servicing Problems Encountered In Actual Experience by Servicemen Everywhere

This section, conducted by our servicemen readers, will be a regular feature of the C-D Capacitor, and is intended to provide other servicemen with helpful notes on testing, locating troubles in specific models of sets, repairing them, or any other suggestions to simplify service work.

Cornell-Dubilier will pay $2.00 for each hint published in this section. Notes must be limited to 75 words, or less. Any number of hints may be submitted at one time. Unpublished items will not be returned. Be sure to give your name and mailing address. Send hints to: Editor, C-D Capacitor, Cornell-Dubilier Electric Corp., So. Plainfield, N. J.

R.C.A. Sets with Iron-Core I.F. Coils

Oscillation in R.C.A. receivers which use iron-core I.F.'s (those from about 1937 and later) will almost always result when a new I.F. tube is installed. This is especially true of the newer receivers using the new single ended tubes. It may even cause motorboating. The cure for this is a complete I.F. alignment. Can be detuned but loss of sensitivity occurs. The only way to align a job like this is to start with the last stage and work towards the first. The important thing to remember is not to touch the tuning of any of the stages once they have been tuned. Do not for instance tune the 3rd I.F., go to the 2nd I.F. and then go back to the 3rd again. This is critical and important. Also by using a metal tube stubborn oscillations may be more easily controlled.—*Milton Ratynski, Richmond, Va.*

Tube Bases for Multi-Plugs

Tube bases make excellent multi-plugs when used with the proper tube socket as receptacle. The desired connections are made to the prongs of the tube base; then it is filled with common red sealing wax care being taken to keep the cord in the center until wax has cooled.

The older single ended types of metal tubes, from which the elements may be readily removed, make good multi-plugs.

A hole of the desired diameter to accommodate the cord, or for sake of neatness, a grommet, is drilled through top of shell. Soldering the leads in the proper prongs and fastening the shell back to the prong base completes the job.—*Chas. L. Culley, Melville, La.*

Rider Chanalyst

If the audio eye shows signal indication while the cable for that channel is completely out of the input jack, remove chassis from cabinet and beneath the audio section will be found an electrolytic by-pass, C-10 on the diagram, mounted on a terminal strip. Remove this unit and replace with a new 10 mfd. Beaver BR 105 will make a very suitable replacement. This capacitor filters the ripple voltage appearing across the inductance L1 in the power supply section and if not in good order will permit this ripple to reach the grid of the 6Q7 audio amplifier and on to the 6E5.—*Paul V. Zyn, Milton, Pa.*

Improvised Voltage Divider Taps

A quick way of making taps, or for obtaining intermediate voltages on voltage dividers such as Candohms is to insert a flat, thin strip of copper or brass about ⅛" to ¼" wide and 1" long down inside the insulation of the unit. By sliding it to one side a good contact can be made with the wire resistor element, and can be tried in various places on the resistor until the desired voltage is obtained. The supply lead may then easily be soldered to the strip.

This is merely an improvised method of tapping this type of resistor but has been found especially practical when a unit is not obtainable with the taps provided, or when there is no time to order a special unit for a job.—*John A. Makuta, Curtisville, Pa.*

Chrysler Motor Interference

A bad case of motor interference in 1941 Chrysler cars sometimes can be remedied by pushing the extrusion in the bakelite insulator of the mopar aerial thru the middle of a four inch piece of ½" shielding and clamping the ends under the clamp around the metal housing. This grounds the upper end of the aerial housing to the cowl and shields the short exposed section of aerial within the insulator.—*R. O. Elmgren, Cloquet, Minn.*

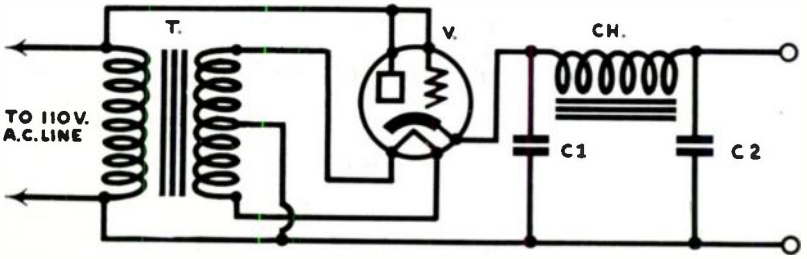
Hum in AC-DC Sets

When abnormally high hum modulation is present in a.c.-d.c. receivers, it is suggested that the heater of the pentagrid converter be located as near chassis potential as possible. In several cases where this condition was investigated, hum modulation was reduced considerably by rearranging heater connections in such a manner that the heater of the pentagrid converter was second from the chassis. The heater of the first a-f tube was located at chassis potential in order to reduce hum introduced in the grid circuit of this tube.—*Milton Bobring, St. Louis, Mo.*

A "B" Power Supply Pack

In many cases a small power supply may be found useful on the service bench to test small receivers or adjust a speaker. The writer built a unit as shown in the diagram herewith and found it especially useful for this purpose.

This pack can also be employed to energize a 2500 ohm dynamic speaker by omitting the choke and second capacitor. The output of the supply is about 100 volts with a current of between 12 to 30 mils.



"T" represents a 2½ v. transformer; "V" a '27 type tube, "C1" and "C2" 4 mfd. capacitors, "CH" 30 henry choke.—*I. W. Stubblebine, Reading, Pa.*

A Free Market-Place for Buyers, Sellers, and Swappers.

These advertisements are listed FREE of charge to C-D readers so if there is anything you would like to buy or sell; if you wish to obtain a position or if you have a position to offer to C-D readers, just send in your ad.

These columns are open only to those who have a legitimate, WANTED, SELL or SWAP proposition to offer. The Cornell-Dubilier Electric Corp. reserves the right to edit advertisements submitted, and to refuse to run any which may be considered unsuitable. We shall endeavor to restrict the ads to legitimate offers but cannot assume any responsibility for the transactions involved.

