

David Brown®

# Service Repair Manual Electrical Equipment

Section H1 (Pub. 9-37222) August 1978

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**David Brown Tractors Ltd**  
A Tenneco Company  
Affiliate of J I Case





This is a safety symbol which indicates important safety messages in this manual. When you see this symbol carefully read the message that follows. The safety symbol is shown when possible injury or death can occur.

Written in **Clear**  
**And**  
**Simple**  
**English**

David Brown Tractors Ltd., will continue to improve their products. As a result, the specification details can have changed after this issue was made. Also, as the David Brown tractor is made to variable specifications for different uses and countries, this manual may give details of items which are not part of any specific tractor.

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**SAFETY RULES**

**DANGER:** Batteries release gases, keep sparks, flames and cigarettes away from batteries. Make sure there is a good movement of air in the area, especially when giving a battery a charge. If these instructions are not followed, combustion of the gases will occur and cause injury.



**WARNING:** When you remove a battery, disconnect the ground cable first. When installing a battery, connect the ground cable last. Failure to follow this procedure will cause sparks. These will cause combustion of the gases released from the battery and cause injury.



**WARNING:** Battery acid can cause bad burns. If acid comes into contact with any part of the body, wash with water. Flush eyes with water for 15 minutes. Permanent damage to the eyes will occur if these instructions are not followed.

For internal treatment, drink large quantities of water or milk. See a doctor as soon as possible.

Keep batteries away from children.



**CAUTION:** Electricity flows through metal. Never have a ring or metal watch band on your body when working near electrical equipment. Injury to the body will occur if these items come into contact with electrical connections.



# BATTERY

## HOW IT WORKS

The battery is made of groups of positive and groups of negative plates separated by insulation plates made of plastic.

All these are put into an electrolyte solution of sulphuric acid and distilled water inside a plastic case. The battery is given an electrical charge by connecting an external current supply to the terminals. The current moves from positive to negative. The positive plates change to lead peroxide and the negative change to spongy lead.

The battery keeps the charge in storage until needed. There will be a gradual loss of charge if the battery is not used. Internal damage will occur if the battery is kept in storage and not given a charge.

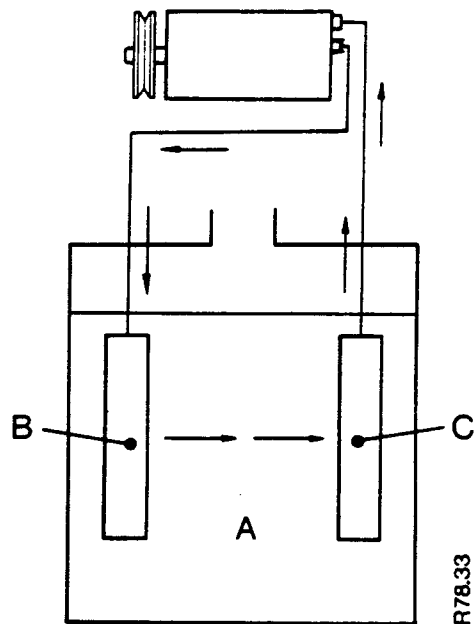
When an electrical circuit is connected to the battery terminals an electrical current flows from the battery. The current moves in the opposite direction to the charging current.

This is caused by a reaction between the electrolyte and the charged lead plates.

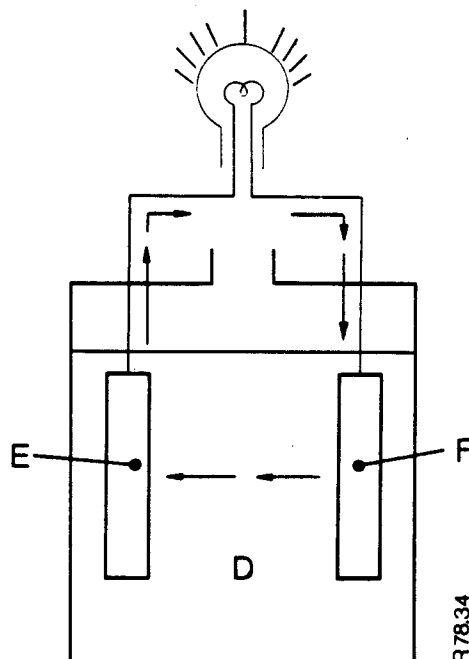
While the battery is releasing current the electrolyte is putting a deposit of sulphate on the plates. This causes the electrolyte to become weak and the battery voltage to decrease.

The battery must be given an electrical charge again to return the battery to a full charge. This is done by the dynamo or alternator while on the vehicle.

The battery is best given a charge from an external current, when the charge condition is less than 70%.



R78.33



R78.34

Figure H1  
MATERIAL CHANGES

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| A. Charged battery.               | D. Discharged battery.            |
| B. Positive plate, lead peroxide. | E. Positive plate, lead sulphate. |
| C. Negative plate, spongy lead.   | F. Negative plate, lead sulphate. |

## FAULT FINDING

### Equipment Needed

Hydrometer.

D.C. moving coil voltmeter (0–40 volts).

D.C. moving coil ammeter (5–60 amps).

Heavy Discharge Tester.

An extra battery, in good condition.

### TEST 1: Specific Gravity

Use an hydrometer A to check the specific gravity of the electrolyte in each cell. The test will not show correct results if distilled water has just been added. The solution must be completely mixed.

### Temperature correction

For every 10° Celcius **less** than 15° Celcius, subtract 0.007 from the specific gravity shown on the hydrometer.

For every 10° Celcius **more** than 15° Celcius, add 0.007 to the specific gravity shown.

For every 10° Fahrenheit **less** than 60° Fahrenheit, subtract 0.004 from the specific gravity shown.

For every 10° Fahrenheit **more** than 60° Fahrenheit add 0.004 to the specific gravity shown.

Example:

Specific gravity corrected to 15° Celcius (60° Fahrenheit) for temperatures **less** than 25° Celcius (77° Fahrenheit).

Full charge 1.270–1.290.

70% charge 1.230–1.250.

Discharged 1.110–1.130.

For temperatures **more** than 25° Celcius (77° Fahrenheit).

Full charge 1.210–1.230.

70% charge 1.170–1.190.

Discharged 1.050–1.070.

The battery must be given a charge if less than 70% charge is shown. If there is a difference of more than 0.040 between cells make a complete check of the battery.

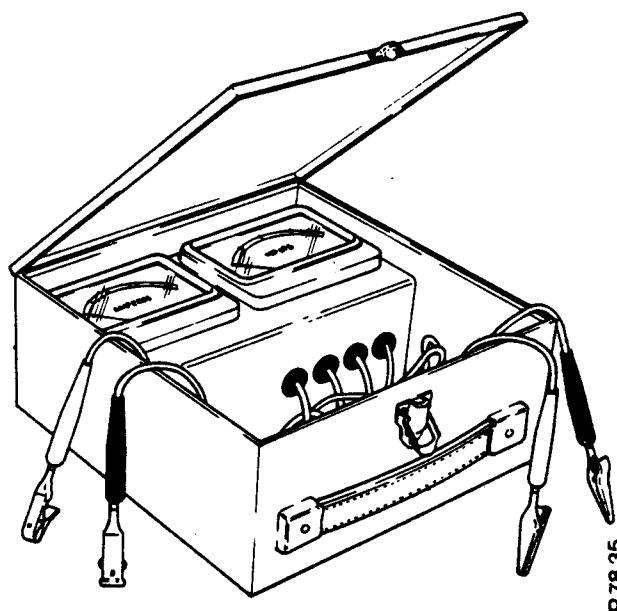
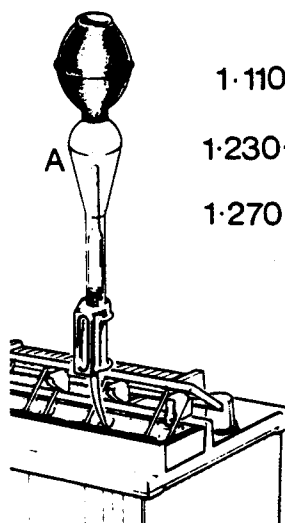


Figure H2  
TEST METERS

R78.35



1.110–1.130	DISCHARGED
1.230–1.250	70% CHARGED
1.270–1.290	FULL CHARGE

Figure H3  
SPECIFIC GRAVITY TEST  
A. Hydrometer

R78.36

### TEST 2: Discharge Rate

This test can be done to check battery condition if the results of TEST 1 are not acceptable.

1. Connect a Heavy Discharge Tester to the battery terminals.

Positive to positive, negative to negative.

2. Set the tester to an ampere setting three times the 20 hour rate of the battery.

Example: Battery capacity is 96 AH (ampere hour) at the 20 hour rate. Multiply the ampere hour by 3, the result is 288. Set the meter to 290 amperes.

3. After 15 seconds discharge at this rate, read the voltmeter.

If the voltmeter shows more than 9.6 volts after 15 seconds the battery is in good condition. If less than 9.6 volts, install a new battery or have it checked by a battery specialist.

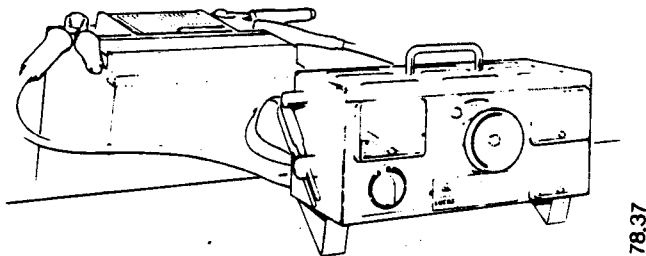


Figure H4  
BATTERY DISCHARGE TESTER

R 78.37

## MAINTENANCE AND REPAIR

### MAINTENANCE

1. Check the level of the electrolyte every 60 hours. Add only distilled water to the level of the splash guard.
2. Keep the battery clean and dry at all times, especially the top.
3. Apply petroleum jelly to the terminals to prevent oxidation. Corrosion between terminal and battery post will give a bad connection and bad starting. Make sure the terminals are tight.
4. Make sure the battery holding clamp is tight. Any vibrations can cause internal damage and a loss of battery efficiency.
5. Keep the battery tray clean. Wash off all corrosion with a solution of ammonia or soda and hot water. Apply acid resistance paint to all metal parts after all corrosion is removed.
6. Batteries in storage must be given a charge from time to time to keep a full charge. Damage will occur if a battery is in storage for a long time in a discharged condition. A discharged battery will freeze in cold conditions.
7. Batteries in use on vehicles must also be given a charge from an external supply every six months. A battery is not kept at full charge by the vehicle generating equipment.

**BATTERY CHARGING**

**Rate:** Set the equipment to  $\frac{1}{10}$ th of the 20 hour rate of the battery.

**Example:** The battery is  $60\text{AH} \div 10 = 6$  amperes setting.

**Filler Caps:** These must be removed when giving a battery a charge.

**Connections:** Make sure the battery and equipment connections are clean and dry.

Make sure the connections are tight and safe from making sparks.



**WARNING:** When you remove a battery, disconnect the ground cable first. When installing a battery, connect the ground cable last. Failure to follow this procedure will cause sparks. These will cause combustion of the gases released from the battery and cause injury.

**Electrolyte:** Keep the electrolyte at the correct level, during the charge. Add only distilled water to the electrolyte. Fill to level of splash guard. Keep the top of the battery dry and free from electrolyte.

Stop the charge before trying to clean the battery top.



**WARNING:** Battery acid can cause bad burns. If acid comes into contact with any part of the body, wash with water. Flush eyes with water for 15 minutes. Permanent damage to the eyes will occur if these instructions are not followed.

For internal treatment, drink large quantities of water or milk. See a doctor as soon as possible.

Keep batteries away from children.

**Specific Gravity:** Check this with an hydrometer at one hour intervals during the charge. When

the specific gravity shows the same results on three checks following each other, the charge is complete.

**Voltage:** Check the battery voltage just before and after the start of the charge. If the voltage has not increased check the polarity of the connections.

**Temperatures of Electrolyte:** For batteries which operate in air temperatures of less than 25° Celcius (77° Fahrenheit), keep the electrolyte temperature to less than 38° Celcius (100° Fahrenheit).

For batteries which operate in air temperatures of more than 25° Celcius (77° Fahrenheit), keep the electrolyte temperature to less than 50° Celcius (120° Fahrenheit).

**Gassing:** This is the name for the release of oxygen and hydrogen gases from the battery. It increases when the battery is given a charge. All possible causes of sparks or flame must be kept away. Also make sure there is a good movement of air through the area.



**DANGER:** Batteries release gases, keep sparks, flames and cigarettes away from batteries. Make sure there is a good movement of air in the area, especially when giving a battery a charge. If these instructions are not followed, combustion of the gases will occur and cause injury.

**Fast Charging**

This must only be done in an emergency. It **must not** be repeated at regular intervals or damage will occur to the battery. The life of the battery will be decreased.

The battery temperature must not increase to more than 43° Celcius (110° Fahrenheit) during the charge. If the air temperature is more than this amount, a fast charge **must not** be given.

## ELECTRICAL EQUIPMENT

A fast rate of charge can be used to increase the charge in a battery to 70%–80%. The rate of charge must be decreased gradually during the charge. The temperature will increase to more than the limit if this is not done. A normal rate of charge must be used to complete the charge, but the battery must first cool to 32° Celcius (90° Fahrenheit).

**Spacing:** There must be a space of not less than 25mm (1in) around all batteries.



**DANGER:** Before removing the connections from the battery always turn the equipment switch to 'OFF'. If the connections are removed first, a spark will occur and cause combustion of the gases.

**Installing:** Make sure the battery is clean and dry and the filler caps are installed correctly. The battery can then be installed on the tractor.



**CAUTION:** Electricity flows through metal. Never have a ring or metal watch band on your body when working near electrical equipment. Injury to the body will occur if these items come into contact with electrical connections.

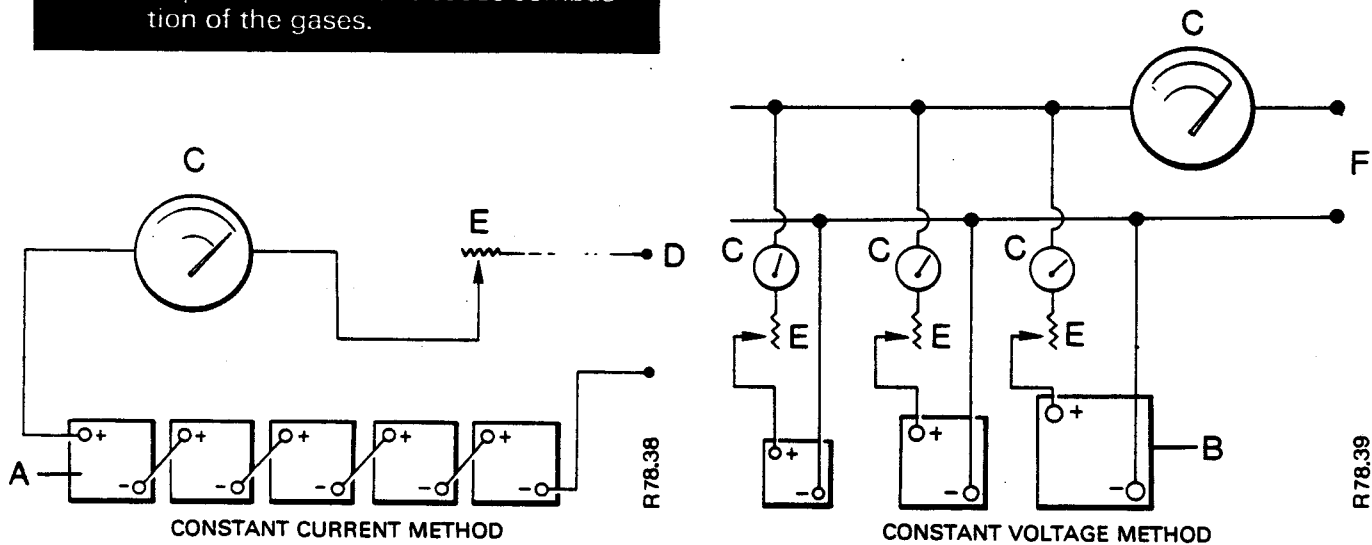


Figure H5  
METHODS OF BATTERY CHARGING

- A. Batteries connected in series.
- B. Batteries connected in parallel.
- C. Ammeter.
- D. 110 volt DC supply.
- E. Resistance.
- F. Constant 110 volt DC supply.

## NEW BATTERIES

### Dry without a charge

Before the battery is given a charge it must be filled with electrolyte of the correct specific gravity.

Specific gravity changes with operating temperature, see FAULT FINDING, page H3. Manufacturers also give instructions with new batteries and these must be followed exactly.

When adding the electrolyte it must be done in two stages to prevent damage to the case. When the acid makes contact with moisture in the plates, heat is generated which can cause the damage.

First, the battery must be approximately half filled and then let it cool for 6–12 hours. Then add electrolyte to the correct level and let it cool for 2 hours. Then give the battery a charge as follows:

Set the charging rate to  $\frac{1}{15}$ th of the 20 hour rate. Example: Battery 128AH  $\div 15 = 8$  amperes charging rate.

The current must be kept constant and not interrupted for the period of the charge. The minimum period is about 48 hours. Check the specific gravity at one hour intervals. When

there is not any change after 5 checks following each other, the charge is complete.

Temperatures must not be more than the limits shown in the normal charge section, page H5.

### Dry with a charge

These batteries are sent from the manufacturer with a full charge but without the electrolyte. The charge can decrease in storage.

Fill each cell with electrolyte of the correct strength according to the operating temperature. Check the specific gravity of the electrolyte after 20 minutes. The battery can be used immediately if the following conditions are correct.

Specific gravity has not decreased more than 0.010 and temperature has not increased more than 6° Celcius (10° Fahrenheit).

If the conditions are not correct the battery must be given a charge at the normal rate. The charge will be complete when the specific gravity shows no change after 3 checks at one hour intervals.

NOTE: For battery testing and temperature corrections see the FAULT FINDING section, page H3.

# ALTERNATOR

## HOW IT WORKS

When the starter key A is turned to the 'ACC' position, current from the battery H illuminates the 'no charge' warning lamp B. The current then goes through the slip rings and brushes to the rotor (field windings) C and returns to the battery.

NOTE: The field windings are on the rotor and not on the body as in the dynamo. The name for the stationary windings is stator.

When the rotor turns, the current in the windings generate an AC current in the stator windings F. This is changed into a DC current

by the rectifier bridge, it then goes to the battery. The AC voltage is changed by the diode trio E to a DC voltage which is sent to the regulator G. The diode trio also prevents the charge returning from the battery to ground through the alternator. A transistor circuit in the regulator controls the flow of DC current which flows through the rotor. When there is an increase in voltage, there is a decrease in current. When there is a decrease in voltage, there is an increase in current. In this way the regulator controls the output voltage of the alternator to keep the battery charge correct.

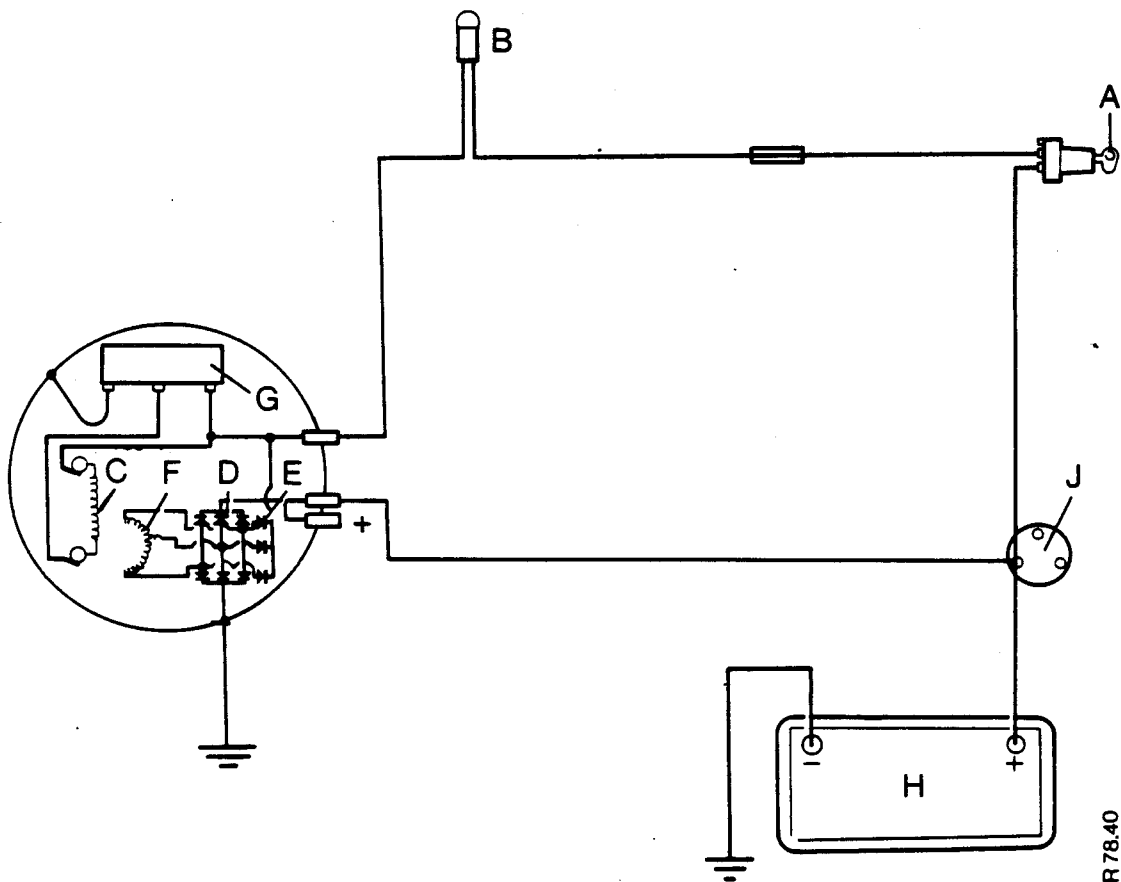


Figure H6  
ALTERNATOR CHARGING CIRCUIT

- |                              |                     |
|------------------------------|---------------------|
| A. Starter key.              | F. Stator windings. |
| B. Warning lamp.             | G. Regulator.       |
| C. Rotor windings.           | H. Battery.         |
| D. Diodes, rectifier bridge. | J. Solenoid.        |
| E. Diode trio.               |                     |

## FAULT FINDING

### LUCAS ALTERNATOR

(see page H13 for AC-Delco)

#### Equipment Needed

Voltmeter  
Ammeter  
Jumper wire

Check the condition of the battery before testing the alternator. A battery in good condition must be used.

**IMPORTANT:** Never disconnect wires when the alternator is running.

Make sure starter switch is in "off" position when the engine is not running. Always check polarity before connecting wires in an alternator circuit, especially battery terminals.

Never run the alternator with the wires disconnected.

Disconnect the alternator if electrical welding is to be done on the tractor.

#### TEST 1: Drive Belt

Check the belt for wear and damage. If wear or damage is found install a new drive belt.

Check the tension of the drive belt. This must be set to 1cm ( $\frac{3}{8}$ in) of movement at the position shown in Figure H7. When checking this movement use only medium finger pressure.

A loose drive belt will decrease the efficiency of the alternator, and cause wear to the belt. A tight drive belt will cause damage to the bearings of the alternator.

#### TEST 2: Connections

Check that all wires are connected correctly and are clean and tight.

#### TEST 3: Wires

1. Disconnect the connector plug from the alternator.
2. Turn the starter key to the 'ACC' position.
3. Use a voltmeter to check if battery voltage is reaching the 'IND' (warning lamp) and '+' (positive) connections.

If the voltmeter does not show any voltage this is an indication that the circuit is broken. Repair before continuing the test.

4. If the voltmeter does not show a voltage at the 'IND' connection, it can be a failure of the warning lamp bulb. Install new bulb.

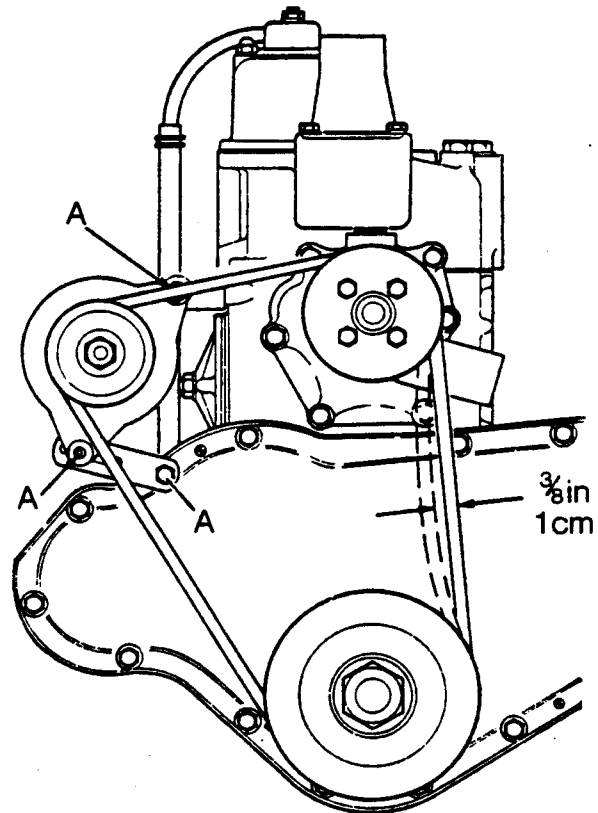


Figure H7  
DRIVE BELT ADJUSTMENT  
A. Fastening bolts.

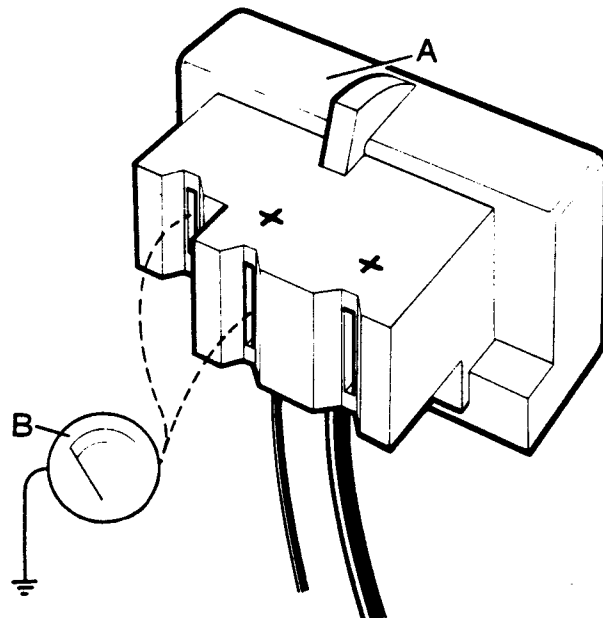


Figure H8  
CHECKING FOR SUPPLY AT PLUG  
A. Alternator plug. B. Voltmeter.



5. If a voltage is shown at both connections reconnect the plug to the alternator.
6. If the warning lamp illuminates, do the next test.
7. If the lamp does not illuminate, the alternator must be removed and the field circuit checked.

## TEST 4: Output

1. Run the engine until normal running temperature is reached.
2. Stop the engine and disconnect the ground cable from the battery.
3. Disconnect the alternator output wire from the solenoid connection.
4. Disconnect the plug from the alternator and remove the plastic cover.
5. Connect an ammeter to the output wire of the alternator and to the solenoid terminal.
6. On Lucas alternators with the 8TRD regulator, connect a jumper wire from the green wire to ground as shown in Figure H10.
7. On Lucas alternators with the 14TR regulator, connect a jumper wire between the case and ground as shown in Figure H11.
8. Reconnect the alternator plug and the battery cable.
9. Turn the starter key to the 'ACC' position. Check that the warning lamp illuminates.  
Start the engine and increase speed slowly. The ammeter will show 28 amperes at 1500 engine r/min if the alternator is working correctly.
10. If the output is less than 28 amperes **stop the engine** and disconnect the surge protection diode. See Figure H12.

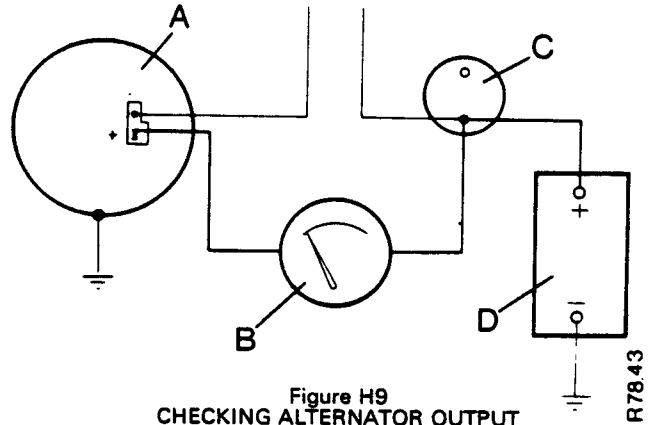


Figure H9  
CHECKING ALTERNATOR OUTPUT

A. Alternator. B. Ammeter.  
C. Starter solenoid. D. Battery.

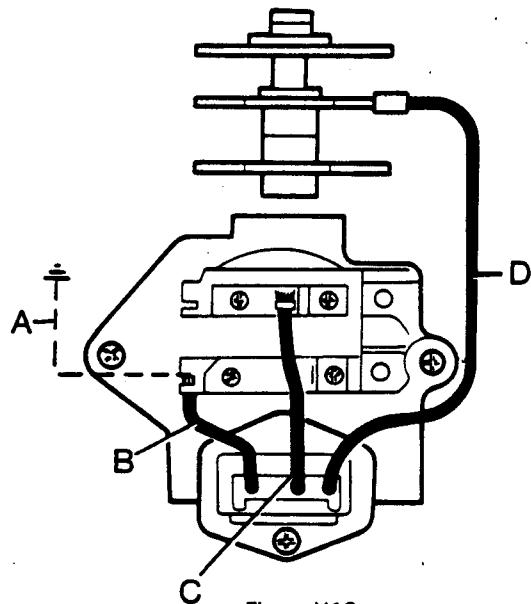


Figure H10  
8TRD REGULATOR

A. Jumper wire. B. Green wire.  
C. Yellow wire. D. Red wire.

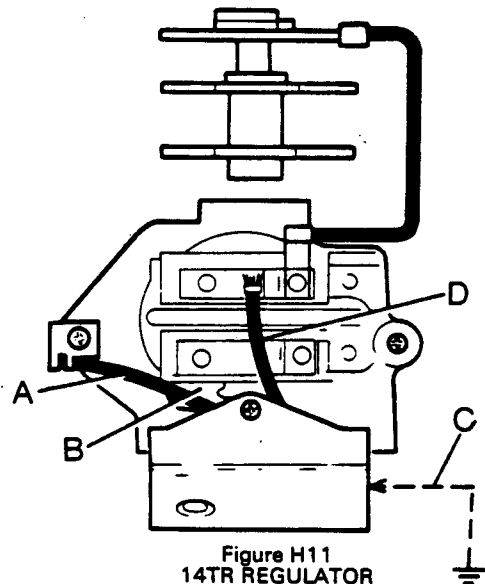


Figure H11  
14TR REGULATOR

A. Black wire. B. Field link.  
C. Jumper wire. D. Yellow wire.

11. Start the engine again and increase speed to 1500 r/min. If the ammeter now shows 28 amperes, install a new surge protection diode.
12. If the output is still less than 28 amperes after installing the surge diode, remove the alternator. See the MAINTENANCE AND REPAIR section for disassembly and checking procedures.
13. If the output is correct, **stop the engine**. Remove the jumper wire from the regulator. Remove the ammeter and reconnect all connections.

**IMPORTANT:** Never disconnect or connect wires or test meters to an alternator while it is running. Damage can occur to internal parts.

#### TEST 5: Circuit Resistance

1. Connect a voltmeter between the alternator output terminal and the battery positive post; **not** to the battery terminal.
2. Put the tractor lighting switch to the main beam position.
3. Start the engine and increase speed to 1500 r/min. The voltmeter must show less than 0.5 volts.
4. Stop the engine and connect the voltmeter between the alternator body and the battery negative post.
5. Start the engine and increase the speed to 1500 r/min. The voltmeter must show less than 0.25 volts.
6. If the voltages are more than these limits; disconnect all connections and clean, especially the battery terminals.  
Make sure all connections are tight when reconnected.
7. Repeat steps 1 to 5.

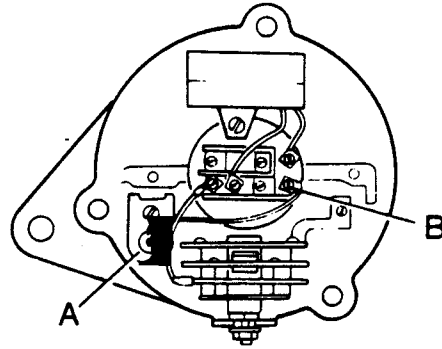


Figure H12  
DISCONNECTING SURGE PROTECTION DIODE  
A. Surge protection diode. B. Diode connection.

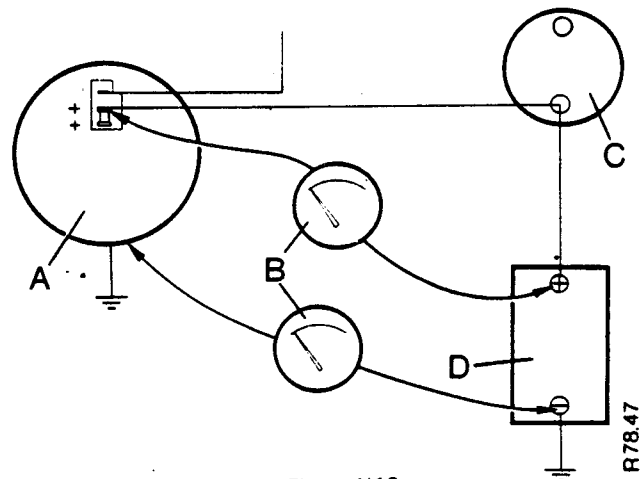


Figure H13  
CHECKING RESISTANCE IN THE CIRCUIT  
A. Alternator. B. Voltmeter.  
C. Solenoid. D. Battery.

## ELECTRICAL EQUIPMENT

### TEST 6: Regulator Setting

Make sure the battery is in good condition with a full charge before doing this test.

1. Disconnect the ground cable from the battery.
2. Disconnect the alternator output wire from the alternator and starter solenoid.
3. Connect an ammeter between the alternator and the starter solenoid to those connections.
4. Connect a voltmeter between the battery terminals and reconnect the ground cable to the battery.
5. Start the engine and increase the speed to 1500 r/min. When the ammeter shows less than 10 amps read the voltmeter. The voltmeter must show between 13.6 to 14.4 volts. If the voltage is not between these voltages install a new regulator.
6. Stop the engine and reconnect all connections if voltages are correct.

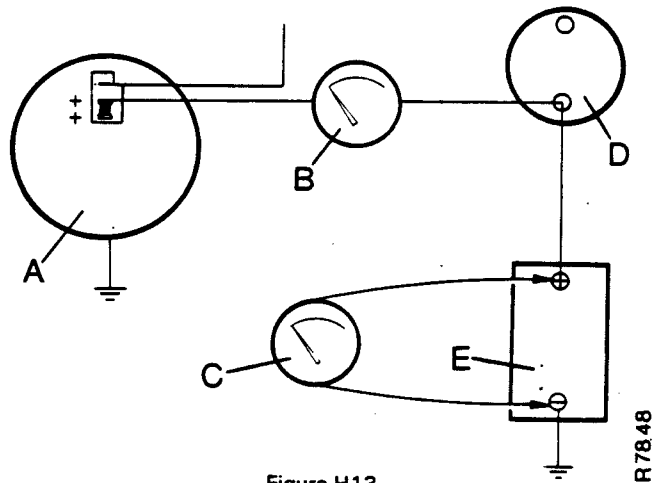


Figure H13  
CHECKING VOLTAGE REGULATOR

A. Alternator.  
B. Ammeter.  
C. Voltmeter.  
D. Solenoid.  
E. Battery.

**FAULT FINDING**

(See page H9 for Lucas)

**AC-DELCO ALTERNATOR****TEST 1: Engine Stopped: Switch 'OFF'  
Lamp Illuminated**

1. Disconnect the wire from the starter switch A to the warning lamp B.
  - (a) If the lamp stops illuminating, check the switch and replace with a new switch if necessary.
  - (b) If the lamp still illuminates with the switch wire disconnected, disconnect the 'IND' wire from the alternator C.
  - (c) If the lamp still illuminates, check for a connection between the 'IND' and '+' wires.
  - (d) If the lamp stops illuminating when the 'IND' wire is disconnected install a new rectifier bridge.
2. Check that the lamp now operates correctly and check the condition of the battery after tests.

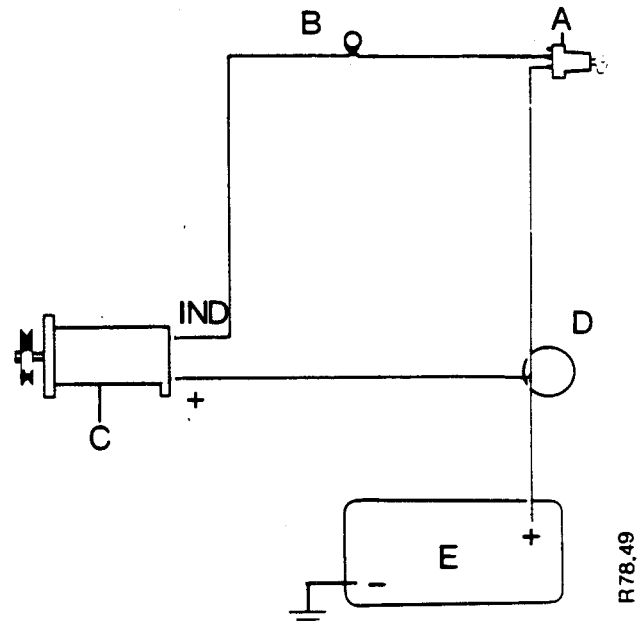


Figure H15  
ALTERNATOR CIRCUIT

A. Starter switch.      D. Solenoid.  
B. Warning lamp.      E. Battery.  
C. Alternator.

**TEST 2: Engine Stopped: Switch 'ON'  
Lamp Not Illuminated**

1. Disconnect the wire from the 'IND' terminal of the alternator and connect it to a good ground.
  - (a) If the lamp does not illuminate; check lamp, bulb socket, wires and fuses.
  - (b) If the lamp illuminates; install a new wire between the 'IND' terminal and the warning lamp.
2. Put the special rod shown in Figure H16 in through the test hole C shown in Figure H17.
  - (a) If the lamp illuminates, install a new regulator and check the rotor windings. See REPAIR section.
  - (b) If the lamp does not illuminate, check the 'IND' terminal connections. Check the brushes, slip rings, and field windings for an open circuit if the connections are correct. See REPAIR section.
3. If all these parts are found in good condition, install a new rectifier bridge.

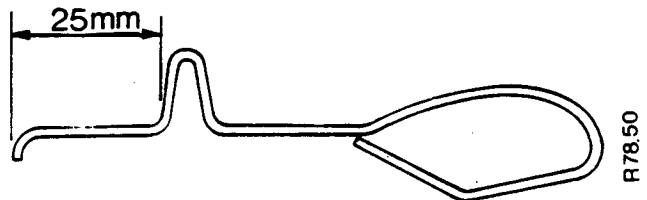


Figure H16  
TOOL FOR CONNECTING BRUSH HOUSING TO GROUND  
Make from welding rod

**TEST 3: Engine Running, Switch 'ON'  
Lamp Illuminated**

1. Check the tension of the drive belt. Adjust if necessary.
2. Make sure all connections are clean and tight.
3. Check for broken wires.
4. Turn the starter key to 'ACC' and connect a voltmeter from the alternator '+' terminal A to a good ground.
  - (a) If the voltmeter shows zero, check for a broken circuit between the battery and the alternator '+' terminal.
5. Connect a voltmeter from the alternator 'IND' terminal B to a good ground.
  - (a) If the voltmeter shows zero, check for a broken circuit between the battery and the 'IND' terminal.

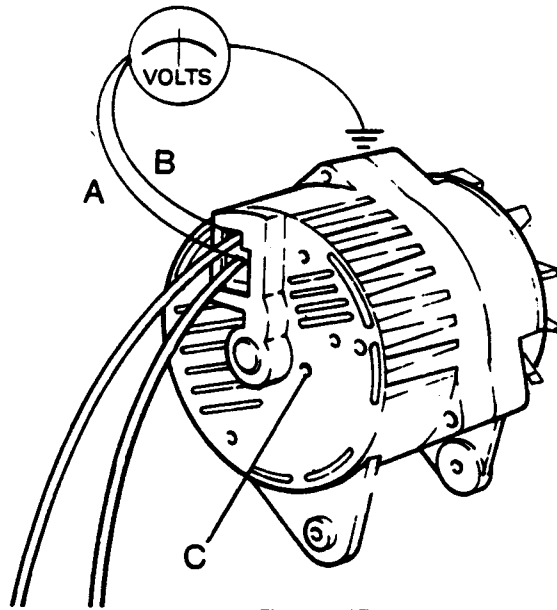


Figure H17  
CHECKING FOR SUPPLY  
A. Positive terminal.  
B. 'IND' terminal.  
C. Test hole.

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## MAINTENANCE AND REPAIR

### LUCAS ALTERNATOR

(see page H21 for AC-Delco)

The alternator is of the machine sensed type, complete with an internal regulator. All the inside connections are soldered.

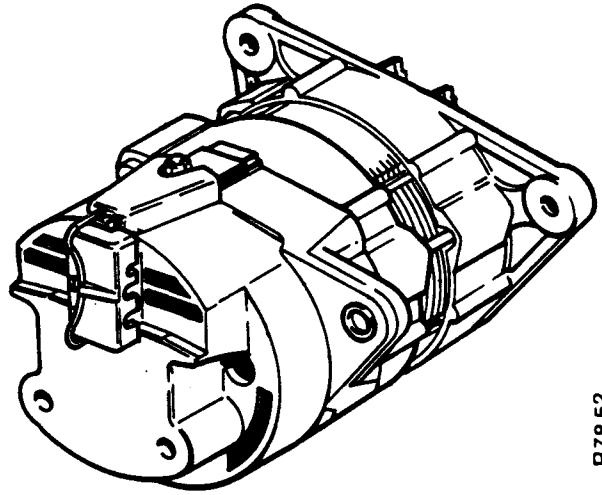
#### IMPORTANT:

Never connect or disconnect wires in the alternator circuit when the alternator is running. Make sure the starter switch is in the 'OFF' position when the engine is not running.

Always check the polarity before connecting wires in the alternator circuit, especially the battery terminals.

Never run the alternator with the wires disconnected.

Disconnect the alternator if electrical welding is to be done on the tractor.



R78.52

Figure H18  
LUCAS ALTERNATOR

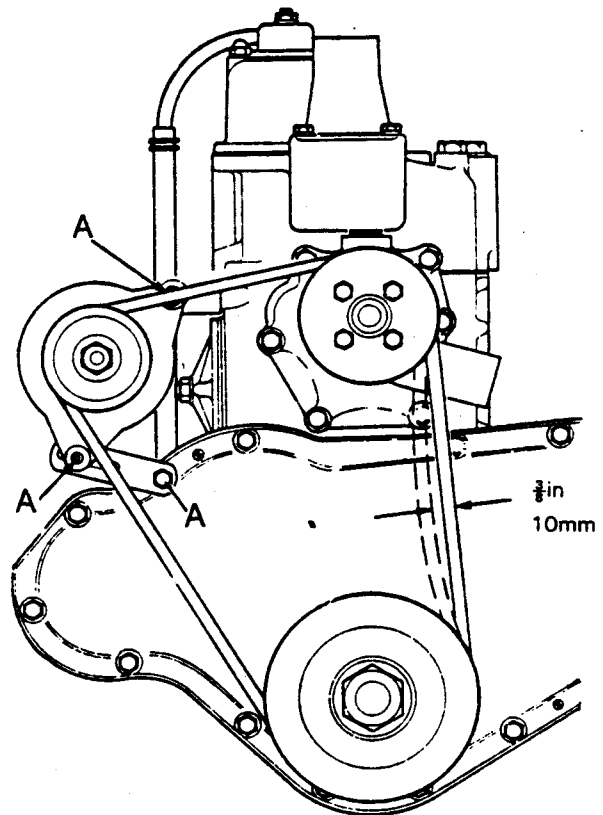
### Equipment Needed

Soldering iron.  
Hammer.  
Voltmeter.  
Pliers (long nose).  
Piece of steel tube.  
Glass paper.  
Ammeter.

### MAINTENANCE

1. Check the tension of the drive belt every 125 and 500 hours. Make sure the adjustment is correct or damage will occur, see page H9, FAULT FINDING.
2. Make sure all connections are clean and tight and connected correctly.
3. Check the tightness of the bolts A which fasten the alternator to the engine.

NOTE: The bearings are filled with lubricant by the manufacturer and need no maintenance.



R78.64

Figure H19  
DRIVE BELT ADJUSTMENT  
A. Fastening bolts.

## DISASSEMBLY

(Figure H20)

1. After the alternator has been removed from the tractor, remove the two screws A from the end cover J. Remove the cover.
2. Use a soldering iron to disconnect the three connections B which connect the stator N to the rectifier R. Use a pair of long nose pliers on the diodes as shown in Figure H25. This will prevent heat causing damage to the diodes. Make a note of the wire positions for correct assembly.
3. Remove the two screws which fasten the brush holder to the regulator P.
4. Loosen the nut C of the rectifier ground bolt.
5. Remove the screw D which fastens the regulator to the end frame K.
6. Remove the brush holder S and rectifier R together complete with wire.
7. Remove the three bolts E which hold the

- two halves of the alternator together.
8. Make a mark across the junction of the two halves before separating to make sure of correct assembly.
9. Use a piece of steel tube which will just go over the slip-ring moulding F. Put the end of the tube on the outer ring of the bearing G. Carefully remove any solder which causes a restriction to the tube, with a file.
10. Hold the alternator with the drive pulley H down. Carefully hit the tube to push the bearing out of the slip-ring end frame. Make sure the drive end has some support when doing this operation.
11. Remove the drive pulley nut T, washer U, pulley H, fan V and key.
12. Push the rotor M out of the drive end frame L.

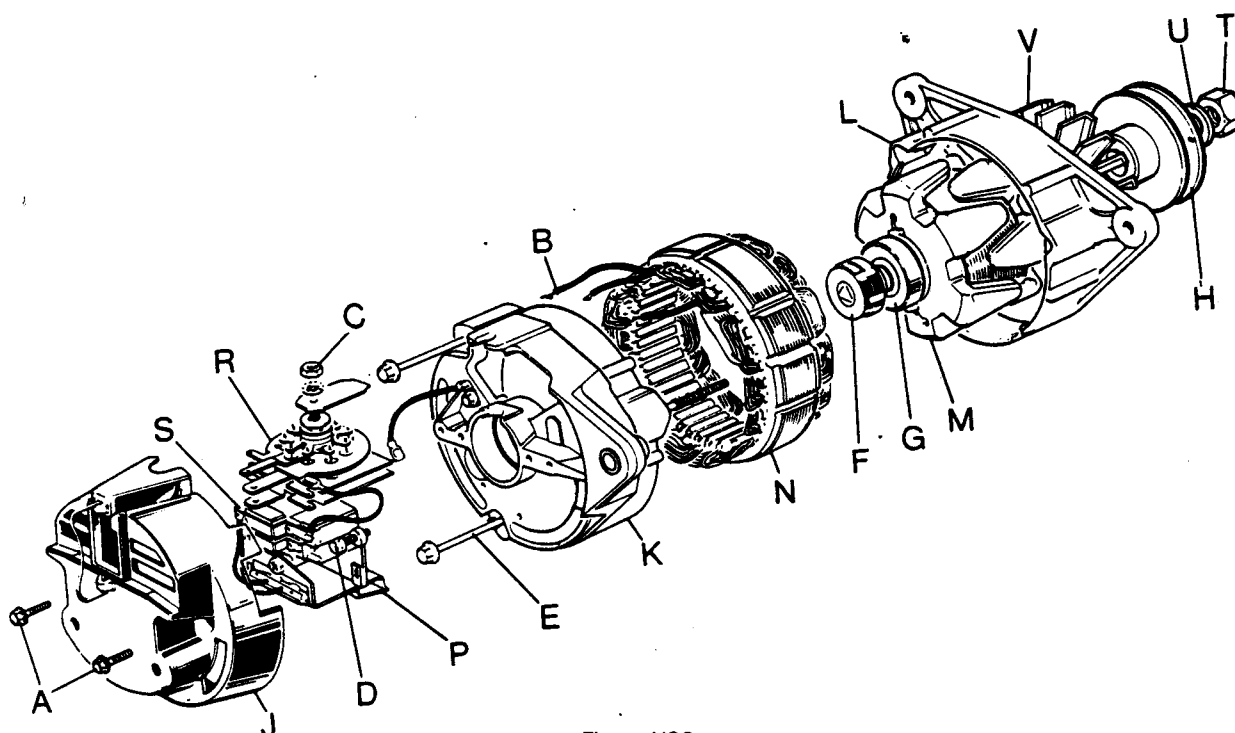


Figure H20  
LUCAS ALTERNATOR ASSEMBLY

- |                           |                     |
|---------------------------|---------------------|
| A. Screws, end cover.     | L. Drive end frame. |
| B. Stator connections.    | M. Rotor.           |
| C. Nut, rectifier ground. | N. Stator.          |
| D. Screw, regulator.      | P. Regulator.       |
| E. Through bolt.          | R. Rectifier.       |
| F. Slip-ring moulding.    | S. Brush holder.    |
| G. Rear bearing.          | T. Pulley nut.      |
| H. Pulley.                | U. Washer.          |
| J. Plastic cover.         | V. Fan.             |
| K. Slip-ring end frame.   |                     |

R7862

## TEST AND REPAIR

### Brushes

1. Measure the amount that the brushes show out of the holder.
2. If this measurement is less than 8mm ( $\frac{3}{10}$ in), install new brushes.
3. When installing new brushes, make sure the small leaf spring at the side of the inner brush does not get lost.
4. Use a push type gauge to check the brush spring pressures as follows: Push the brush into the holder until the end of the brush is level with the holder. The gauge will show between 255–368g (9–13oz) if the springs are in good condition.
5. If the pressure is less than 255g (9oz), install new springs.
6. If the pressure is more than 368g (13oz), check for a restriction of the brushes in the holder. Clean the brushes with a small amount of petrol on a cloth or carefully with a smooth file. DO NOT use emery or similar abrasives.

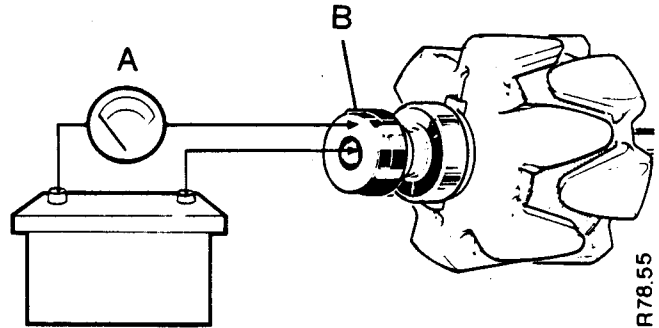


Figure H21  
CHECKING ROTOR WINDING RESISTANCE

A. Ammeter. B. Slip-rings.

### Rotor

1. Connect an ohmmeter or a 12volt battery and an ammeter between the slip-rings. The resistance of the windings must be as follows:  
pink windings: 4.3 ohms or  
2.8 amperes.  
purple windings: 3.3 ohms or  
3.6 amperes.
2. Use a 110volt AC supply to check the insulation. Connect a 15 watt test lamp between the slip-rings and the poles as shown. If the lamp illuminates, install a new rotor.

NOTE: The poles must not be machined. DO NOT try to correct any distortion of the shaft; install a new rotor.

