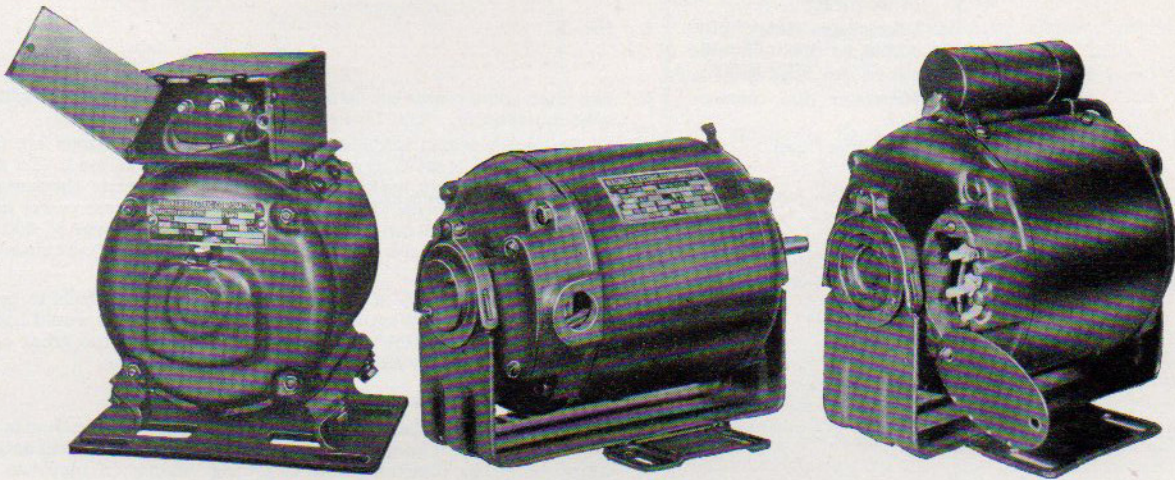


# SERVICE INSTRUCTIONS

for  
CAPACITOR-START INDUCTION-RUN MOTORS  
and  
SPLIT-PHASE MOTORS



A complete stock of new and factory-rebuilt motors, as well as replacement parts, is available at each of the Wagner branches listed below:

Atlanta, Ga. ....	14 Alexander St. N. W.	Memphis, Tenn. ....	689 Union Ave.
Baltimore, Md. ....	116-122 W. 20th St.	Milwaukee, Wis. ....	925-927 North Broadway
Boston, Mass. ....	158 Brookline Ave.	Minneapolis, Minn. ....	111-115 S. 12th St.
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Dallas, Texas ....	417 Olive St.	Portland, Ore. ....	N. W. 9th and Glisan
Denver, Colo. ....	1225 Lincoln St.	San Francisco, Cal. ....	457 Ninth St.
Detroit, Mich. ....	6050 Cass Ave.	Seattle, Wash. ....	1918 1st Ave., South
Indianapolis, Ind. ....	1231-33 N. Meridian St.	Saint Louis, Mo. ....	2017 Locust St.
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Los Angeles, Cal. ....	1240 S. Hope St.		

## Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, Mo., U. S. A.



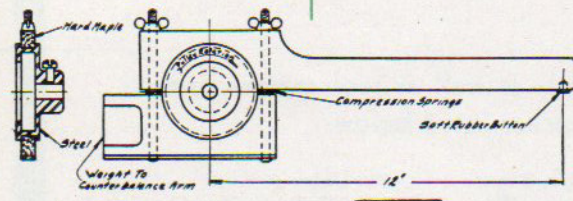
# SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN & SPLIT-PHASE MOTORS

