Service Bulletin 1G-280

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Supersedes Bulletin 1G-280
Dated 7-1-74, 9-1-79 and 8-1-85
Reference: 1G-187 and 1G-188

Delco Remy

Tests of

DELCOTRON® INTEGRAL CHARGING SYSTEM

(30-SI and 30-SI/TR Series)

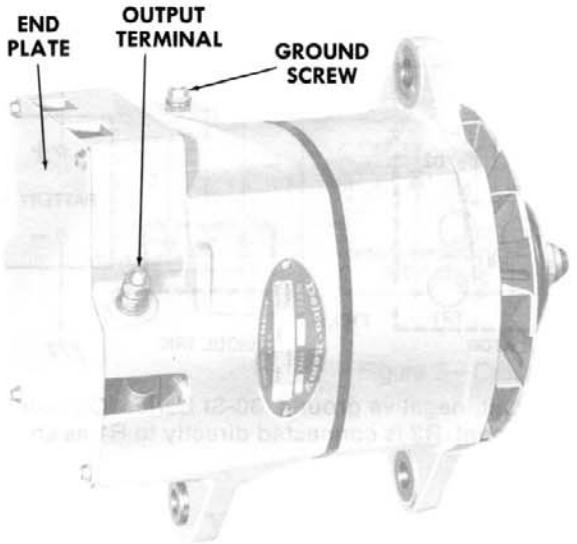


Figure 1—Typical 30-SI Series

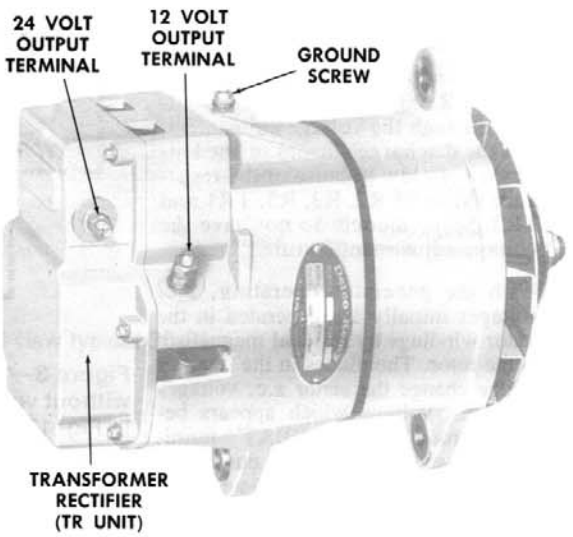


Figure 2—Typical 30-SI/TR Series

INTRODUCTION

The Integral Charging Systems, or generators, shown in Figures 1 and 2 feature a solid state regulator that is mounted inside the end frame. The regulator voltage setting on some models can be adjusted externally by repositioning a voltage adjustment cap in the rectifier end frame. On some models a relay terminal provides about half system voltage to which accessories can be connected.

The 30-SI Series shown in Figure 1 uses one wire with an adequate ground return to charge the vehicle battery in the usual manner. The 30-SI/TR is a standard 30-SI with a transformer-rectifier, or TR unit, mounted on the end frame. The TR unit provides a separate voltage to charge a cranking battery. The cranking battery is connected in series with the system battery to provide 24-volt cranking. When the engine is running, the cranking battery is charged at a low rate to maintain its full state of charge. The vehicle electrical system, except for the cranking motor is 12 volts. The 30-SI/TR eliminates the need for a series-parallel switch and associated wiring.

OPERATING PRINCIPLES

(30-SI SERIES)

A typical wiring diagram is shown in Figures 3 and 4. The basic operating principles are explained as follows:

The base-emitter of transistors TR3 and TR1 is connected to the battery through resistor R5, thus turning these transistors on. Also, resistors R2 and R3 are connected to the battery through the voltage adjustment, but the discharge current of the battery is very low because of the resistance values of R2, R3, R5, TR1 and TR3. Some models do not have the voltage adjustment feature.

With the generator operating, a.c. voltages initially are generated in the stator windings by residual magnetism in the rotor. The diodes in the rectifier bridge change the stator a.c. voltages to a d.c. voltage which appears between ground and the "BAT" terminal. As speed increases, current is provided for charging the battery and operating electrical accessories.

The stator also supplies d.c. field current through the diode trio, the field, TR1, and then through the diodes in the rectifier bridge back to the stator.

As the speed and voltage increase the voltage between R2 and R3 increases to the value where zener diode D1 conducts. Transistor TR2 then turns on and TR1 and TR3 turn off. With TR1 off, the field current and system voltage decrease and D1 then blocks current flow causing TR1 and TR3 to turn back on. The field current and system voltage increase and this cycle then repeats many times per second to limit the voltage to the adjusted value.

If the voltage adjustment cube should become open-circuit TR3 and TR1 will turn off, thus preventing high system voltage.

Capacitor C1 smooths out the voltage across R3, resistor R4 prevents excessive current through TR1 at high temperatures, and diode D2 prevents high-induced voltages in the field windings when TR1 turns off.

