

Jackson 112, 650, and 650A Capacitor Analyzers
Instructions, Rebuild and Calibration Notes by Erik Knutson
January 2006

Jackson models 112, 650, and 650A are very similar in their basic circuitry, and differ primarily by capacitance ranges offered. The "A" model adds a high capacitance range. All models are circa 1940. The calibration information below was derived with a 650A, but also applies to 112's and 650's. Many thanks to Marvin M. and Avery C. for the instructions and schematics that are included with this document.

Rebuild Notes:

- Replace the power cord with a three-wire one. On 650A's, there's a handy small bolt near the power terminal strip where you can connect the ground.
- Replace both the electrolytic capacitors. If you don't have any 8uF cap's, a 10uF will work just fine instead. Make sure your replacements are rated for at least 450 volts.
- There are three standard capacitors in the 650A: 3.0uF, 0.03 uF, and 0.0003uF. The largest, a big metal box, needs to be introduced to your trash can. It will be so leaky, you won't even be able to measure its value (the bottom of the can isn't soldered metal like some "bathtub" cap's, it's just a fiber plate, and it's been in there for 65+ years). If you're nostalgic, you can easily hollow it out and put your new standard 3.0uF inside. **DON'T USE AN ELECTROLYTIC.** The best bet is to parallel three 1uF film cap's. The next standard, the 0.03uF, is a paper cap, and will need to be replaced. Three paralleled 0.01uF film cap's will work well. The smallest standard, a mica cap, you can assume to be fine if there's no physical damage to it. Note that every standard capacitor you replace needs to be within 1% of the specified value.
- Check all the resistors, and replace anything that's outside of its marked tolerance. If you replace the 200 ohm, use at least a two watt, since this is the resistor through which capacitors under test discharge (yes, this is a higher wattage rating than the factory used).
- Clean all the slide switches with DeOxIt or something equally good. Spray some cleaner in the voltage selector switch and rotate it several times to clean it too.
- Some of the 650A's parts come way too close to frame metal. The electrolytics and the power switch are two examples. Add electrical tape or other suitable insulating material anywhere you think it's appropriate.

CALIBRATION

If you've been diligent about checking your resistors and replacing your standard cap's, your 650A is capable of being very accurate, as much so as a Sprague TO-x. Jackson used an excellent variable resistor for the main capacitance test (what you turn to measure capacitance) which will track the printed scale very closely if it's not damaged.

Calibration is very simple, since there are only two parts that can be varied: a slider potentiometer near the electrolytic cap's, and the meter needles (which have a common anchor). Start by setting the slider pot inside the unit to the middle of its range, and

remove the panel meter knob and glass mounting. Turn the meter pointer fully counterclockwise. The needle should line up with the black lines at the top and bottom of the scale, or be very slightly to the left of the lines. If this is not the case, loosen the pointer sleeve's set screw and adjust the pointer. NOTE that during all calibration steps, the power factor knob should be fully CCW.

1. Start by pressing the C_2 range button **after** connecting an 0.1uF film capacitor (of known tolerance) to the test jacks directly.
2. Turn the capacitance knob to maximize the eye tube's opening, and verify that the value the pointer is indicating (on the middle scale) matches that of the capacitor. If it doesn't, first try moving the slider pot inside the unit **with an insulated screwdriver** to get the eye tube to open up at the correct meter pointer value. The slider pot is very limited in its range, so if it's not possible to establish the correct value using it, loosen the meter pointer sleeve's set screw and align the pointer with the correct value on the middle scale, then retighten the pointer sleeve.
3. Switch the tester off and release all buttons to discharge the capacitor you've plugged into the jacks. Replace it with a 0.01uF film cap of known tolerance, press the C_2 button, and turn on the tester.
4. Adjust the capacity knob for maximum opening of the eye tube, and verify the pointer is indicating the correct value. If it is not, very gently bend the longer pointer to the correct value. Note that this should only be done to correct small deviations. If you already performed step 2, and all the component values in your tester were verified or correctly established, there should be very little error.
5. Check other regions of the various ranges for accuracy. If you find significant discrepancies, and are certain of the values of the capacitors you are using to test, recheck the steps above. If you still find significant errors, recheck your bridge components.