Please limit your ad to a maximum of 40 words, including name and address. Advertisements will be run as promptly as space limitations permit.

WANTED—Late Radio Service Course, also Electrical Course. Must be in good condition. Please state cash price and all particulars. Radio Electric Service, 323 Broad Street, Grove City, Pa.

WILL SWAP—11 blueprints, 2 single tube radios, button mike and transformer, magnetic speaker, 14 N.R.I. lessons. Want good battery volt-ohm-ma. meter. D. B. Brown, Park Spring, Texas.

WANTED—Candler's, Jr. course in code instruction. Give all particulars and price asked. J. I. Smith, 30 W. Main St., Reynoldsville, Pa.

FOR SALE OR TRADE—What am I offered for a "DeForest Radio-Sound-Television" course. Omnigraph code machine. A "Gardiner-Levering" automatic code sender. All A-1 shape. James E. Smith, B 612, Spindale, N. C.

POSITION WANTED—Motion picture projectionist 14 years experience, union, American. Will work anywhere at permanent job. H. Simmons, 497 Rentschler St., Akron, Ohio.

FOR SALE OR SWAP—Two Wright-Decoster 12 inch speakers, (para-curve cones) exciters and 64" x 46" x 25" horns with reflex channels. Speaker list $58. each. All for $30. Also have 110 v. a.c. generator and other items. Need Hickok traceometer. Precision Radio Service, Langdon, N. Dak.

WANTED TO SELL—Rebuilt meter movements. Universal, a.c. and d.c. various scales. One thousand, twenty-five hundred ohms per volt. Compact assembled test kits, milliamohmeters, Western Electric magnetic speaker model 540 AW. E. M. C. D. Bendheim, 22-33 Thirty-first St., Astoria, L. I., N. Y.

WANTED—C-D Capacitor Bridge, BN. Have motors, engines, radios, chassis, books, and parts. All correspondence acknowledged. A. Penquite, Jr., 513 So. 5th St., Marshalltown, Iowa.

WANTED—Jensen PMJ-18 in A-1 condition, Radio News HI-FI amplifier, Rider's volumes 1, 2, and 10. State condition and price. Abernathy Radio, Blakesburg, Iowa.

FOR SALE—Meters, several makes, low and high range, volts and milliamps, sell all or part cheap. Also several sizes P.M. and coil dynamic speakers. Want test equipment, V.T. voltmeter. Clark Bros. Radio Shop, Albia, Iowa.

FOR SALE—American D9AT mike, Shure 707A mike 455 kc. crystal filter, Radio City trouble shooter, 30 watt modulation transformer, Mac audio oscillator, R.C.A. 807 tube, Bliley 40 meter crystal in holder, Gilbert 200 power microscope. Fred E. Lee, 2239a Montgomery St., St. Louis, Mo.

FOR SALE OR TRADE—Motorola "65" six tube auto radio, perfect condition, 1939 model, has Oldsmobile dial, $18.00, or trade for good a.c.-d.c. battery portable. Erwin Lee 2234 S. 108 St., West Allis, Wis.

WANTED—Will buy back issue of Electronics of April, 1940. Dewey Mell, 619 Ohio St., Lima, Ohio.

WILL SWAP—1 Supreme diagnometer test panel (original cost $160), also 1 Ranger model 640 free point tester, for volumes 1 and 2 Rider's Manuals in good condition. C. F. Delagi, 2175 So. Blvd., Bronx, New York City.

(*Continued on page* 13)

COIL AND CONDENSER TESTING*

IN FIXED condensers, whether of the tubular or electrolytic type, temperature and humidity changes, together with the normal strains to which they are subject due to operating conditions, serve to produce defects which are often none too easy to check, particularly when intermittent in character. Yet, despite all these considerations, it is unfortunately true that the majority of service shops are not equipped to test for any but the simplest defects in condensers, other than by substitution.

The same situation exists with regard to troubles occurring in coils and transformers. While most defects arising in the latter are rather easy to locate, there are some (such as a decrease in Q due to moisture absorption) for which most service shops have no satisfactory means of testing.

In this discussion we are considering tests of both coils and condensers, since often the same apparatus is suitable for either. And, though we must necessarily devote some space to the measurements of fundamental quantities, such as inductance, capacity and impedance, it will be kept in mind that the primary object of any test is to determine whether or not the unit will perform satisfactorily in the circuit in which it is to be used.

Often this means that the measured value of capacitance is of very little importance—bypass condensers often may be much greater or much less than rated capacitance without affecting the performance of the circuit in which they are used. Then, again, while we think of high capacity as providing improved bypass action, in practice we frequently find that other considerations are of much more importance. Take, for instance, the bypassing of an ultra-high frequency circuit. A 1-mfd condenser, theoretically, would have only 1/1000th the reactance of a tiny .001-mfd mica type, yet the unavoidably higher internal resistance of the former renders it much less effective in bypassing in the u-h-f circuit.

The same situation exists with reference to electrolytics. While excellent in bypassing action in power-supply filter circuits, the electrolytic often is less efficient in radio-frequency circuits than a paper condenser of much lower capacity. That is why we often see a large electrolytic shunted by a small paper or mica condenser; the electrolytic does a swell job of filtration on the lower frequencies where the paper or mica condensers, of lower capacity, are ineffective, and the latter take care of the r-f components which the electrolytics can't handle.

Coil and Condenser Measurements

One of the simplest arrangements for checking the capacity or inductance of condensers or coils is shown in Fig. 1. In this setup, what is actually measured is the impedance of the unit under test, and this is evaluated in terms of capacity and inductance by assuming that the reactance is very large with respect to

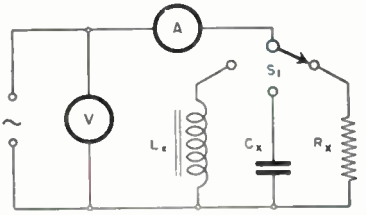


Fig. 1. Simple circuit for checking either capacity or inductance.