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
(A) FAILURE TO START	<ol style="list-style-type: none"> <li>1. Blowing of fuses or operation of overload device.</li> <li>2. No voltage or low voltage.</li> <li>3. Open-circuited field.</li> <li>4. Improper current supply. Incorrect voltage or frequency.</li> <li>5. Condenser short circuited or open circuited (Type RK, RBZ).</li> <li>6. Improper line connection.</li> <li>7. Excessive load.</li> </ol>	<ol style="list-style-type: none"> <li>1. Examine motor bearings, be sure that they are in good condition and properly lubricated. Be sure motor and driven machine both turn freely. Check circuit voltage at motor terminals against voltage stamped on motor name plate. Examine overload protection of motor. Overload relays operating on either magnetic or thermal principles, or a combination of the two, offer adequate protection to the motor. Ordinary fuses of sufficient size to permit motor to start do not protect motor against burnout. A combination fuse and thermal relay such as the Buss Fusetron protects the motor and is inexpensive. If motor does not have overload protection the fuses should be replaced with overload relays or Buss Fusetrons. After installing suitable fuses and resetting overload relays, allow the machine to go through its operating cycle and if protective devices again operate, check the load. If motor is excessively overloaded take up with the appliance manufacturer.</li> <li>2. Measure volts at motor terminals with switch closed. See that it is within 10% of voltage stamped on name plate of motor.</li> <li>3. Indicated by humming sound when switch is closed. Examine for broken wires, loose connections.</li> <li>4. Requires motor built for operation on power supply available. A. C. motors will not operate on D. C. circuit or vice versa.</li> <li>5. See F.</li> <li>6. See that connections are exactly like connection diagram which is sent with motor. (See Drawing No. MX53.)</li> <li>7. If the motor starts idle and if all the above conditions are O. K. then failure to start is most likely due to excessive load. To determine this definitely make or have a reliable electric shop make a test of starting torque. Most Wagner fractional horse power capacitor-start induction-run motors have a starting torque of 400% or more of full load torque. If the load requires more than this a larger motor is required.</li> </ol>

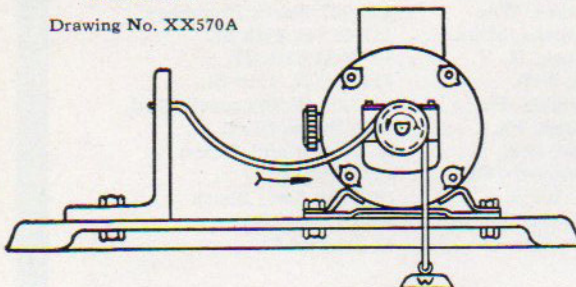
If this figure is 400% of full load torque and motor fails to pull in, consult the nearest Wagner Branch inasmuch as this would indicate either a misapplication of the motor, resulting in too great a load, or an increased load due to faulty driven apparatus.

### To Determine the Load:

- a. **PRONY BRAKE** (See Drawing No. XX570A). This method is probably the most generally used. It requires a pulley, brake arm and scale (may be either platform scale or spring balance, if platform scale be sure that load is applied to center of platform, if spring balance is used the pull must always be at right angle to the brake arm, and in either case scale must have small enough variations to accurately read torque on smaller rated motors). Brake arm should be made up so that the distance between center of pulley and contact point where load is measured is exactly 12 inches. Scale reading will then be in pounds feet. **BEFORE STARTING TEST MAKE SURE THAT DIRECTION OF ROTATION IS SUCH THAT BRAKE ARM WILL BE MOVED AGAINST BALANCE.** In order to measure starting torque clamp arm to pulley tight enough to allow pulley to turn very slowly — read scale when slowly turning. To measure pull in torque release brake clamp until motor is just able to pull up to speed. The true pull in torque is the highest scale reading for which the centrifugal switch inside the motor will operate.
- b. **ROPE AND WEIGHT** (See Drawing No. XX570B). This method gives equally satisfactory results and yet does not require the equipment of the Prony Brake method. It requires a smooth face flanged iron pulley, rope and weight. Tie one end of the rope to the projection from the test bench so that the rope will be at 90° to the shaft. Wrap the rope around the pulley opposite to the pulley rotation and hang a weight on the free end of the rope. Wrap sufficient turns around the pulley so that the tied end of the rope will be slack when the weight is lifted and the pulley rotates. To prevent the rope from gripping the pulley, oil or paraffin the rope slightly. Be sure that the hanging weight does not touch the floor or test bench. **SOME PROTECTIVE MEASURES SHOULD BE TAKEN TO PREVENT THE WEIGHT FROM INJURING THE OPERATOR IN CASE THE ROPE GRIPS TOO TIGHT.** Proceed to test as follows. Increase the weight until the motor will just start, then calculate as follows:



Drawing No. XX570A



Drawing No. XX570B



# SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN & SPLIT-PHASE MOTORS

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
	8. Shorted stator.	<p>For example, to make starting test on a <math>\frac{1}{4}</math> HP, 1725 RPM motor select a 4" pulley, <math>\frac{1}{8}</math>" rope, and necessary weight. If assortment of graduated weights are not handy use bucket and sand (or shot) adding weight so that pulley is slowly turning.</p> $\text{Brake Arm} = \frac{\text{Pulley Dia. in inches} + \text{rope dia. in inches}}{12 \times 2}$ $= \frac{4 + .125}{24} = .172 \text{ Ft.}$ <p>Starting Torque in Lb. Ft. = Brake Arm x weight hung on rope = .172 x weight.</p> $\text{Full Load Torque in Lb. Ft.} = \frac{\text{Full Load HP} \times 5250}{\text{Full Load RPM}}$ $= \frac{.25 \times 5250}{1725} = .76 \text{ Lb. Ft.}$ <p>Starting Torque in Percent of F. L. Torque = <math>\frac{\text{Starting Torque}}{\text{Full Load Torque}}</math></p> <p>While both of these methods are widely used by small service organizations for checking test values on electric motors of all sizes, it should be specially noted that both methods do contain an element of danger to the operator, and should be used with extreme care from the standpoint of both safety to operator and accuracy of test results.</p>
(B) EXCESSIVE BEARING WEAR	<ol style="list-style-type: none"> <li>1. Belt tension too great; unbalanced or out-of-line coupling; eccentric or too closely meshed gears.</li> <li>2. Improper, unclean or insufficient oil.</li> <li>3. Dirty bearings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Belts, either flat or "V", should have only sufficient tension to prevent slipping. "V" belts usually require less tension than an equivalent flat belt. Slipping of belts will cause pulleys to heat (touch), squeak (sound), or burn belts (smell). In case of unbalanced or out-of-line couplings or eccentric or too closely meshed gears — correct mechanical condition.</li> <li>2. The lubrication system of Wagner small motors provide for supplying the right amount of filtered oil to bearing. It is only necessary for the user to keep wool yarn saturated with a good grade of machine oil.</li> <li>3. When bearings get clogged with dirt motor may need protection from excessive dust. Application may be such that especially constructed motor should be used — consult Wagner.</li> </ol>
(C) MOTOR RUNS HOT (Don't judge motor temperature by feel of hand. Measure it with a thermometer and check with temperature rise stamped on name plate.)	<ol style="list-style-type: none"> <li>1. Bearing trouble.</li> <li>2. Short circuited coils in stator.</li> <li>3. Rotor rubbing stator.</li> <li>4. Excessive loads.</li> <li>5. Low voltage.</li> <li>6. High voltage.</li> <li>7. Incorrect line connections to motor leads.</li> </ol>	<ol style="list-style-type: none"> <li>1. See condition under B.</li> <li>2. Shorted coil may be located by fact that one coil feels much hotter than other. Very great increase over normal magnetic noise may also indicate shorted stator.</li> <li>3. Some extraneous matter may be between rotor and stator, or bearings may be badly worn.</li> <li>4. Be sure proper pulleys are on motor and machine. Driving the load at higher speed requires more horsepower. Take an ammeter reading. If current draw exceeds name plate amperes for full load, the answer is evident.</li> <li>5. Measure voltage at motor terminals with line switch closed. Should not vary more than 10% from value stamped on name plate.</li> <li>6. See No. 5.</li> <li>7. Check with connection diagram sent with motor.</li> </ol>
(D) MOTOR BURNS OUT	<ol style="list-style-type: none"> <li>1. Frozen bearings.</li> <li>2. Some condition of prolonged excessive overload.</li> </ol>	<ol style="list-style-type: none"> <li>1. Causes may be same as under B.</li> <li>2. It is important that the load be examined carefully before the burned out motor is replaced so as to locate and remove the cause of the overload. Certain jobs such as refrigerators will under unusual conditions of operation, apply prolonged overloads which may destroy a motor and which may be difficult to locate unless examined carefully. On jobs where it is assumed somewhat intermittent service will normally prevail and which consequently are closely motored, the load cycle should be especially checked, as a change in this feature will easily produce excessive overload for the motor. Examine carefully to determine mechanical condition of the driven appliance.</li> </ol>



# SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN & SPLIT-PHASE MOTORS

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
(E) MOTOR IS NOISY	<ol style="list-style-type: none"> <li>1. Unbalanced rotor.</li> <li>2. Worn bearings.</li> <li>3. Switch rattles.</li> <li>4. Excessive endplay.</li> <li>5. Motor not properly aligned with driven machine.</li> <li>6. Motor not firmly fastened to mounting base.</li> <li>7. Loose accessories on motor.</li> <li>8. Air gap not uniform.</li> <li>9. Amplified motor noises</li> </ol>	<ol style="list-style-type: none"> <li>1. When transportation handling has been so rough as to damage the heavy Wagner shipping case, it is well to test motor for unbalance conditions at once. It is even possible (though it rarely happens) that a shaft may be sprung. In any case the rotor should be re-balanced dynamically.</li> <li>2. If unduly frequent, examine for cause. See B.</li> <li>3. Install new switch hub and felt washer.</li> <li>4. End play should be reduced as near as possible to zero. In doing this be sure the bearings do not bind. <i>Rotor must turn freely.</i> Washers supplied by factory should be used in making this adjustment.</li> <li>5. Correct mechanical condition.</li> <li>6. All Wagner small motors have steel bases so they can be firmly bolted to mounting without fear of breaking. It is, of course, not to be expected that the base should be strained out of shape in order to make up for roughness in mounting base.</li> <li>7. Such parts as oil covers, capacitor box or cover, guards, if any, on end plate, etc. should especially be checked for security if they have been removed for investigation of any sort. The conduit box should be tightened when top is fitted after connections are made. Pulley must be tight on shaft.</li> <li>8. This results from sprung shaft or unbalanced rotor. (See No. 1 above).</li> <li>9. When this condition is suspected, set motor on a firm floor, and if motor is quiet, then the mounting is acting as an amplifier to bring about certain noises. This may occur even though mounting is quite firm in structure. The use of rubber-mounted-type motors almost invariably eliminates the amplification of motor noises.</li> </ol>

## (F) TESTS FOR ELECTROLYTIC CONDENSERS (TYPE RK, RBZ)

1. To obtain the capacity in microfarads.
2. Test for open circuits.
3. Test for shorts.
4. Test for grounded condenser.

1. Remove all motor leads from the condenser terminal board. Apply rated voltage at 60 cycles across terminals of condenser and measure volts and amperes. The capacity in microfarads is approximately

$$\text{Capacity} = 2650 \times \frac{\text{amperes}}{\text{volts}}$$

The above formula applies to a test made at 60 cycles only. This test should be made with a fuse in series with the condenser to protect the line in case the condenser is shorted.

Capacity of condenser should not be less than the rated value marked on cardboard case of condenser but may exceed it by any amount up to 40%.

