



ELECTRICAL SYSTEM
644, 200 & 444 TRACTORS
S/N AND AFTER
Service Manual No. 9-51171

INGERSOLL
Ingersoll Equipment Co., Inc.

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SAFETY MESSAGES



This safety alert symbol indicates Important Safety Messages in this manual. When you see this symbol carefully read the message that follows and be alert to the possibility of personal injury or death.



CAUTION: Never wear rings or metal watch bands that may ground a live circuit. Severe burns may result.



CAUTION: Think out your circuit before you make or break a connection. A wrong connection can be painful and expensive.



DANGER: Charging batteries produce explosive hydrogen gas. Keep sparks, flames and cigarettes away. Ventilate when charging or using in enclosed space. Always shield eyes when working near batteries. Explosion of hydrogen gas can cause serious injury.



CAUTION: When working around storage batteries remember that all exposed metal parts are "live". Never lay a metal object across the terminals as a spark or short circuit may result.



CAUTION: When removing a battery always disconnect the negative (ground) cable first. When installing the battery always connect the negative (ground) cable last. This will prevent accidental grounding of wrench when disconnecting or connecting the positive cable. Place all electrical switches in the 'off' position.



POISON: Batteries contain sulfuric acid which can cause severe burns. Avoid contact with skin, eyes or clothing. Antidote - external flush with water - internal drink large quantities of water or milk. Follow with Milk of Magnesia, beaten egg or vegetable oil. Call physician immediately. Eyes flush with water for 15 minutes and get prompt medical attention. Keep out of reach of children.

INTRODUCTION

This service manual section applies to units equipped with Kohler Engines with flywheel alternators and Bendix type permanent magnet starting motors beginning with Models and Serial Numbers listed.

| MODEL | SERIAL NUMBER AND AFTER |
|-------|-------------------------|
| 210 | 9733525 |
| 220 | 9734870 |
| 222 | 9736999 |
| 224 | 9738336 |
| 444 | 9739739 |
| 644 | 9744750 |

TEST EQUIPMENT

The following listing is the minimum suggested test equipment needed to perform the troubleshooting steps outlined in this service manual section.

1. VOM Meter

A Volt-Ohm-Milliamp Meter with the following ranges:

| | |
|------------------------|--|
| Volts - AC - 0 to 30 - | Used for measuring alternator - stator output. |
| Volts - DC - 0 to 1 - | Used for measuring voltage drops in circuitry. |
| Volts - DC - 0 to 20 - | Used for measuring battery charging voltage. |
| mA - DC - 0 to 3 - | Used for measuring current leakage. |
| Ohms - Rxl - | Used for measuring low resistance values such as stator windings, primary ignition coil winding. |

Ohms - RX1000-

Used for measuring higher resistance values such as in ignition coil secondary windings.

Several suitable meters are:

Radio Shack Model 22-202 and Model 22-203
LaFayette Model 99R50734 and Model 99R50841

2. An automotive type ampmeter such as, Case Part Number C18389, with leads and alligator clips.
3. Spark Tester, such as, Briggs and Stratton Part Number 19051.
4. Clip on ampmeter
5. Jumper leads 24" long, 14 gauge wire with alligator clips.
6. 12 Volt test light
7. Battery Hydrometer
8. DC Power Timing Light

