

BOSCH DYNASTART

Bill Rogers

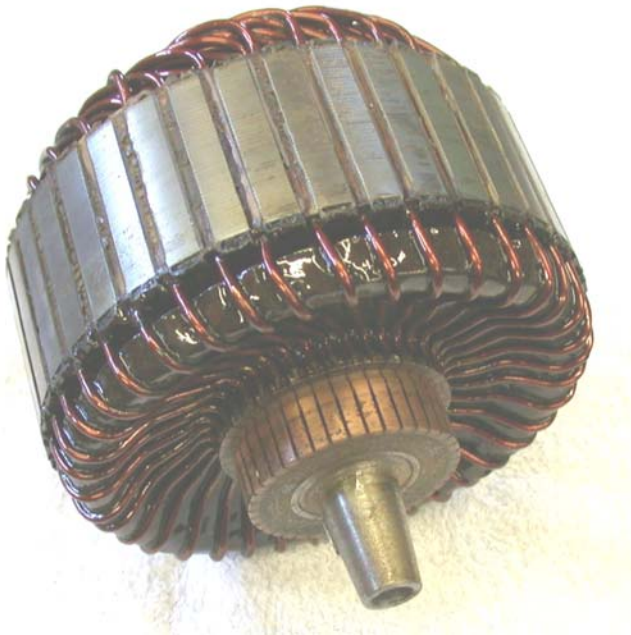
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GENERAL INFORMAITON:

The dynastart used on the BMW 600, Isetta and other microcars of the 1950s and 1960 incorporated an armature and two sets of field coils to provide a compact starter and generator in one unit. This document concentrates on the use of the dynastart as it applies to the BMW 600 and the Isetta 300 / 250. The differences between the dynastart used on the BMW 600 and the Isetta 300 / 250 are as follows:

- The armature and field coils used on the BMW 600 are slightly longer and thus not interchangeable with the 300 / 250 units.
- The main post on the field coils of the BMW 600 is shorter and does not protrude outside the air guide as it does on the Isetta 300 / 250.
- The condenser, for the ignition points, is normally installed on the dynastart in the BMW 600 as apposed to being installed at the coil on the Isetta 300 / 250.

A picture of the armature is shown below. The armature is no different from any armature used in either a generator or starter motor except that is has a much larger diameter. This larger diameter is designed to provide the additional torque and lower speed needed for its specialized application. Since the armature is mounted directly to the crankshaft and no gearing is provided between the starter and the engine, lower speed and higher torque is a necessity. This photo shows an armature from a 600 engine. The 300 armature is the same except slightly shorter in length.



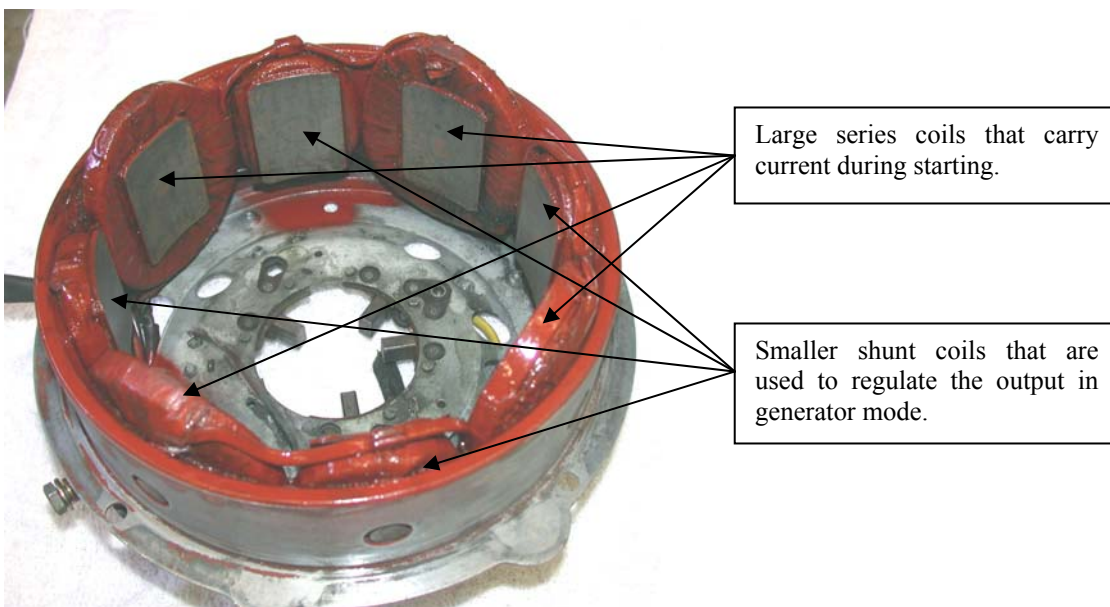
The field coil assembly is designed to carry both the series field and shunt fields. It also carries a set of points for the ignition system. The photo below does not show the points installed, but they would reside on the post shown in approximately the 1 o'clock position near the center hole. In addition, the larger brass post, with a nut on the top at about the 2 o'clock position, is the connection for the cable from the regulator