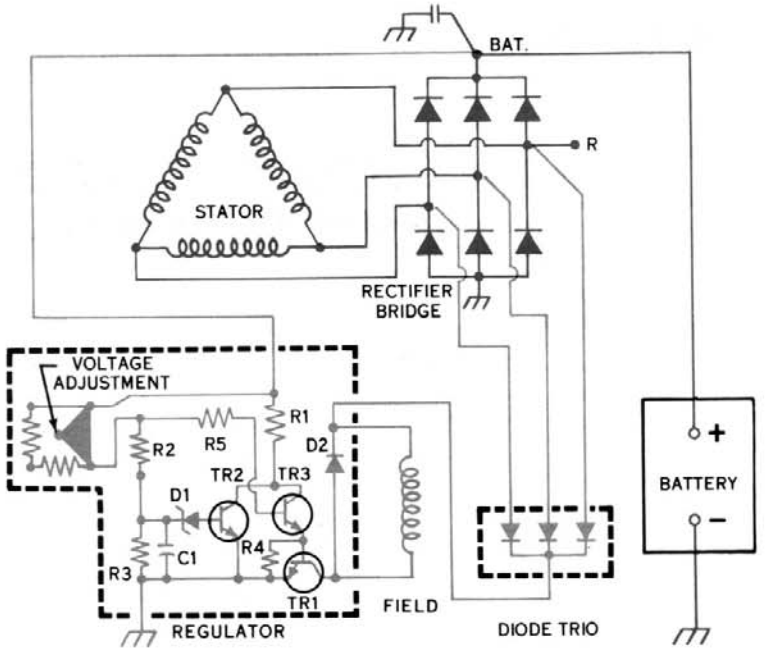


Figure 3—Typical circuit, negative ground, 30-SI Series. On models without voltage adjustment, R2 is connected directly to R1 as shown in Fig. 17.

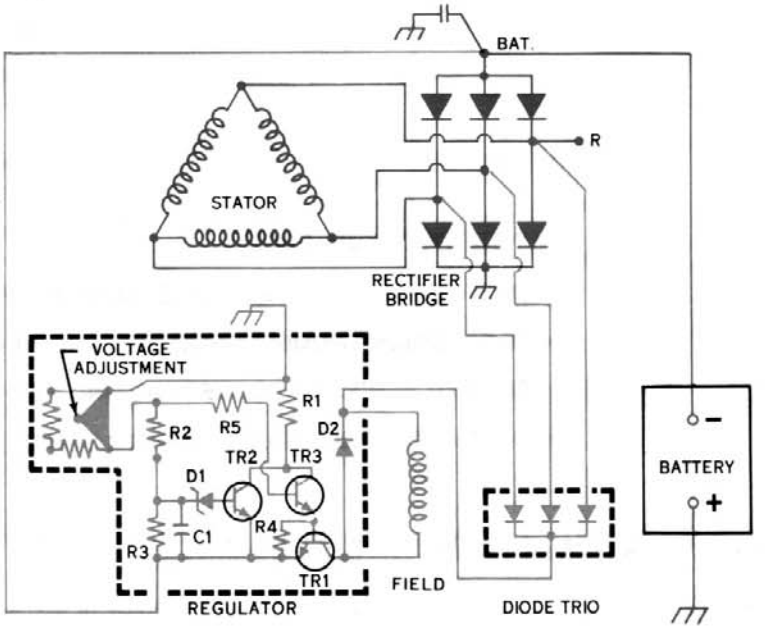


Figure 4—Typical circuit, positive ground, 30-SI Series. On models without voltage adjustment, R2 is connected directly to ground as shown in Fig. 18.

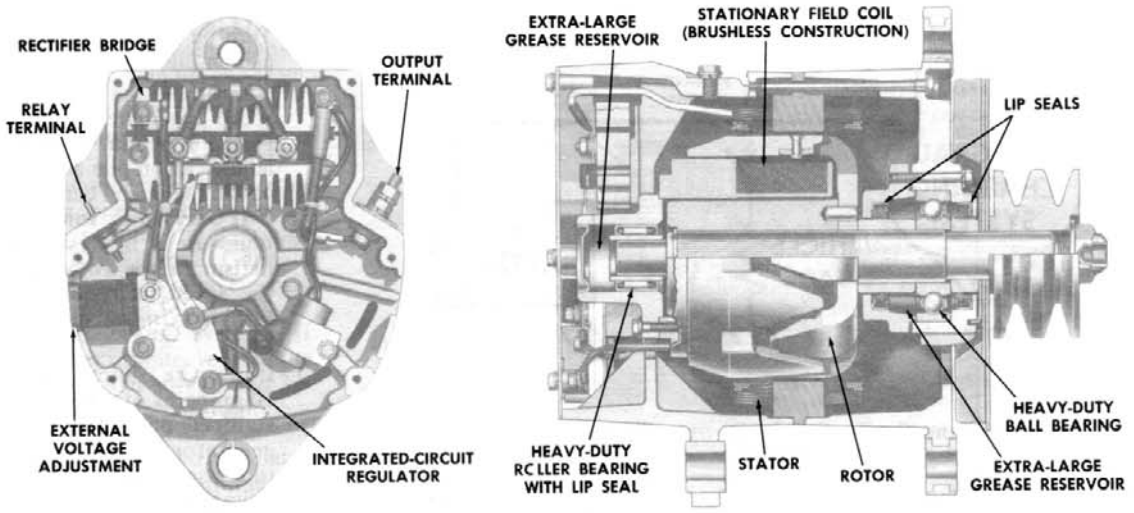


Figure 5—Cross-sectional view typical 30-SI

TROUBLESHOOTING PROCEDURES

(30-SI SERIES)

ENERGIZING SPEED

The energizing speed is the rpm at which the regulator turns on to energize the field coil. This speed is higher than some speeds at which output can be obtained. Therefore, when checking output at low speeds, increase the speed until the regulator turns on, then reduce the speed to check the output. No output can be obtained until the regulator turns on. Once the regulator turns on, it will remain turned on until the engine is stopped.

