INSTRUCTIONS FOR OPERATING

The C-D CAPACITOR ANALYZER

Model BF-50 115 Volts A.C., 50-60 Cycles

CORNELL-DUBILIER ELECTRIC CORPORATION
South Plainfield, New Jersey
New Bedford, Mass.

• GUARANTEE •

This Capacitor Analyzer is guaranteed to perform as described and to be free from any defects in materials or workmanship. Any failure due to these causes will be adjusted by repair or replacement without charge if the instrument is returned prepaid to our factory within 90 days from date of purchase.

Capacitor Analyzer, Model BF-50, Manufactured Under Cornell-Dubilier U. S. Patents 1,823,492 and 1,757,659. Other Patents Pending.

Form No. 100-171A
Printed in U. S. A.
Recorder Press, Plainfield, N. J.
10-45

Copyright 1939
by
CORNELL-DUBILIER
ELECTRIC CORP.

INSTRUCTIONS FOR OPERATING THE C-D CAPACITOR BRIDGE

Model BF-50 115 Volts A.C., 50-60 Cycles

MODEL BF-50 CAPACITOR ANALYZER quickly and accurately measures all the important characteristics of all types of capacitors. It detects defective capacitors such as open and short-circuited, intermittent operation, high and low capacity, high leakage and power factor of electrolytic capacitors, and paper or mica capacitors with low insulation resistance. It may also be used to measure the capacity between wires and cables, shielded wire, circuit continuity, and insulation resistance between coil windings, insulation, etc.

Capacity and power factor measurements are made on a Wien bridge which is connected to an amplifier for high sensitivity adjustment. The balance condition of the bridge is indicated by a visual eye detector. These measurements are independent of line voltage variation and can be made with far greater accuracy than most meter type instruments.

Leakage and insulation resistance measurements are made by means of an adjustable D. C. power supply with the visual eye indicating the degree of quality of the capacitor under test.

A 12A7 tube is used as a rectifier and amplifier, and a 6E5 eye tube is used for the bridge detector and leakage indicator.

OPERATION OF PUSH BUTTON SWITCHES

The upper bank of switches operates the control circuits, with the different circuit connections for the "IN" and "OUT" position. The top button of this bank is connected to the switches in the lower bank. When in the "LEAKAGE" position (IN) it connects voltage to the lower bank, and for the "CAPACITY" position (OUT) it connects the main bridge circuit for the capacity test.

The lower bank is the selector circuit which operates only when the various buttons are depressed. The white button is the line switch, which is "OFF" when depressed and "ON" for the normal position. To release for "ON" position press C6. Buttons C1, C2, C3, C4, C5, and C6 depressed will arrange circuits for various capacity scales when "LEAKAGE-CAPACITY" switch is OUT and at various voltages for leakage test when the "LEAKAGE-CAPACITY" button is IN. To place two buttons of upper bank at IN, depress both simultaneously. When two are at IN, one may be released

to OUT position by pressing the other closer to the panel. To release buttons on either bank, simply depress one button on the same bank slightly.

The operation of the analyzer is entirely safe under all circumstances, provided the instructions are followed carefully. With button C-6 depressed, there is no voltage at the test terminals at any time. Before making leakage tests, be sure that all buttons are released and button C-6 depressed. Likewise, when the test is finished, clear the buttons and depress button C-6.

Although the analyzer is not easily damaged unless abused, the instructions for operation of the push button switches should be followed carefully. **Do not at any time depress more than one button in the lower bank, as this is not part of any test and may shorten the life of the instrument.** On the leakage tests, a shorted capacitor should be removed from test terminals after a few seconds. If allowed to be connected over a period of time it may cause excessive wear on the tubes and component parts.

The analyzer is so designed that leakage and insulation resistance measurements should be made on capacitors before capacity tests are made. This is to detect many types of defective capacitors immediately, and for electrolytic capacitors permits aging current to stabilize capacity and power factor characteristics.

PAPER AND MICA CAPACITOR TESTS

LEAKAGE TESTS

1. Partially depress any button on upper bank then release so that all buttons will be OUT.

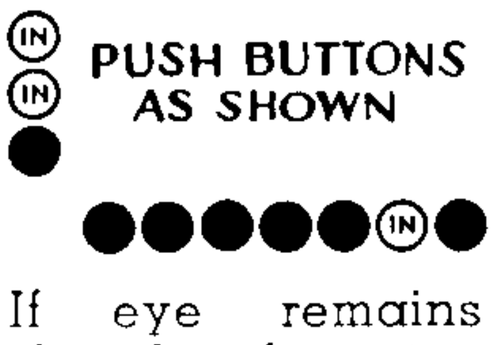
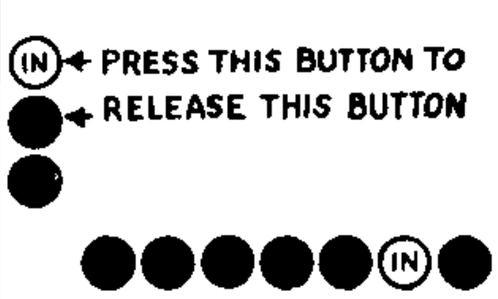
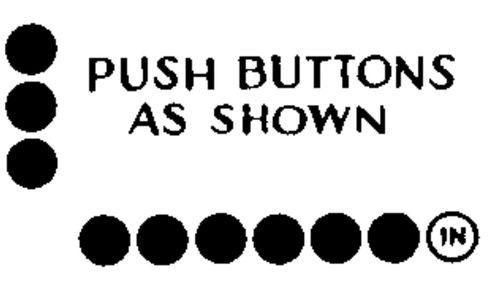
2. Depress C6 button on lower switch bank so that line switch will be released to "ON" position. All buttons except C6 should then be in normal (OUT) position.

3. Attach line cord to power line receptacle and allow one minute for the 12A7 and 6E5 tubes, plugged into their respective sockets, to reach operating temperature.

4. Attach capacitor to terminals marked "TEST". (Connect ground terminal to any convenient ground such as a radiator or a wall receptacle plate, etc., only when high sensitivity, high accuracy measurements are desired.)

5. Set "VOLTAGE CONTROL" at 10. Capacity and "POWER FACTOR" knobs are not in circuit for paper or mica leakage tests and so may be left in any position. Proceed with test following instructions given in the chart shown on next page.