TRACTOR WIRING DIAGRAM

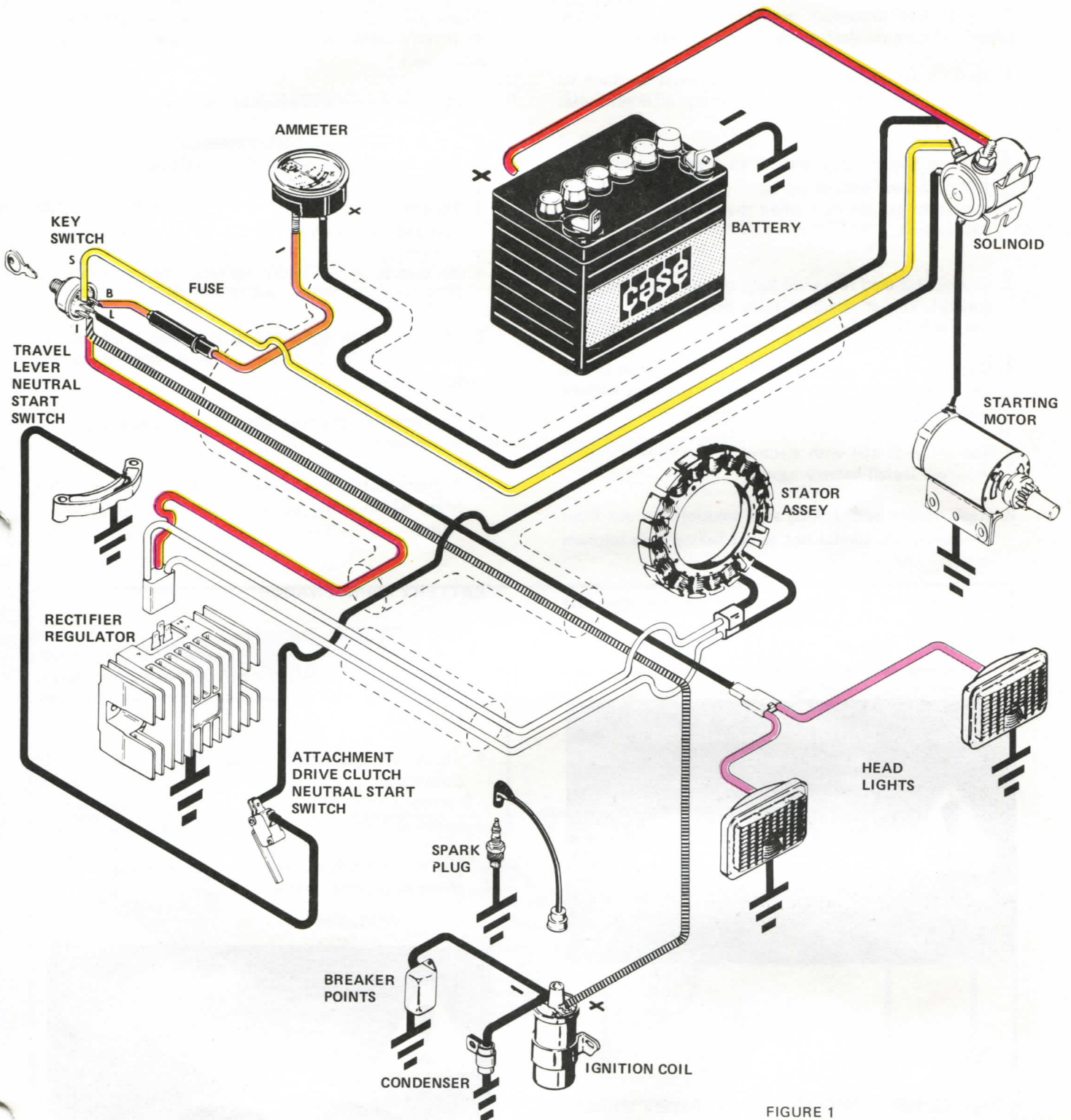


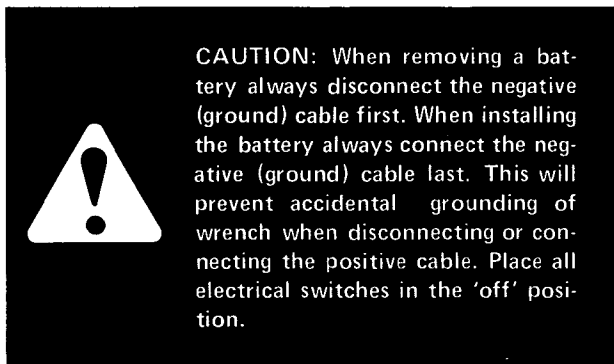
FIGURE 1

BATTERY CARE AND MAINTENANCE

ACTIVATING THE DRY-CHARGED BATTERY

The activation procedure described below must be followed to insure satisfactory battery performance.

1. Remove battery from tractor. This must be done to prevent accidental spillage of battery acid on metal tractor parts.
2. Remove battery caps and fill to a point slightly **BELOW** the vent well. Small battery size may cause electrolyte to bubble over when charging if filled to vent well at first.
3. Charge at 3 amp rate until fully charged (1260 specific gravity). Higher charging rates may damage battery. See the Battery Maintenance section of this manual.
4. Disconnect charger. Unplug charger from wall before disconnecting at battery to prevent spark at battery post.
5. Top off each cell with electrolyte to the vent well if required. Install battery caps.
6. Wash battery with baking soda solution if moist from electrolyte. Be careful not to get baking soda solution in cells.
7. Install battery in tractor. Connect positive cable first and negative cable last. Coat terminals with cup grease to prevent corrosion.



8. Maintain battery as described in the Battery Maintenance section of this manual.

REMOVAL AND INSTALLATION

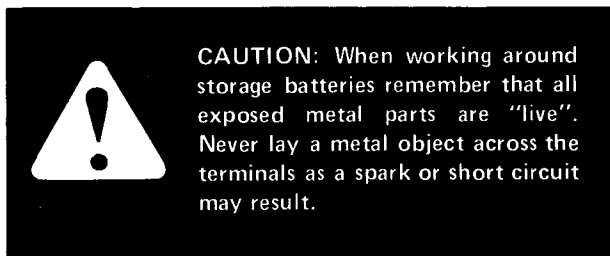
Proper removal and installation procedures are required to prevent personal injury and damage to battery or equipment.

1. Place all electrical switches in the "off" position.
2. To remove battery: **DISCONNECT NEGATIVE ("-")** cable first and **POSITIVE ("+")** cable last.
3. To install battery: **CONNECT POSITIVE ("+")** cable first and **NEGATIVE ("-")** cable last.
4. Be sure to install insulating boot when provided, on **POSITIVE ("+")** terminal.
5. Use care when tightening or loosening cables at battery terminals. Excessive force or hammering will cause damage to battery.
6. Coat battery terminals with light cup grease to prevent corrosion.
7. Tighten battery hold down securely. Avoid overtightening which could cause damage to battery case or cells.

BATTERY MAINTENANCE

1. **BATTERY TOP:** The battery top must be kept clean and dry. Dirt or moisture will cause the battery to self-discharge. The battery top can be cleaned with baking soda solution. Do not allow baking soda solution to enter the cells.
2. **TERMINAL CONNECTIONS:** The battery terminal connections must be kept clean and tight. Loose or corroded connections offer resistance to current flow resulting in poor battery performance.

Use a wire brush to clean terminals and coat with cup grease to prevent corrosion.



3. **ELECTROLYTE LEVEL:** The electrolyte level must be maintained above the cell plates at all times to avoid permanent battery damage. The battery must be kept filled to the vent well with water free of scale forming minerals.

Water consumption in excess of 1 ounce every 25 hours of operation indicates an overcharging problem. See the testing section of this manual.

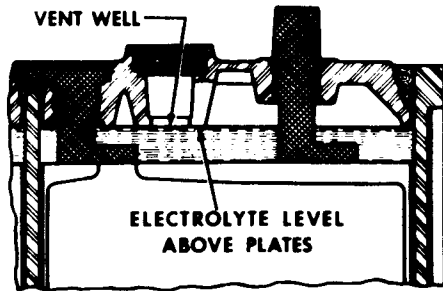


FIGURE 2

4. **STATE OF CHARGE:** The battery must be maintained in a full state of charge as indicated by hydrometer readings. A battery that is allowed to stand in a discharged condition will become permanently damaged.

An idle battery will self discharge. For this reason, idle batteries should be checked periodically and charged as necessary.

Discharged batteries will freeze in cold weather. For example, a battery with specific gravity of 1175 will freeze at 0°F (-18°C).

5. **CHARGING PROCEDURE:**

- A. Charging at a rate not to exceed 3 amps is recommended.
- B. Charging at higher rates up to 15 amps is permissible as long as:
- Violent gasing does not occur
 - Electrolyte is not spewed from vents
 - Electrolyte temperature does not exceed 125°F (51°C)

DO NOT exceed 15 amps charge rate.

- C. A battery is fully charged when, after two, two hour intervals at a low charge rate (3 amps), all cells are gasing freely and no change in specific gravity occurs.

- D. Always turn charger off or unplug from wall before removing clips from battery terminals. This prevents arcing at battery which can cause explosion of hydrogen gas created while charging.

BATTERY TESTING

SPECIFIC GRAVITY TEST (HYDROMETER TEST): The hydrometer is used to measure the specific gravity of battery electrolyte (weight of electrolyte as compared to water). This indicates the state of charge of the battery.

Mix newly added water with electrolyte before taking hydrometer readings by:

- charging for 15 minutes at 3 amps and
- applying a 75 amp load for 15 seconds (about equal to cranking engine for 15 seconds).

The hydrometer reading is only correct when electrolyte temperature is 80°F (25°C). Correct readings for temperature variation in accordance with the following guidelines:

Electrolyte temperature correction - Fahrenheit scale

For every 10°F below 80°F **SUBTRACT .004** from the observed hydrometer reading.

For every 10°F above 80°F **ADD .004** to the observed hydrometer reading.

Electrolyte temperature correction - Celsius scale

For every 10°C below 25°C **SUBTRACT .007** from the observed hydrometer reading.