** By courtesy of "Radio Service Dealer"*

the resistance of the unit and is therefore substantially equal to the impedance. The impedance is determined by the familiar formula

$$Z = E/I \quad (1)$$

which is Ohm's law for alternating currents. Z represents the impedance in ohms, E the voltage and I the current in amperes. For example, if the line voltage were 100 and the milliammeter showed a reading of 50 milliamperes, a.c., the impedance of the unit would be

$$Z = 100/.050 = 2000 \ ohms \quad (2)$$

Capacitive reactance is usually represented by the symbol X_C and inductive reactance as X_L. Knowing the capacitive reactance, we can determine the capacitance of a condenser from the following formula

$$C = \frac{1{,}000{,}000}{6.28\, f\, X_c} \quad (3)$$

in which C is in microfarads, f is the frequency in cycles and X_c the capacitive reactance in ohms. If we consider X_c as being equal to Z, by substituting the result obtained in equation (2) above, we find that the capacitance C of a condenser which has an impedance of 2000 ohms at 60 cycles is

$$C = \frac{1{,}000{,}000}{6.28 \times 60 \times 2{,}000} = 1.33 \ mfd$$

And, if the a.c. milliammeter gave a reading of 5 milliamperes instead of 50 milliamperes, at 60 cycles, the impedance of the condenser would be 10 times as great—20,000 ohms—and the capacitance one-tenth as great, or about 0.133 mfd.

For coils, the inductance in henries is found from the following formula:

$$L = \frac{X_L}{6.28\, f}$$

where L is the inductance in henries, f is in cycles and X_L represents the inductive reactance in ohms. Taking the same example as for the condenser, and considering the inductive reactance to be substantially the same as the impedance, we find that the inductance of a choke which passes 50 ma at 100 volts, 60 cycles, is

$$L = \frac{2{,}000}{6.28 \times 60} = 5.3 \ henries$$

And, for the common 30-henry choke, the reading of an a-c milliammeter in the circuit of Fig. 1 would be about one-sixth of 50 ma, or approximately 8 ma.

Other points can be determined in like manner. In many analyzers, the copper-oxide rectifier meter is used in just this manner to measure inductance and capacity. However, and this is important, *this circuit should not be used for testing electrolytics.* Applying such a high alternating voltage without a d-c polarizing voltage might wreck the condenser instantly.

Wide Range Checker

An arrangement for checking a wide range of paper and mica condensers, using the same fundamental circuit of Fig. 1, is shown in Fig. 4. $T1$ is a 1-to-1 isolating transformer, often omitted, and the meter is the usual 1000 ohms-per-volt copper-oxide type voltmeter, used on the 100-volt scale. Three ranges are obtained by using shunts $C1$ and $C2$

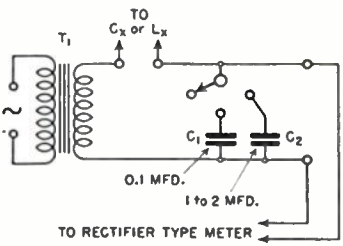


Fig. 4. Circuit for checking a wide range of paper and mica condensers.

for the higher-capacity ranges, up to about 6 mfd. Without the capacity shunt, maximum sensitivity is obtained, enabling a check of capacities as low as .001 mfd, though of course it is none too accurate at such low values.

output circuit. The input to the audio amplifier is first connected to the condenser or choke by throwing the switch and the output meter reading is noted, varying the volume control of the a-f amplifier until a convenient arbitrary reading is ob-

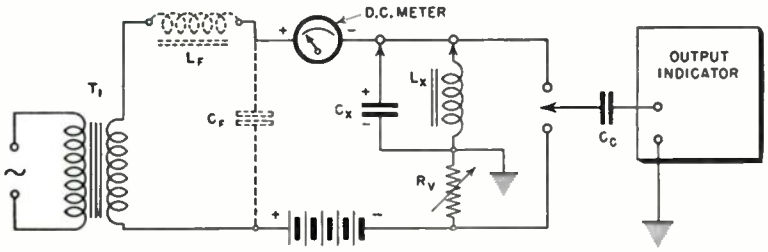


Fig. 2. Circuit for checking condenser leakage and measuring the impedance of inductances.

Another test method is shown in Fig. 2. In this arrangement, as in the circuit of Fig. 1, the impedance of the unit is determined This is done by using a tube voltmeter, or other similar out-put indicator, and adjusting the calibrated resistor *Rv* until the same indication occurs on the output indicator as is obtained when the output indicator is connected across the unit under test. The applied alternating voltage may be very low—just sufficient to give a reading on the output indicator—so that electrolytics may be tested. Further, a battery and d-c meter may be hooked in series, as shown, so as to check for leakage in condensers and to supply a polarizing voltage. For chokes, the impedance may be measured while normal d-c is flowing in the circuit, so the conditions more closely approximate normal operation. For precise work, the low-pass filter *Lf-Cf* is used to attenuate harmonics of the 60-cycle test frequency so that more accurate results may be obtained.

For the output indicator an ordinary two-stage a-f amplifier may be employed, using any meter suitable for aligning purposes across the

tained. The switch is then thrown so as to place the amplifier input across *Rv*, and *Rv* is varied until the original reference output meter reading is obtained again. The reading across the condenser or choke is again checked. When the readings are equal, the resistance of *Rv* is equal to the impedance of the unit under test. The capacity or inductance may then be determined in the same manner as was described for the circuit of Fig. 1, using the same formulas.