RATED VOLTAGE

On 12-, 24-, and 32-volt systems, the Integral Charging System output preferably should be checked at the "RATED VOLTAGE" given in the table.

However, it is permissible to check the output in amperes at any voltage within the "OPERATING RANGE" listed in the table, since the current output will be quite close to the value that would be obtained at "RATED VOLTAGE." The voltage should never be allowed to rise above the "OPERATING RANGE" for any length of time

SYSTEM VOLTAGE	RATED VOLTAGE	OPERATING RANGE
12	14.0	13.0-15.0
24	28.0	26.0-30.0
32	37.5	33.0-39.0

It should be noted that the voltage may be below the "OPERATING RANGE" if the battery is in a low state of charge. However, as the battery receives a charge, the voltage will rise to some value within the "OPERATING RANGE."

MAGNETIZING THE ROTOR

The rotor normally retains magnetism to provide voltage build-up when the engine is started. After disassembly or servicing, however, it may be necessary to re-establish the magnetism. To magnetize the rotor connect the Integral Charging System to the battery in a normal manner, then momentarily connect a jumper lead from the **battery positive post to the Integral Charging System relay terminal**, identified in Figure 5. This procedure applies to both negative and positive ground systems, and will restore the normal residual magnetism in the rotor.

On the 30-SI/TR series, be sure to jumper from the positive post of the system battery so that 12 volts will be applied to the relay terminal. On generators without a relay terminal, remove the end plate and jumper from the battery positive post to one of the stator lead terminals on the rectifier bridge.

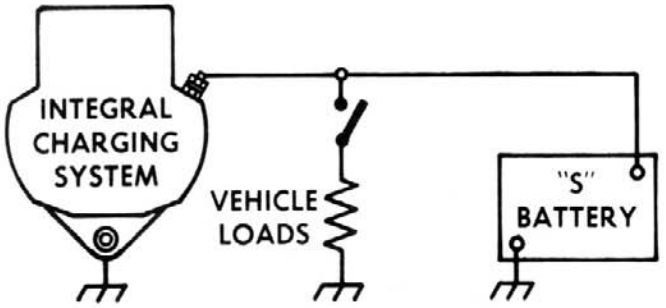
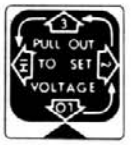


Figure 6—Typical 30-SI wiring diagram

A cross-sectional view of a typical 30-SI is shown in Figure 5. A basic wiring diagram is shown in Figure 6.

1. Insure that an undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension.
3. If a battery defect is suspected, check per the applicable Delco Remy Service Bulletin.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including the battery connectors.
5. Connect a voltmeter from output or "BAT" terminal on Integral Charging System to ground. A zero reading indicates an open between voltmeter connection and battery.
6. With all accessories turned off, increase engine speed as required to obtain maximum voltage reading.
7. If voltage exceeds 15 volts on a 12-volt system, 30 volts on a 24-volt system or 39 volts on a 32-volt system, remove Integral Charging System for repair as covered under heading of "INTEGRAL CHARGING SYSTEM REPAIR."
8. If previous Steps 1 thru 6 check satisfactorily, check generator as follows:
   a. Disconnect battery ground cable.
   b. Connect an ammeter in the circuit at the output terminal of the generator.
   c. Reconnect battery ground cable.
   d. Turn on accessories. Connect a carbon pile across the battery.
   e. Operate engine at moderate speed as required, usually 4000 generator r.p.m. or more, and adjust carbon pile as required to obtain maximum current output. **IMPORTANT: Initial voltage build-up is by residual magnetism in the rotor. Increase the speed as required to obtain maximum current output.**
   f. If ampere output is within 10 amperes of rated output as stamped on generator frame, generator is not defective. In this case, an adjustment of the voltage setting on models with this feature may correct the condition. Raise or lower the setting by removing the voltage adjusting cap, rotating in increments of 90°, and then reinserting the cap in the connector body.
   g. As illustrated in Figure 7, for 12 and 24 volt, the cap is set for low voltage. With position 2 aligned with the arrow, the setting is medium low, position 3 is medium high, and position "HI" is the highest regulator setting. On 32-volt systems (16-cell battery system) use the cap *only* on "HI" setting. On 30-volt systems (15-cell battery system) use the cap *only* on position 3.
   h. If ampere output is not within 10 amperes of rated output as stamped on Integral Charging System frame, remove the Integral Charging System for repair as covered in section entitled "INTEGRAL CHARGING SYSTEM REPAIR."



ENLARGED VIEW

TOP OF VOLTAGE ADJUSTMENT CAP SHOWN IN "LO" POSITION

Figure 7—Voltage adjustment caps

INTEGRAL CHARGING SYSTEM REPAIR

Component parts and connections are shown in Figures 8, 9, 10, and 11. Note that the diode trio has been removed in Figure 12, along with the end plate.

CONNECTOR BODY CHECK

Omit this check on models without this feature.