For every 10°C above 25°C **ADD .007** to the observed hydrometer reading.

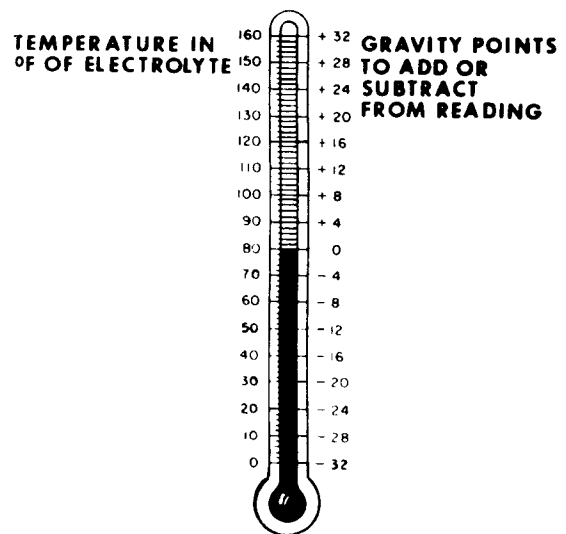


FIGURE 3

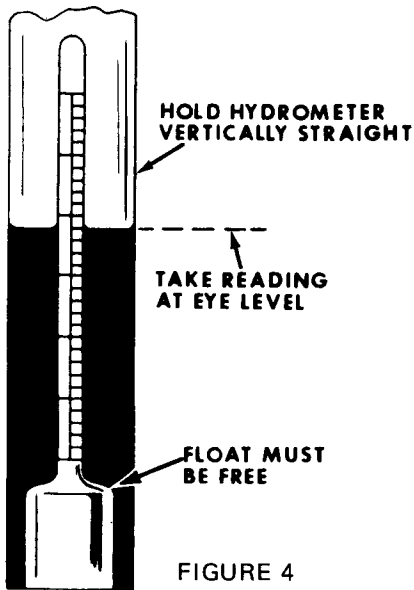


FIGURE 4

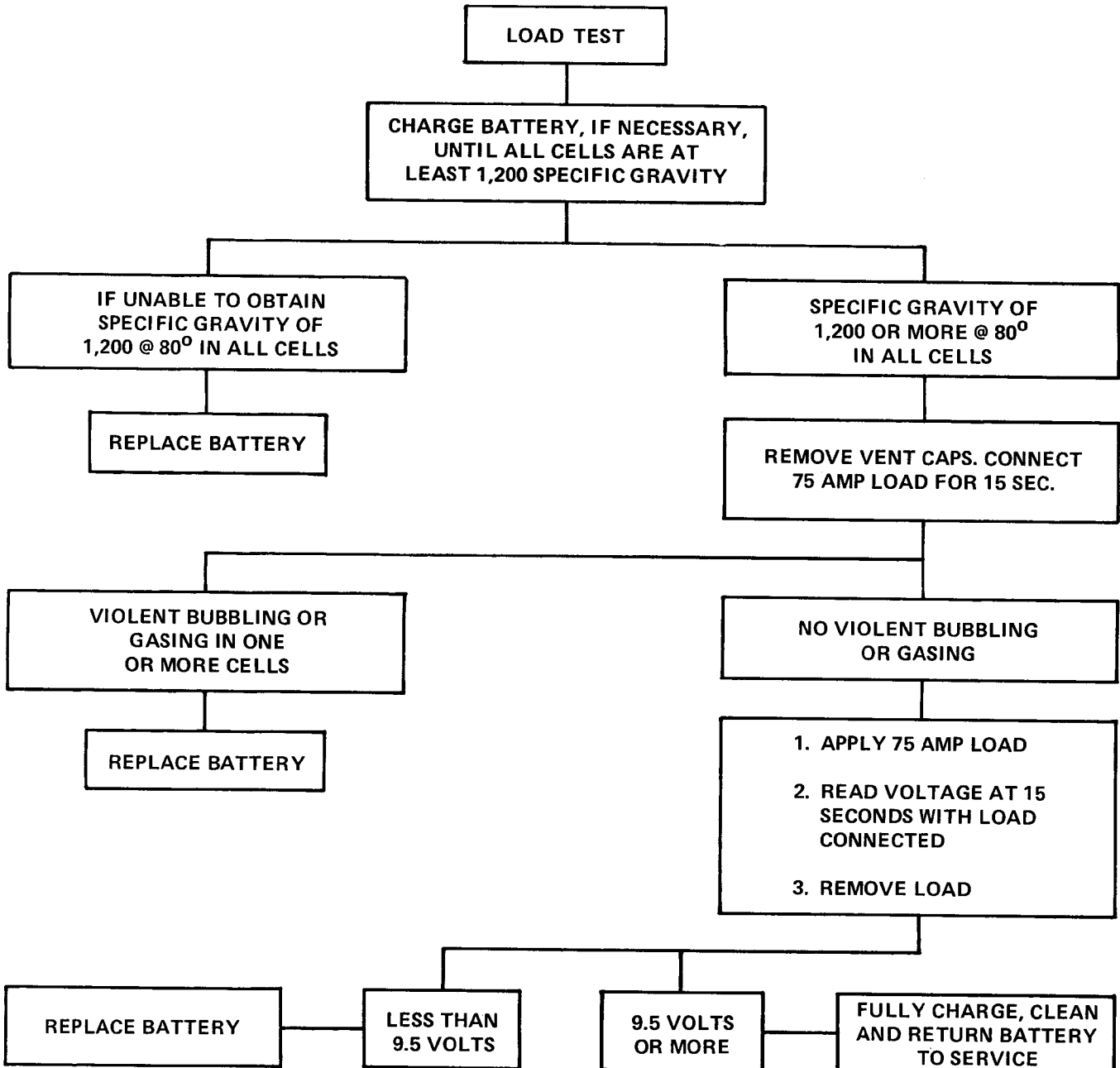
Fill hydrometer with enough electrolyte to allow float to float freely. Hold hydrometer vertically and at eye level when taking a reading. Record reading for each cell, and correct for temperature as described above. Refer to battery check sheet.

LOAD TEST: Perform the battery load test by loading the battery to 3 times its amp-hour rating for 15 seconds.

Examples: 3 x 24 amp-hour = 72 amp load
3 x 32 amp-hour = 96 amp load

This load can be created with a battery load tester or by cranking the engine (cranking load of room temperature engine is approximately 80 amps).

Follow the step-chart and enter results on the battery check sheet.