terminal 30h. This is a field coil unit from a 600 engine. The 300 coils are somewhat shallower and the main post is longer.



Four brushes can be seen in the above photo. During starting, power is applied to the brass post at the 2 O'clock position and flows through the larger series fields to the brushes shown in the 4 and 7 o'clock positions. The current then flows through the armature and is collected by the remaining two brushes that are connected to ground. During the generator phase, power flows out of the two brushes at the 4 and 7 o'clock positions and through the blue wire to the D+/61 terminals of the regulator.

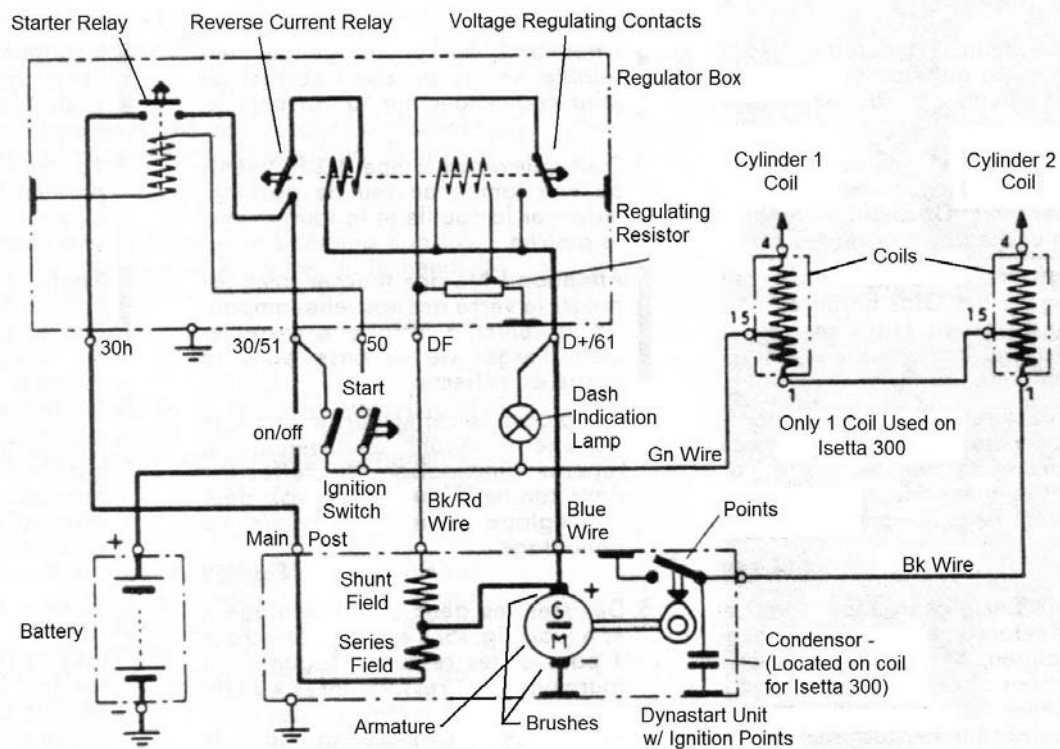
The last photo shows the back side of the field coil assembly. There are a total of eight coils. Four larger coils (series field) and four smaller coils (shunt field). The four larger coils are connected to the brass post described above and carry the full load of the starting current. Therefore, these coils are made from much larger wire. The smaller shunt coils are only used to excite the armature during the generator phase of operation and are made of much smaller gauge wire. These coils only carry a small current.