Paper and Mica Capacitor Tests

Approximate Capacity Rating	STEP 1	STEP 2	STEP 3
All capacity and voltage ratings.	 If eye remains closed after ten seconds proceed with STEP 2. If eye is open capacitor is short circuited. (Omit STEP 2).	 After one minute check capacitor quality. For capacities above 1 mfd. allow several minutes before taking readings.	 When capacitor quality has been determined return all buttons to normal position as described in instructions 1 and 2.

OPEN OR INTERMITTENT CAPACITOR

Open and intermittent operation capacitors are detected on capacity test.

SHORTED CAPACITOR

If eye is open after ten seconds on STEP 1, capacitor is shorted (Omit STEP 2.) (Replace capacitor).

LEAKY CAPACITOR

If eye flashes more than once per second after several minutes on STEP 2, the capacitor is leaky. For capacities above 1.0 mfd. a flashing rate exceeding two flashes per second indicates a leaky capacitor. (Replace capacitor).

SATISFACTORY CAPACITOR

If visual eye remains closed after several minutes on STEP 2 or flashes at a rate not exceeding once per second, the capacitor is satisfactory for normal use. For capacities above 1.0 mfd. less than two flashes per second is considered satisfactory.

SPECIAL INSTRUCTIONS—LEAKAGE TEST

It is important to follow above instructions closely in order to obtain the true leakage-resistance condition of a paper or mica capacitor. In STEP 1 the capacitor is tested for short circuit and if not defective is charged to the maximum test voltage.

To arrange buttons for STEP 2 simply press top button in upper bank closer to panel to release middle button to out position. **Do not** release both buttons then depress top button as this may discharge capacitor and give incorrect measurements.

In STEP 2 the insulation resistance of the capacitor is measured by the indication of the visual eye. A rapid series of flashes indicates a low insulation resistance condition while a slow flashing rate or no flashes indicates satisfactory or high insulation resistance.

Instructions for Operating the C-D Capacitor Analyzer

When testing capacities below 1 mfd. flashing will start in less than one minute after switches are connected as shown in STEP 2. For higher capacities flashing will take place after several minutes.

The basic flashing rate for all insulation tests will be periodic, at uniform time intervals. If the power line voltage is subject to any abrupt fluctuations the extent of eye opening for the flashes will vary. This does not interfere with the accuracy of measurement as each flash will indicate the same insulation resistance regardless of the degree of opening of the eye.

The Analyzer should be kept in a warm, dry place to avoid moisture condensation on wiring, switches and terminals. It is essential to avoid any internal leakage from this source which might interfere with high insulation resistance measurements.

Do not test leakage of a paper or mica capacitor in Step 2 until capacitor has been charged to full voltage on Step 1. Any deviation from instructions outlined in test chart may result in incorrect insulation resistance readings.

CAPACITY TEST

6. Follow instructions 1 to 4 then set "SENSITIVITY" and "POWER FACTOR" controls at zero. Proceed with capacity test as described below.

Approximate Rated Capacity	STEP 4	STEP 5	STEP 6
Steps 5 and 6 are same for all capacities.	● **PUSH BUTTONS AS SHOWN** ● (IN) ● C1 C2 C3 C4 C5 C6 For "C" bank see below.	With power factor control at 0, rotate capacity control until approximate capacity value is indicated by open position of eye. Then adjust SENSITIVITY and CAPACITY CONTROLS for sharp balance. Read capacity from scale underlying point corresponding with "C" button depressed.	● **PUSH BUTTONS AS SHOWN** ● ● ● ● ● ● ● (IN) Return all buttons to normal positions as described in instructions 1 and 2.
.00001 to .0012 mfd.	Depress C6		
.001 to .012 mfd.	Depress C5		
.01 to .12 mfd.	Depress C4		
.10 to 1.2 mfd.	Depress C3		
1.0 to 24 mfd.	Depress C2		
20 to 240 mfd.	Depress C1		

OPEN CAPACITOR

When a balance on STEP 5 can only be obtained at extreme counter clockwise position of capacity control, the capacitor is open circuited.

Paper and Mica Capacitor Tests

SHORTED CAPACITOR

All shorted capacitors are detected on the leakage test.

INTERMITTENT CAPACITOR

When a balance of the visual eye cannot be obtained after all the above instructions are followed carefully, the capacitor under test is usually intermittent operation type of defect. This defect may also balance as an open circuited capacitor.

ADJUSTMENTS FOR HIGH SENSITIVITY MEASUREMENTS

When measuring mica or paper capacitors for capacity, it will be noted that a perfect balance cannot always be obtained. This is due to the losses in the capacitor under test. For such cases, simply adjust the sensitivity and power factor controls until the indication of the eye is entirely clear. For high sensitivity adjustments it may be impossible to obtain an entirely clear balance indication. This condition will not affect the accuracy of the measurements if the Analyzer chassis is grounded.

For accurate measurement of capacitors under .0005 mfd., place capacitor leads directly into the test terminals, so that the stray capacity will not impair the accuracy of the capacity measurements. The position of the line cord plug in the power line receptacle may change the reading on very low capacity tests. To eliminate this source of error, simply reverse the plug so that maximum capacity reading is obtained.

It is good practice to connect the ground terminal to ground for all tests. While it is not necessary when larger capacitors are tested, it is required when testing lower values.

DEFECTIVE PAPER AND MICA CAPACITORS

While it is evident that open, shorted, or intermittent capacitors are definitely defective, it is somewhat difficult to set up exact standards for leaky or high and low capacity capacitors. In the case of grid coupling capacitors, see Fig. 1, a very high insulation resistance is required. This is because a low insulation resistance capacitor will pass direct current, which in this circuit, will decrease the grid bias on the tube to which it is connected. For such capacitors, the flashing rate as indicated by the analyzer leakage test should be not more than once every two seconds.

Capacitors in low voltage application, see Fig. 2, such as cathode by-pass, where 10 or 25 volts is the maximum condition, a leakage indication of two flashes or less per second may be sat-

isfactory. Wherever a capacitor is shunted by a resistance, greater leakage or lower insulation resistance can usually be tolerated.