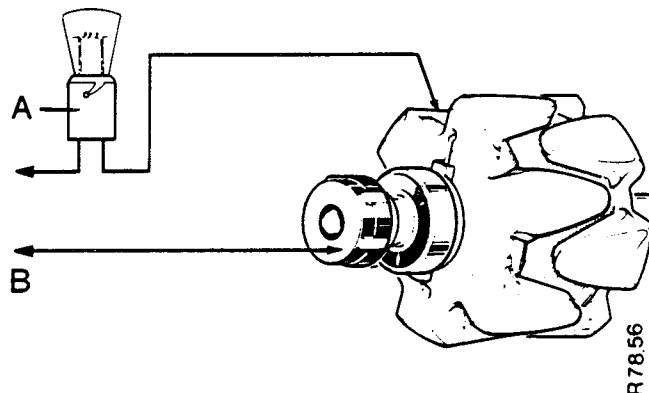


Figure H22  
TESTING INSULATION OF ROTOR WINDINGS

A. 15W test lamp. B. 110 volt supply.

### Slip-rings

1. Clean any dirt, oil or grease from the slip-ring surfaces with a small amount of petrol on a cloth.
2. Remove scratches or other surface damage with smooth glass paper. DO NOT use emery cloth, similar abrasive or a machine for this purpose.



## Diodes

Disconnect all the diodes with a soldering iron and proceed as follows:

NOTE: Use a pair of pliers to remove the heat away from the diodes, see Figure H25.

1. Connect one of the nine diodes in series with a 1.5 watt test lamp and 12volt battery. See Figure H24.
2. Connect the other battery terminal to the heat sink to which the diode being tested is fastened. Make a note of the results.
3. Now change the connections with each other. If the lamp shows the same result install a new rectifier assembly. The lamp must only illuminate in one direction.
4. Repeat 1 to 3 on all nine diodes.
5. Check the surge protection diode in the same way. The lamp must only illuminate when connected in one way.

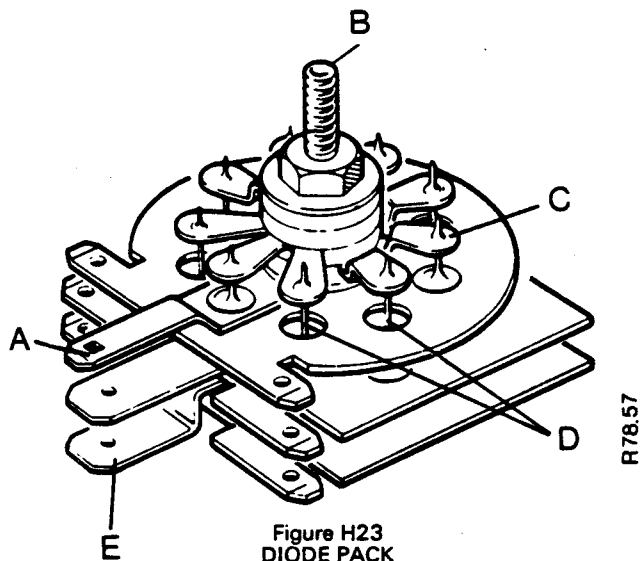


Figure H23  
DIODE PACK

A. Ind connection. B. Earth connection. C. Field diode. D. Output diode. E. Positive (+) connections.

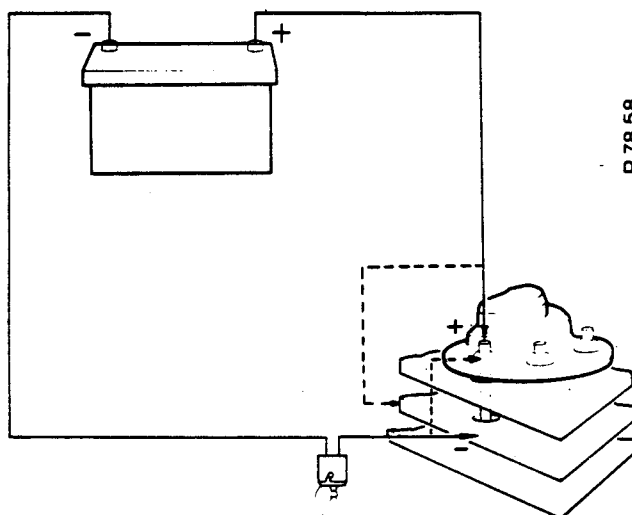


Figure H24  
CHECKING DIODE

**IMPORTANT:** When using the soldering iron to connect or disconnect the diodes use pliers as shown to remove the heat. Use only 'M' grade solder (45-55 tin-lead) with resin core and do the job as fast as possible.

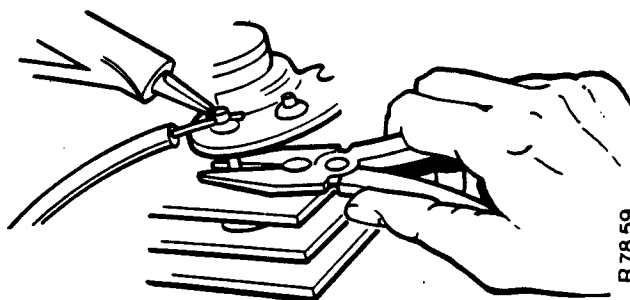
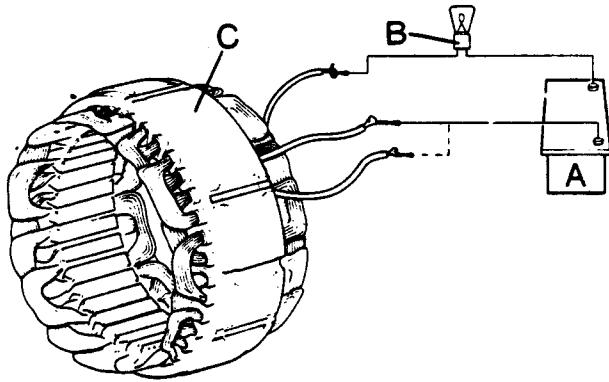


Figure H25  
APPLYING SOLDER TO DIODE CONNECTION

**Stator**

Use a 12volt battery and a test lamp of not less than 36 watts to check the windings.

1. Connect the test lamp between any two of the windings, as shown.
2. Repeat the test on all connections. Failure of the lamp to illuminate is an indication of a broken circuit. Install a new stator.



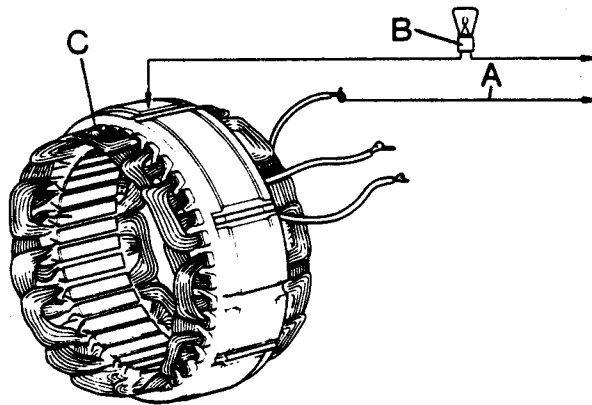
R7860

Figure H26  
CHECKING CONTINUITY OF STATOR WINDINGS

- A. 12volt battery.  
B. Test lamp, 36 watt.  
C. Stator.

Use a 110volt AC supply and a 15 watt test lamp to check the stator insulation as follows:

1. Connect the lamp between any one of the wires and the laminations as shown.
2. Repeat on the other two wires. If the lamp illuminates there is a failure in the stator windings. Install a new stator.



R7861

Figure H27  
TESTING INSULATION OF STATOR WINDINGS

- A. Supply of 110 volts AC.  
B. Test lamp, 15 watt.  
C. Stator laminations.

## BEARING REPLACEMENT

Slip-ring End  
Figure H28.

1. Use a soldering iron to disconnect the slip-ring wires. Remove the slip-ring moulding F from the rotor shaft.
2. Pull the bearing G from the shaft with an acceptable puller.
3. Clean the shaft and position the new bearing with the shield nearest the slip-ring moulding.
4. Push the bearing on to the shaft as far as it can go.
5. Install the slip-ring moulding and use 'M' grade solder to reconnect the rotor winding wires.

## Drive End

1. Remove the circlip and push the bearing out of the drive end frame.
2. Press the new bearing into the end frame.

Fit the circlip and make sure it has fully entered the groove all the way round.

ASSEMBLY  
Figure H28

Assemble the alternator in the opposite sequence to disassembly. Make sure the following instructions are followed when assembling.

1. Push the bearing G at the slip-ring end on to the shaft as far as it can go.
2. Put the brushes into the holder before installing the holder in the alternator.
3. Use a steel tube as a support on the inner ring of the drive end bearing. Install the rotor. DO NOT use the drive-end frame as a support when installing the rotor.
4. Tighten the three bolts E which hold the two halves of the alternator together, to 75Nm (8kgm) (55lbin).

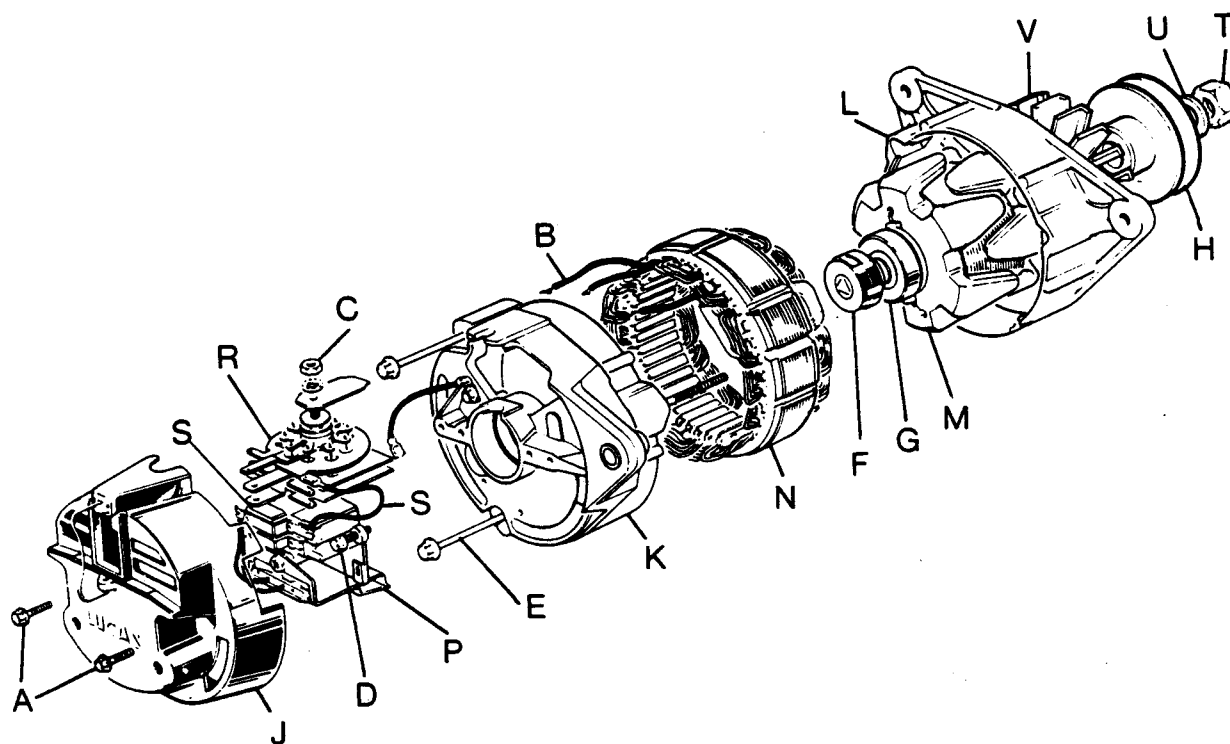


Figure H28  
LUCAS ALTERNATOR ASSEMBLY

- |                           |                     |
|---------------------------|---------------------|
| A. Screws, end cover.     | L. Drive end frame. |
| B. Stator connections.    | M. Rotor.           |
| C. Nut, rectifier ground. | N. Stator.          |
| D. Screw, regulator.      | P. Regulator.       |
| E. Through bolt.          | R. Rectifier.       |
| F. Slip-ring moulding.    | S. Brush holder.    |
| G. Rear bearing.          | T. Pulley nut.      |
| H. Pulley.                | U. Washer.          |
| J. Plastic cover.         | V. Fan.             |
| K. Slip-ring end frame.   |                     |

R78.54

## MAINTENANCE AND REPAIR

### AC-DELCO ALTERNATOR

(see page H15 for Lucas)

The alternator is of the machine sensed type complete with regulator. All internal connections are fastened by screws or nuts and easily removed.

#### IMPORTANT

Never connect or disconnect wires in the alternator circuit when the alternator is running. Always make sure the starter switch is in the 'OFF' position if the engine is not running.

Always check the polarity before connecting wires in the alternator circuit, especially battery terminals.

Never run the alternator with the wires disconnected.

Disconnect the alternator if electrical welding is to be done on the tractor.

#### EQUIPMENT NEEDED

$\frac{15}{16}$  AF and 8mm open end spanners.

$\frac{5}{16}$  in Allen key.

$\frac{9}{16}$  AF, 8mm and 10mm sockets.

Pozidriv screwdriver.

Long nose pliers.

Ohmmeter and test lamp.

Hammer and punch.

#### MAINTENANCE

1. Check the drive belt tension every 125 and 500 hours.
2. Keep the alternator clean, especially around the connections.
3. Check the tightness of the bolts A which fasten the alternator to the engine.
4. Make sure all electrical connections are clean, tight and connected correctly.

NOTE: The bearings are filled with lubricant by the manufacturer and do not need maintenance.

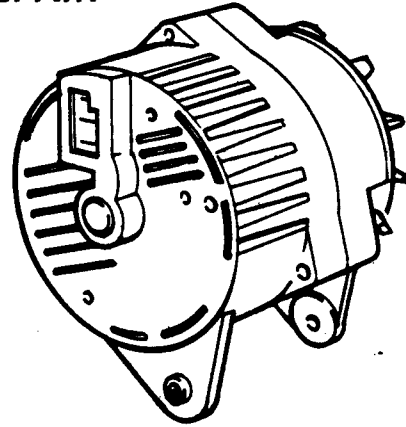


Figure H29  
AC-DELCO ALTERNATOR

R78.63

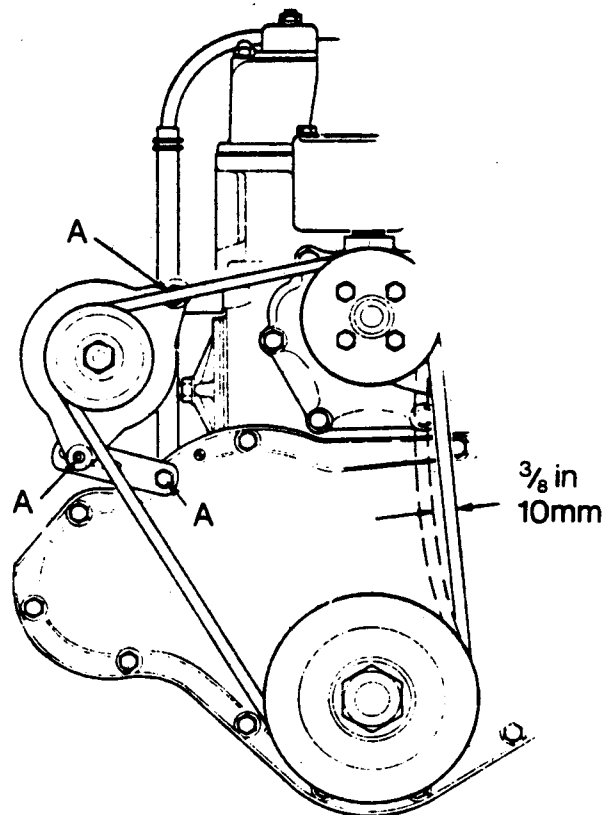


Figure H30  
DRIVE BELT ADJUSTMENT  
A. Fastening bolts.

R78.53

**DISASSEMBLY****Slip-Ring end**

1. Make a mark across the junction of the two halves of the alternator. This will make sure the halves are assembled in the same position.
2. Remove the three bolts which hold the two halves together.
3. Carefully separate the two halves and look for the brush springs which can fall out.
4. Put a piece of tape over the bearing A in the slip-ring end frame B. This will prevent dirt from entering.
5. Put a piece of tape on the bearing surface of the rotor shaft to give it protection from damage.
6. Remove the three nuts C which hold the stator wires to the rectifier bridge D.
7. Carefully remove the stator from the end frame. Put the stator on the bench with the terminal lugs up.
8. Use an ohmmeter to check the insulation of the diode trio E before removing it. Connect the ohmmeter between the link F and the frame B. If the ohmmeter shows a low resistance then a new fastening screw G must be installed when assembling.
9. Remove the Pozidrive screw G holding the diode trio E and remove the diode trio.
10. Use an ohmmeter to check the insulation of the screw H holding the brush assembly. Connect the ohmmeter between the brush assembly clip and the frame B. If a low resistance is shown, install a new screw H when assembling.
11. Remove the Pozidrive screw H holding the brush assembly and remove the brush assembly J.
12. Remove the two screws K and L holding the rectifier bridge and remove the rectifier bridge D.
13. Remove the Pozidrive screw M holding the regulator N and remove the regulator.

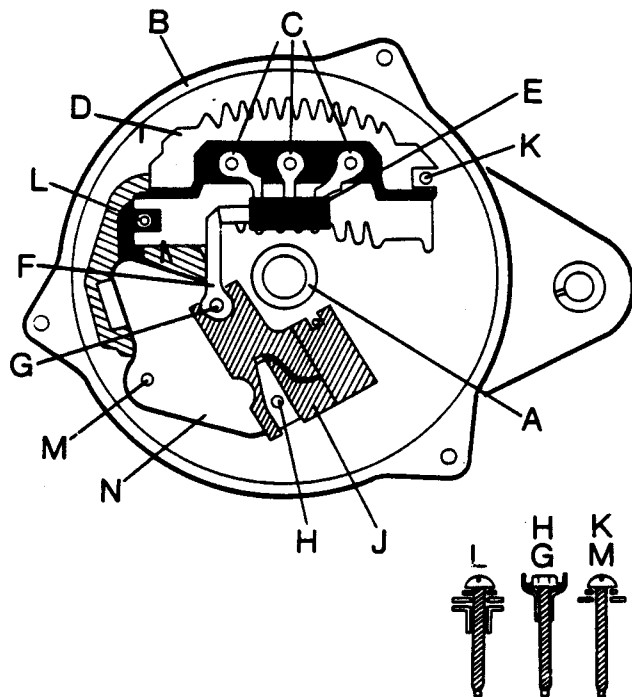


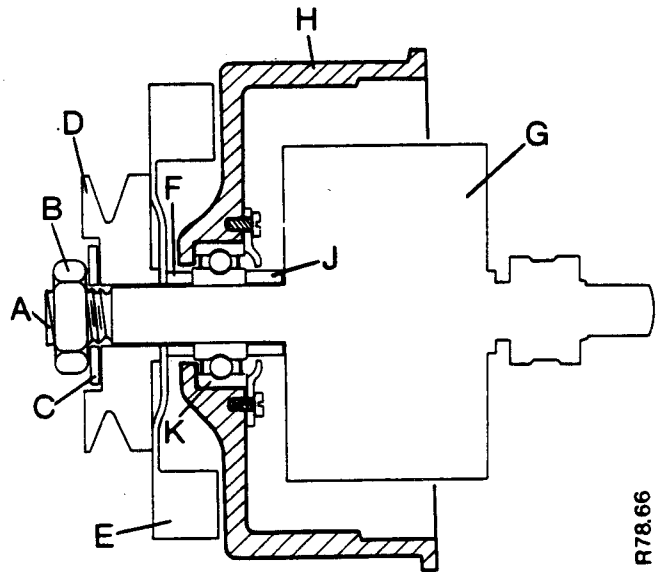
Figure H31  
SLIP-RING END FRAME

- A. Bearing, roller type.
- B. Frame, slip-ring end.
- C. Rectifier terminals.
- D. Rectifier bridge.
- E. Diode trio.
- F. Link, diode trio.
- G. Diode trio screw, with insulation.
- H. Brush holder screw, with insulation.
- J. Brush holder.
- K. Rectifier screw.
- L. Rectifier screw, with insulation.
- M. Regulator screw.
- N. Regulator.

R7865

**Drive End**

1. Put a  $\frac{5}{16}$  in Allen Key in the drive end of the rotor shaft A to prevent it from turning. Use a  $\frac{15}{16}$  AF spanner to loosen the pulley nut B.
2. Remove the nut B, washer C, pulley D, fan E and outer spacer F from the rotor shaft.
3. Carefully remove the rotor G from the end frame H. Remove the inner spacer J from the rotor shaft.



R78.66

Figure H32  
DRIVE END FRAME

- |            |                  |
|------------|------------------|
| A. Shaft.  | F. Outer spacer. |
| B. Nut.    | G. Rotor.        |
| C. Washer. | H. End Frame.    |
| D. Pulley. | J. Inner spacer. |
| E. Fan.    |                  |

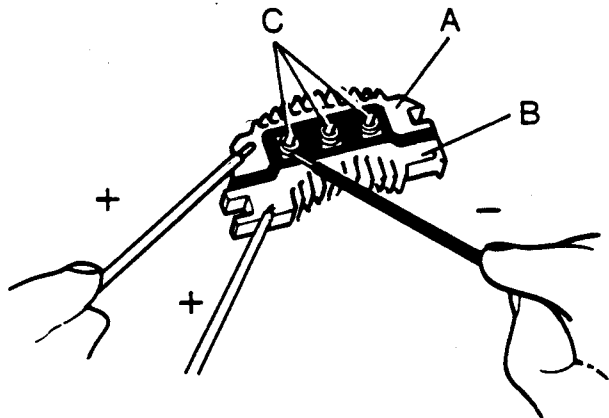
**TEST AND REPAIR**

**NOTE:** Test procedures for the stator, rotor and slip-rings are the same as for the Lucas alternator.

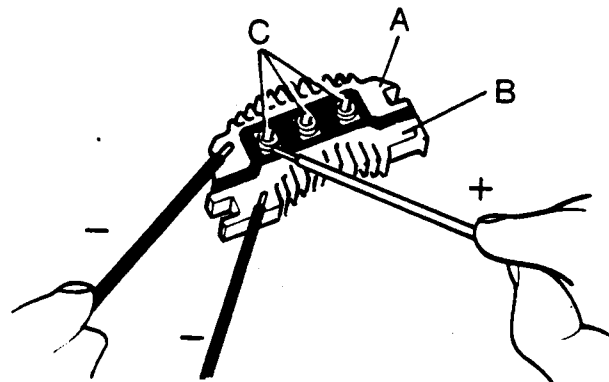
**Rectifier Bridge**

Use a ohmmeter or test lamp to check the rectifier bridge in the following way.

1. Connect the positive wire of the test equipment to the insulated heat sink A.
2. Connect the negative wire of the test equipment to each terminal C of the rectifier, one at a time. Make a note of each result.
3. Now connect the negative wire to the heat sink A and the positive wire to the terminals C. Make a note of each result.
4. Install a new rectifier bridge if the same result is shown when the wires are connected in both ways.
5. Repeat steps 1 to 4 on the heat sink B which has no insulation.



R78.67.1



R78.67.2

Figure H33  
TESTING THE RECTIFIER BRIDGE

- |                                  |
|----------------------------------|
| A. Heat sink with insulation.    |
| B. Heat sink with no insulation. |
| C. Terminals.                    |

## Diode Trio

Use the following method to test the diode trio.

1. Connect the positive wire of the test equipment to the brush holder connection A. Now connect the negative wire to each of the three rectifier connections B. Make a note of each result.
2. Now connect the negative to the brush holder connection A and the positive to each of the other wires B. Make a note of each result.
3. Install a new diode trio, if any connection shows the same result when connected in both ways.

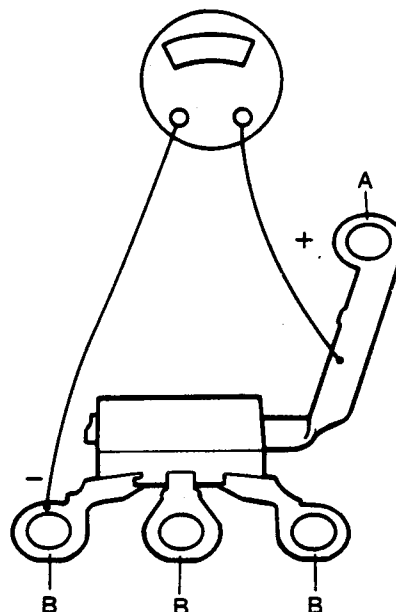


Figure H34  
TESTING THE DIODE TRIO  
A. Brush holder connection.  
B. Rectifier connections.

## Brushes

1. Remove the brushes from the holder.
2. Measure the length of the brushes. Install new brushes if less than 10mm.
3. Clean the brushes with a small amount of petrol on a cloth before installing into the holder.
4. Get a pin, approximately 2.38mm x 50mm ( $\frac{3}{32}$  in x 2 in) and made of a material which is not a conductor. Push the brushes down into the holder. Put the pin through the hole in the holder to hold the brushes down. The pin is removed after the alternator has been completely assembled.

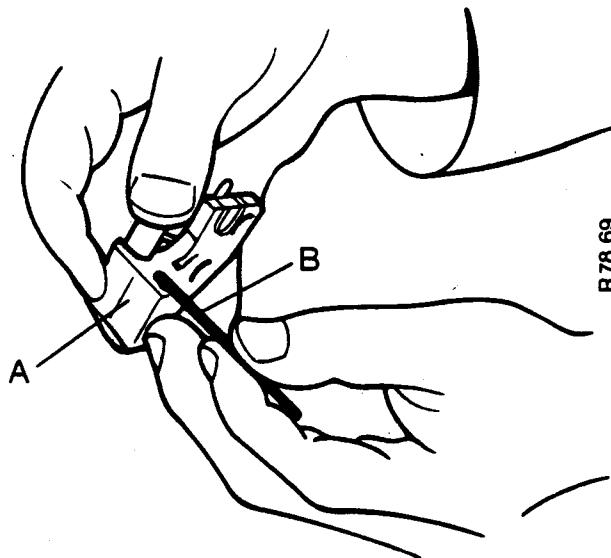


Figure H35  
INSTALLING THE BRUSHES  
A. Brush holder.  
B. Pin, made of a material which is not a conductor.

### Regulator

To check the regulator it must be connected into a circuit with a variable DC voltage. Use a supply with a maximum of 18 volts.

1. Make a test circuit as shown in Figure H36.
2. Set the supply voltage D to 10 volts. Check the voltmeter E; if showing 1.5 volts continue with test. If showing 10 volts, install a new regulator.
3. Set the supply voltage D to between 14 and 15.5 volts. Check the voltmeter E; if showing supply voltage continue with test. If showing a different reading, install a new regulator.
4. Decrease the supply voltage D until the voltmeter E shows 1.5 volts. Check the supply voltage; it will be between 14.2 and 15.1 volts if the regulator is working correctly.

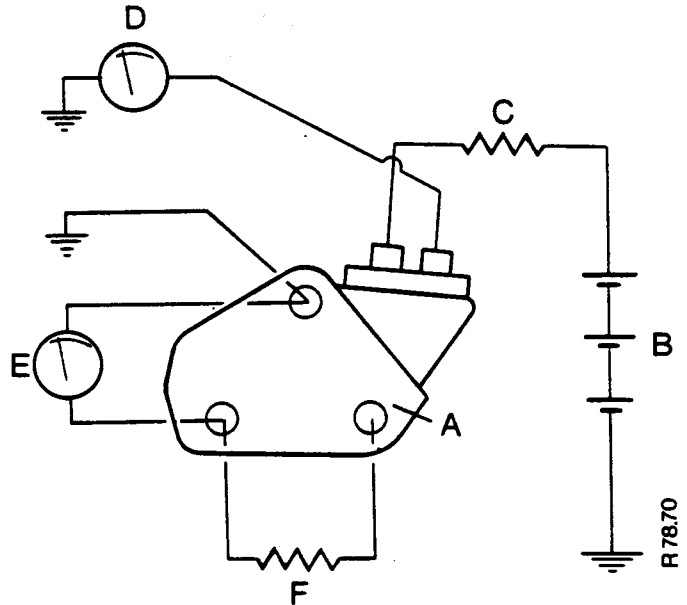


Figure H36

#### REGULATOR TEST CIRCUIT

- A. Regulator.  
B. 18 volt supply DC.  
C. Variable resistor.  
D. Supply voltmeter.  
E. Output voltmeter.  
F. Resistor, 3 ohms 5 amp capacity.

### BEARING REPLACEMENT

#### Slip-ring End

1. Use a piece of steel tube A 50mm (2in) in diameter as a support for the inside of the frame.
2. Use a piece of steel tube D with an outside diameter of 16.6mm ( $\frac{5}{8}$ in). Push the bearing out of the frame from the outside.
3. Heat the frame B to about 50° Celcius. Push the new bearing C into the frame from the outside until it is level with the frame.
4. Put tape on the bearing to stop dirt entering. Remove when ready for assembling.

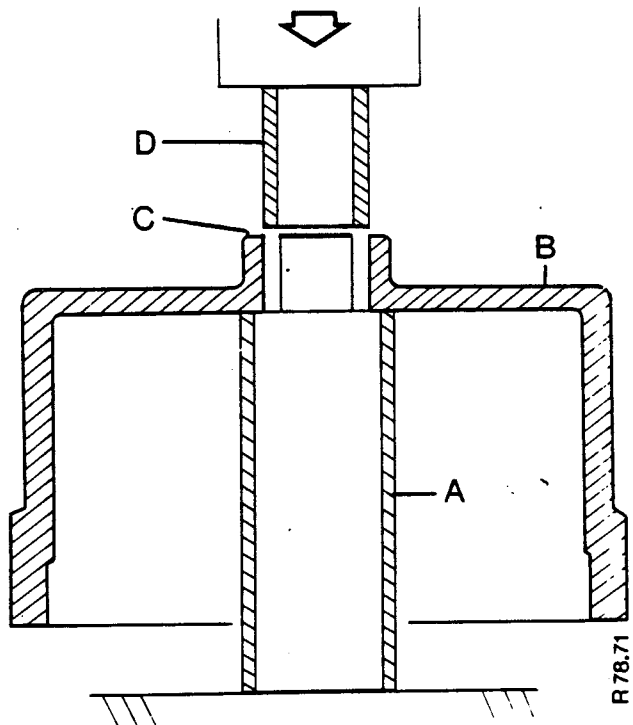


Figure H37

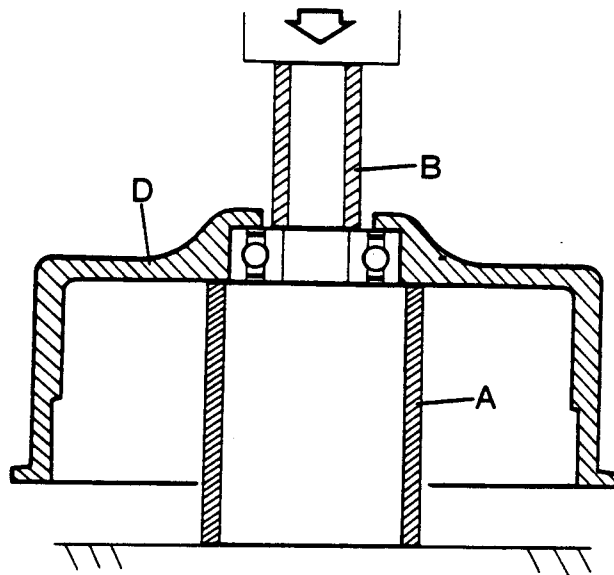
#### REMOVING AND INSTALLING SLIP-RING END BEARING

- A. 50mm (2in) steel tube.  
B. End frame.  
C. Roller bearing.  
D. 16.6mm ( $\frac{5}{8}$ in) steel tube.

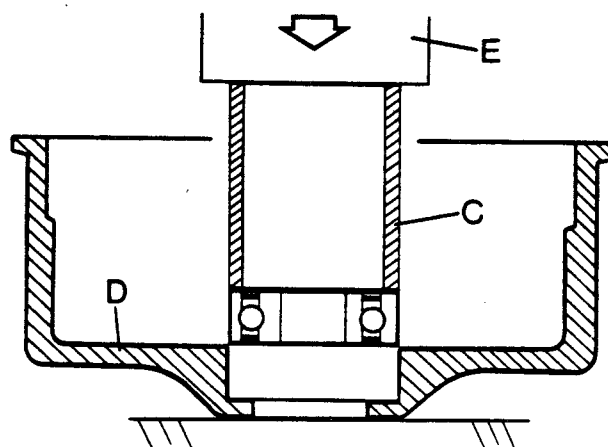


**Drive End**

1. Remove the three screws from the retainer plate which keeps the bearing in place. Remove the plate.
2. Use a piece of steel tube A 50mm (2in) diameter as a support on the inside of the frame.
3. Using a piece of steel tube B the same size as the inner ring of the bearing. Push the bearing out of the frame, from the outside of the frame.
4. Heat the frame to about 50° Celcius. Using a piece of tube C the same size as the outer ring of the bearing. Push the new bearing into the frame, with the tube, from the inside of the frame.



R78.72



R78.73

Figure H38  
**REMOVING AND INSTALLING DRIVE END BEARING**  
 A. 50mm (2in) steel tube.  
 B. Steel tube, same size as bearing inner ring.  
 C. Steel tube, same size as bearing outer ring.  
 D. Drive end frame.  
 E. A press.

## ASSEMBLY

### Slip-ring End

1. Fasten the regulator N loosely into position with the screw M which has no insulation.
2. Install the insulation sleeve P to the rectifier bridge D.
3. Install the rectifier bridge into the frame. Align the terminals in the centre of the terminal opening. Install and tighten the screws L and K.
4. Put the brush holder J on to the regulator. Make sure the pin R which holds the brushes in place, goes through the hole in the end frame.
5. Install the insulated screw H but do not tighten.
6. Install the diode trio E and the other insulated screw G but do not tighten.
7. Move the brush holder towards the outside of the frame and tighten the screws. Now tighten the regulator screw M.
8. Put the stator into the frame. Connect the three wires to the rectifier and tighten the nuts. Make sure the three terminals C are not making contact with the heat sink. Bend clear if necessary.
9. Remove the tape from the bearing in the end frame and from the rotor shaft. Clean off any deposit remaining.

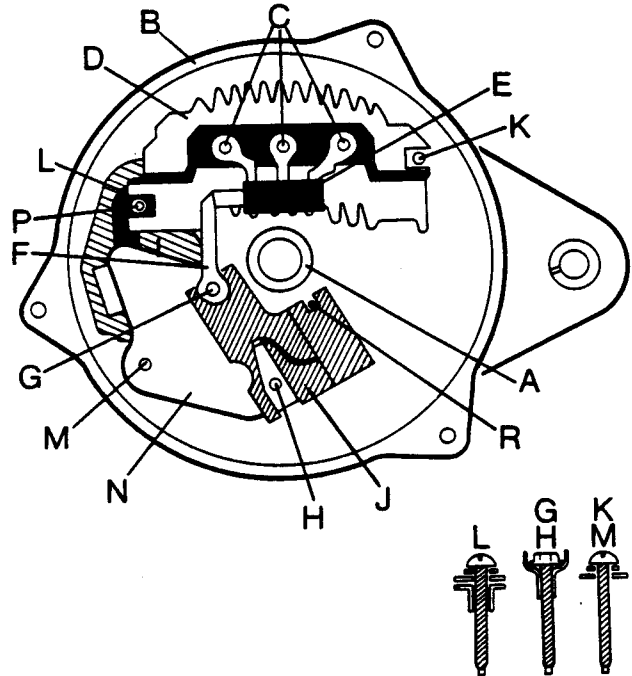


Figure H39  
SLIP-RING END FRAME

- |                            |   |
|----------------------------|---|
| A. Bearing.                | K. Rectifier screw, without insulation. |
| B. Frame.                  | L. Rectifier screw, with insulation.    |
| C. Terminals of rectifier. | M. Regulator screw, without insulation. |
| D. Rectifier.              | N. Regulator.                           |
| E. Diode trio.             | P. Insulation sleeve.                   |
| F. Diode trio link.        | R. Pin, brushes.                        |
| G. Screw with insulation.  |   |
| H. Screw with insulation.  |   |
| J. Brush holder.           |   |

R78.74

**Drive End**

1. Clean all the parts.
2. Put the larger of the two spacers J on the drive end of the rotor shaft A. Make sure the chamfer is towards the end of the shaft.
3. Install the rotor G into the end frame bearing K.
4. Put the outer spacer F on the armature shaft.
5. Put the fan E, pulley D, washer C and nut B on to the shaft in that sequence.
6. Tighten the pulley nut B to a torque of 54–80Nm (5.5–8.3kgm) (40–60lbft).
7. Make sure the slip-rings are clean, then enter the rotor shaft into the slip-ring frame bearing.
8. Align the marks made on the two halves of the frame and push the halves together.
9. Install the three bolts which hold the two halves together and tighten to a torque of 40–68Nm (4–7kgm) (30–50lb in).
10. Remove the pin R, Figure H39, which is holding the brushes into the holder.

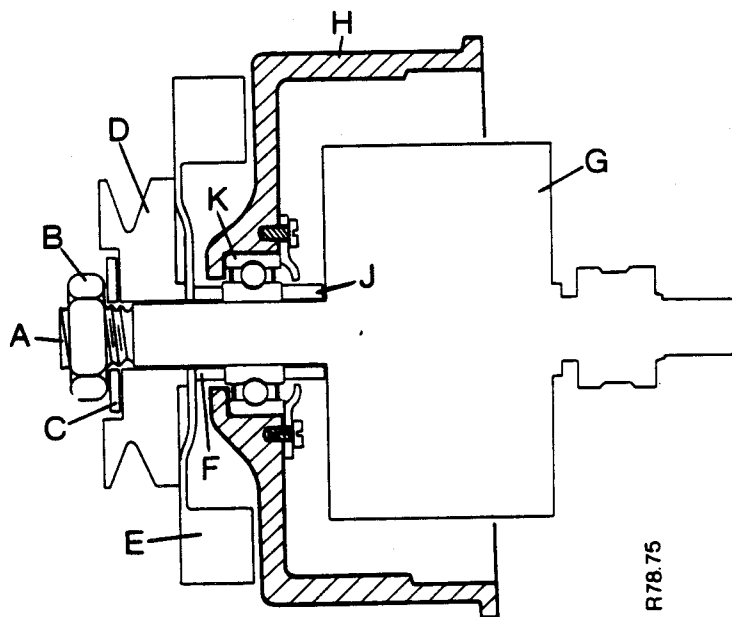


Figure H40  
DRIVE END FRAME

- |            |                  |
|------------|------------------|
| A. Shaft.  | F. Outer spacer. |
| B. Nut.    | G. Rotor.        |
| C. Washer. | H. End Frame.    |
| D. Pulley. | J. Inner spacer. |
| E. Fan.    | K. Bearing.      |

# DYNAMO

## HOW IT WORKS

When the starter key A is turned to the ACC position the 'no charge' warning lamp J is illuminated. Battery current goes through the brushes and armature windings B to ground.

When the engine is started a current is generated in the armature windings. This is caused by the armature turning in a magnetic field made by the field magnets C. The current goes from the armature to the field windings. This current in the field winding increases the strength of the magnetic field. The effect is to increase the armature current. Both currents increase with armature speed. When the armature output reaches 13 volts the cut-out contacts D of the regulator close. This connects the dynamo to the battery and charging starts. When the output decreases to 12 volts the contacts open to prevent the current returning through the dynamo.

When the dynamo output voltage increases the voltage difference at the warning lamp terminals decreases. This causes the lamp to stop illuminating.

The maximum output of the armature is regulated by another set of contacts E. These open, at a set maximum and interrupts the current to the field windings. Field current decreases causing armature current to decrease and the contacts close again. All this occurs at a fast rate, keeping output limited to a set amount. Charging current is controlled by the battery charge condition. A discharged battery will take a high rate of charge. A charged battery will take a low rate of charge.

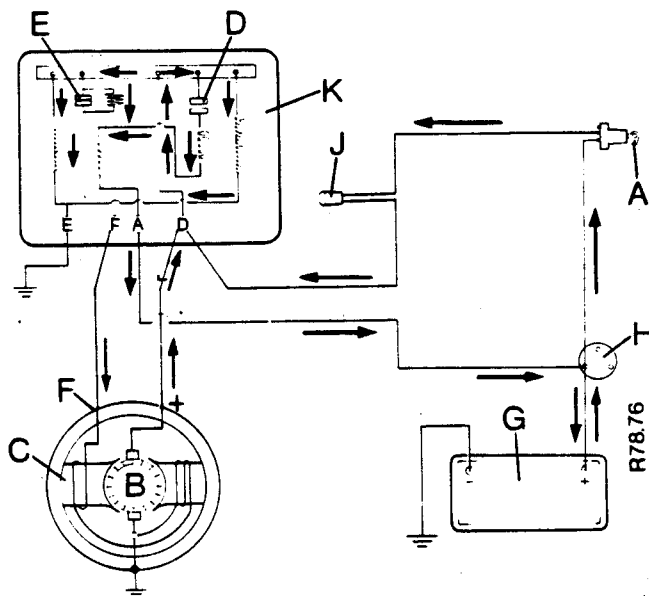


Figure H41

### DYNAMO CIRCUIT

- A. Starter key.
- B. Commutator.
- C. Field magnets.
- D. Cut-out contacts.
- E. Regulator contacts.
- F. Field connection.
- G. Battery.
- H. Starter solenoid.
- J. Warning lamp.
- K. RB108 type regulator.

## FAULT FINDING

### Equipment Needed

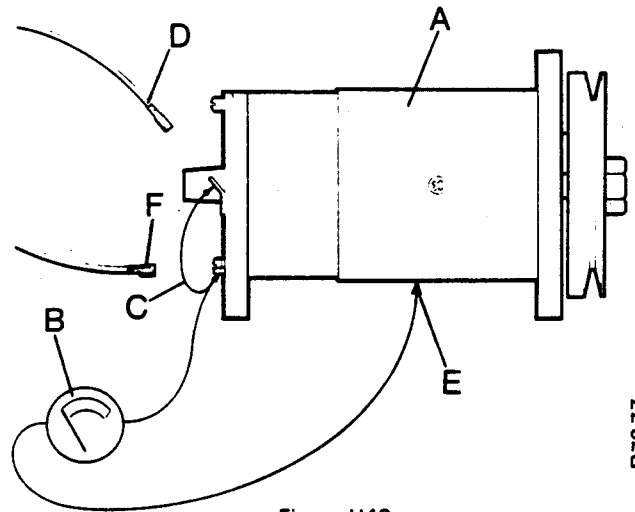
Voltmeter  
Jumper wires

### TEST 1: Output

1. Check that the drive belt is adjusted correctly. Check for wear and damage.
2. Disconnect both the wires from the dynamo terminals and connect a jumper wire from one terminal to the other as shown Figure H42.
3. Connect a voltmeter from the jumper lead to ground. Start the engine and let it run at idle speed. The voltmeter must show between 10 and 13 volts and increase with engine speed at a rapid rate. Do not let the voltage increase more than 20 volts or damage can occur to the dynamo.

If the voltage is less than 10 volts or does not increase at a rapid rate remove the dynamo.

4. Disassemble the dynamo and check all parts. See MAINTENANCE AND REPAIR section for procedures.
5. If the voltage is correct reconnect the dynamo wires.



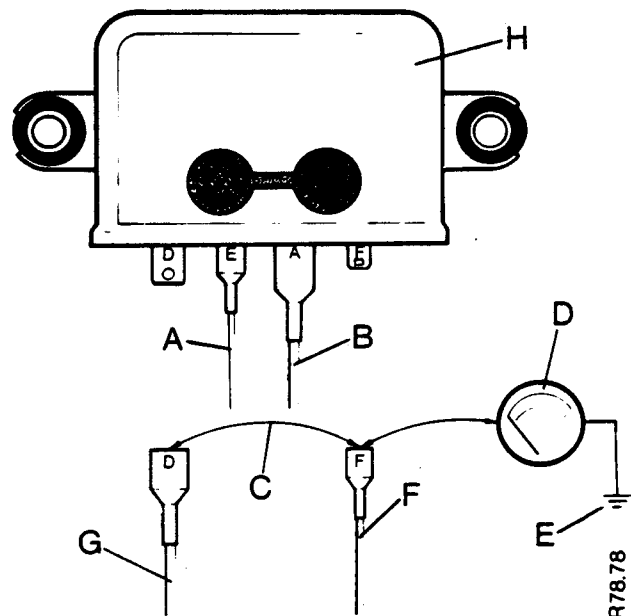
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Figure H42  
CHECKING DYNAMO OUTPUT

A. Dynamo	D. Positive wire.
B. Voltmeter.	E. Ground connection.
C. Jumper wire.	F. Field wire.

### TEST 2: Wiring

1. Disconnect the wires from the D and F terminals of the voltage regulator and connect the wires together. Make sure the wires do not make contact to ground.
2. Connect a voltmeter between the ends of the wires and earth.
3. Start the engine and let it run at idle speed. The voltmeter must show a voltage of 10 to 13 volts. If the voltmeter does not show any voltage, check for a break in the wires. Check for loose or dirty connections.



R78.78

Figure H43  
CHECKING DYNAMO WIRING

A. Black wire.	E. Ground.
B. Brown wire.	F. Brown/Green wire.
C. Jumper wire.	G. Brown/Yellow wire.
D. Voltmeter.	H. Regulator.

4. Disconnect the D & F wires from the dynamo. Use a jumper wire to connect one end of the D wire to the battery positive terminal. Connect a voltmeter between the other end of the D wire and ground. The voltmeter must show battery voltage or there is a break in the wire. Do the same with the F wire.
5. Connect one end of the D wire to the battery positive terminal. Connect the voltmeter from the F wire to ground. If a voltage is shown on the voltmeter there is a leakage from D to F. Reconnect all wires if correct.

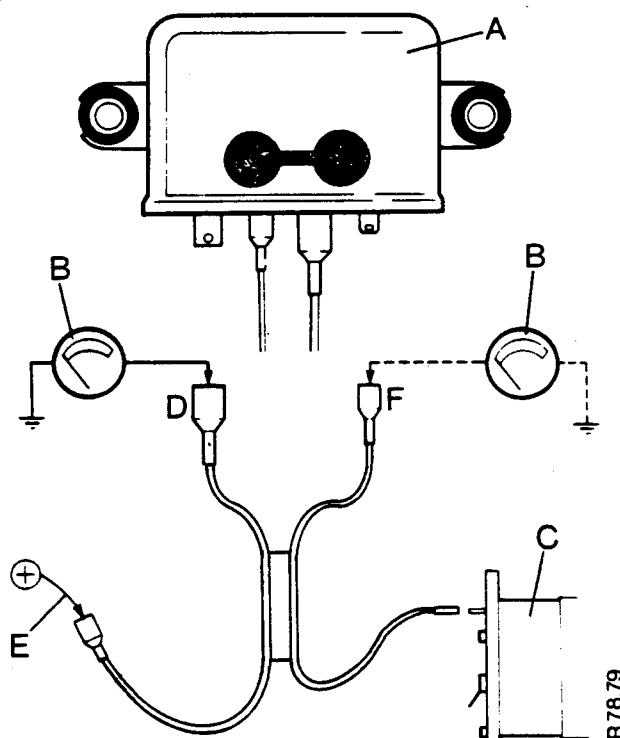


Figure H44  
CHECKING DYNAMO WIRING

- |                       |                                     |
|-----------------------|-------------------------------------|
| A. Regulator.         | E. Jumper wire to battery positive. |
| B. Voltmeter.         | F. Brown/Green wire.                |
| C. Dynamo.            |                                     |
| D. Brown/Yellow wire. |                                     |

### TEST 3: Regulator

1. Make sure the black wire from the E terminal of the regulator is making a good connection to ground.
2. Disconnect the wire from the A terminal of the regulator. Make sure the wire does not make contact to ground.
3. Connect a voltmeter to the D terminal of the regulator and to ground. Do not disconnect the D wire from the regulator.
4. Start the engine and increase the speed to 2000 r/min. The voltmeter must show 16 to 16.6 volts at 20° Celcius (68° Fahrenheit).
5. If the voltage is more, connect a jumper wire from the E terminal to a good ground. Do the check again. If the voltage then decreases, the E wire is not making a good connection to ground.
6. If the voltage is not correct the regulator can be adjusted.

To increase the voltage turn the screw nearest the F terminal clockwise. See Figure H46.

To decrease the voltage turn the screw counterclockwise.

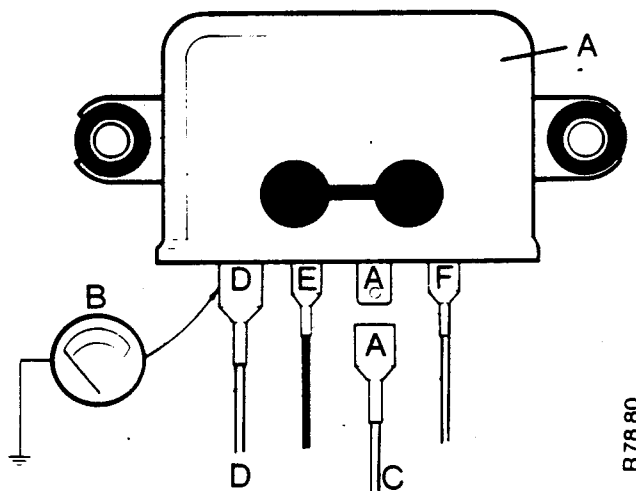


Figure H45  
CHECKING DYNAMO OUTPUT

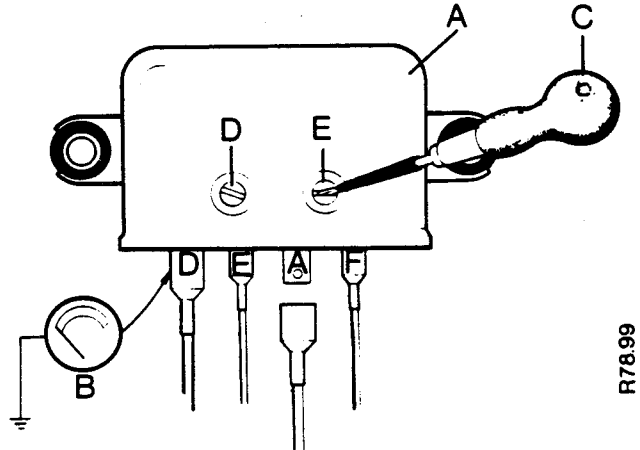
- |                |                                  |
|----------------|----------------------------------|
| A. Regulator.  | D. Brown/Yellow wire connection. |
| B. Voltmeter.  | E. Black wire, to ground.        |
| C. Brown wire. | F. Field wire.                   |

## ELECTRICAL EQUIPMENT

**IMPORTANT:** Use a screwdriver which has insulation on the blade. Output voltage flows through the adjusting screws and the case is connected to ground.

Make sure the test is done without delay or heat will cause the voltages to change.

7. Reconnect the wire to the A terminal and connect the voltmeter from D to ground.
8. Put the tractor lighting switch to the main beam position and start the engine. The voltage must increase to between 12.7 to 13.3 volts then decrease a small amount.
9. If the voltage is not correct adjust the screw nearest the D terminal. Turn the screw clockwise to increase the voltage or counter-clockwise to decrease the voltage.