Remove the connector body from the regulator and check with an ohmmeter using the middle range scale as shown in Figure 8. Connect the ohmmeter to each adjacent pair of terminals, making four checks in all on 12- and 24-volt systems. If any one check is infinite, replace the connector body. On 30-volt and 32-volt systems, with cap removed, connect ohmmeter to the two terminals that connect to the two regulator terminals. If reading is infinite, replace connector body.

REGULATOR CHECK

The regulator cannot be checked with an ohmmeter. Use an approved regulator tester available from various test equipment manufacturers.

RECTIFIER BRIDGE CHECK

(Omit for overcharged battery) To check the rectifier bridge, connect the ohmmeter to a heat sink and one of the three terminals (Step 1, Fig. 12). Then reverse the lead connections to the same heat sink and same terminal.

If both readings are the same, replace the rectifier bridge by detaching the necessary screws and nuts. A good

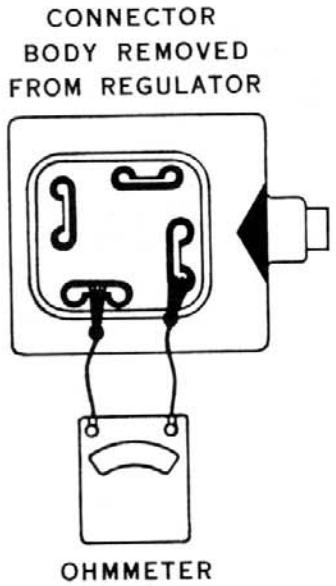


Figure 8—Checking connector body (12 and 24 volt shown)