BATTERY CHECK SHEET

TEST Result Summary Indication Remedy

VISUAL INSPECTION

| | | | |
|---------------------------|---|-------------------------------------|-----------------------------|
| 1. Dirty battery top_____ | | Battery OK | Clean |
| 2. Clogged vents _____ | | Battery OK | Clean |
| 3. Corrosion _____ | | If severe, possible battery defect. | Clean and continue testing. |
| 4. Low water level _____ | Excess water use - Test for overcharging. | Battery OK | Add water |
| 5. Cracked case _____ | | Defective battery | Replace |

SPECIFIC GRAVITY CHECK

| | | | |
|------------------|--|---|---|
| Cell No. 1 _____ | 1. More than 30 gravity points variation between cells. | 1. Defective, discharged or worn out battery. | 1. Recharge battery. Repeat test. If cell readings still vary more than 30 points, replace battery. |
| Cell No. 2 _____ | | | |
| Cell No. 3 _____ | 2. Most cells below 1.230 and within 30 points. | 2. Discharged | 2. Recharge and make Load Test. |
| Cell No. 4 _____ | | | |
| Cell No. 5 _____ | 3. Most cells at or near full charge (1.260) and within 30 points. | 3. Charged | 3. Make Load Test. |
| Cell No. 6 _____ | | | |
| | 4. Most cells above full charge (1.260) | 4. Overcharged | 4. Check regulator. |

NOTE: Specific gravity readings apply to original equipment or Case supplied replacement batteries only. Other makes may vary.

LOAD TEST

| | | | |
|--|-----------------|------------|-----------------------|
| Battery must have 1200 specific gravity. Load equals 20-hour amp rating x 3 for 15 seconds | | | |
| 12 volt battery _____ | Over 9.5 volts | Battery OK | Recharge if necessary |
| | Under 9.5 volts | Defective | Replace |

TROUBLESHOOTING CHART

I. ENGINE WILL NOT CRANK

| SYMPTOM | POSSIBLE CAUSE | TEST | SOLUTION |
|--|---|---|---|
| A. Solenoid doesn't click or clicks repeatedly (See "B" below) | 1. Dead or weak battery | Hydrometer test. Voltmeter reading 9.5 minimum at battery terminals when cranking | Charge or replace battery |
| | 2. Poor or open connection at solenoid, ampmeter, fuse, key switch, or neutral start switches | Visually inspect | Clean and tighten loose or corroded connections |
| B. Solenoid doesn't click | 1. One or both neutral start switches open | Connect jumper wire from solenoid post to ground (Small post ground side) | Disengage PTO clutch and put travel lever in N. Repair or replace one or both N start switches if defective |
| | 2. Fuse blown | Check continuity | Replace fuse |
| | 3. Open ampmeter | Check continuity | Replace ampmeter |
| | 4. Open solenoid | Check continuity | Replace solenoid |
| | 5. Open ignition switch | Connect jumper from battery positive to solenoid "+" small terminal or from B to S terminal on switch | Replace ignition switch |
| C. Solenoid click but engine won't crank (See A above) | 1. Engine tight or ACR malfunction | Attempt to turn engine manually to check for free rotation | Repair engine if found to be tight |
| | 2. Defective solenoid switch | Connect jumper wire across large solenoid posts. Engine should crank. | Replace solenoid |
| | 3. Defective or worn starter | | Repair or replace. See starter motor section of this manual. |

II. ENGINE CRANKS, BUT WON'T START

| | | | |
|--|-----------------------------------|--|---|
| A. Engine cranks slowly and won't start (Electrical problems only) | See A. & C. above | | |
| B. Engine cranks but won't start (No spark) | 1. Points not opening and closing | Check gap | Clean and set gap to .017" to .024". Time engine. |
| | 2. No current to coil | Check for battery voltage at coil + with voltmeter or testing light. Hold switch in "start" position. Check wire connections and ignition switch continuity from "B" to "I" in both start and run positions | Replace switch or wires as required |
| | 3. Spark plug | Inspect for grounded high tension lead or cracked insulator or fouled spark plug | Repair or replace lead or plug as required |
| | 4. Defective ignition coil | Use coil tester | Replace |
| | 5. Shorted to ground condenser | Unhook condenser lead. Crank engine. If weak spark is now seen, condenser was shorted. | Replace condenser |

III. ENGINE RUNS ERRATICALLY

| | | | |
|--|--|-------------------------------------|---|
| A. Engine runs at idle and erratically (electrical problems only). Flashing blue arc at points. Points burned. | Faulty condenser or condenser connected to coil "+" (points and condenser should be connected to coil "-") | Condenser test. Inspect connection. | Replace or connect condenser to coil "-". |
|--|--|-------------------------------------|---|

IV. ENGINE CRANKS IN GEAR

| | | | |
|---|---|--|--|
| A. Engine cranks with travel lever in drive (210 - clutch pedal up; 644 - travel pedal depressed) | Grounded N start switch (travel or PTO) or wire lead | Visual inspection. Disconnect wire from small solenoid post to PTO N-Start switch. | Repair or replace wire lead or N - Start switch (travel or PTO). |
| B. Engine cranks with PTO clutch in gear or both travel and PTO in gear. | Grounded PTO N - Start switch or wire lead or grounded starter solenoid | Visual inspection. Disconnect wire from small solenoid posts N - Start switch. Attempt to crank engine | Repair or replace lead or N - Start switch. If unit cranks with wire disconnected - R & R solenoid |

V. BATTERY UNDER CHARGING (OR NO CHARGE)

| | | | |
|--|--|--|--|
| A. Battery goes dead with normal usage | 1. Defective battery | Recharge and perform battery test | Replace if necessary |
| | 2. Cold weather, short running periods | Recharge and perform battery test | Use battery heater and trickle charger |
| | 3. Stop start operation | Recharge and perform battery test | Keep engine speed high enough to charge |
| | 4. Dirty or corroded terminals or wires | Visual inspection | Clean |
| | 5. Excessive electrical loads | Total individual loads | Reduce total load |
| B. No charge to battery (ampmeter at .0) | Battery fully charged | Turn head lights on for 5 minutes with engine shut off. Start tractor. | Ampmeter shows charge. Indicates charging system functioning properly. |
| | Defective rectifier, regulator or stator | Run engine at 3600 RPM for 3 - 5 minutes. Measure D-C volts at battery terminal Run engine at 3600 RPM. Measure AC volts at stator output plug* (unplug from rectifier regulator) | If 13.6 volts charging system okay, check for faulty ammeter or fully charged battery. If less than 13.6 volts, test stator output. If less than 28 VAC replace stator†. Retest rectifier regulator. If more than 28 VAC, stator okay, replace rectifier regulator. |

*NOTE: Be sure to check all connections for continuity before replacing major components. Be sure rectifier regulator is grounded to tractor frame.

†NOTE: Stator output voltage between 14 and 28 volts AC is adequate to charge battery at reduced rate. Reduced stator output could be caused by dirt accumulations or weak flywheel magnets. Remove flywheel, inspect and correct as necessary.