R78.99

Figure H46  
VOLTAGE REGULATOR ADJUSTMENT

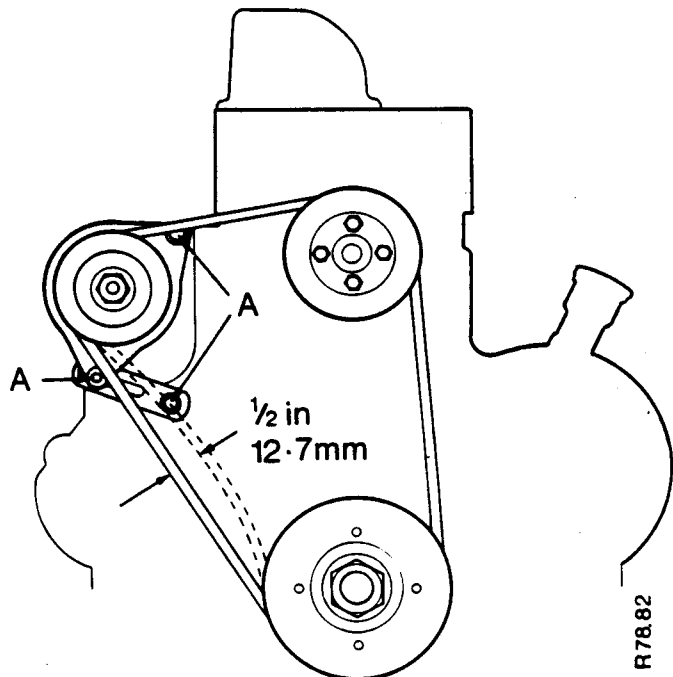
A. Regulator. C. Screwdriver.  
B. Voltmeter. D. & E. Adjusting screws.

## MAINTENANCE AND REPAIR

Two models of dynamo are installed on David Brown tractors. These are the Lucas C40A and C40T models.

### MAINTENANCE

1. Every 125 hours check the tension of the drive belt. Adjust if necessary.
2. Every 500 hours apply a small amount of engine oil to the felt pad in the commutator end plate. Remove the rubber plug, apply oil through the hole and install plug again.
3. Check the tightness of the bolts A which fasten the dynamo to the engine.
4. Make sure the electrical connections are clean, tight and correctly connected.
5. Clean the dynamo, especially around the electrical connections.



R78.82

Figure H47  
FAN BELT ADJUSTMENT  
A. Dynamo fastening bolts

**DISASSEMBLY**

After the dynamo has been removed from the tractor use the following procedure to disassemble.

1. Remove the two bolts A which hold the assembly together.
2. If an early type dynamo, remove the nut and washers from the field connection B.
3. Remove the end bracket C at the commutator end of the dynamo.
4. Remove the drive end bracket D complete with pulley and armature E from the yoke F.

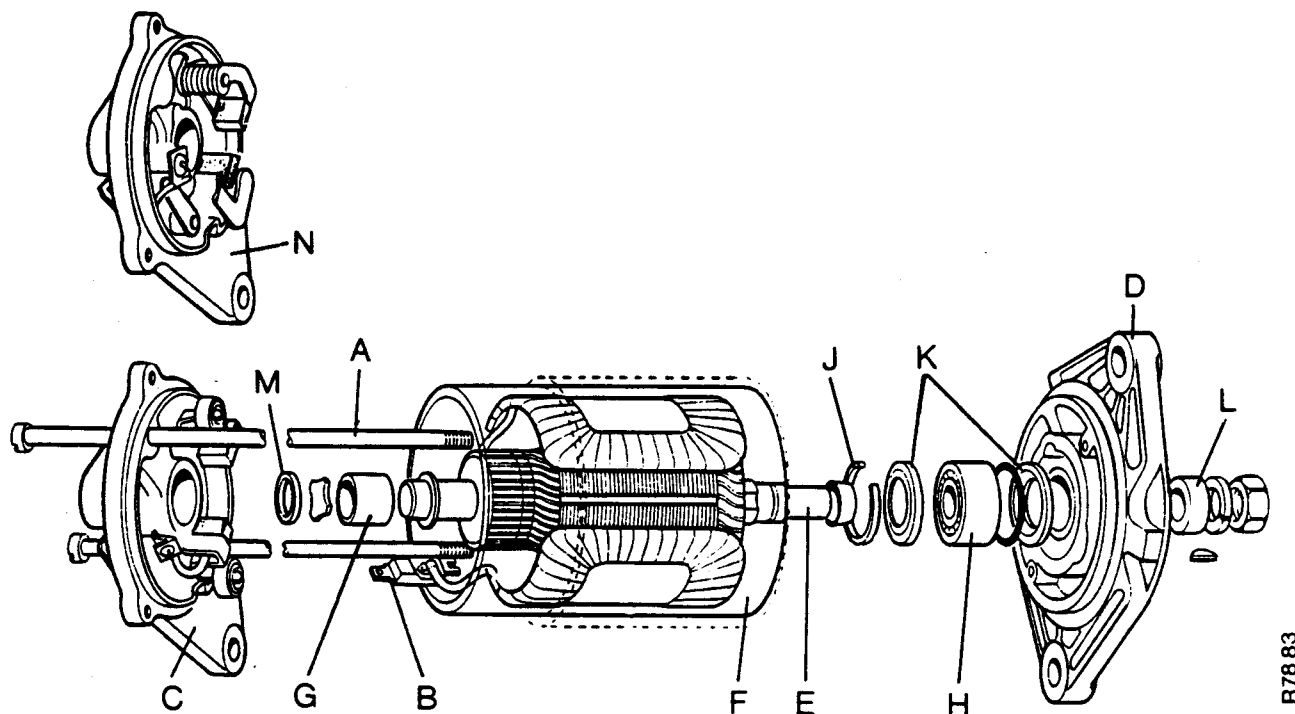


Figure H48  
DYNAMO ASSEMBLY

- |                            |                      |
|----------------------------|----------------------|
| A. Through bolt.           | H. Ball bearing.     |
| B. Field terminal.         | J. Circlip.          |
| C. Commutator end bracket. | K. Seals.            |
| D. Drive end bracket.      | L. Pulley spacer.    |
| E. Armature.               | M. Felt oil pad.     |
| F. Yoke.                   | N. C40T end bracket. |
| G. Bush.                   |                      |

R78.83



## TEST AND REPAIR

## Brushes

1. Remove the brushes from the holders and measure the length. If less than 8mm ( $\frac{5}{16}$  in), install new brushes.

On the C40T model, measure to the shoulder of the brush.

2. Clean the brushes with a small amount of petrol on a cloth. Make sure the brushes can move easily in the holders after installing.
3. Apply a small amount of engine oil to the brush pivot arms of the C40T model.
4. Install the end plate complete with brushes on to the commutator.
5. Use a spring-balance to check the brush spring tension with the brushes in the working position.

6. Install new springs if the tensions are not inside the following limits:

C40A model: 368–850g (13–30oz)

C40T model: 567–680g (20–24oz)

NOTE: When installing new springs in the C40A model, make sure the spring is as shown in Figure H49.

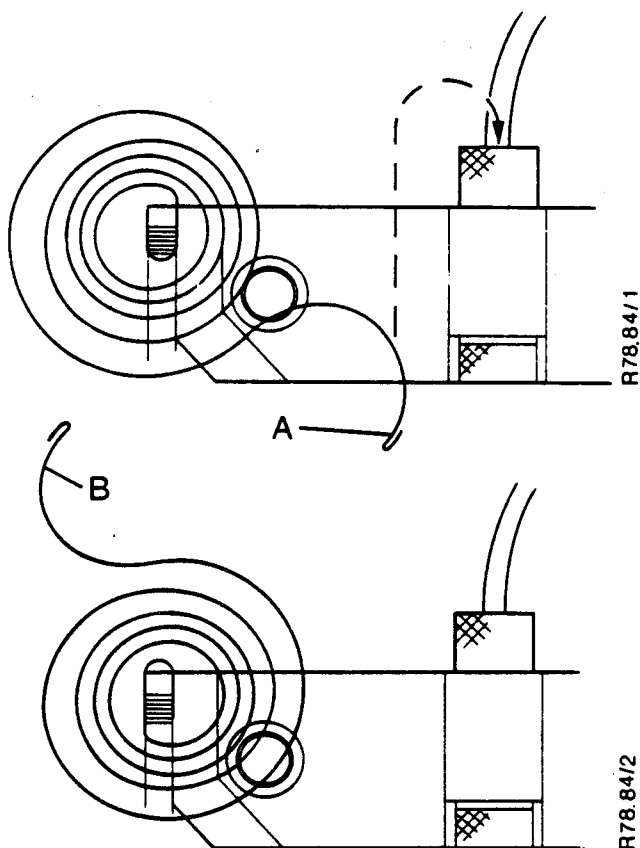


Figure H49  
INSTALLING BRUSH SPRINGS

A. Correct.

B. Wrong.

**Armature**

1. Check for damage or movement of solder connections, caused by heat.
2. Check for movement of commutator segments.
3. Install a new armature if any of the above damage is found. Look for possible cause before running the dynamo again.
4. Check for any indication of armature to field winding contact. If any is found, check bearings for wear. Check the tightness of the screws which fasten the pole shoes to the yoke.
5. Clean the commutator with a small amount of petrol on a cloth. Remove small surface damage with smooth glass paper. Do NOT use emery or similar abrasive.
6. If the damage is deep, a lathe can be used to remove the damage. First check what type of commutator is used, fabricated or moulded, see Figure H50.

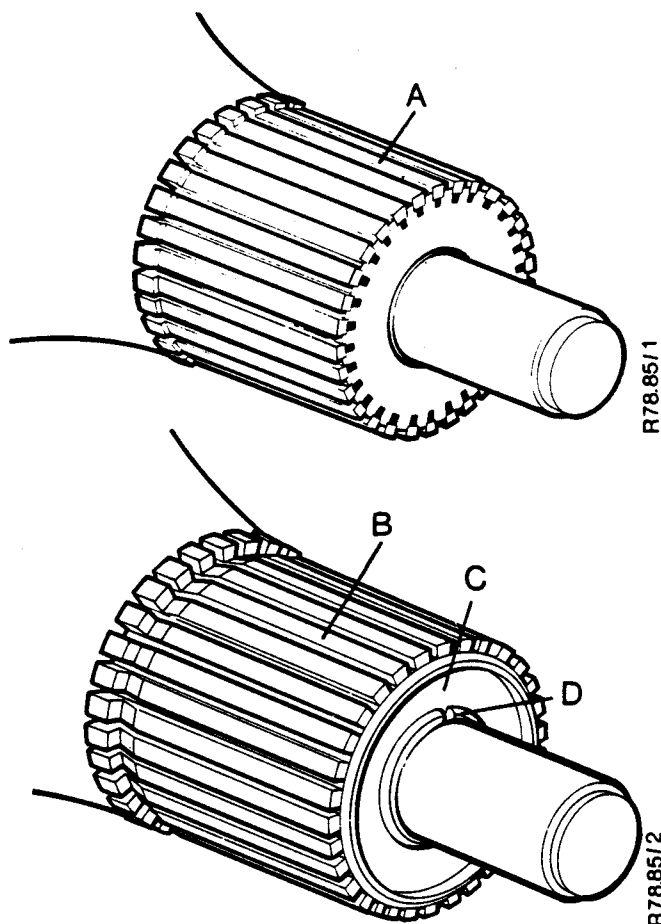


Figure H50  
IDENTIFICATION OF COMMUTATORS  
A. Moulded commutator.  
B. Fabricated commutator.  
C. Insulation cone.  
D. Metal roll over.

Before doing any repair make sure the armature windings are in good condition.

1. Use a 110 volt AC supply and a 15 watt test lamp to check the insulation as follows:  
Connect the supply to the armature shaft and the test lamp to one of the segments. Repeat the test on all segments. If the lamp illuminates, install a new armature.
2. Connect an ohmmeter between two segments next to each other. Continue this check all round the commutator until all segments have been checked. The reading must be the same for all segments. If a zero or low reading is shown, install a new armature.

If the armature is in good condition the following procedures must be followed for a repair.

1. For fabricated commutators the segments must not be decreased to less than a thickness of 1.5mm ( $\frac{1}{16}$ in). Cut the insulation to 0.8mm ( $\frac{1}{32}$ in) below the segments.
2. For moulded commutators the diameter of the commutator must not be decreased to less than 37mm (1.45in). DO NOT cut the insulation away between the segments. It is made to a set depth by the manufacturer.
3. Use a very fine glass paper to get a smooth finish. Clean away particles with an air jet.

NOTE: Make sure all particles of copper are removed from between the segments after a repair.

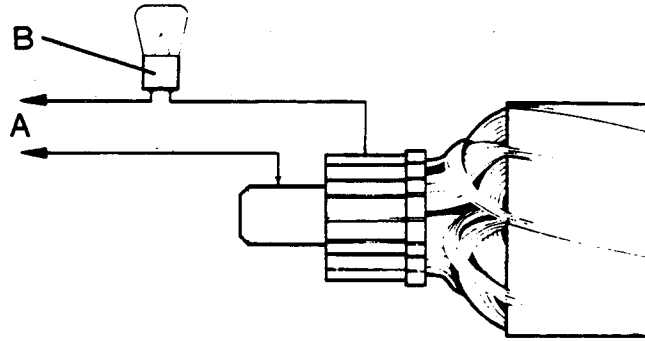


Figure H51  
CHECKING INSULATION OF ARMATURE WINDINGS  
A. 110 volt AC supply.  
B. 15 watt test lamp.

R7886

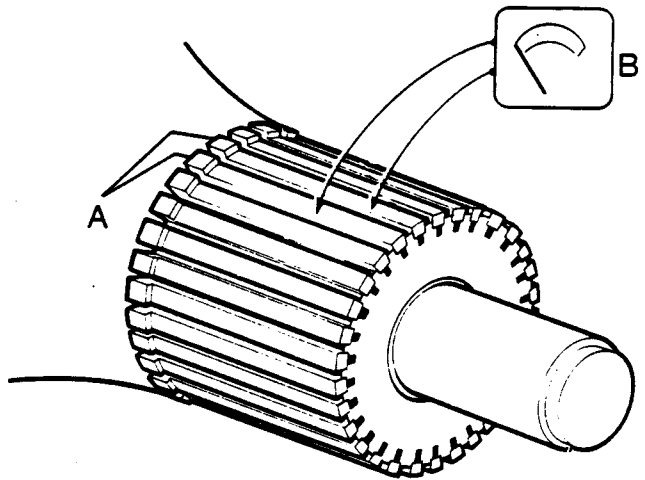
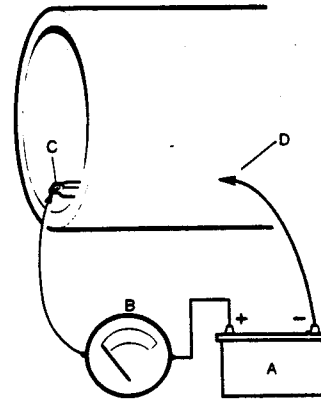


Figure H52  
CHECKING CONTINUITY OF ARMATURE WINDINGS  
A. Commutator segments.  
B. Ohmmeter.

R7887

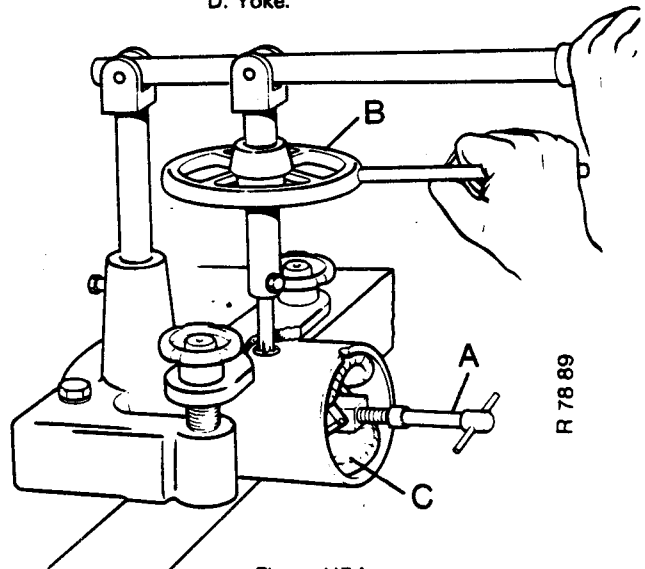
## Field Windings

1. Check the tightness of the pole shoe screws.
2. Make an inspection of the windings for any indication of contact with the armature.
3. Check for damage to insulation material.
4. Check for damage to the wire which connects the two windings together.
5. Check the windings for damage caused by heat. Install new windings if damage is found. Look for the possible cause before running the dynamo after assembly.
6. Connect an ohmmeter between the field winding connection and a good ground connection on the yoke. The resistance shown must be 6 ohms, if less look for a short circuit. If the reading is more, check for bad ground connection between the windings and the yoke.  
NOTE: This test can also be done by using an ammeter as shown in Figure H53. The reading will be 2 amperes if the windings are in good condition.
7. To remove the windings, use a drill to remove the rivet which connects the windings to the yoke. Then remove the screws which fasten the pole shoes to the yoke. Remove the windings and shoes.
8. When new windings are to be installed, clean and install old pole shoes to new windings. If a threaded terminal is used, this must be fastened to the new windings. Make a note of the arrangement and colour of the wires before disconnecting.
9. Use a shoe expander to install the shoes to the yoke as shown in Figure H54.
10. Install and tighten the screws which fasten the shoes to the yoke to 41Nm (4kgm) (30lbft).
11. Fasten the windings to the yoke with a new rivet.
12. The wire which connects the windings together must be set in the following positions. See Figure H55.
  - (a) If the wire has an insulation sleeve, put it in the position shown in Figure H55C.
  - (b) If the wire is without an insulation sleeve and is connected in the middle, set as in Figure H55C.
  - (c) If the wire is without an insulation sleeve and connected next to a winding, set as in Figure H55B.



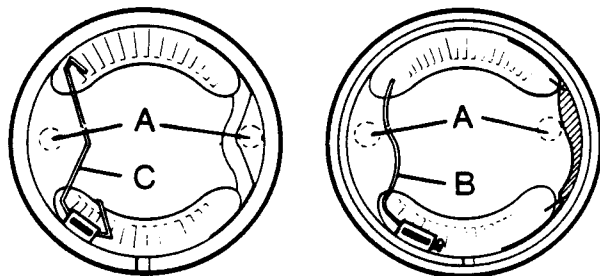
R 78 88

Figure H53  
CHECKING RESISTANCE OF FIELD WINDING  
A. 12 volt battery.  
B. Ammeter.  
C. Field terminal.  
D. Yoke.



R 78 89

Figure H54  
INSTALLING FIELD WINDINGS  
A. Field shoe expander.  
B. Wheel type screwdriver.  
C. Field windings.



R 78 90

Figure H55  
FIELD LINK POSITIONS  
A. Through bolts.  
B. Link wire early type.  
C. Link wire later type.

## BEARING REPLACEMENT

### Drive End

1. To check the condition of the drive end bearing do the following: Hold the drive end bracket complete with armature vertical and turn the armature by hand. Repeat this with the armature held horizontal.
2. To remove the bearing from the end bracket first remove the pulley nut. Remove the pulley and key from the shaft.
3. Press the shaft out of the end bracket.
4. Use a drill to remove the rivets which fasten the bearing retainer plate to the end bracket.
5. Use a hammer and punch to remove the rivets from the end plate.
6. Press the bearing out of the end plate.
7. Clean around the area and press the new bearing into the end bracket.
8. Use new rivets to install the bearing retainer plate.
9. Press the armature through the bearing of the end bracket as far as it can go.

10. Install the key, pulley, washer and nut to the shaft. Tighten the nut to a torque of 34Nm (3.5 kgm) (25 lbft).

### Commutator End

1. Put the new bush in engine oil for 24 hours.
2. Turn a  $\frac{5}{8}$ in thread tap into the old bush and pull the bush out of the end bracket.
3. Remove the disc and felt oil pad from the bush hole; clean the hole.
4. Apply engine oil to the felt pad and install with the disc into the end bracket.
5. Use a mandrel with a shoulder to press the new bush into the end bracket. The mandrel must be 0.002in larger than the armature shaft.

DO NOT put a reamer through the bush after it has been installed. This will decrease the lubrication quality of the bush.

## ASSEMBLY

1. Install the armature complete with drive end bracket and pulley into the yoke.
2. Install the end bracket to the commutator end.

On the C40A type, hold the brushes up in the holders with the springs as shown at A, Figure H56. Push the bracket on to the armature, pull the springs up on to the top of the brushes.

Use the special tool shown in Figure H57 for this purpose.

On the C40T type, hold the brush pivot arms outwards with your fingers, while you push the bracket on. Release the arms slowly when the brushes are over the commutator.

3. Make sure both end brackets are correctly installed. Install the two through bolts and tighten to 8Nm (0.8kgm) (6 lbft).
4. Check the output, see FAULT FINDING, page H30.
5. If test equipment is not available check the dynamo as follows:

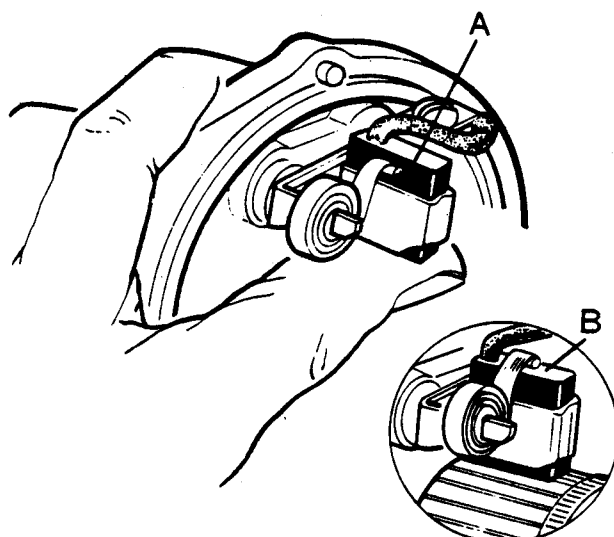
Make a connection between the field and output terminals. Then connect these to the positive terminal of a 12 volt battery. Connect the negative of the battery to a good ground connection on the yoke.

If assembled correctly the dynamo will run as a motor.

**IMPORTANT:** Make sure the polarity is correct before making the connections.

6. To correct the polarity of a dynamo fitted to a tractor use the following procedure:

Connect a jumper wire to the battery positive terminal. Put the other end of the wire against the field terminal several times. Hold it in contact with the terminal for part of a second only, each time.



R 7891

Figure H56  
INSTALLING BRUSHES BEFORE FITTING END PLATE  
C40A DYNAMO

A. Brush held with spring.  
B. Brush in working position.

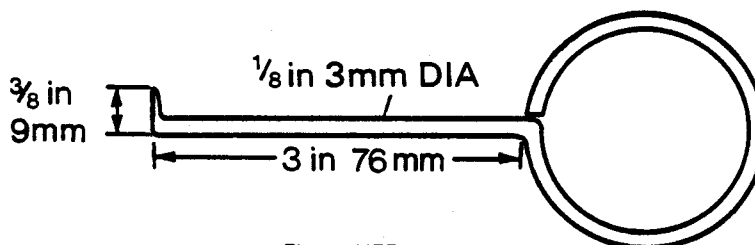
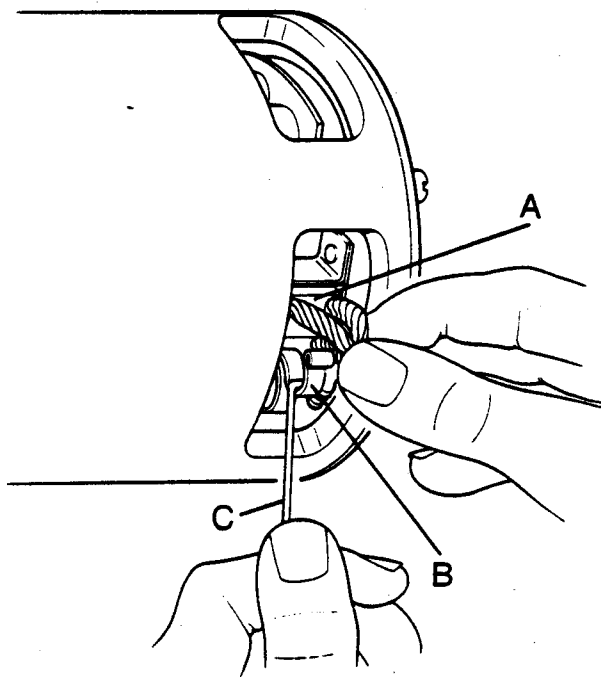


Figure H57  
BRUSH SPRING HOOKING TOOL

R 7892



R 7893

Figure H58  
USING BRUSH SPRING TOOL  
A. Brush. B. Spring. C. Tool.

## VOLTAGE REGULATOR

Tractors with the Lucas C40A dynamo installed, use the Lucas RB108, Despatch number 37394A or 37398A. David Brown Part number K90890. Tractors with the Lucas C40T dynamo installed use the Lucas RB108, Despatch number 37467. David Brown Part number K928729.

### MAINTENANCE

The only maintenance needed is a regular check of the connections, especially the wire between 'E' and ground.

The regulator will not operate correctly if there is a bad connection to ground. The result of this can be an increase in the operating temperature of the dynamo, causing damage. The charge rate will also increase to more than the battery needs.

### TEST AND REPAIR

Before doing the following tests and adjustments do tests in the FAULT FINDING section. If the fault is not corrected, proceed as follows:

1. Remove the four wires and two fastening screws. Remove the regulator from the tractor.
2. Remove the regulator cover by bending the edge of the cover away from the baseplate.
3. Remove any dust with a dry brush. Use methylated spirits to remove dirt which cannot be removed with a dry brush, if necessary.
4. Clean the voltage regulator contacts with a smooth carborundum stone or silicon carbide paper, if necessary.
5. Clean the cut-out contacts with a fine glass paper. DO NOT use emery cloth or a carborundum stone.

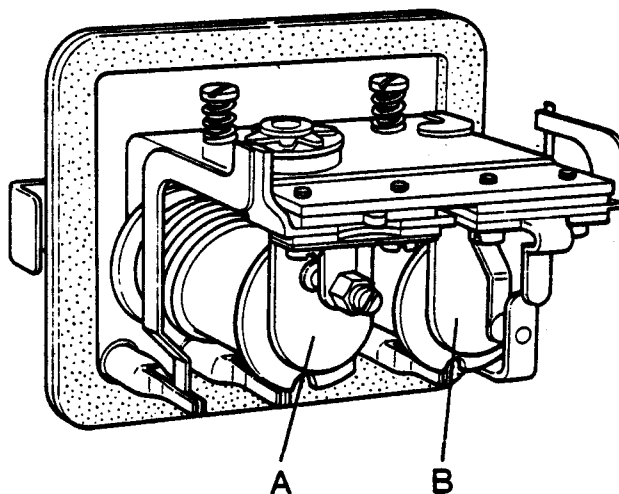


Figure H59  
RB108 VOLTAGE REGULATOR  
A. Regulator armature.  
B. Cut out armature.

**Regulator Contacts Gap**

This is set by the manufacturer and normally does not need setting. If it is necessary to set the gap, use the following procedure.

1. Loosen the fixed contact locknut F and turn the fixed contact screw B counter-clockwise away from the armature C.
2. Loosen the screws A which fasten the armature.
3. Put a feeler gauge D of 0.50mm (0.020in) thickness between the armature and the coil core face.
4. Press the armature down against the feeler gauge and tighten the screws A which fasten the armature.
5. With the feeler gauge still in position, turn the fixed contact screw B clockwise. Continue turning until the fixed contact is just against the armature. Lock the fixed contact in this position with the locknut.
6. Reset the voltage adjustment screw E.

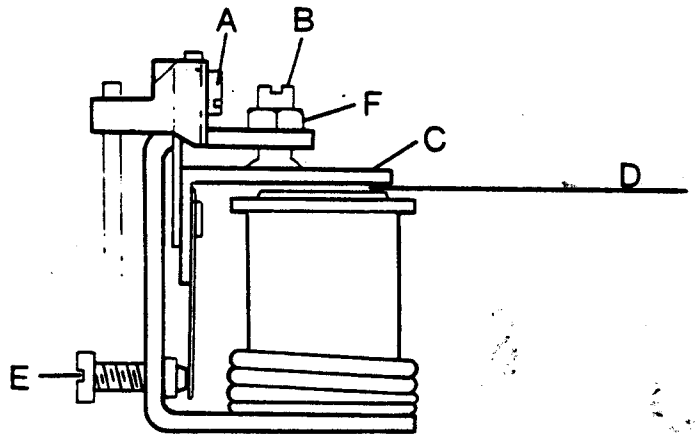


Figure H60  
REGULATOR GAP SETTING  
A. Armature fastening screws.  
B. Fixed contact.  
C. Armature.  
D. Feeler gauge.  
E. Voltage adjustment screw.  
F. Fixed contact locknut.

**Cut-out Contacts Gap**

This is also set by the manufacturer but can be set as follows if necessary:

1. Loosen the screws A which fasten the cut-out armature C.
2. Press the armature down against the coil core face and tighten the fastening screws.
3. Hold the armature down in this position and measure the gap F between the armature and the stop arm D. The gap must be 0.60–1.01mm (0.025–0.040in) and can be adjusted by bending the stop arm.
4. Release the armature and measure the gap F between the cut-out contacts. This must be 0.25–0.51mm (0.010–0.020in) and can be adjusted by bending the fixed contact blade B.
5. Reset the voltage adjustment screw E.

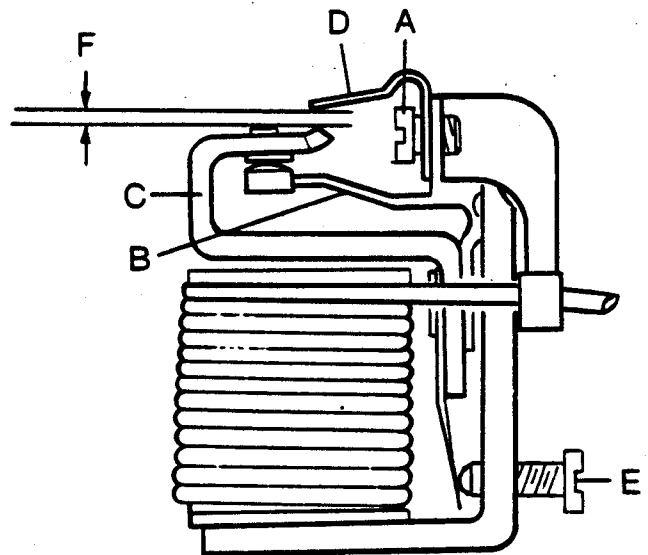


Figure H61  
CUT-OUT GAP SETTING  
A. Armature fastening screws.  
B. Fixed contact blade.  
C. Armature.  
D. Stop arm.  
E. Voltage adjustment screw.  
F. Gap.



**Cut-out Adjustment**

1. Connect a voltmeter A between the voltage adjustment screw B on the cut-out and a good ground connection.
2. Start the engine and gradually increase speed. The voltage must increase to 12.7 to 13.3 volts and then decrease a small amount.
3. Make a note of the voltage at which the voltage decreases. If this is not between 12.7 and 13.3 volts adjust by turning the adjustment screw B.
4. Check the cut-in voltage again after the adjustment has been made. Let the engine run at idle speed and then increase the speed gradually until the voltage decreases.
5. Disconnect the wire from the 'A' terminal and make sure it does not connect with ground.
6. Connect a voltmeter A between the 'A' terminal and a good ground connection.
7. Start the engine and increase the speed to 1500 r/min, then decrease speed slowly and read the voltmeter.
8. Make a note of the voltage at which the needle returns to zero. This is an indication of the cut-out contacts opening and must occur at 8.5 to 10 volts.
9. If the contacts open outside these limits, remove the cover. Bend the fixed contact blade B, Figure H61, page H41. Bend the blade towards the armature to decrease the voltage at which the contacts open. Bend the blade away from the armature to increase the voltage at which the contacts open.
10. When all adjustments have been completed and all voltages are correct, reconnect the wire to the 'A' terminal. Put the cover in position and bend the edges over the base-plate.

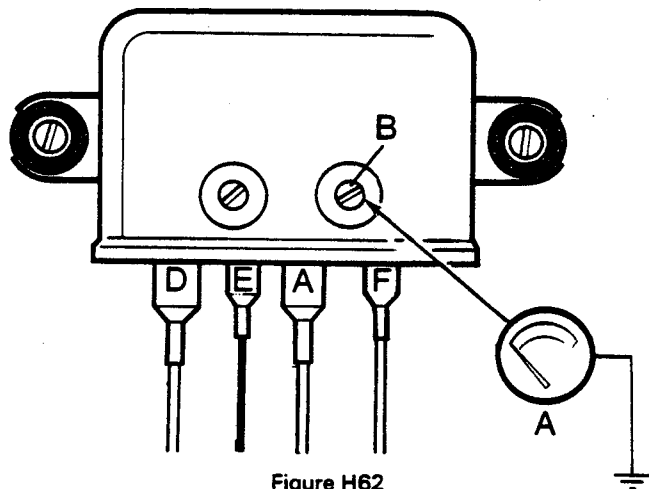


Figure H62  
CHECKING CUT-IN SETTING OF CUT-OUT  
A. Voltmeter.  
B. Cut out adjustment screw.

R78.97

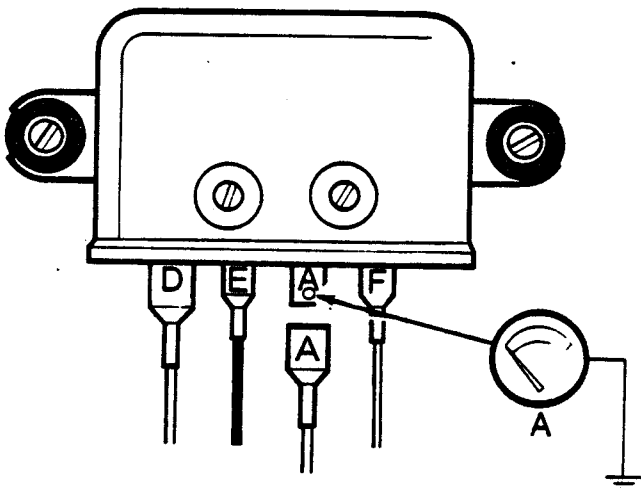


Figure H63  
CHECKING CUT-OUT DROP-OFF VOLTAGE  
A. Voltmeter.

R78.98

**Regulator Voltage Adjustment.**

If a test bench is not available, install the regulator on the tractor and use the following procedure.

1. Make sure all connections are clean and tight, especially the ground wire connections.
2. Remove the wire to the 'A' terminal. Make sure it is prevented from making contact with ground.
3. Start the engine and run it at 1500 r/min.
4. Connect a voltmeter B between the regulator adjustment screw D and a good ground connection.
5. Turn the adjustment screw E clockwise to increase the voltage and counter-clockwise to decrease it.
6. The voltage must be set to the following values shown:
 

Air Temperature	Voltage:
10° Celcius (50° Fahrenheit)	Open Circuit 16.1 to 16.7
20° Celcius (68° Fahrenheit)	16.0 to 16.6
30° Celcius (86° Fahrenheit)	15.9 to 16.5
40° Celcius (104° Fahrenheit)	15.8 to 16.4

NOTE: Do the adjustment as fast as possible or the coils will generate heat and change the readings.
7. When the voltage is correct, stop the engine. Start the engine again after a short period and check the voltage. If it is still correct reconnect the 'A' terminal wire.

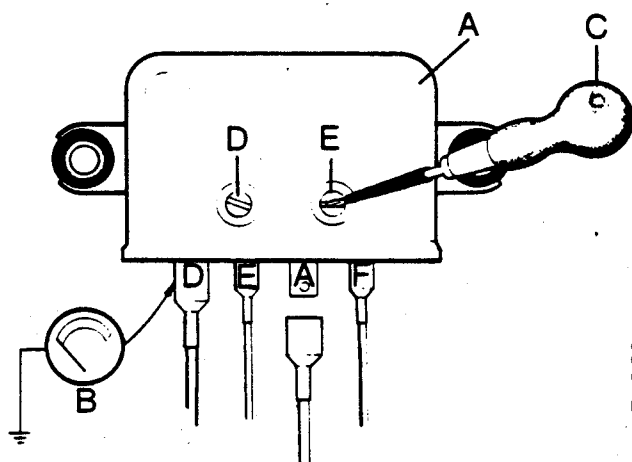


Figure H64  
CHECKING DYNAMO OPEN-CIRCUIT VOLTAGE  
A. Voltage regulator.  
B. Voltmeter.  
C. Screwdriver with insulation on the blade.  
D. Regulator adjustment screw.  
E. Cut-out adjustment screw.

R78.99

# STARTER

## HOW IT WORKS

### Lucas M.50 Model

Before the starter can be operated the starter safety switch has to be closed. This is done by putting the range lever (Hydra-Shift) or gear lever (Syncromesh) in the neutral position.

When the starter-key is turned to the START position battery current energises the solenoid coils. The solenoid plunger A is retracted and the pinion B is engaged with the flywheel ring gear C.

The solenoid has two sets of contacts. The first set D to close are connected to only one field-winding E. The second set F is connected to the other three. If the teeth of the pinion and flywheel are not aligned only the first set close. This gives enough power to turn the armature to align the teeth. The engagement spring G then engages the pinion with the flywheel and closes the second contacts. With both contacts closed full power is available to turn the engine.

When the starter key is released the current to the solenoid is interrupted and the plunger is released. The return spring H disengages the pinion from the flywheel and opens both sets of contacts.

To prevent the engine turning the starter when the key is released a one-way clutch is installed. This is part of the pinion assembly and has rollers which lock in one direction only, Figure H69.

To stop the starter as soon as the key is released a centrifugal brake is installed. Two shoes are fastened to the commutator end of the armature with springs. The shoes move outwards and make contact with end plate as the armature speed increases. The brake also prevents the starter speed increasing above a set rate if the load is low.

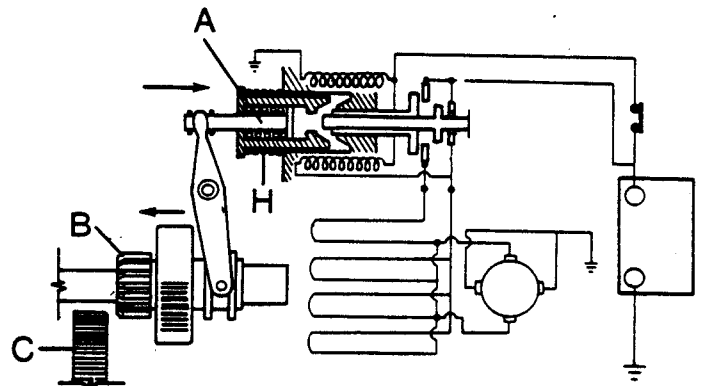


Figure H65  
PINION DISENGAGED

A. Plunger.  
B. Drive pinion.  
C. Flywheel gear.

R78.100

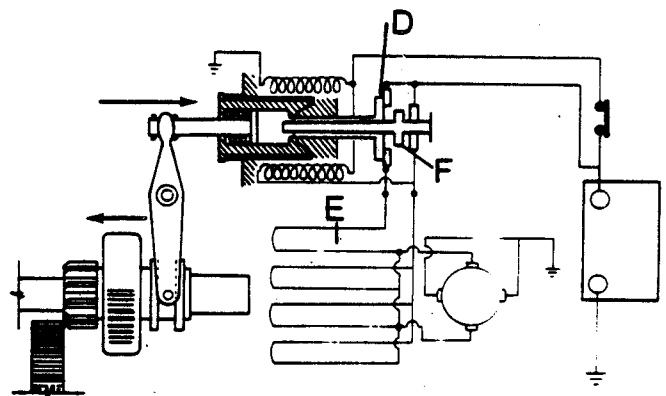


Figure H66  
TOOTH TO TOOTH CONTACT

D. First contacts.  
E. Field winding.  
F. Second contacts.

R78.101

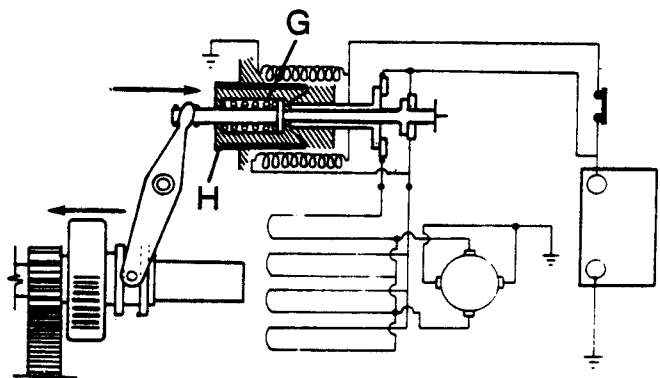


Figure H67  
PINION ENGAGED  
G. Engagement spring.  
H. Return spring.

R78.102

### Lucas M45 Model

Before the starter will operate the safety switch must be closed. This is done by putting the range lever (Hydra-Shift) or gear lever (Synchromesh) in the neutral position.

After the safety switch A has been closed the starter key B is turned to the START position. Battery current then energises the solenoid coil C which retracts the plunger D.

As the plunger is retracted it engages the pinion with the flywheel ring gear. When the plunger is fully retracted it closes a set of contacts E. Battery current now goes to the armature and field windings F. Full power is available to turn the engine.

If the teeth of the pinion and flywheel are not aligned the engagement spring coils close. The plunger can then complete the movement to close the contacts to give current to turn the armature. The engagement spring engages the pinion when the teeth are aligned. A one-way clutch prevents the engine turning the starter when the engine starts, see Figure H69.

Early starters had multi-plate clutches but later models have a roller type, as installed on the M50 model.

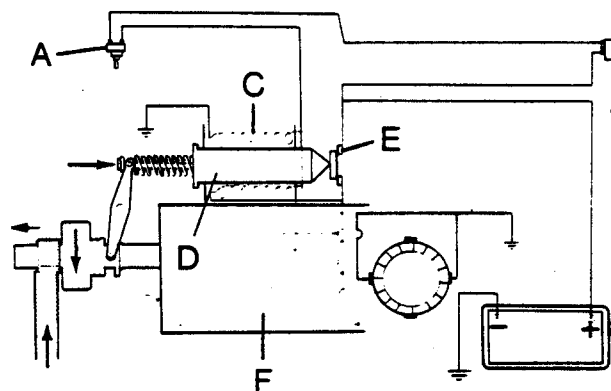


Figure H68  
LUCAS M45G STARTER

- |                      |                    |
|----------------------|--------------------|
| A. Safety switch.    | D. Plunger.        |
| B. Starter switch.   | E. Contacts.       |
| C. Solenoid winding. | F. Field windings. |

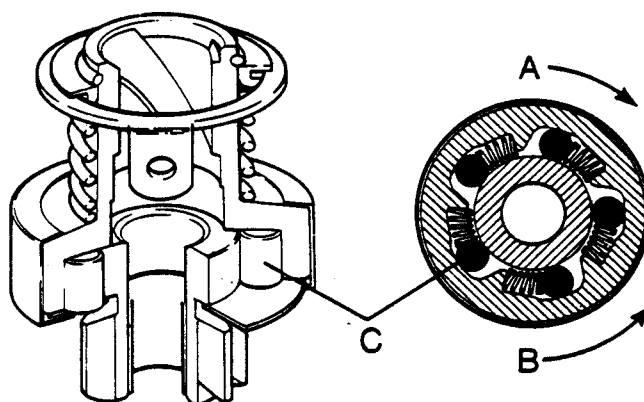


Figure H69  
ROLLER CLUTCH ASSEMBLY

- |                    |
|--------------------|
| A. Lock direction. |
| B. Free direction. |
| C. Rollers.        |

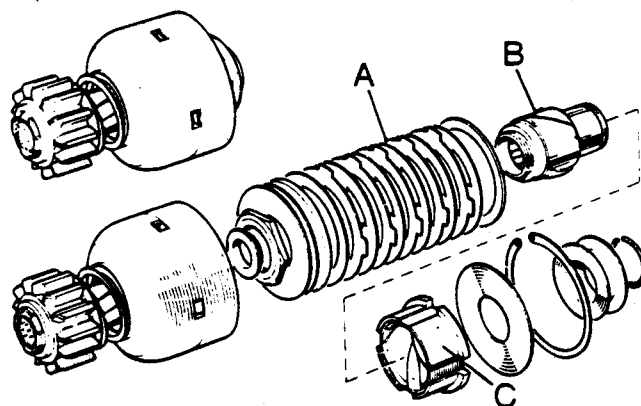


Figure H70  
PLATE CLUTCH ASSEMBLY

- |                   |
|-------------------|
| A. Clutch plates  |
| B. Driving sleeve |
| C. Moving member  |

**Starter for Gasoline Engine**

The safety switch A is closed with the gear lever in neutral. When the ignition key B is turned to START battery current energises the solenoid C and closes a set of contacts D. Current then goes through the contacts to the armature E and field windings F to give full power.

The pinion is not directly connected to the armature but moves along a spiral sleeve on the armature. The sleeve has a large external spiral which fits an internal spiral of the pinion. When the armature turns, the sleeve turns and the pinion moves along the sleeve towards the flywheel. The sleeve is prevented from moving along the armature shaft by a strong spring. This spring absorbs any shocks when the pinion first engages the flywheel.

When the starter key is released the armature stops turning. The flywheel moves the pinion along the sleeve in the opposite direction until it disengages.

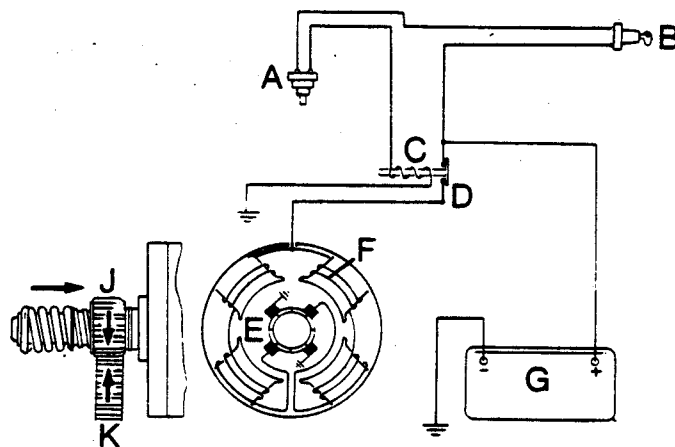


Figure H71  
STARTER CIRCUIT GASOLINE ENGINE

- |                    |                     |
|--------------------|---------------------|
| A. Safety switch.  | F. Field windings.  |
| B. Starter switch. | G. Battery.         |
| C. Solenoid.       | J. Pinion assembly. |
| D. Contacts.       | K. Flywheel gear.   |
| E. Armature.       |                     |

R 78.106

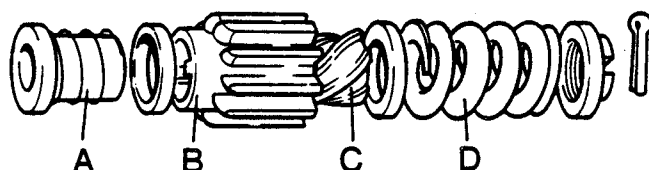


Figure H72  
DRIVE PINION ASSEMBLY

- |                        |
|------------------------|
| A. Anti rattle spring. |
| B. Drive pinion.       |
| C. Spiral sleeve.      |
| D. Drive spring.       |

R 78.107

## FAULT FINDING

Make sure the battery has a full charge and that all connections are clean and tight before starting the tests.

Before operating the starter:

- (a) Put the gear-lever (Synchromesh) or range-lever (Hydra-Shift) in the neutral position.
- (b) Put the engine stop control in the stop position.

### TEST 1: Switch Circuit

If the starter does not operate when the starter switch is turned to START proceed as follows:

1. Connect a new switch in between the solenoid and the battery positive terminal as shown in Figure H73.
2. Close the switch; if the starter works check for dirty, loose or broken connections in the switch circuit.
3. Check the starter switch and safety switch for correct operation if all wires and connections are correct.
4. Install new switches if necessary and test again.
5. If starter turns slowly do the next test.

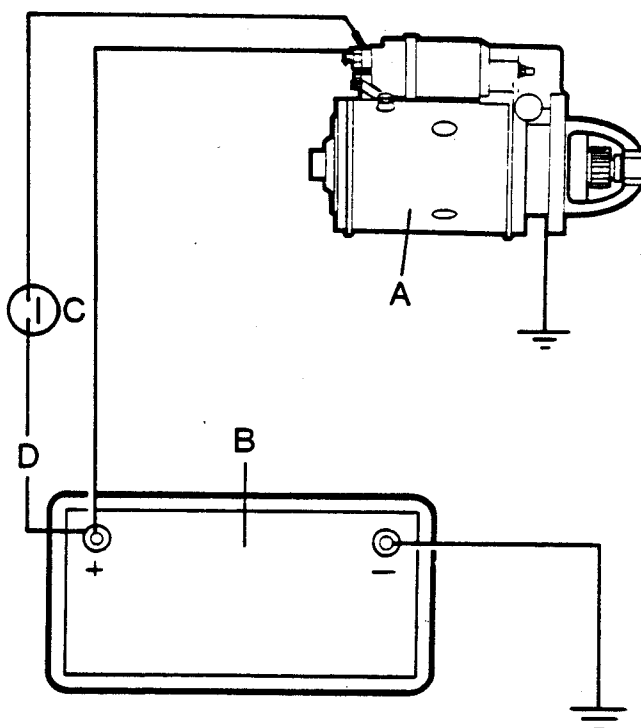


Figure H73  
CHECKING STARTER SWITCH CIRCUIT  
A. Starter motor.  
B. Battery.  
C. New switch.  
D. Jumper wire.

R 78.108

### TEST 2: Battery Voltage

1. Connect a voltmeter between the battery posts, not the cable terminals.
2. Operate the starter by turning the starter key. The voltmeter must show 9.5 to 10.5 volts, with the engine warm.
3. If the voltage is less than 9.5 volts or the starter turning speed is still slow do the next test.

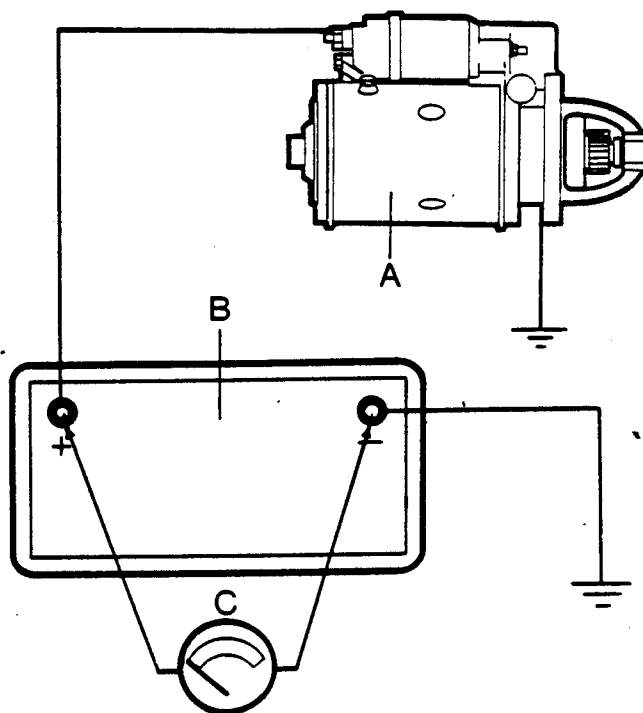
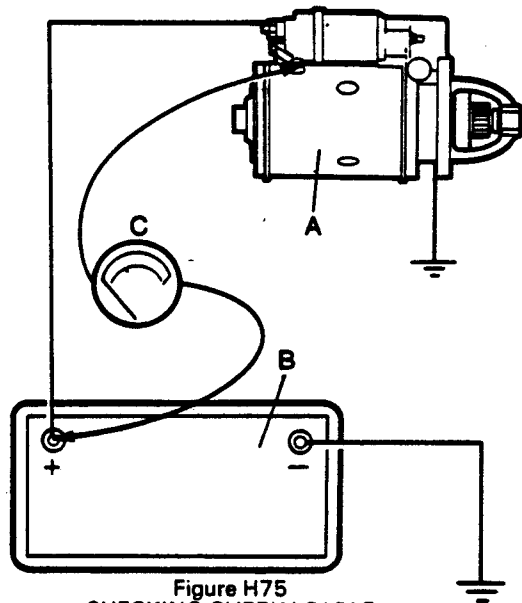


Figure H74  
CHECKING BATTERY VOLTAGE WITH LOAD  
A. Starter motor.  
B. Battery.  
C. Voltmeter.