A complete electrical diagram of the dynastart and its connections to the controlling regulator is shown in the diagram below. This diagram shows how the system is connected for a BMW 600 car. The setup is the same for the Isetta 300 or 250 with the exception of the following.

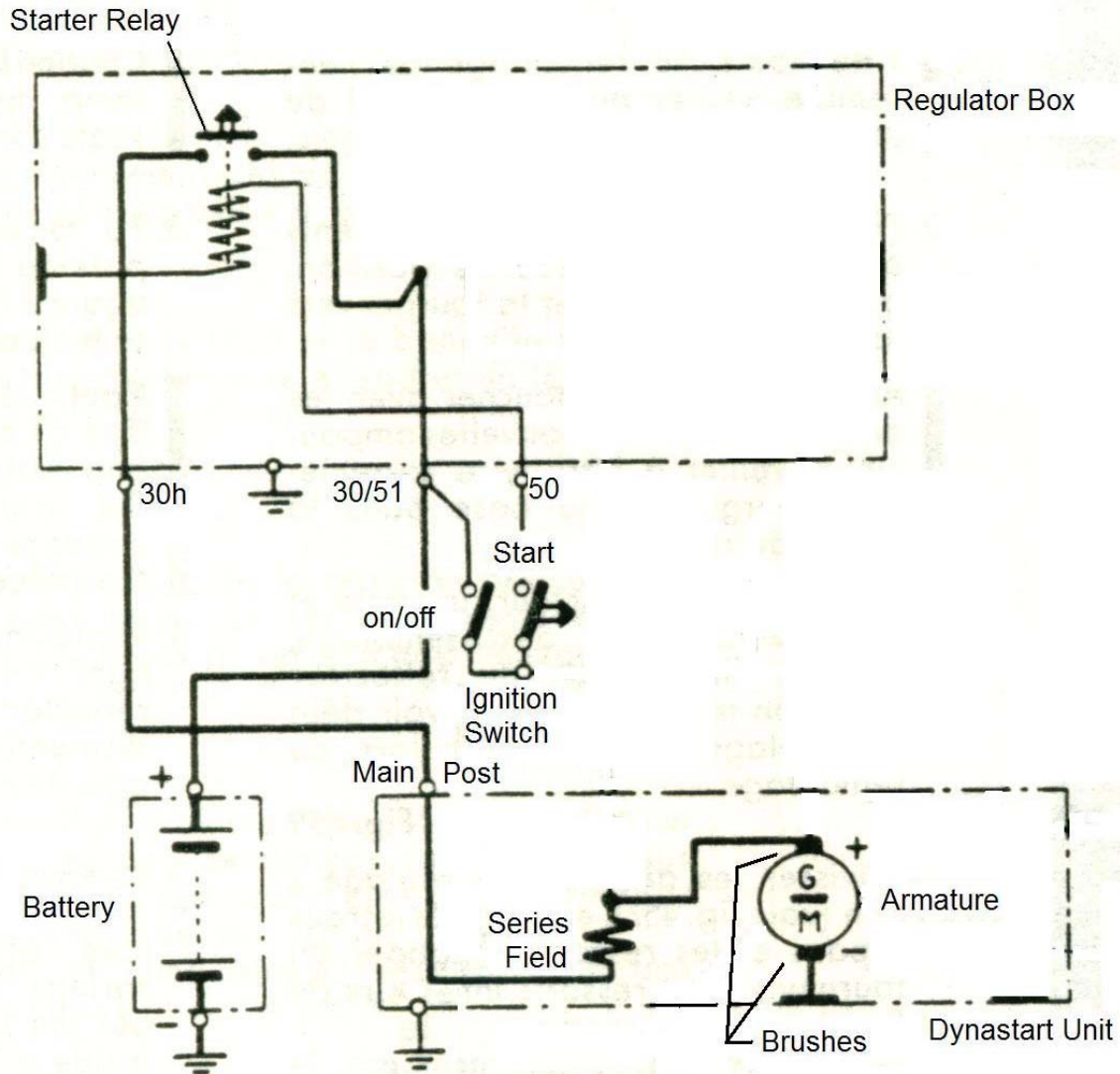
- Only one ignition coil is used in the Isetta
- The condenser is usually located on terminal “1” of the coil instead of inside the dynastart.