USAGE NOTES

- There are two pointers used for indicating capacitance. The shorter pointer only applies to the middle and lower (high capacity) scales, and the longer pointer only applies to the top scale.
- The "test voltage" control knob only applies to leakage tests. All capacitance tests are done at around 45 volts a.c. combined with just over 10 volts d.c., so don't test any capacitor on your 650A that's not rated for 50 or more volts.
- On paper/mica leakage tests, it takes 3 microamps of leakage to keep the eye tube from fully opening (~40 megohms of insulation resistance). If leakage is under 3 microamps, the eye tube will open fully.
- For electrolytic leakage tests, 0.5 milliamps is the leakage threshold at which the eye tube will open.
- The power factor control only applies to the C_H and C_1 ranges.
- When all buttons are released (out), any capacitor attached to the terminals discharges through a 200 ohm resistor. Let any capacitor you test discharge before removing it, and make sure the buttons are fully released. Any button being pressed or stuck in **even by a small amount** will keep the discharge circuit

from being completed, so be aware of potential voltages on your cap's if your buttons don't release fully.

- The higher the value and higher the voltage used for leakage tests, the longer it will take for the eye tube to open. Be patient with large caps, it can take a few seconds.

CONDENSED OPERATING INSTRUCTIONS

MODEL 650A CONDENSER TESTER (110 Volts 60 Cycles)

The Model 650A tests condensers for shorted, leaky, open, intermittent, incorrect capacity and bad power factor conditions. Two tests are made upon the condenser to indicate the above conditions. The CAPACITY TEST indicates the true capacity of the condenser. This test also shows open, shorted, intermittent and bad power factor conditions. The LEAKAGE TEST rejects condensers with excessive leakage resistance and supplies the correct polarizing voltage to electrolytics for test.

DIAL CALIBRATIONS: The Capacity control knob rotates through an arc of approximately 300 degrees. For convenience in reading and to provide a long effective scale length the arc has been divided into two sections and two pointers provided on the control arm. When the long pointer is on the scale the outside arc is used. When the short pointer is on the scale the inside arc is used. These scales are designated in colors both on the dial scale and by dots on the selector buttons. A special High Capacity scale is provided for testing condensers above 50 microfarads.

OPERATION

Connect the instrument to power line and turn the OFF-ON switch to the ON position. Allow sufficient time for the tubes in the instrument to warm up.

PAPER AND MICA CONDENSERS

1st—Connect condenser to the jacks by means of the test leads or insert the leads of the condenser directly in the jacks. When accurate measurement of the capacity of small value mica condensers is made the condenser must be connected directly to the jacks to eliminate the stray capacity of the connecting leads.

2nd—Set the TEST VOLTAGE selector to the 500 volt position to obtain maximum leakage sensitivity. (If the value of the condenser is above 1 MFD set to the 200 volt position.)

3rd—Press the PAPER-MICA leakage button. If the shadow remains closed the condenser has excessive leakage and should be rejected. If the shadow opens the leakage value is satisfactory.

4th—Press the CAPACITY TEST button covering the approximate value of the condenser. Rotate capacity dial to point of maximum angle of the indicator tube. Read capacity value on the range selected by the capacity test button.

Note:—The POWER FACTOR control should be set to zero when the CH or CI range is used in testing paper and mica condensers. Bad power factor of paper and mica condensers will be indicated by the inability to obtain a complete balance at any point on the capacity dial scale. If the condenser is open it will balance at the "OPEN" end of the capacity dial on all ranges. Shorted condensers will balance at the "SHORT" end of the dial on all ranges.

Intermittent condensers will usually show open or shorted and sometimes are indicated by variation of capacity value when jarred or tapped.

ELECTROLYTIC CONDENSERS

1st—Connect the positive lead of the condenser to the red tip jack. Connect the negative lead to the black tip jack.

2nd—Set the TEST VOLTAGE selector to the position providing the correct rated voltage of the condenser under test. If the voltage rating of the condenser is between the values indicated, set to the next lower voltage position. For example, if the rating of the condenser is 450 volts set the TEST VOLTAGE selector to the 400 volt position.