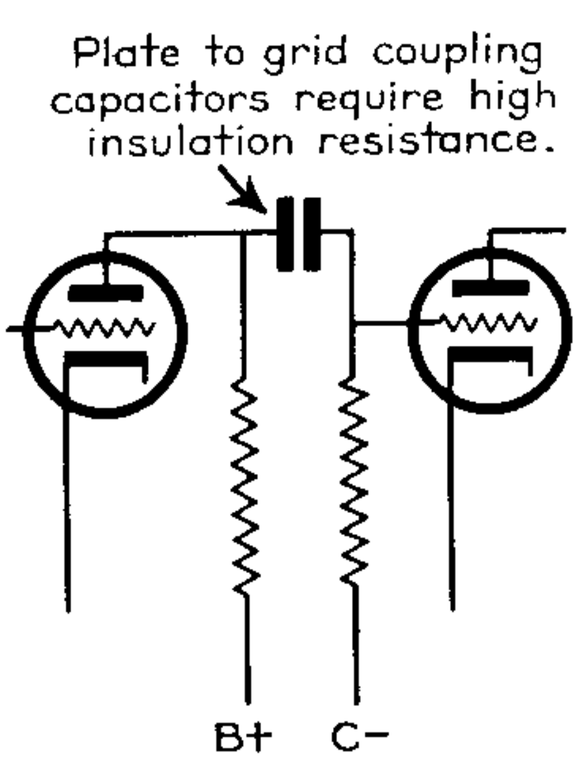


Fig.1

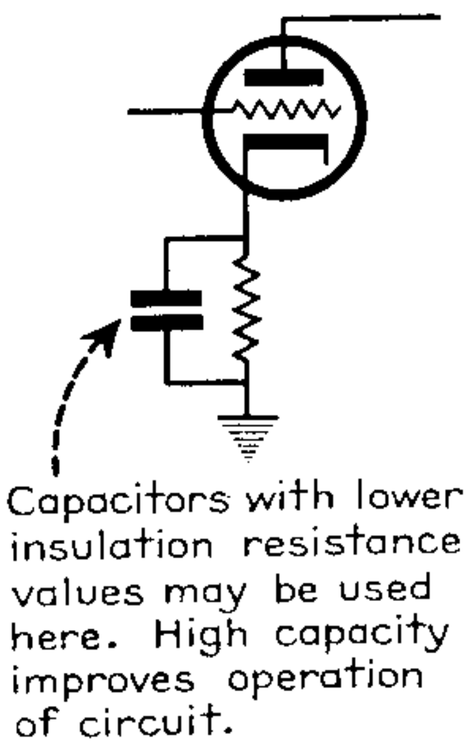


Fig.2

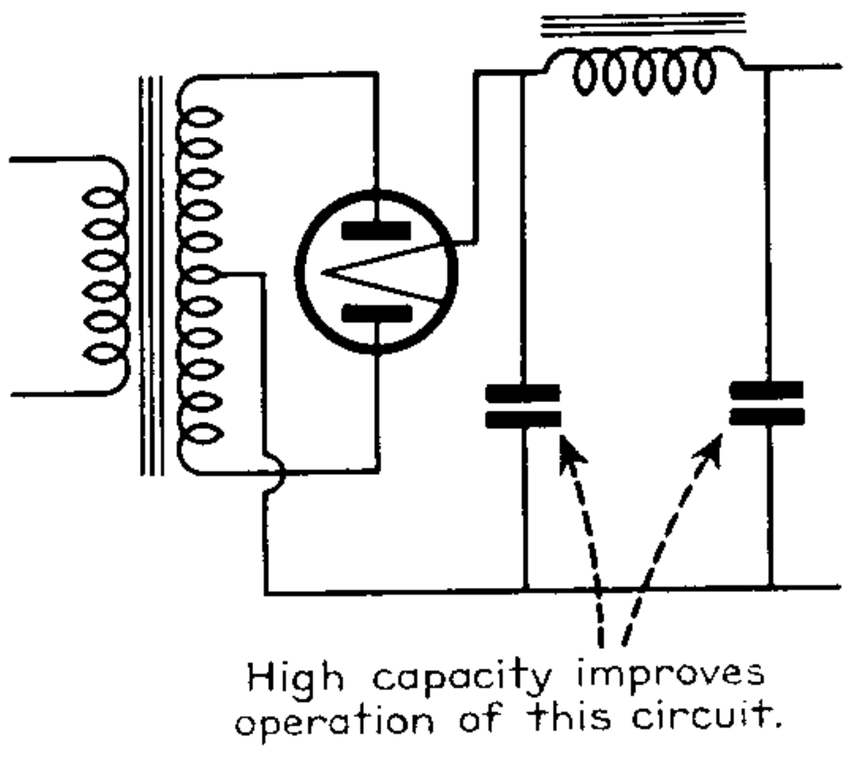


Fig.3

One of the most important measurements of capacitor quality is the insulation resistance test. A low resistance capacitor means that the quality of this unit has been impaired and if subjected to normal rated voltage will not give a very satisfactory useful life.

High and low capacity, that is a deviation of more than 10% from the normal capacity rating can be tolerated in most circuits. For filter circuits see Fig. 3, cathode by-pass, and similar applications, capacitors with a 100% plus tolerance usually work quite satisfactorily. Likewise, a minus 10 or 20% deviation may not seriously affect the performance. However, there are more critical circuits, such as plate or grid by-pass, tuned circuits, etc., which may require the capacity within 10% of the nominal value.

It can be seen that the circuit requirements more or less determine the quality of the capacitor required. One capacitor may give poor operation in one type of circuit and yet operate quite satisfactorily in another. Since it is fairly difficult to set up a series of standards which would accurately meet the requirements of all types of circuits, it is suggested that a degree of good judgment be employed when using the capacitor analyzer.

ELECTROLYTIC CAPACITOR TESTS

Direct Current Types

LEAKAGE CURRENT

The direct current leakage of any electrolytic capacitor is a highly variable factor and no definite boundary line can be established as to what values of leakage constitute a usable and a

non-usable capacitor. Direct current leakage values normally increase with idle shelf time and also with increase in temperature. In order, therefore, to offset, to some degree, these two factors, it has become a standardized procedure to "age" electrolytic capacitors by applying a D. C. voltage, equal to the rated working voltage, to the capacitor for ten minutes prior to making any electrical tests. Also, it is standard practice to make all electrical measurements on electrolytic capacitors at a temperature of 21 degrees Centigrade (69.8 degrees F.) or as nearly so as possible.