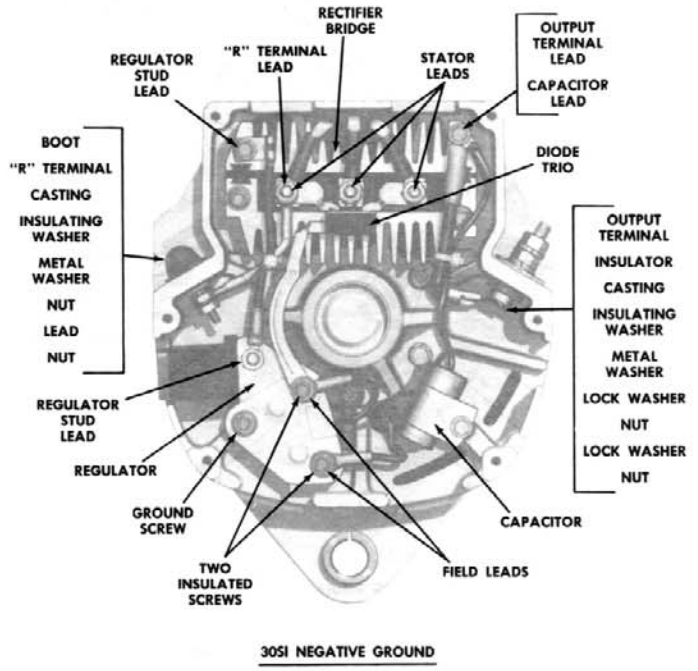


Figure 9—Typical 30-SI negative ground

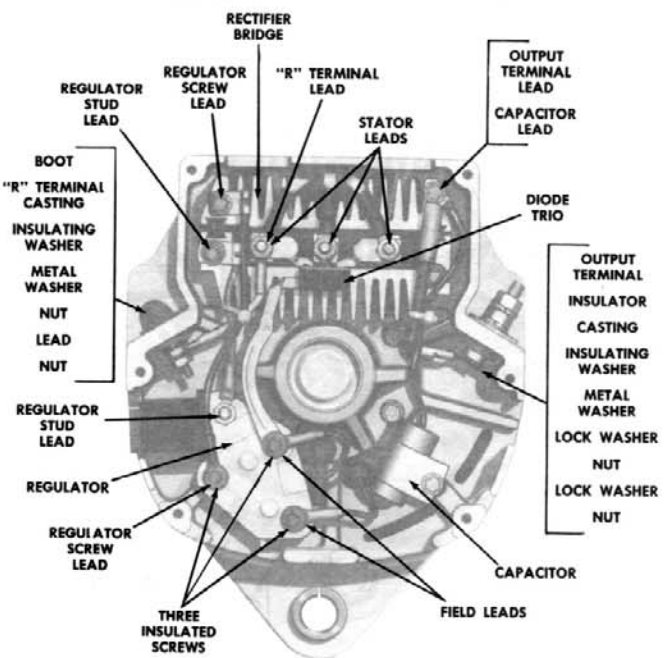


Figure 10—Typical 30-SI positive ground

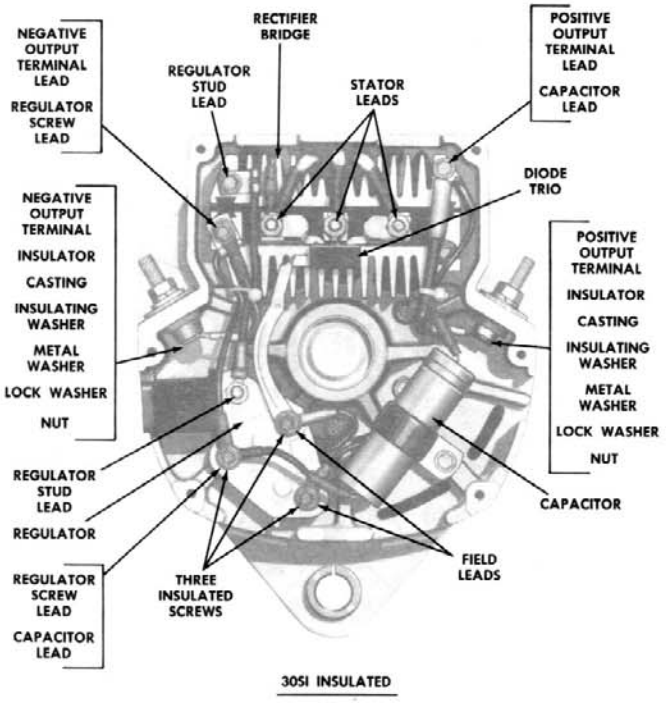


Figure 11—Typical 30-SI insulated

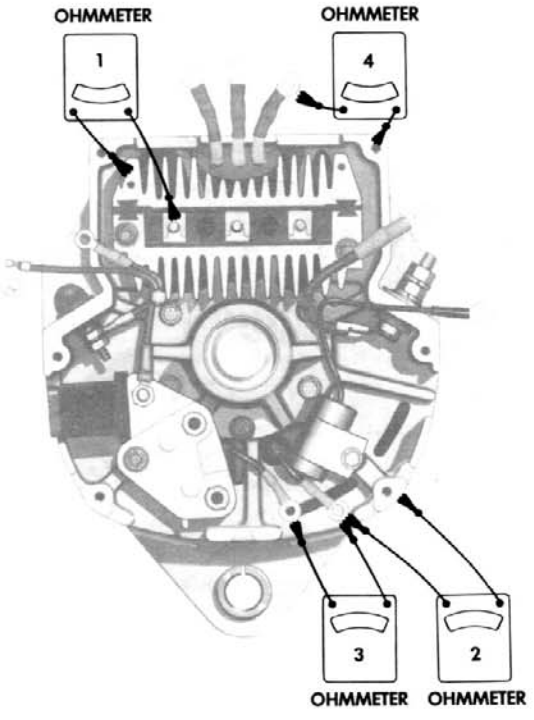


Figure 12—Ohmmeter checks

rectifier bridge will give one high and one low reading. Repeat this same test between the same heat sink and the other two terminals, and between the other heat sink and each of the three terminals. This makes a total of six checks, with two readings taken for each check on each rectifier bridge. IMPORTANT: If rectifier bridge is constructed with flat metal clips at the three studs, press down firmly onto flat metal clips and not onto threaded stud.

FIELD COIL CHECKS

To check for grounds, connect an ohmmeter to one field coil lead and to the end frame as illustrated in Step 2, Figure 12. If ohmmeter reading is low, the field coil is grounded.

To check for opens, connect an ohmmeter to the two field coil leads as shown in Step 3, Figure 12. If ohmmeter reading is high (infinite), the field coil is open.

The winding is checked for short-circuits by connecting a battery and ammeter in series with the field coil. Note the ammeter reading and refer to Delco Remy Service Bulletin 1G-187 or 1G-188 for specifications. An ammeter reading above the specified value indicates shorted windings. An alternate method is to check the resistance of the field by connecting an ohmmeter to the field coil. If the resistance reading is below the specified value, the winding is shorted. The specified resistance value can be determined by dividing the voltage by the current given in Bulletin 1G-187 or 1G-188. To replace the field coil, see the section entitled "Disassembly."

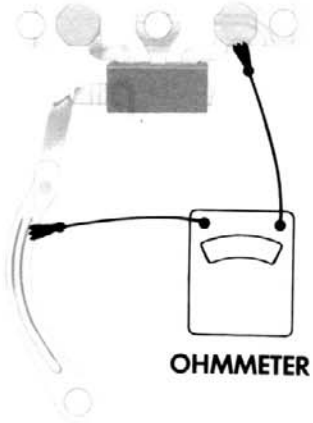


Figure 13—Diode trio check

DIODE TRIO CHECK

To check the diode trio, remove it from the end frame assembly by detaching the nuts and attaching screw. **NOTE that the insulating washer on the screw is assembled over the top of the diode trio connector.** Connect an ohmmeter having a 1½-volt cell, and using the lowest range scale, to the single connector and to one of the three connectors, (Fig. 13). Observe the reading. Then reverse the ohmmeter leads to the **same two** connectors. If both readings are the same, replace the diode trio. A good diode trio will give one high and one low reading. Repeat this same test between the single connector and each of the other two connectors.

STATOR CHECK

(Omit for overcharged battery)

Most stators are delta wound and only a check for grounds can be made with an ohmmeter. Connect from either lead to the frame, (Step 4, Fig. 12). The reading should be infinite. If not, replace the stator. See section entitled "Disassembly."

If the regulator checks good and if the generator fails to supply rated output, replace the stator if it is badly discolored.