VI. BATTERY CONTINUOUSLY CHARGES AT HIGH RATE

| | | | |
|--|--|---|---|
| A. Ampmeter continuously shows high value. Water consumption exceeds 1 oz each 25 hours. | Rectifier-regulator over-charging or defective battery | Run engine at 3600 RPM for 3-5 minutes. Measure DC volts at battery terminal. | If more than 14.7 volts, replace rectifier - regulator. If less than 14.7 volts, battery unable to hold charge. Test battery, replace if necessary. |
|--|--|---|---|

REPAIR

STARTING MOTORS

TROUBLE ANALYSIS: Problems that can occur during normal usage are listed in the accompanying chart. The symptom, possible cause and the suggested remedy are stated. If these steps do not solve the problem, the starting motor should be replaced.

TEST PROCEDURE CHART

| CONDITION | POSSIBLE FAULT AND CORRECTION |
|---|--|
| A. STARTER FAILS TO ENERGIZE | <ol style="list-style-type: none">1. Wiring: Check for badly corroded or loose connections, also broken or frayed insulation. Clean and tighten connections, replace wires in poor condition.2. Starting Solenoid: Bypass the solenoid with jumper wire - if starter cranks normally, replace defective part.3. Battery: Check specific gravity of battery - if low, recharge or replace battery as necessary. |
| B. STARTER ENERGIZES BUT TURNS TOO SLOWLY | <ol style="list-style-type: none">1. Battery: Check condition of battery (See A-3).2. Brushes: Remove end cap, check for unevenly worn or dirty brushes and commutator. Use a coarse cloth (not emery paper) to clean. Replace brushes if excessively or unevenly worn. See brush replacement procedure.3. ACR: Be sure ACR is functioning and engine turns freely. |

STARTER MOTOR REPAIR

See Figure 6.

Starter motor repairs may be made if troubleshooting procedures described in this manual reveal an internal starter problem.

BRUSH - COMMUTATOR SERVICE: The starter must be completely disassembled to service brushes and commutator. Proceed as follows:

1. Remove thru bolts.
2. Separate end cap from armature.

NOTE: Brush springs will probably fall out when brushes pull free of the commutator

3. Clean up commutator with a coarse, lint-free cloth--if badly worn or grooved, turn down on lathe.

4. Replace brushes as follows: The input brushes are part of the terminal stud assembly. To replace, remove nuts, and pull stud out thru inside of end cap. Insert new stud terminal-brush unit after transferring insulation bushing from old unit. To replace insulated brushes, simply remove capscrew and lockwasher. Always use new brushes and springs. Assemble brushes with chamfered side away from springs. Keep brush leads away from contact with metal of end cap.

5. To keep brushes in position so that they will fit over the commutator as the end cap is reinstalled, use a brush holder tool which can easily be cut out of thin sheet metal. See Figure 5.

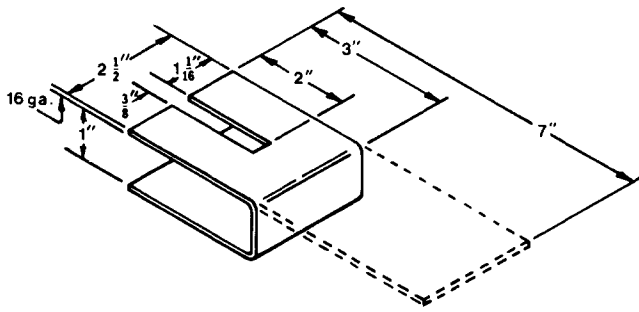


FIGURE 5 Brush Holder Tool

DRIVE ASSEMBLY: Replace drive assembly if pinion is badly worn or has broken teeth.

To remove drive assembly:

1. Hold armature shaft.
2. Remove dust shield (16), stop nut (15), pinion stop (13), anti drift spring (12) and dust shield retainer (17).
3. Slip drive pinion off over spline and armature shaft.

Leave drive off if further disassembly of starter is required.

To install drive assembly:

1. Thoroughly clean the drive shaft and pinion and apply a small amount of lubriplate AERO grease or other dry lubricant such as graphite.
2. Install drive pinion, dust shield retainer, anti drift spring, pinion stop.
3. Apply Locktite # 271 to threads. Tighten stop nut to 150-170 lb. in. (17-19 Nm). Wipe excess Locktite from threads.
4. Push dust shield on until it snaps into position over the shield retainer.

STARTER MOTOR INSTALLATION: Use only the special shoulder cap screws to mount starter to engine block. This is required to insure proper alignment between starter pinion and flywheel ring gear.