Electrolytic Tester

In Fig. 3 is shown a circuit employed frequently in factory testing of electrolytics. The a-c milliammeter reads the current resulting from the applied a-c, and is thus a measure of the impedance of the condenser, and the d-c milliammeter reads the leakage current. The purpose of the high-inductance choke is to prevent the battery and d-c meter from acting as a short circuit across the condenser under test.

In these circuits it is apparent that as the impedance of the unit under test increases, the current decreases. This means that the a-c milliammeter

must be very sensitive if small values of capacity are to be tested at 60 cycles. Furthermore, it is always more desirable to check the unit at somewhere near the normal operating frequency of the circuit in which it is to be used.

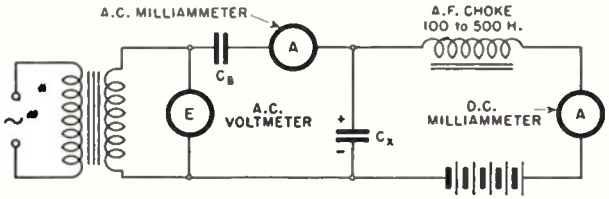


Fig. 3. Circuit arrangement for the testing of electrolytic condensers.

One way of doing this is shown in Fig. 5-A. This is a simple broadcast-band oscillator which uses a tuning condenser calibrated in micromicrofarads. In operation, the condenser *Ct* is adjusted until the plates are well in mesh and the resulting oscillation is picked up on an adjacent radio receiver, preferably one using a tuning indicator to tune in the unmodulated oscillator signal. Alternatively, the receiver may be tuned to a broadcast station at the low-frequency end of the dial and the oscillator adjusted to zero beat with the broadcast signal. The condenser to be checked *Cx*, is then shunted across *Ct* and the capacity of *Ct* in mmfd is noted. *Ct* is then readjusted until the oscillator frequency again zero beats with the broadcast signal. The amount by which the capacity of *Ct* has to be decreased to restore the original reference frequency of oscillation is a measure of the capacity of *Cx*.

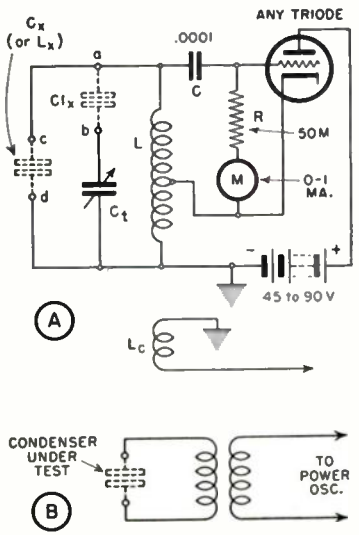


Fig. 5. Variable oscillator circuit for checking the capacity of condensers, etc.

For larger values of capacitance, which are beyond the calibrated range of the tuning condenser *Ct*, the unknown condenser may be connected in series with *Ct*, as *Clx*. The capacity of *Clx* is then determined by first tuning in the oscillator signal before connecting in *Clx*, and noting the capacity setting of the condenser. Then *Clx* is connected, as shown, in series with *Ct*. Since the addition of *Clx* in series reduces the total capacity across the coil, the tuning condenser *Ct* will have to be readjusted to a somewhat higher value of capacitance to restore the original reference frequency of oscillation. We may call the amount by which the capacity of *Ct* must be increased to restore this condition *Cr*. Then we

can find the capacity of *Clx* from the formula

$$Clx = \frac{Ct^2}{Cr} - 1$$

For example, if the oscillator frequency were 1000 kc with *Ct* set at a capacity of 300 mmfd, and, after connecting Clx in series between the points *a* and *b*, the capacity of *Ct* had to be increased by 50 mmfd to restore operation at 1000 kc, the capacity of *Clx* would figure out as follows

$$Clx = \frac{300^2}{50} - 1 =$$

$$1800 - 1 = 1799 \text{ mmfd}$$

We can see from the above that we need not bother about the —1 in the formula when *Clx* is large compared with *Cr*. This method works out very well for setting up padding condensers or checking their maximum and minimum capacitances.

Intermittent Checker

Occasionally, especially in tubular condensers, intermittent action is caused by a poor weld between the lead and the foil. This results usually in a high resistance joint at such times when the lead does make contact with the foil, but the defect is seldom revealed by usual methods of test. If an ohmmeter is employed, the high insulation resistance of the condenser—really enormous in comparison with the resistance of the defective joint with which it is in series—prevents any indication being obtained. Such conditions are readily checked by using a coupling coil to a power oscillator, as shown in Fig. 5-B. The suspected condenser is connected across the coupling coil and the alternating current which then circulates, due to the low impedance of the condenser to r.f., causes heat to be developed at the high-resistance joint. If the current is sufficiently great, the defective joint will be burned so that the joint becomes permanently open and will no longer function intermittently. For "hams," the amateur transmitter can be requisitioned for this service, connecting the suspected condenser across the antenna coupling coil.

Other methods of checking for such conditions involve tapping the condenser or moving the leads during operation to induce the defective contact to open. The danger of this practice is that the mechanical movement may cause a good condenser to develop a defective contact. The electrical test is fool-proof in that a good condenser cannot be damaged; its limitation is that unless the defective joint has pretty high resistance, considerable power from the r-f oscillator may be required to cause a burnout of the joint.

Versatile Oscillator

A thoroughly practical oscillator circuit which has a great many applications around any laboratory or service shop is shown in Fig. 6.

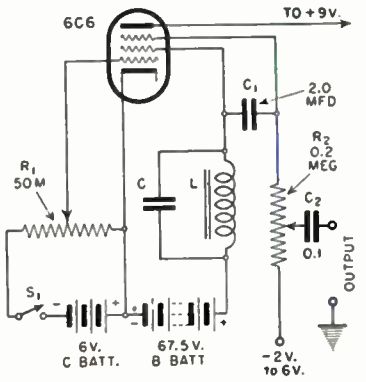


Fig. 6. A versatile single-coil oscillator with many shop applications.