DISASSEMBLY (Fig. 5)

1. Remove screws and end plate.
2. Remove fan and pulley.
3. Remove 4 thru-bolts.
4. Separate Drive End frame and rotor from Rectifier End frame and stator.
5. Press rotor from end frame.
6. Remove collar from end frame.
7. Remove collar from shaft.
8. To replace Drive End frame bearing:
   a. Remove 4 retaining plate attaching screws.
   b. Remove retainer plate and gasket.
   c. Push on inner race to remove bearing.
   d. Pull out seals from end frame and from retainer.
   e. Press in new seals with lip toward bearing.
   f. Press in new bearing against outer race.
   g. Fill retainer cavity half full with Delco Remy Lubricant Part No. 1948791 so part of lubricant will touch bearing when assembled.
   h. Assemble retainer with thru-bolts.
   i. Assemble inside collar over shaft.
   j. Assemble outer collar under seal next to bearing while supporting outer collar.
   k. Press rotor into drive end frame.
9. To replace Rectifier End Frame bearing:
   a. Pull inner race from shaft and bearing from end frame.
   b. Assemble new inner race and bearing as shown in Figure 5, with bearing seal away from grease reservoir.
   c. Use Delco Remy lubricant Part No. 1948791 and fill reservoir half full. Arrange lubricant so a portion will touch bearing when assembled.
10. To replace field coil:
    a. Remove attaching bolts.
    b. Install new field coil and torque bolts to 55 inch-lbs.

TROUBLESHOOTING PROCEDURES

(30-SI/TR Series)

Read the section on Page 3 before proceeding.

A basic wiring diagram is shown in Figure 14. A cross-sectional view of a typical 30-SI/TR is shown in Figure 15. The 30-SI and system battery, or "S" battery, operate together in the normal manner in the 12-volt vehicle electrical system. The transformer rectifier, or TR unit, is an "add on" unit on the 30-SI generator. It charges the cranking battery, or "C" battery which is connected in series with the "S" battery to provide 24 volts to the cranking motor. When the engine is running, the "C" battery receives a low charge rate from the TR unit to maintain its full state of charge.

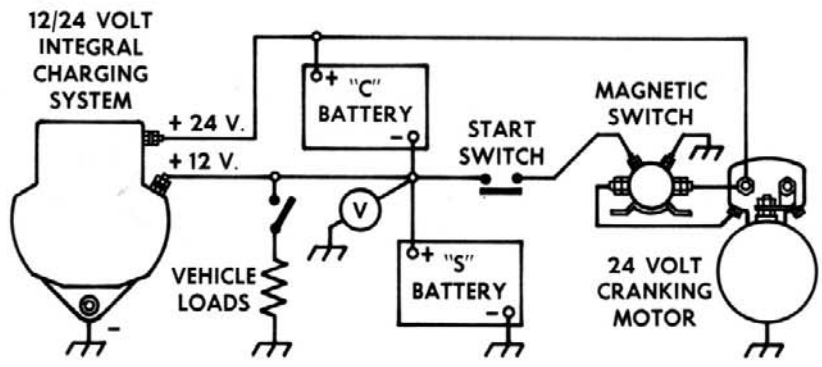


Figure 14—Typical 30-SI/TR circuit

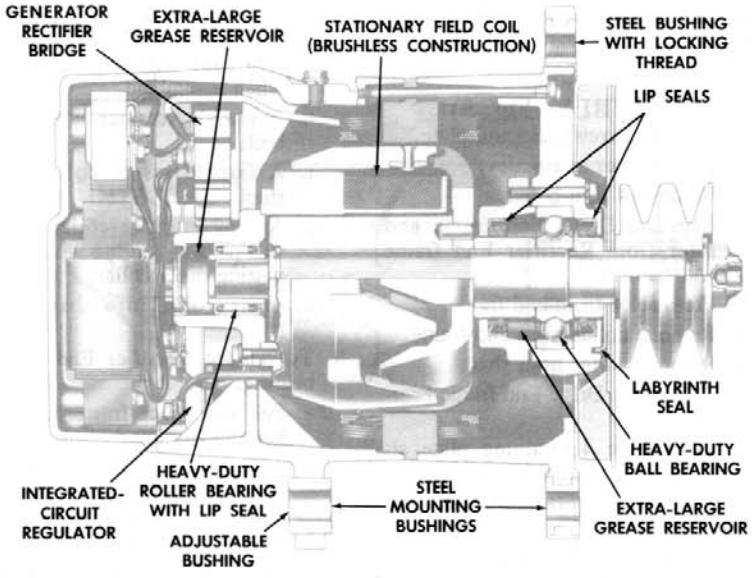


Figure 15—Cross-sectional view typical 30-SI/TR

If either battery is undercharged or overcharged, observe the following procedure:

1. DO NOT ALLOW LEADS OR TERMINALS TO TOUCH GROUND!
2. Completely remove the TR unit from the 30-SI generator as follows:
   a. Remove attaching screws.
   b. Pull TR unit away from the 30-SI generator to expose lead connections.
   c. Detach three transformer leads from the three studs on the 30-SI rectifier bridge. Reassemble nuts onto 30-SI rectifier bridge studs.
   d. If there is a remaining TR single lead connected from the TR rectifier bridge heat sink to the 30-SI rectifier bridge heat sink, **detach this lead** from the 30-SI 12-volt heat sink. (Some models may not use this lead).
3. The circuit is now a regular 12-volt 30-SI charging system connected to the "S" battery.
4. Return to page 3 and check the 30-SI as covered in the "TROUBLESHOOTING PROCEDURES" section.
5. If a defect is found, repair as required and reinstall the TR unit.
6. If no defect is found, check the rectifier bridge on the TR unit as follows:

   Disconnect transformer leads from rectifier bridge. Connect the ohmmeter to a heat sink and one of the three terminals (Step A, Fig. 16). Then reverse the lead connections to the same terminal.