Since no hard and fast limits can be established, the following tabulation of leakage current values is given for the purpose of determining satisfactory leakage current characteristics.

DRY ELECTROLYTIC CAPACITORS

Working Voltages	D.C. Leakage in M.A.
25 50 100	0.01 M.A. per mfd. plus 0.5 M.A.
150 200 250 300	0.02 M.A. per mfd. plus 0.5 M.A.
350 400 450 500	0.03 M.A. per mfd. plus 0.5 M.A.

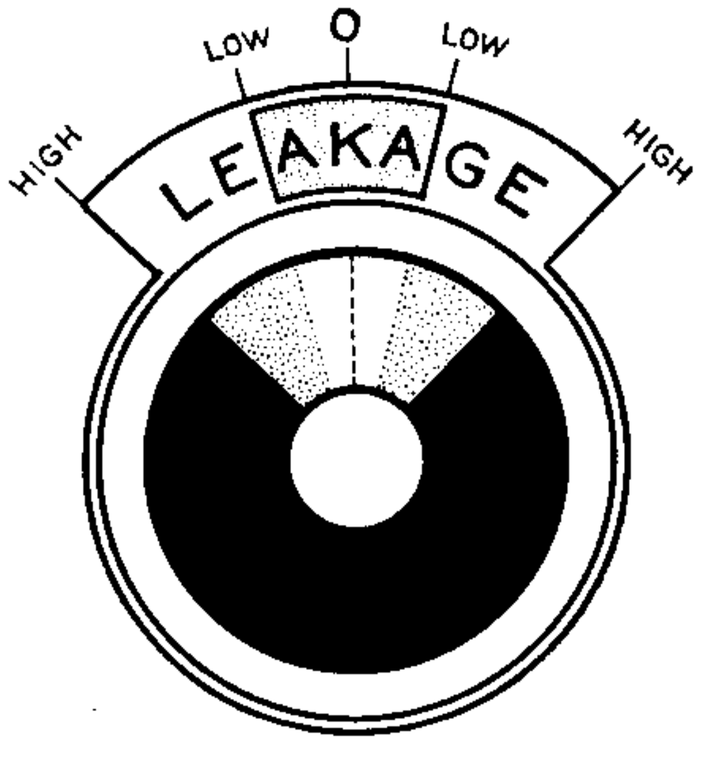
WET ELECTROLYTIC CAPACITORS

Working Voltages	D.C. Leakage in M.A.
25 50 100	0.02 M.A. per mfd. plus 0.9 M.A.
150 200 250 300	0.03 M.A. per mfd. plus 1.0 M.A.
350 400 450 500	0.05 M.A. per mfd. plus 1.0 M.A.

LEAKAGE INDICATOR

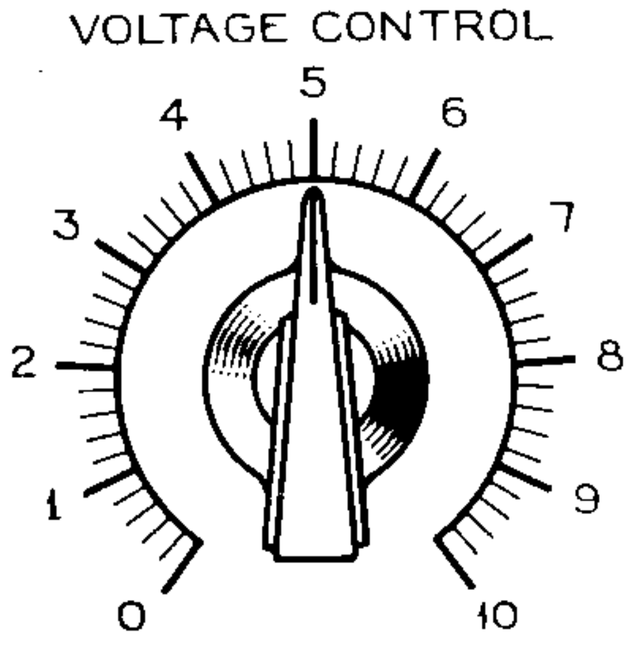
The "electric eye" used for the visual indication of direct current leakage of electrolytic capacitors is arranged to show substantially zero leakage when the eye is closed. (See Fig. 4.)

The outer boundaries of the red segment indicate a satisfactory leakage condition while eye indications beyond this point indicate high leakage. For a shorted capacitor the eye will indicate maximum opening.



Visual eye opening may be calibrated in milliamperes for electrolytic capacitor leakage tests.

Fig.4



SETTING OF VOLTAGE CONTROL	TEST * VOLTAGE
0	0
1	10
2	20
3	30
4	40
5	50
6	60
7	70
8	80
9	90
10	100

* **Note:** The voltage control will provide intermediate test voltages between range limits of push button depressed. Actual voltage at test terminals is dependent upon leakage current.

Fig.5

VOLTAGE ADJUSTMENTS FOR LEAKAGE TEST

Each push button in the lower bank is marked the test voltage range it will provide when depressed. The voltage adjustments using these buttons are in 100 volt steps. Only one button should be depressed on any test.

For intermediate test voltages adjust the "VOLTAGE CONTROL" to correspond with the exact working voltage of the capacitor under test. This control is marked in ten volt steps (0 to 100 v.) which is provided when leakage current reaches a sufficiently low value. (See Fig. 5.)

The voltage provided at the test terminals is dependent upon the leakage current. For high values of leakage the voltage supplied will be less than the capacitor voltage rating. As the leakage current decreases with the aging time the test voltage will increase approaching rated voltage conditions for satisfactory leakage values. Maximum voltage supplied is 450 V.D.C.