As can be seen from the diagram below, the regulator unit contained the regulator, a reverse current relay and starter relay. The balance of this document will break down the starting and generating section of the dynastart and discuss ways to test the different parts. Finally, a short troubleshooting section is added to point you in the correct direction based on symptoms.



STARTING MODE:

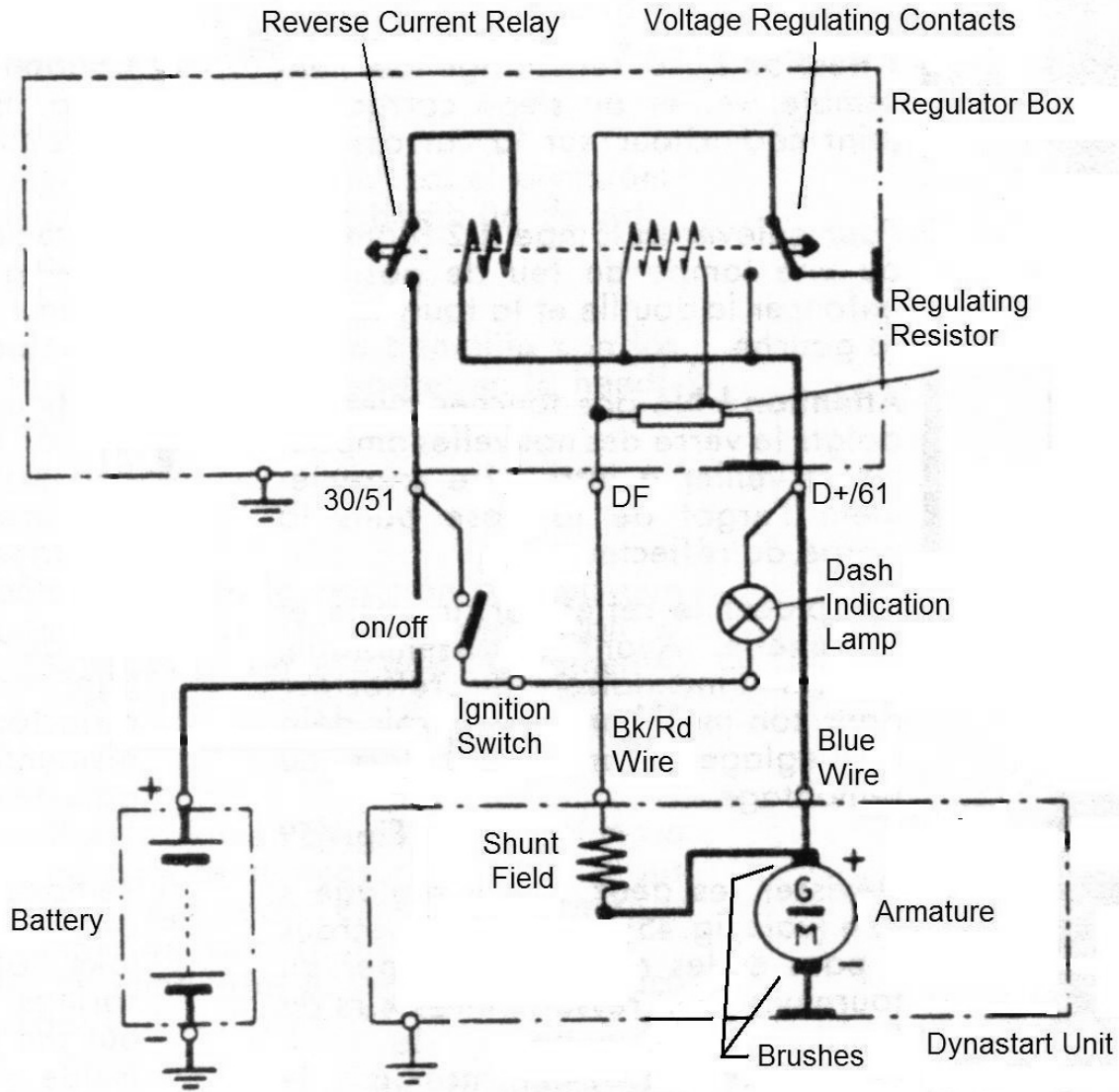
Refer to the diagram on the next page for a simplified version of the starter circuit. Although the shunt field is energized during starting, its contribution to starting torque is irrelevant and considered negligible. It is therefore not shown in this simplified diagram. In the starter mode, power is fed from the positive post of the battery and flows into terminal 30/51 of the regulator unit. When the ignition switch is moved past the “on” position to the start position the starter relay is closed. The circuit between terminals 30/51 and 30h is complete and power flows out terminal 30h of the regulator to the “main post” on the dynastart unit. The power then flows through the series fields (heavy wire coils) and into the positive terminal of the armature. Power passes through the armature with the aid of the carbon brushes to complete the circuit and cause the dynastart to operate as a motor. After the engine starts, the ignition switch is released. The release of the ignition switch removes power from the starter relay. This removes battery power from the main post of the dynastart.