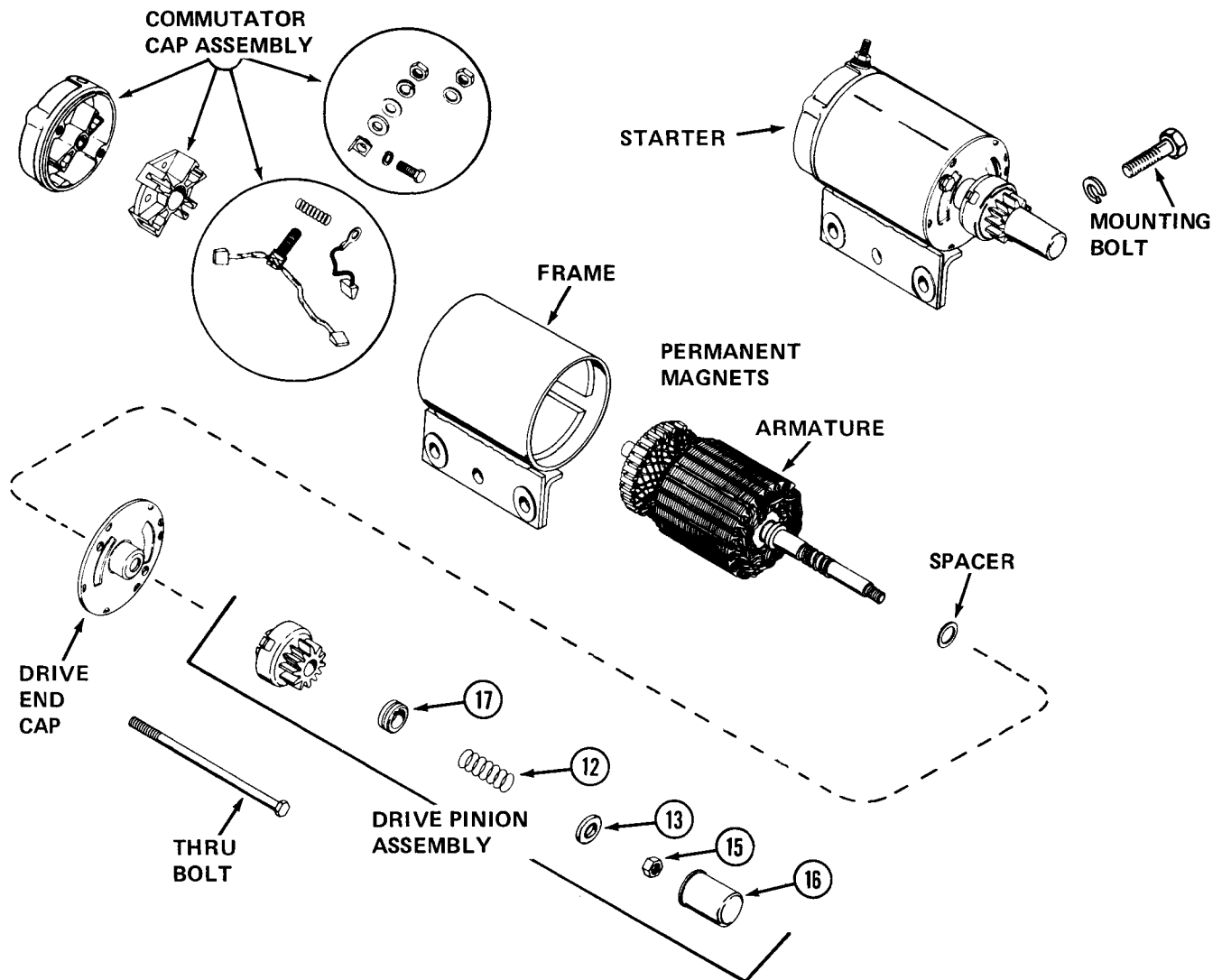


FIGURE 6 Permanent Magnet Type Starting Motor

RING GEAR

RING GEAR REPLACEMENT: If inspection of the ring gear reveals broken, excessively worn or otherwise damaged teeth, the ring gear must be replaced. The ring gear is press fitted into a recess on the outer perimeter of the flywheel. The flywheel must be removed from the engine for ring gear replacement.

Several methods may be used to remove the damaged ring gear. One method is to break the gear into sections with a cold chisel and/or a hack saw. Another way is to heat the ring gear with a torch, then drive the gear off the flywheel. If the latter method is used, the flywheel will also absorb some heat and it must be allowed to cool before the new ring gear can be installed.

The new gear must be expanded with heat before installation. This can be done by submerging the gear in hot oil or heating in an oven to about 400°F (200°C). Position the heated gear on the flywheel, then after making sure it is not cocked, either press the gear on with an arbor press or drive it on with a soft head hammer. As the gear cools, it will contract to form a tight press fit on the flywheel. Be sure to tighten the flywheel retaining nut to the proper torque value after reinstalling the flywheel on the engine.

STATOR ASSEMBLY REPAIR

Test the stator output in accordance with charging system troubleshooting section of this manual. Be sure to check for continuity at terminal connections.

If A.C. output is more than zero but less than 28, remove flywheel and inspect for dirt accumulation or weak magnets.

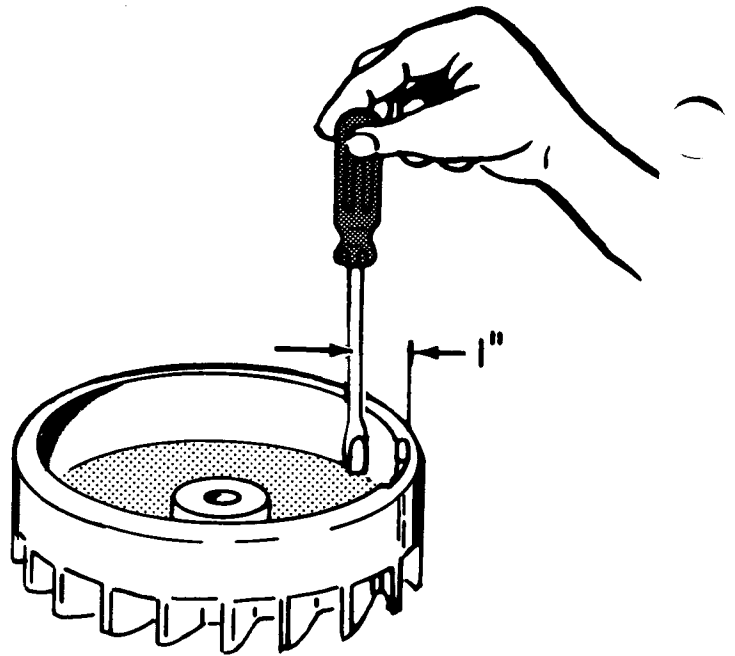


FIGURE 7 Testing Magnet Strength

Flywheel magnet strength can be tested by loosely holding an unmagnetized screwdriver parallel with each magnet. The screwdriver should be drawn in contact with magnets from a distance of one inch (25 mm).

Install flywheel and retest AC output after cleaning and magnet inspection.

IGNITION SYSTEM REPAIR

COMMON CAUSES - - POOR OR NO IGNITION

NO IGNITION SPARK

1. Switch turned off
2. Leads disconnected or broken
3. Bad plug
4. Ignition switch faulty
5. Breaker points oxidized
6. Breaker points stuck
7. Condenser faulty
8. Ignition coil faulty

POOR IGNITION

1. Plug wet
2. Plug gap incorrect
3. Plug carbon fouled
4. Wrong plug
5. Breaker points dirty or bad condition
6. Point gap wrong
7. Condenser weak
8. Push rod sticking or worn
9. Cam lobe worn

See Troubleshooting section of this manual for more complete troubleshooting information.