The principle of operation is based on negative conductance; the feedback is accomplished electronically.

The oscillator functions over an enormous frequency range, from 10 cycles to about 10 megacycles, simply by changing the values of inductance and capacity in the circuit. Capacity may be checked in this circuit in the same manner as that described for Fig. 5-A, and, in addition, it is possible to check coils. Further, an idea of the relative efficiency, or Q, of the coil or transformer under test may be obtained. And it serves as a very stable signal source for any tests which may require such an instrument.

As shown, the inductance and capacity are placed in the screen circuit, which is capacity coupled to the suppressor of the 6C6. The suppressor grid leak is an 0.2-meg. potentiometer, which serves as an output control when the oscillator is used as a signal source.

The variable control *R*1 across the control grid bias is used to adjust the conductance of the tube until oscillation just commences. Under such conditions, best waveform is obtained. Since the bias voltage at which oscillation just starts is also dependent upon the Q of the tuned circuit, the better the coil, the greater the bias voltage which may be employed and still obtain oscillation. By noting the bias voltage at which oscillation is secured, using a coil known to be good, a standard for other coils of the same general type and characteristics may be obtained. Thus, tests can be made of i-f transformers, r-f coils, etc., against reference standards established in this manner. The same applies to condensers, which are best tested at low audio frequencies, if we are interested in their Q, or efficiency. Small mica and tubular paper condensers can likewise be checked at radio frequencies by simply changing the tuning coil inductance. One of the very great additional advantages of this circuit is that no tapped coil or tickler is required to obtain oscillation, thus enabling tests of any desired form of coil.

Coil Matching

Matching coils is done in this circuit by taking the master coil and tuning it with a shunt condenser until oscillation at a frequency in the broadcast band is secured. This r-f signal is then picked up with a radio receiver, as described for the previous circuit of Fig. 5-A. For exact work, the zero-beat method against a reference broadcast signal is used. Then each coil to be matched is substituted in turn for the master coil, taking care that the lead positions and shunt capacity are not changed, and the coil inductance is adjusted until oscillation occurs at the same frequency as was obtained with the master coil. The coils are then alike at this frequency.

Often it is desirable to check both at a high-frequency and a low-frequency point of the coil's normal operating range in the application for which it was designed, to make certain that matching is obtained at both points. For, if the distributed capacitance of the coil under test were greater or less than that of the master, adjustment to match with a given value of capacitance at one frequency would not result in proper matching at some higher frequency.

Note that battery operation is specified for the oscillator of Fig 6. This is done advisedly; best operation is thereby secured. However, it is feasible to use a-c for the heater. The type 57 tube functions equally well in this circuit. Smaller values of *C*1 are suitable for frequencies above 30 cycles.

Before leaving this portion of the subject, there are a few pointers which may be of interest. In checking any resonant circuit, high Q will be evidenced by sharpness in tuning. Thus, if you are aligning a receiver, and one i-f transformer tunes much more sharply than another of similar design in a similar circuit, there is reason to suspect that the Q of the broader-tuning unit is sub-normal.

It should be remembered, of course, that the L-C ratio is also important. If an i-f transformer employs a fixed condenser shunted by a small variable across the winding, it stands to reason that the adjustment of the small variable condenser will be less critical than if the entire shunt capacity were being varied. And, in diode input stages, the loading effect of the diode tends to broaden the tuning of the input i-f transformer. In superheterodyne oscillator circuits, low Q in the oscillator coil causes a decrease in the oscillator voltage developed and therefore a lower rectified d-c voltage across the oscillator grid leak.

Bridge Circuits

In commercial condenser and coil testers, bridge circuits are in pretty general use. The fundamental bridge circuit for small capacity measurement is shown in Fig. 7. The two

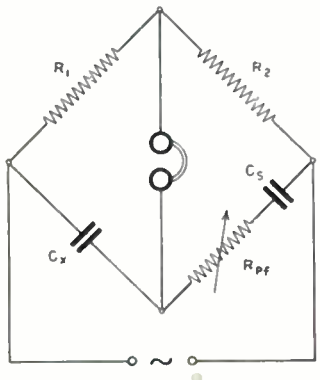


Fig. 7. Fundamental bridge circuit for small capacity measurement.

resistances *R1* and *R2* are usually made equal and of about 5000 ohms resistance. The condenser *Cs* is a high grade standard condenser, and the series resistor R_{pf} is used for power factor determination. The condenser under test is represented as Cx and is placed in the remaining arm of the bridge.

It is assumed that the power factor of the condenser under test will always be greater than that of the standard condenser; therefore, it will be necessary to add resistance to the standard condenser arm until its losses are equal to that of the condenser under test. When this is done, a sharp balance will be obtained on the bridge. For greatest accuracy, all arms of the bridge are made equal at balance and are carefully shielded.

Capacity measurements with bridges of this type are usually made only at audio frequencies, 1000 cycles being customary.

Another of the many types of alternating-current bridges is shown in Fig. 8. This is known as the Schering

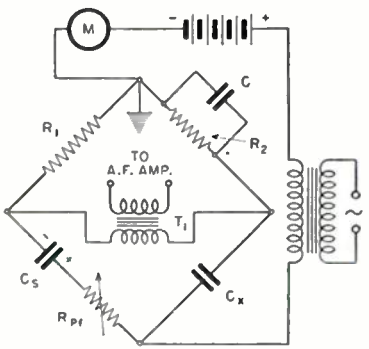


Fig. 8. Alternating-current Schering bridge. Leakage as well as capacitance can be measured.

bridge. This arrangement has advantages in that high voltage may be applied across *Cs* and *Cx* in parallel and thus enables applying polarizing potentials to electrolytics, as shown. Thus, in this bridge setup, leakage as well as capacitance may be measured. Further, it is possible to substitute a choke for the

standard condenser and use the apparatus as an impedance bridge for the measurement of high inductances at audio frequencies, employing d.c. to represent dynamic operating conditions when so desired.