Electrolytic Capacitor Tests

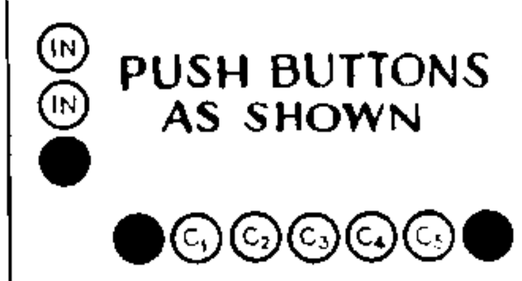
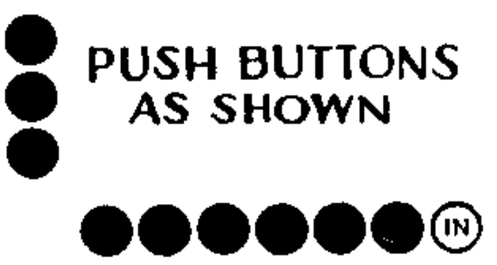
LEAKAGE TEST

1. Partially depress any button on the upper left hand switch bank, then release so that all buttons will be out.

2. Depress button C6 on lower switch bank so that the line switch will be released to "ON" position. All buttons except C6 should now be in the normal "OUT" position.

3. Plug line cord into convenient 115 volt A. C. outlet and allow sufficient time for the 12A7 and 6E5 tubes to reach operating temperature. Connect electrolytic capacitor to terminals marked "Test", observing the correct polarity by connecting the positive (+) terminal of the instrument to the positive (+) terminal of the capacitor.

4. Set the "VOLTAGE CONTROL" at zero. The capacity and "POWER FACTOR" controls are not in the circuit when leakage determinations are being made so may be left in any positions. Proceed with the leakage test by following the directions shown in the following chart:

Approximate Capacitor Rating	STEP 7	STEP 8	STEP 9
For AC electrolytic capacitors no leakage test is necessary. Simply measure capacity and power factor. (See paragraphs describing AC electrolytic capacitor test.)	 **PUSH BUTTONS AS SHOWN**	With push buttons in same position as Step 7 adjust "VOLTAGE CONTROL" for intermediate voltage. Example: For 150 VDC capacitor press C2 for 100 V, then adjust voltage control to 5 to increase to 150 V.	 **PUSH BUTTONS AS SHOWN**
0-240 mfd. 20-100 V. DC	Depress C1		
0-240 mfd. 100-200 V. DC	Depress C2	For capacitors with voltage ratings above 500 V. DC, set voltage control at 10.	When quality of capacitor has been determined return all buttons to normal positions as described in instructions 1 and 2.
0-240 mfd. 200-300 V. DC	Depress C3		
0-240 mfd. 300-400 V. DC	Depress C4		
0-240 mfd. 400-600 V. DC	Depress C5	Check quality of capacitor.	

OPEN CAPACITORS

Open circuit capacitors are identified on the capacity test.

SHORTED CAPACITORS

Short circuited capacitors are identified by no capacity indication on the capacity test and a completely open eye on the leakage test.

A short circuited capacitor may be distinguished from one having an extremely high leakage current by reducing the value of the applied test voltage to a value much lower than the rated working voltage where the eye opens. At the same time, a capacity indication should be able to be obtained on the capacity test.

INTERMITTENT CAPACITORS

Intermittently short circuited capacitors may indicate as satisfactory, then become shorted for a few seconds. If eye flashes or opens after satisfactory leakage condition has been indicated, capacitor may be intermittently shorted type of defect.

LEAKY CAPACITOR

If eye opening is larger than red segment after several minutes capacitor has high leakage. It should be allowed to age for ten minutes. If eye opening is still larger than red segment capacitor is leaky.

An eye opening smaller than red segment indicates satisfactory leakage. Wet electrolytic capacitors are satisfactory for most uses even though they have a higher leakage than other types.

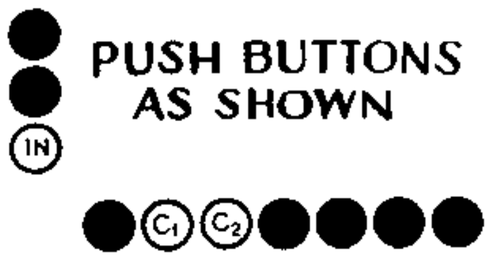
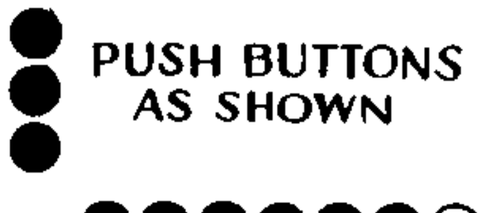
GROUNDED CAPACITORS

Where electrolytic capacitors are enclosed in metallic containers, and the container does not constitute the negative terminal of the capacitor, it is well to test the capacitor for a grounded condition. To do this, remove the negative connection of the instrument from the capacitor and connect it to the container. If the capacitor is **not** grounded to the container, the leakage should be zero on leakage test and the capacity zero on the capacity test. Use rated working voltages for this test.

CAPACITY TEST

5. Follow instructions 1 to 4, then set SENSITIVITY and capacity controls at zero. Proceed with capacity test as follows. Test should be conducted at room temperature, nominally 21° C. (69.8° F.).

Electrolytic Capacitor Tests

Approximate Capacity Rating	STEP 10	STEP 11	STEP 12
Steps 11 and 12 are the same for all capacities.	PUSH BUTTONS AS SHOWN 	Rotate CAPACITY CONTROL until approximate balance is indicated by the OPEN position of eye. Adjust POWER FACTOR, SENSITIVITY and CAPACITY CONTROL for sharp balance. Read power factor directly, and capacity from scale underlying pointer marking corresponding with "C" button depressed.	PUSH BUTTONS AS SHOWN 
	For C bank see below		Return all buttons to normal position as described in instructions 1 and 2.
1.0 to 24 mfd.	Depress C2		
20 to 240 mfd.	Depress C1		

SHORTED CAPACITORS

Short circuited capacitors, on the capacity test, will not produce a null point balance upon rotating the capacity control. The eye remains closed.

OPEN CAPACITORS

Open circuited capacitors, on the capacity test, will not produce a definite null point balance, but will show a condition approaching a balance. That is, the eye may open when the capacity control is rotated to the extreme counter clockwise position. No actual balance point occurs however.