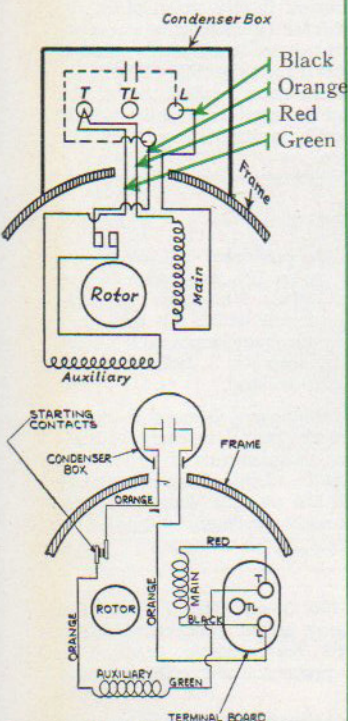
2. Remove all motor leads from the condenser terminal board. Apply rated voltage at 60 cycles across terminals of condenser with an ammeter in series. If the ammeter shows no current reading the condenser is open circuited. This test should be made with a fuse in series with the condenser to protect the line in case the condenser is shorted.
3. Remove all motor leads from the condenser terminal board. Apply rated voltage at 60 cycles to the condenser terminals with a fuse in series. If the fuse blows the condenser is short circuited. A 10 ampere fuse will be ample for testing a 110 volt condenser of 150 MF rating or smaller. For larger condensers use a heavier fuse.
4. To determine whether a condenser terminal is grounded to the metal container remove all motor leads and apply rated voltage between the terminal and the metal container with a 10 ampere fuse in series. If the fuse blows the condenser is grounded.

If both terminals are grounded to the metal container these grounds will constitute a short circuit. (See "3-Test for Shorts").

If only one terminal is grounded to the case no harm will result since the container is insulated from the condenser compartment by means of a cardboard box.

If voltage is applied between one of the terminals and the metal container a slight spark may occur when the circuit is broken. This is due to leakage of current through the electrolyte between the terminal and the metal container and does not indicate a ground or a defective condenser. The condenser is not grounded unless enough current flows when making this test to blow a 10 ampere fuse.

Electrolytic condensers are intended to stand intermittent applications of voltage over short intervals and will be injured if the voltage is left on too long. When making these tests the voltage should not be applied to the condenser any longer than is necessary.

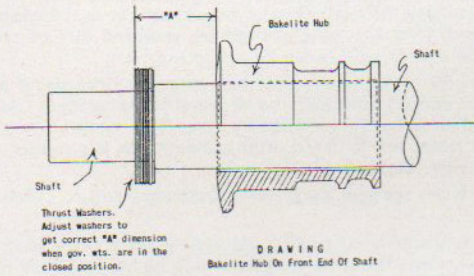


General

Drawing No. MX53—Connection diagrams of capacitor-start induction-run motor (Type RK, RBZ). These connections are for counter-clock wise rotation looking at the front end (switch end) of the motor.



