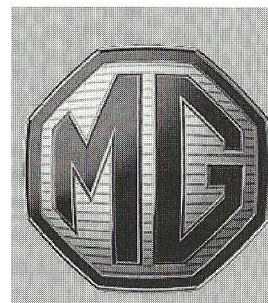


Troubleshooting Guide



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Engine and Transmission Troubleshooting Guide

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This guide was reproduced using a publication of the now defunct Vesta Battery Company. The Vesta guide was originally published in 1943 so the copyright has expired. Club Members are advised to carry this publication in their historic vehicles as it will provide a useful framework for analysing problems with older cars using conventional mechanical and electrical systems.

ENGINE WONT START OR STARTS HARD

Due to Ignition Wiring & Connections

- 1-Loose or corroded connections at the ammeter, ignition switch, coil or distributor.
- 2-Low tension wire insulation cracked or worn through.
- 3-Poor low tension wire ground connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Faulty ammeter.
- 6-Loose or corroded high tension terminals or cable sockets.
- 7-Cracked, oil soaked, wet, chafed or worn high tension cable insulation.
- 8-High tension cables installed not according to engine firing order.
- 9-High tension cable from coil to distributor not connected.
- 10-Poor ground between coil and its mounting.
- 11 Poor ground between distributor and engine.

Due to Distributor

- 1-Breaker point gap much too wide.
- 2-Breaker points not synchronised.
- 3-Breaker points dirty, pitted or burned.
- 4-Breaker arm spring weak or broken.
- 5-Breaker arm sticking.
- 6-Breaker arm grounded due to worn or broken insulating bushing.
- 7-Breaker arm rubbing block loose or badly worn.
- 8-Breaker arm plate loose or not properly grounded.
- 9-Loose breaker plate terminal posts.
- 10-Breaker pigtail lead wires loose or broken.
- 11-Breaker cam loose due to burrs on cam locking screw taper.
- 12-Incorrect ignition timing.
- 13-Distributor cap cracked.
- 14-Distributor cap inserts bent, loose or badly burned.
- 15-Too much clearance between distributor cap inserts and rotor.
- 16-Grounded rotor.
- 17-Broken, loose or bent rotor spring.
- 18-Distributor cap centre terminal (rotor

- contact) missing or broken.
- 19-Distributor cap wet or dirty.
- 20-Broken or bent distributor shaft.
- 21-Distributor shaft worn.
- 22-Distributor shaft bushing or bearing loose or worn.
- 23-Distributor drive gear or coupling sheared, broken or loose on shaft.
- 24-Distributor drive gear not timed properly with oil pump drive gear.
- 25-Automatic spark advance plate installed backwards.
- 26-Weak or grounded condenser.
- 27-Defective coil.
- 28-Cracked coil tower.
- 29-Wet or dirty coil tower.

Due to Battery

- 1-Battery in low state of charge.
- 2-Battery completely discharged.
- 3-Poor ground connection between battery and frame.
- 4-Poor ground connection - frame/engine.
- 5-Battery terminals badly corroded or loose.
- 6 -Cable from starter to battery broken, or terminal cracked.
- 7--Cable loose in terminal socket.
- 8-Dead cell in battery.
- 9-Under-sized battery cables.

Due to Spark Plugs

- 1-Plugs operating too cold, causing fouling.
- 2-Fouled plugs due to an excessively rich carburettor mixture.
- 3-Fouled plugs due to engine oil gashing piston rings.
- 4--Fouled plugs due to their being loose in cylinder head.
- 5-Fouled plugs due to damaged or ineffective plug gaskets.
- 6-Fouled plugs due to improper operation of choke.
- 7-Use of too hot operating plugs, causing pre-ignition.
- 8-Spark plug gaps much too wide.
- 9-Use of some types of spark plug and coil radio suppressors.
- 10-Spark plugs damp or covered with dirt.

Due to Starting Motor

- 1-Broken starter pinion.
- 2-Broken flywheel ring gear.
- 3-Sticking starter due to burred teeth on starter pinion or flywheel gear.
- 4-Broken Bendix spring.
- 5-Oil congealed in starter drive due to the use of too heavy a grade.
- 6-Starting switch not operating properly.
- 7-Starting switch not grounded properly. Switch contacts burned or corroded.
- 8-Rotation of starter prevented due to bent armature shaft, cracked or distorted housing, tight bearings, misaligned bearings, lack of lubrication, sludge formation in starter drive, starter not aligned properly with engine.
- 9-Rotation of starter prevented due to loose brush connections, loose pig-tails, brushes sticking in holders, bent brush holder arms, weak or broken brush springs, sticking brush holders, incorrect type of brushes, brushes worn too short.
- 10-Armature shorted.
- 11-Commutator surface dirty, burned, pitted or excessively lubricated.
- 12-High mica between commutator segments due to worn commutator.
- 13-Brush ring set incorrectly or grounded.
- 14-Excessive brush spring tension, causing rapid wear of brushes and commutator.
- 15-Burned out, shorted or open-circuited field coils.
- 16-Brushes sticking in brush holder.
- 17-Worn bushings or bearings causing armature to drag against pole pieces.

Due to Fuel System

- 1-intake manifold and cylinders flooded with fuel due to faulty choke operation.
- 2-Old, stale or a poor grade of fuel being used, particularly during cold weather or after being in dead storage.
- 3-Air leaks due to: cracked intake manifold, air horn gasket broken or damaged, worn throttle shaft bearing, loose manifold attaching nuts, loose carburettor attaching nuts, warped carburettor flange, broken or damaged intake manifold or carburettor gaskets, poor vacuum line connection at

- the intake manifold, loose or missing intake manifold core hole plugs or warped choke cover.
- 4-Choke valve fails to close fully when starting a cold engine. Broken or loose choke wire.
- 5-Low carburettor float or fuel level.
- 6-Clogged or dirty carburettor screen.
- 7-Inoperative fuel pump.
- 8-Restricted, broken or clogged fuel line from the pump to carburettor.
- 9-Restrictions in carburettor passages due to presence of ice, corrosion or water.
- 10-No fuel supply.
- 11-Ice formation in fuel pump sediment trap.
- 12-Vapour lock.
- 13-Automatic choke control faulty or sticking.
- 14-Leaky carburettor jet gasket so that carburettor is dry after car is parked for some time.

Due to Loss of Engine Compression

- 1-Spark plugs loose in cylinder head.
- 2-Cylinder head bolts loose.
- 3-Piston rings broken, worn, or stuck.
- 4-Cylinder head gasket damaged or improperly installed.
- 5-Valves held open due to insufficient tappet clearance.
- 6-Valves held open due to warped, corroded or gummed stems.
- 7-Valve seating poorly.
- 8-Valve springs weak or broken.

Due to Other Conditions

- 1-Broken or loose camshaft or distributor drive shaft gear.
- 2-Valves improperly timed.
- 3-Cracked cylinder block.
- 4-Water in cylinders.
- 5-Excessive internal friction of engine assembly due to insufficient clearances.
- 6-Broken or jammed internal parts of clutch or transmission.
- 7-Engine "seized" due to overheating.
- 8-Broken flywheel ring gear.
- 9-Petrol tank filler cap clogged.
- 10-Sludge conditions due to water in oil.

ENGINE MISSES REGULARLY IN ONE CYLINDER WHEN IDLING

Due to Ignition Wiring

- 1-Loose or corroded high tension terminal or cable socket.
- 2-Cracked, oil soaked, wet, chafed or worn high tension cable insulation.
- 3-High tension cable not connected.
- 4-Broken wire inside of cable.
- 5-Stray cable strand shorting spark plug.