SPECIAL TYPES OF ELECTROLYTIC CAPACITORS

NON-POLARIZED CAPACITORS

Where direct current types of electrolytic capacitors are of the non-polarized type the same test procedure is followed as has been outlined as far as capacity is determined. Leakage current is, however, checked in both directions. This is done by checking the leakage with the instrument terminals connected to the capacitor in one direction and then again checking the leakage with the terminals reversed to the other direction.

ALTERNATING CURRENT TYPES OF ELECTROLYTIC CAPACITORS

No direct current leakage test is normally required or made on the alternating current types of electrolytic capacitors.

Capacity and power factor determinations are made in the same manner as has been outlined for the direct current types. These determinations should be made at or as near as possible to nominal room temperature, that is, 21° C. (69.8° F.).

CAPACITOR QUALITY

Direct Current Types

LEAKAGE

Satisfactory electrolytic capacitors should, after a ten minute application of rated working voltages, show leakage currents substantially no more than the tabulated values given. A capacitor of excessive leakage may be made satisfactory in some cases by applying rated voltage for a longer aging period. If not, it should be discarded and this particularly applies to the physically smaller capacitors of the etched foil or equivalent types.

CAPACITY

It is difficult to say when a capacitor needs to be replaced if the capacity value is below the rated value. This depends upon the circuit requirements of the particular circuit of which the capacitor is a part.

Most D. C. electrolytic capacitors are used as filter or by-pass units and a capacity higher than rated values is beneficial rather than detrimental.

If an electrolytic capacitor is within minus 10% and plus 200% of its rated value, it may be considered satisfactory.

A recommendation may be made, however, that an electrolytic capacitor, showing a capacity 20% below rated value, should be replaced.

POWER FACTOR

The power factor of a dry electrolytic capacitor may have little bearing on its efficient functioning in a circuit. Nominal values of power factor range from 5 to 10 per cent for single section units rated at any voltage from 5 to 500 volts working.

Where multiple section capacitors contain sections rated at both high and low voltages, for example, 25 and 450 working volts, the power factor of the lower voltage section may nominally be as high as 50%.

Wet electrolytic capacitors normally have power factor considerably higher than dry electrolytic capacitors and this is particularly true of the higher voltage types.

High values of power factor should not, in itself, be sufficient cause for the rejection of a capacitor.

General Uses for Capacitor Analyzer

The effect of a higher value of power factor in either a filter or by-pass function may very readily be offset by a value of capacity in excess of the rated value of a particular capacitor. It is recommended that higher values of power factor be a cause of rejection of capacitors only when such high values are accompanied by low capacity and evidence of failure of proper circuit operation.

Alternating Current Types

CAPACITY

Most alternating current types of electrolytic capacitors are used with capacitor type, single phase, alternating current motors of fractional horse power sizes.

In connection with such motor applications, there is always an optimum value of capacity which is required for the maximum starting torque of the motor. Any variation below or above this value will cause a proportionate reduction in the starting torque of the motor. Just how much variation from the rated value of a capacitor can be tolerated depends a great deal upon the starting torque requirements of a given motor application.

As a general rule, a capacitor should be replaced if the measured capacity is found to be more than 25% below the rated capacity.

POWER FACTOR

A high power factor causes a small reduction in starting torque of the motor but this is not of serious consequence as a rule. The nominal power factor of the A. C. type electrolytic capacitor lies within the range of from 5% to 10%. Values of power factor as great as 30% should not be the cause of the capacitor's rejection unless low values of capacity are also encountered at the same time and the particular motor involved has insufficient starting torque.

GENERAL USES FOR CAPACITOR ANALYZER

CAPACITY TESTS

Since the capacity of a capacitor is similar to capacity between wires and shielding, windings of transformers, wires in cables etc. these measurements can be made by following the instructions outlined for capacity tests.

INSULATION TESTS

Many types of insulation such as are found on terminal strips, tube sockets, between windings of transformers, and wires in cables, etc. may be tested with the analyzer. Simply adjust controls as

described in leakage tests for paper and mica capacitors. Then attach test clips for point to point insulation measurement.

The periodic flashing rate of visual eye will indicate the condition of the insulation.

R = 50 N
R = Insulation resistance in megohms.
N = Number of seconds per flash

As shown above a periodic flashing rate of once per second will indicate an insulation resistance of 50 megohms. Read special instructions leakage test page 5 describing operation of insulation resistance test circuit before making these tests.

CONTINUITY TESTS

The analyzer may be used as a D.C. continuity meter for both resistive and inductive circuits. For circuits less than 100,000 ohms set controls as described in leakage tests of electrolytic capacitors. Depress button C1 and check point to point continuity with test clips.

For high resistance circuits adjust controls as described in capacity tests paper and mica capacitors. Depress button C5 and balance capacity control at zero. Rotate sensitivity control to zero. Check point to point conductivity with test clips. The visual eye will indicate circuit condition.

BALANCE INDICATOR

To use this instrument as a sensitive alternating current balance indicator adjust controls as described in capacity tests paper and mica capacitors. Remove grid cap connection of 12A7 tube. Then connect the sliding tap of an external 50,000 ohm potentiometer to grid terminal of the tube and one end tap to chassis.

Apply test voltage across end terminals of potentiometer. Adjust this control for sensitivity of measurement desired. Read balance condition when eye indication shows maximum opening.

OUTPUT INDICATOR

To use analyzer as an extremely sensitive A.C. output indicator adjust controls and connect external potentiometer as described in "BALANCE INDICATOR." Calibrate potentiometer scale in degrees output or in voltage graduations by introducing known voltages across end terminals and adjusting potentiometer until eye is exactly closed. Mark each point the value of the known voltage, until the complete range of the scale has been covered.

General Uses for Capacitor Analyzer

Connect test voltages across end terminals of potentiometer and adjust knob until eye is exactly closed. Read voltage value directly from scale marking.