3rd—Now press the ELECTROLYTIC Leakage test button. If the condenser is formed or has been used recently the shadow should open immediately. In case the condenser is new or has been out of

service for a period of time it may require approximately 1 minute for the plates to form sufficiently for the shadow to open. A closed shadow indicates excessive leakage current and the condenser should be rejected. If the shadow opens to any extent the leakage value is satisfactory.

4th—CAPACITY AND POWER FACTOR: The capacity of all ordinary electrolytic condensers falls within the capacity ranges of CH and CI. On these two ranges the POWER FACTOR control is connected in the circuit.

To test the capacity and Power factor press the Capacity Test button CH or CI and adjust the pointer for maximum shadow angle. Next adjust the POWER FACTOR control for further balance (maximum angle) of the indicator tube. Read the capacity value on the dial scale. The POWER FACTOR control reads directly in percent the power factor of the condenser.

If no balance can be obtained at any setting of the POWER FACTOR control the condenser has a higher power factor than 60 percent and should be rejected.

If the condenser is open it will balance at the "OPEN" end of the dial scale. If the condenser is shorted it will balance at the "SHORT" end of the scale.

Intermittent condensers will usually show open or shorted and are sometimes indicated by a variation of capacity.

NOTE: A. C. ELECTROLYTIC MOTOR STARTING CAPACITORS. These condensers do not have polarity. Make the leakage test first by inserting the leads in the test jacks, disregarding polarity. Next reverse the leads to the jacks and repeat the leakage test. The leakage value should be satisfactory for both connections.

CONDENSER TOLERANCE

The permissible capacity limits for condensers must be determined by their application in the circuit. However, the following limits should normally prove satisfactory:

PAPER and MICA condensers used solely for R. F. and A. F. bypass may vary plus or minus 20 percent. Condensers used for coupling or in R. F. padding circuits are more critical and the tolerance must be determined for each case.

ELECTROLYTIC condensers used in ordinary power supply filters may vary from minus 20 to 30 percent to plus 100 percent. Condensers used in tuned filters require close tolerance limited by the particular application.

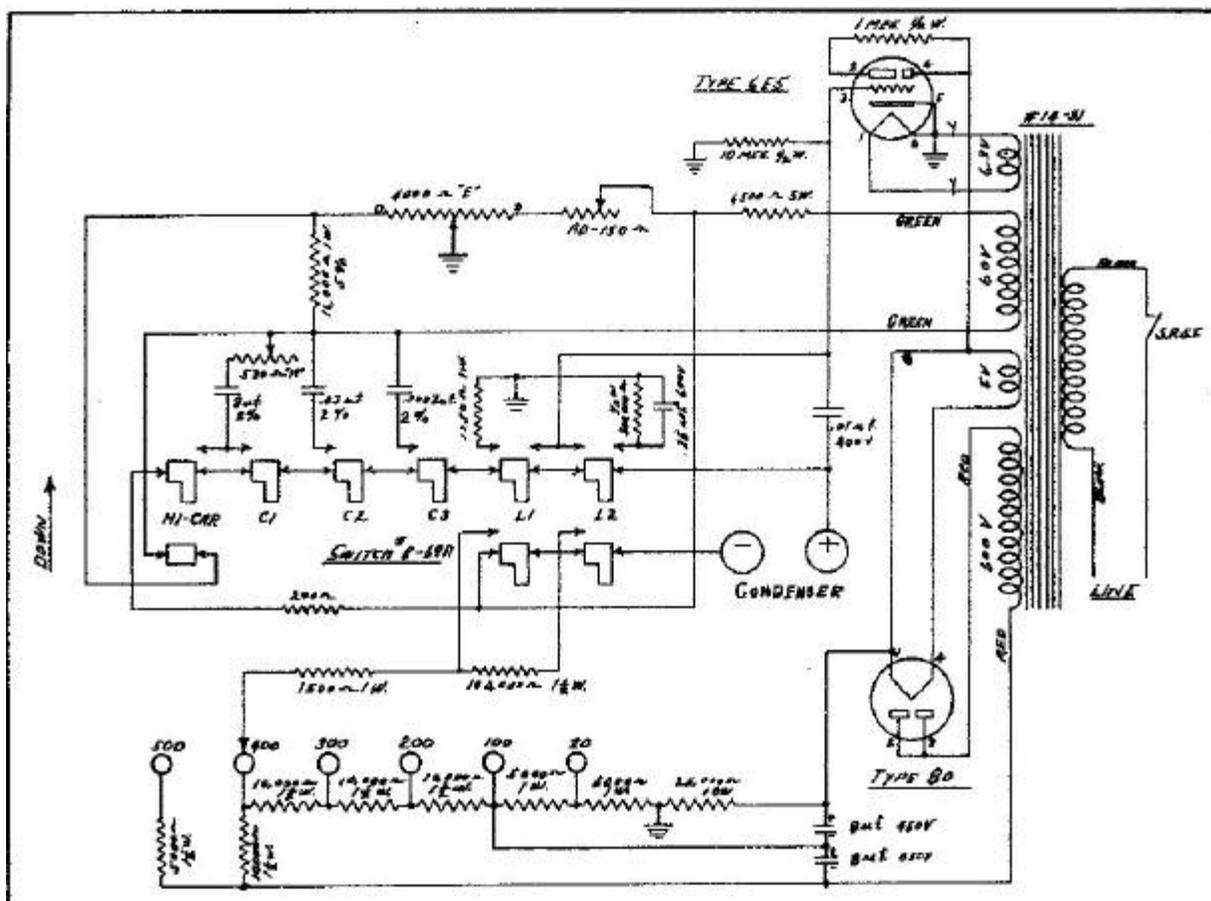
Electrolytic condensers used for power filtering purposes may have a power factor from zero to 50 percent without seriously affecting the filtering efficiency. When an electrolytic condenser is used as a combination filter and R. F. bypass or as a straight R. F. or A. F. bypass it should have a power factor lower than 10 percent. High power factor in audio bypass condensers frequently cause motor-boating.