Due to Spark Plug

- 1-Spark plug operating too cold, causing fouling.
- 2-Spark plug operating too hot, causing pre-ignition.
- 3-Fouled plug due to engine oil passing piston rings.
- 4 -Fouled plug loose in cylinder head.
- 5-Fouled plug due to damaged or ineffective plug gasket.
- 6-Spark plug gap too wide.
- 7-Spark plug gap too narrow.
- 8-Insulator loose in shell.
- 9-Insulator interior coated with carbon oil or water.
- 10-Insulator cracked, glaze-scratched or melted, allowing carbon deposit, etc , to provide path for current.
- 11-Spark plug gap filled with oil, water or fuel.
- 12-Spark plug threads dirty.
- 13-Spark plug shorted by some metal part out of place.
- 14-Defective radio suppressor.

Due to Valve System

- 1-Valve leaks clue to faulty seating.
- 2-Warped valve face.
- 3-Shoulder on valve face.
- 4-Valve sticking.
- 5-Valve burned.
- 6-Carbon on valve seat.
- 7-Valve pitted.
- 8-Cracked valve seat.
- 9-Gum on valve stem.
- 10-Broken valve spring.
- 11-Bent valve stem.
- 12-Valve stem too tight in guide.
- 13-No or incorrect tappet clearance.

- 14-Sticking rocker arm.
- 15-Broken mushroom on lifter assembly.
- 16-Valve insert loose in block.
- 17-Valve lifter screw lock loose causing valve to be held open.

Due to Other Conditions

- 1-Cracked cylinder head.
- 2-Broken cylinder head gasket.
- 3-Distributor cap insert bent, loose or burned.
- 4-Air leak around intake valve stem due to excessive stem-to-guide clearance.
- 5-Loss of engine compression in cylinder.
- 6-Slight water leak in cylinder or combustion chamber.
- 7-Ignition points too close with low lobe on cam and worn distributor shaft or loose bushing.

ENGINE MISSES - NO PARTICULAR CYLINDER - IDLING OR OPERATING BELOW 20MPH WITH NO LOAD

Due to Ignition

- 1-Loose or corroded connections or terminals at the ammeter, ignition switch, coil or distributor.
- 2-Slight short in primary circuit wiring.
- 3-Poor low tension wire ground connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Loose or corroded high tension terminals or cable sockets.
- 6-Cracked, oil soaked, wet, chafed or worn high tension cable insulation.
- 7-Poor ground - coil to mounting.
- 8-Poor ground - distributor and engine.
- 9-Breaker point gap incorrect.
- 10-Breaker points not synchronised.
- 11-Breaker points dirty, cracked, pitted or burned.
- 12-Breaker arm spring weak or broken.
- 13-Breaker arm sticking.
- 14-Breaker arm insulating bushing worn.
- 15-Breaker arm rubbing block loose or badly worn.
- 16-Breaker arm plate loose or not properly grounded.
- 17-Loose breaker plate terminal posts.
- 18-Breaker plate pigtail leads loose/broken.

- 19-Breaker cam with low lobe.
- 20-Breaker cam loose due to burrs on cam locking screw taper.
- 21-Incorrect ignition timing.
- 22-Distributor cap cracked, wet or dirty.
- 23-Distributor cap inserts bent, loose or badly burned.
- 24-Distributor shaft bent or worn.
- 25-Distributor shaft bushing or bearing loose or worn.
- 26-Weak condenser.
- 27-Defective coil.
- 28-Cracked, wet or dirty coil tower.
- 29-Defective spark plug or coil radio suppressor.
- 30-Defective spark plugs.
- 31-Spark plugs not gapped properly.
- 32-Weak battery.
- 33-Ruptured automatic advance diaphragm.

Due to Fuel System

- 1-Float level too high or too low.
- 2-Idle adjusting screws (dual carburetors) not properly balanced.
- 3-Throttle valves (dual carburetors) not properly synchronised.
- 4-Restricted or partially clogged idle air passage.
- 5-Restricted or partially clogged idle jet, or passage.
- 6-Air leaking around throttle shaft.
- 7-Air leaking around idle tube.
- 8-Loose manifold connections.
- 9-Air leak in vacuum lines.
- 10-Loose manifold nuts.
- 11-Broken or damaged carburettor or intake manifold gaskets.
- 12-Cracked intake manifold.
- 13-Contacting surface of intake manifold warped or damaged.
- 14-Slight leak at check valves in fuel pump.
- 15-Punctured diaphragm in vacuum section of combination fuel pump causing fouled spark plugs due to oil being drawn into cylinders.

Due to Other Conditions

- 1-Unequal compression in cylinders.
- 2-Slight water leak in cylinders or combus-

tion chambers

ENGINE MISSES AT HIGH SPEED

Due to Ignition

- 1-Loose or corroded connections or terminals at the ammeter, ignition switch, coil or distributor.
- 2-Slight short in primary circuit wiring.
- 3-Poor low tension ground connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Loose or corroded high tension terminals or cable sockets.
- 6-Cracked, oil soaked, wet, chafed or worn high tension cable insulation.
- 7-Broken wire inside of cable.
- 8-Stray cable strand shorting spark plug.
- 9-Poor ground between coil and mounting.
- 10-Poor ground between distributor and engine.
- 11-Breaker point gap incorrect.
- 12-Breaker points not synchronised.
- 13-Breaker points dirty cracked pitted or burned.
- 14-Breaker arm spring weak.
- 15-Breaker arm sticking.
- 16-Breaker arm insulating bushing worn.
- 17-Breaker arm rubbing block loose or badly worn.
- 18-Rreaker arm plate loose or not properly grounded.
- 19-Loose breaker plate terminal posts.
- 20-Breaker plate pigtail leads loose or broken.
- 21-Breaker cam with low lobe.
- 22-Breaker cam loose due to burrs on cam locking screw taper.
- 23-incorrect ignition timing.
- 24-Distributor cap cracked, wet dirty.
- 25-Distributor cap inserts bent, loose or badly burned.
- 26-Rent or worn distributor shaft.
- 27-Distributor shaft hushing or bearing loose or worn.
- 28-Automatic spark advance plate loose.
- 29-Automatic advance governor springs weak or broken.
- 30-Automatic advance weight pins worn.
- 31-Weak condenser.
- 32-Defective coil.

- 33-Cracked, wet or dirty coil tower.
- 34-Defective spark plugs.
- 35-Spark plug gapped too wide.
- 36-Spark plugs operating, too hot/too cold.
- 37-Spark plugs loose in cylinder head.
- 38-Fouled plugs due to damaged or ineffective gaskets.
- 39-Faulty radio suppressor.
- 40-Pre-ignition due to any source.
- 41-Weak battery in combination with an inoperative generator.

Due to Fuel System

- 1-Dirty air cleaner.
- 2-Restricted air passages in air cleaner silencer.
- 3-Oil level too high in oil bath type air cleaner, causing restriction.
- 4-Choke valve not fully open.
- 5-Punctured diaphragm in vacuum section of combination fuel pump, causing fouled spark plugs due to oil being drawn into cylinder.
- 6-Float level too low.
- 7-Throttle valves (dual carburetors) not properly synchronised.
- 8-Air leak around throttle shaft.
- 9-Loose manifold connections.
- 10-Air leak in vacuum lines.
- 11-Loose manifold nuts.
- 12-Broken or damaged carburettor or intake manifold gaskets.
- 13-Cracked intake manifold.
- 14-Contacting surface of intake manifold being warped or damaged.
- 15-Slight leak at check valves in fuel pump.
- 16 Improper setting of economiser valve in carburettor.
- 17-Carburettor throttle lever loose on shaft.
- 18-Water in petrol.
- 19-Clogged filter screens.

Due to Valve System

- 1-Warped valve face.
- 1-Valve leaks due to faulty seating.
- 3-Valve sticking.
- 4-Valve badly burned.
- 5-Cracked valve seat.
- 6-Valve spring weak or broken.
- 7-Bent valve stem.

