

Problem Diagnosis of Heat Engine: A Case Study of a Petrol Engine of Heat Engine Laboratory at CUET

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Abstract- This study deals with the “Problem Diagnosis of Heat Engine” (Case Study- Petrol Engine of CUET’S Heat Engine Laboratory). It describes the diagnosis and repairs of damaged heat engine of CUET’s Heat Engine Lab. Trouble shooting is generally a process of finding faults and the procedure is carried out correctly and systematically for an accurate diagnosis of the troubles and should be made in the minimum amount of time. For an internal combustion engine to run properly there are three basic requirements, these are ignition, fuel and compression system. There are other factors of course, but as a rule an engine failure to start can be attributed to a fault in one or more of these three systems. The work is divided into two parts- 1.Theoretical studies. 2. Practical studies. Theoretical Studies have been done about heat engine, its history, various types, operation principle, engine cycles, various system (fuel-injection, ignition, cooling, lubrication system etc.), maintenance, fault diagnosis and repairs of heat engine. Practical studies have been done on this work to diagnose the fault and repair the damaged petrol engine of CUET’s Heat Engine Lab. The engine was checked to detect its fault. Various parts of the engine were disassembled and some of them were found to be not in working condition. After repairing and replacing they have been set to their original position. Finally the engine has been tested and brought back to working condition. Here, efforts have been given to explain the periodic methodology to find out the problem of Heat Engine and suggest systematic way to solve IC Engine related problems.

Keywords: Troubleshooting, Heat engine, Engine Problem Diagnosis Chart, CUETS Heat Engine Laboratory, Reciprocating Engine System.

1. INTRODUCTION

Trouble shooting is generally a process of finding faults and the procedure is carried out correctly and systematically for an accurate diagnosis of the troubles and should be made in the minimum amount of time. These problems can be caused by many things. So generally there is no simple answer to fix it. It will take some patience and methodical approach to finding the cause. The fix will follow once the cause is understood. For an internal combustion engine to run properly there are three basic requirements, these are ignition, fuel and compression. There are other factors of course, but as a rule an engine failure to start can be attributed to a fault in one or more of these three systems. The aims of this work are as follows:

1. To study about heat engine, it’s types & various systems.
2. To study the condition of damaged engines of Heat Engine Lab.
3. To know about the procedure of repairing and maintenance.

4. List the basic engine troubles.
5. How to make quick checks of the fuel and ignition system.
6. Diagnose the causes of troubles in spark-ignition engine.

2. METHODOLOGY

1. To inspect all engines individually by trying to run.
2. To select the damaged engine for repairing
3. To open up the engine which is not in working condition.
4. To find out cause of damage of selected engine.
5. To replace or repair the damaged parts.
6. To do assembling after replacement or repairing the damaged parts.
7. To test the engine.

3. PROBLEM-DIAGNOSIS

3.1 TROUBLE-DIAGNOSIS

Troubleshooting is practical wisdom, which is, using knowledge in a logical manner to eliminate the causes of a malfunction. One can use this guide hopefully also for the increased sagacity for preventative mechanics. One will need: A complete set of Craftsmen or Snap-On or whatever tools, a garage with lifts, and a certified mechanic, but some of these things one might do oneself.

3.2 ENGINE TROUBLE-DIAGNOSIS CHART

The Engine, Powerhouse of Today's Mobility: A Kind of Triage Checklist

(1) The engine will not turn when attempting to start.

- a. Check battery terminal connection for loose attachment of wires or corrosion, tighten and or clean.
- b. Check for a discharged battery with ignition turned on, and see if lights or windshield (windscreen) wipers work: if not, battery has lost all its charge.
- c. The automatic transaxle maybe not totally positioned in Park or Neutral, or for manual, clutch not completely pressed
- d. There may be broken, loose or disconnected wiring in the starting circuitry, starting with the battery, then the starter solenoid and finally the ignition switch.
- e. Starter motor pinion could be jammed in the flywheel. For manual transaxles, place in gear, and rock the vehicle to force the engine to turn. Remove starter as soon as practical to inspect pinion and flywheel.
- f. Starter solenoid may be faulty.
- g. The starter motor might be malfunctioning.
- h. The ignition switch possibly has failed.

(2) The engine turns but will not start.

- a) There is no fuel in tank.
- b) Is the carburetor or fuel injection system failing?
- c) If the engine rotates slowly, very possibly the battery has discharged. See (1).
- d) Battery terminals could be loose or corroded. See (1).
- e) Fuel pump pooped out.
- f) Damaged ignition components, maybe by excess water.

- g) Worn, and or improperly gapped spark plugs.
- h) Messed up wiring as described previously.
- i) If one has a distributor, it might have come loose -- check by turning it until engine starts.
- j) Inspect for bad ignition coil or wires connecting to it.

(3) The starter motor operates but does not turn the engine.

- a) The starter pinion may be sticking. Inspect the removed starter
- b) There may be broken teeth on the pinion or the flywheel, inspect after removing the drive plate access cover.

(4) The engine is hard to start when cold.

- a) As discussed in (1) the battery may be discharged.
- b) A problem in the fuel or electrical systems may need to be checked.
- c) The carburetor may need overhauling.
- d) There may be a damaged distributor rotor, or covered with carbon tracking.
- e) The choke control may be stuck or not working.