R 78.109

**TEST 3: Starter Cable**

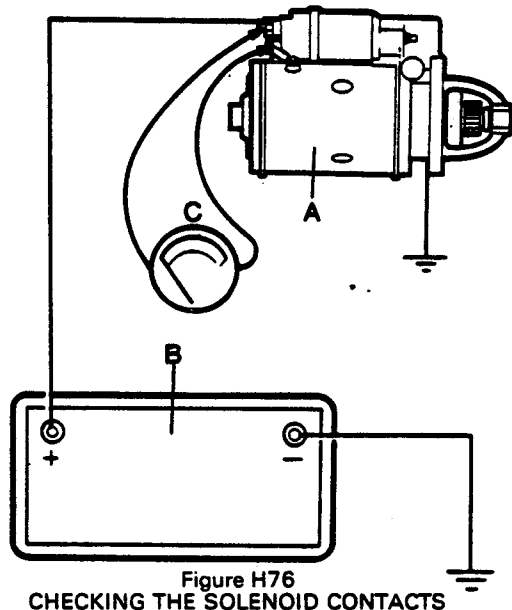
1. Connect the voltmeter between the insulated terminal on the starter body and the battery positive post as shown.
2. Turn the starter key to the 'ACC' position. The voltmeter must show battery voltage.
3. Operate the starter and read the voltmeter. If the voltmeter now shows more than 0.5 volts check all battery, starter and solenoid connections. Make sure a cable of the correct capacity has been installed.



R 78.110

**TEST 4: Solenoid**

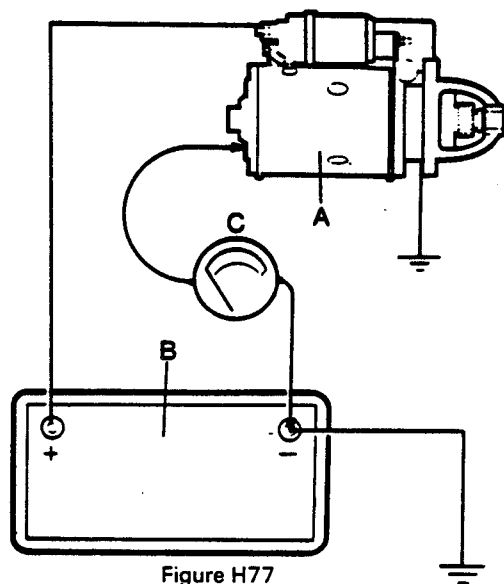
1. Connect a voltmeter between the solenoid terminals as shown.
2. Operate the starter and read the voltmeter. The voltmeter must show zero when the starter is operating. If the meter shows a voltage, the solenoid contacts must be checked.



R 78.111

**TEST 5: Ground Connections**

1. Connect a voltmeter between the battery ground post and the commutator end bracket as shown.
2. Operate the starter and read the voltmeter. If more than 0.5 volts are shown, check the connections from the starter and battery to ground.
3. If tests show that the wiring and battery are correct, remove the starter for more checks. See MAINTENANCE AND REPAIR.



R 78.112

A. Starter motor.  
B. Battery.  
C. Voltmeter.

## MAINTENANCE AND REPAIR

### TYPES AND TRACTORS

Lucas M50, 1412 and 1410 tractors. Despatch Number 26379A. David Brown Part Number K919752.

Lucas M45, 1212, 1210, 996, 995, 990 tractors. Despatch Number 26278. David Brown Part Number K89772.

Lucas M45, 880, 780, 885 tractors with diesel engines. Despatch Number 26215. David Brown Part Number K913007.

Lucas 3M100, 885 tractor with gasoline engines — from January 1973. Despatch Number 25679A. David Brown Part Number K944488.

Lucas M45G, 4600, 3800, and 885 tractors to December 1972. Despatch Number 26277. David Brown Part Number K922703.

Bosch 0-001-362-060, all 4cyl models from August 1977, not all tractors. David Brown Part Number K954700.

### MAINTENANCE

Check the tightness of the bolts which fasten the starter motor to the engine.

Make sure the connections are clean and tight.

NOTE: Lubrication is not needed while the starter is in use.

### DISASSEMBLY

#### Lucas M50 and M45

1. Disconnect the battery and remove the starter from the tractor.
2. Remove the link A which connects the starter to the solenoid R.
3. Remove the nuts and washers or Bolts B which fasten the solenoid to the starter.
4. Pull the solenoid away from the starter. Disconnect the engagement fork K from the end of the plunger C. Remove the solenoid from the starter.

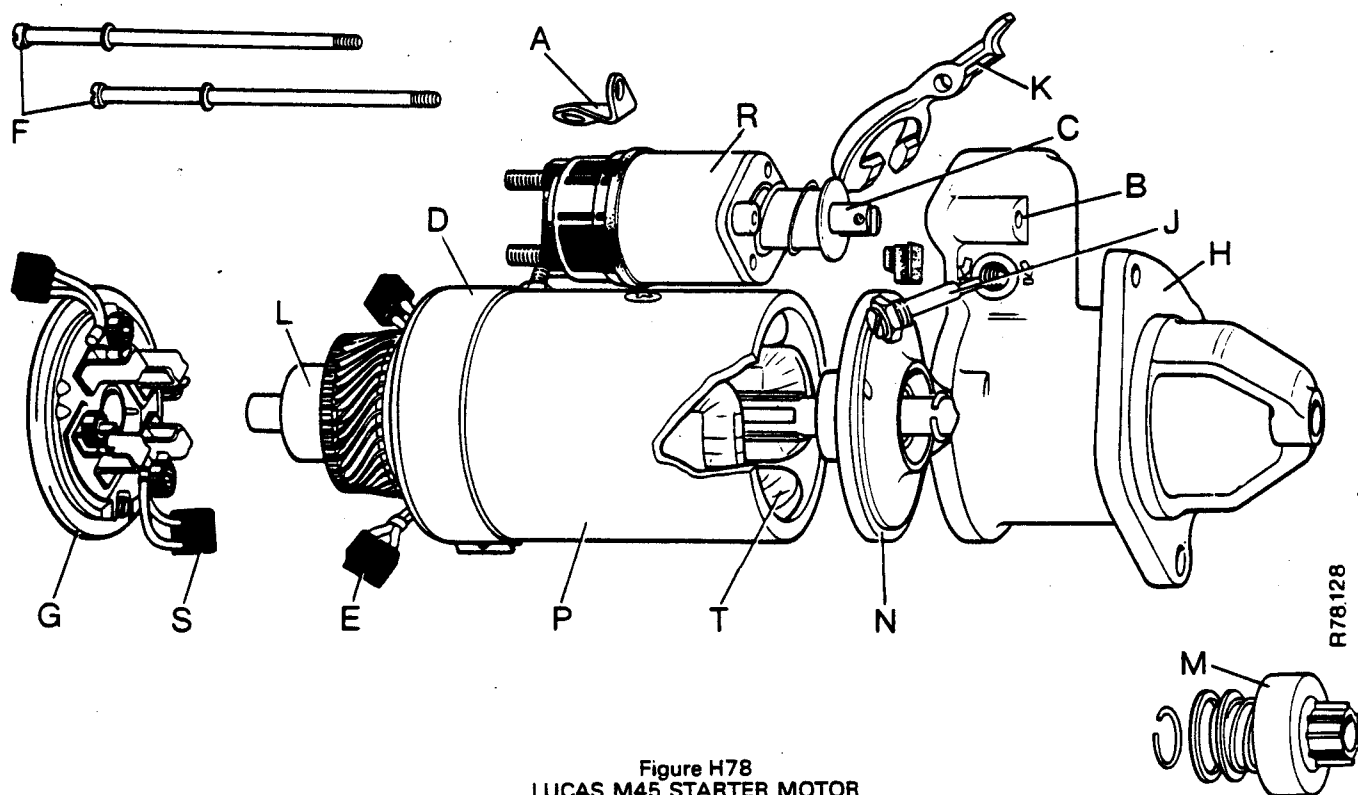


Figure H78  
LUCAS M45 STARTER MOTOR

- |                            |                          |
|----------------------------|--------------------------|
| A. Link to solenoid.       | K. Engagement fork.      |
| B. Bolts to solenoid.      | L. Armature.             |
| C. Solenoid plunger.       | M. Drive assembly.       |
| D. Metal band.             | N. Intermediate bracket. |
| E. Field brush.            | P. Yoke.                 |
| F. Through bolts.          | R. Solenoid.             |
| G. Commutator end bracket. | S. Ground brush.         |
| H. Drive end bracket.      | T. Field windings.       |
| J. Pivot pin.              |                          |



5. On the M45 types, remove the metal band D from the yoke. Remove the field brushes E from the holders. Remove the two bolts F which hold the assembly together and remove the end bracket G.

On the M50 type, first remove the two bolts F which go through the starter to hold the assembly together. Move the end bracket G away from the yoke and pull the field brushes D out of the holders. Remove the end bracket G.

6. Remove the brake shoe assembly and thrust washers from the end bracket. Make a note of the positions of the washers for correct assembly.
7. Remove the rubber seal from the commutator bracket on the M50 type.

8. Loosen the locknut of the pivot pin J for the engagement fork K. Use a screwdriver to remove the pin from the end bracket H.
9. Remove the end bracket H and the engagement fork K.
10. Remove armature L complete with drive assembly M and intermediate bracket N from the yoke P.
11. Hold the armature in a vice with soft jaws. Push the thrust collar away from the circlip at the drive end.

Remove the circlip and remove the thrust collar and drive assembly from the shaft.

12. Remove the intermediate bracket and any shims from the armature shaft. Keep the shims safe for correct assembly.
13. Clean all parts ready for checking.

### Lucas M45G Starter

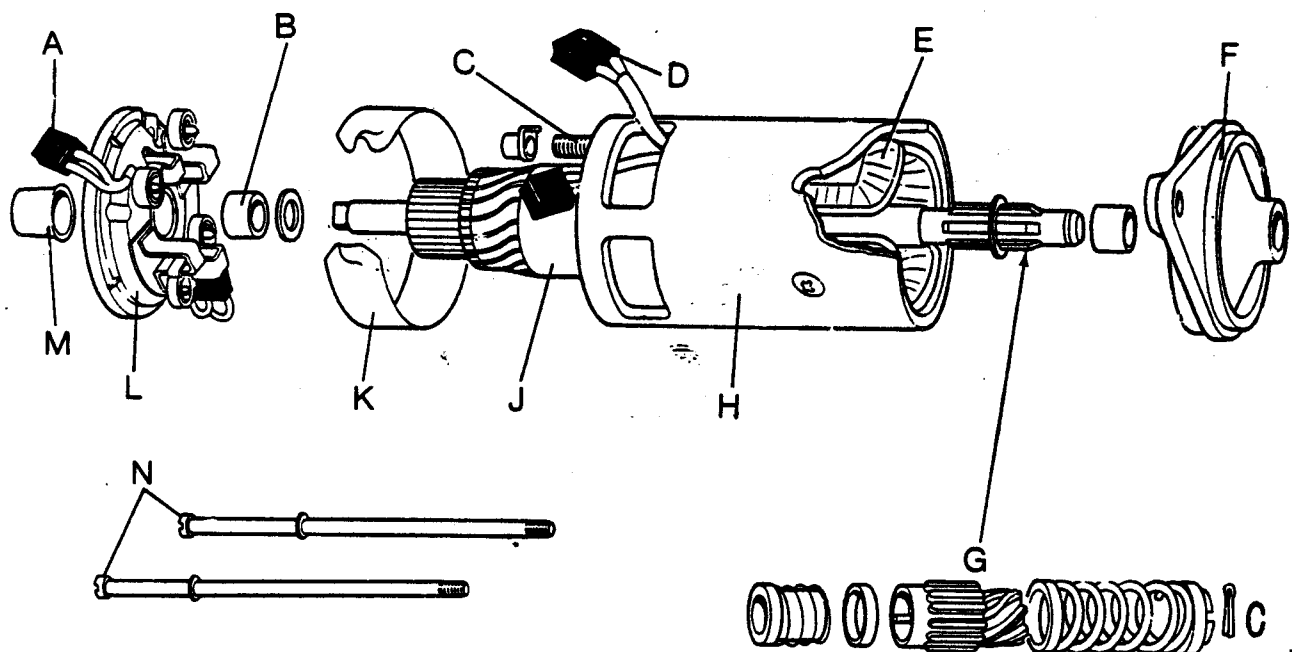


Figure H79  
LUCAS M45G TYPE STARTER MOTOR

- |                       |                            |
|-----------------------|----------------------------|
| A. Ground brush.      | H. Yoke.                   |
| B. Bush bearing.      | J. Armature.               |
| C. Field terminal.    | K. Metal band.             |
| D. Field brush.       | L. Commutator end bracket. |
| E. Field winding.     | M. Cap.                    |
| F. Drive end bracket. | N. Through bolts.          |
| G. Drive assembly.    |                            |

R78114

**Lucas 3M100 Starter**

1. Disconnect the battery and starter. Remove the starter from the tractor.
2. Remove the cap A over the end of the shaft in the commutator end bracket D.
3. Use a small, sharp chisel to remove the claws of the retainer ring B on the end of the shaft. Remove the ring.
4. Remove the terminal nut and washers C.
5. Remove the two bolts which holds the starter assembly together.
6. Separate the end bracket D at the commutator end from the yoke E. Remove the two field brushes F from the holders. Remove the end bracket D completely.
7. Remove the bracket G, drive assembly and armature M complete, from the yoke E.
8. Remove the retainer ring H from the end of the drive shaft. Remove the collar J, spring K and drive assembly L.

NOTE: Some starters have a split pin and nut at the end of the shaft.

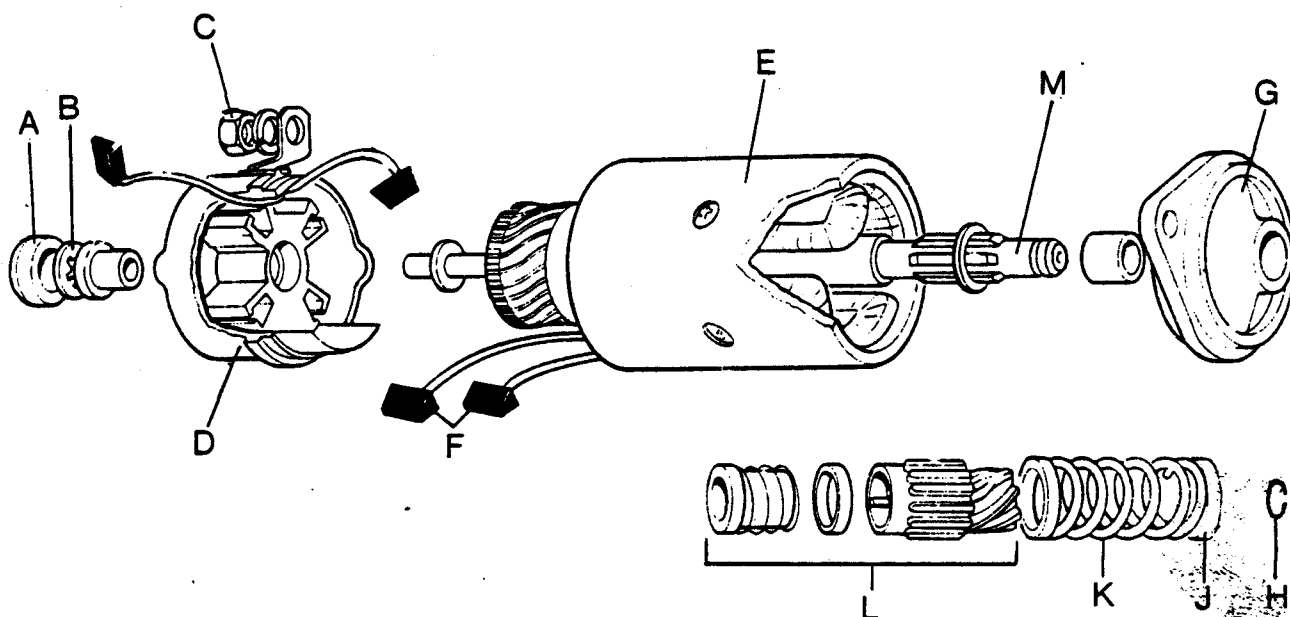


Figure H80  
LUCAS STARTER MOTOR TYPE 3M100

- A. Cap.
- B. Retainer ring.
- C. Terminal nut and washers.
- D. Commutator end bracket.
- E. Yoke.
- F. Field brushes.
- G. Drive end bracket.
- H. Retaining ring drive assembly.
- J. Thrust collar.
- K. Drive spring.
- L. Drive assembly.
- M. Armature.

R78115

## TEST AND REPAIR

## Brushes

1. Measure the length of each brush. If less than 14mm ( $\frac{9}{16}$ in) on M50 and M45 types or 9.5mm ( $\frac{3}{8}$ in) on 3M100 type, install new brushes.
2. Use a soldering iron to install new ground brushes on to the end bracket.
3. To install new field brushes, first cut the brush wires 3mm ( $\frac{1}{8}$ in) from the connection to the field. Open the loop of the new brush and put solder on it. Put solder on the end of the field wire. Put the cut end through the loop of the brush wire and close the loop with pliers. Complete the connection by heating with a soldering iron.
4. Make sure the brushes can move easily in the holders. Clean brushes and holders if necessary.
5. Check the pressures of the brush springs as shown in Figure H81. If the pressure is less than 1.22kg (43oz) M50 and M45 types or 1.02kg (36oz) 3M100 type, install new springs.
6. On 3M100 type starter remove the springs with long nose pliers. To install new springs, close the coils of the spring and put it down into the holder. Move the spring in to the operating position with a small screwdriver.

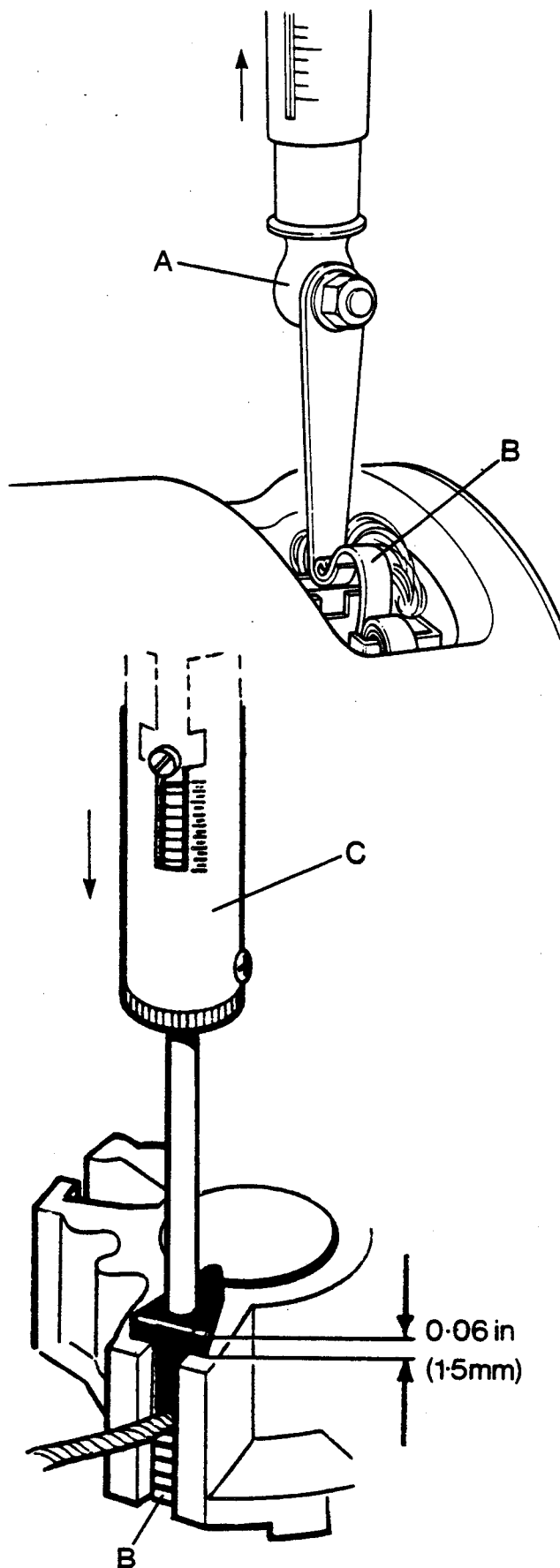


Figure H81  
CHECKING BRUSH SPRING PRESSURE  
A. Pull type gauge for M50 and M45 starters.  
B. Brush springs.  
C. Push type gauge for 3M100 starter.

7. To check the field brush holder insulation on the M45G type, use a 110 volt supply. Connect the supply to the end bracket and a 15 watt test lamp to the holder. Repeat on the other holder. The lamp must not illuminate.
8. Check the spring insulation of the 3M100 type as follows. Connect the supply to the end bracket and the test lamp to the spring. Repeat on the other spring. The lamp must not illuminate.

NOTE: Make sure the brush wires do not contact the bracket during the test.

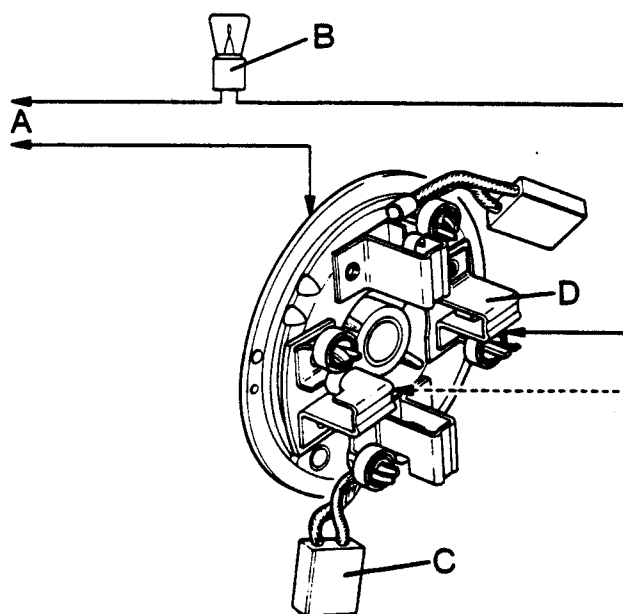


Figure H82  
TESTING BRUSH HOLDER INSULATION  
A. 110 volt AC supply.  
B. 15 watt test lamp.  
C. Earth brush.  
D. Brush holder.

R78.118

### Commutator

1. Clean the surface with a small amount of petrol on a cloth.
2. Use a fine glass paper to remove small amounts of damage.
3. If the damage can not be removed by glass paper, use a lathe. Run the lathe at a fast speed and take the smallest cut possible. Make sure the cutting tool is sharp.

DO NOT decrease the diameter of the M50 and M45 commutators to less than 38.1mm (1.50in).

DO NOT decrease the thickness of the segments on the 3M100 type commutator to less than 3.5mm (0.140in).

Use a fine glass paper to get a smooth finish after cutting.

DO NOT cut the insulation below the segments.

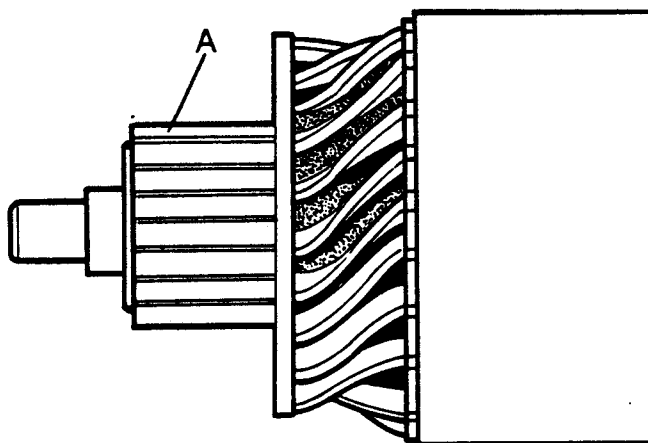


Figure H83  
COMMUTATOR  
A. Type used on M50 and M45 starters.

R78.119

**Field Windings**

1. Make an inspection of the inside of the yoke. Look for any indication of the armature making contact with the windings.
2. Look for burn marks on the insulation of the windings. This shows a high operating temperature. Look for cause before you install new windings.
3. Check the insulation on the M50 starter by connecting a 110 volt supply A to the field terminal D. Connect a 15 watt test lamp B to a clean connection on the yoke E. Make sure the brushes C do not contact the yoke during the test. The lamp must not illuminate.

On the M45G type starter connect the supply to the yoke and the lamp to each brush one at a time. Then connect the lamp to the field terminal. The lamp must not illuminate. Make sure the brush wires do not contact the yoke during the test.

On the 3M100 type starter the rivet which connects the windings to the yoke must be removed. Make sure the test is necessary before removing this rivet.

After the rivet has been removed, connect a test lamp to the end which has been disconnected. Connect the supply to a clean part of the yoke. The lamp must not illuminate.

4. To remove the field windings, first remove the rivet from the 3M100 type starter with a drill. Then remove the four screws which fasten the pole shoes to the yoke.
5. Clean the inside of the yoke and put the new windings in position. Install the screws but do not tighten.
6. Install the through bolt insulation pieces and tighten the screws to a torque of 41Nm (4kgm) (30lbft).

NOTE: Put the insulation pieces at 180 degrees to each other and at 90 degrees to the field brushes.

7. Install a new rivet on the 3M100 type starter.

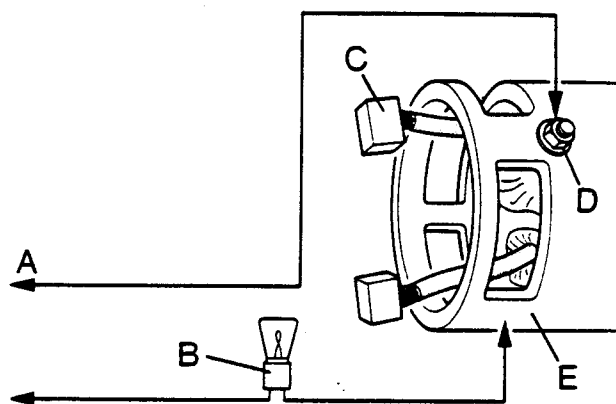


Figure H84  
TESTING FIELD WINDING INSULATION  
A. 110 volt AC supply.  
B. 15 watt test lamp.  
C. Field brushes.  
D. Field terminal.  
E. Yoke.

R78.120

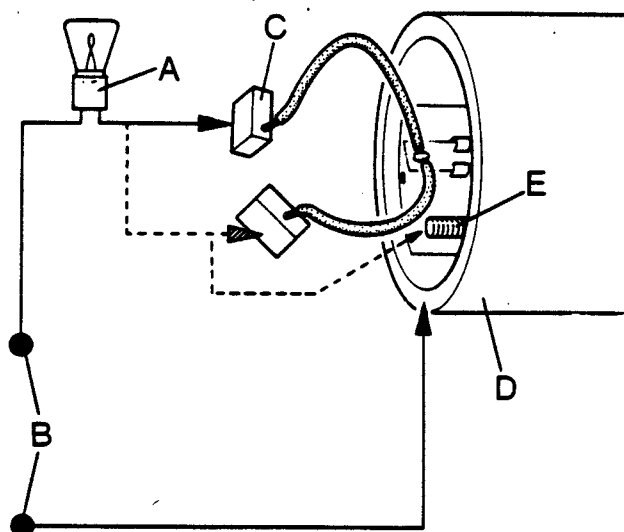


Figure H85  
M45 STARTER

- A. 15 watt test lamp.  
B. 110 volt AC supply.  
C. Field brush.  
D. Yoke.  
E. Field terminal.

R 21

**Bearings: Bush Type**

1. Measure the internal diameter of the bearings.

If more than the following, install new bearings.

M50	Commutator end	12.83mm (0.505in)
and	Intermediate	28.63mm (1.127in)
M45	Drive end	17.14mm (0.675in)

3M100 Commutator end 11.2mm (0.441in)

type Drive end 12.1mm (0.476in)

NOTE: Put bushes in clean engine oil for 24 hours before installing.

2. Remove old bearings from the end brackets.
3. Use a mandrel which has a shoulder and which fits into the bearing with a small clearance. Install the new bearings.

Mandrel sizes for M50 and M45 starters are as follows:

Commutator end 12.71mm (0.5005in)

Intermediate 28.52mm (1.123in)

Drive end 17.03mm (0.6705in)

**IMPORTANT:** Do NOT put a reamer through the bushes after installing. This will decrease the lubrication quality of the bearing.

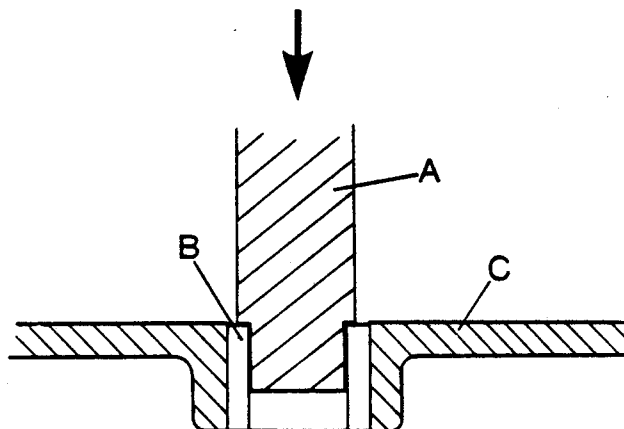


Figure H86  
BEARING REPLACEMENT

A. Mandrel.  
B. Bush.  
C. End bracket.

R78.122

**Armature**

1. Look for movement of the segments. Movement here can be caused by an increase in operating speed, check clutch and brake assemblies.
2. Look for damage or movement of solder connections. If there is any indication of a high operating temperature, look for cause before you install a new armature.
3. Check for any indication of armature to field winding contact. If damage is found, check the tightness of the screws which fasten the pole shoes. Make an inspection of the bearings for wear.

Check the armature shaft for distortion. DO NOT try to correct any distortion of the shaft, install a new armature.

4. Connect a 110 volt supply and use a 15 watt test lamp to check the insulation as shown. Repeat the test on all segments of the commutator. If the lamp illuminates install a new armature. Make sure the circuit is not being completed through dirt.
5. Check the windings with 'growler' equipment according to manufacturers instructions.

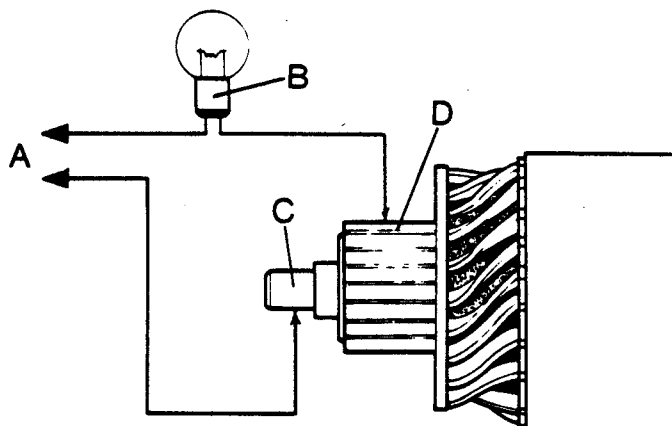


Figure H87  
TESTING ARMATURE INSULATION  
A. 110 volt AC supply.  
B. 15 watt test lamp.  
C. Armature shaft.  
D. Commutator segments.

**Roller Clutch**

1. Check that the clutch locks in one direction C only and turns freely in the opposite direction B.
2. Make sure the assembly can move freely on the armature shaft.

3. Install a new unit when a defect is found. The unit is sealed and cannot be repaired.

**IMPORTANT:** Do NOT wash the unit in cleaning fluid or apply any lubrication.

4. Apply the following greases to the splines of the unit.

Cold climates: Shell SB 2628

Hot climates: Shell Retinax A

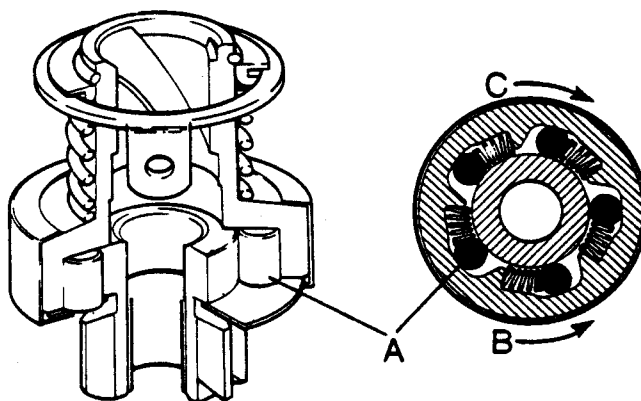


Figure H88  
ROLLER CLUTCH ASSEMBLY

- A. Rollers.  
B. Free direction.  
C. Locked direction.

R78.124

**Plate Clutch**

1. Hold the starter armature in a vice with soft jaw grips.
2. Put the plate clutch on to the armature shaft temporary.
3. Use a torque wrench to turn the pinion D counter-clockwise. The clutch will lose grip at 9–11kgm (66–80lbft) if set correctly.
4. To adjust the setting, disassemble the clutch and install or remove shims. These are between the backing ring and 1st outer plate F.

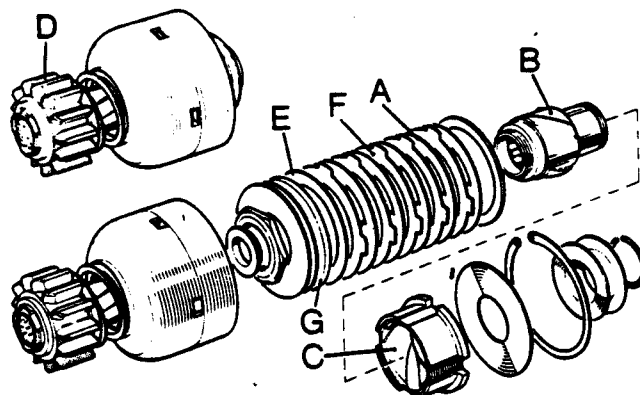


Figure H89  
PLATE CLUTCH ASSEMBLY

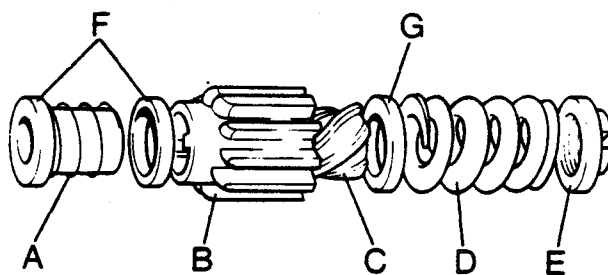
- A. Clutch plate inner.  
B. Driving sleeve.  
C. Moving member.  
D. Pinion.  
E. Shims.  
F. Outer clutch plate.  
G. Backing ring.

R78.125



### Inertia Drive

1. Check the pinion teeth for wear and damage. Check flywheel ring gear also when damage is found.
2. To remove the assembly from the shaft, hold the armature in a vice by the square end.
3. Remove the split pin and nut or circlip and collar from the end of the shaft.
4. Remove spring, pinion and sleeve assembly.
5. Wash all parts in paraffin.
6. Make sure the pinion moves easily on the sleeve and the sleeve moves easily on the shaft. DO NOT put any lubricant on the assembly.



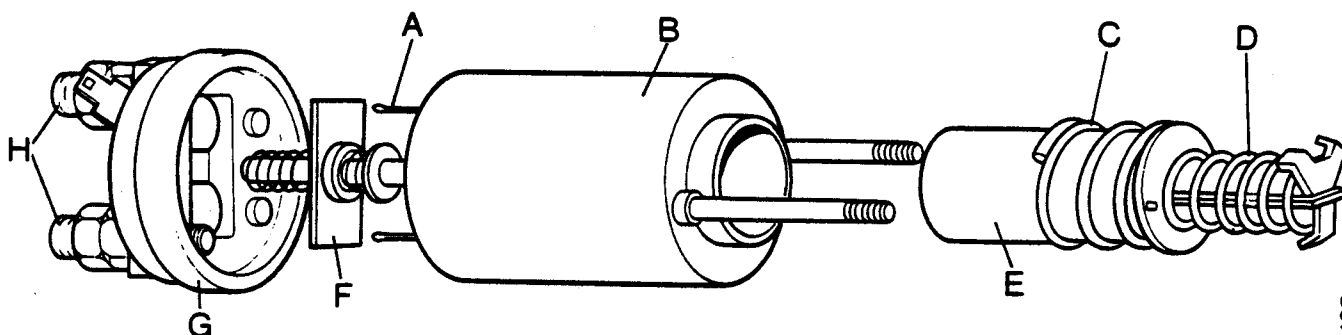
R78126

Figure H90  
INERTIA DRIVE ASSEMBLY

- |                        |                      |
|------------------------|----------------------|
| A. Anti Rattle spring. | E. Thrust collar.    |
| B. Pinion.             | F. Spring retainers. |
| C. Sleeve.             | G. Buffer washer.    |
| D. Drive spring.       |                      |

### Solenoid

1. Check the springs for damage and weakness. The internal spring can be checked by pulling on the inner plunger.
2. To replace the contacts separate the terminal assembly from the body. Use a hot soldering iron to disconnect the two solder connections. Hit the terminals on the bench to remove the solder.
3. Put the solenoid in a vice with the terminals up.
4. Apply heat with the soldering iron to the terminals while pulling on the cover until free.
5. When assembling the terminals make sure the connections are clean and dry. Make sure the temperature of connections is correct before applying the solder.
6. Install the two screws which fasten the terminal assembly to the body. Tighten the screws to a torque of 2.5Nm (0.25kgm) (2lbft).



R78127

Figure H91  
SOLENOID MODEL 19S

- |                          |
|--------------------------|
| A. Coil connections.     |
| B. Body.                 |
| C. Plunger spring.       |
| D. Inner plunger spring. |
| E. Plunger.              |
| F. Contact assembly.     |
| G. Terminal assembly.    |
| H. Main terminals.       |

**ASSEMBLY Figure H**

1. Make sure all parts are clean and have been checked.
2. Put the shims and intermediate bracket N (M50 and M45) onto the armature.
3. Install drive end bracket H on to the armature shaft.
4. Install armature L complete with drive end bracket into the yoke P.
5. Put the commutator end bracket into position on the end of the shaft. Make sure the thrust washers and brake shoes are assembled correctly.
6. Install field brushes E into the holders and push the end bracket fully into position. Make sure brush wires are not between end bracket and yoke.
7. Install the two bolts F, which holds the complete assembly together, through the starter.

Tighten the bolts to a torque setting of:

$\frac{1}{2}$  in bolts 11Nm, 1kgm, 8lb ft.

$\frac{3}{8}$  in bolts 13Nm, 1.3kgm, 10lb ft.

8. Install a new retainer ring on the shaft end of the 3M100 type starter. Install end cap.
9. Use a dial gauge to check the amount of free movement at the end of the shaft. (M50 and M45 types.)  
The amount must be from 0.13 to 0.51mm (0.005 to 0.020in). Adjust by adding or subtracting shims from between the intermediate bracket N and the armature.
10. When the movement is correct, remove the bolts F which fasten the assembly together. Remove the end bracket H.
11. Install the drive pinion assembly M on to the shaft.

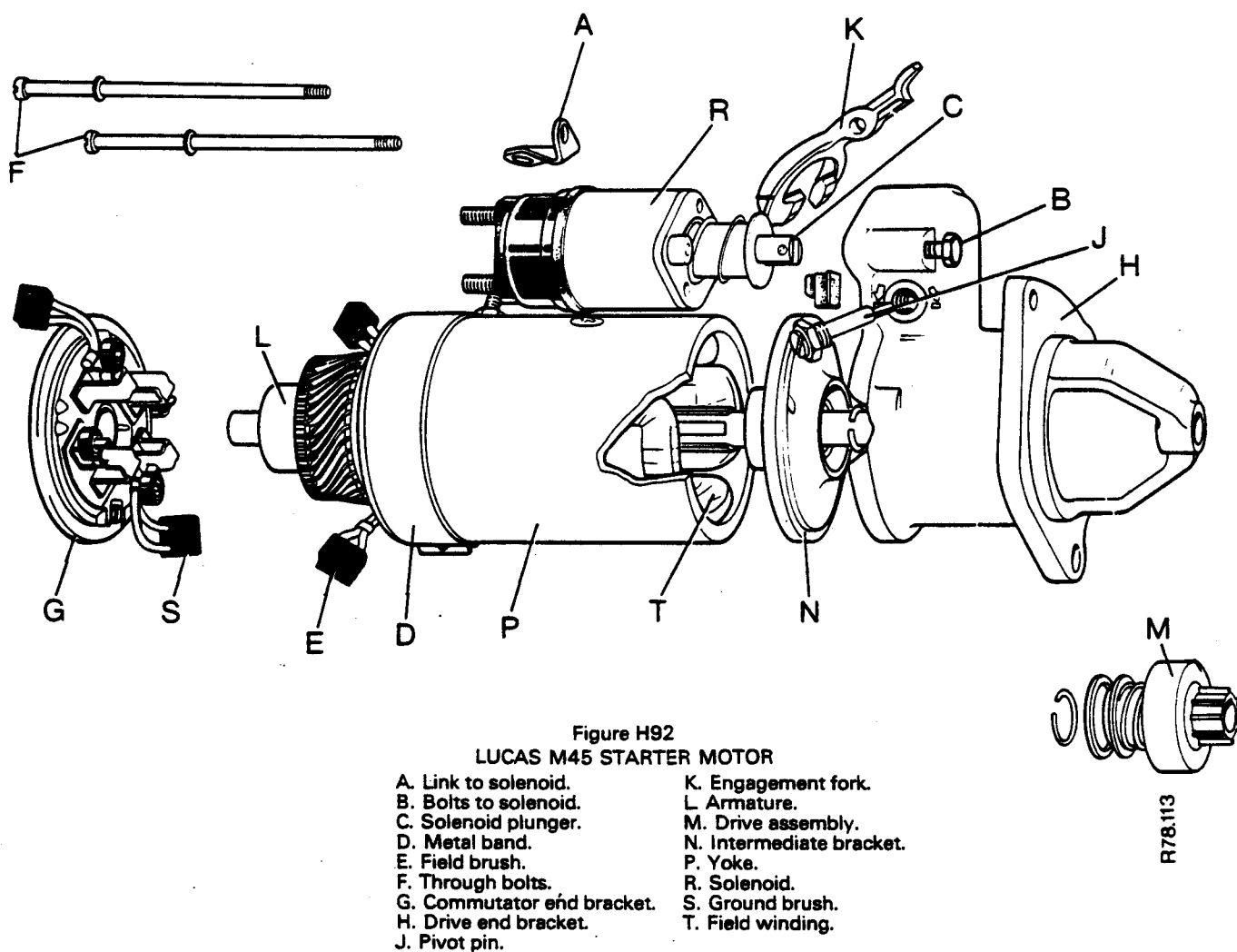


Figure H92  
LUCAS M45 STARTER MOTOR

- |                            |                          |
|----------------------------|--------------------------|
| A. Link to solenoid.       | K. Engagement fork.      |
| B. Bolts to solenoid.      | L. Armature.             |
| C. Solenoid plunger.       | M. Drive assembly.       |
| D. Metal band.             | N. Intermediate bracket. |
| E. Field brush.            | P. Yoke.                 |
| F. Through bolts.          | R. Solenoid.             |
| G. Commutator end bracket. | S. Ground brush.         |
| H. Drive end bracket.      | T. Field winding.        |
| J. Pivot pin.              |                          |

## ELECTRICAL EQUIPMENT

12. Install the engagement fork and end bracket. Install the two fastening bolts. Install the pivot pin for the fork but do not lock it.
13. Adjust the drive pinion to bracket clearances as follows (M50 and M45 types).
  - (a) Connect a 6 volt battery to the starter. This will prevent damage to the solenoid during the adjustment.
  - (b) Measure the gap as shown in Figure H93, between the pinion and the end bracket.
  - (c) The gap must be set to the following dimensions.

Starter Type Gap Setting	
M45 roller clutch:	0.13–0.38mm (0.005–0.015in)
M45 plate clutch:	0.51–0.76mm (0.020–0.030in)
M50 roller clutch:	0.13–1.14mm (0.005–0.045in)
  - (d) Adjust by turning the pivot pin. The arrow on the pin must not be moved beyond the arrows on the bracket. Hold the pinion towards the armature, with a small amount of pressure, while adjusting.
  - (e) Tighten the locknut of the pivot pin when the clearance is correct. Apply paint or Loctite to the threads of the pin.
14. Install the solenoid to M50 and M45 starters.

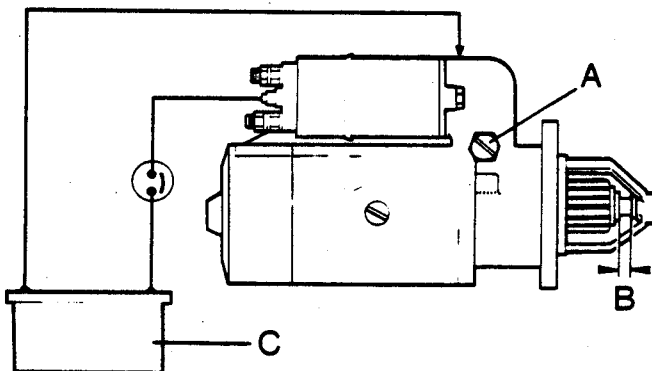


Figure H93  
PINION SETTING DISTANCE  
A. Pivot pin.  
B. Clearance.  
C. 6 volt battery.

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**BOSCH STARTER MOTOR**

The Bosch starter motor has been installed on some tractors. All four cylinder engines can have a Bosch or a Lucas starter motor.

On 14 series tractors a 0.060in shim is installed between the starter flange and the engine.

**IMPORTANT:** DO NOT replace a Lucas starter with a Bosch starter on the 14 series tractor.

To install a Bosch starter to other models the terminal holes have to be increased to 10.3mm ( $\frac{13}{32}$ in).

Contact any Bosch dealer for service information.

Repair information is included in Bosch publications:

VDT-WPE 510/2-6B  
VDT-WPE 510/2B-AL

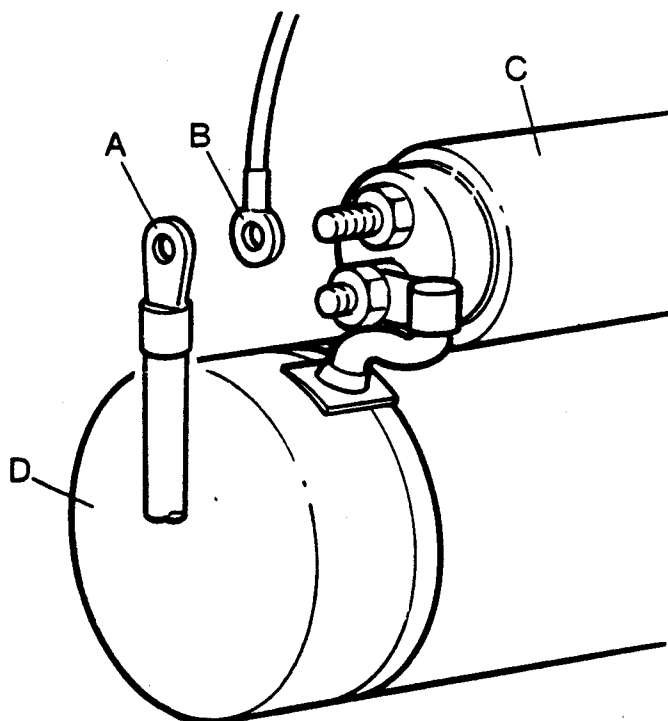


Figure H94  
BOSCH STARTER CONNECTIONS  
A. Battery cable.  
B. Brown wire.  
C. Solenoid.  
D. Starter motor.

R 78.130

# WIPER MOTOR

## HOW IT WORKS

Two permanent magnets A are used for the field supply of the motor. The armature B receives a supply of current from the battery when the operator closes the wiper switch. This actuates the motor.

The armature shaft has a worm-gear C on the commutator end. This is engaged with a gear-wheel D in the gearbox of the motor. The gear-wheel is connected to a cable-rack E by a connecting rod F. The cable rack is free to move inside a tube G which is fastened at each end. The other end of the cable rack is engaged with a gear-wheel and spindle assembly H. The wiper arm and blade are fastened to the spindle.

When the armature turns, it turns the gear wheel. The connecting rod moves the cable rack backwards and forwards through the tube. The movement of the cable rack causes the gear wheel and spindle assembly to make a part turn one way then the other. This moves the arm and blade across the windscreen.

## Limit Switch

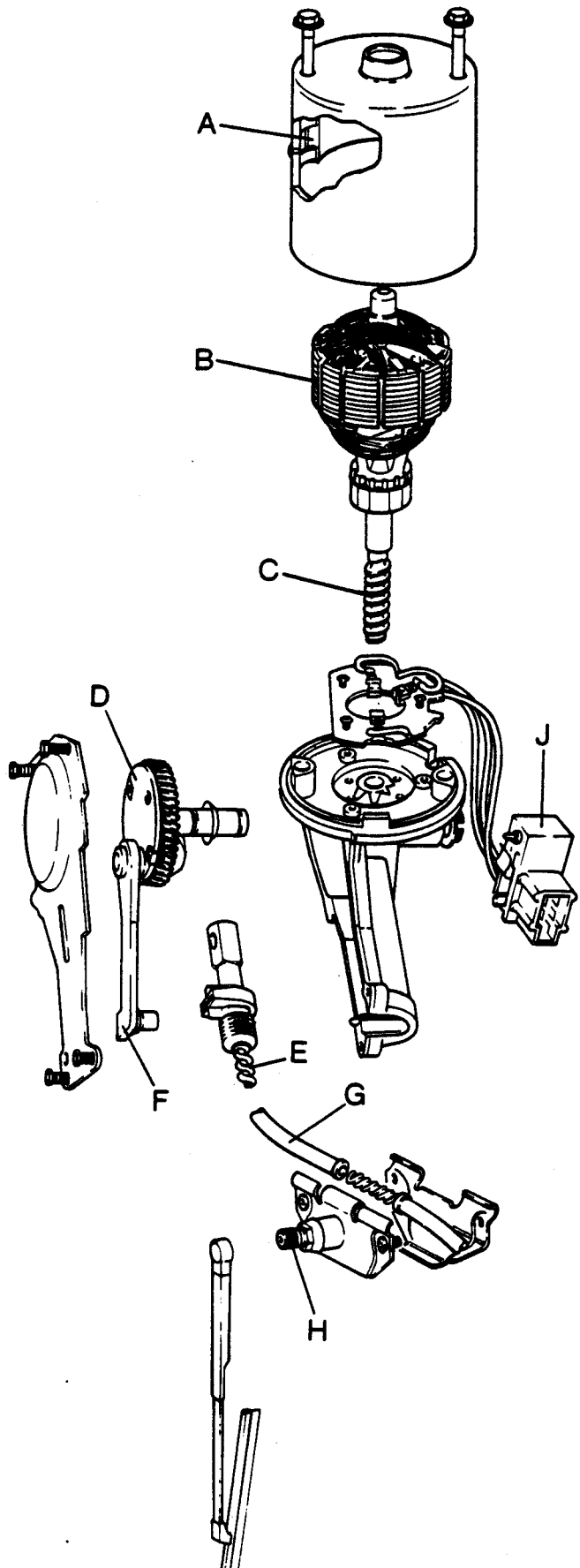
This is installed in the terminal assembly J of some wiper motors to provide a parking facility.

It permits the current to continue to the motor after the wiper switch has been put to 'OFF'. When the wiper arm reaches one side of the windscreen the limit switch stops the motor.

The switch is actuated by a cam on the gear-wheel pushing against the plunger of the switch. The plunger opens a set of contacts which interrupts the circuit and stops the motor.

Figure H95  
THE WIPER MOTOR ASSEMBLY

- A. Magnets.
- B. Armature.
- C. Worm gear.
- D. Gear wheel.
- E. Cable rack.
- F. Connecting rod.
- G. Cable tube.
- H. Drive spindle.
- J. Terminal assembly.