- 8-Valve stem too tight in its guide.
- 9-No or too great tappet clearance.
- 10-Sticking rocker arm.
- 11-Broken mushroom on valve lifter.
- 12-Valve held open due to shoulder on valve face.
- 13-Valve held open due to carbon on seat.
- 14-Valve held open due to gum on stem.

Due to Other Conditions

- 1-Partially restricted or clogged muffler, exhaust pipe or tail pipe.
- 2-Engine overheated.
- 3-Unequal or lack of engine cylinder compression.
- 4-Manifold heat control valve held in closed position.
- 5-Cracked cylinder head.
- 6-Broken cylinder head gasket.

ENGINE MISSES AT ALL SPEEDS

Due to Ignition

- 1-Loose or corroded connections or terminals at the ammeter, ignition switch, coil or distributor.
- 2 -Low tension wire insulation cracked or worn through.
- 3-Poor low tension ground connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Faulty ammeter.
- 6-Loose or corroded high tension terminals or cable sockets.
- 7-Cracked, oil soaked, wet, chafed or worn high tension cable insulation.
- 8-Broken wire inside of cable.
- 9-Stray cable strand shorting spark plug.
- 10-Wet high tension cables.
- 11-Improper ground between the coil and its mounting.
- 12-Improper ground between the distributor and engine.
- 13-Breaker point gap incorrect.
- 14-Breaker points not synchronised.
- 15-Breaker points dirty, cracked, pitted or burned.
- 16-Breaker arm spring weak or broken.
- 17-Breaker arm sticking.
- 18-Breaker arm insulating bushing worn.
- 19-Breaker arm rubbing block loose/worn.

- 20-Breaker arm plate loose or not properly grounded.
- 21-Breaker plate terminal posts loose.
- 22-Breaker pigtail leads loose or broken.
- 23-Breaker cam with low lobe.
- 24-Breaker cam loose due to burrs on cam locking screw taper.
- 25-Ignition timing incorrect.
- 26-Distributor cap cracked, wet or dirty.
- 27-Distributor cap inserts bent, loose or badly burned.
- 28-Worn or bent distributor shaft.
- 29-Distributor shaft bushing or bearing loose or worn.
- 30-Automatic advance plate loose.
- 31-Automatic advance governor springs weak or broken.
- 32-Automatic advance governor sticking or dirty.
- 33-Automatic advance governor pins worn.
- 34-Weak condenser.
- 35-Detective coil.
- 36-Cracked, wet or dirty coil tower.
- 37-Defective spark plugs.
- 38-Spark plug's loose in cylinder head.
- 39-Fouled plugs due to damaged or ineffective gaskets.
- 40-Spark plugs operating too hot/too cold.
- 41-Pre-ignition from any source.
- 42-Faulty spark plug, coil or radio suppressor.

Due to Fuel System

- 1-Float level too high or too low.
- 2-Throttle valve (dual carburetors) not properly synchronised. :
- 3-Air leak around throttle shaft.
- 4-Loose manifold connections.
- 5-Air leak in vacuum lines.
- 6-Loose manifold nuts.
- 7-Broken or damaged carburettor or intake manifold gaskets.
- 8-Cracked intake manifold.
- 9-Contacting surface of intake manifold being warped or damaged.
- 10-Slight leak at check valves in fuel pump.
- 11-Punctured diaphragm in vacuum section of combination fuel pump, causing fouled plugs.
- 12-Dirty carburettor air cleaner.

- 13-Restricted air passages in air cleaner.
- 14-Oil level too high in oil bath type air cleaner, causing restrictions.
- 15-Choke valve not fully open.
- 16-Improper setting of economiser valve in carburettor.
- 17-Carburettor throttle lever loose on throttle shaft.
- 18-Water in petrol or poor grade of petrol.

Due to Valve System

- 1-Valve leaks due to faulty seating.
- 2-Warped valve face.
- 3-Shoulder on valve face.
- 4-Valve sticking.
- 5-Valve burned.
- 6-Carbon on valve seat.
- 7-Valve pitted badly.
- 8-Cracked valve seat.
- 9-Gum on valve stem.
- 10-Broken or weak valve spring.
- 11-Bent valve stem.
- 12-Valve stem too tight in its guide.
- 13-No and too much clearance.
- 14-Sticking rocker arm.
- 15-Broken mushroom on valve lifter.

Due to Other Conditions

- 1-Partially restricted or clogged muffler, exhaust pipe or tail pipe.
- 2-Engine overheated.
- 3-Unequal or lack of engine cylinder compression.
- 4--Hole in piston head.
- 5-Manifold heat control valve held in, closed position.
- 6-Cracked cylinder head.
- 7-Broken cylinder head gasket.

POOR HIGH SPEED PERFORMANCE OR LACK OF POWER

Due to Ignition

- 1-Loose or corroded connections or terminals at the ammeter, ignition switch, coil or distributor.
- 2-Slight short in primary circuit wiring.
- 3-Poor low tension wire ground connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Faulty ammeter.

- 6-Loose or corroded high tension terminals or cable sockets.
- 7-Cracked, oil soaked, wet or worn high tension cable insulation.
- 8-Improper ground between coil and its mounting.
- 9-Improper ground between distributor and engine.
- 10-Breaker point gap incorrect.
- 11-Breaker points not synchronised.
- 12-Breaker points dirty, cracked, pitted or burned.
- 13-Breaker arm spring weak.
- 14-Breaker arm sticking.
- 15-Breaker arm insulating bushing worn.
- 16-Breaker arm rubbing block loose/worn.
- 17-Breaker arm plate loose or not properly grounded.
- 18-Breaker plate terminal posts loose.
- 19-Breaker pigtail leads loose or broken.
- 20-Breaker cam with low lobe.
- 21-Breaker cam loose due to burrs on cam locking screw taper.
- 22-Incorrect ignition timing.
- 23-Distributor cap cracked, wet or dirty.
- 24-Distributor cap inserts bent, loose or badly burned.
- 25-Distributor shaft bent or worn.
- 26-Distributor shaft bushing or bearing loose or worn.
- 27-Distributor drive gear not timed properly with oil pump drive gear.
- 28-Vacuum spark advance diaphragm or spring broken.
- 29-Automatic spark advance plate stuck or loose.
- 30-Automatic advance governor springs weak or broken.
- 31-Automatic advance governor sticking or dirty.
- 32-Automatic advance governor pins worn.
- 33-Weak condenser.
- 34-Defective coil.
- 35-Cracked, wet or dirty coil tower.
- 36-Defective spark plugs.
- 37-Spark plugs operating too cold/too hot.
- 38-Spark plugs improperly gapped.
- 39-Spark plugs loose in cylinder head.
- 40-Fouled plugs due to damaged or ineffective gaskets.

- 41-Pre-ignition due to any source.
- 42-Defective radio suppressors.

Due to Fuel System

- 1-Fuel level too high - causing a flooded condition.
- 2-Fuel level too low - causing a starved condition.
- 3-Excessive fuel pump pressure causing a flooded condition.
- 4-Low fuel pump pressure causing a starved condition.
- 5-Float punctured and partially filled with fuel-causing a flooded condition.
- 6-Float needle valve leaking due to dirt/wear.
- 7-External carburettor leaks.
- 8-Accelerating pump improperly adjusted.
- 9-Economiser piston stuck in its cylinder.
- 10-Economiser valve stem sticking in its guide.
- 11-Economiser valve and accelerating pump control linkage not properly adjusted.
- 12-Internal leak due to accelerating pump valve not seating properly.
- 13-Economiser or power valve not seating properly causing internal leak.
- 14-Internal leak -broken or cracked passages.
- 15-Use of metering jets, metering pins or nozzles which are too small.
- 16-Loose plugs or damaged gaskets at base of main discharge nozzles.
- 17-Manifold heat control valve held in closed position.
- 18-Dirty or restricted carburettor air cleaner.
- 19-Oil level too high in oil bath type air cleaner.
- 20-Choke valve not fully open.
- 21-Carburettor throttle lever loose on throttle shaft.
- 22-Throttle linkage not properly adjusted preventing a full throttle opening.
- 23-Carburettor adjusted for normal altitudes may have a rich adjustment at high altitudes, and vice versa.