SPECIAL INSTRUCTIONS

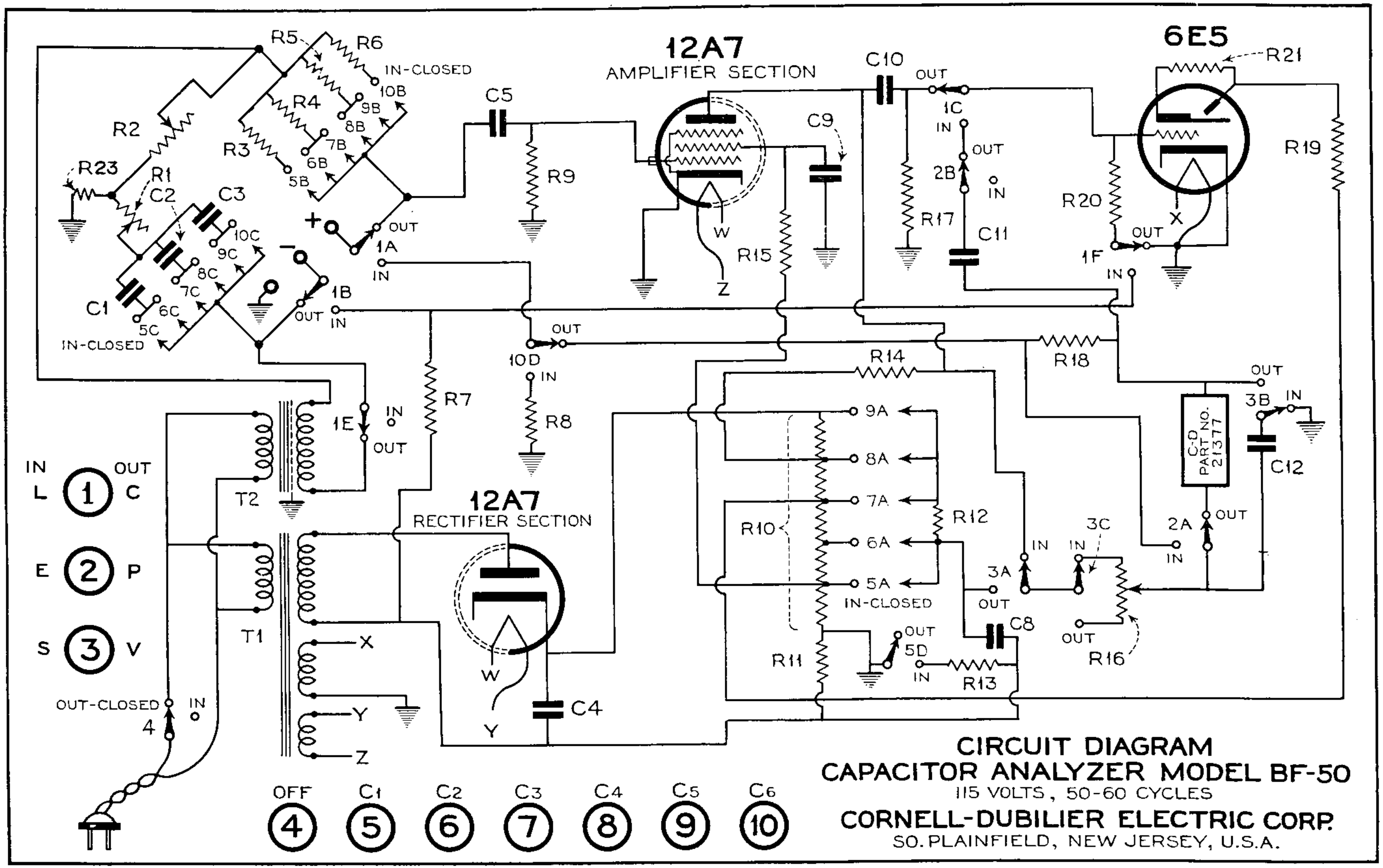
To test capacitors installed in radio equipment or other apparatus disconnect high potential side of capacitor from circuit. Then connect test terminals directly to capacitor and proceed with tests according to instructions. During the tests the power line plug and ground connections of the receiver should be disconnected.

Although many types of capacitors may be measured for capacity without removing circuit connections the above procedure should be followed for all tests to eliminate any possible sources of error.

When the analyzer chassis is connected to ground the test leads should not be connected to a capacitor in a grounded circuit. Such procedure would result in incorrect measurements and excessive wear on the instrument. Where it is necessary to make such tests disconnect the ground lead of the analyzer and make tests following usual instructions.

With C6 button depressed and all other buttons in normal (out) positions, there is substantially zero voltage across test terminals. When a capacitor has been tested, this arrangement of the push button switches will discharge the capacitor within a few seconds.

The most important details in the operation of the analyzer are given in this booklet. Should any problems arise concerning this instrument, capacitors or capacitor replacements, simply write to the Cornell-Dubilier Electric Corporation and complete information will be furnished you promptly.


12A7
AMPLIFIER SECTION
6E5
12A7
RECTIFIER SECTION
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R23
C1
C2
C3
C4
C5
C8
C9
C10
C11
C12
T1
T2
IN-CLOSED
OUT-CLOSED
C-D PART NO. 21377
CIRCUIT DIAGRAM
CAPACITOR ANALYZER MODEL BF-50
115 VOLTS, 50-60 CYCLES
CORNELL-DUBILIER ELECTRIC CORP.
SO. PLAINFIELD, NEW JERSEY, U.S.A.

LIST OF PARTS

MODEL BF-50 CAPACITOR ANALYZER

Pt. No.	Value	Rating	C-D Part No.
C 1	2.4 Mfd.±2%	60 V.A.C.	HC 3389
C 2	.12 Mfd.±2%	200 V.D.C.	ZB 40E4
C 3	.0115 Mfd.±2%	200 V.D.C.	3W
C 4	8.0 Mfd.	500 V.D.C.	BR 850
C 5	.05 Mfd.	400 V.D.C.	ZB 4024
C 8	8.0 Mfd.	500 V.D.C.	BR 850
C 9	.1 Mfd.	200 V.D.C.	ZB 2027
C10	.05 Mfd.	400 V.D.C.	ZB 4024
C11	.5 Mfd.	600 V.D.C.	PC 1354
C12	.5 Mfd.	400 V.D.C.	ZB 4033
R 1	640 Ohms±5%	Rheostat	21236
R 2	50,000 Ohms	Potentiometer	21175 matched
R 3	500 Ohms	6 Watts W.W.	21167 matched
R 4	5,000 Ohms	1 Watt W.W.	21168 matched
R 5	50,000 Ohms	1 Watt W.W.	21169 matched
R 6	500,000 Ohms±2%	BT ½	21581 matched
R 7	2,000 Ohms±5%	BW 1	21582
R 8	25,000 Ohms	BT ½	21583
R 9	2 Meg.	BT ½	21584
R10	45,000 Ohms	Tapped 4x10M+5M	21171
R11	900 Ohms±5%	BW 1	21585
R12	15,000 Ohms	5 Watts W.W.	21586
R13	3,000 Ohms	BT ½	21587
R14	500,000 Ohms	BT ½	21588
R15	500,000 Ohms	BT ½	21588
R16	50,000 Ohms±5%	Potentiometer	21176
R17	1 Meg.	BT ½	21590
R18	20 Meg.	BT ½	21591
R19	25,000 Ohms	BT 1	21592
R20	10 Meg.	BT ½	21593
R21	1 Meg.	BT ½	21590
R23	2,000 Ohms	BT 1	21582