## FAULT FINDING

### TEST 1: Slow Operating Speed

1. Make sure the windscreen is wet enough.
2. Check that the arm can move away from the windscreen.
3. Check that the correct arm tension spring is installed.
4. If these checks are correct, disconnect the cable-rack from the motor.
5. Remove the arm and blade assembly from the wheel-box spindle.
6. Push the cable-rack completely into the tube.
7. Connect a spring-balance A to the end of the cable-rack B.
8. Pull the cable-rack out of the tube with the spring-balance. The maximum force needed must not be more than 27N (6 lbf).
9. If the force needed is more than this amount, check the tube and cable-rack for damage. If any damage is found, install new parts.
10. If the cable-rack and tube are in good condition: Disconnect the rack from the wheel-box and check the spindle for seizure.
11. When all mechanical parts are checked and found acceptable, check the motor. Connect an ammeter in series with the motor to check the current it is using. Compare this with the amount shown in the DATA SECTION.  
Remove the cover from the gearbox and check the gearwheel revolutions against time.
12. Compare the speed of the gearwheel with that shown in the DATA SECTION.

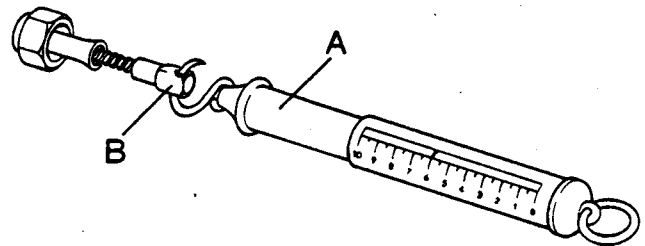


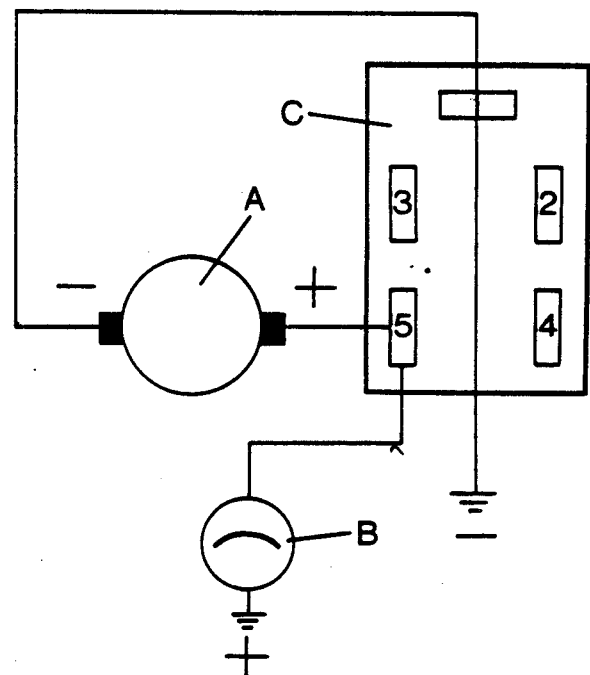
Figure H96  
CHECKING CABLE-RACK  
A. Spring-balance.  
B. Cable rack.

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### TEST 2: Wiper will not operate

1. Check the circuit fuse, if a failure is found, look for possible cause before installing new fuse.
2. Check other circuits which use the same fuse.
3. Make sure all connections are clean and tight, especially ground connection.
4. Use a voltmeter or test lamp to check for a connection between the supply and ground as follows: Connect the test equipment from a supply to the positive terminal of the wiper motor.

If the lamp illuminates or the voltmeter shows a reading, the supply wire is making a connection to ground.



CHECKING CURRENT USED  
A. Wiper motor.  
B. Ammeter.  
C. Wiper switch.

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5. To check the supply, disconnect the harness plug from the motor.
6. Put the wiper switch to the 'on' position.
7. Check for a supply voltage between terminals 1 and 5 of the harness plug.
8. If there is no indication of voltage, disconnect the equipment from terminal 1 and connect it to ground.
9. Check for supply voltage at both terminals of the wiper switch. If there is supply in and not out, with switch 'on', install a new switch. If there is no supply check for broken, dirty or loose connections.
10. If the supply voltage is coming out of the switch but not reaching the motor check wire. Install a new wire if necessary.

**TEST 3: Arm not parking.**

This facility is only installed on some motors. Check if yours is of this type.

1. Put wiper switch to 'OFF' position.
2. Disconnect the harness plug from the motor.
3. Use a voltmeter or test lamp to check the voltage between terminals 1 and 4 of the plug. This voltage must be the same as the supply voltage.
4. Check connection at the supply if no voltage is shown.
5. Now connect the test equipment between terminals 1 and 5 of the plug. Connect a jumper wire between 2 and 4 as shown.

The test lamp will illuminate or the voltmeter will show the supply voltage if limit switch has a failure.

NOTE: To test internal parts of the motor, see REPAIR SECTION.

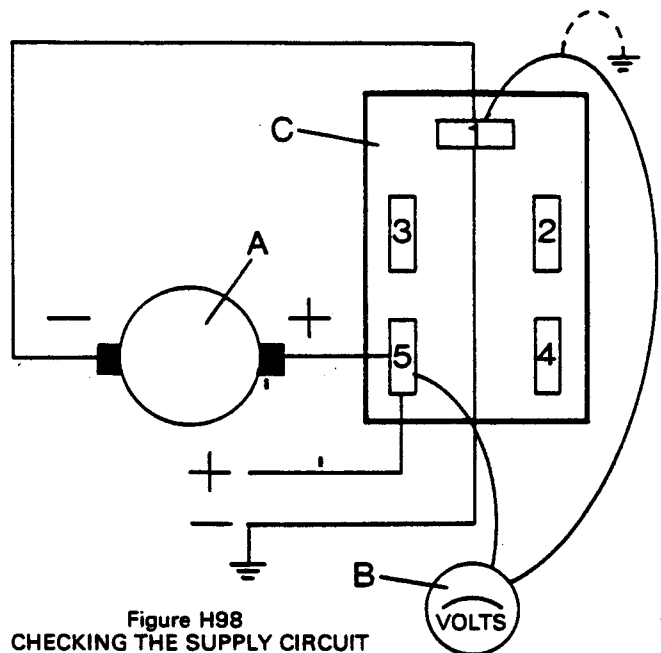


Figure H98  
CHECKING THE SUPPLY CIRCUIT

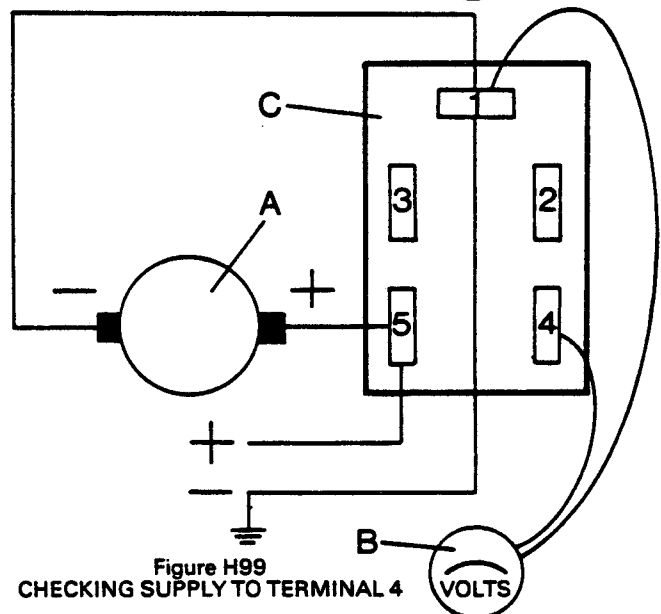


Figure H99  
CHECKING SUPPLY TO TERMINAL 4

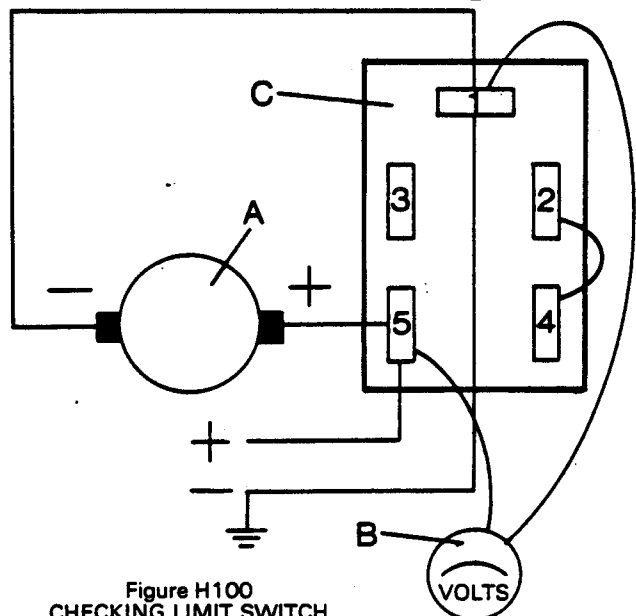


Figure H100  
CHECKING LIMIT SWITCH

A. Wiper motor.  
B. Voltmeter.  
C. Wiper switch.

## MAINTENANCE AND REPAIR

**TYPE:** Lucas 14W single speed, self parking on De-Luxe cab.

### MAINTENANCE

1. Check the tightness of the bolts which fasten the motor to the cab.
2. Make sure the wire connections are clean and tight, especially the ground wire.
3. Check the condition of the blade at regular intervals.

### DISASSEMBLY

1. Remove the arm and blade K.
2. Disconnect the terminal assembly J.
3. Remove the bolts which fasten the wiper motor to the cab.
4. Remove the gearbox cover screws.
5. Remove the circlip which fastens the connecting rod to the crank pin.
6. Remove the connecting rod F from the gear-wheel D and cable-rack E.
7. Remove the flat washer from the crankpin.
8. Disconnect the cable-rack from the gearbox and remove the motor from the tractor.
9. Remove the circlip from the end of the gear-wheel shaft. Make sure the shaft has no sharp edges before pulling it through the bearing.
10. Remove the dished washer under the gear-wheel.
11. Remove the two bolts which fasten the yoke to the gearbox.
12. Remove the yoke and armature B from the gearbox.
13. Put the yoke away from metal particles which can be pulled on to the pole magnets.
14. Remove the brush and terminal assemblies from the gearbox.

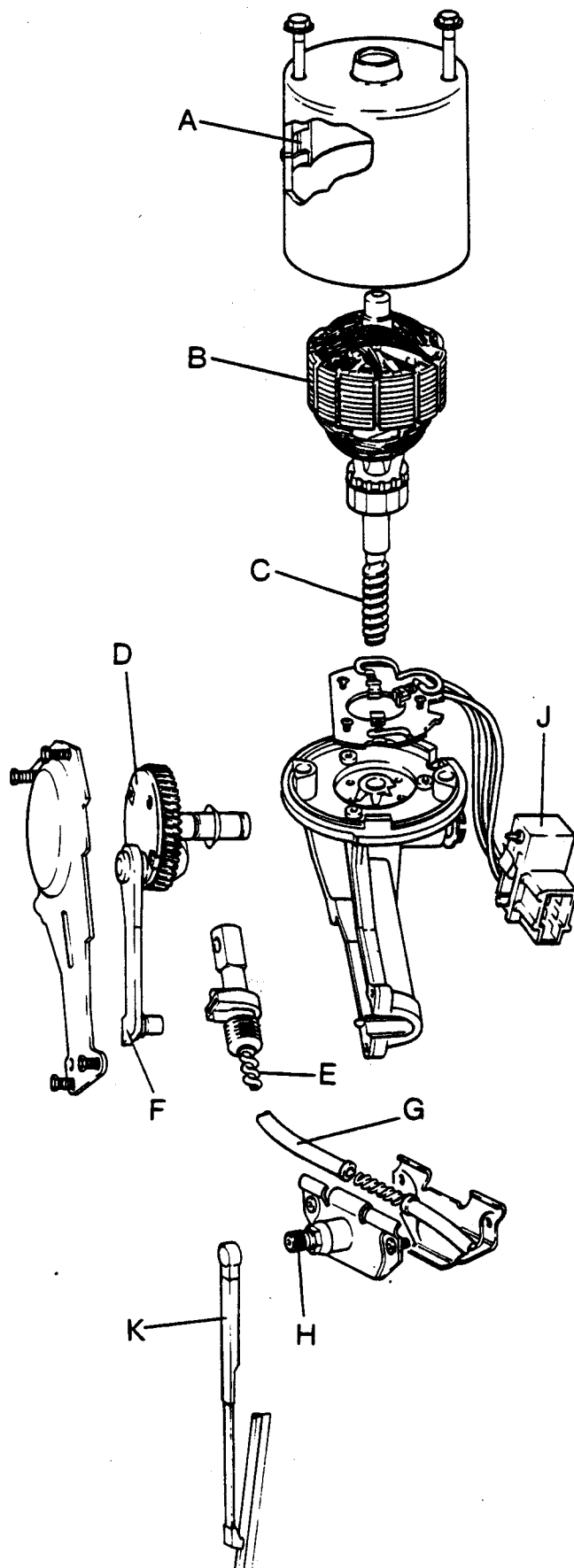


Figure H101  
WIPER MOTOR

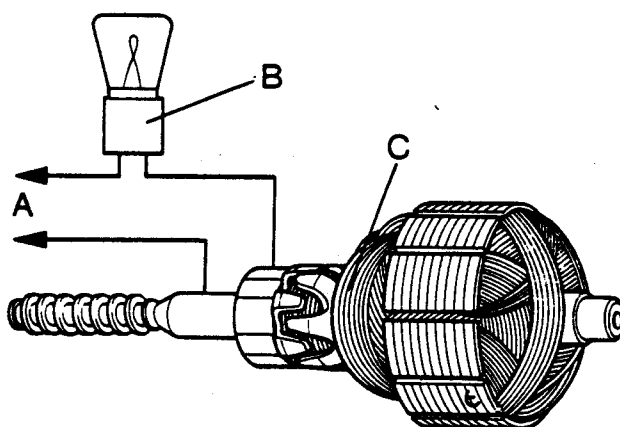
- A. Magnets.
- B. Armature.
- C. Worm gear.
- D. Gearwheel.
- E. Cable-rack.
- F. Connecting rod.
- G. Cable tube.
- H. Drive spindle.
- J. Terminal assembly.
- K. Arm and blade.



## TEST AND REPAIR

### Armature

1. Check the armature insulation as follows:  
Connect a 110 volt supply to the armature shaft. Connect a 15 watt test lamp to a segment of the commutator. Repeat test on all segments. Install a new armature if the lamp illuminates.
2. Check the commutator for damage and wear. Remove small amounts of damage with fine glass paper. Deep damage can be removed with a lathe but the smallest possible cut must be taken. Remove particles of copper from between the segments after cutting.
3. Check for damage to windings, solder connections and worm gear. Install a new armature if any damage is found.

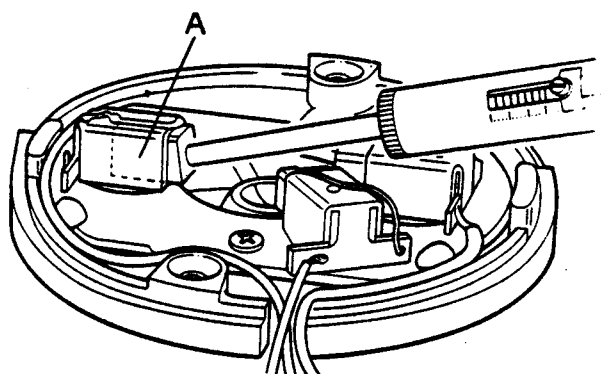


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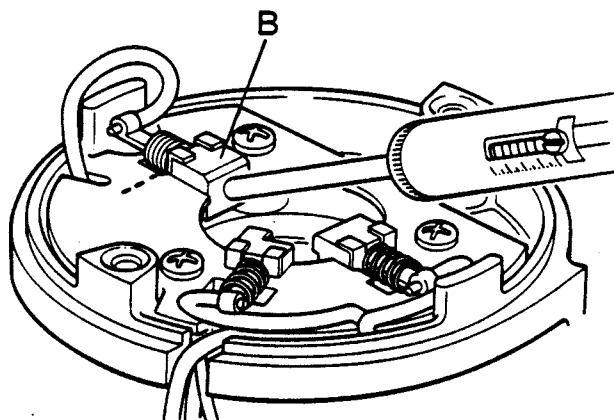
Figure H102  
ARMATURE INSULATION TEST  
A. 110 volt AC supply.  
B. 15 watt test lamp.  
C. Armature.

### Brushes

1. Check brushes for damage.
2. Measure the length of the brushes. If 5mm ( $\frac{3}{16}$  in) or less install new brushes.
3. Make sure the brushes move easily in the holders.
4. Check brush spring pressure with a push type gauge as shown or a dial gauge.  
Push brush to broken line and check the reading. The pressure must be 1.7Nm (170g f) (6oz f).



R78 139/1



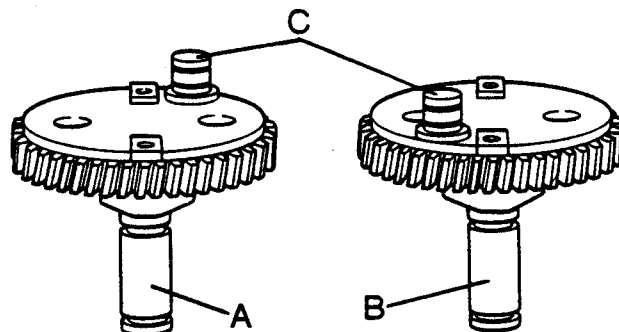
R77 139/2

Figure H103  
CHECKING BRUSH SPRING PRESSURE  
A. Early type.  
B. Later type.

**Gearwheel Assembly**

1. Check the teeth for wear and damage.
2. Check the shaft for distortion, wear and damage.
3. Make sure the crankpin is installed in the correct position if the wheel and shaft have been separated. See Figure H104.

NOTE: The gearwheel and shaft are supplied as an assembly if it is necessary to install a new item.

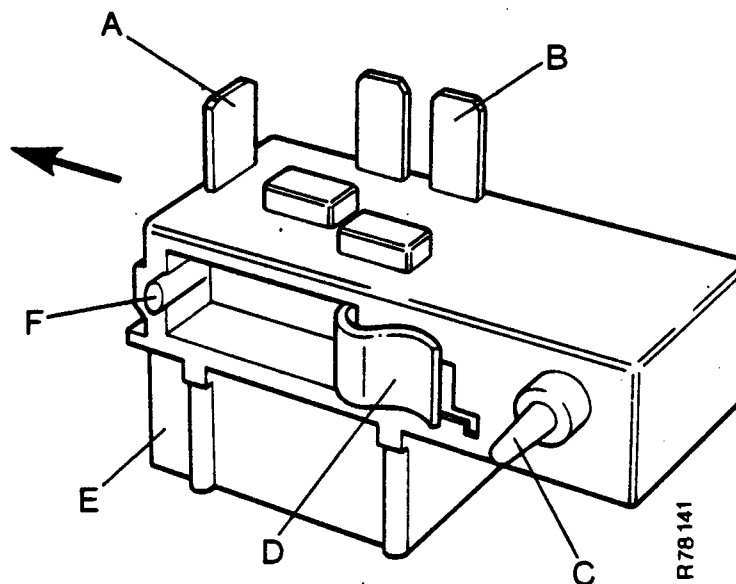


R78140

Figure H104  
ALTERNATIVE POSITIONS OF CRANKPIN  
A. Parking with cable rack retracted.  
B. Parking with cable rack extended.  
C. Crankpin positions.

**Limit Switch**

1. Remove switch from motor by lifting retaining post end of switch and moving it in direction of arrow.
2. Push the plunger of the switch fully in. Let it return to the original position. Measure the plunger. The plunger must be 7mm ( $\frac{9}{32}$ in) out of the switch.
3. See FAULT FINDING for electrical checks.



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Figure H105  
LATER DESIGN LIMIT SWITCH  
A. Negative (—) terminal.  
B. Positive (+) terminal.  
C. Plunger.  
D. Retainer clip.  
E. Terminal connector.  
F. Retainer post.

**ASSEMBLY**

1. Fasten the brush and terminal assemblies to the gearbox.
2. Apply Shell Turbo 41 oil to the bearings and armature shaft bearing surfaces.
3. Apply Ragosine Listate grease to the worm-gear on the armature.
4. Install the armature into the gearbox.
5. Make sure the inside of the yoke is clean. Make sure the thrust disc and oil pad are in position inside the yoke bearing. The disc goes in first with the felt oil pad on top.
6. Install the yoke on to the armature and gearbox.

**IMPORTANT:** Align the mark on the yoke with the arrow on the gearbox to make sure of correct rotation.

7. Install and tighten the two bolts which holds the assembly together. Tighten to a torque of 1.35–1.80Nm (0.138–0.184kgm) (12–16 lb in).

8. Adjust the armature end movement if an adjustment screw is installed.

Turn the adjustment screw clockwise until it contacts the end of the armature.

Then turn the screw counterclockwise  $\frac{1}{4}$  of a turn. Tighten the locknut of the adjustment screw.

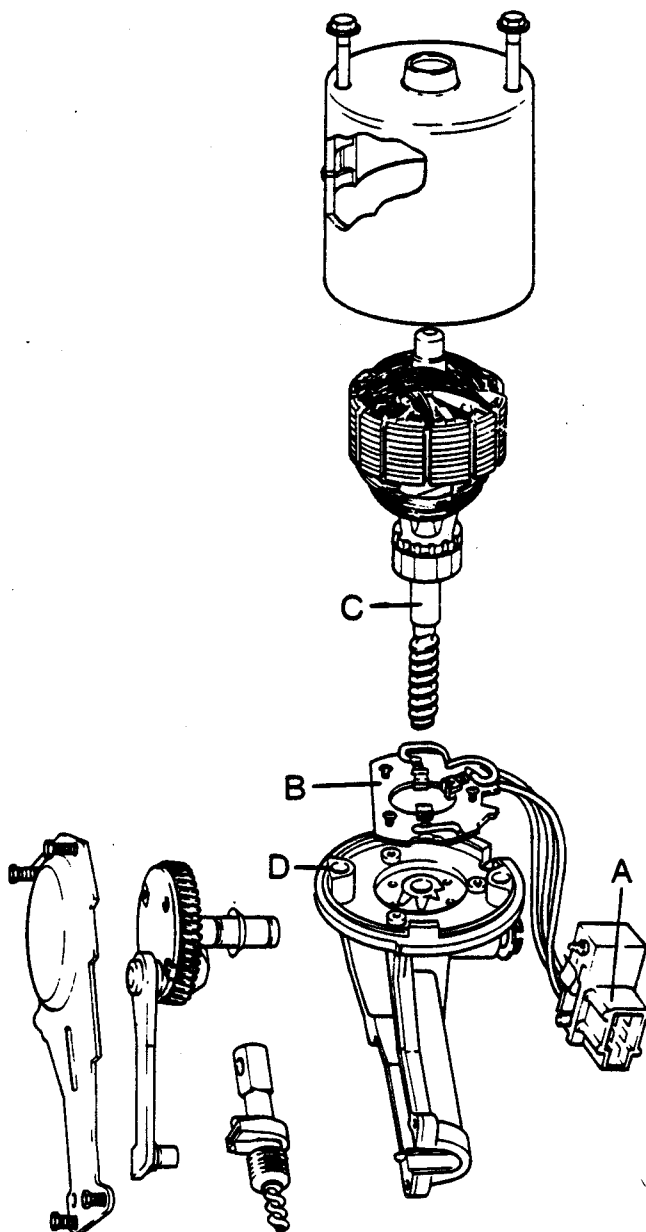


Figure H106  
WIPER MOTOR ASSEMBLY  
A. Terminal assembly.  
B. Brush plate.  
C. Armature.  
D. Gearbox.

78.142

## GAUGES

### HOW THEY WORK THE FUEL GAUGE

The fuel gauge circuit is energised when the starter key A is turned to the 'ACC' position.

The gauge circuit has two coils. One pulls the needle towards the full mark. The other pulls the needle towards the empty mark. The needle moves towards the coil with the most current going through it.

The fuel tank unit has a rheostat B activated by the movement of the float. When the tank is empty the resistance of the rheostat is at a minimum.

This puts a low resistance across the full coil. This reduces the current through the full coil C. The empty coil D then pulls the needle to the empty mark. When fuel is added to the tank the float moves up with the fuel. It increases the rheostat resistance across the full coil. Current starts to move through the full coil and the needle moves towards FULL (F). All positions in between FULL and EMPTY are shown by a balance between the currents in the two coils.

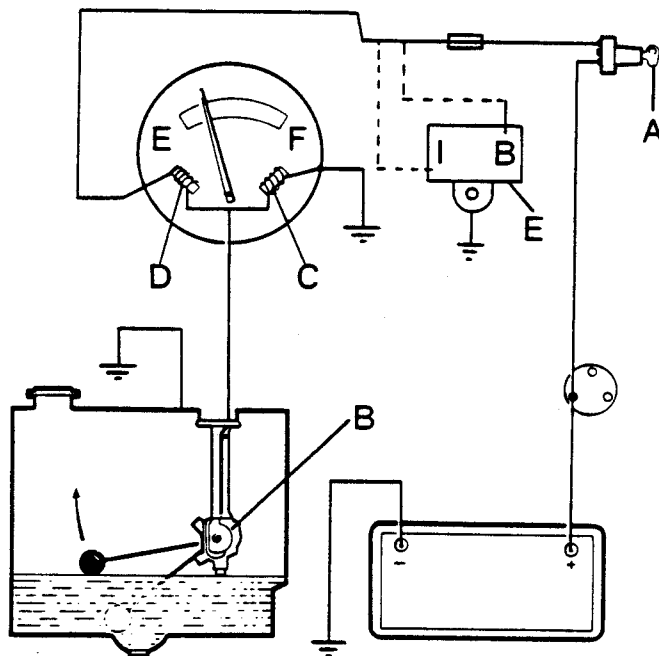


Figure H107  
FUEL GAUGE CIRCUIT

- A. Starter key.
- B. Rheostat.
- C. Full coil.
- D. Empty coil.
- E. Voltage stabiliser  
885 model only.

R 78.143

### THE TEMPERATURE GAUGE

The sender unit A installed in the engine coolant system has a resistor inside. The resistor reacts to temperature decreasing resistance when the coolant temperature increases.

The resistance of the sender is between the hot coil and ground. As the temperature increases, the current through the cold coil increases. This lets the hot coil pull the needle towards the hot mark. When the temperature of the coolant decreases, more current flows through the cold coil. This pulls the needle more strongly towards the cold mark. The pull of the cold coil being stronger than the pull of the hot coil.

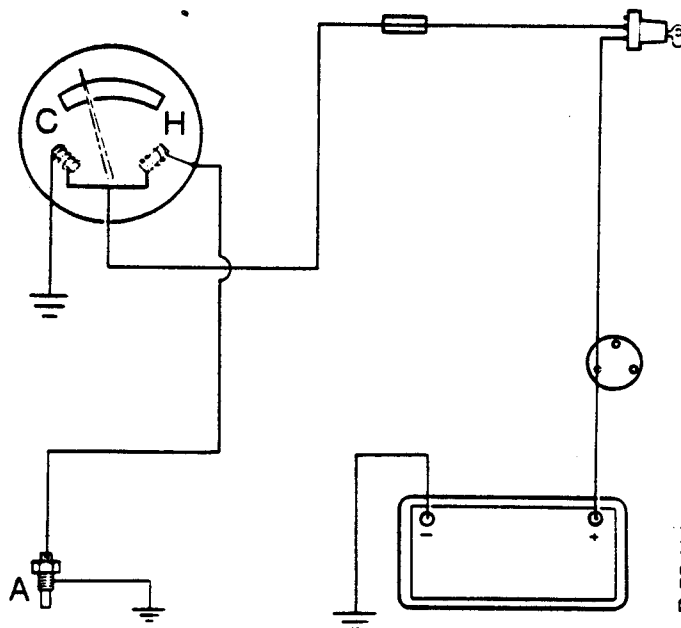


Figure H108  
TEMPERATURE GAUGE CIRCUIT

- A. Sender unit.

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† Amended September 1980

## FAULT FINDING

### FUEL GAUGE

#### TEST 1: Tank Full

1. Turn the starter key to the 'ACC' position.
2. If the needle does not move check for broken or disconnected wire between switch and gauge.
3. If the needle moves to EMPTY check the wire from the gauge to the tank unit for a connection to ground.
4. If the gauge to tank unit wire is good make sure the gauge has a good connection to ground through the instrument panel.

**IMPORTANT:** Do not connect the two wires on the gauge together, this will cause damage to the tank unit.

#### TEST 2: Tank Not Full

1. If the needle moves to FULL when the starter switch is turned to the 'ACC' position. Make sure the tank unit has a good connection to ground.
2. Check the wire between the gauge and the tank unit for dirty or loose connections. Check for a break in the wire.
3. If the gauge does not show a reading, remove tank unit from tank. Keep the wire to the gauge connected.
4. Make a good connection to ground from the unit. Move the float up and down by hand and look at the gauge. This will show if the gauge is working correctly.

#### TEST 3: 885 Tractors only

On the 885 tractor a voltage stabiliser A is included in the circuit. The stabiliser has two connections; 'B' from the battery, 'I' to the gauge. The unit is connected to ground through the bracket.

1. Check the voltage at 'B' with a voltmeter. This must be battery voltage.

**NOTE:** This does not include the 885Q and 885N models, which have different gauges.

2. Check the voltage at 'I'; if zero voltage is shown the unit must be replaced with a new unit.

**IMPORTANT:** Do not connect gauge wires together; this will cause damage to the tank unit.

Gauges, tank units and stabilisers are not adjustable. Do not try to disassemble.

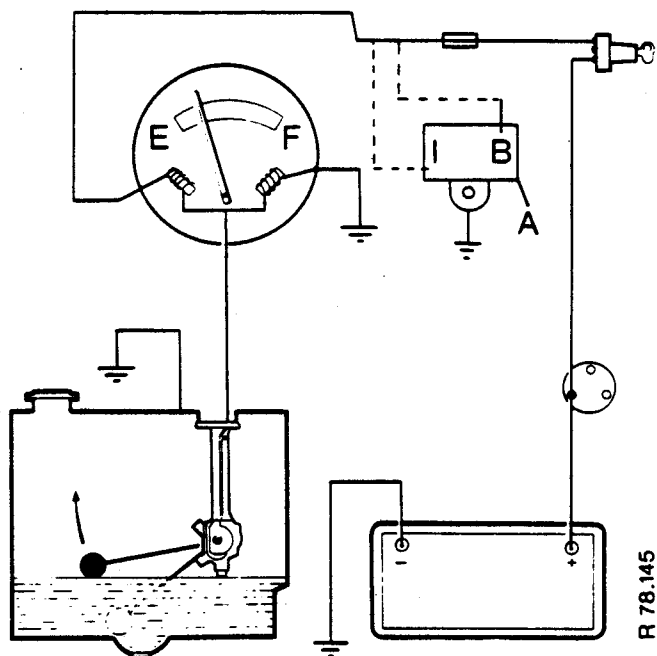


Figure H109  
FUEL GAUGE CIRCUIT  
A. Voltage stabiliser.

## TEMPERATURE GAUGE

### TEST 1: Engine Hot

If the needle does not move towards HOT when the engine temperature increases:

1. Disconnect the wire A from the sender unit and connect the wire to ground.
2. If the needle then moves to HOT the sender unit must be replaced with a new unit.
3. If the needle does not move, check the wiring for breaks or bad connections.

### TEST 2: Engine Cold

If the needle moves to HOT when the starter key is turned to the 'ACC' position:

1. Check the wire from the gauge to the sender unit for a connection to ground.
2. Check that the gauge is making a good connection to ground through the instrument panel.
3. Install a new gauge to compare results with the old gauge and to check other parts.

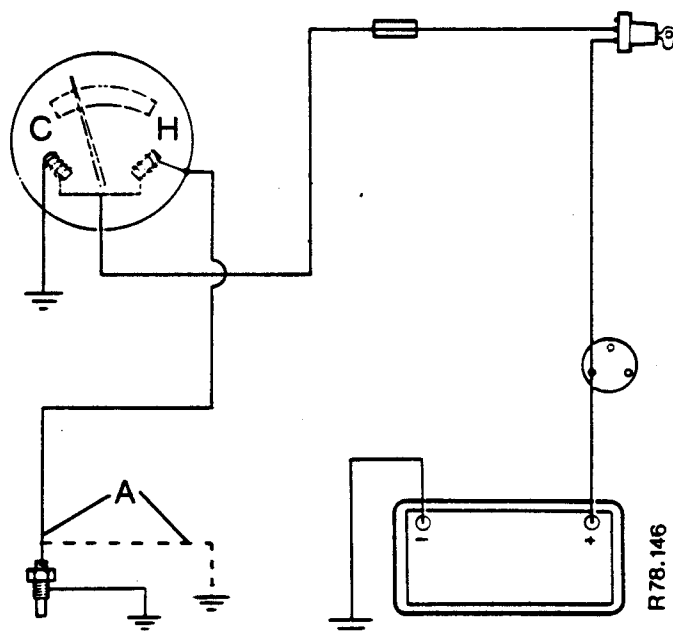


Figure H110  
TEMPERATURE GAUGE CIRCUIT  
A. Wire to sender unit.

# WARNING LAMPS

## HOW THEY WORK

### ENGINE OIL PRESSURE

Battery current illuminates the lamp A when the starter key is turned to the ACC position. The circuit is connected to earth through the pressure switch B contacts. When the engine is started the oil pressure opens the contacts. This interrupts the circuit and the lamp stops illuminating. If the oil pressure decreases below the setting of the pressure switch the contacts close and the lamp illuminates.

### HYDRAULIC OIL FILTER

Battery current illuminates the lamp C when the starter key is turned to the ACC position. The circuit is connected to ground through the dynamo or alternator. When the engine is started the dynamo or alternator output causes the lamp to stop illuminating.

The output current is prevented from going through the warning lamp by a diode D included in the circuit.

If the hydraulic filter becomes restricted the contacts of the vacuum switch E close. This re-connects the circuit to ground illuminating the warning lamp again.

The vacuum switch is installed in the oil pump suction pipe.

NOTE: This is not installed on later tractors with external hydraulic filter.

### NO CHARGE

Battery current illuminates lamp F when the starter key is turned to ACC. The circuit is completed to ground through the dynamo or alternator. When these start to charge the voltage difference at the warning lamp terminals decreases. This causes the lamp to stop illuminating.

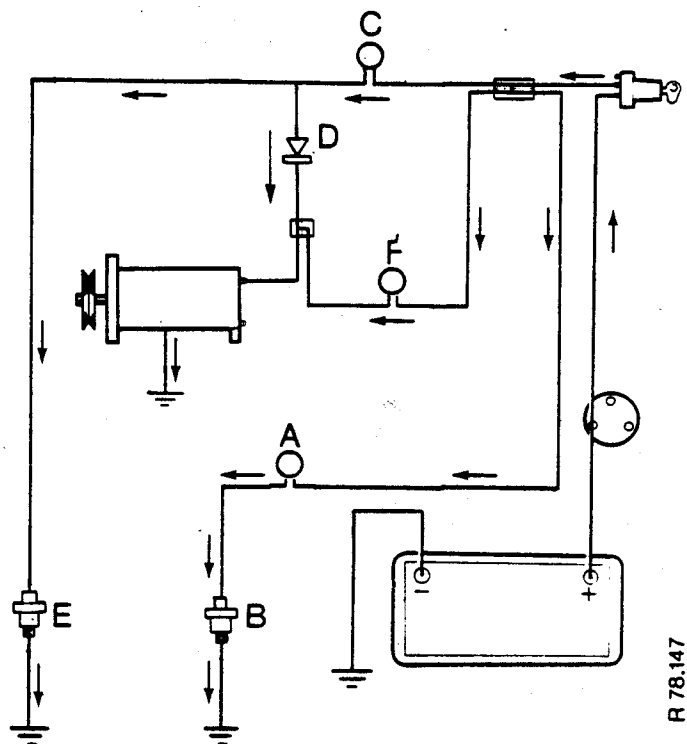


Figure H111  
CIRCUIT WITH DYNAMO

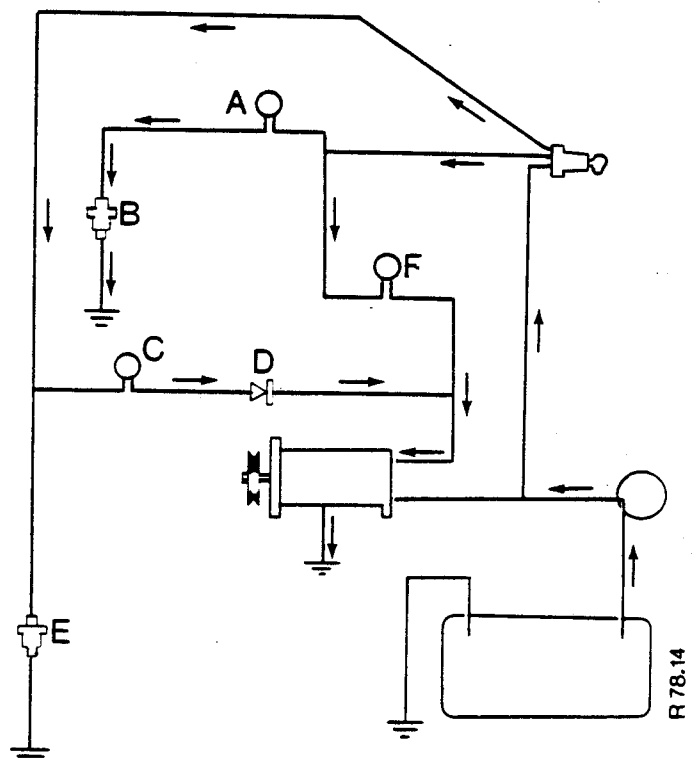


Figure H112  
CIRCUIT WITH ALTERNATOR

- |                          |                       |
|--------------------------|-----------------------|
| A. Oil pressure warning. | D. Diode.             |
| B. Oil pressure switch.  | E. Vacuum switch.     |
| C. Hydraulic warning.    | F. No charge warning. |

# THERMOSTART

## HOW IT WORKS

When the starter key A is turned to the HEAT position current energises the unit B in the inlet manifold.

Current heats a coil C which opens the fuel valve D and then changes the fuel into vapour. Another coil E causes the vapour to burn which warms the air going into the cylinders. This makes the engine easier to start in very cold weather.

The unit is still energised when the starter is being operated.

**IMPORTANT:** Always disconnect the thermostart wire if ether or similar fluid is used for starting.



**WARNING** — Ether or similar starting fluid must not be used without first following the procedure below. The Thermostart heater is energised when the starter is operated. Ether or starting fluid can cause an explosion or fire if it comes into contact with the Thermostart coil. This can cause injury.

## PROCEDURE, ETHER

If ether starting fluid has to be used in an emergency, the following procedure and sequence **must** be followed.

1. Disconnect the electrical supply wire from the Thermostart heater.
2. Operate the starter motor for 10 seconds, with the stop control in the stop position, to remove any fuel before using ether.
3. Put a small amount of ether in the air cleaner inlet while the starter is being operated.

**Do not put ether in the intake unless the starter motor is rotating the engine.**

**Do not use ether with the Thermostart connected.**

**Do not use ether if the battery is discharged.**

**Damage will occur if ether is used carelessly.**

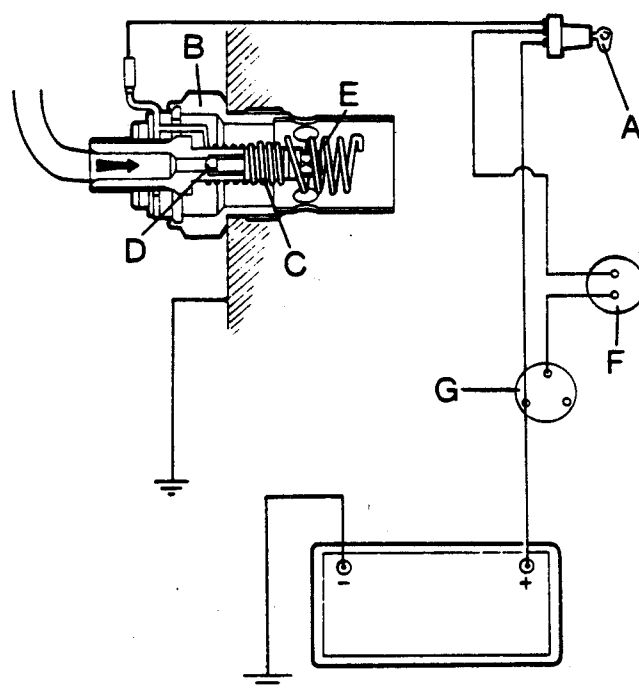


Figure H113  
THE THERMOSTART CIRCUIT

- A. Starter key.
- B. Thermostart unit.
- C. Valve coil.
- D. Fuel valve.
- E. Burner coil.
- F. Starter safety switch.
- G. Starter solenoid.

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## FAULT FINDING

## TEST 1

1. Remove the pipe between the air cleaner and the inlet manifold.
2. Turn the starter key to 'HEAT' and hold this position for 10 to 25 seconds.
3. Make sure the gear levers are in the neutral position, then operate the starter.
4. Get assistance to look into the manifold to see if the thermostart is working. This will be shown by light from the burning fuel.
5. If the unit is not working return the key to 'OFF' and do test 2.

## TEST 2

1. Connect a voltmeter between the terminal on the thermostart and ground.
2. Turn the starter key to 'HEAT' and check the voltmeter.

If the voltmeter does not show a voltage check the wire and connections to the starter switch.

3. If current is reaching the thermostart disconnect the fuel pipe A and check for a restriction of the fuel flow.

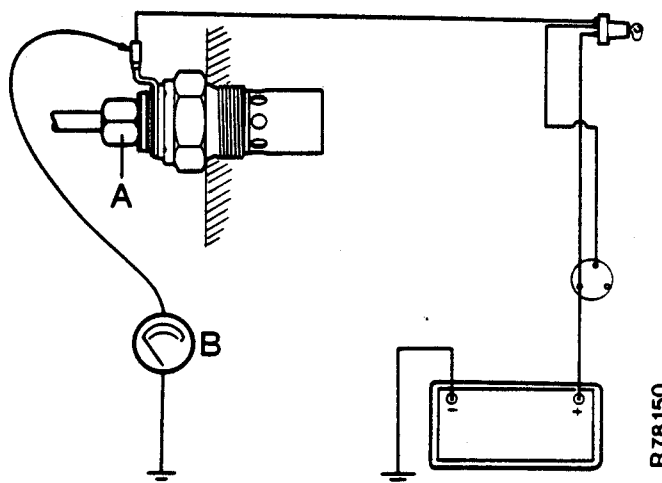


Figure H114  
CHECKING CURRENT SUPPLY

A. Fuel pipe connection.  
B. Voltmeter.

# WIRING

## GENERAL DESCRIPTION

The tractor wiring is divided into three main harnesses. These are: Engine harness; Instrument panel harness; Rear harness. A fourth harness is added when a cab is added to a tractor. When a repair has to be made to the wiring it can be easier to replace one or two wires. If the defect includes more than one or two wires it is best to install a harness.

To make vehicle wiring flexible it is made with a number of single thin wires of the same thickness. The amount of single wires and the thickness of each is shown by the wire size number. Example: 44/012 is an indication that the wire has 44 single wires and each single wire has a thickness of 0.012in. This is the same as 44/030, 44 single wires of 0.30mm thickness.

The wire sizes shown in the chart will normally be those used on a tractor. This does not include the starter cables and H.T. ignition cables on gasoline engines.

The diameter of a wire used is controlled by the amount of current flowing in the circuit. Also the voltage being used must not decrease by more than 10% after going through a wire. For a 12 volt system for example, the voltage must not decrease by more than 1.2 volts.

Never replace the original wire of a circuit with a wire of a smaller diameter. Use a micrometer to measure the single wires and make a count of the amount. Use the next largest size if the correct size is not available.

A large decrease in voltage will cause a decrease in the performance of the electrical unit.



**CAUTION** Always use the correct size wire for the job. A smaller wire will cause resistance to current. This will increase the temperature of the wire and cause the wire to burn and start a fire.

## WIRE DETAILS

Number and diameter of wires		Cross-section area of conductor		Resistance per metre at 20° Celcius	Approximate current rating	Nearest American gauge size
mm.	inches	sq. mm.	sq. inches	ohms	amperes	
14/0.25	14/010	0.69	0.0011	0.0271	6.00	19
14/0.30	14/012	0.99	0.0015	0.0188	8.75	17
28/0.30	28/012	1.98	0.0031	0.0094	17.50	14
44/0.30	44/012	3.11	0.0048	0.0060	27.50	12
65/0.30	65/012	4.59	0.0071	0.0041	35.00	10
84/0.30	84/012	5.94	0.0092	0.0031	45.00	9
97/0.30	97/012	6.86	0.0106	0.0027	50.00	8
120/0.30	120/012	8.48	0.0131	0.0022	60.00	8

When installing wiring make a note of the following details.

- (a) Make sure all wiring is clear of any part of the tractor which gets hot.
- (b) Keep the wiring away from sharp edges.
- (c) Make sure the wiring is clear when assembling and installing parts of the tractor.
- (d) Fasten the wiring correctly and make sure the wires are not putting tension on the connections.
- (e) Always use the correct type of connectors for the job. Make sure the crimp type connector is the correct size before you fit it. Make sure connections made with solder are clean, dry and the correct amount of heat is applied.
- (f) All wires have a colour code for easy identification. Letters or words can be used on wiring diagrams.
- (g) The first letter or word is the main colour and the second is the line. Example: G/B = Green/Black. This is a green wire with a black line.

### WIRING COLOUR CODE

B = Black  
G = Green  
K = Pink  
N = Brown  
P = Purple  
R = Red  
S = Slate (Grey)  
U = Blue  
W = White  
Y = Yellow  
LG = Light Green

### CIRCUIT COLOUR CODE

The wiring is divided into a number of circuits and each circuit uses a colour for identification.

Examples:

**Brown** is used for the main supply. Current flows at all times in this circuit.

**Brown/Yellow** is used for the alternator circuit.

**Green** is used for the engine auxiliaries. This circuit only has current flowing when the starter key is in the 'ACC' position.

**Green/Blue** is used for the temperature gauge circuit.

**Red** is used for the side and rear lamp circuits.

**Blue** is used for the headlamp circuit.

**White** is used for the warning lamp circuit.

**Black** is used for all ground connections.

**NOTE:** The colour of a wire does not give any indication of the capacity of the wire. Do not confuse with wiring colour code.

WIRE SIZE	COLOURS		APPLICATION
	Main	— Line	
14/0-25mm (14/0-010in)	Green	— White	Flasher switch to 7-way connector Right-hand flasher light and 7-point socket
	Green	— Red	Flasher switch to 7-way connector Left-hand flasher light and 7-point socket
	Black	— Lt. Green	Hydraulic filter switch light to 7-way connector
	Green	— Blue	Temperature gauge to 10-way connector 10-way connector to temperature sender
	Green	— Black	Fuel gauge to 10-way connector 7-way connector to vacuum switch 10-way connector to tank gauge unit
	White	— Brown	Oil warning light to 10-way connector 10-way connector to oil warning switch
	Purple	— Black	Horn push to 10-way connector 10-way connector to horn
	Brown	— Yellow	Hydraulic filter and charge lamps to 10-way connector 10-way connector to alternator
	White		Starter switch to charge and oil warning lamps
	Green		To hydraulic filter warning light To temperature gauge, to fuel gauge, to horn, to flasher unit or hazard warning switch, flasher unit to trailer indicator light, flasher unit to flasher switch
	Black		All ground (chassis) connections
	Red		To tail lights, 7-point socket and rear number plate light
28/0-30mm (28/0-012in)	White	— Red	10-way connector to starter solenoid Starter switch to 7-way connector 7-way connector starter safety switch 7-way to 10-way, 10-way connector to starter safety switch
	Brown	— Red	Starter switch to 10-way connector 10-way connector to Thermostat
	Green	— Brown	Flasher unit to flasher switch
32/0-20mm (32/0-008 in)	Red		Lighting switch to 7-way connector
	Green		7-way connector to harness
	Blue	— White	Lighting switch to 10-way connector 10-way connector to headlamps (main beam)
	Blue	— Red	10-way connector to headlamps (dip) Lighting switch to 10-way connector
	Green		7-way connector to main harness to stop lamp switch
	Green	— Purple	Stop lamp switch to main harness to stop light connectors to 7-point socket
44/0-30mm (44/0-012in)	Brown		Starter to main harness Harness to alternator and 10-way connector Harness to starter switch and fuse Fuse to lighting switch
	Green		Starter switch to fuse

## ELECTRICAL EQUIPMENT

There are differences between wiring of each tractor according to the specifications. Changes occur with the type of fender used. Changes also occur where the hazard warning

system is installed.

Tractors with cabs have several items of extra electrical equipment.

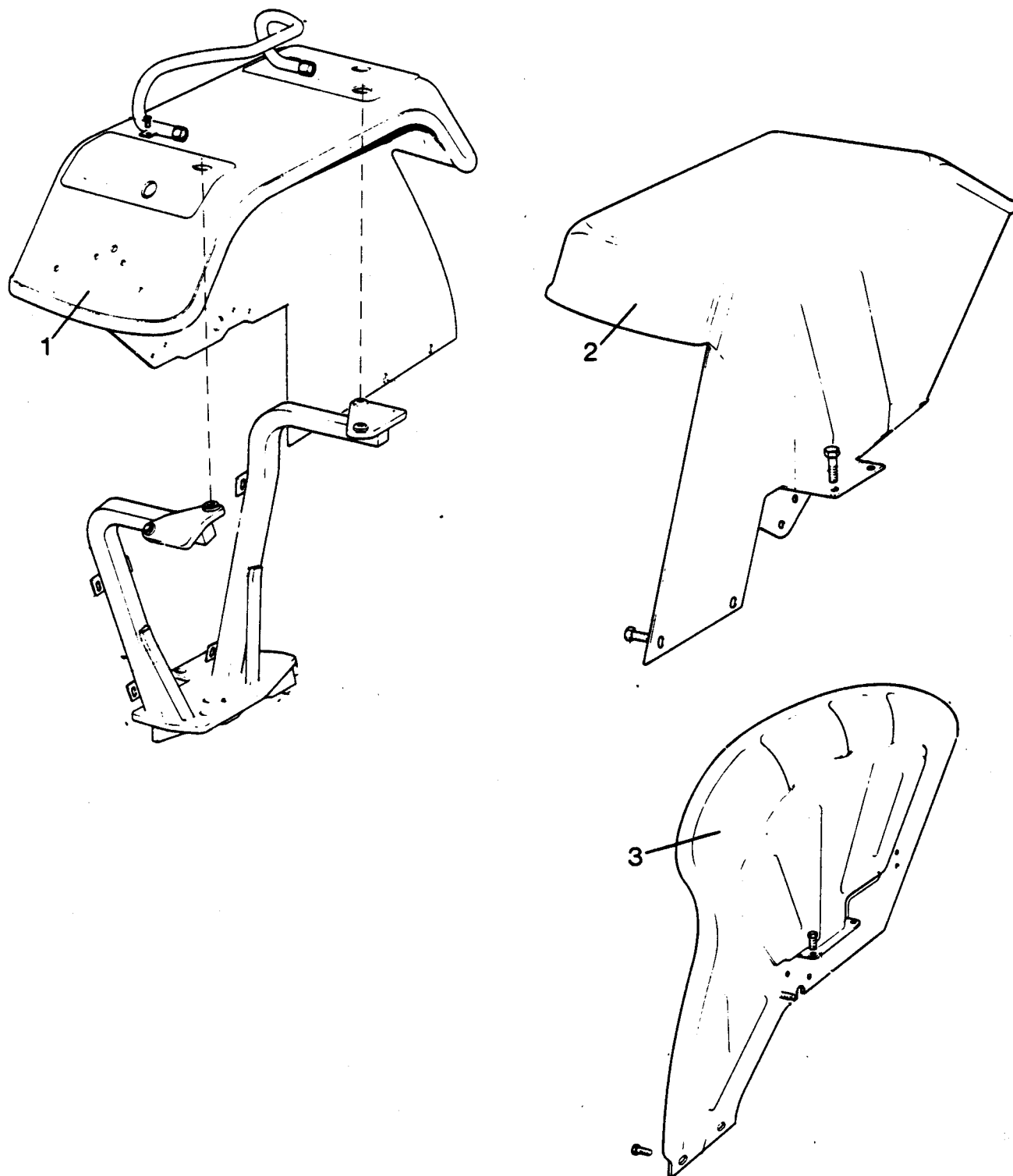


Figure H115  
TYPES OF FENDER USED

1. Full fender, reinforced.
2. Full fender, light duty.
3. Shell or fan fender.

**CRIMP CONNECTIONS**

1. Use the stripper part of the tool A to remove 1cm of the insulation from the end of the wire.
2. Push the wire into the snap-in connector as far as it can go.
3. Use the crimping part of the tool B to make two crimps. One on the wire and one to grip the insulation.