Due to Other Conditions

- 1-Unequal or insufficient cylinder compression.

- 2-Restricted or clogged muffler, exhaust pipe or tail pipe.
- 3-Engine overheated.
- 4-Excessive internal friction due to insufficient engine clearances.
- 5-Connecting rods misaligned.
- 6-The use of too heavy a grade engine oil.
- 7-The use of expansion rings under piston rings-causing excessive friction.
- 8-Clutch slipping.
- 9-Tyres under-inflated.
- 10-Rear axle misaligned.
- 11-Brakes dragging.
- 12-Bearings too tight in wheel, pinion, differential or transmission.
- 13-The use of oversize tyres.
- 14-A gear ratio which is too low.
- 15-Incorrect valve timing.
- 16-A slow-reading speedometer gives the impression of lack of power.
- 17-Excessive front wheel toe-in or toe-out.
- 18-Loose fan blade.
- 19-Unbalanced fan.
- 20-Engine mountings not properly adjusted or loose.
- 21-Scored pistons.
- 22-Loose or worn timing gears or chain sets up torsional vibration causing automatic advance governor failure.

LOSS OF ENGINE COMPRESSION Valves

- 1-Weak or broken valve springs.
- 2-Valves held open due to insufficient tappet clearance.
- 3-Sticking valves due to insufficient valve stem-to-guide clearance.
- 4-Sticking valves due to carbon deposits or gum on the valve stems and in the valve guides.
- 5-Warped or broken valve heads.
- 6-Bent valve stems.
- 7-Pitted, burned or distorted valve seats.

The entire list of defects in engine parts has already been completed. It will be evident from the two samples above that by explaining what engine troubles defects will cause, the reader will have an excellent background for using this system of diagnosis intelligently.

Piston and Ring Conditions

- 1-Scored cylinder walls.
- 2-Excessive clearance between cylinder walls and pistons.
- 3-Tapered or eccentric cylinder bores.
- 4-Worn ring grooves.
- 5-Undersize rings.
- 6-Hole in piston head.
- 7-Insufficient ring tension.
- 8-Rings stuck in grooves due to gum or carbon deposit.
- 9-Scored piston ring faces.
- 10-Scored pistons.
- 11-Insufficient piston ring end gap clearance may cause scored cylinders.

Other Conditions

- 1-Broken cylinder head gasket.
- 2-Loose cylinder head bolts.
- 3-Spark plugs loose in cylinder head.
- 4-Compression loss due to faulty spark plug gaskets.
- 5-Warped cylinder head.

Engine backfires through carburettor

- 1-Incorrect valve timing.
- 2-Incorrect ignition timing.
- 3-Improper choke action in conjunction with cold engine.
- 4-Intake valve not seating properly.
- 5-Pre-ignition.
- 6-Excessively lean carburettor mixture.
- 7-Abnormally rich carburettor mixture.
- 8-Intake manifold air leaks.
- 9-Broken cylinder head gasket between cylinders.
- 10-Spark plug cables installed not according to engine firing order.
- 11-Distributor governor sticking.
- 12-Poor quality fuel.
- 13-Shorted distributor cap.
- 14-Wet distributor cap or wires.

PRE IGNITION OR SPARK KNOCK

- 1-Ignition timed too early.
- 2-Weak distributor automatic advance springs.
- 3-Combustion chamber with large carbon deposits.
- 4-Spark advance not operating upon ac-

- celeration.
- 5-Use of spark plug which is too hot.
- 6-Spark plug electrodes or insulators burned or carbonised.
- 7-Sharp metallic edges in combustion chamber.
- 8-Cylinder head gasket projecting into combustion chamber.
- 9-Excessively lean carburettor mixture.
- 10-Automatic heat control valve held in closed position.
- 11-Engine overheated.
- 12-Poor grade fuel.
- 13-Old or stale fuel - lost its volatility.
- 14-Using a high compression cylinder head with standard fuel.
- 15-Hot engine valves caused by incorrect valve seat width.
- 16-Hot engine valves caused by insufficient tappet clearance.
- 17-Hot engine valves due to use of wrong type or valves having thin edges.

EXCESSIVE OIL CONSUMPTION

External Leaks

- 1-Leak at oil gauge pipe connections.
- 2-Leak at oil filter lines.
- 3-Improperly installed rear camshaft bearing welch plug.
- 4-Loose rear camshaft bearing welch plug.
- 5-Loose fuel Pump or faulty gasket.
- 6-Timing gear cover not properly centred.
- 7-Faulty crankshaft oil seals.
- 8-Crankshaft pulley hub eccentric.
- 9-Restricted oil return groove in pulley hub.
- 10-Rough crankshaft pulley hub.
- 11-Crankshaft pulley nut, washer or gasket not properly installed.
- 12-Oil pan gasket broken or improperly installed.
- 13-Oil pan cap screws loose.
- 14-Oil pan gasket flange distorted.
- 15-Oil pan cracked.
- 16-Oil pan drain plug loose.
- 17-Oil pan drain plug gasket missing or damaged.
- 18-Timing gear cover gasket broken or improperly installed.
- 19-Timing gear cover bolts loose.
- 20-Timing gear cover flange distorted.

- 21-Timing gear cover cracked.
- 22-Valve cover plate gasket broken or improperly installed.
- 23-Breather housing or housing tube loose or clogged.
- 24-Oil pump cover gasket broken, loose or improperly installed.
- 25-Valve stems or guides worn.

Internal Conditions

- 1-Piston rings badly worn or scuffed.
- 2-Broken piston rings.
- 3-Insufficient ring tension.
- 4-Insufficient end gap clearance (if piston rings which may cause cylinder scores.
- 5-Poor quality oil.
- 6-Oil of improper viscosity.
- 7-Oil which is badly diluted.
- 8-Excessive amount of oil in oil pan.
- 9-Continuous high speed operation.
- 10-Excessive oil pressure.
- 11-Punctured diaphragm in vacuum section of combination fuel pump.
- 12-Scuffed pistons.
- 13-Excessive clearance between cylinder walls and pistons.
- 14-Tapered, scored or eccentric cylinder bores.
- 15-Abnormally high crankcase temperatures.
- 16-Excessive clearance between intake valve stems and guides.
- 17-Crankshaft journals out of round.
- 18-Main and connecting rod bearings with excessive endwise on radial clearance.
- 19-Cylinder block distorted glue due to uneven tightening of cylinder head bolts.
- 20-Bearing chipped.

LOW OIL PRESSURE

- 1-Excessive clearance between push rods and guides.
- 2-Use of badly diluted engine oil.
- 3-Use of too light a grade of engine oil.
- 4-Oil pump intake screen clogged with water, sludge or dirt.
- 5-Weak or broken oil relief valve spring.
- 6-Relief valve spring not adjusted properly.
- 7-Relief valve face or seat distorted.
- 8-Relief valve face or seat held open by

- dirt, etc.
- 9-Air leak in oil pump suction line.
- 10-Excessive clearance of oil pump gears in pump body.
- 11-Oil pump gears damaged or badly worn.
- 12-Loose oil pump body or cover.
- 13-Oil pump gaskets improperly installed or damaged.
- 14-Broken oil pipe or tube.
- 15-Loose oil pipe or tube connections.
- 16-Excessive clearance of main, connecting rod or camshaft bearings.
- 17-Inaccurate oil pressure gauge giving an impression of low oil pressure.
- 18-Bearings chipped.
- 19-Bearing caps filed out of round.