It is not necessary for all arms of a bridge to be equal to secure a condition of balance, though this is the most sensitive and accurate condition. In the case of the bridge shown in Fig. 7, the equations for balance are

$$Cx = \frac{R1}{R2} Cs$$

for capacity and, for the resistance component Cr of the condenser under test,

$$Cr = \frac{R1}{R2} R_{pl}$$

In any event, both the resistive and the capacitive components have to be adjusted for a balance unless the condenser under test has the same power factor as that of the standard.

In the circuit of Fig. 8, note that the null indicator is not represented as a pair of headphones, as in Fig. 7. Using a coupling transformer and an a-f amplifier in the manner shown, much greater sensitivity may be obtained. If desired, the amplifier may terminate in an indicator tube, such as a 6E5, thus eliminating the need for phones. Also, using a tube indicator, there is no need to use a test frequency of 1000 cycles, which is chosen largely because headphones are most sensitive at that frequency.

Tests at either lower or higher frequencies may be made with the amplifier and indicator. In fact, frequencies above the audio range are permissible. In such cases, however, the bridge must be very carefully designed because stray capacities become more important.

Noisy Amplifiers*

All high-gain amplifiers are inherently noisy; the amount of the noise produced being partially dependent upon the excellence of the components used in the amplifier.

One of the most prolific sources of noise is due to the high value of resistors employed in the input stage. All resistors of high value are potentially capable of producing noise, for it must be remembered that even a relatively small random motion of electrons will result in appreciable noise voltages in resistors of this large magnitude.

The next time that you have to service a high-gain amplifier it would to well to replace the resistors which are present with special noise-tested resistors. Although noise-tested resistors cost somewhat more than ordinary ones, the reduction in the output noise of the amplifier is usually sufficiently great as to make this price differential of relatively small significance. Since the input stage of a high-gain amplifier is usually a pentode, the resistors to be replaced, in order of decreasing importance, are the input grid-leak, the plate load resistor, and the screen-grid dropping resistor. Although all three of these locations require only fractional wattage resistors, it is advisable, nevertheless, to employ noise-tested resistors of the one-watt type, in order to minimize the effects of surface leakage, for we must remember that surface leakage, which is due to dust and moisture, is variable in character and is, therefore, also a potential source of noise. D. B.

**By courtesy of "Service" magazine*

THE RADIO TRADING POST

(*Continued from page* 4)

FOR SALE—Supreme Analyzer model 500, completely modernized, Gernsback Manuals 1 and 2, BP-10 R.C.A. Personal radio perfect condition, L-C checker—used three weeks, Astatic microphone JT-30-TT, new, never used. Best offer takes any or all. Supreme Radio Service, 103 E. Franklin St., Sparta, Wis.

FOR SALE—Triplett 1503 analyzer and tube checker, Thordarson oscilloscope, Rider's Manuals Nos. 2, 3, 4, and 7, complete R.T.I. radio reference encyclopedia. $50.00 takes all or will sell separately if desired. Frank M. Falk, 30 South St., Three Rivers, Mass.

FOR SALE—All like new—Rider chanalyst $50.00, Supreme oscilloscope 546, $25.00, Supreme signal generator and frequency modulator 582, $25.00. Rider's Manuals 1 to 7, $25.00. Frank Bolfeta, 430 So. Ohio, Butte, Mont.

WANTED—Copy of Rider's publication, "Power Supplies" in new condition. F. E. Flint, P.O. Box 86, Elizabeth, W. Va.

WILL SWAP—L.E.S. course in electrical engineering for tube tester, or what have you in test equipment? Alva L. Crouch, 633 W. Main St., Thorntown, Ind.

WANTED—Used Candler course. State price. Have slightly used Echophone receiver. Herbert Schumann, Battery C 26th C.A.T.B., Camp Wallace, Texas.

FOR SALE OR SWAP—Back copies of radio magazines and radio text books, amateur radio handbooks, eight volumes power plant engineering books and am interested in screw cutting lathe attachments, drill or condenser checker. Wm. E. Barrett, 2828 So. 9th St., Sheboygan, Wis.

FOR SALE—Supreme Signal Generator model 189 $15.00, also Solar capacitor analyzer type cc160 $12. both in good condition. Lerch Music Shop, 22 E. Bway, Port Jefferson, L. I., N. Y.

WILL TRADE—Diesel Engineering course in easy understandable lecture form. Complete engine theory with diagrams. Want V.T.V.M. or radio test equipment. L. Reves, 11343/4 W. Temple St., Los Angeles, Calif.

FOR SALE OR TRADE—Buescher, "C" melody saxophone, brass finish and case, needs cleaning but no dents. Want—signal generator, late tube tester, condenser analyzer, Rider's Manuals, "RCP" No. 411 super-tester, or guns. Leonard Stretz, Box 304, Boonville, Mo.

WANTED—Communiccations receiver, signal generator, preselector, analyser, etc. Have 30 meters, tubes, magazines, Analyzers, checkers, motors, portables, genemotors, receivers, rifles, tools, code set, electric eye, rare Bibles, trombone manuals, National parts. Roby, 6305 Kenwood, Chicago.

WANTED—Rider's Manuals 5 to 9, 10, or 11. Give condition, etc., and best cash price. J. B. Mosley, 1426 N. 24th St., Birmingham, Ala.