Make sure the jaws of the tool close completely at C.

The tool can be used for the following sizes:

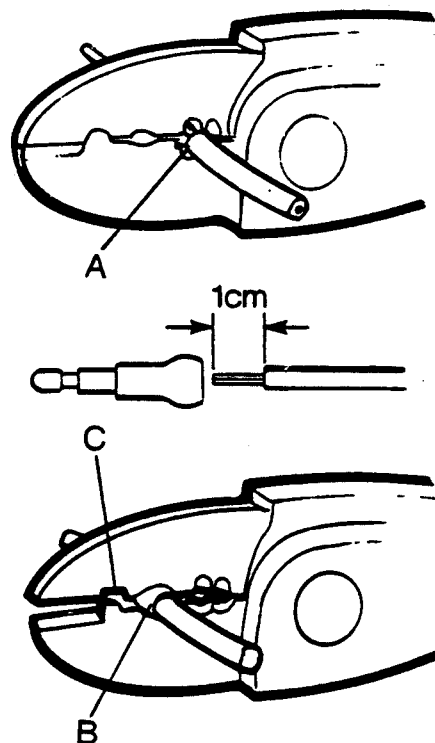
14/0.25mm (14/0.010in):

14/0.30mm (14/0.012in):

28/0.30mm (28/0.012in):

35/0.30mm (35/0.012in):

NOTE: A kit complete with pliers is available from your David Brown dealer, part number K.964626.



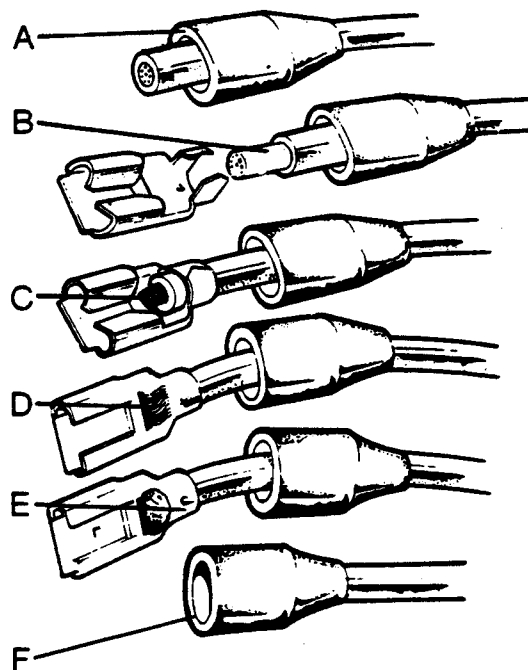
R78151

Figure H116  
MAKING A CONNECTION USING A CRIMPING TOOL

A. Stripper jaws. C. Jaw stop.  
B. Crimping jaws.

**SOLDER CONNECTIONS**





1. Put the insulation cover A over the wire as shown.
2. Remove about 1cm of insulation from the end of the wire B.
3. Push the end of the wire through the slot in the Lucar connector C. Bend the end of the wire D backwards and flat on to the connector.
4. Bend the lugs E at the rear of the connector around the insulation of the wire.
5. Use solder to connect the wire to the connector.
6. Let the connector cool, then push the insulation cover F over the connector.








R78152

Figure H117  
MAKING A CONNECTION USING SOLDER

LUCAR CONNECTORS

3/16" (.187") LUCAR MATERIAL: BRASS. FOR CRIMPING OR SOLDERING			
Connector Lucas Part No.	Approximate Rating	Application (Cable Size)	Insulating Cover P.V.C. Lucas Part No.
 54190972	6 amps	1-14/0.25mm (14/.010")	 54190680
 54954279		1-28/0.30mm (28/.012") 2-14/0.25mm (14/.010")	 54190953

1/4" (.250") LUCAR MATERIAL: BRASS. FOR CRIMPING OR SOLDERING			
Connector Lucas Part No.	Approximate Rating	Application (Cable Size)	Insulating Cover P.V.C. Lucas Part No.
 54960660	17½ amps	1-14/0.25mm (14/.010")	 54959401 For details see below
 54960661		1-28/0.30mm (28/.012") 2-14/0.25mm (14/.010")	

3/8" (.375") LUCAR MATERIAL: PHOSPHOR BRONZE. FOR SOLDERING			
Connector Lucas Part No.	Approximate Rating	Application (Cable Size)	Insulating Cover P.V.C. Lucas Part No.
 549420779	35 amps	1-28/0.30mm (28/.012") 1-44/0.30mm (44/.012") 1-65/0.30mm (65/.012")	 54190043

INSULATION COVER

Lucas Part Number 54959401.

This cover can be used on the complete range of ¼in straight Lucar connectors.

It can be used for wire sizes from 14/.025mm (14/.010in) to 44/0.30mm (44/.012in).

To install the cover, push it over the terminal until the locking lug goes into the location.

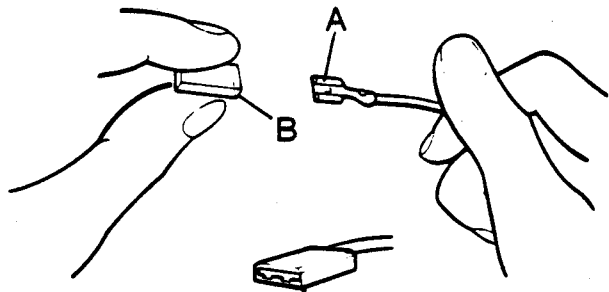


Figure H118  
LUCAR CONNECTORS  
A. Connector.  
B. Cover.

BLADE TERMINALS AND INSULATORS




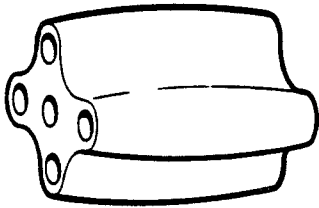
	Flag or Right Angle Female Terminal for 14/-010", 9/-012", 14/-012", 28/-012" Cables 25 amp rating		Straight Female Terminal for 28/-012", 35/-012", 44/-012", 65/-012" Cables 45 amp rating													
	Flag or Right Angle Female Terminal for 28/-012", 35/-012", 44/-012" Cables 45 amp rating		Straight Male Terminal for 14/-010", 9/-012", 14/-012", 28/-012" Cables 25 amp rating													
	Straight Female Terminal for 44/-012" Single Cable or 28/-012" Twin Cables 25 amp rating		Straight Female Terminal for use with Round Dollies for 28/-012", 35/-012", 44/-012", 65/-012" Cables 25 amp rating													
	Straight Female Terminal for 14/-010", 9/-012", 14/-012", 28/-012", 35/-012" Cables 25 amp rating		Miniature Straight Female Terminal For Blade .187 wide 15 amp rating													
	Insulator for Flag Terminals (for use with double Cables)		Insulator for straight terminals													
	Insulator for straight terminals		Insulator for Flag Terminals													
	Insulator for straight terminals															
	Insulator for round 'dolly' Terminals	<table><tr><td rowspan="4"></td><td>No.</td><td>Rated Value Amps</td><td>Length-Dia.</td></tr><tr><td>RF25</td><td>25</td><td>1 5/32 × 1/4</td></tr><tr><td>RF35</td><td>35</td><td></td></tr><tr><td></td><td></td><td></td></tr></table>			No.	Rated Value Amps	Length-Dia.	RF25	25	1 5/32 × 1/4	RF35	35				
	No.	Rated Value Amps	Length-Dia.													
	RF25	25	1 5/32 × 1/4													
	RF35	35														

R78156

Figure H119  
BLADE TERMINALS - BS SIZES



## SNAP-IN CONNECTORS AND TERMINALS

	Description	Packets of	Lucas Part No.
	2-way snap-in (may be used with 9/32" single cable clip)	10	900288
	4-way. (Double)	1	850641
	6-way. (Three 2-way)	1	850344
	10-way. (Five 2-way)	1	850832

SNAP-IN (BULLET) TERMINAL ENDS  
(For use with the above connectors)



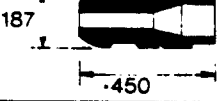



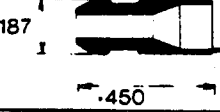

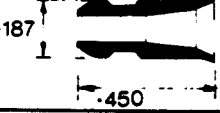


	Description	Packets of	Lucas Part No.
	 Solder type. For cable size 28/0-30mm (28/-012") P.T. and S.P.T.	10	900269
	 Hexagonal crimp type. For cable size 14/0-25mm (14/-010") P.T. and S.P.T.	10	54941384
	 Hexagonal crimp type. For cable size 14/0-30mm (14/-012") P.T.	10	54944088
	 Hexagonal crimp type. For cable size 28/0-30mm (28/-012") P.T.	10	54944095
	 Hexagonal crimp type. For cable sizes 44/0-30mm (44/-012") or 65/0-30mm (65/-012") P.T.	10	54946098
	3/16" (0.188") diameter ferrule	10	188818

Figure H120  
SNAP-IN CONNECTORS

9-37222

H82

**HAZARD WARNING SWITCHES**

Two different types of hazard warning switches were installed up to the following serial numbers.

885/633680

990/862037

995/930639

996/985304

1210/727072

1212/1003291

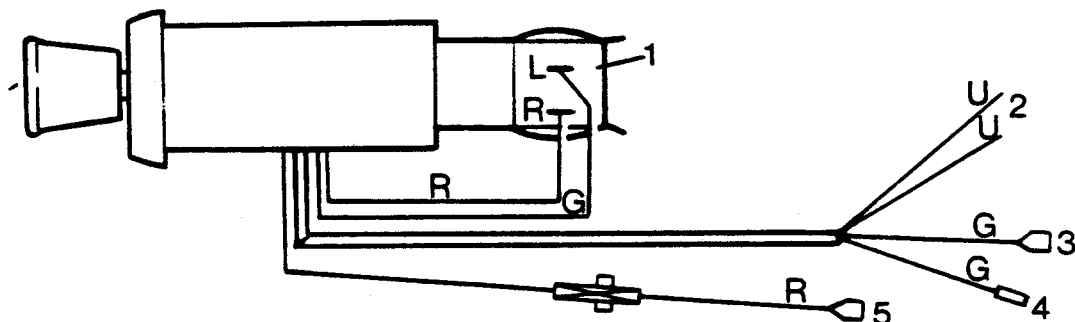


Figure H121  
EARLY TYPE  
Part Number K9446644

1. Hazard flasher unit.
2. Connections to L and R terminals of the direction indicator switch.
3. Connection to 49 + terminal of the direction flasher unit.
4. To green wire in the harness next to flasher unit.
5. Connection to terminal 1 of the starter switch.

R78159

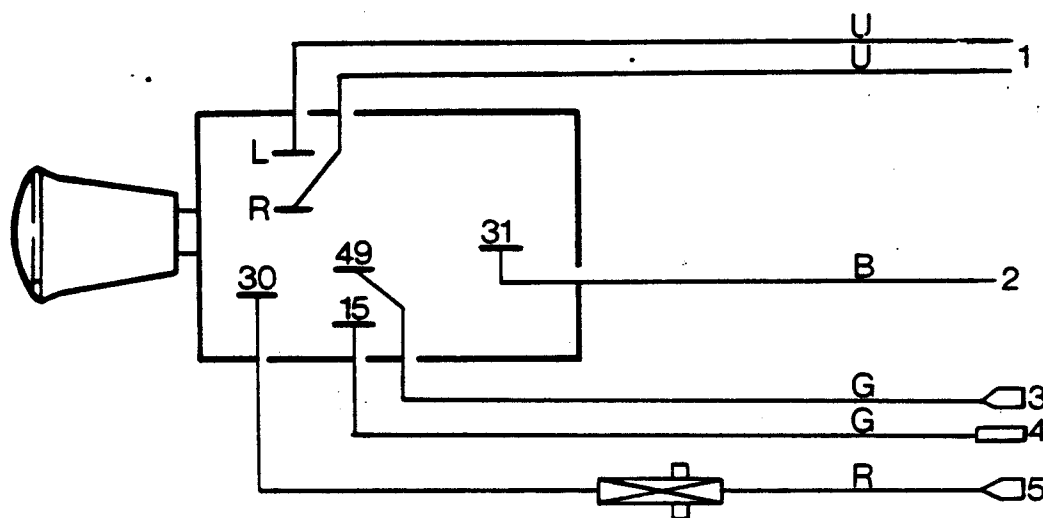
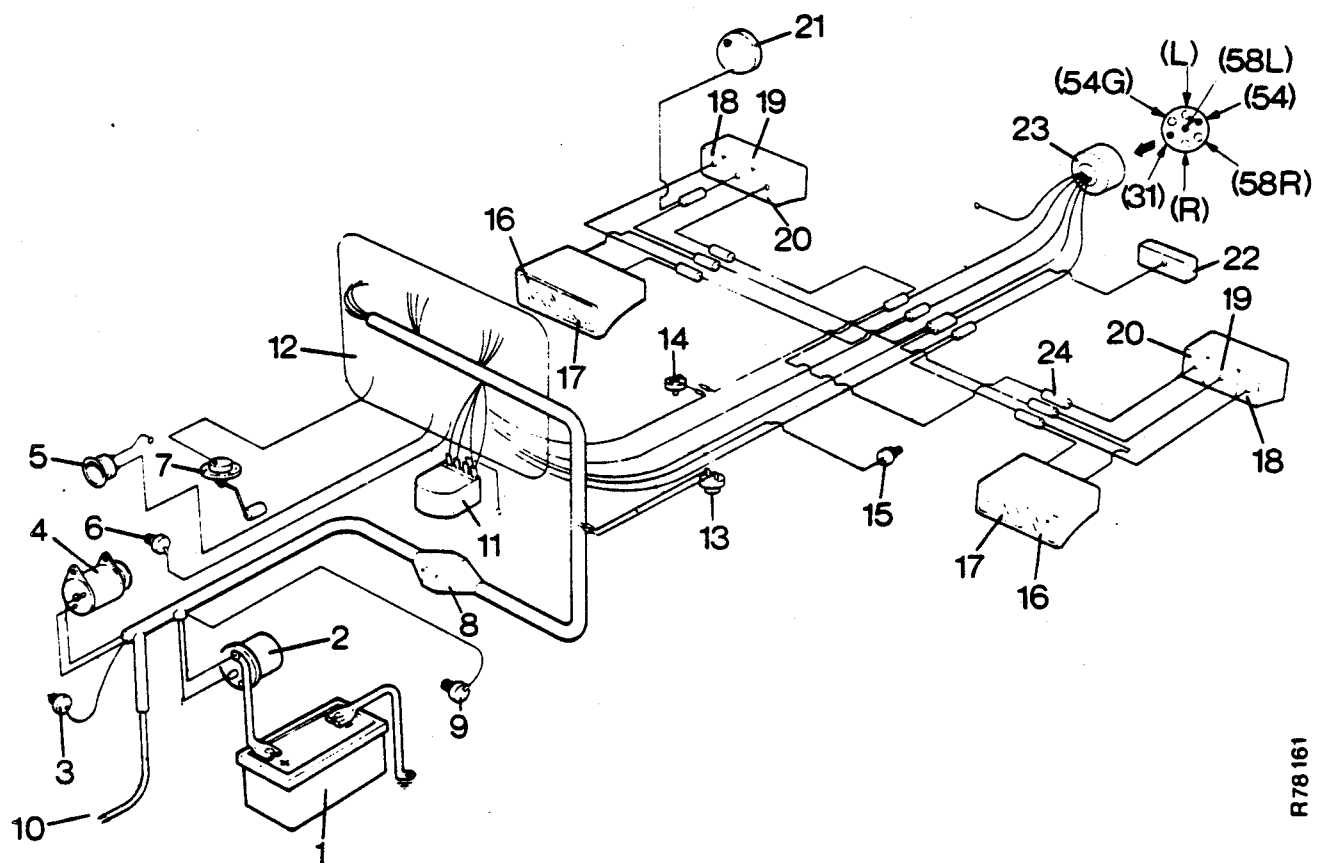


Figure H122  
LATER TYPE  
Part Number K950431

1. Connections to L and R terminals of the direction indicator switch.
2. Connection to ground.
3. Connection to 49 + terminal of direction
4. To green wire in the harness next to flasher unit.
5. To number 1 terminal of the starter switch.

R78160



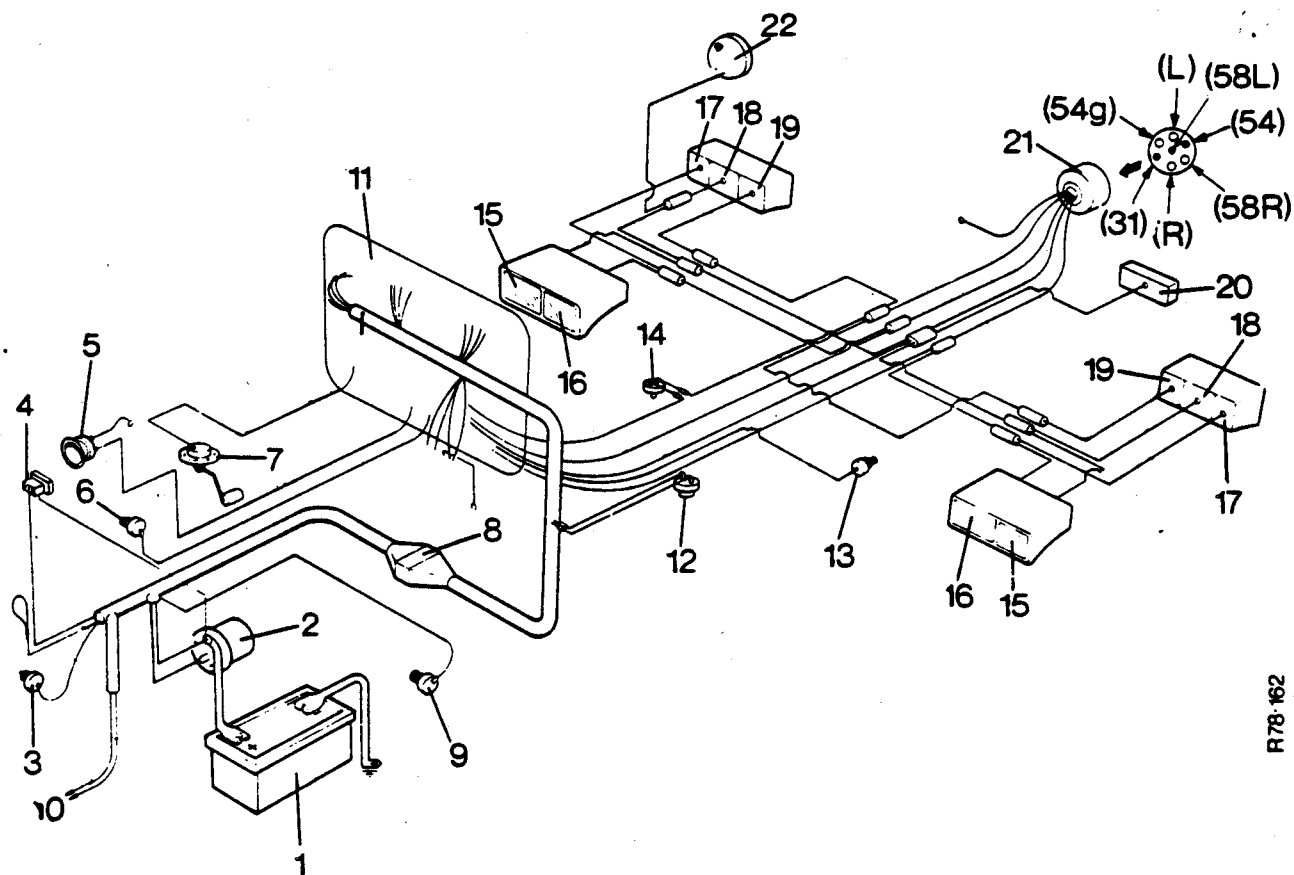
R78161

Figure H123  
ARRANGEMENT OF WIRING  
Tractors with full fenders, dynamo and early type wiring harness.

- |                              |                                 |
|------------------------------|---------------------------------|
| 1. Battery.                  | 17. Front direction indicators. |
| 2. Starter Solenoid.         | 18. Rear direction indicators.  |
| 3. Temperature sender unit.  | 19. Rear lamps.                 |
| 4. Dynamo.                   | 20. Stop lamps.                 |
| 5. Horn.                     | 21. Flood lamp.                 |
| 6. Thermostart.              | 22. Number plate lamp.          |
| 7. Fuel tank unit.           | 23. Trailer socket.             |
| 8. 10-way connector.         |                                 |
| 9. Oil pressure switch.      |                                 |
| 10. To headlamps.            |                                 |
| 11. Regulator.               |                                 |
| 12. Instrument panel.        |                                 |
| 13. Starter safety switch.   |                                 |
| 14. Stop lamp switch.        |                                 |
| 15. Hydraulic filter switch. |                                 |
| 16. Side lamps.              |                                 |

## TRAILER SOCKET

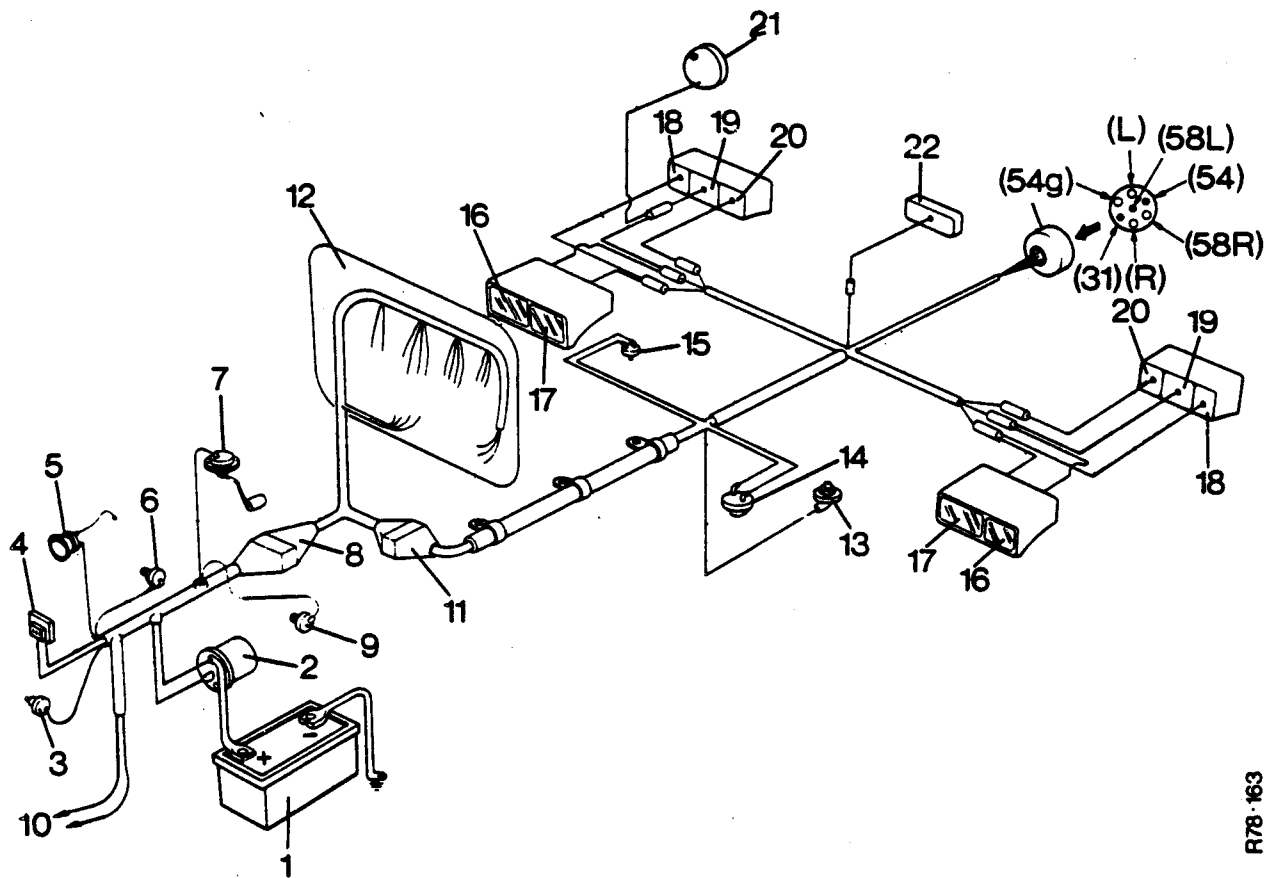
- 54G. Extra position.
- 58L. Left-hand, side and rear lamps.
- 58R. Right-hand, side and rear lamps.
- 54. Stop lamps.
- 31. Ground
- R. Right hand indicators.
- L. Left hand indicators.



R78-162

Figure H124  
ARRANGEMENT OF WIRING  
Tractors with full fenders, alternator and early type of wiring harness.

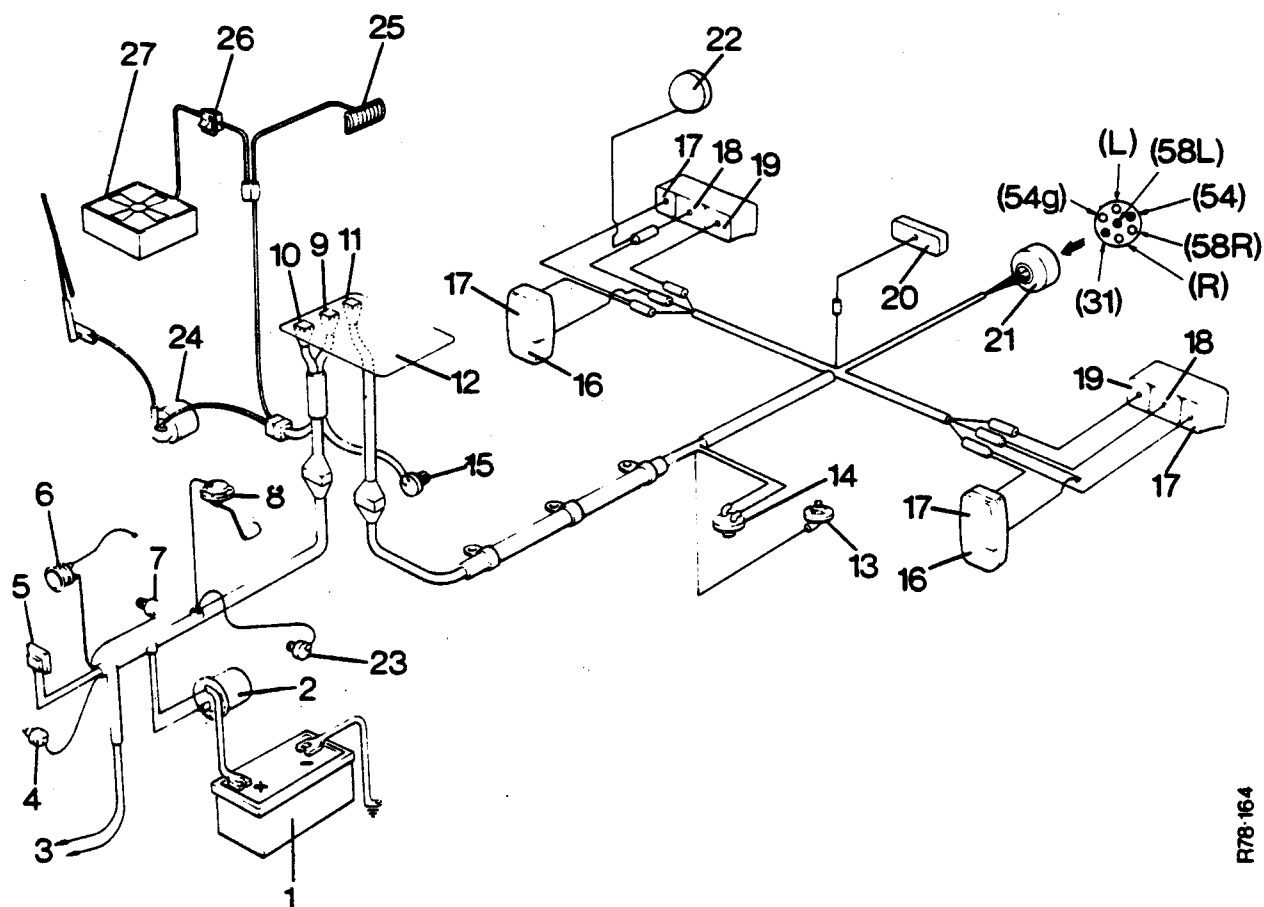
- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 1. Battery.                     | 17. Rear direction indicators.        |
| 2. Starter solenoid.            | 18. Rear lamps.                       |
| 3. Temperature sender unit.     | 19. Stop lamps.                       |
| 4. Alternator socket.           | 20. Number plate lamp.                |
| 5. Horn.                        | 21. Trailer socket.                   |
| 6. Thermostart.                 | 22. Flood lamp.                       |
| 7. Fuel tank unit.              | TRAILER SOCKET                        |
| 8. 10-way connector.            | 54g. Extra position.                  |
| 9. Oil pressure switch.         | 58L. Left-hand, side and rear lamps.  |
| 10. To headlamps.               | 58R. Right-hand, side and rear lamps. |
| 11. Instrument panel.           | 54. Stop lamps.                       |
| 12. Starter safety switch.      | 31. Ground.                           |
| 13. Hydraulic filter switch.    | R. Right hand indicators.             |
| 14. Stop lamp switch.           | L. Left hand indicators.              |
| 15. Side lamps.                 |                                       |
| 16. Front direction indicators. |                                       |



R78-163

Figure H125  
ARRANGEMENT OF WIRING  
Tractors with full fenders, alternator and later type wiring harness.

- |                                 |                                       |
|---------------------------------|---------------------------------------|
| 1. Battery.                     | 18. Rear direction indicators.        |
| 2. Starter solenoid.            | 19. Rear lamps.                       |
| 3. Temperature sender unit.     | 20. Stop lamps.                       |
| 4. Alternator socket.           | 21. Flood lamp.                       |
| 5. Horn.                        | 22. Number plate lamp.                |
| 6. Thermostart.                 | 23. Trailer socket.                   |
| 7. Fuel tank unit.              | TRAILER SOCKET                        |
| 8. 10-way connector.            | 54g. Extra position.                  |
| 9. Oil pressure switch.         | 58L. Left-hand, side and rear lamps.  |
| 10. To headlamps.               | 58R. Right-hand, side and rear lamps. |
| 11. 7-way socket.               | 54. Stop lights.                      |
| 12. Instrument panel.           | 31. Ground.                           |
| 13. Hydraulic filter switch.    | R. Right hand indicators.             |
| 14. Starter safety switch.      | L. Left hand indicators.              |
| 15. Stop lamp switch.           |                                       |
| 16. Side lamps.                 |                                       |
| 17. Front direction indicators. |                                       |



R78-164

Figure H126  
ARRANGEMENT OF WIRING  
For tractors with Q-Cab.

- |                              |                               |
|------------------------------|-------------------------------|
| 1. Battery.                  | 20. Number plate lamp.        |
| 2. Starter solenoid.         | 21. Trailer socket.           |
| 3. To headlamps.             | 22. Flood lamp.               |
| 4. Temperature sender unit.  | 23. Oil pressure switch.      |
| 5. Alternator socket.        | 24. Wiper motor.              |
| 6. Horn.                     | 25. Interior lamp.            |
| 7. Thermostart.              | 26. Fan switch.               |
| 8. Fuel tank unit.           | 27. Heater unit.              |
| 9. 11-way connector.         | TRAILER SOCKET                |
| 10. 2-way connector.         | 54g. Extra position.          |
| 11. 7-way connector.         | 58L. Left-hand, side and rear |
| 12. Instrument panel.        | lamps.                        |
| 13. Hydraulic filter switch. | 58R. Right-hand, side and     |
| 14. Starter safety switch.   | rear lamps.                   |
| 15. Stop lamp switch.        | 54. Stop lamps.               |
| 16. Side lamps.              | 31. Ground.                   |
| 17. Direction indicators.    | R. Right hand indicators.     |
| 18. Rear lamps.              | L. Left hand indicators.      |
| 19. Stop lamps.              |                               |

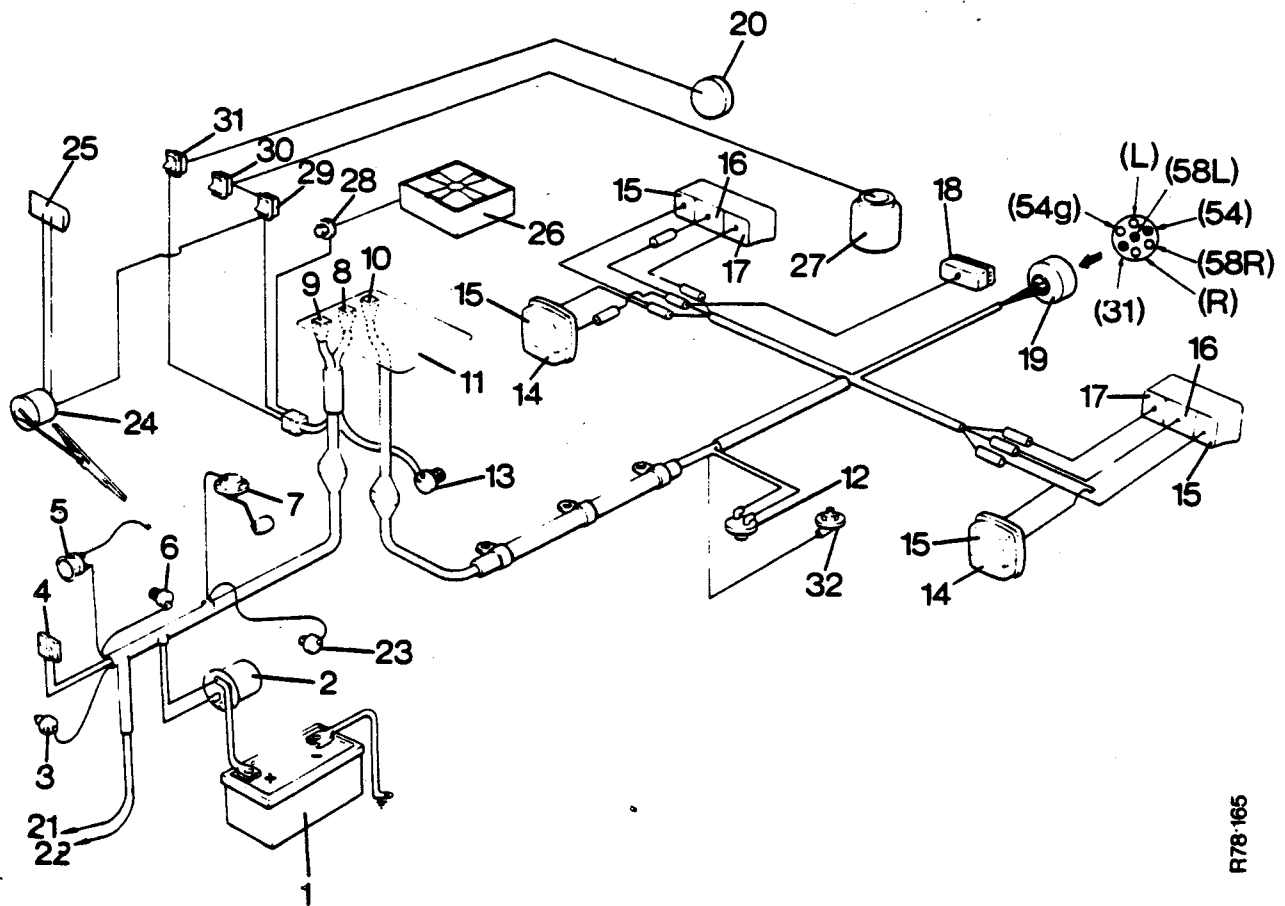
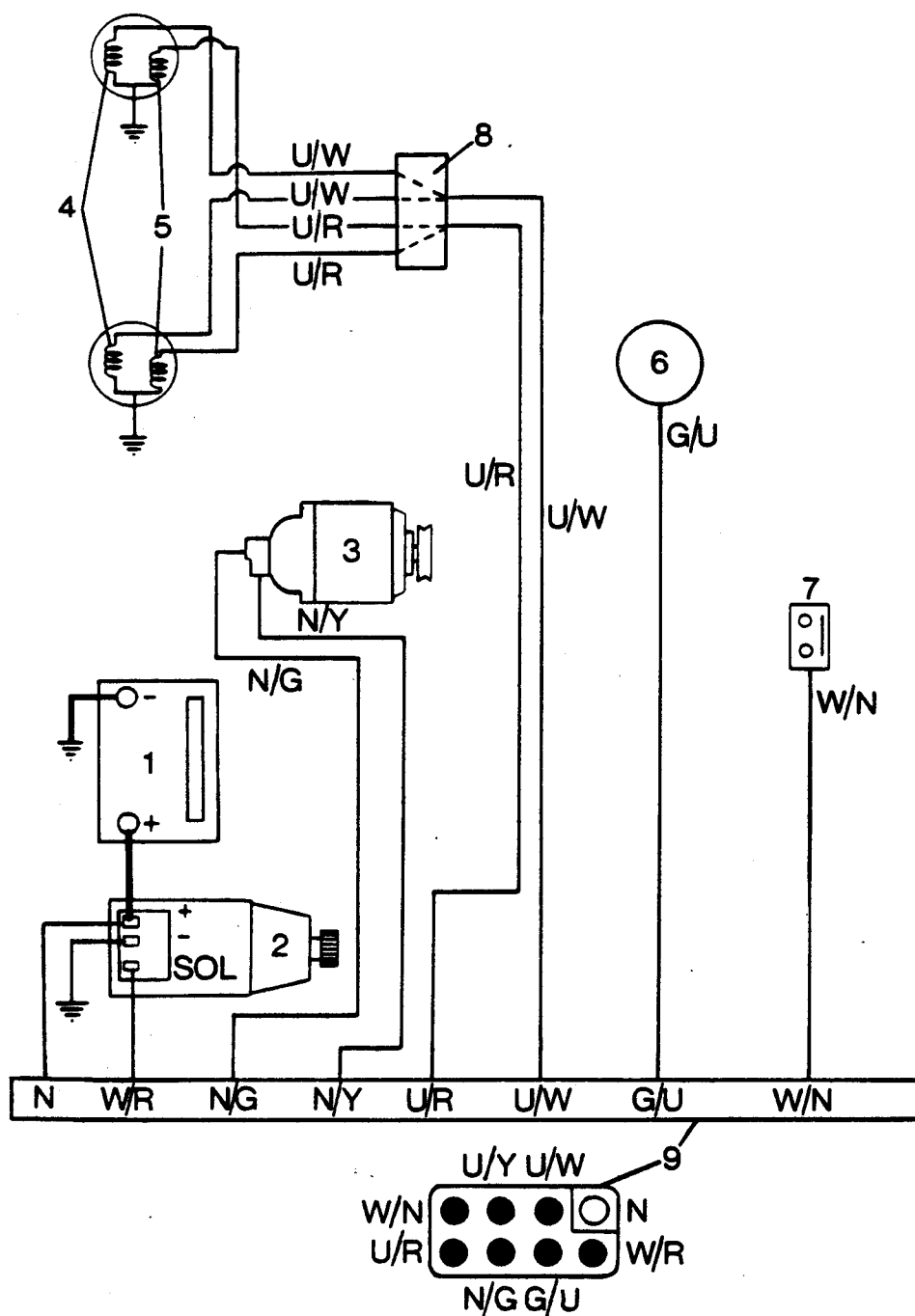


Figure H127  
ARRANGEMENT OF WIRING  
Tractors with de-luxe cab and Sekura cab.

- |                               |   |
|-------------------------------|---|
| 1. Battery.                   | 18. Number plate lamp.  |
| 2. Starter solenoid.          | 19. 7-point trailer socket.   |
| 3. Temperature sender.        | 20. Rear flood lamp.  |
| 4. Alternator socket.         | 21. Dip beam.   |
| 5. Horn.                      | 22. Main beam.  |
| 6. Thermostart.               | 23. Oil pressure switch.  |
| 7. Fuel tank unit.            | 24. Windshield wiper motor.   |
| 8. 11-way connector.          | 25. Cab interior lamp.  |
| 9. 2-way connector.           | 26. Fan unit.   |
| 10. 7-way connector.          | 27. Washer motor.   |
| 11. Instrument panel.         | 28. Fan switch.   |
| 12. Starter safety switch.    | 29. Wiper switch.   |
| 13. Stop lamp switch.         | 30. Washer switch.  |
| 14. Side lamp.                | 31. Floodlamp switch.   |
| 15. Direction indicator lamp. | 32. Hydraulic filter switch, installed on 8, 9 and 12 series tractors only. |
| 16. Rear lamp.                |   |
| 17. Stop lamp.                |   |

R78-165



R78-166

Figure H128  
ENGINE HARNESS

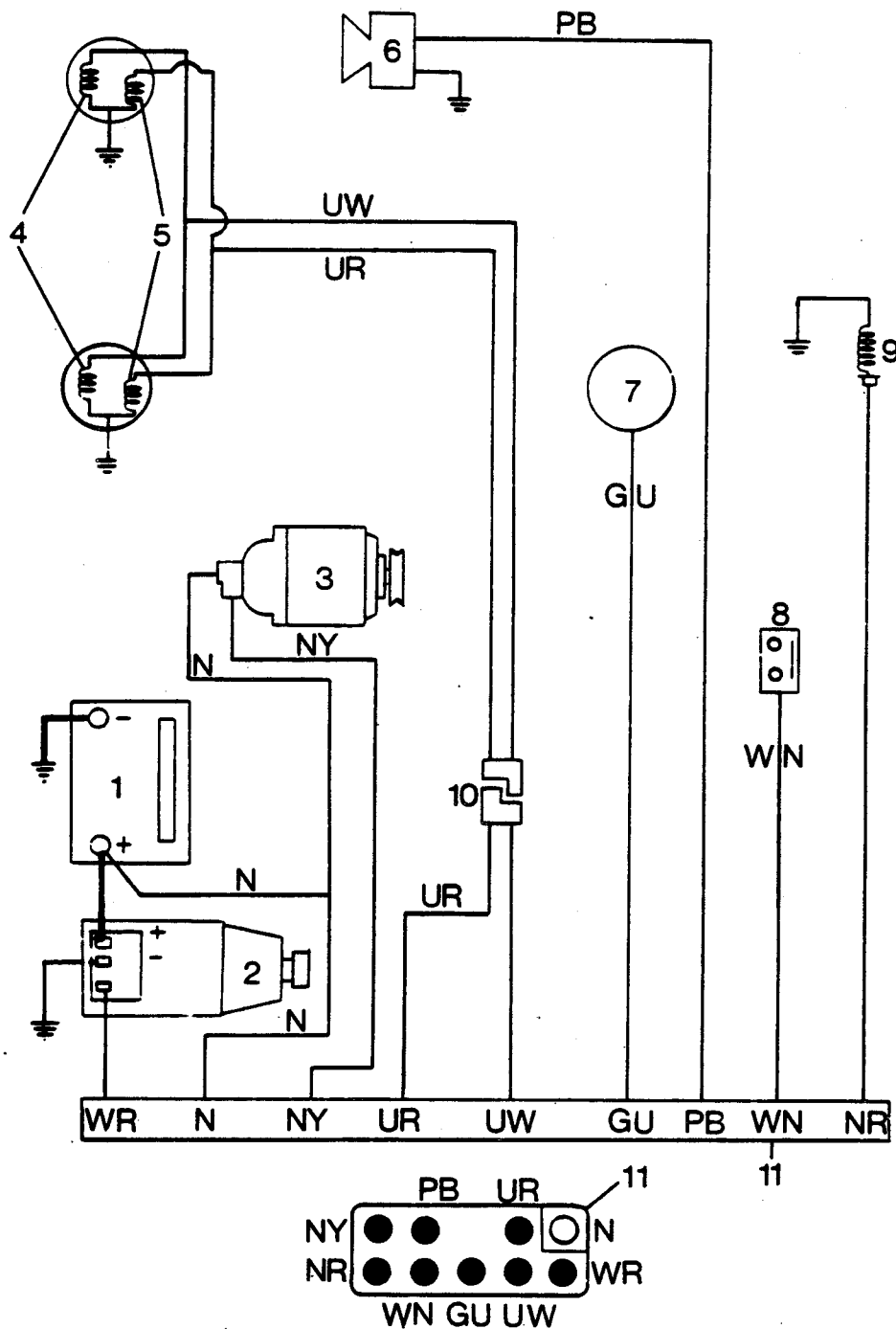
For tractors with a dynamo, up to the following serial numbers:

885: 633680  
990: 862037  
995: 930639

996: 985304  
1210: 727072  
1212: 1003291

- 1. Battery.
- 2. Starter.
- 3. Dynamo.
- 4. Headlamp, main.
- 5. Headlamp, dip.
- 6. Temperature sender unit.
- 7. Oil pressure switch.
- 8. Headlamp connector, 4-way.
- 9. 8-way connector to instrument panel.





R 78.167

Figure H129  
ENGINE HARNESS

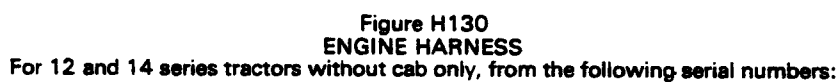
For tractors with an alternator, from the following serial numbers:

885:629959  
885Q:1100001  
990:558824  
990Q:11070001  
995:927997  
995Q:11070001

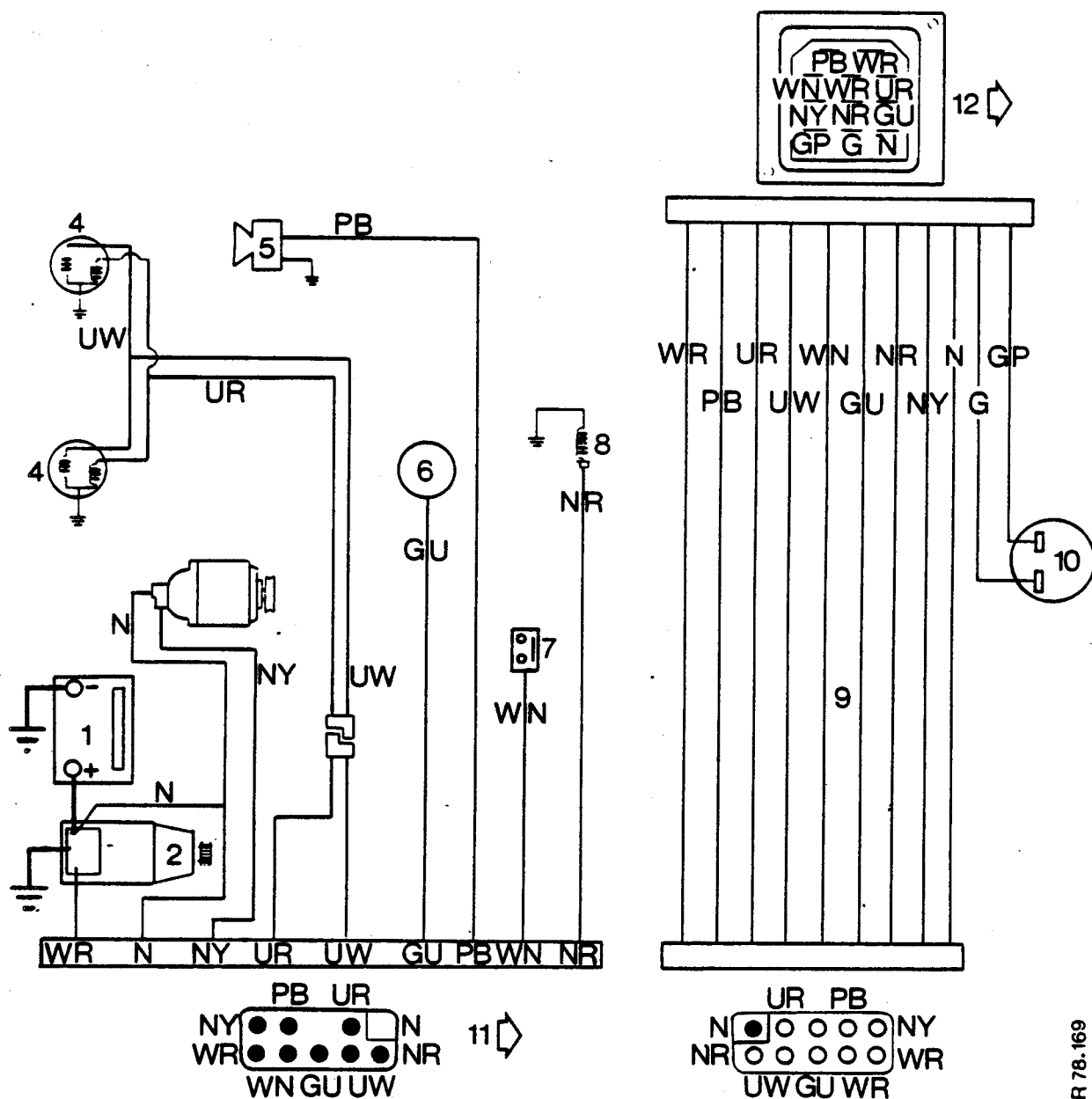
996:983735  
996Q:11070001  
1210Q } 11150001  
1212Q }  
1410Q } 11200001  
1412Q }

1. Battery.
2. Starter.
3. Alternator.
4. Headlamp, main.
5. Headlamp, dip.
6. Horn.

7. Temperature sender unit.
8. Oil pressure switch.
9. Thermostart.
10. Headlamp connector, 2-way.
11. 9-way connector to instrument panel.



7. Temperature sender unit.
8. Oil pressure switch.
9. Thermostat.
10. Headlamp connector, 2-way.
11. Fuel tank unit.
12. 10-way connector to instrument panel.