HIGH OIL PRESSURE

- 1-Use of too heavy a grade of engine oil.
- 2-Restricted oil passage at the relief valve.
- 2-Relief valve improperly adjusted.
- 4-Relief valve spring too stiff or too heavy.
- 5-Stuck relief valve.
- 6-Inaccurate oil pressure gauge gives impression of high oil pressure.

Engine oil filter inoperative

- 1-Filter element clogged.
- 2-Inlet or outlet pipes, passages or connections clogged or restricted.
- 3-Inlet or outlet pipes, passages or connections leaking.

ENGINE NOISY

Crankshaft noise

- 1-Loose crankshaft gear or sprocket.
- 2-Loose flywheel.
- 3-Loose vibration damper.
- 4-Engine oil too thin due to dilution.
- 5-Sprung crankshaft.
- 6-Excessive radial bearing clearance.
- 7-Excessive crankshaft end play.
- 8-Low oil pressure.
- 9-Bearing misalignment.
- 10-Out of round or eccentric journals.
- 11-Insufficient oil supply.
- 12-Distorted crankcase.
- 13-Broken crankcase web.
- 14-Flywheel or clutch out of balance.

Connecting rod noise

- 1-Out of round or eccentric crankpins.
- 2-Excessive radial bearing clearance.
- 3-Insufficient oil supply.
- 4-Low oil pressure.
- 5-Engine oil too thin due to dilution.
- 6-Connecting rods misaligned.
- 7-Bearing caps filed.
- 8-Oil dippers not supplying oil to bearings.

Piston noise

- 1-Collapsed piston skirts.
- 2-Insufficient piston pin clearance.
- 3-Excessive clearance between piston and cylinder bore.
- 4-Connecting rod misalignment.
- 5-Tapered or eccentric cylinder bores.
- 6-Rings or piston butting against ridge at top of cylinder bore.
- 7-Piston head butting against projecting cylinder head gasket.
- 8-Broken or stuck piston rings.
- 9-Excessive vertical clearance between ring and ring groove.
- 10-Piston pin hole not square with the piston.
- 11-Piston ring lands not relieved properly.
- 12-Piston head butting against carbon accumulation at top of cylinder bore.
- 13-Scored piston.
- 14-Piston pin frozen.

Piston pin noise

- 1-Loose piston pin clamp screw.
- 2-Excessive piston pin clearance.
- 3-Piston slap caused by insufficient piston pin clearance.
- 4-Piston pin loose in connecting rod.
- 5-Piston pin rubbing cylinder wall.
- 6-Upper end of connecting rod rubbing against piston pin boss.
- 7-Oil passage through rod clogged.

Valve or valve lifter noise

- 1-Worn lifter adjusting screw face.
- 2-Lifter adjusting screw face not machined properly.
- 3-Lifter adjusting screw threads stripped or crossed.
- 4-Weak valve springs.

- 5-Excessive valve stem to tappet clearance.
- 6-Lifter assembly loose on the cylinder block.
- 7-Excessive clearance between lifter and guide.
- 8-Lifter misaligned on cylinder block.
- 9-Lower end of the lifter broken, worn, chipped, rough or scored.
- 10-Too much or too little clearance between valve stem and guide.
- 11-Warped valve head.
- 12-Valve head face or valve seat face not concentric with valve stem axis.
- 13-Rough cam surfaces.
- 14-Rough lifter bore surfaces.
- 15-Valve seat insert loose.

Engine torsional vibration

- 1-Vibration damper not assembled properly.
- 2-Vibration damper not adjusted properly.
- 3-Vibration damper loose on crankshaft.
- 4-Inoperative damper due to sticking.
- 5-Excessive timing gear or chain lash.
- 6-Timing gears or sprockets loose on camshaft or crankshaft.
- 7-Engine slightly loose in mountings.
- 8-Clutch linkage cross shaft not free, or not properly lubricated.
- 9-Excessive clearance at front cam-shaft bearing.
- 10-Excessive clearance at front crank-shaft bearing.
- 11-Eccentric timing gear-usually due to high key.
- 12-Loose timing chain.

Engine vibration- especially high speed

- 1-Engine missing at high speed.
- 2-Loose fan blade.
- 3-Unbalanced fan.
- 4-Uneven cylinder compression.
- 5-Distributor points not synchronised.
- 6-Engine mountings not adjusted properly.
- 7-Loose engine mountings.
- 8-Crankshaft which is sprung or unbalanced.
- 9-Engine support loose.
- 10-Scored pistons.

- 11-Insufficient clearances of internal engine parts.
- 12-Flywheel loose.
- 13-Fan belt worn or broken.

Engine noises due to other conditions

- 1-Manifold heat control valve rattle.
- 2-Loose flywheel on crankshaft.
- 3-Crankshaft pulley or vibration damper loose on crankshaft.
- 4-Front or rear engine supports loose or broken.
- 5-Engine loose in frame.
- 6-A thin-walled manifold may produce a roaring noise.
- 7-Exhaust pipe loose at manifold connections.
- 8-Foreign object in exhaust passages or manifold.
- 9-Intake to exhaust manifold gaskets blown.
- 10-Exhaust pipe rubbing against engine side pan or frame.
- 11-Loose engine side pan.
- 12-Loose units such as generator, water pump, fan, horn, etc.
- 13 -Engine rubbing against dash.
- 14-Transmission rubbing against floorboards.
- 15-Water pump noisy.
- 16-Camshaft end play excessive.
- 17-Timing chain loose.

Oil pump & distributor drive shaft noise

- 1-End play in distributor drive shaft.
- 2-End play in oil pump drive shaft.
- 3-Oil pump not rigidly mounted.
- 4-Scuffed or damaged oil pump drive gears.
- 5-Worn or damaged oil pump and distributor driven gear.
- 6-Worn or damaged camshaft drive gear.
- 7-Oil pump drive and driven gears not meshed properly.
- 8-Couplings loose on shaft.
- 9-Excessive clearance of shaft in pump body.
- 10-Excessive clearance of shaft in distributor bracket bushings.
- 11-Hydraulic oil pump noise or rap.

- 12-Noise telegraphed through oil lines.
- 13-Relief valve clogged causing excessive oil pressure.

EXCESSIVE FUEL CONSUMPTION

Due to Ignition

- 1-Loose or corroded connections to terminals at the ammeter, ignition switch, coil or distributor.
- 2-Slight short in primary circuit wiring.
- 3-Poor low tension wire earth connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Faulty ammeter.
- 6-Loose or corroded high tension terminals or cable sockets.
- 7-Cracked, oil soaked, wet, chafed or worn high tension cable insulation.
- 8-Poor earth between coil and its mounting.
- 9-Poor earth between distributor/engine.
- 10-Breaker points not spaced properly.
- 11-Break points dirty, cracked, pitted or burned.
- 12-Breaker arm spring weak.
- 13-Breaker arm sticking.
- 14-Breaker arm insulating bushing worn.
- 15-Breaker arm rubbing block loose/worn.
- 16-Breaker arm plate loose or not properly earthed.
- 17-Breaker plate terminal posts loose.
- 18-Breaker pigtail lead wires loose/broken.
- 19-Ignition timing too late.
- 20-Distributor cap cracked, dirty or wet.
- 21-Distributor cap inserts bent, loose or badly burned.
- 22-Distributor shaft bent or worn.
- 23-Distributor shaft bushing or bearing loose or worn.
- 24-Distributor drive gear not timed properly with oil pump drive gear.
- 25-Vacuum spark advance diaphragm or spring broken.
- 26-Automatic spark advance plate stuck or loose.
- 27-Automatic advance governor springs weak or broken.
- 28-Automatic advance governor sticking or dirty.
- 29-Automatic advance governor pins worn.
- 30-Weak condenser.

- 31-Defective coil.
- 32-Cracked, wet or dirty coil tower.
- 33-Defective spark plugs.
- 34-Spark plugs operating too hot /too cold.
- 35-Spark plugs improperly gapped.
- 36-Spark plugs loose in cylinder head.
- 37-Fouled plugs due to damaged or ineffective gaskets.
- 38-Pre-ignition due to any source.
- 39-Weak battery.
- 40-Defective spark plugs or coil radio suppressors.