# SERVICE INSTRUCTIONS FOR CAPACITOR-START INDUCTION-RUN & SPLIT-PHASE MOTORS

PROBLEM	PROBABLE CAUSE	TEST AND REMEDY
<p>(G) PROTECTOR (motor mounted) trips after the motor starts but before it changes to the Induction Winding.</p>  <p>Drawing No. MX161</p>	<ol style="list-style-type: none"> <li>1. Low voltage.</li> <li>2. The driven machine requires excessive torque. This may be due to high inertia or heavy load.</li> <li>3. The centrifugal switch opens at too high a speed (late).</li> <li>4. Defective electrolytic condenser. (Type RK, RBZ).</li> <li>5. Too frequent starting.</li> <li>6. Defective (motor mounted) protector.</li> </ol>	<ol style="list-style-type: none"> <li>1. Measure the voltage at the motor-terminals while the motor is operating; it should be within 10% of the voltage stamped on the motor nameplate.</li> <li>2. Measure the time required for the motor to come from zero to a constant speed. This acceleration period <i>must not</i> exceed 2 seconds for types RB and RB-5 (GB) or 3 seconds for type RK (RBZ). It usually is on the order of 0.5 to 1.0 second. If the long acceleration period cannot be overcome by oiling and greasing bearings, correcting obvious mechanical defects, etc., take the matter up with the appliance manufacturer.</li> <li>3. Measure the speed at which the centrifugal switch opens; it <i>must not</i> exceed 1300 rpm on types RB and RB-5 (GB) and 1500 rpm on type RK (RBZ) 60 cycle motors. When found to exceed this limit, examine the motor assembly. The following specifications on the 56, 57, 60, and 65 RB, RB-5, and RK, 1725 rpm motors will probably give satisfactory opening speed. <ul style="list-style-type: none"> <li>2—Governor Weight Springs HC-5306</li> <li>1—Bakelite Hub HC-7310</li> </ul>                     Dimension "A" (See Drawing No. MX161): <ul style="list-style-type: none"> <li>With felt pads new, "A" = 15/32"</li> <li>With felt pads worn (permitting the bakelite hub to rest directly upon the moving contact arm), "A" = 7/16"</li> <li>Motors without felt pads on moving contact arm, "A" = 7/16" (same as worn felt pad).</li> </ul> </li> <li>4. Test the condenser as outlined under Problem (F).</li> <li>5. It is difficult to establish the maximum number of starts per hour which will not trip out the protector since there are so many different types of load to which motors are applied. In general, however, too frequent starting may be a possible cause of trouble if the motor is starting 6 or more times per hour. If it is thought that this is the trouble, contact Wagner giving complete details.</li> <li>6. First be sure that steps No. 1, No. 2, No. 3, No. 4, and No. 5 have been checked and remedied if necessary; they probably will have rectified the trouble. But if the application is still unsatisfactory, record each of the "on" times of the motor for 10 successive attempts to start. If two or more of these "on" times are less than 2 seconds for types RB and RB-5 (GB), or 3 seconds for type RK (RBZ), replace the protector with a new unit of the rating called for on the motor nameplate. Operate the motor on the appliance under actual load conditions. If the application is still unsatisfactory, transmit <i>all</i> the information obtained to Wagner.</li> </ol>
<p>(H) PROTECTOR (motor mounted) trips after the motor has come up to speed.</p>	<ol style="list-style-type: none"> <li>1. Low voltage.</li> <li>2. Excessive room temperature.</li> <li>3. Excessive load.</li> <li>4. Too frequent starting.</li> <li>5. Defective (motor mounted) protector.</li> </ol>	<ol style="list-style-type: none"> <li>1. See G-1.</li> <li>2. The current input to the motor, which the protector will allow continuously without tripping, decreases 1/2 to 1% for every degree Centigrade of room temperature above 40° C. (For room temperatures below 40° C the continuous input current which the protector will allow is increased by approximately the same amount.) Therefore, the allowable load as determined by step No. 3 (below) should be corrected for room temperature <i>at the motor</i>.</li> <li>3. The protector on standard Fractional Horsepower, General Purpose, Open Type motors is designed to allow the motor to carry at least 140% of full load horsepower in a room temperature of 40° C; the current input at this load is approximately 125% of the nameplate current. Take an ammeter reading. If the current drawn exceeds the 125% of full load value refer the trouble with complete details to Wagner.</li> <li>4. See G-5.</li> <li>5. First be sure that steps No. 1, No. 2, No. 3, and No. 4 have been checked and remedied if necessary. Look at the protector; if it is obvious that it is physically damaged (for example, cracked or broken bakelite) replace it with a new protector of the same rating as called for on the motor nameplate. <ul style="list-style-type: none"> <li>If, after a complete investigation as outlined in the various steps above, the trouble has not been found, refer the matter to Wagner with <i>all</i> the information obtained.</li> </ul> </li> </ol>