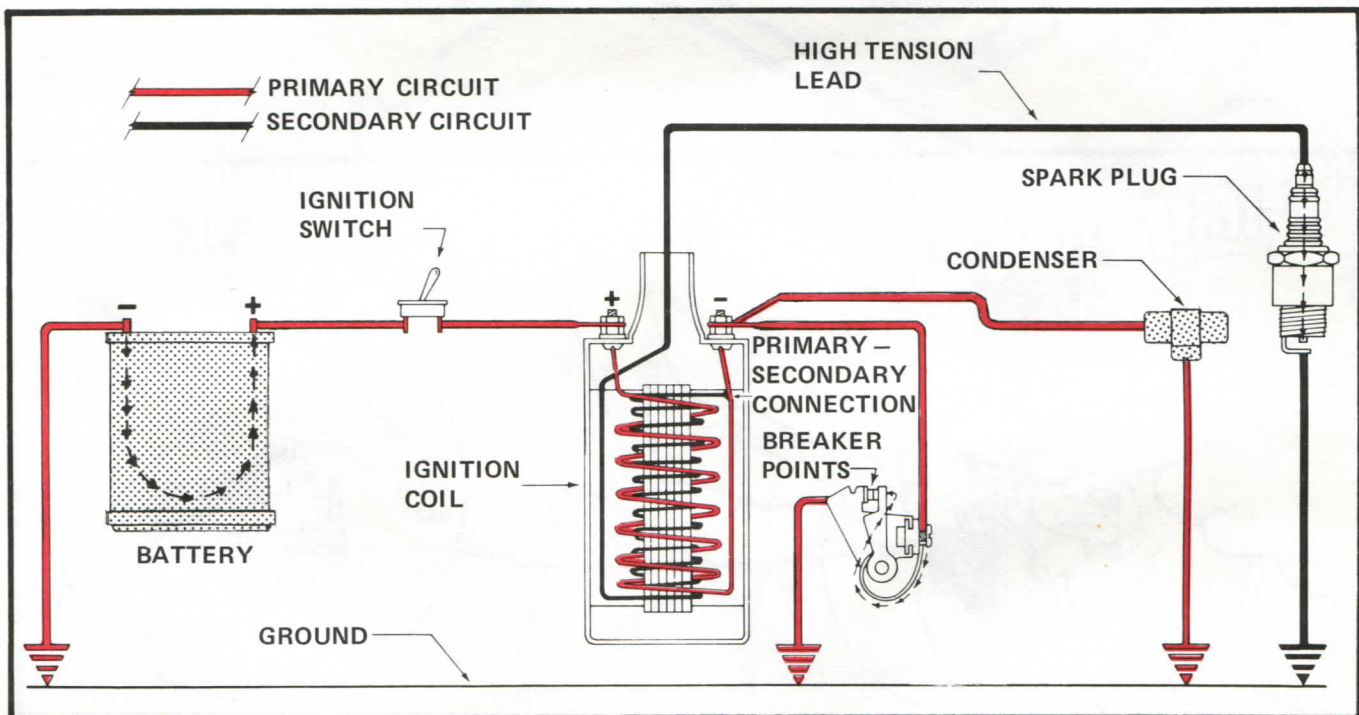


FIGURE 6 Schematic of a typical battery ignition system.

BREAKER POINT SERVICE: Engine operation is greatly affected by breaker point condition and adjustment of the gap. If points are burned or badly oxidized, little or no current will pass and as a result the engine may not operate at all, or if it does run it is likely to misfire, particularly at full throttle.

The breaker point gap affects the time that the contacts are opened and closed. If the points are adjusted to a wider gap, they will open earlier and close later. A definite time is required for the magnetic field within the ignition coil to build up to sufficient value. If the contact points are closed for too short a time, a weak spark will be produced by the coil. If points are set too wide, they will open before the primary current reaches the maximum value and on the other hand if set too close, they will open after the primary current has passed its maximum value.

Breaker Point Replacement: Rotate engine flywheel until "T" mark (top dead center) is in center of timing sight hole with piston on compression stroke.

Replace breaker point assembly. Set gap at .020" (.50 mm).

This will allow engine to start and run so ignition timing may be checked and adjusted.

Ignition Timing: Connect timing light to tractor battery and spark plug in accordance with directions provided with your timing light.

Start and run engine at a medium speed (about 1800 RPM).

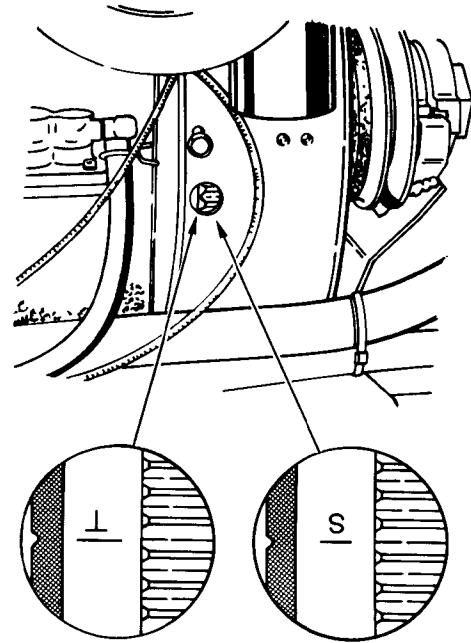


FIGURE 9

Aim timing light into timing sight hole. "S" mark should be centered. Adjust point gap as required to center "S" mark in timing sight hole.

NOTE: The timing mark may be easier to see if after aligning "S" mark in sight hole a chalk mark is made between the blower housing and rotating air screen.

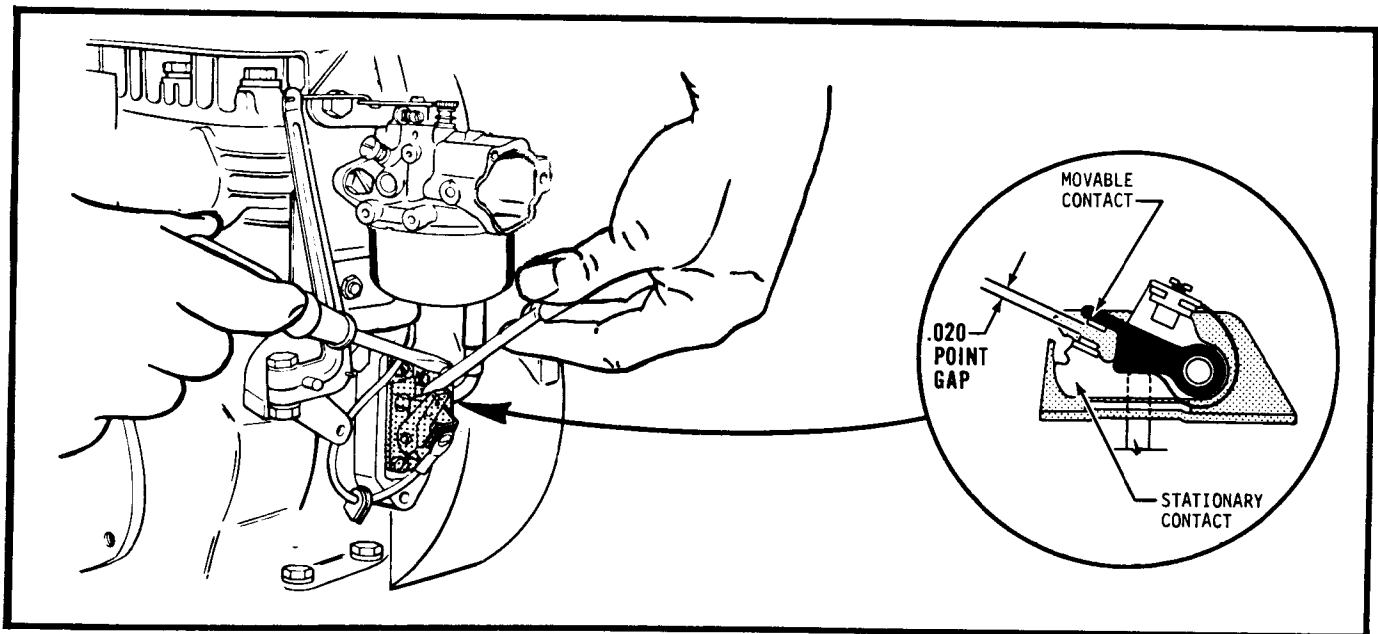


FIGURE 10
Breaker point gap adjustment

COIL SERVICE: Inspection: The ignition coil should be kept clean and dry and connections must be kept tight. The rubber boot on the high tension terminal must be in good condition to prevent leakage of current across exposed surfaces.