Due to Fuel System

- 1-Fuel level too high.
- 2-Excessive fuel pump pressure.
- 3-Float punctured and partially filled with fuel.
- 4-Float needle valve leaking due to wear or dirt.
- 5-External carburettor leaks.
- 6-Accelerating pump improperly adjusted.
- 7-Economiser piston stuck in its cylinder.
- 8-Economiser valve stem sticking in its guide.
- 9-Economiser valve and accelerating pump control linkage not properly adjusted.
- 10-Internal leak due to accelerating pump valve not seating properly.
- 11-Economiser or power valve not seating properly causing internal leak.
- 12-Economiser valve operating too quickly.
- 13-Internal leak due to broken or cracked passages.
- 14-Use of metering jets, metering rods or nozzles which are too large.
- 15-Loose plugs or damaged gaskets at base of main discharge nozzles.
- 16-Manifold heat control valve held in closed position.
- 17-Dirty or restricted carburettor air cleaner.
- 18-Oil level too high in oil bath type air cleaner.
- 19-Choke valve not fully open.
- 20-Carburettor adjusted for normal altitudes may have too rich a mixture at higher altitudes.
- 21-Automatic choke not functioning properly.
- 22-Fuel pump diaphragm leaking.

23-Abnormally fast engine idle speed.

Due to Other Conditions

- 1-Unequal or insufficient cylinder compression.
- 2-Restricted or partially clogged muffler, exhaust or tail pipe.
- 3-Engine overheated.
- 4-Excessive internal friction due to insufficient engine clearances.
- 5-Connecting rods misaligned.
- 6-The use of expansion rings under piston rings-causing excessive friction.
- 7-The use of too heavy a grade engine oil.
- 8-Clutch slipping.
- 9-Tyres under-inflated.
- 10-Rear axle misaligned.
- 11-Brakes dragging.
- 12-Bearings too tight in wheel, pinion, differential or transmission.
- 13-A gear ratio which is too low.
- 14-Incorrect valve timing.
- 15-Excessive front wheel toe-in or toe-out.
- 16-Scored pistons.
- 17-Loose or worn timing gears or chain sets up torsional vibration, causing failure of automatic advance governor in distributor.
- 18-High speed operation for long periods.
- 19-Long periods of idle operation.
- 20-Constant operation on short trips only.
- 21-Numerous starts and stops due to operation in congested traffic.
- 22-Failure to use cooling system thermostat or radiator covers, etc., in cold weather.
- 23-Sudden starting and stopping.
- 24-High speed driving.

Manifold leaks

- 1-Missing or loose intake manifold core hole plugs.
- 2-Broken or damaged gaskets.
- 3-Leaks due to improper connections or broken vacuum lines.
- 4-Loose manifold nuts.
- 5-Not enough threads on manifold studs causing nuts to bottom.
- 6-Misaligned or distorted gasket surfaces on the intake or exhaust manifold, carburettor flange or between the carburettor flange

and spacer.

- 7-Excessive back pressure due to restricted or clogged muffler, exhaust pipe or tail pipe.
- 8-Misaligned parts between manifold and cylinder block.
- 9-Manifold cracked.

Fuel delivery insufficient

- 1-Fuel pump filter bowl loose.
- 1a-Fuel pump filter screen restricted or partially clogged.
- 2-Fuel pump filter bowl gasket not sealing properly.
- 3-Punctured or worn fuel pump diaphragm.
- 4-Leak occurring around fuel pump diaphragm shaft or pull rod.
- 5-Loose fuel pump valve seats.
- 6-Fuel pump valves not seating properly.
- 7-Fuel pump valves sticking.
- 8-Fuel pump rocker arm shaft out of place.
- 9-Fuel pump rocker arm broken.
- 10-Fuel pinup rocker arm not following or contacting engine camshaft.
- 11-Petrol tank vent cap restricted.
- 12-Petrol line from tank to fuel pump collapsed or partially clogged.
- 13-Vapour locked petrol line between tank and fuel pump.
- 14-Air leak at connections or petrol lines.
- 15-Petrol tank outlet pipe partially clogged or bent.
- 16-Air leak above the fuel level petrol tank outlet pipe.
- 17-Pump linkage worn.

Fuel Pump noise

- 1-Scored rocker arm or camshaft eccentric.
- 2-Diaphragm spring rubbing on fibre bushing.
- 3-Rocker arm or pin worn.
- 4-Fuel pump linkage striking the diaphragm protector.
- 5-Fuel pump connection to engine loose.
- 6-Rocker arm contact spring weak or broken.
- 7-Rocker arm rubbing against inner surface of crankcase.
- 8-Warped spring on vacuum side.

IGNITION TROUBLES

Due to Ignition Wiring and Connections

- 1-Loose or corroded connections or terminals at the ammeter, ignition switch, coil or distributor.
- 2-Low tension wire insulation cracked or worn through.
- 3-Poor low tension wire earth connection.
- 4-Loose, corroded or burned ignition switch contacts.
- 5-Faulty ammeter.
- 6-Loose or corroded high tension terminals or cable sockets.
- 7-Cracked, oil-soaked, wet, chafed or worn high tension cable insulation.
- 8-High tension cables installed not according to engine firing order.
- 9-High tension cable from coil tower to distributor not connected.
- 10 Broken wire inside of cable.
- 11-Stray cable strand shorting plug.
- 12-Improper earth between coil and its mounting.
- 13-Improper earth - distributor and engine.

Due to Distributor

- 1-Breaker point gap incorrect.
- 2-Breaker points not synchronised properly.
- 3-Breaker points dirty, cracked, pitted or burned.
- 4-Breaker arm spring weak or broken.
- 5-Breaker arm sticking.
- 6-Breaker arm earthed due to worn or broken insulating bushing.
- 7-Breaker arm rubbing block loose or badly worn.
- 8-Breaker arm plate loose or not properly earthed.
- 8a-Loose breaker plate terminal posts.
- 9-Breaker pigtail lead wires loose/broken.
- 10-Breaker cam with low lobe.
- 10a-Breaker cam loose due to burrs on cam locking screw taper.
- 11-Ignition timed too early.
- 12-Ignition timed too late.
- 13-Distributor cap cracked.
- 14-Distributor cap inserts bent, loose or badly burned.
- 15-Too much clearance between distributor cap inserts and rotor.

16-Earthed rotor.

- 17-Broken, loose or bent rotor spring.
- 18-Distributor cap centre terminal (rotor contact) missing or broken.
- 19-Distributor cap wet or dirty.
- 20-Broken or bent distributor shaft.
- 21-Distributor shaft worn.
- 22-Distributor shaft bushings or bearing loose or worn.
- 23-Distributor drive gear or coupling sheared, broken or loose on shaft.
- 24-Distributor drive gear not timed properly with oil pump drive gear.
- 25-Vacuum spark advance diaphragm broken.
- 26-Vacuum spark advance spring broken.
- 27-Automatic spark advance plate stuck or loose.
- 28-Automatic spark advance plate installed backwards.
- 29 Automatic advance governor springs weak or broken.
- 30-Automatic advance governor sticking or dirty.
- 31-Automatic advance governor pins worn.
- 32-Weak condenser.
- 33-Grounded condenser.
- 34-Defective coil.
- 35-Cracked coil tower.
- 36 Wet or dirty coil tower.

Due to Battery

- 1-Battery in low state of charge.
- 2-Battery completely discharged.
- 3-Poor ground connection between battery and frame.
- 4-Poor ground connection between frame and engine.
- 5-Battery terminals badly corroded or loose.
- 6-Cable from starter to battery broken or terminal cracked.
- 7-Cable loose in terminal socket.