GENERATOR MODE:

After starting is complete and the engine is idling, the system converts to a generator. The starter relay is opened and the series fields are not used until the next start sequence. Now the unit is controlled by the voltage regulating contacts and the reverse current relay. Refer to the diagram on the next page for generator operations. With the armature being driven by the engine, voltage is produced at the positive brushes of the armature. This power is collected by the brushes and is available at the D+/61 terminal. Additionally, power will flow through the shunt fields (smaller wire coils) and be present at the DF terminal of the regulator. At idle speeds, the residual magnetism in the shunt field is strong enough to allow the generation of a small output voltage. Typically the output voltage of the dynastart at idle is around four to six volts. The voltage regulator's contacts at idle are in the following states:

- Reverse current relay is open to prevent battery current from flowing into the dynastart
- The voltage regulating contacts are connected to ground.



IMPORTANT NOTE: The dash indicator light for the generator should have two terminals. The wire from the ignition switch is connected to one of the terminals. A second wire, that enters the wiring harness and goes to the voltage regulator, is connected to the other terminal. If the indicator lamp installed in your car does not have two terminals, it is the wrong unit and must be replaced. Connecting the two wires under a single terminal lamp holder will damage the wiring in your car and could cause a fire!

With the voltage regulating contacts connected to ground, the 4 to 6 volts applied to the shunt field is provided a path to ground. This will cause a small current to flow in the shunt field that reinforces the residual magnetism. At the same time, the dash indication light will be glowing red. This is because on the D+/61 terminal there is only 4 to 6 volts while on the other side of the indication lamp 12 volts is present from the battery power. This 6 to 8 volts difference is enough to turn on the lamp.

Terminal DF is held at ground potential during engine acceleration. This will result in a steady increase in shunt field current as the output voltage of the armature increases. As the output voltage on the armature increases, it increases the voltage at terminal D+/61. This will continue until the output of the armature reaches a sufficient voltage to operate the voltage-regulating relay. When the voltage-regulating relay

operates, the current path for the shunt field is interrupted causing the field to “collapse”. The collapse of the field will result in a rapid decrease in output voltage of the armature. This process will continue in rapid succession and result in a regulated output voltage around 14 to 15 volts. This normally stabilizes at engine speeds above 1200 rpm.