   If both readings are the same, replace the rectifier bridge by detaching the necessary screws and nuts. A good rectifier bridge will give one high and one low reading. Repeat this same test between the same heat sink and the other two terminals, and between the other heat sink and each of the three terminals. This makes a total of six checks, with two readings taken for each check. If rectifier bridge is constructed with flat metal clips at the three studs, press down very firmly onto flat metal clips and not onto threaded stud.

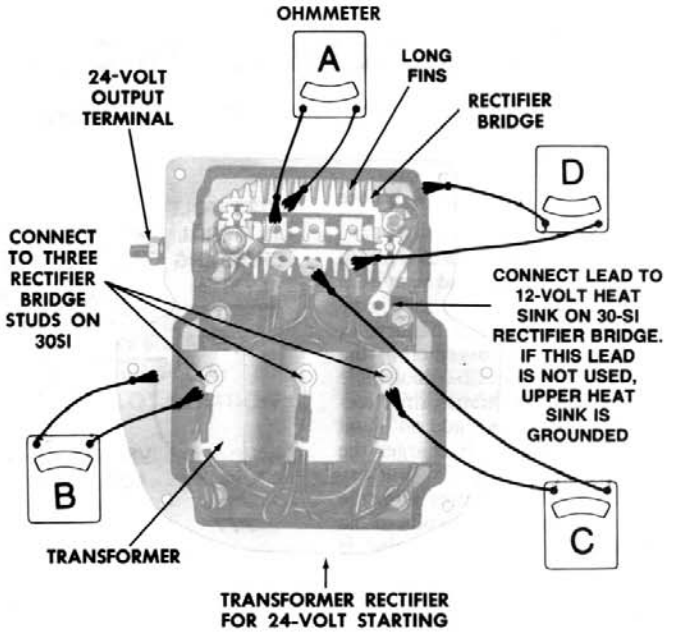


Figure 16—Ohmmeter checks of transformer and rectifier bridge diodes in TR unit

IMPORTANT—When replacing rectifier bridge, note stackup of parts so unit can be properly re-assembled. For **negative ground** systems, bridge is assembled with **long** cooling fins next to end frame, and **short** fins next to transformer, as shown in Figure 16.

The **same** rectifier bridge is used on **positive ground** systems, but turned 180°, so short fins are next to end frame and long fins are next to transformer (not illustrated).

7. Check the transformer on the TR unit as follows: Connect ohmmeter three ways as shown in Step B, Step C and Step D, Figure 16. Each reading should be very high (infinite). If not, replace transformer.
8. Reinstall the TR unit onto the 30-SI generator.
9. Detach 24-volt lead from generator. DO NOT ALLOW LEAD TO TOUCH GROUND.
10. Connect ammeter between 24-volt TR terminal and disconnected lead.
11. Connect a 5-20-ampere load, such as one or two 12-volt headlamps across the 12-volt cranking or "C" battery.
12. Operate generator at speed sufficient to produce maximum output.
13. TR unit output to "C" battery and load should be 5 amperes or more. If less than 5 amperes, replace transformer.
14. If 5 amperes or more, TR unit is not defective, and it will charge "C" battery when engine is run a sufficient length of time.