Installation: The coil must be installed with the primary positive (+) terminal connected to battery positive (+) (from key switch). The coil negative (-) must be connected to the breaker points and condenser. See Figure 8.

Testing: Ohmmeter test for coil primary winding.

1. Select RX 1 scale on ohmmeter.
2. Zero ohmmeter needle.
3. Connect one ohmmeter lead to coil "+" terminal, the other to coil "-" terminal.
4. Resistance should be from 4 to 8 ohms.

Infinite resistance indicates open primary circuit. Less than 4 ohms resistance indicates a shorted primary circuit.

Ohmmeter test for coil secondary winding.

1. Select RX 1,000 scale on ohmmeter.
2. Zero ohmmeter needle.
3. Connect one ohmmeter lead to coil spark plug terminal, the other to coil "-" terminal.
4. Resistance should be about 8,000 ohms.

Infinite resistance indicates an open secondary circuit. Substantially less than 8,000 ohms indicates a shorted secondary circuit.

Ohmmeter test for grounded windings.

1. Select RX 1,000 scale on ohmmeter.
2. Zero ohmmeter needle.
3. Connect one ohmmeter lead to coil "-" terminal, the other to metal case of coil.
4. Infinite resistance indicates a good coil. Continuity indicates a grounded coil.

NOTE: Do not touch ohmmeter leads with fingers when performing this test.

A coil testing "good" with the ohmmeter test is not conclusive. Coils may fail intermittantly when subjected to load, heat, and vibration of a running engine.

The use of a spark tester or coil tester will complete the testing of coil output.

Coil Tester Test.

Follow the instructions provided with the coil tester. If a coil tester is not available, the spark tester check may be used.

Spark Tester Test.

1. Connect spark tester ground clip to engine ground.
2. Connect spark plug wire to test terminal of spark tester.
3. Crank engine.
4. A sharp blue spark should be visible.
5. Connect spark tester ground clip to spark plug. (Now spark tester is in series with engine spark plug.)
6. Start and operate engine under load. Presence of spark (coil output) can be monitored during operation.

CONDENSER SERVICE:

Symptoms:

Condenser shorted to ground will prevent coil from producing secondary voltage.

Condenser with open circuit or decreased capacitance reduces coil output voltage and will cause points to burn excessively.

Condenser with too little capacitance will cause metal to build up on the moveable contact.

Condenser with too much capacitance will cause metal to build up on the stationary contact.

Replace condenser with proper one as indicated in parts listing.

Testing: Ohmmeter test:

1. Remove condenser.
2. Select RX1 scale on ohmmeter.
3. Connect ohmmeter leads between condenser lead and condenser mounting tab.
4. A low resistance reading should be indicated when first connected followed immediately by a high reading.
5. If low resistance is indicated continuously, the condenser is shorted and must be replaced.

IMPORTANT: Be sure to connect condenser to the breaker point side of the coil. That is the negative (-) side on the negative ground system.

SPARK PLUG SERVICE

Symptoms: Spark plugs in poor condition or gapped improperly can cause engine misfire and poor operation.

Refer to Figures 11, 12 and 13 for examples of failed spark plugs. Correct the cause of the failure before returning the engine to service.

Removal:

Every 100 hours remove plug, check condition and reset gap.

CLEAN AREA around plug before removal.

DO NOT sandblast, wire brush, scrape or otherwise service plug in poor condition--best results are obtained with new plug.

Set spark gap at .035" (.89 mm) for standard plugs and .025" (.64 mm) for resistor plugs. Tighten plug to 18 to 22 lbs. ft. (25 to 29 Nm) with a torque wrench.

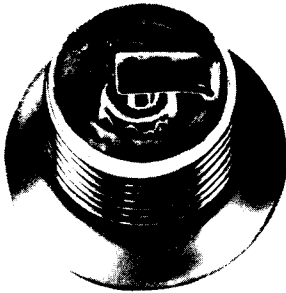


FIGURE 11 Oil Fouled Spark Plug

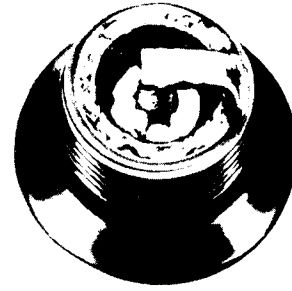


FIGURE 12 Overheated Spark Plug

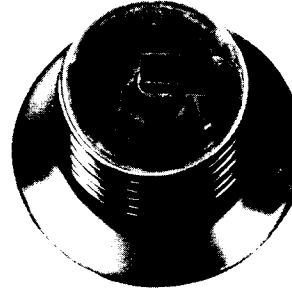


FIGURE 13 Fuel Fouled Spark Plug

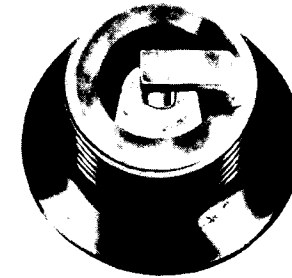
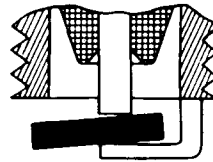
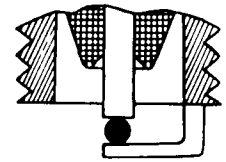


FIGURE 14 Spark Plug With Normal Wear



FLAT FEELER GAUGE CAN GIVE FALSE READING



ROUND FEELER GAUGE WILL GIVE A MORE ACCURATE READING

FIGURE 15 Spark Plug Gap

SPARK PLUG SPECIFICATIONS

| ENGINE MODEL | PLUG SIZE | HEX. SIZE | PLUG REACH | STANDARD PLUGS SOLID POST | RESISTOR PLUGS NON SHIELDED | SHIELDED |
|----------------------|-----------|-----------|------------|---------------------------|-----------------------------|-----------------|
| K241 K301 K321 | 14 mm | 13/16" | 7/16" | H-10 *235040-S | XH-10 *235041-S | XEH-10 235259-S |

Use only the spark plug specified

*Champion or equivalent

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