Due to Spark Plugs

- 1-Fouled plugs due to too cold an operating plug.
- 2-Fouled plugs due to an excessively rich carburettor mixture.
- 3-Fouled plugs due to engine oil passing piston rings.

- 4-Fouled plugs due to their being loose in cylinder head.
- 5-Fouled plugs due to damaged or ineffective spark plug gaskets.
- 6-Fouled plugs due to improper operation of choke.
- 7-Use of too hot an operating plug causing pre-ignition.
- 8-Spark plug gap too wide.
- 9-Spark plug gap too narrow.
- 10-Insulator loose in shell.
- 11-Insulator interior coated with carbon, oil, lead bromide, water or salt.
- 12-Insulator cracked, glaze-scratched or melted-allowing carbon deposit, etc., to provide a path for current.
- 13-Spark plug gap filled with oil, water or fuel.
- 14-Spark plug threads dirty.
- 15-Spark plug shorted by some metal part out of place.
- 16-Use of some types of spark plug and coil radio suppressors.

Starting motor not operating properly or inoperative

- 1-Battery in low state of charge.
- 2-Battery completely discharged.
- 3-Poor ground connection between battery and frame or from frame to engine.
- 4-Battery terminals badly corroded or loose.
- 5-Cable from battery to starter broken or terminal cracked.
- 6-Broken starter pinion.
- 7-Broken flywheel ring gear.
- 8-Sticking starter due to burred teeth on starter pinion or flywheel ring gear.
- 9-Broken Bendix spring.
- 10-Use of engine oil which is too heavy-especially in cold weather.
- 11-Starting switch not operating properly.
- 12-Starting switch not grounded properly.
- 13-Rotation of starter excessively resisted due to bent armature shaft cracked or distorted housing, tight bearings, misaligned bearings, lack of lubrication, sludge formation in starter drive, starter not aligned properly with engine.
- 14-Improper functioning of starter brushes

- due to loose brush connections loose pigtailed, brushes sticking in holders, bent brush holder arms, weak or broken brush springs, sticking brush holders, incorrect type of brushes worn too short.
- 15-Armature shorted.
- 16-Commutator surface dirty, burned pitted or excessively lubricated.
- 17-High mica between commutator segments due to worn commutator.
- 18-Brush ring set incorrectly or grounded.
- 19-Excessive brush spring tension causing rapid wear of brushes and commutator.
- 20-Burned out, shorted or open circuited field coils.
- 21-Worn bushings or bearings causing armature to drag against pole pieces.
- 22-Battery cables undersize.
- 23-Winding thrown from armature.

Starter drive noises

- 1 -Starting motor loose on engine.
- 2-Starter motor not properly mounted.
- 3-Starter motor armature shaft bearing worn, broken or dirty.
- 4-Starter pinion teeth burred, chipped or otherwise damaged.
- 5-Flywheel teeth burred, chipped or otherwise damaged.
- 6-Starter drive shaft sprung, bent or distorted.

Generator not charging properly or inoperative

- 1-Engine idles too low on cars with free wheel and overdrive.
- 2-Incorrect size generator drive pulley.
- 3-Slipping belt.
- 4-Generator drive pulley loose on shaft.
- 5-Ammeter indicates no charging rate or incorrect charging rate.
- 6-Cutout relay points remaining open.
- 7-Generator regulator not operating properly.
- 8-Commutator not concentric.
- 9-Armature open circuited, causing a low or no charging rate.
- 10-Armature grounded.
- 11-Generator pole piece loose, preventing easy rotation of armature.

- 12-Short circuit between commutator bars.
- 13-Bent or worn armature shaft, producing generator noise.
- 14-Brushes improperly seated or worn.
- 15-Incorrect type brushes being used.
- 16-Brush springs weak or broken.
- 17-High mica between commutator bars.
- 18-Commutator glazed, charred or dirty.
- 19-Brush holder arms sticking, probably caused by excessively worn brushes.
- 20-Field coils open circuited, short circuited or burned out.
- 21-Brushes oily or soft due to excessive lubrication.

Generator noises

- 1-Generator loose on engine.
- 2-Generator drive belt not aligned properly.
- 3-Generator pulley loose on shaft.
- 4-Cracked pulley.
- 5-Generator shaft having excessive end play.
- 6-Generator bearings worn.
- 7-Bearings not lubricated sufficiently.
- 8-Generator brush noises caused by: Brushes loose in holder. Rough or dirty commutator. High mica between commutator bars. High commutator bars. Brushes not seating properly. Too little or too much brush spring tension. Hard spots on brushes. Field magnets loose and rubbing armature.

FREQUENT BATTERY CHARGING NECESSARY

Due to Internal Battery Conditions

- 1-Ineffective battery plate separators.
- 2-Plates badly sulphated.
- 3-A leak in cell due to crack, or sealing compound not sealing properly.
- 4-Water level not maintained at proper height.

Due to Excessive Load

- 1-Stop light switch closed at all times.
- 2-Tail and stop lamp wires reversed.
- 3-Use of too high candle power head-lamp bulbs.
- 4-Car operation confined mostly to night driving.

- 5-Excessive use of spot lamps, radio, car heater, cigar lighter or defroster.
- 6-Lighting circuit grounded or shorted.
- 7-Using headlamps excessively while car is parked.

Due to Generator Conditions

- 1-Generator inoperative.
- 2-Fan belt slipping.
- 3-Incorrect size generator drive pulley.
- 4-Ammeter indicating higher charging rate than actual.
- 5-Generator regulator not adjusted properly.
- 6-Engine idle too low, particularly on cars with free wheel and overdrive.
- 7-Loose external circuit connections.
- 8-Corroded battery terminals and/or ground connection.

Due to Starter

- 1-Starter commutator badly worn or burned.
- 2-High mica between commutator bars.
- 3-Use of starter too frequently.
- 4-Excessive use of starter due to starting difficulties.

Faulty headlamp action

- 1-Loose connections at ammeter.
- 2-Bulbs loose in sockets.
- 3-Poor contacts at lighting switch.
- 4-Loose or dirty connections at cable terminals or bulb contacts.
- 5-Headlamp reflector or body -poor ground.
- 6-Battery in a discharged or semi discharged condition.
- 7-Poor battery ground connection, causing rapid bulb failure.
- 8-Loose contact between lamp body and reflector.
- 9-Faulty generator or regulator action.
- 10-Intermittent short or earth in wiring harness.

EXCESSIVE ENGINE TEMPERATURES

Pre-Ignition

- 1-Ignition timed too early.
- 2-Weak distributor automatic advance springs.

- 3-Combustion chamber with large carbon deposits.
- 4-Spark advance not operating upon acceleration.
- 5-Use of spark plugs which are too hot.
- 6-Spark plug electrodes or insulators burned or carbonised.
- 7-Sharp metallic edges in combustion chamber.
- 8-Cylinder head gasket projecting into combustion chamber.
- 9-Excessively lean carburettor mixture.
- 10-Automatic heat control valve held in closed position.
- 11-Poor grade of fuel being used.
- 12-Stale fuel which has lost its volatility.
- 13-Using a high compression cylinder head with standard fuel.
- 14-Hot engine valves caused by incorrect valve seat width.
- 15-Hot engine valves caused by insufficient valve tappet clearance.
- 16-Hot engine valves - use of wrong type.
- 17-Hot engine valves - having thin edges.