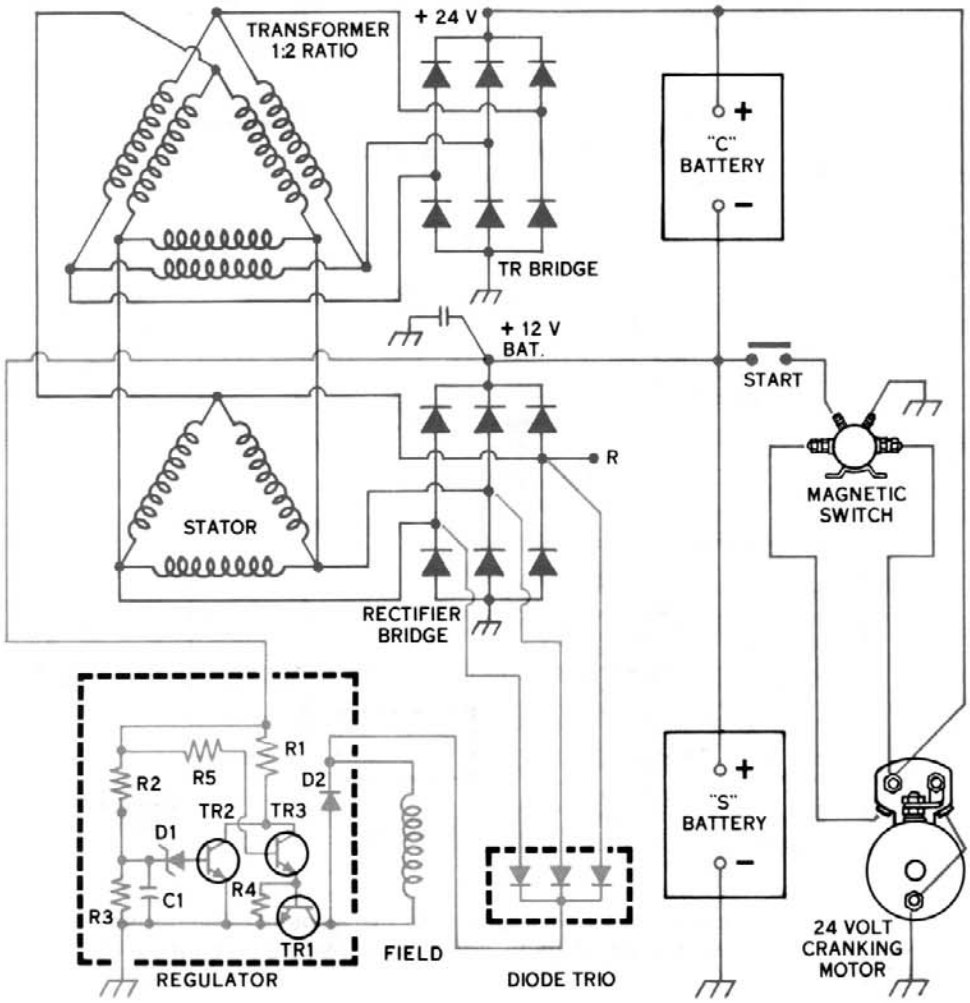


Figure 17—Typical 30-SI/TR circuit, negative ground. This circuit shows regulator without voltage adjustment feature, identified in Fig. 5.

OPERATING PRINCIPLES

(30-SI/TR Series)

Typical circuits showing the 30-SI/TR are illustrated in Figures 17 and 18. (Negative ground and positive ground).

The lower portion of each circuit, with the system or "S" battery, is the same as the circuits in Figures 3 and 4. The operating principles are explained on Page 2.

A transformer-rectifier, or TR unit, is mounted on the rectifier end frame, and is connected to the cranking, or "C" battery, as shown. The two batteries are connected in series to provide 24 volts for cranking or starting.

The delta primary of the transformer is connected to the delta stator. The a.c. voltages in the stator cause an a.c. current to flow in the primary. This changing, or a.c. current, creates magnetic fields which induce voltages in the transformer secondary winding. The secondary then provides current through the rectifier bridge to charge the "C" battery.

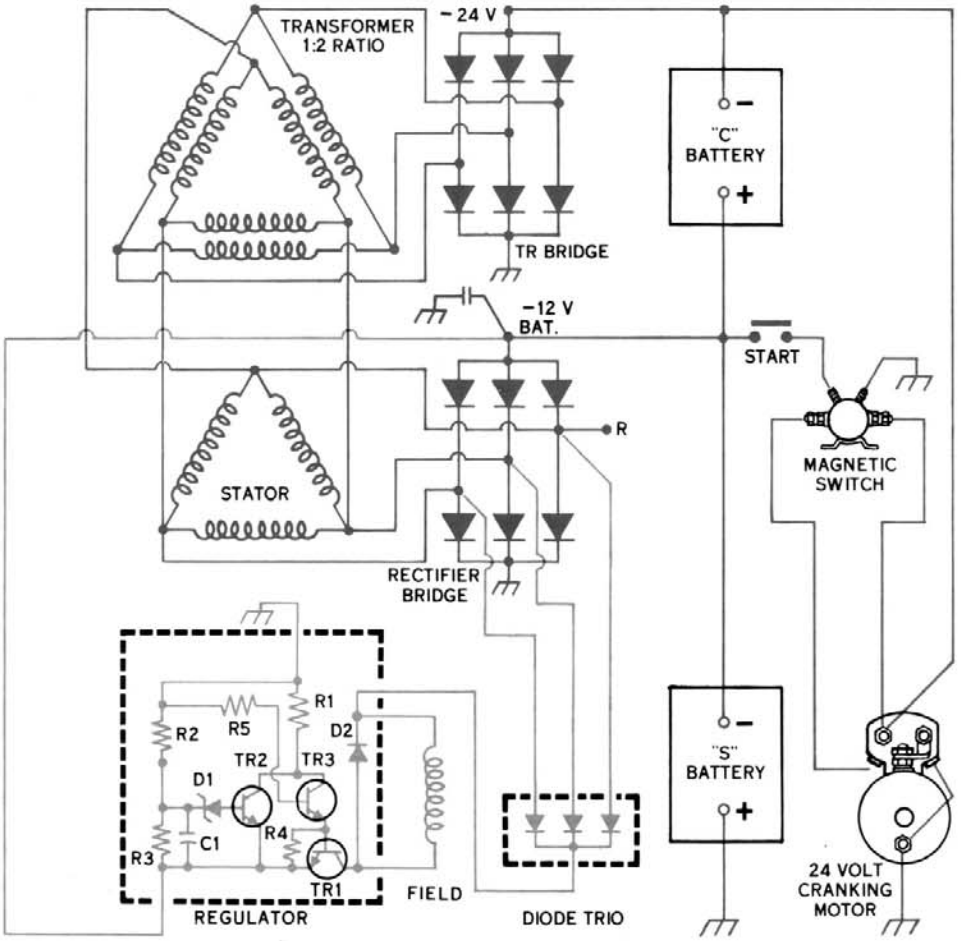


Figure 18—Typical 30-SI/TR circuit, positive ground. This circuit shows regulator without voltage adjustment feature, identified in Fig. 5.

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