Capacitor Analyzer. Model BF-50. The C-D Capacitor Analyzer measures capacities between .00001 and 240 mid of all types of capacitors. Measures power-factor, 0-50%. Checks insulation resistance. Direct reading linear scale calibration. Push button switching. Cathode eye for bridge balance; six color coded scales. Model BF-50 complete, less tubes—List $49.80—**Net $29.88.**

Capacitor Bridge. Will accurately check capacities .00001 to 50 mfd of all type capacitors. Indicates power-factor of electrolytics. Checks for open, shorts, and high and low capacity. Can be used as a continuity meter. Direct reading ranges, with all markings directly in microfarads. The C-D Capacitor Bridge is the most compact and useful instrument of its type, ever offered to the radio industry. Model BN complete, less tubes—List $19.80—**Net $11.88.**

Capacitor Decades. The C-D Capacitor Decades are the first inexpensive, practical capacitor decades ever developed. Ideally suited for experimental circuits, filter design, bridge measurements, etc. Capacity range between .0001 and 11.1 mfd available in three decades, which can be used continuously on 220 V. A. C. or 500 V. D. C. circuits. Decades supplied in attractive bakelite cases 3⅝" x 5" x 3".

Model CDA-5, .011 mfd. in .0001 mfd. steps —List $10.80—**Net $6.48**

Model CDB-5, 1.1 mid. in .01 mfd. steps— List $10.80—**Net $6.48**

Model CDC-5, 10. mfd. in 1 mfd. steps— List $19.20—**Net $11.52**

Commercial tolerance of 5% used in above models. Tolerance of 3% available at slightly higher cost.

CORNELL-DUBILIER
ELECTRIC CORPORATION

1030 Hamilton Boulevard, South Plainfield, New Jersey

CABLE ADDRESS: "CORDU"

SUBSTITUTION OF TUBES USED IN CORNELL-DUBILIER CAPACITOR BRIDGE, MODEL BN AND CAPACITOR ANALYZER, MODEL BF-50

Production of 6E5, 6AF6-G, and 12A7 tubes has been curtailed during the war emergency. Although these tubes are still being made they are not always readily available.

Where it is impossible to obtain a 6AF6-G tube for the BN Bridge a 6AD6-G may be substituted without circuit changes.

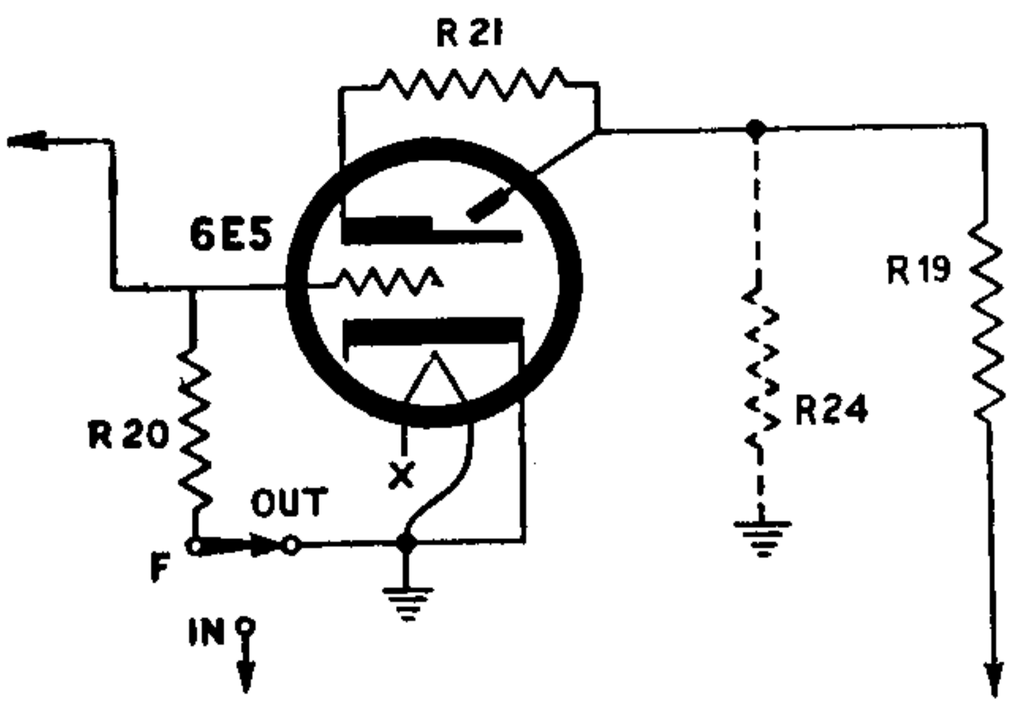


Fig. 1

Several tubes may be substituted for the 6E5 in the BF-50 Capacitor Analyzer. Use of 6U5, 6G5, 6AB, or a 6N5 in place of the 6E5 in the Capacitor Analyzer will not alter the operation of the instrument provided an additional resistor R-24 (25,000 ohms $1/2$ watt) is connected from plate to chassis as shown in Fig. 1. This resistor should not be used in connection with a 6E5 tube.

There is no satisfactory substitute for the 12A7. Although a 25A7 is the nearest equivalent neither instrument will provide the required 25 volt heater supply. Where this voltage can be supplied from another source, a 25A7 may be used in place of the 12A7.

Cornell-Dubilier Electric Corporation

SOUTH PLAINFIELD, N. J., U. S. A.

Form 100-385