A. C. ELECTROLYTIC condensers used for motor starting purposes should ordinarily have a capacity tolerance of plus or minus 20 percent. The power factor should be under 15 percent to prevent heating and provide high starting torque.

IMPORTANT: The voltages indicated on the TEST VOLTAGE selector are actually applied to the condenser when making the leakage test. These voltages are dangerous and care should be taken not to come in contact with the leads. The two leakage buttons do not lock down but do release the capacity test buttons. When all buttons are up the test jacks are shorted, thereby discharging the condenser. Therefore by depressing a leakage button momentarily any Capacity Test buttons which were down will be released and the condenser terminals shorted. The condenser can then be removed without any danger from shock.

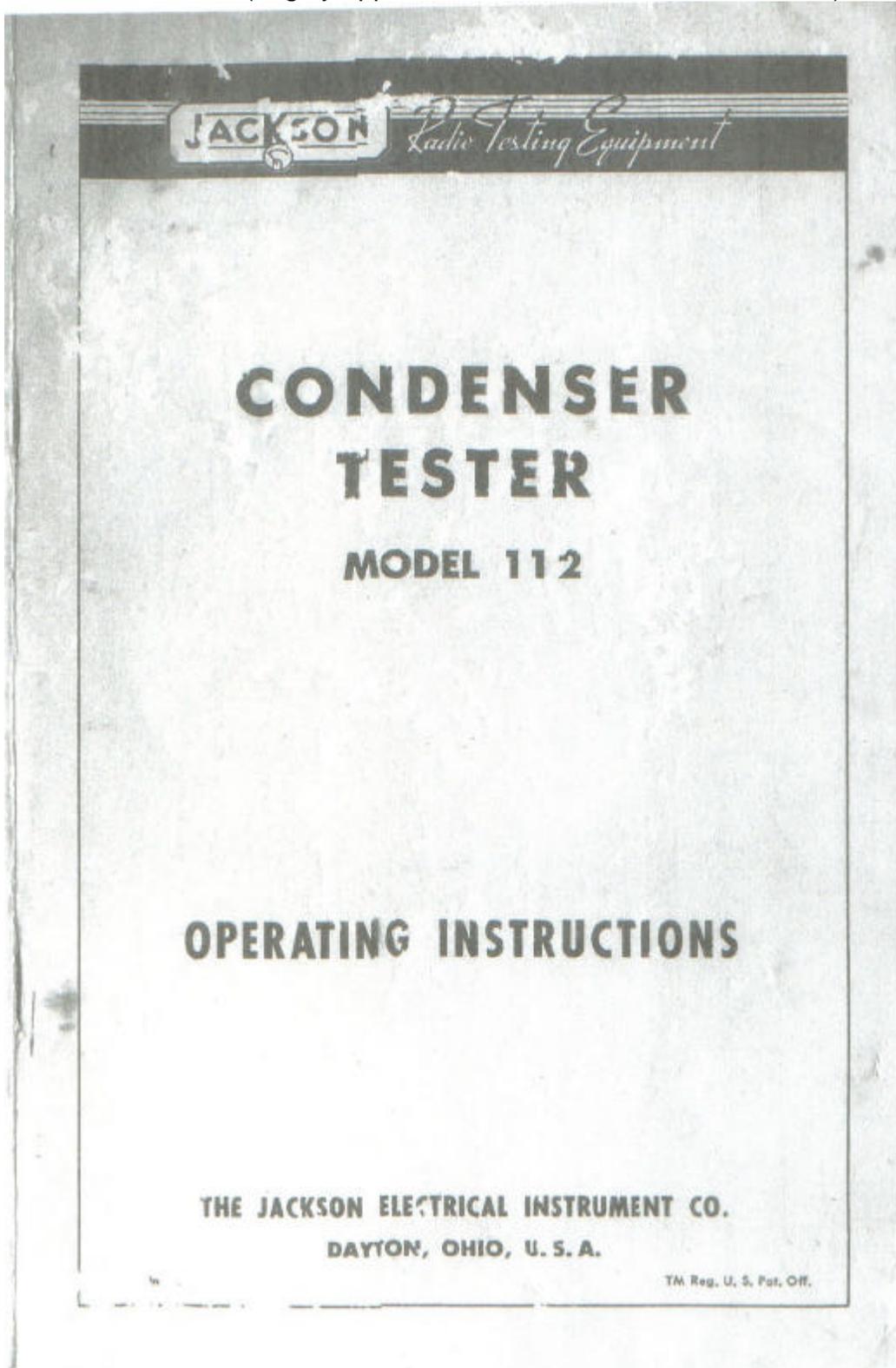
OBSELETE - NO PARTS SERVICE NO LONGER MAINTAINED

SCHEMATIC



THE JACKSON ELECTRICAL INSTRUMENT CO. DAYTON, OHIO	
MODEL 112 & 650A CIRCUIT	
DATE APRIL 12, 1940	SCALE
DWN. BY R.G.A.	CHEK. BY
PART NO.	SER. NO. 4,401-
DRAWING NO. C-472	

FULL INSTRUCTIONS
(largely applicable to models 650 and 650A also)



**CONDENSER
TESTER**

MODEL 112

OPERATING INSTRUCTIONS

**THE JACKSON ELECTRICAL INSTRUMENT CO.
DAYTON, OHIO, U. S. A.**

TM Reg. U. S. Pat. Off.

OPERATING INSTRUCTIONS FOR JACKSON MODEL 112

CONDENSER TESTER

The Model 112 tests condensers for shorted, leaky, open, intermittent, incorrect capacity and bad power factor conditions. Two tests are made upon the condenser to indicate the above conditions. The Capacity Test indicates the true capacity of the condenser. This test also shows open, shorted, intermittent and bad power factor conditions. The LEAKAGE TEST rejects condensers with excessive leakage resistance and supplies the correct polarizing voltage to electrolytics for test.

DIAL CALIBRATIONS: The Capacity control knob rotates through an arc of approximately 300 degrees. For convenience in reading and to provide a long effective scale length the arc has been divided into two sections and two pointers provided on the control arm. When the long pointer is on the scale the outside arc is used. When the short pointer is on the scale the inside arc is used. These scales are designated on the dial scale and on the selector buttons. A special High Capacity scale is provided for testing condensers above 30 microfarads.

OPERATION: Connect the instrument to a power line and turn the OFF-ON switch to the ON position. Allow sufficient time for the tubes in the instrument to warm up.

PAPER AND MICA CONDENSERS

1st - Connect condenser to the jacks by means of the test leads or insert the leads of the condenser directly in the jacks. When accurate measurement of the capacity of small value mica condensers is made the condenser must be connected directly to the jacks to eliminate the stray capacity of the connecting leads.