**Figure H131**  
**ENGINE HARNESS**

**For tractors with Q-cab, de-luxe cab, and Sekura cab, from the following serial numbers:**

```

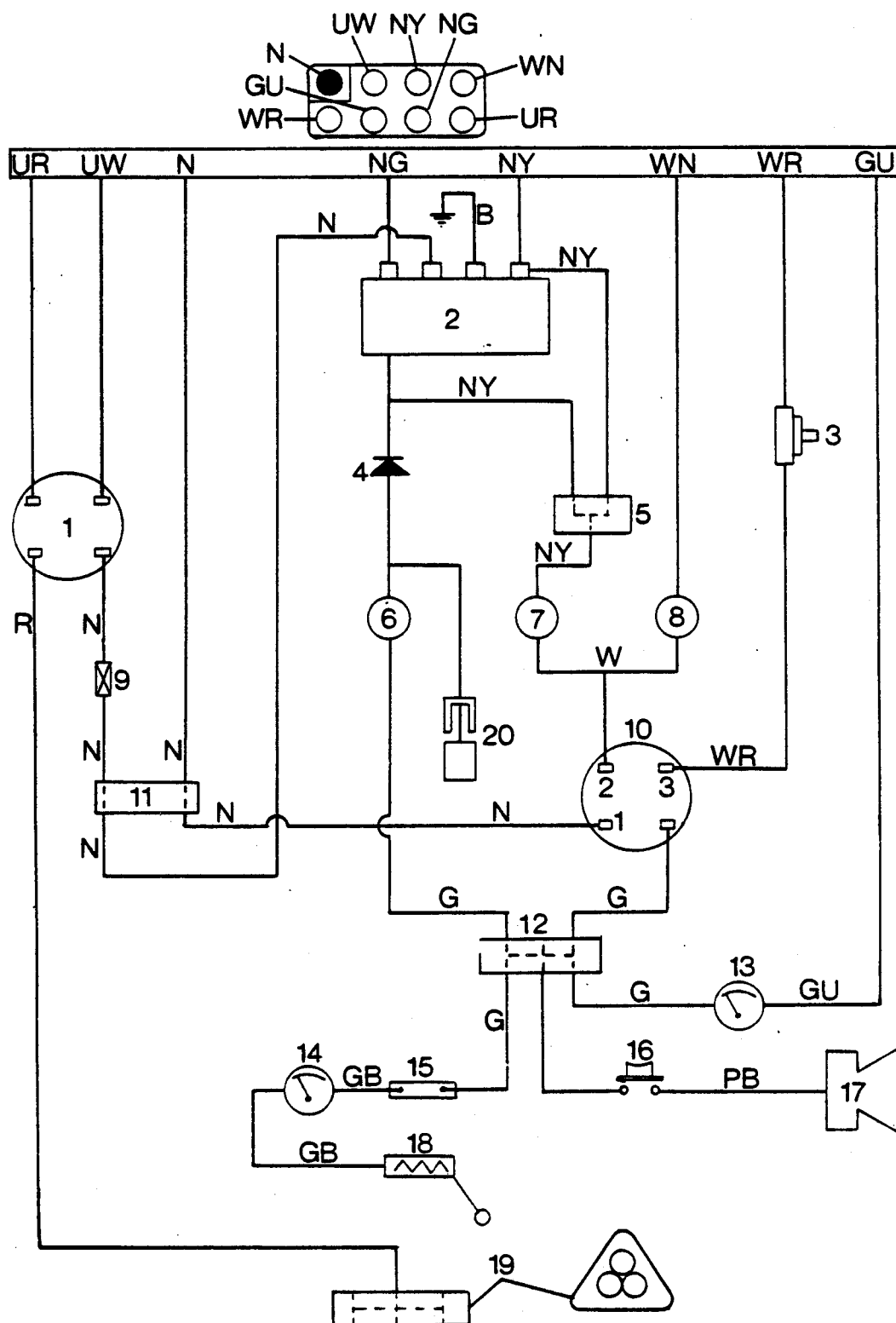
885:11000001
990 } 1107001
995 }
996 }

```

$$\begin{array}{l} 1210 \\ 1212 \end{array} \left. \vphantom{\begin{array}{l} 1210 \\ 1212 \end{array}} \right\} 11150001$$
  

$$\begin{array}{l} 1410 \\ 1412 \end{array} \left. \vphantom{\begin{array}{l} 1410 \\ 1412 \end{array}} \right\} 11200001$$

1. Battery.
2. Starter.
3. Alternator.
4. Headlamp.
5. Horn.
6. Temperature sender unit.
7. Oil pressure switch.
8. Thermostat.
9. Console harness.
10. Stop lamp switch.
11. 9-way connector, to console harness.
12. 11-way connector, to instrument panel.



R 78,170

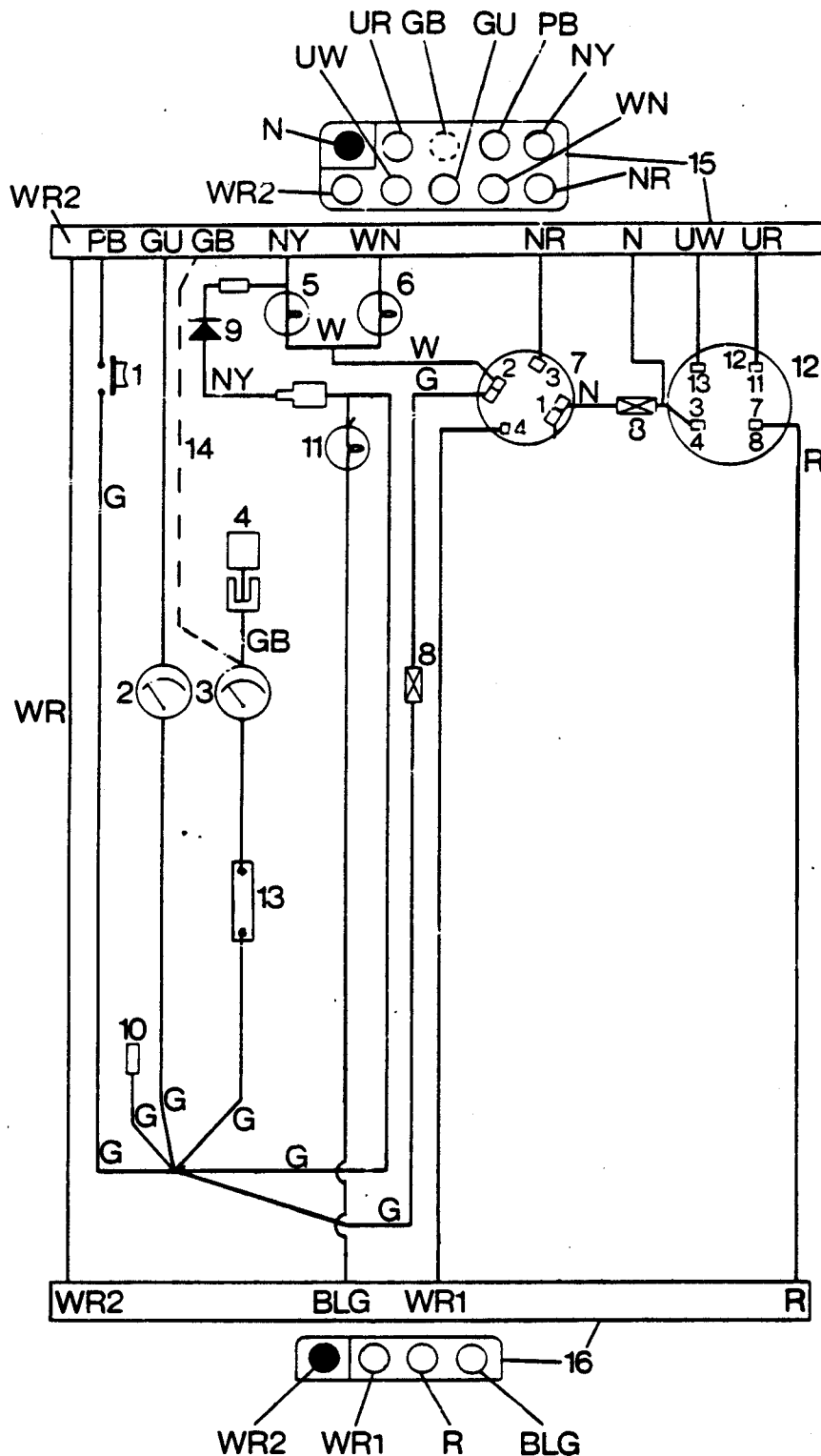
Figure H132  
INSTRUMENT PANEL HARNESS

For tractors with shell fenders, up to the following serial numbers:

- |                                      |                                      |
|--------------------------------------|--------------------------------------|
| 885:633680                           | 996:985304                           |
| 990:860237                           | 1210:727072                          |
| 995:930639                           | 1212:1003291                         |
| 1. Lighting switch.                  | 11. Double connector.                |
| 2. Regulator.                        | 12. Connector 3-way.                 |
| 3. Starter safety switch.            | 13. Temperature gauge.               |
| 4. Diode.                            | 14. Fuel gauge.                      |
| 5. Double connector.                 | 15. Voltage stabiliser, 885 only.    |
| 6. Hydraulic filter lamp, yellow.    | 16. Horn button.                     |
| 7. Charge warning lamp, red.         | 17. Horn.                            |
| 8. Oil pressure warning lamp, green. | 18. Fuel tank unit.                  |
| 9. Fuse.                             | 19. Connector 3-way to rear harness. |
| 10. Starter/Isolating switch.        | 20. Hydraulic filter switch.         |

9-37222

H93



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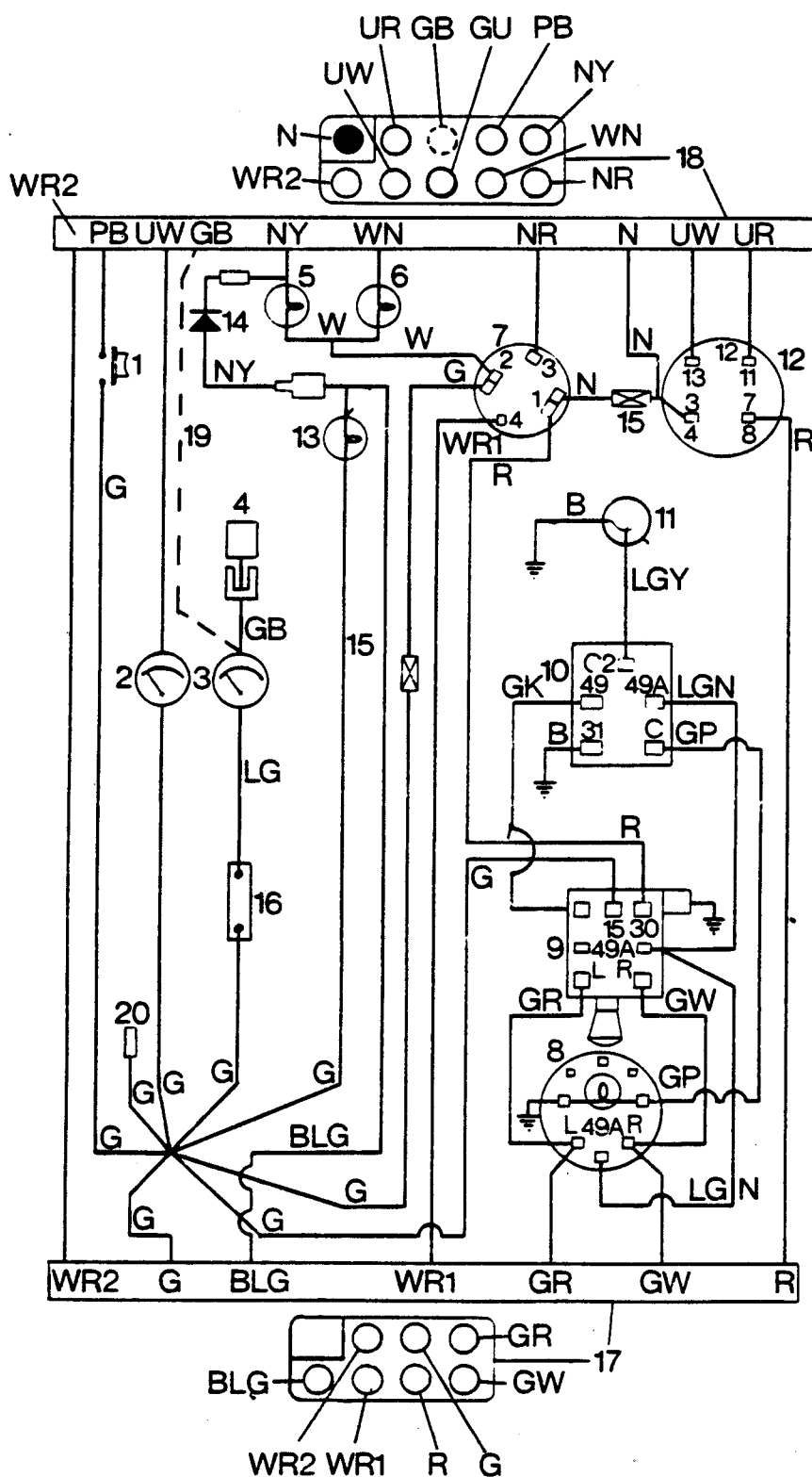
Figure H133  
INSTRUMENT PANEL HARNESS

For tractors with shell fenders, from the following serial numbers:

885:633680  
990:862037  
995:930639

996:985304  
1210:727072  
1212:1003291

- |                                      |  |
|--------------------------------------|--|
| 1. Horn button.                      | 10. Connection for extra equipment.                                    |
| 2. Temperature gauge.                | 11. Hydraulic filter lamp, yellow.                                     |
| 3. Fuel gauge.                       | 12. Lighting switch.   |
| 4. Fuel tank unit.                   | 13. Voltage stabiliser, 885 only.                                      |
| 5. Charge warning lamp, red.         | 14. Connection to fuel tank unit in engine harness, 12 series tractor. |
| 6. Oil pressure warning lamp, green. | 15. 10-way connector, to engine harness.                               |
| 7. Isolating/Starter switch.         | 16. 4-way connector to rear harness.                                   |
| 8. Fuses.                            |  |
| 9. Diode.                            |  |

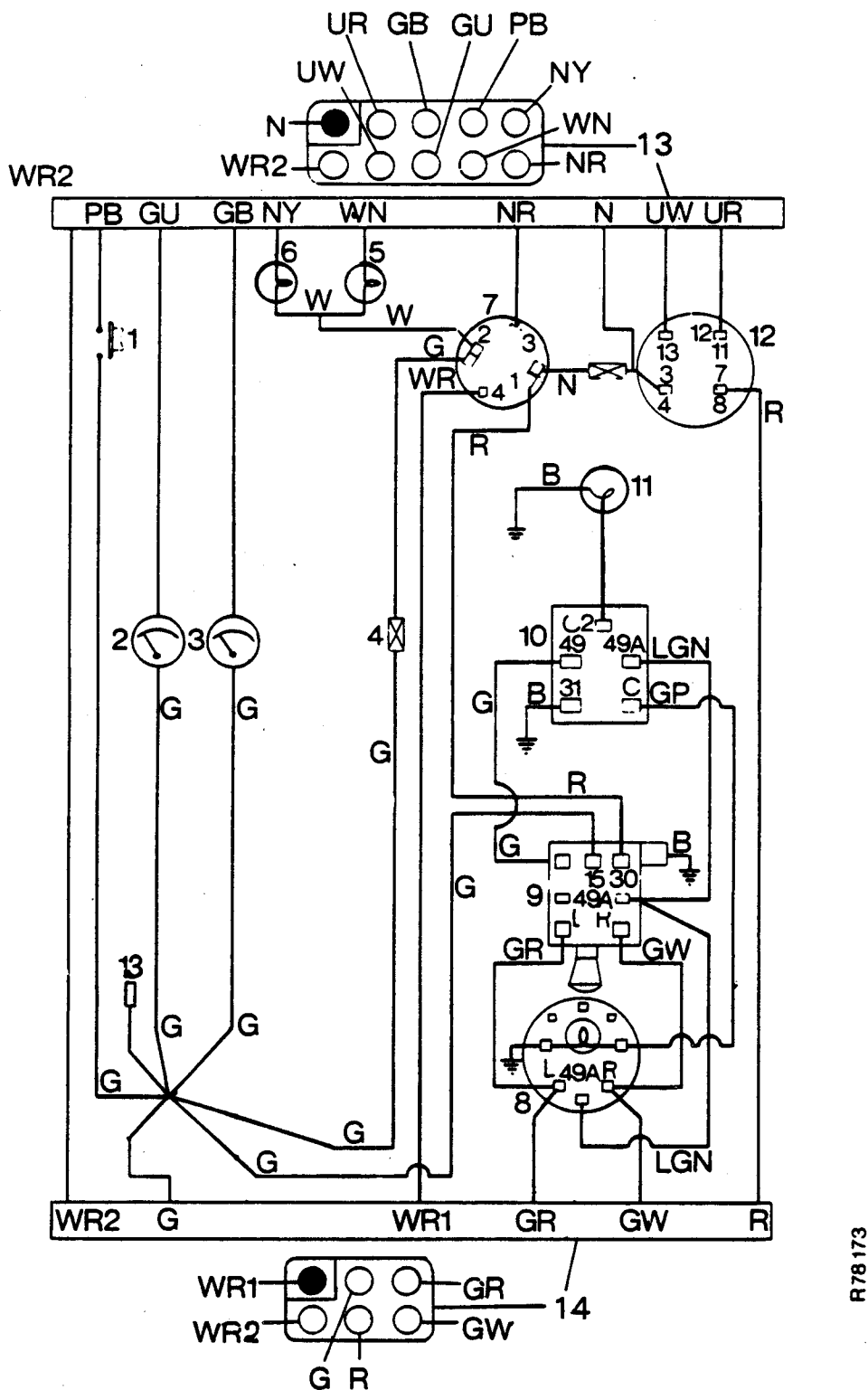


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Figure H134  
INSTRUMENT PANEL HARNESS  
For tractors with full fenders, from the following serial numbers:

885:633680	1210:727072
990:862037	1212:1003291
995:930639	1410 }
996:985304	1412 } 1050001

- |                                      |   |  |
|--------------------------------------|---|--|
| 1. Horn button.                      | 8. Direction indicator switch.                  | 15. Fuses.   |
| 2. Temperature gauge.                | 9. Hazard warning switch.                       | 16. Voltage stabiliser, 885 only.                        |
| 3. Fuel gauge.                       | 10. Flasher unit.                               | 17. 7-way connector, to rear harness.                    |
| 4. Fuel tank sender unit.            | 11. Warning lamp, trailer direction indicators. | 18. 9-way connector, to engine harness.                  |
| 5. Charge warning lamp, red.         | 12. Lighting switch.                            | 19. Connection to fuel tank unit, 12 and 14 series only. |
| 6. Oil pressure warning lamp, green. | 13. Hydraulic filter warning lamp, yellow.      | 20. Connection for extra equipment.                      |
| 7. Isolating/Starter switch.         | 14. Diode.                                      |  |



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Figure H136  
INSTRUMENT PANEL HARNESS

For 12 and 14 series tractors, with full fenders, from the following serial numbers:

1210 } 11152567  
1212 }

1410 11200752  
1412

- |                                      |   |
|--------------------------------------|---|
| 1. Horn button.                      | 8. Direction indicator switch.                  |
| 2. Temperature gauge.                | 9. Hazard warning switch.                       |
| 3. Fuel contents gauge.              | 10. Flasher unit.                               |
| 4. Fuses.                            | 11. Warning lamp, trailer direction indicators. |
| 5. Charge warning lamp, red.         | 12. Lighting switch.                            |
| 6. Oil pressure warning lamp, green. | 13. 10-way connector, to engine harness.        |
| 7. Isolating/starter switch.         | 14. 6-way connector, to rear harness.           |

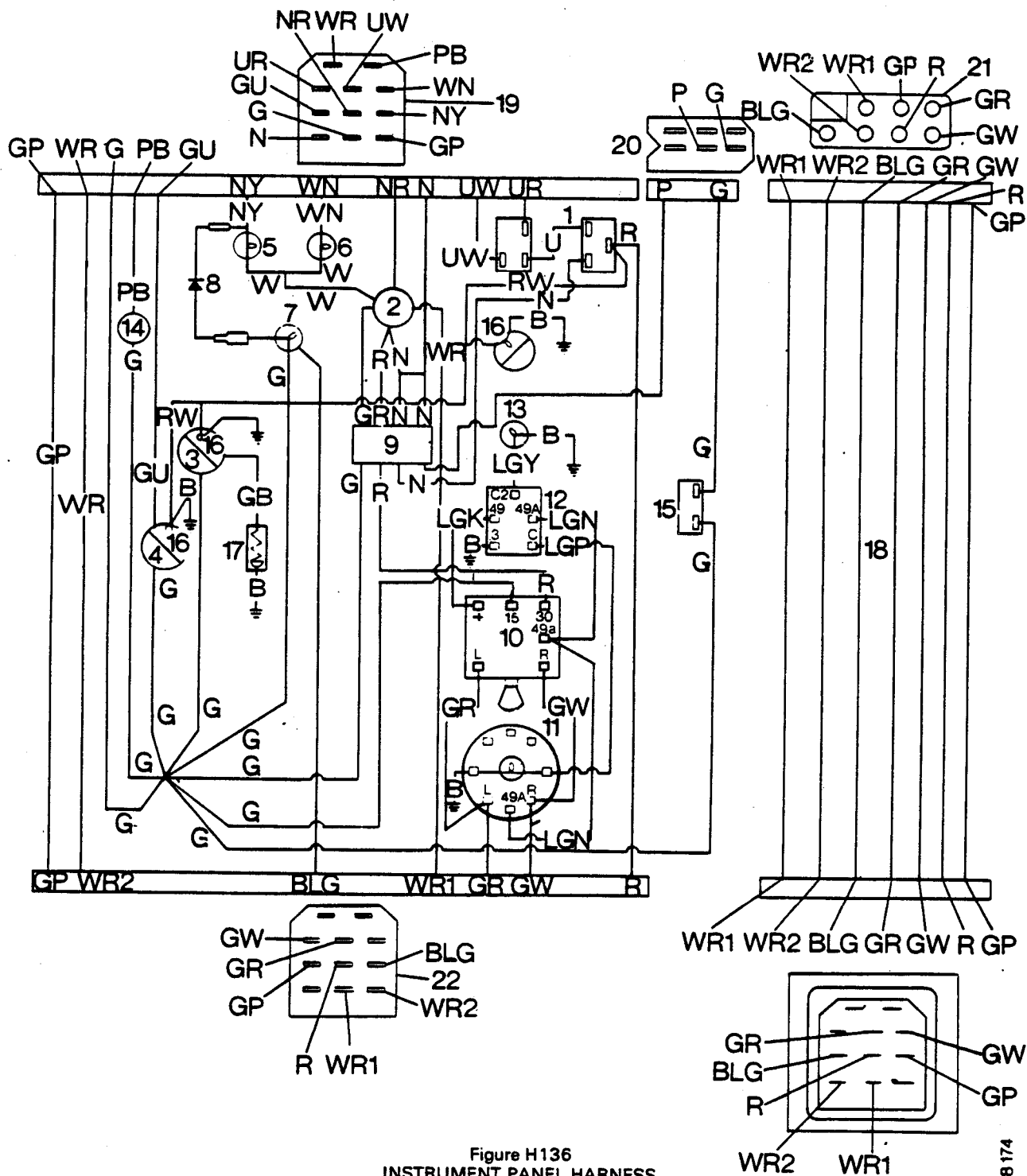


Figure H136  
INSTRUMENT PANEL HARNESS  
For tractors with Q-cab, from the following serial numbers:

*Without console harness:*

885Q: 11000001  
990Q }  
995Q } 11070001  
996Q }

1210Q } 11150001  
121Q }  
1410Q } 11200001  
1412Q }

*With console harness:*

885Q: 11006680  
990Q }  
995Q } 11083020  
996Q }

1210Q } 11156513  
1212Q }  
1410Q } 11202423  
1412Q }

1. Lighting switches.
2. Isolating/starter switch.
3. Fuel gauge.
4. Temperature gauge.
5. Charge warning lamp, red.
6. Oil pressure warning lamp, green.
7. Hydraulic filter lamp, yellow.
8. Diode.

9. Fuses.
10. Hazard warning switch.
11. Direction indicator switch.
12. Flasher unit.
13. Warning lamp, trailer direction indicators.
14. Horn button.
15. Wiper switch.
16. Panel lamps.

17. Fuel tank unit.
18. Console harness, not on early tractors with cab.
19. 11-way connector, to engine console harness.
20. 2-way connector, to cab harness.
21. 7-way connector, to rear harness.
22. 7-way connector, to console harness.

**NOTE:** Items 7 and 8 are not installed on 12 series from 11152617 and 14 series from 11200752.



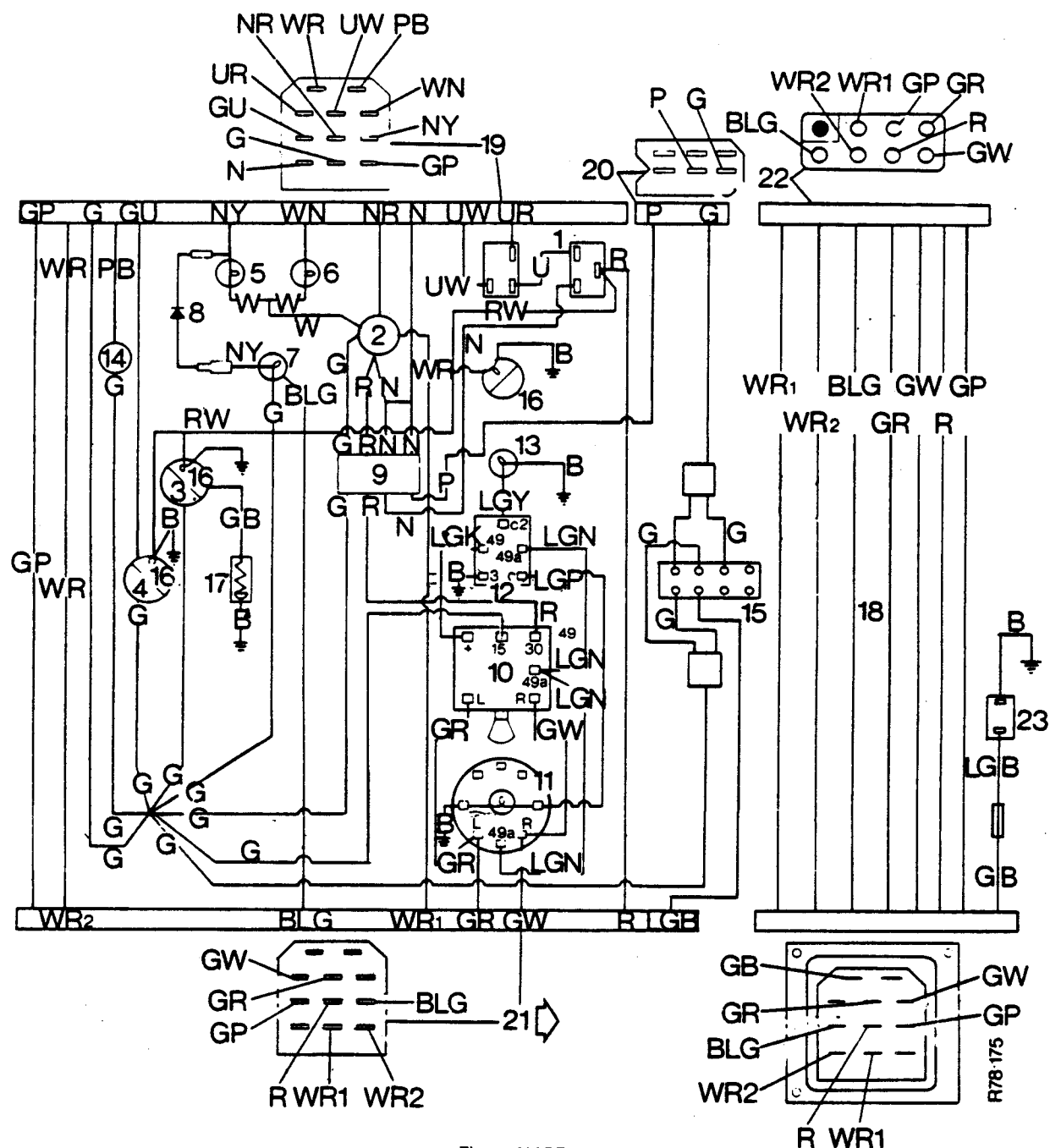


Figure H137  
INSTRUMENT PANEL HARNESS

For tractors with Q-cab from the following serial numbers:

885Q:11010300  
990 }  
995 } 11088300  
996 }

1210 } 111558600  
1212 }  
1410 } 11203600  
1412 }

1. Lighting switches.
2. Isolating/starter switch.
3. Fuel gauge.
4. Temperature gauge.
5. Charge warning lamp, red.
6. Oil pressure warning lamp, green.
7. Hydraulic filter lamp, yellow.
8. Diode.
9. Fuses.
10. Hazard warning switch.
11. Direction indicator switch.
12. Flasher unit.

13. Warning lamp, trailer direction indicators.
14. Horn button.
15. Wiper/Washer switch.
16. Panel lamps.
17. Fuel tank unit.
18. Console harness.
19. 11-way connector, to engine console harness.
20. 2-way connector, to cab harness.
21. 7-way connector, to console harness.
22. 7-way connector, to rear harness.
23. Windshield washer motor.

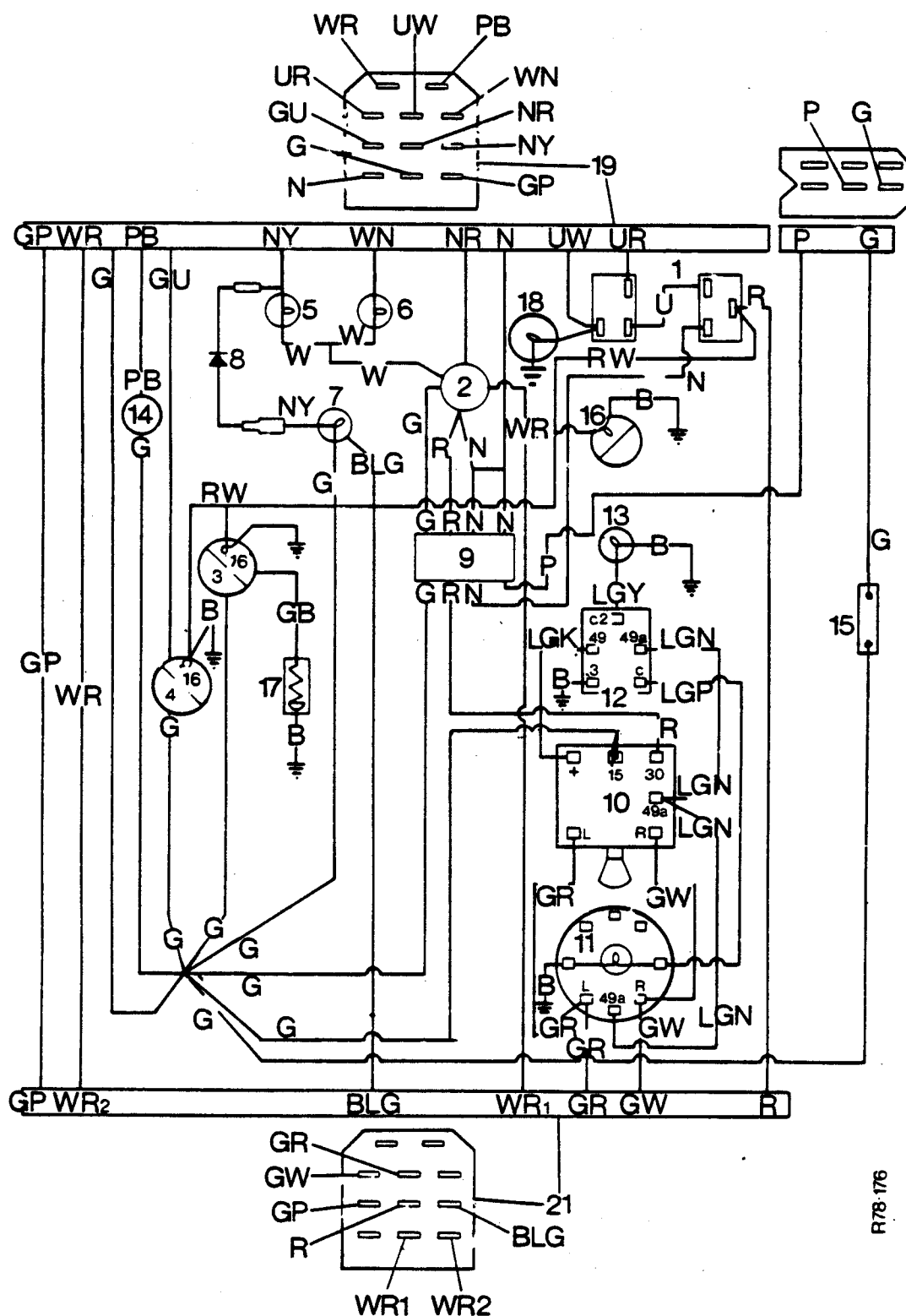


Figure H138  
INSTRUMENT PANEL HARNESS

For tractors with a de-luxe cab and Sekura cab, from the following serial numbers:

885	11010509	1210	11158982
990		1212	
995	11088651	1410	11203600
996		1412	

- |                                      |   |  |
|--------------------------------------|---|--|
| 1. Lighting switches.                | 9. Fuses.                                       | 17. Fuel tank unit.                              |
| 2. Isolating/Starter switch.         | 10. Hazard warning switch.                      | 18. Main headlamp warning, blue.                 |
| 3. Fuel gauge.                       | 11. Direction indicator switch.                 | 19. 11-way connector, to engine console harness. |
| 4. Temperature gauge.                | 12. Flasher unit.                               | 20. 2-way connector, to cab harness.             |
| 5. Charge warning lamp, red.         | 13. Warning lamp, trailer direction indicators. | 21. 7-way connector, to rear harness.            |
| 6. Oil pressure warning lamp, green. | 14. Horn button.                                |  |
| 7. Hydraulic filter lamp, yellow.    | 15. Single connector.                           |  |
| 8. Diode.                            | 16. Panel lamps.                                |  |



Figure H139  
INSTRUMENT PANEL HARNESS  
For tractor without cab, Germany.

- |                                       |   |
|---------------------------------------|---|
| 1. 4-way connector to headlamps.      | 10. Oil pressure warning lamp, green.           |
| 2. 9-way connector to engine harness. | 11. Isolation/Starter switch.                   |
| 3. 2-way connector to headlamps.      | 12. Direction indicators switch.                |
| 4. Fuse box, 8 fuses.                 | 13. Hazard warning switch.                      |
| 5. Horn button.                       | 14. Flasher unit.                               |
| 6. Temperature gauge.                 | 15. Warning lamp, trailer direction indicators. |
| 7. Fuel gauge.                        | 16. Light switch.                               |
| 8. Fuel tank unit.                    | 17. Hydraulic filter warning, yellow.           |
| 9. Charge warning lamp, red.          | 18. 7-way connector to rear harness.            |

Figure H140  
INSTRUMENT PANEL HARNESS

For tractors for Germany with de-luxe cab (Sekura), from the following serial numbers:

990 }  
995 } 11087366  
996 }

1210 }  
1212 } 11158779  
1410 }  
1412 } 11203833

1. Lighting switches.
2. Isolating/Starter switch.
3. Fuel gauge.
4. Temperature gauge.
5. Charge warning lamp, red.
6. Oil pressure warning lamp, green.
7. Hydraulic filter lamp, yellow.
8. Diode.
9. Fuses.
10. Hazard warning switch.
11. Direction indicator switch.

12. Flasher unit.
13. Warning lamps, trailer direction indicators.
14. Horn button.
15. Single connector.
16. Panel.
17. Fuel tank unit.
18. Main headlamp warning, blue.
19. 11-way connector to engine harness.
20. Connection to console harness.
21. Connection to cab harness.
22. 7-way connector to rear harness.



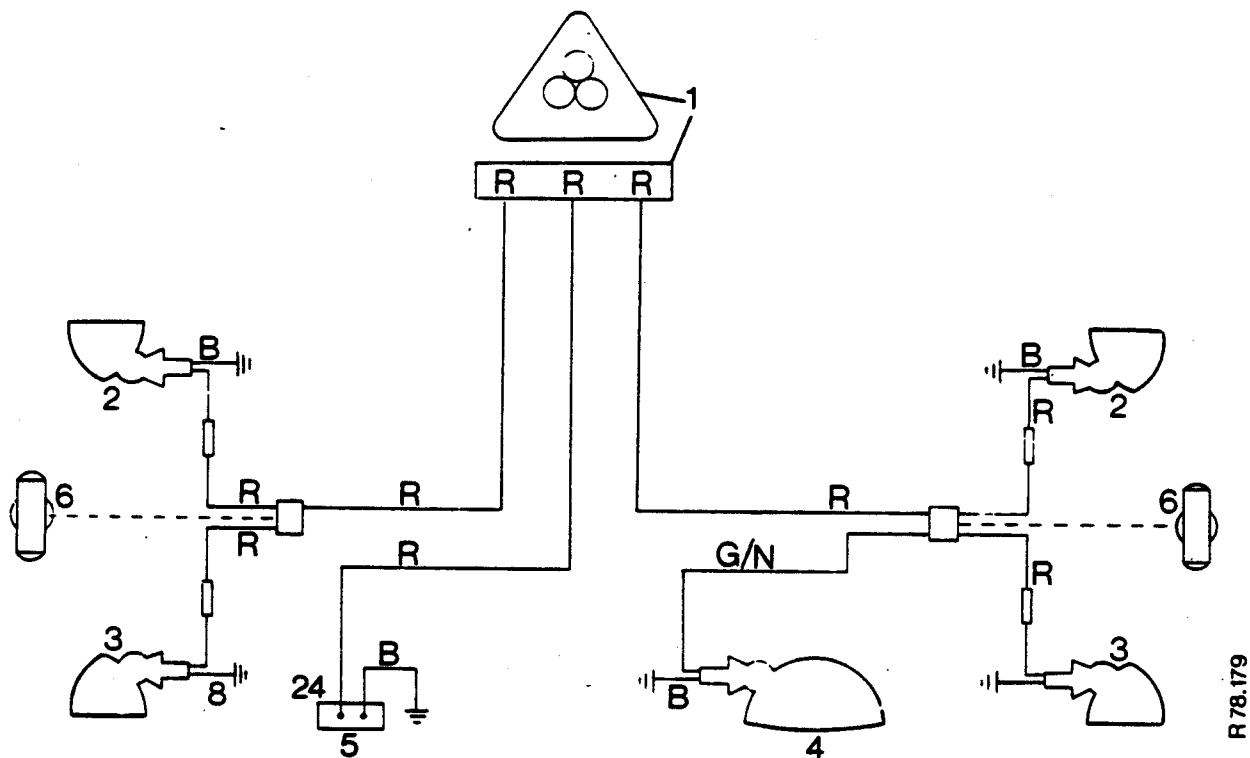


Figure H141  
REAR HARNESS

For tractors with shell fenders up to the following serial numbers:

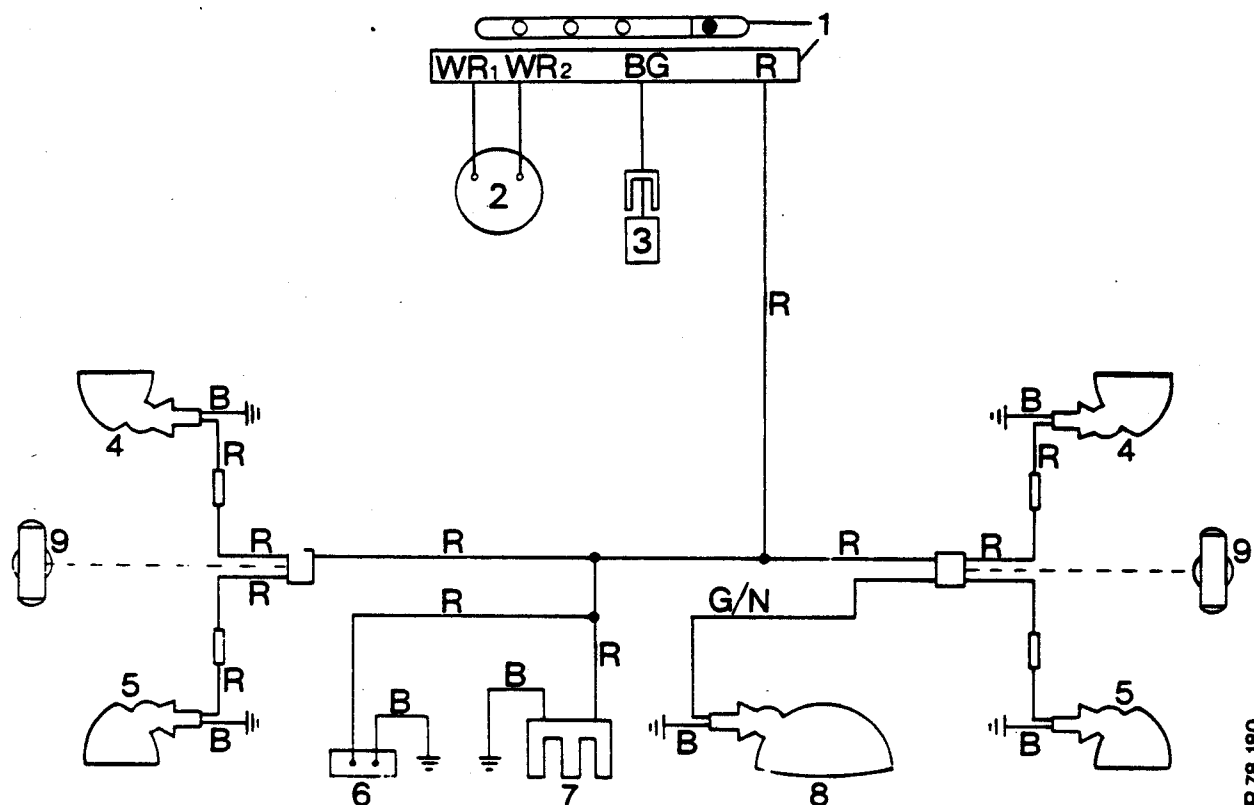
885:633680  
990:862037  
995:930639

996:985304  
1210:727072  
1212:1003291

1. 3-way connector.  
2. Side lamps.  
3. Rear lamps.

4. Flood lamp.  
5. Number plate lamp.  
6. Single side/rear lamp as installed on some tractor models.

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R 78.180

Figure H142  
REAR HARNESS

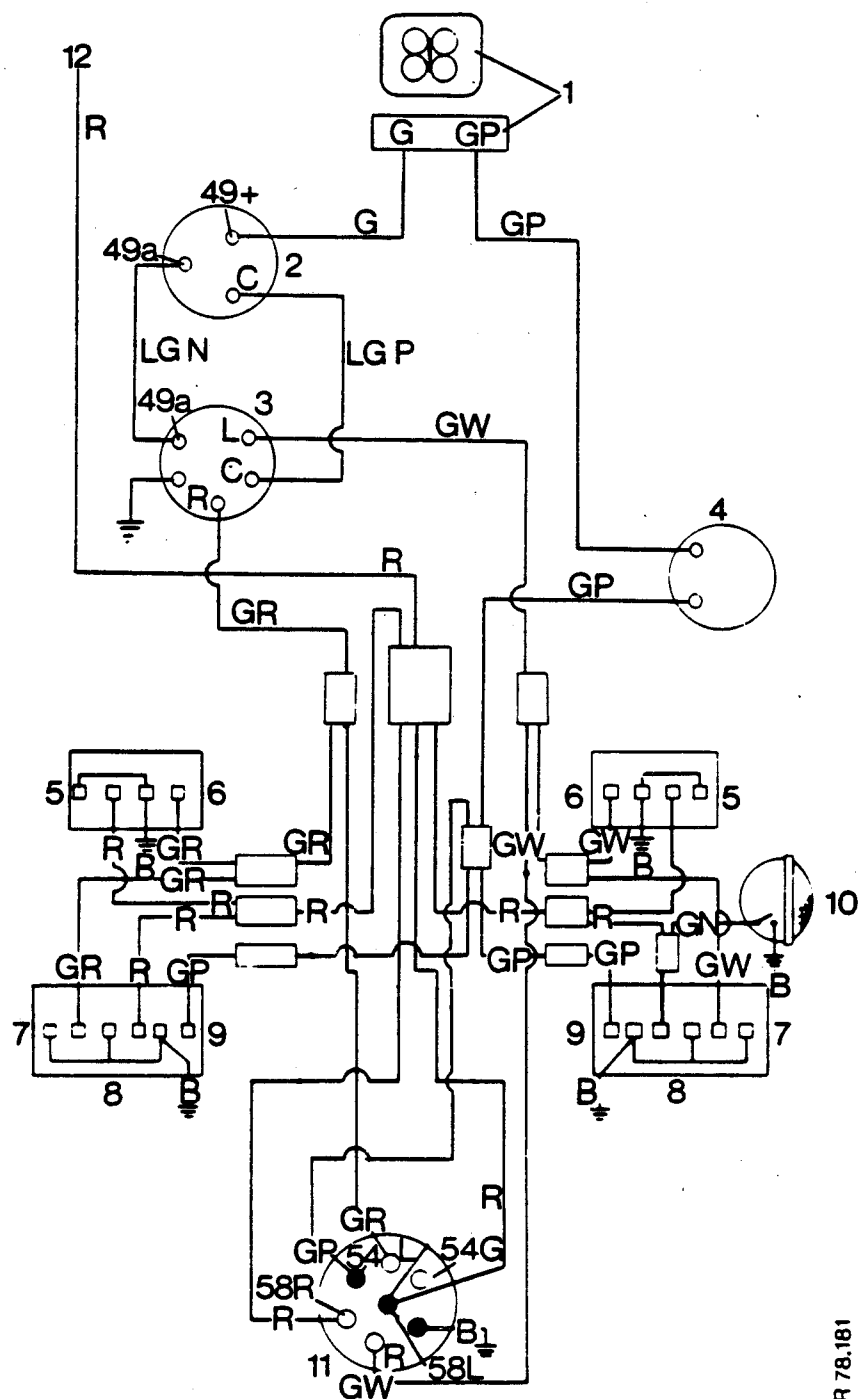
For tractors with shell fenders, from the following serial numbers:

885:633680  
990:862037  
995:930639

996:985304  
1210:727072  
1212:1003291

- |                             |   |
|-----------------------------|---|
| 1. 4-way connector.         | 6. Number plate lamp.                                       |
| 2. Starter safety switch.   | 7. 2-pin trailer socket.                                    |
| 3. Hydraulic filter switch. | 8. Flood lamp.  |
| 4. Side lamps.              | 9. Single side/rear lamp, installed on some tractor models. |
| 5. Rear lamps.              |   |





R 78.181

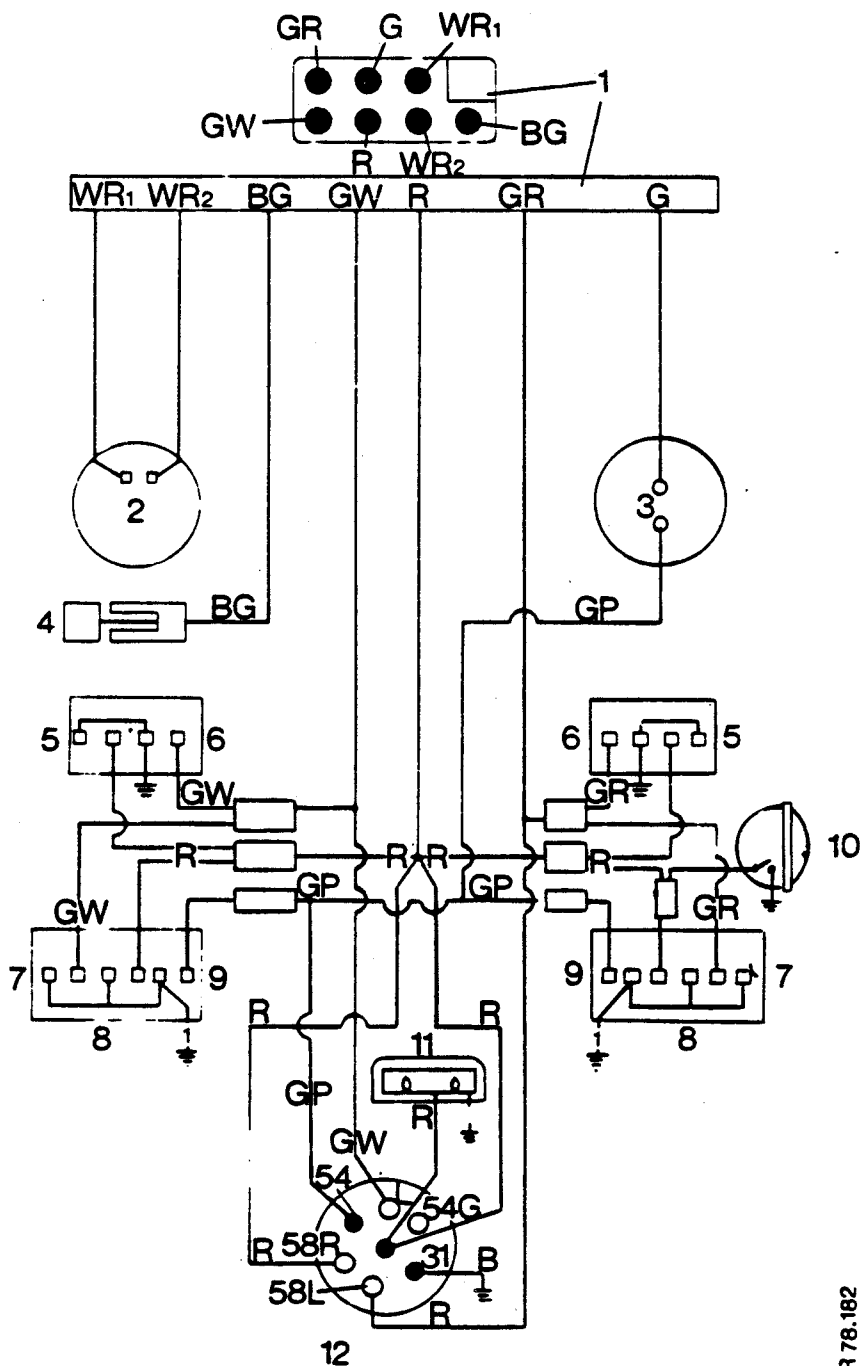
Figure H143  
REAR HARNESS

For tractors with light duty type full fenders, from the following serial numbers:

885:630292  
990:859162  
995:928254

996:985304  
1210:723842  
1212:1002144

- |                               |                              |
|-------------------------------|------------------------------|
| 1. 4-way connector.           | 7. Rear direction indicator. |
| 2. Flasher unit.              | 8. Rear lamps.               |
| 3. Indicator switch.          | 9. Stop lamps.               |
| 4. Starter safety switch.     | 10. Flood lamp.              |
| 5. Side lamps.                | 11. Trailer socket.          |
| 6. Front direction indicator. | 12. Wire to lighting switch. |



R 78.182

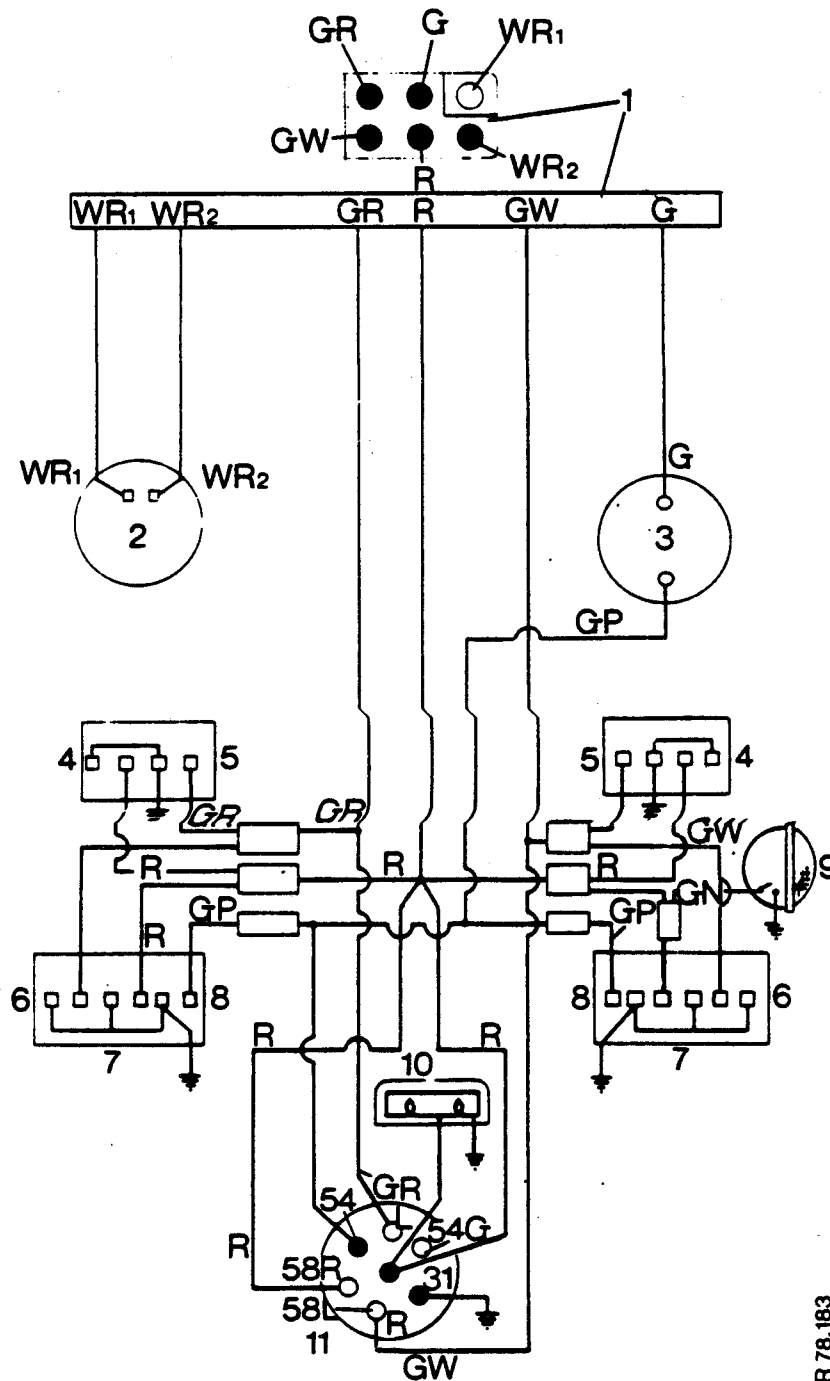
Figure H144  
REAR HARNESS

For tractors with reinforced full fenders, from the following serial numbers:

885:633680  
990:862037  
995:930639  
996:985304

1210:727072  
1212:1003291  
1410 } up to  
1412 } 11200752

- |                                |                               |
|--------------------------------|-------------------------------|
| 1. 7-way connector.            | 7. Rear direction indicators. |
| 2. Starter safety switch.      | 8. Rear lamps.                |
| 3. Stop lamps switch.          | 9. Stop lamps.                |
| 4. Hydraulic filter switch.    | 10. Flood lamp.               |
| 5. Side lamps.                 | 11. Number plate lamp.        |
| 6. Front direction indicators. | 12. Trailer socket.           |



R 78.183

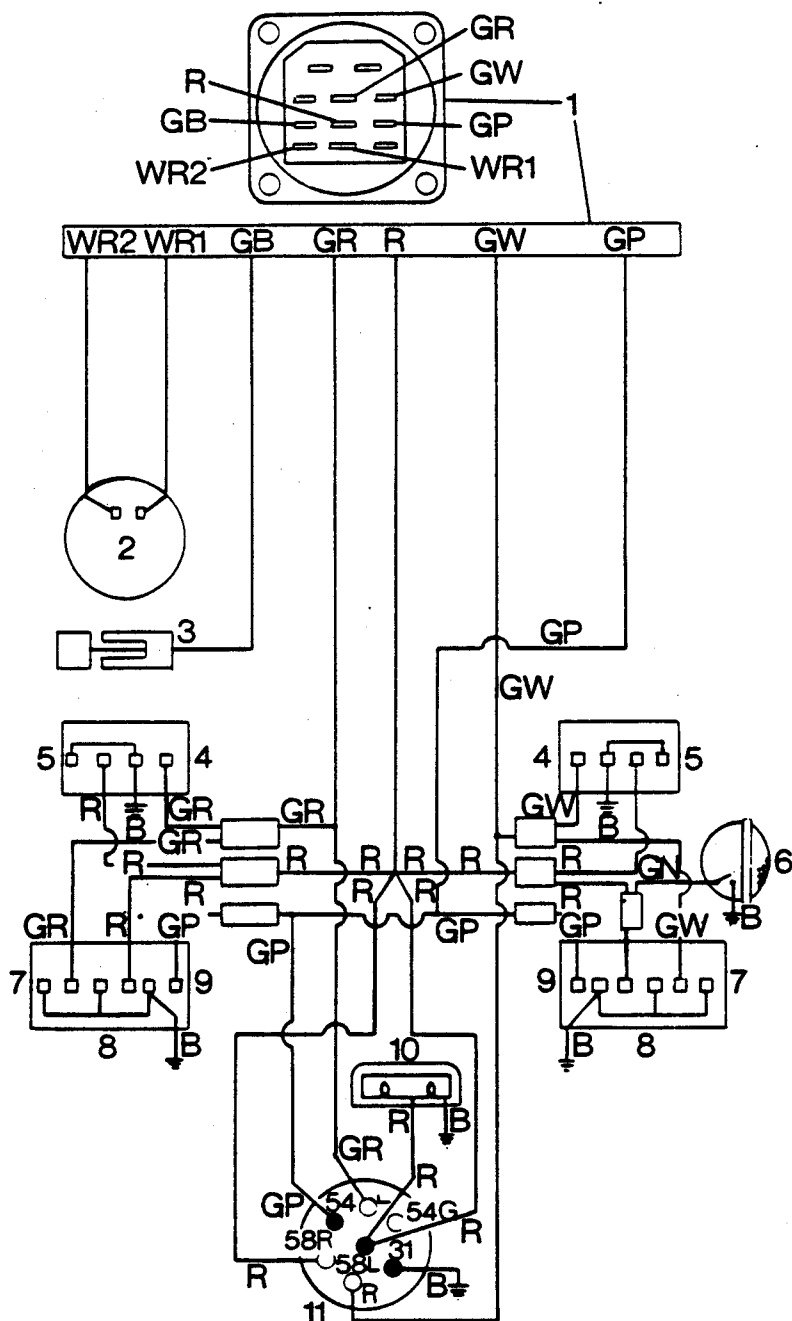
Figure H145  
REAR HARNESS

For 12 and 14 series tractors with full fenders, from the following serial numbers:

1210, 1212:11152567

1410, 1412:11200752

- |                               |                         |
|-------------------------------|-------------------------|
| 1. 6-way connector.           | 7. Rear lamps.          |
| 2. Starter safety switch.     | 8. Stop lamps.          |
| 3. Stop lamp switch.          | 9. Flood lamp.          |
| 4. Side lamps.                | 10. Number plate lamps. |
| 5. Front direction indicator. | 11. Trailer socket.     |
| 6. Rear direction indicator.  |                         |



R78.184

Figure H146  
REAR HARNESS

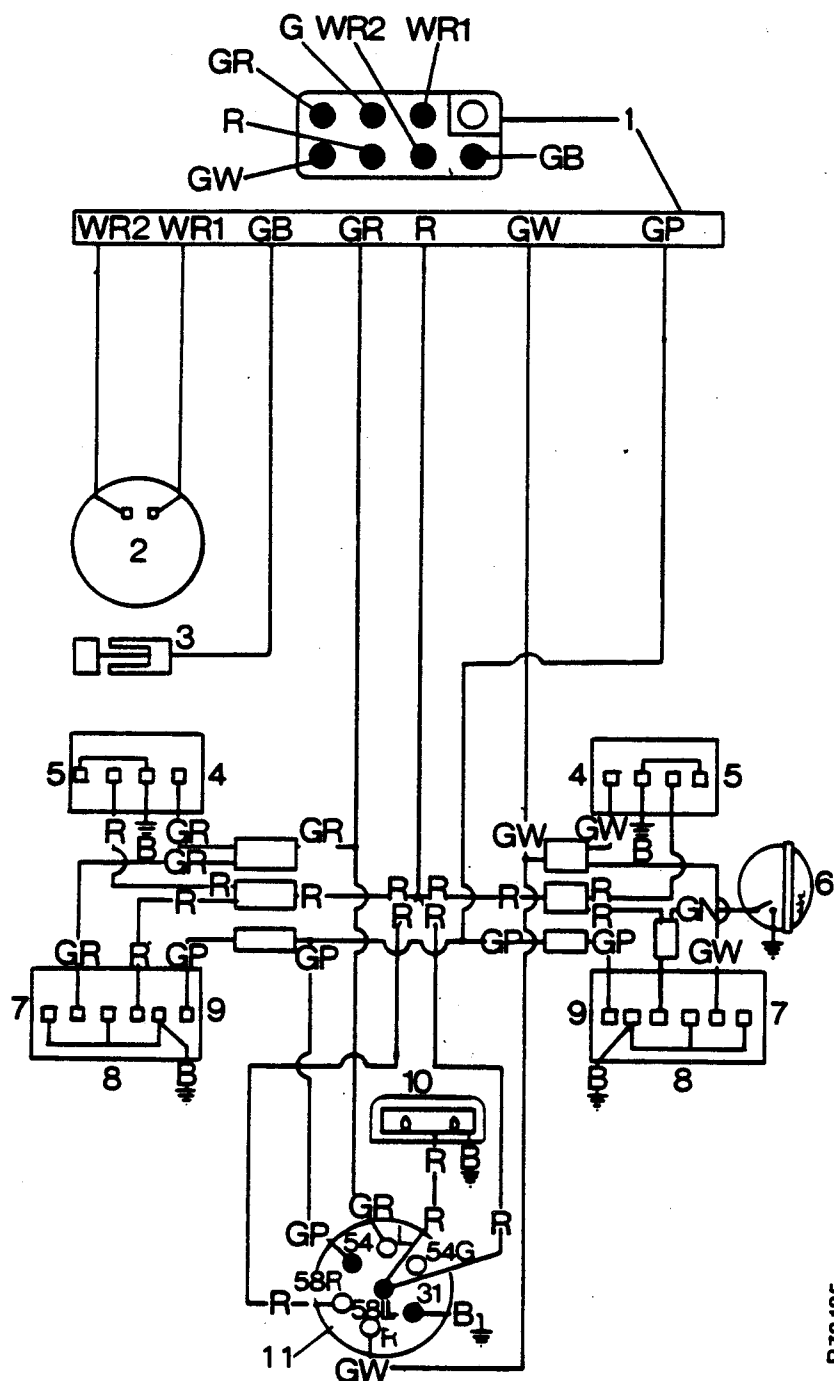
For tractors with Q-cab up to the following serial numbers:

885:11006680  
990 }  
995 } 11083020  
996 }

1210 } 11156513  
1212 }  
1410 } 11202423  
1412 }

- |                                |                               |
|--------------------------------|-------------------------------|
| 1. 11-way connector.           | 7. Rear direction indicators. |
| 2. Starter safety switch.      | 8. Rear lamps.                |
| 3. Hydraulic filter switch.    | 9. Stop lamps.                |
| 4. Front direction indicators. | 10. Number plate lamp.        |
| 5. Side lamps.                 | 11. Trailer socket.           |
| 6. Flood lamp.                 |                               |

**NOTE:** Item 3 is not installed on 12 series tractors from 11152617 and 14 series from 11200752.



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Figure H147  
REAR HARNESS

For tractors with Q-cab from the following serial numbers:

885:11006680

990 } 11083020

995 } 11083020

996 } 11083020

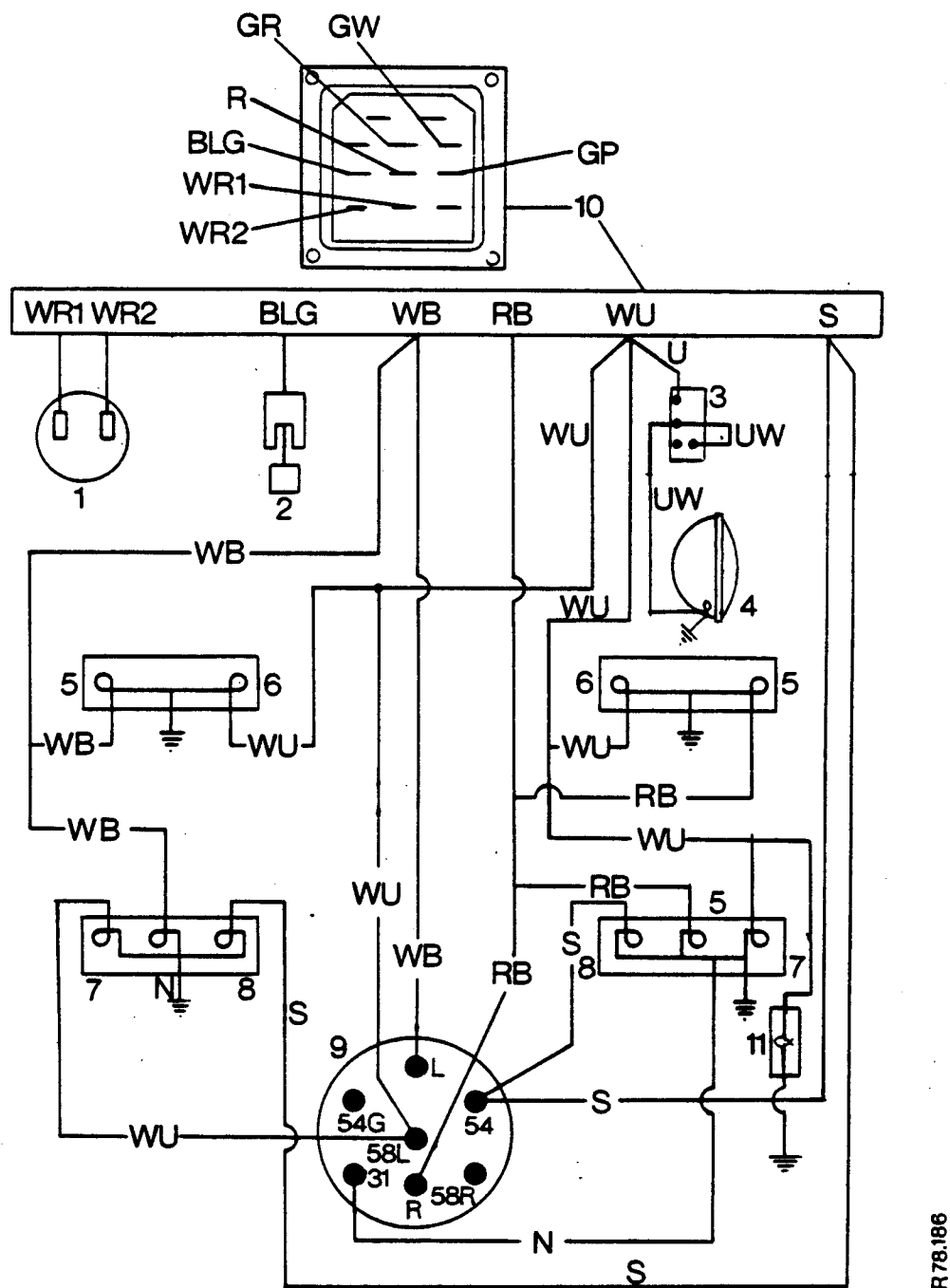
1210 } 11156513

1212 } 11156513

1410 } 11202423

1412 } 11202423

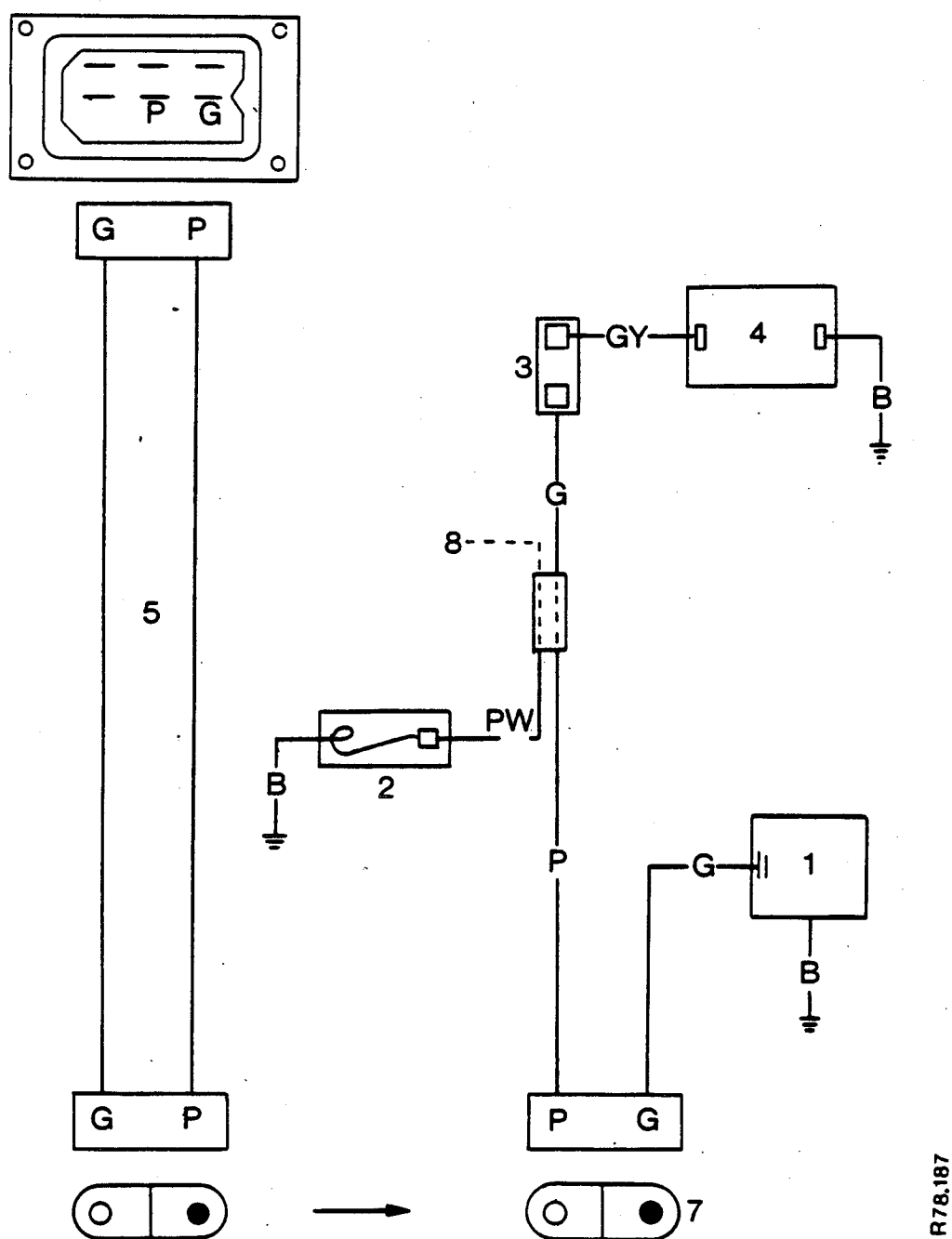
1. 8-way connector.
2. Starter safety switch.
3. Hydraulic filter switch.
4. Front direction indicators.
5. Side lamps.
6. Flood lamp.
7. Rear direction indicators.
8. Rear lamps.
9. Stop lamps.
10. Number plate lamp.
11. Trailer socket.



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Figure H148  
REAR HARNESS  
For tractors with de-luxe cab and Sekura cab.

- |                             |   |
|-----------------------------|---|
| 1. Starter safety switch.   | 7. Tail lamps.                              |
| 2. Hydraulic filter switch. | 8. Stop lamps.                              |
| 3. Flood lamp switch.       | 9. Trailer socket.                          |
| 4. Flood lamp.              | 10. Connector, 11-way, to instrument panel. |
| 5. Direction indicators.    | 11. Number plate lamp.                      |
| 6. Side lamps.              |   |



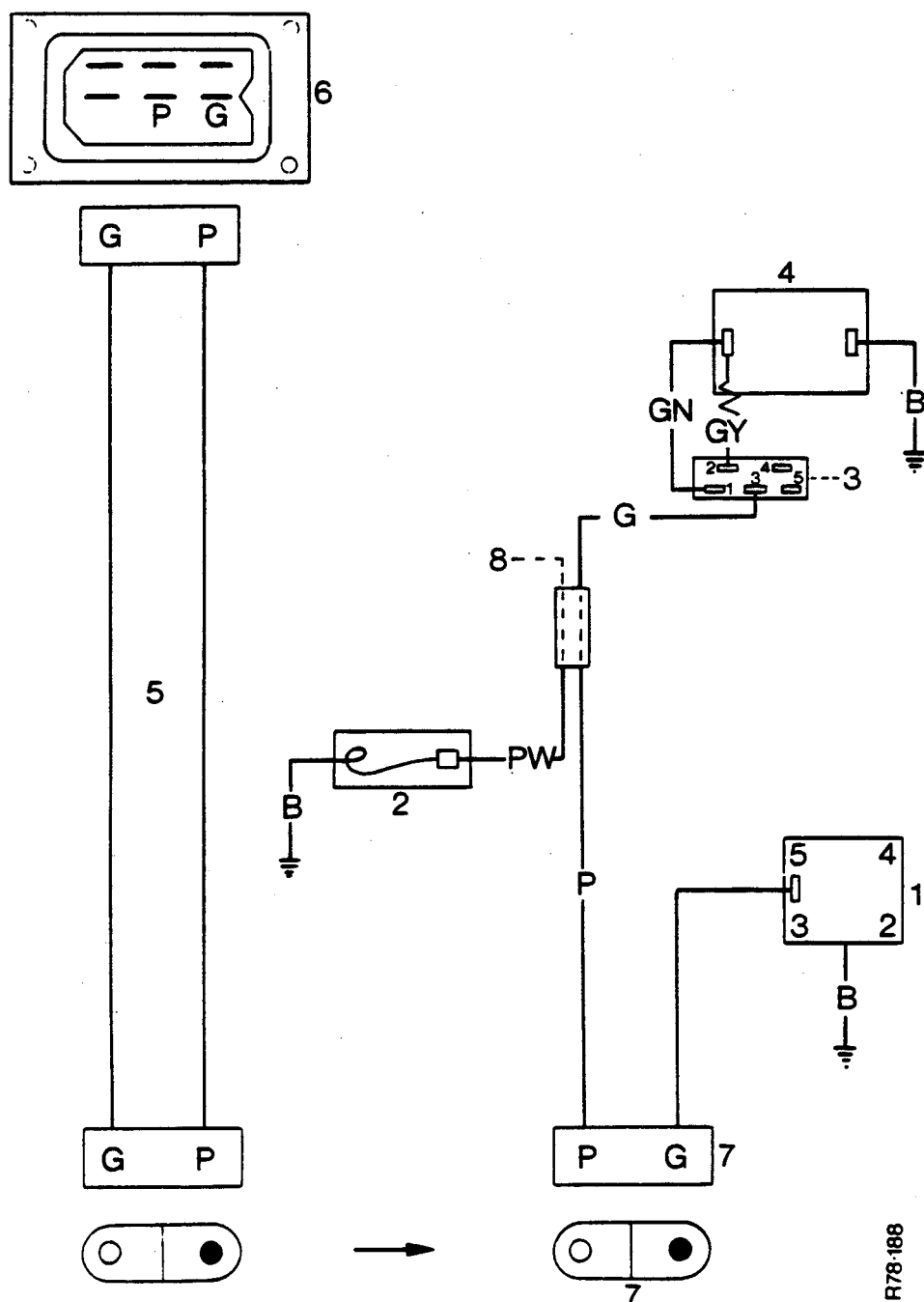
R78.187

Figure H149  
CAB HARNESS

For tractors with Q-cab, from the following serial numbers:

885:11000001	1210	} 11150001
990	1212	
995 } 11070001	1410	} 11200001
996	1412	

- |                          |   |
|--------------------------|---|
| 1. Wiper motor.          | 6. Connector, 2-way, to instrument panel harness. |
| 2. Cab light and switch. | 7. Connector, 2-way, cab to console harness.      |
| 3. Heater fan switch.    | 8. Use for radio connection with inline fuse.     |
| 4. Heater fan unit.      |   |
| 5. Console harness.      |   |



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Figure H150  
CAB HARNESS

For tractors with Q-cab, from the following serial numbers:

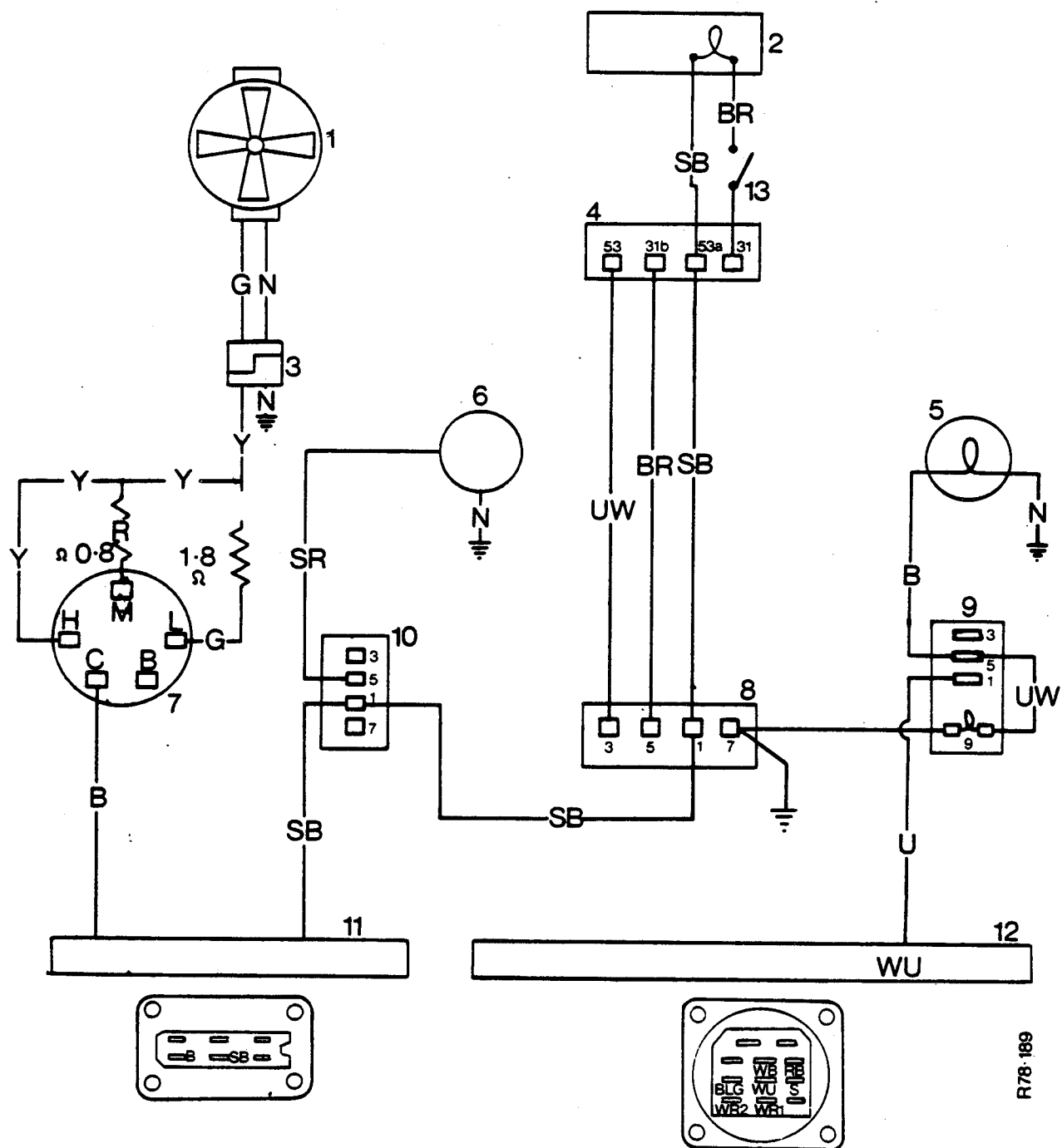
885: 11010300  
990 }  
995 } 11088300  
996 }

1210 }  
1212 } 11158600  
1410 }  
1412 } 11203600

1. Wiper motor, 2 speed.
2. Cab light and switch.
3. Heater fan switch, 3 positions.
4. Heater fan unit.
5. Console harness.

6. 2-way connector, to instrument panel harness.
7. Connector, 2-way, cab harness to console harness.
8. Use for radio connection with inline fuse.





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Figure H151  
CAB HARNESS  
De-luxe cab and Sekura cab.

- |                      |                                    |
|----------------------|------------------------------------|
| 1. Heater motor.     | 8. Wiper switch.                   |
| 2. Interior lamp.    | 9. Flood lamp switch.              |
| 3. Connector, 2-way. | 10. Washer switch.                 |
| 4. Wiper motor.      | 11. Connector to instrument panel. |
| 5. Flood lamp.       | 12. Rear harness connector.        |
| 6. Washer motor.     | 13. Interior lamp switch.          |
| 7. Heater switch.    |                                    |

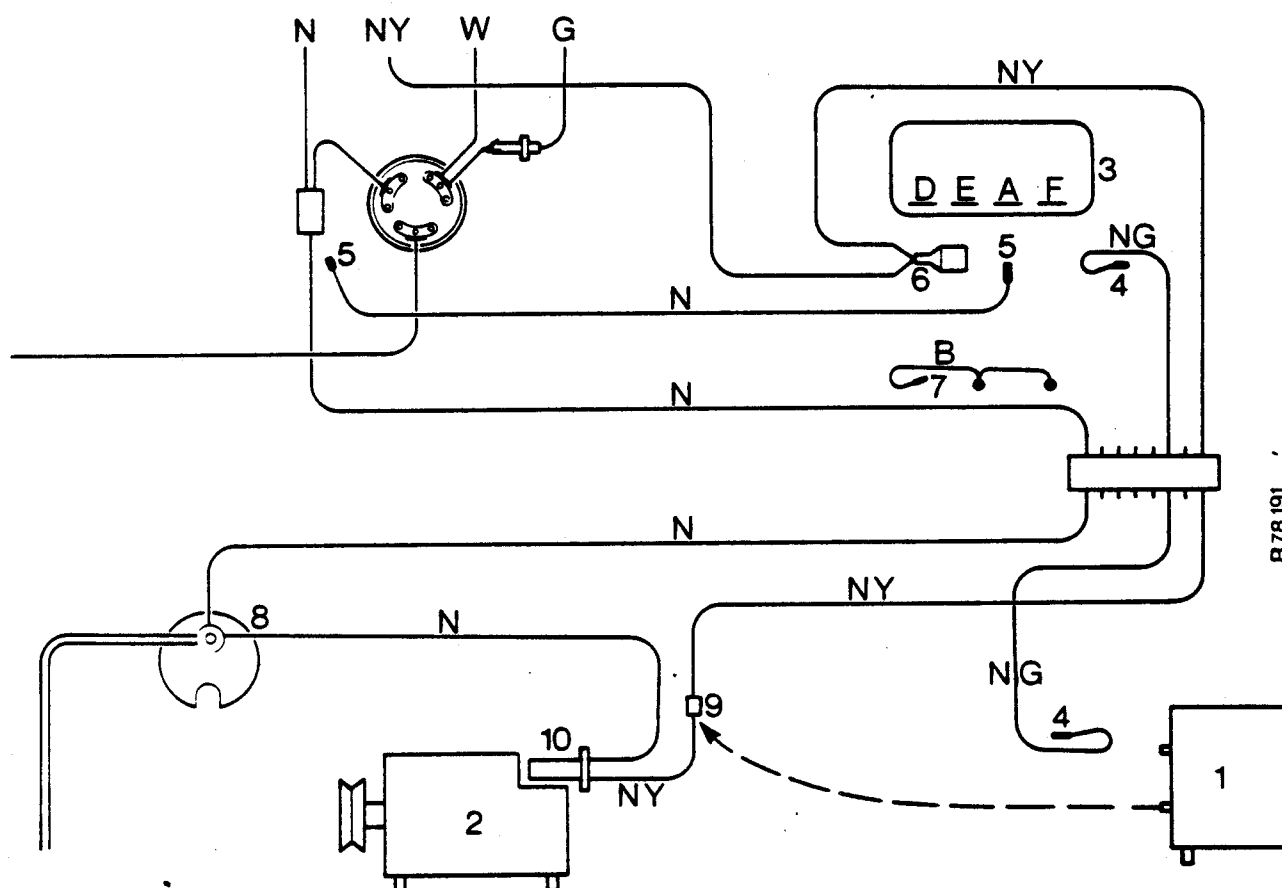


Figure H152  
REPLACING A DYNAMO WITH A MACHINE SENSED ALTERNATOR

1. Disconnect and remove the dynamo.
2. Fasten the alternator to the engine, install a new drive belt and adjust the tension.
3. Disconnect and remove the regulator.
4. Cut both ends off the Brown/Green field wire. Fasten it to the harness with tape. This wire will not be used.
5. Remove the Brown wire which is connected between the 'A' terminal of the regulator and the 4-way connector.
6. Make sure the two Brown/Yellow wires are correctly connected together. Put tape around the connection for insulation.
7. Put tape around the end of the Black (ground) wire for insulation.
8. Disconnect the battery. Connect the Brown wire from the alternator to the starter solenoid. Use the same terminal which has a brown wire connected to it. Reconnect the battery.
9. Connect the Brown/Yellow wire, which was disconnected from the dynamo, to the alternator socket.
10. Connect the socket to the alternator and turn the starter key to the 'ACC' position. Check that the warning lamp illuminates. Start the engine, check that the lamp stops illuminating. This will show that the alternator is making a charge.
11. Make sure the operator is told of the procedure to protect the alternator. See important note on pages H15 and H21.

## ELECTRICAL EQUIPMENT

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# SPECIFICATION AND DATA

## BATTERY

K929951 (Exide 6/RHAZ 17R) standard duty	...	...	...	...	1412, 1410
K929951 (Exide 6/RHAZ 17R) heavy duty	...	...	...	...	1212, 1210
K918881 (Exide 6/TAZ 15R) standard duty	...	...	...	...	{ 996, 995 990, 885 885 gasoline
K907789 (Exide 6/TXMZ 15L) standard duty	...	...	...	...	
K929951 (Exide 6/RHAZ 17R) heavy duty	...	...	...	...	
K923878 (Exide 6/TAZ 11L) heavy duty	...	...	...	...	

### Capacities at 25° Celcius (77° Fahrenheit)

K918881	—	96 amp hours at 20 hour rate
K929951	—	128 amp hours at 20 hour rate
K907789	—	96 amp hours at 20 hour rate
K923878	—	71 amp hours at 20 hour rate

### Specific Gravity of electrolyte—initial filling

dry) (below 25° Celcius (77° Fahrenheit)	...	1.270 to 1.260
uncharged) (above 25° Celcius (77° Fahrenheit)	...	1.240 to 1.230
dry) (below 25° Celcius (77° Fahrenheit)	...	1.260
charged) (above 25° Celcius (77° Fahrenheit)	...	1.210

### Specific Gravity of electrolyte—corrected to 15°C (60°F)

S.G. of filling	fully charged	70% charged	discharged
acid			
1.260	1.290—1.270	1.250—1.230	1.130—1.110
1.250	1.270—1.250	1.230—1.210	1.110—1.090
1.210	1.230—1.210	1.190—1.170	1.070—1.050

### Electrolyte temperature correction—Celcius scale

For every 10° Celcius below 15° subtract 0.007 from the hydrometer reading.  
For every 10° Celcius above 15° add 0.007 to the hydrometer reading.

### Electrolyte temperature correction—Fahrenheit scale

For every 10° Fahrenheit below 60° Fahrenheit subtract 0.004 from the hydrometer reading.  
For every 10° Fahrenheit above 60° Fahrenheit add 0.004 to the hydrometer reading.

### Freezing temperature of battery electrolyte

Specific gravity	Freezing point
1.130	— 10° Celcius (—13° Fahrenheit)
1.200	— 30° Celcius (—22° Fahrenheit)
1.280	— 67° Celcius (—90°F)

## ALTERNATOR

### Lucas type 15 ACR. Machine sensed unit with European Termination

Alternator (without fan and pulley). Lucas despatch number (23700)	...	23774 (parts replacement)
Polarity	...	negative earth
Voltage (nominal)	...	12.0
Voltage (maximum)	...	14.4
Output (at maximum voltage)	...	28 amp
Rotor winding resistance (at 20° Celcius)	...	4.13—4.53 ohms
Brush spring tension (with brush face flush with brush box housing)	...	255—368g (9—13oz)
Brush length (new)	...	(12.6mm (½in)
Brush protrusion (minimum when free)	...	5mm (0.2in)
Regulator—STRD or 14TR	...	Lucas 37565
Rectifier pack	...	Lucas 83166
Surge protection diode	...	Lucas 54486144

### AC-Delco type DN460, 35 amp. Machine sensed

AC-Delco number	...	7982952
Polarity	...	negative ground
Voltage, nominal	...	12 volts
Output, maximum	...	35 amp
Rotor winding resistance	...	2.6—3.0 ohm
Brush spring tension	...	226.8—368.5g (8—13oz)
Brush length, new	...	13.2mm (0.5in)
Minimum brush length	...	10mm (0.4in)
Rotation	...	clockwise from the front

## DYNAMO

### Lucas type C40A (non-ventilation) } Alternatives Lucas type C40T (ventilated) } all models

Lucas despatch number C40A (22733)	...	22703 (parts replacement)
Lucas despatch number C40T (22758)	...	22756 (parts replacement)
Polarity	...	negative earth
Voltage (nominal)	...	12 volts
Voltage (maximum)	...	13.5 volts
Output (at maximum voltage) C40A	...	11 amp
Output (at maximum voltage) C40T	...	22 amp
Field winding resistance	...	6.0 ohms
Brush length (minimum)	...	8mm (5/16in)
Brush spring pressure, C40A	...	369—850g (13—30oz)
Brush spring pressure, C40T	...	567—680g (20—24oz)

### Commutator: details—

Minimum diameter (moulded commutator)	...	37mm (1 29/64in)
Minimum thickness of segments	{ fabricated commutator	1.5mm (1/16in)
Depth of undercut		0.8mm (1/32in)

## ELECTRICAL EQUIPMENT

## VOLTAGE REGULATOR

**Lucas type R.B 108**

Lucas despatch number. When used with C40A dynamo	...	...	...	37408 (parts replacement)
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Lucas despatch number. When used with C40T dynamo	...	...	...	37467 (parts replacement)
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### Regulator voltage setting

<b>Ambient temperature</b>	<b>open-circuit voltage</b>
10° Celcius (50° Fahrenheit)	16.1 to 16.7
20° Celcius (68° Fahrenheit)	16.0 to 16.6
30° Celcius (86° Fahrenheit)	15.9 to 16.5
40° Celcius (104° Fahrenheit)	15.8 to 16.4

### Cut-out voltage settings

Cut-in voltage	12.7 to 13.3 volts
Drop-off voltage	8.5 to 10.0 volts
Regulator gap setting	0.5mm (0.020in)
Cut-out armature movement	0.6–1.0mm (0.025–0.040in)
Cut-out contact blade deflection	0.25–0.5mm (0.10–0.20in)
Regulator field resistance:	
Carbon resistance	60–75 ohms
Wire wound resistance	55–85 ohms
Shunt winding resistance (checked between 'D' and 'E' terminals)	50–56 ohms

## STARTER MOTORS

**1412, 1410: Part No. K919752 (Lucas M50, No. 26379A)**

**1212, 1210, 1200, 996, 995, 990: Part No. K89772 (Lucas M45G, No. 26278)**

885 diesel, 880, 780: Part No. K913007 (Lucas M45G. No. 29215)

885 gasoline from January 1973: Part No. K944488 (Lucas 3M100, No. 25679A)

4600, 3800, 885 gasoline to January 1973: Part No. K922703 (Lucas No. M45G. No. 26277)

**Alternative starter on:**

1210, 1212 from Serial No. 11157537 and 1410, 1412, 996, 995, 990, all from August 1977:

Part No. K954700 (Bosch No. 00-001-362-080)

[illegible]

**FUEL GAUGE**

Tank Unit—1412, 1410, 1212, 1210, 1200—K916755	...	...	...	(AC-Delco 7967414)
Tank Unit—996, 995, 990—K946158	...	...	...	(AC-Delco E/PG 163902)
Tank Unit—996, 995, 990, 880, 780, 770—K916635	...	...	...	(AC-Delco 7967410)
Tank Unit—885, 885G—K946184	...	...	...	(Smiths Ex 15601)
Tank Unit—885, 885G—K943347	...	...	...	(Smiths TBS 1514/008)
Instrument—all models except 885—K921147	...	...	...	(AC-Delco 7974119)
Instrument—885, 885G—K942442	...	...	...	(Smiths BR/2100/02)
Voltage Stabiliser—885, 885G—K942740	...	...	...	(Smiths BR/1300/01A)

**TEMPERATURE GAUGE**

Sender unit—all models—K921149	...	...	...	...	(AC-Delco 7966281)
Instrument—all models—K921148	...	...	...	...	(AC-Delco 7966282)

**WARNING LAMP SWITCHES**

Oil filter switch—all models—K921317	...	...	...	...	(AC-Delco 7954473)
Operating vacuum oil filter switch	...	...	...	...	19.7–222mm (7½–8½in) Hg.
Oil pressure switch—all models—K903851	...	...	...	...	(AC-Delco 7954181)
Operating pressure, oil pressure switch	...	...	...	...	0.6–0.9kg/sq cm (9–13lb/sq in)

**WIPER MOTOR**

Lucas model 14W, 12 volts	...	...	...	...	Lucas 54071929
Brush length	...	...	...	...	Minimum 4.8mm (3/16in)
Brush spring pressure	...	...	...	...	17Nm, 6ozf or 170gf
Armature end movement	...	...	...	...	0.05–0.25mm (0.002–0.010in)
Yoke bolts, torque	...	...	...	...	1.35–1.80Nm, 0.138–0.184kgm, 12–16ft lb

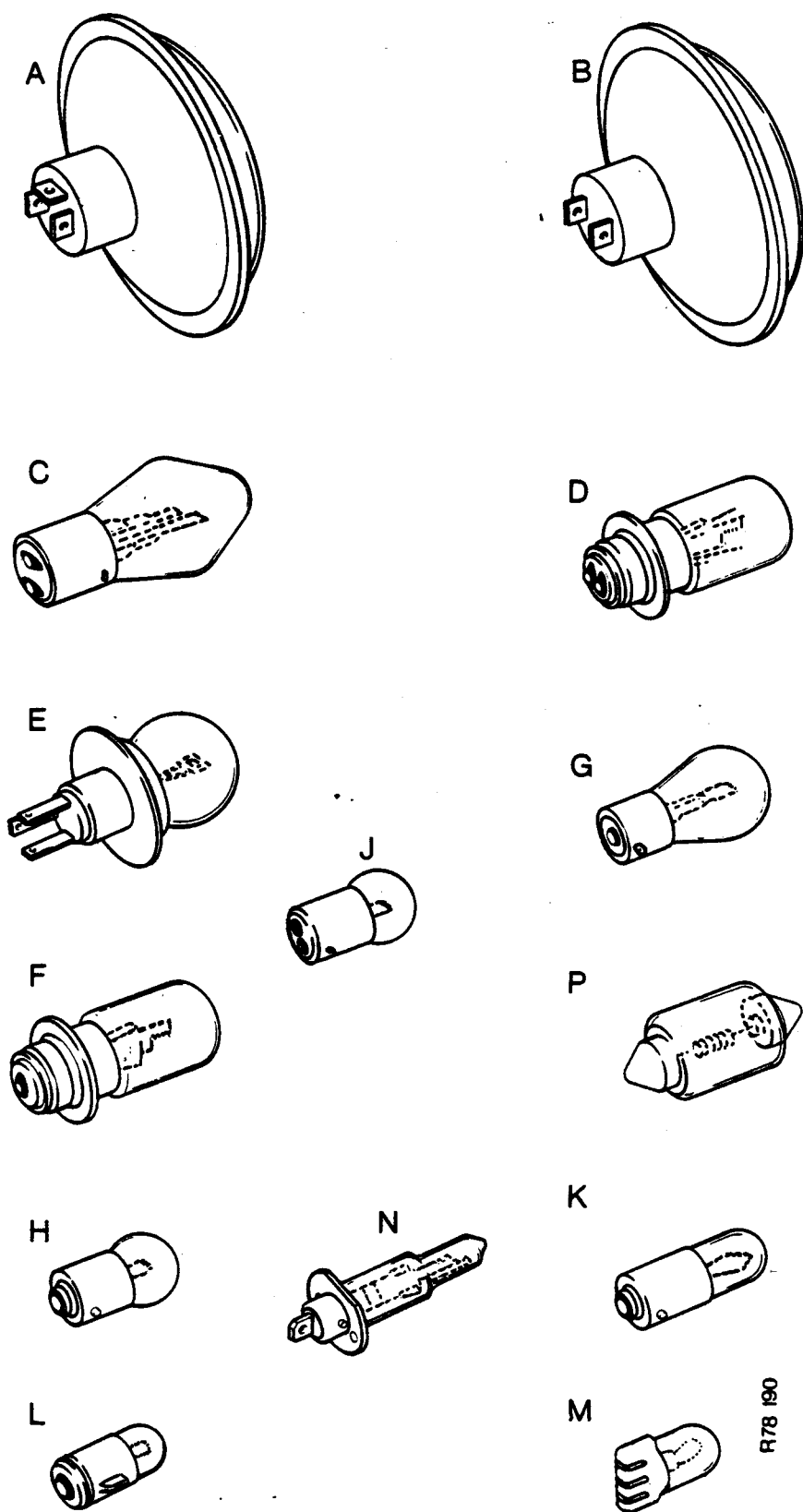


Figure H153  
TYPES OF BULBS

## LAMP BULBS

	Description	Qty.	Remarks
A	Sealed Beam 12V-40/40W 3 pin Butler Part No. 1720-40 G.E.C. Part No. GE 4440	2	Headlamp-Inboard K915874
B	Sealed Beam 12V-35W 2 pin Butler Part No. 1720-38 G.E.C. Part No. GE 4411	2	Headlamp-Inboard K915141
C	Double Contact 12V-35/35W Unified European Cap Hella Part No. B 1235/35	2	Headlamp-Inboard European K917233
D	Double Contact 12V-35/35W B.P.F. British Pre-Focus Butler Part No. B 275 Lucas Part No. 350	2	Headlamps-Outboard U.K. K921082 K921083
E	Double Filament 12V-45/40W Duplo 'D' Continental Pre-Focus Butler Part No. B 268 Lucas Part No. 410 Butler Part No. B 295 Lucas Part No. 411	2	Headlamps-Outboard Continental K944729 K944730 K944731 K944723
F	Single Contact 12V-35W B.P.F. British Pre-Focus Butler Part No. B 165 Lucas Part No. 162	1	Rear Flood Lamp K943976 K943977 K921081
G	Single Contact 12V-21W S.C.C. Small Bayonet Cap Butler Part No. B 364 Lucas Part No. 382	6	Combined Lamps Flasher & Stop K948815/6 K929166/7 K929168/9 K929172/3 K948813/4
H	Single Contact 12V/5W S.C.C. Butler Part No. B 370 Lucas Part No. 223 (14V/7W)	4	Side & Tail
J	Double Contact 12V/5W S.B.C. Small Bayonet Cap Butler Part No. B 201 Lucas Part No. 218 (14V/7W)	2 or 4	Side Tail Lamp K921079/80 K921233/4 K921235/6
K	Single Contact 12V/5W M.C.C. Small Bayonet Cap Butler Part No. B 267 Lucas Part No. 989	1 or 2	Rear Number Plate Lamp 943308 K773358 K921076 Hazard Warning Switch K944664
L	Single Contact 12V/2W B.A.7s Miniature Bayonet Cap Lucas Part No. 281 Philips Part No. 12829	5	Warning Lamp & Indicator Switch K917370/1 K921367 K94364 K913565
M	Capless 12V/5W 5mm Panel Double Contact Lucas Part No. 286 Philips Part No. 12516	1	Hazard Warning Switch K947482
N	Halogen, 12V/55W	1	Flood Lamp. De-luxe and Sekura cab
P	Festoon 12V/5W	4	Side and rear lamps later tractors
	Festoon 12V/10W	1	Cab Lamp



## SUMMARY OF DESIGN CHANGES

**Details of Change**

Colour code of wiring changed to conform to British Standard practice.  
Isolating switch changed from K961975 (AC-Deico) to K920923 (Lucas)

Starter safety switch (K918672) changed to plunger operated switch (K916479) operated directly from clutch pedal

Lighting switch (K912388, 5-position) changed to a 4-position switch (K902464).  
Vacuum switch wiring re-routed through conduit on gearbox top

Voltage regulator earth lead (K921174) changed to lead K924142, which has two earthing points. One under regulator mounting bolt and another under fuel tank support

Stop lamp switch (K917301) changed to switch K929737, which is positioned on left-hand brake pedal so that stop lamps do not operate when hand brake is applied

Combined stop/rear/direction indicator lamps fitted to tractors with full fenders instead of the separate lamps fitted previously

Fuse incorporated in accessories lead, to provide protection for equipment which is operative when isolating switch is turned 'on', e.g. windscreen wiper, instruments, etc.

Starter K922703 (Lucas M45G) changed to Lucas 3M100 starter (K944488). The new starter, which has a face type commutator and window-less yoke, is interchangeable with previous starter

Flasher unit (K913564—18 watt rating) changed to a 21 watt unit K945512. Units are interchangeable and later unit should always be used as a replacement

**Models and Serial Numbers**

770/588498  
880/544392  
990/504027  
1200/703305  
(November, 1967)

880/547055  
990/800751  
(March, 1968)

770/589439  
780/601520  
880/547986  
990/802575  
1200/705856  
(May, 1968)

770/590006  
780/602231  
880/549153  
990/804700  
1200/706430  
4800/900196  
(October, 1968)

1200/718062  
(November, 1971)

780/610673  
880/562338  
990/829679  
1200/717256  
(October, 1971)

885/620001  
885G/651001  
885N/646001  
990/850689  
995/920003  
1210/720001  
1212/100049  
(July, 1972)

885G/651141  
(December, 1972)

885/624732  
885G/651239  
990/854925  
995/925509  
996/981938  
1210/722546  
1212/100125  
(March, 1973)

SUMMARY OF DESIGN CHANGES

Details of Change

Isolating switch K920923, changed to switch K945294, which has a larger connector blade on input terminal

Fuel tank unit position changed from front to top of fuel tank. Part number of tank unit changed from K916635 to K946158

Fuel gauge tank unit position changed from front to top of fuel tank. Part number of tank unit changed from K943347 to K946184

Alternator mounting bracket changed from K912758, which was also used for mounting dynamo, to bracket K947375, which can only be used for alternator

Wiring harness changed to include two multi-pin sockets, to facilitate instrument panel removal. Hazard warning switch K944664 changed to K947482 and flasher unit changed from K945512 to K948611

New battery clamp frame K947080 with vertical studs and wing nuts installed

Latest type wiring with multi-pin sockets installed on German models for easier removal and servicing

Bayonet type bulb holders installed in Butler side and rear lamps

Hazard warning switch installed. 5-way female connector for flasher unit installed

Hydraulic filter warning system removed from 12 and 14 series tractors

Capless type bulbs and holders installed for instrument panel

AC-Delco Alternator installed on some tractors

Front console harnesses added to wiring on tractors with Q-Cabs

Models and Serial Numbers

885/626173  
885G/651239  
885N/646322  
990/855819  
995/926076  
996/982318  
1210/732932  
1212/1001467  
(April, 1973)

996/983083  
995/926701  
990/856494  
(June, 1973)

885/626877  
885G/651280  
(June, 1973)

All Models  
(June, 1974)

1212/1002145  
1210/723843  
996/985305  
995/928255  
990/959163  
885/630293  
(February, 1975)

885 } June 1975  
885N }  
990/866452  
995/934315  
996/987778  
1210/730832  
1212/1004792

885G/638731  
990G/868010  
995G/835195  
996G/988358  
(October, 1975)

885/11000001  
990 }  
995 } 11070001  
996 }  
1210 } 11150457  
1212 }  
1410 } 11200001  
1412 }  
(January, 1976)

885/11001375  
(April, 1976)

1210 } 11152576 Series 1  
1212 } 11152617 Series 2  
1410 } 11200752  
1412 }  
(June, 1976)

1210 } 11150721  
1212 }  
1410 } 11200162  
1412 }  
(April, 1976)

(April, 1977)

8 series/1100680  
9 series/11083020  
12 series/11156513  
14 series/11202423  
(April, 1977)

## ELECTRICAL EQUIPMENT

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### Details of Change

Thermostart installed as normal equipment on tractors with Q-Cabs

### Models and Serial Numbers

885/11007594

990 } 11157412

995 } 11157412

996 } 11084956

1210 } 11084956

1212 } 11084956

(June, 1977)

Festoon type bulbs installed in Butler side and tail lamps.

8 series 11007544

9 series 11084517

12 series 11157259

14 series 11202741

(June, 1977)

Bosch pre-engaged starter installed on some four cylinder engines

(July, 1977)

Warning lamp for headlamp main beam installed on Sekura cabs for Scandinavia

8 series/11011842

9 series/11090489

12 series/11660275

14 series/11204265

(March, 1978)