Due to Other Conditions

- 1-Ignition timed too late.
- 2-Slipping fan belt.
- 3-Radiator core covered with dirt or heavy paint.
- 4-Radiator core tubes clogged/restricted.
- 5-Radiator core surface restricted by licence plate or emblems.
- 6-Heavy sludge or dirt accumulation in engine block.
- 4-Water manifold rusted, loose/damaged.
- 8-Engine thermostat not installed properly or not opening.
- 9-Collapsed or deteriorated water hose.
- 10-Water pump impeller loose on shaft.
- 11-Too much clearance between pump housing and impeller.
- 12-Use of certain types of anti-freeze solution during warm weather periods.
- 13-Water transfer holes in cylinder block or cylinder head restricted.
- 14-Cylinder head gasket installed in such a manner as to restrict the flow of water.
- 15-Fan blades not pitched properly.
- 16-Using a rear axle gear ratio which is

- too fast, or oversize tyres, in mountainous regions.
- 17-Brakes dragging.
- 18-Wheel bearings too tight.
- 19-Clutch slipping.
- 20-High frictional resistance in engine caused by: Insufficient oil circulation. Internal clearances of engine parts insufficient. Internal engine parts misaligned. Use of too heavy a grade engine oil.
- 21-High frictional resistance in power transmitting units.
- 22-A floating foreign object in cylinder head which occasionally restricts water circulation.
- 23-Screen for insects in front of radiator too fine.

Due to Water Loss

- 1-Radiator leak.
- 2-Any water hose leakage.
- 3-Leaky cooling system drain plug or valve.
- 4-Leaky water pump.
- 5-Broken water pump gasket-or any cooling system gasket.
- 6-Cracked cylinder head or block causing an internal or external leak.
- 7-Water loss through overflow pipe, especially when engine is overheated.
- 8-Radiator upper tank baffle plate loose.
- 9-Loose cylinder head cap screws or a broken cylinder head gasket, allowing combustion gases to leak into the cooling system, causing overheating.
- 10-Loss of water at high speed due to an air leak at the water pump packing gland.
- 11-Loose or corroded water jacket cover plate.

Water pump noise

- 1-Water pump shaft pulley loose.
- 2-Impeller loose on shaft.
- 3-Too much end play in pump shaft.
- 4-Too much clearance between water pump shaft and bushings.
- 5-Impeller blades rubbing against water pump housing.
- 6-Impeller pin sheared off or impeller broken.
- 7-Rough bearing.

- 8-Water pump seal too hard.

Fan and Fan belt noise

- 1-Distorted fan blades.
- 2-Fan blades not pitched properly.
- 3-Fan shaft bushing loose.
- 4-Improper lubrication of fan shaft bushing.
- 5-Excessive fan shaft end play.
- 6-Unbalanced fan blade assembly.
- 7-Fan hub loose and turning on shaft.
- 8-Fan blades loose on hub or spider.
- 9-Fan blades striking radiator core/fan belt.
- 10-Any drive pulley cracked or distorted.
- 11-Fan belt pulleys misaligned.
- 12-Belt too tight causing squeak.
- 13-Belt too loose causing squeak upon acceleration.
- 14-Dirt, grease, rust or other foreign matter on belt or pulleys.
- 15-Incorrect fan belt.
- 16-Belt worn or badly burned.

Premature Fan belt failure

- 1-Rough or broken fan pulley flanges.
- 2-Misalignment of belt pulleys.
- 3-Belt stretched abnormally due to too tight adjustment.
- 4-Belt too loose causing excessive slippage.
- 5-Wrong type belt being used.
- 6-Oily or greasy belt will rapidly deteriorate.
- 7-Belt striking or rubbing blades.
- 8-Operating at sustained high speeds.
- 9-Belt overloaded due to excessive friction in water pump, generator or fan.
- 10-Generator mounting bolts loose.

TRANSMISSION TROUBLES

Noises in Neutral

Transmission noises in neutral, when the engine is idling, can generally be classified as a hiss or growl. Bearing difficulty is generally apparent as a hiss, although in severe cases a bump or thud will be heard. Rough, worn, chipped or scuffed gears are apparent as an intermittent growl or hum. An out-of-alignment condition between the transmissions and the engine assembly will cause a grind after the transmission has been in service for some time.

- 1-Insufficient lubricant in transmission.
- 2-Lubricant - poor quality or incorrect type.
- 3-Shifter forks not positioned properly on shift rails, causing forks to rub in the grooves or causing gear interference.
- 4-Mainshaft pilot bearing broken/worn.
- 5-Excessive end play of the counter gear pinion, or reverse idler gear.
- 6-Excessive backlash in constant mesh gears.
- 7-A second speed constant mesh gear which is out of round.
- 8-A countergear assembly which is out of round.
- 9-A sprung or badly worn counter-shaft.
- 10-Countershaft bushings or bearings worn, dirty, rough or scored.
- 11-Reverse idler gear shaft or bushing worn, rough or scored.
- 12-Reverse idler gear chipped, worn, burred, scuffed or not machined properly.
- 13-Constant mesh gears not matched or meshed properly.
- 14-Replacing of only one constant mesh gear instead of complete set.
- 15-Second speed mainshaft gear bushing badly worn, rough or scored.
- 16-Constant mesh gears which are chipped scuffed, worn, burred or improperly machined.
- 17-Main drive gear hearing worn/dirty.
- 18-Misalignment of transmission with the engine.
- 19-A constant click which is evident in neutral usually indicates a nicked gear or bearing. Check all gears, bearings and the end play of all parts which operate in neutral.
- 20-Loose transmission strut rod.

Noise in Gear

Most transmission noises in neutral will also be noticed in gear, although the frequency of the noise will increase. Transmission noises due to engine torsional periods occur at definite speeds and are not apparent throughout the entire speed range. Torsional transmission noises are usually a high-pitched, high-frequency, metallic rattle.

- 1-Any of the symptoms which are listed

under "Noise in Neutral" will usually be more pronounced at low road speeds. If the noise is limited to any one or more transmission speeds, trace the gears under load and examine for damage.

2-Noisy speedometer gears.

3-Synchroniser clutch noise, when equipped with free wheeling.

4-Too much end play of the second speed mainshaft gear on the mainshaft.

5-Mainshaft rear hearing worn, rough/dirty.

6-Sliding gear teeth tapered, chipped, burned, pitted, scuffed, rough or worn.

7-Torsional periods of the engine being transmitted to the transmission due to using a clutch plate without a dampened hub: weak or broken clutch plate damper springs, inoperative or improperly adjusted clutch plate damper, damper springs which are loose in the clutch hub windows due to worn windows.

Leaks Oil

1-Oil level too high in transmission case.

2-Damaged, improperly installed or missing gaskets.

3-Damaged or improperly installed oil seals.

4-Damaged, inproperly installed or missing oil throw rings.

5-Transmission case plugs loose or threads damaged.

6-Transmission case bolts loose, missing, or threads stripped.

7-Gear shift lever felt oil seal damaged, saturated or improperly installed.

8-Sand hole or crack in transmission case or cover.

9-Use of a lubricant which foams excessively.

Lubricant Passing to Rear Axle (Torque Tube Jobs)

1-Scored universal joint or bushing.

2-Gasket plugging return hole.

3-More than .006 in. clearance between universal joint and bushing.

4-Loose adjustment of ball joint.

5-Runout of front end of propeller shaft.

Shifting Troubles

1-Failure to completely release engine clutch.

2-Engine clutch spinning or sticking on splined pinion shaft.

3-Gear shift rods sprung and binding.

4-Sliding gear tight on main shaft splines.

5-Insufficient chamfer of sliding gear teeth.

6-Main shaft splines distorted, burred or otherwise damaged.

7-Synchronising unit outer sleeve fits too tightly on synchroniser hub.

8-Improper adjustment of remote control linkage.

Hard Shifting

1-Too much tension on shifter shaft retaining springs.

2-Improper adjustment of the cross wire.

3-Looseness of cable clip which secures cross wire to bell housing.

Block-Out of High or Second Speed Gear

1-Scored synchroniser cones drums.

2-Rough cam surfaces on ends of sliding sleeve and on synchronising drum cams.

Lever Sticks in Gear

1-Engine clutch not completely released.

2-Abnormal spring tension on gear shift rod lock balls.

3-Insufficient chamfer at edge of gear shift lever lock ball notches.