During this same time, the reverse current relay is also sensing the voltage on terminal D+/61. This relay is designed to close its contacts when the voltage on D+/61 reaches a voltage of 13 to 13.6 volts. This relay prevents the battery from being discharged into the dynastart when the output of the dynastart is insufficient.

Once the voltage regulating contacts are in a “regulating” mode (switching on and off rapidly to regulate the output voltage), and the reverse current relay has been satisfied, the generator indicating lamp will no longer be lit. This is because the voltages on both sides of the lamp are at the same potential.

TESTING THE STARTING WINDINGS:

To test the field coils it is necessary to disconnect all the wires connected to the voltage regulator. You should also remove and separate the wires connected to the terminal post on the face of the field assembly at the 3 o’clock position. This will allow you to check the resistance of each set of coils individually and check for any shorts to ground.



Remove wires and separate them from each other and this terminal.

To check the main start windings, connect an ohmmeter between the 2 locations pointed out in the next photo. The ohmmeter should be set to its lowest setting. You should read “0” ohms or very close to that. Any reading above what you read when the two probes of the ohmmeter are connected directly together would indicate a loose connection in the windings.



Connect the meter between the main post and the heavy yellow wire shown at the left. You should read close to "0" ohms.

You should next check to see if these coils are shorted to ground. Change the meter setting to its highest ohms scale. Place the probes of the meter between the main post and the metal case of the coils. The meter should read an "open" circuit or very high resistance. Any reading above 1,000,000 ohms (or 1-mega ohms) is very good. Any reading less than 500,000 ohms would indicate the coils are contaminated and need additional cleaning. A reading close to zero ohms would indicate a shorted coil and require coil repair or replacement. Be sure that when you are taking this last reading the heavy yellow wire is not touching the metal frame of the field coils or the readings will be invalid.

A visual check of the connections between the main post, windings and yellow jumper wire should also be done to ensure you do not have a loose solder joint. Refer to the next photo for the location of these joints. It is required that you remove the field coils to check these solder joints.



Solder joint between main post and the series field windings (starter windings). Check for loose solder joint.

Solder joint between series field and yellow jumper wire to terminal post at 3 o'clock position. Check for good solder joint.

TESTING THE GENERATOR WINDINGS:

To check the generator field windings, connect an ohmmeter between the black / red wire and the yellow wire pointed out in the next photo. The ohmmeter should be set to its lowest setting. You should read between 4.5 and 5.7 ohms. Any reading above or below this range would indicate a problem in the windings.



Connect the meter between this lead and the black / red lead in the dynastart wiring harness.

After completing the above test, check the windings for grounds. This is done by placing the meter on its highest scale and attaching the meter's probes between the yellow wire and the metal case of the field assembly. Make sure the black / red wire is not touching any metallic part of the field assembly. The meter should read above 1-mega ohms. Any reading less than 500,000 ohms would indicate the coils are contaminated and need additional cleaning. A reading close to zero ohms would indicate a shorted coil and require coil repair or replacement.

ARMATURE CHECKS AND TESTS:

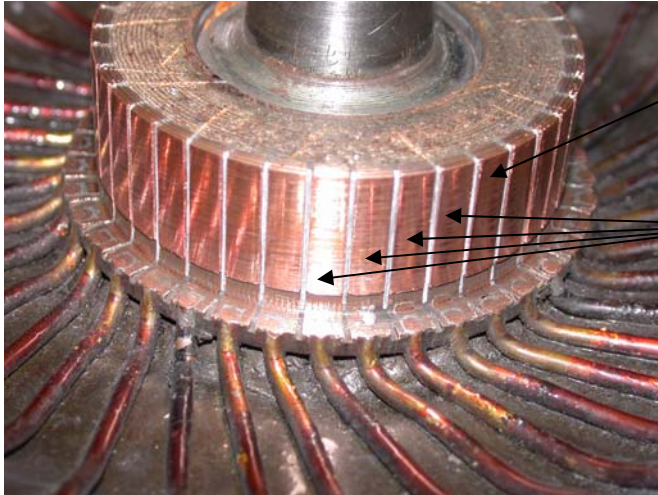
If you have access to a "growler" this is one test that can be performed on the dynastart armature to test for internal shorts. If there is a local motor shop in your area, they should be able to perform this test for you at a minimal charge. This test will reveal internal shorts, but will not discover some other defects. One defect that can be found with a simple ohmmeter and a good magnifying glass is broken solder joints at the commutator (the raised copper bars the carbon brushes ride against). The next photograph shows an armature that tested good on the growler, but had several open connections at the commutator.