FOR SALE OR SWAP—Rider's 1, 2, and 3, good condition. Two Weston 0-1 mil. meters. Rola G 12-1000 ohm. For cash or can use inexpensive signal tracer and 8mm. projector, or what have you? Aaron Ignal, Blvd. Radio Service, 1485 So. Blvd., Bronx, N. Y.

FOR TRADE—R.C.A. radio, sound and television course, Official Radio Service Handibook, Hawkin's 10 vol. Electrical Guides, model gas engine, model steam engine, technical books. Want—refrigeration manuals or course, also watchmaking course, screw cutting lathe, or what have you? Anthony F. Grimaldi, 133 84th St., Woodhaven, L. I. N. Y.

WANTED—203-A, 211 or other transmitting tubes of 100 watts, R.F. output, also 1200 volt 200 M.A. power transformer, may be used but must be in good condition. All letters acknowledged, state lowest price. Jos. Woscyna, 7 Lincoln St., South River, N. J.

FOR SALE—Supreme 385 automatic $25.00 good condition. Ranger 5 band signal generator $6.00, good condition. Superior 1130S 6 band a.c.-d.c. signal generator, used once, $10.00. D. T. De Simone, 801 So. Oak Drive, N. Y. C., N. Y.

POSITION WANTED—Young man 24, graduate radio engineering course, amateur license, restricted radio operator permit. No bad habits, steady, good references. Wants job in experimental laboratory or business. Require about $40. week. Employed at present. Prefer New England or west coast. Carl H. Stello, Beltsville, Md.

FOR SALE—Supreme radio analyzer model 339, Readrite tube tester model 430, Rider's Manuals 2, 3, 4, and 5, "Servicing Receivers by Resistance measurements," "Servicing Superhetrodynes" by Rider. Reasonable price, A-1 condition. Michael Bottos, 454 Pursel St., Phillipsburg, N. J.

FOR TRADE—1940 De Forest's training course in radio, television, and sound. More than 100 lessons in absolute A-1 condition, cost over $165. Want late model commercial amateur superhetrodyne in good condition. Edwin Gardner, 4151a Cleveland, St. Louis, Mo.

FOR SALE—1940 N.R.I. radio servicing course, complete and like new, $25.00. Have many other radio books. John Broderick, 137 High St., Dolton, Mass.

WANTED—Will pay cash for any code machine in good condition. Send full particulars and price in first letter. Elizabeth Kalmer, 154 So. 3rd St., Brooklyn, N. Y.

FOR TRADE—Watches for radio test equipment. I have American and Swiss watches, both pocket and wrist for man or ladies, if interested send description of testers. R. I. Gardner, 2689 L St., San Diego, Calif.

FOR SALE—Rider's Manuals vols. 1 through 7 $30.00. Good condition. Frank B. Husted, 386 Bedford Road, Pleasantville, N. Y.

FOR SALE—R.C.A. chanalyst in new condition. Also R.C.A. volt-ohmist. What am I offered? W. Sammons, 478 High St., Oshkosh, Wis.

FOR TRADE—Weston 771 tube checker. Can use a neon sign with or without transformer. Sign must read RADIO SERVICE. Also have other equipment to trade for sign. Mike Ola, 119 Tudor Pl., Bronx, N. Y.

WILL SWAP—Complete radio engineering and television course for communications receiver in good condition, 500 watt a.c. generator, or what have you? Carl H. Stello, Beltsville, Md.

FOR SALE—Premax vertical radiator, telescoping type, adjustable from 6 feet 5 inches, to 33 feet 9 inches, base insulator, made of high tensile copper-nickel steel tubing, cost $18.00. What am I offered for it? Dyer Matlock, Jr., Box 423, Mt. Pleasant, Tenn.

FOR SALE—Complete N.R.I. radio course, like new, $30.00, also 40 late phono records 10c each and two brand new a.c.-d.c. plastic radio sets, have not been used $10.00 each. Write for details. Want Cinandograph SV-18-12, Utah L15P, or Jenson type J dual loudspeaker. E. P. Schoeneck, Route 2, Box 16, Wahpeton, N. D.

WANTED—16mm. used model K Eastman movie camera with f 1.9 lens. Will pay cash. Superior Radio Service, 215 W. Blackhawk Ave., Prairie du Chien, Wis.

FOR SALE OR TRADE—Quiet power supply, dynamic speakers, small power transformer, sport magazines, radio magazines, and miscellaneous parts. Wanted—B eliminator, battery charger, midget radios, etc. Royce Saxton, R. 1, Pontiac, Ill.

FOR SALE—Rider's Manuals one to six with index, all in A-1 condition like new. All for $20.00 or $3.50 each. Also 1-2-3 combination volume for $6.50. Clinton Radio Sales & Service, 330 Clinton St., Hempstead, L. I., N. Y.

WANTED—Used 18" dynamic speaker, P-M or E-M type. State factory model, price, condition and full description. Will pay cash. Ideal Radio, 1713 Larrabee St., Chicago, Ill.

FOR SALE OR SWAP—Precision model E200 signal generator, slightly used, bought the first part of this year. Will sell for $25.00. Also a copy of Modern Radio Servicing. What have you? Harwood Radio, 43 Harwood St., Dorchester, Mass.

FOR SALE—In sealed cartons, G.E. tubes as follows: 2—12Z3, 5—38, 5—6F7, 4—36, 7—5W4, 2—25A6. Vito F. Daidone, 212 Fairmont Ave., Newark, N. J.

WILL SWAP—New radio books, parts, sets, etc., for U.S. or foreign stamps. What do you have in stamps? What do you want? Major Fred Luther Kline, 146 N. Prospect St., Kent, Ohio.

WILL TRADE—Remington automatic rifle 22 cal. long, good shape. Aerovox No. 75 condenser analyzer, Supreme 535 scope 2 inches. Want good outboard motor, cash, or beat frequency oscillator. Also have radio books for trade. Popma Radio Service, Orange City, Iowa.