2nd - Set the TEST VOLTAGE selector to the 500 volt position to obtain maximum leakage sensitivity. (If the value of the condenser is above 1 MFD set to the 200 volt position.)

3rd - Press the PAPER-MICA leakage button. If the shadow remains closed the condenser has excessive leakage and should be rejected. If the shadow opens the leakage value is satisfactory.

4th - Press the CAPACITY TEST button covering the approximate value of the condenser. Rotate capacity dial to the point of maximum angle of the indicator tube. Read the capacity value on the range selected by the capacity test button.

Note: - The POWER FACTOR control should be set to zero when the C_H or C_1 range is used in testing paper and mica condensers. Bad power factor of paper and mica condensers will be indicated by the inability to obtain a complete balance at any point on the capacity dial scale. If the condenser is open it will balance at the "OPEN" end of the capacity dial. Shorted condensers will balance at the "SHORT" end of the dial.

Intermittent condensers will usually show open or shorted and sometimes are indicated by variation of capacity value when jarred or tapped.

ELECTROLYTIC CONDENSERS

1st - Connect the positive lead of the condenser to the positive tip jack. Connect the negative lead to the negative tip jack.

2nd - Set the TEST VOLTAGE selector to the position providing the correct rated voltage of the condenser under test. If the voltage rating of the condenser is between the values indicated, set to the next lower voltage position. For example, if the rating of the condenser is 450 volts set the TEST VOLTAGE selector to the 400 volt position.

3rd - Now press the ELECTROLYTIC leakage test button. If the condenser is formed or has been used recently the shadow should open immediately. In case the condenser is new or has been out of service for a period of time it may require approximately 1 minute for the plates to form sufficiently for the shadow to open. A closed shadow indicates excessive leakage current and the condenser should be rejected. If the shadow opens to any extent the leakage value is satisfactory.

4th - CAPACITY AND POWER FACTOR: The capacity of all ordinary electrolytic condensers falls within the capacity ranges of C_H and C_1 . On these two ranges the POWER FACTOR control is connected in the circuit.

To test the capacity and power factor press the Capacity Test button C_H or C_1 and adjust the pointer for maximum shadow angle. Next adjust the POWER FACTOR control for further balance (maximum angle) of the indicator tube. Read the capacity value on the dial scale. The POWER FACTOR control reads directly in percent, the power factor of the condenser.

If no balance can be obtained at any setting of the POWER FACTOR control the condenser has a higher power factor than 60 percent and should be rejected.

Intermittent condensers will usually show open or shorted and are sometimes indicated by a variation of capacity.

Note: - A. C. ELECTROLYTIC MOTOR STARTING CAPACITORS. These condensers do not have polarity. Make the leakage test first by inserting the leads in the test jacks, disregarding polarity. Next reverse the leads to the jacks and repeat the leakage test. The leakage value should be satisfactory for both connections.

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Electrolytic condensers used for power filtering purposes may have a power factor from zero to 50 percent without seriously affecting the filtering efficiency. When an electrolytic condenser is used as a combination filter and R.F. bypass or as a straight R.F. or A.F. bypass it should have a power factor lower than 10 percent. High power factor in audio bypass condensers frequently cause motor-boating.

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IMPORTANT: The voltages indicated on the TEST VOLTAGE selector are actually applied to the condenser through a resistive network when making the leakage test. These voltages are dangerous and care should be taken not to come in contact with the leads. The two leakage buttons do not lock down but do release the capacity test buttons. When all buttons are up the test jacks are shorted, thereby discharging the condenser. Therefore by depressing a leakage button momentarily any CAPACITY TEST buttons which were down will be released and the condenser terminals shorted. The condenser can then be removed without any danger from shock.

GENERAL INFORMATION

Mail the Registration Card for your instrument promptly, giving correct name and address, so that additional technical bulletins from our factory will be properly delivered. Notify us of a change of address, listing model number and serial number of your instrument in the notice.

Repairs and adjustments will be made under the terms and conditions stated in the guarantee furnished with this instrument. The instrument should not be returned to our factory except where we authorize such return to be advisable. When corresponding concerning this instrument, always mention model number and serial number. Be certain to describe fully and accurately the information desired.

THE JACKSON ELECTRICAL INSTRUMENT COMPANY
DAYTON, OHIO