Solder joint was broken loose at this point and several other points on the commutator.

Once a close visual inspection has been completed, the armature should be checked for open circuits. This is done by placing your ohmmeter on its lowest scale and connecting it to each bar on the armature. This should be accomplished by placing one probe on a specific bar and the other probe should be placed on each

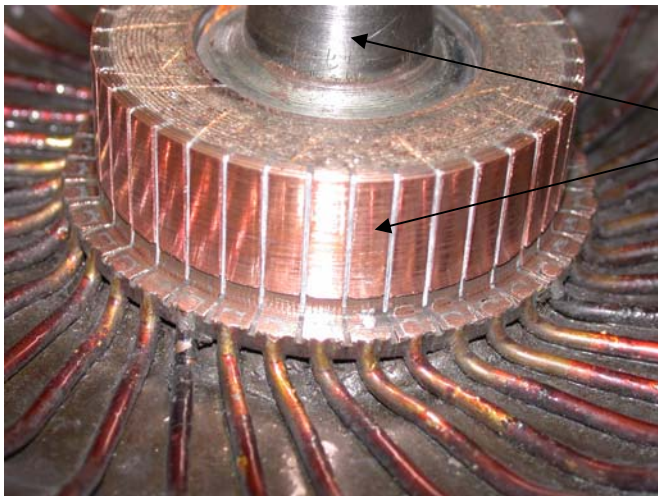
of the other bars and readings taken. This should be done until all bars have been checked back to the first bar.



Place one probe on any bar.

Then place the other probe on each of the remaining bars, one at a time, and take the resistance reading.

The meter should read “0” ohms for each reading between every bar. If you find a bar or group of bars with readings higher than “0” ohms, then there is a connection problem within the dynastart armature. The next check will test for grounds within the armature. Place the meter on its highest scale and check between any bar and the shaft of the armature. The reading should be above 1-mega ohms. Again, as before any reading less than 500,000 ohms is reason for concern.



Place meter probes between any bar and the stub shaft of the armature.

TROUBLESHOOTING:

Symptom	Possible Causes	Checks / Repair
<p>Engine will not turn over when key is moved to start. If car is push started – generator works correctly.</p>	<ol style="list-style-type: none"> 1. Battery is dead. 2. Starter relay not pulling in. 3. Starter relay contacts not making good electrical contact. 4. Carbon brushes worn and only making contact intermittently. 5. Solder joint at base of main post broken loose or poor connection. 6. Solder joint at heavy jumper wire loose. 7. Series field coils open or shorted to ground. 	<ol style="list-style-type: none"> 1. Check the battery voltage when the ignition switch is in the start position. The voltage should not drop below 9-10 volts. 2. Listen for a clicking sound when the ignition switch is moved from run to start. No clicking sound could mean a bad starter relay within the voltage regulator or bad ignition switch. 3. Using a voltmeter set to read 12 volts DC, place the positive probe on the main post of the dynastart and the negative probe to the engine case. Have an assistant move the ignition switch to the start position and check the voltage. The voltage should be between 9 – 10 volts. 12 volts would indicate an open circuit inside the dynastart (check for broken solder joints or worn brushes), less than 6 volts would indicate a short within the dynastart (check for grounded starting coils) or a dead battery. 4. If you get a reading of 12 volts in item 3 above, then you will need to remove the fan housing and fan from the dynastart to perform the next checks. With the fan off, make a visual check of the brush condition. If the brush's pigtails are near the end of travel in the brushholder slots, replace the brushes. Also, check for any broken brush springs. 5. Remove the spark advance unit and check the solder joints referred to in "Testing the Starting Windings" section above. Resolder loose joints or replace the coils as needed. 6. Same as item 5. 7. Using the information in the section above titled "Testing the Starting Windings" check for open circuits or shorts to ground. Repair or replace the field coils as necessary.
<p>Engine will not turn over when key is moved to start. If car is push started – generator does not generate.</p>	<ol style="list-style-type: none"> 1. Battery is dead. 2. The ground connection for the voltage regulator is not making a good connection. 3. Carbon brushes worn and only making contact intermittently. 	<ol style="list-style-type: none"> 1. Check the battery voltage when the ignition switch is in the start position. The voltage should not drop below 9-10 volts. 2. Check the ground connection (bolts that hold the regulator to the floor) and make sure that paint is not insulating the regulator from ground.