FOR SALE—Supreme 385 analyzer and tube tester, Rider's Manuals, clean and good as new from 2 to 7 inclusive, N.R.I. radio and television course. Best offer takes any or all. Everything shipped C.O.D. Harold M. Gross, R.R. 3, Richmond, Ind.

WANTED—Electrically operated a.c. code machine to cut and receive international morse code from radio receiver. State price, condition, and make. Victor Kozma, 3104 Wilkinson, New York, N. Y.

FOR SALE OR SWAP—Nat. TMA50A, SW3 and coils, 807, Thordarson 750-550 ct 100 va 60 cycle transformer, etc. Crosley type "D" antique pocket book variable condenser, Want meters, bridges, physics or radio engineering books. A. A. Fazakas, 1 Cathedral Ave., Nutley, N. J.

FOR SALE OR SWAP—Original model of closet door work bench as described in July, 1937, Radio News. Interested in camera or P.A. equipment. Walter L. Linde, 72 Wadsworth Ter., New York, N. Y.

WANTED—Late model set analyzer combined with up-to-date tube checker. Must be in good condition such as Precision 900-920P, Supreme 502-S, 506 Weston, 772. State lowest cash price. L. Stolove 715 Hopkinson Ave., Brooklyn, N. Y.

WANTED—Rider's Manuals vols 1, 2, 3. Must be in good condition, state lowest price. R. J. Sherman, 619 So. Euclid Ave., Sioux Falls, S. D.

FOR SALE OR TRADE—Two button carbon mike, one Kellog and one Weston electric 387, never used. Want a 5 x 7 view camera with good lens and shutter. Edward V. Colman, Radio Service, Woonsocket, S. D.

FOR SALE—1938-39 National School of Electronics radio and television course in good shape, over 100 lessons. Will sell for $50.00. Chas. E. Lowry, Blue Mound, Kan.

FOR TRADE OR SALE—6-WE type 205D transmitting tubes, a 50 watt tube socket, 2 WE type 109A retardation coils, and 2 WE type 274A high vacuum rectifiers. Will sell all for only $18., or trade for good Xtal mic, or what have you. Wayne Mc Clung, 1114 Dawson Rd., Albany, Ga.

WILL SWAP—12" Tesla coil, Rochelle crystals, stopwatch, Corona typewriter, R.F. meters, test equipment, manuals, magazines, drafting sets, M.G. for R.C.A. 1S4BFO, 50W sockets, bakelite material, tools, meters, T-55 HF200, 1500 V. 300 Mil. P.T. R. Denmark, 1475 Walton Ave., New York, N. Y.

FOR SALE—Triplett tube tester model 1613 for portable or counter use, $20. cash, as good as new. White Plains Radio Service, 136 Martine Ave., White Plains, N. Y.

FOR SALE—A Torit acetylene torch kit No. 23, used for welding and soldering, used very little. Also N.R.I. radio fundamentals and servicing course. Complete except for experimental parts. Highest bidder takes one or both. Orris E. Stark, 302 E. Drayton St., Ferndale, Mich.

FOR SALE OR TRADE—Esco slip clutch, 450 W., 110 v. a.c. generator—good condition, $75.00, or will trade for 6' trumpets or amplifiers. E. O. Reinhardt, 411 E. Pikes Peak Ave., Colorado Springs, Colo.

WILL SWAP—Supreme tube tester model 85 with large fan meter, also Jewel 209 tube checker with one Na-ald adapter and one multi-dapter. Want Rider Manuals, 4, 5, 7, and 8. Millhurst Radio Service, Freehold, N. J.

WILL SWAP—15 watt phono-amplifier, eight tubes, push-pull 6V6-G's, rimdrive motor, volume indicator, 10" speaker, crystal pickup in portable case. Unit practically brand new has space for carrying records, will include cutting head and mike for recording. Want—Sky-buddy or other ham receiver in good condition. Thompson Irwin, 37 Cottage Park Rd., Medford, Mass.

FOR SALE OR TRADE—2 12" P.M. Philco speakers, 1 P460 Webster electric P.A. system. What have you? Have lots of radio parts and odd amateur radio equipment. Walter D. Keith, 315 E. 3rd St., N. Newton, Iowa.

WANTED—Motor generator or converter, 110 v. d.c. to 110 v. a.c. about 100 watts output. Rider Manuals 9, 10. State price F.O.B. N. Y. C., and condition. M. Wangler, 234 W. 13 St., New York, N. Y.

WANTED—A record cutting machine, complete with amplifier, mike. Must be in perfect working condition. Trade or sell 5 x 7 plate camera with tripod and all equipment, W. E. tubes all new, other radio test equipment and manuals. David Meyerson, 3425 Knox Pl., Bronx, N. Y.

WANTED—Rider's Manuals 1, 2, and 3. State condition and price when writing. Stanley Luffy, R.D. 1, Box 38, Verona, Pa.

FOR SALE—New model 1280 Tube and set tester combination, complete for $15.00 cash, F.O.B. and other equipment cheap. George A. Remling, 22 Lawrence Ave., N. Tarrytown, N. Y.

FOR SALE OR TRADE—12", 25watt dynamic speaker with field supply in baffle case, 2 genemotors, battery charger 4-2 amp. Want a.c.-d.c. voltmeters, 40 meter Xtal, small transmitting tubes, Xtal earphones, etc. Floyd Paul, 773 N. Alexandria, Los Angeles, Calif.

FOR SALE OR TRADE—Supreme No. 585 diagnometer in excellent condition and used very little. Will trade for high power transmitting final and modulator components. What am I offered? Bert Easton, 347 So. 4th Ave., Saginaw, Mich.

WANTED—Modern test equipment. Write stating condition, make, price, etc. Leo Stein, 7 Monroe St., Mt. Vernon, N. Y.

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