		<p>This would prevent both starting and generator operation.</p> <p>3. With the fan removed, make a visual check of the brush condition. If the brush's pigtails are near the end of travel in the brushholder slots, replace the brushes. Also, check for any broken brush springs.</p>
<p>Engine will start but the generator light stays on all the time.</p>	<ol style="list-style-type: none"> 1. Regulator not functioning correctly. 2. Carbon brushes worn and only making contact intermittently. 3. Open or shorted shunt field coils. 	<ol style="list-style-type: none"> 1. The contact points within the regulator may need burnishing. This can be tested by the following procedure: <ol style="list-style-type: none"> a. Set your voltmeter to read 12 volts DC. Connect the meter between the D+/61 terminal and ground. b. With the engine running at idle, the meter should read between 3 to 6 volts. c. <u>VERY CAREFULLY</u> remove the black/red wire from the DF terminal on the voltage regulator. d. Connect the black/red wire to ground and slowly increase the engine rpms (do not allow the meter reading to exceed 13 volts for more than a few seconds). e. If the voltage on the meter rises to 14 volts or higher – the dynastart is in good condition and your problem is in the regulator. If the voltage on terminal D+/61 does not rise, the problem is within the dynastart. <p>Refer to my document on regulator operation for location of appropriate contacts to burnish.</p> 2. With the fan removed, make a visual check of the brush condition. If the brush's pigtails are near the end of travel in the brushholder slots, replace the brushes. Also, check for any broken brush springs. 3. Disconnect the wires from the terminal at the 3 o'clock position on

		<p>the front of the dynastart field coils. Check for proper field resistance and grounds as described in “Testing the Generator Windings” above. If the windings fail this test, repair or replace as necessary.</p>
<p>Engine will start but the generator light continues to glow very dimly. (most of the time this problem is in the regulator and burnishing the contacts will correct the problem)</p>	<ol style="list-style-type: none"> 1. Regulator not functioning correctly. 2. High resistance found in field coils. 	<ol style="list-style-type: none"> 1. The contact points within the regulator may need burnishing. This can be tested by the following procedure: <ol style="list-style-type: none"> a. Set your voltmeter to read 12 volts DC. Connect the meter between the D+/61 terminal and ground. b. With the engine running at idle, the meter should read between 3 to 6 volts. c. <u>VERY CAREFULLY</u> remove the black/red wire from the DF terminal on the voltage regulator. d. Connect the black/red wire to ground and slowly increase the engine rpms (do not allow the meter reading to exceed 13 volts for more than a few seconds). e. If the voltage on the meter rises to 14 volts or higher – the dynastart is in good condition and your problem is in the regulator. If the voltage on terminal D+/61 does not rise, the problem is within the dynastart. <p>Refer to my document on regulator operation for location of appropriate contacts to burnish.</p> 2. Disconnect the wires from the terminal at the 3 o’clock position on the front of the dynastart field coils. Check for proper field resistance and grounds as described in “Testing the Generator Windings” above. If the windings fail this test, repair or replace as necessary.