(5) The engine is difficult to start when hot.

- a) The air filter could be clogged.
- b) There may be a problem with the fuel or electrical systems.
- c) The carburetor or fuel injection systems may be starved for gasoline. Perhaps a vapor lock.

(6) The starter motor is emitting loud noises and running very rough.

- a) Examine the likelihood of broken or worn pinion or flywheel gear teeth by removing cover at rear of engine, if available.
- b) Check for loose or missing bolts on starter motor mount.

(7) The engine engages but stops immediately.

- a) Are there loose or faulty electrical connections at the distributor, coil, or alternator?
- b) Fuel or electrical system malfunctioning should be considered.
- c) Not enough fuel could be making it to the carburetor or fuel injectors, and one should check the fuel pump.
- d) If there is a vacuum leak at the gasket surfaces of the intake manifold, or carburetor and throttle

body then one must retighten nuts and bolts tightly, and re-attach or replace vacuum hoses.

(8) The engine jerks or is kind of wild during idling.

- a) Vacuum leaks may be a possibility so check the mounting bolts and nuts at the carburetor and throttle body and at the intake manifold for tightness. Make sure all vacuum hoses are connected and in working shape.
- b) Fault in the fuel or electrical systems.
- c) Check for leaking EGR valve or clogged PCV valve.
- d) Is the air filter overly dirty?
- e) Is the fuel pump not delivering sufficient gas to the carburetor or fuel injection system?
- f) Tune up and or adjustment needed for the carburetor or throttle body.
- g) Perform a compression check for the possibility of leaking head gasket.
- h) Are the camshaft lobes worn.

(9) The engine is missing at idle speed.

- a) Gap the spark plugs and check for wear.
- b) It could be the old faulty fuel or electrical system.
- c) Check for frayed or disconnected spark plug wires.

(10) The engine is missing throughout driving speed range.

- a) Did the fuel system get fouled, or did the fuel filter get blocked.
- b) Correct too close or far gapped spark plugs or replace.
- c) The fuel and electrical systems may have failed.
- d) The ignition timing could be off.
- e) If one has a distributor cap it could be cracked or other parts might be broken, but there could just be loose distributor wires.
- f) The spark plug wires should be checked for integrity.
- g) Emission components that have "gone south" could be to blame.
- h) After removing the spark plugs, test for low or uneven cylinder compression with a gauge.
- i) The ignition system could be insipid or null.

- j) There could be vacuum leaks at the carburetor and throttle body, and or intake manifold, vacuum hoses.

(11) The engine dies (knocks) out.

- a) After referring to the VECI label, examine the idle speed.
- b) Water or foreign substances may be in the fuel system or the filter is clogged.
- c) Are distributor parts dinged or wet?
- d) System sensors could be malfunctioning for fuel or emission information system.
- e) The emissions system components out of commission.
- f) Spark plugs, again, gapped or how are the wires?
- g) Sounding like a broken record: there could be vacuum leaks at the carburetor and throttle body, and or intake manifold, vacuum hoses. (See 8)

(12) The engine is woefully weak.

- a) The ignition timing could be off.
- b) It could be the old faulty fuel or electrical system.
- c) Excepting the DIS system, see if there is too much play in the distributor shaft as well discern for a damaged rotor, cap, or wires.
- d) Spark plugs: gapped correctly or are the wires worn or disconnected?
- e) There may be an out of adjustment or worn carburetor or throttle body.
- f) Is the coil defective?
- g) Are the brakes locking up?
- h) Check the automatic transaxle fluid level.
- i) A slipping clutch will rob power.
- j) Dirt in the fuel system, or a overly goofed up fuel filter can sap energy.
- k) Emissions systems control systems: error!
- l) Stop using that cheap 85 octane junk and move up to high octane! (Especially if the automobile requires premium.)
- m) Test cylinder compression pressures with a tester looking for leaking valves and or a blown head gasket.

- (13) **The Engine explosively backfires.**
- Emissions systems out of whack.
 - Fuel or carburetor problems perhaps.
 - Ill-timed ignition.
 - Secondary ignition system miscues like cracked spark plug insulator, bad wires.
 - The emissions systems must be considered.
 - See section 8 for discussion of vacuum leaks.
 - The valves could be sticking.
- (14) **One hears metallic tapping or tapping/banging sounds from the engine during acceleration or going up an incline.**
- Get a better octane grade of gasoline.
 - Electrical or fuel system bop-up.
 - Fix ignition timing.
 - Re-tune carburetor.
 - Check the spark plugs referring to the VECI label under the hood (bonnet), and re-examine spark plugs and their wires for damage.
 - The distributor could have been hurt or just plain "wore out."
 - Suspect emissions systems.
 - Vacuum leaks as problematic discussed in (9).
- (15) **The engine 'diesels'**
- Idle speed could be too fast.
 - The fuel and electrical, lack, again.
 - The ignition timing may be off.
 - Maybe the thermo-controlled air cleaner heat valve is not running a hundred percent.
 - Engine may be running too hot. Check shot thermostat, clogged radiator, or a failing water pump.
 - Check the anti-dieseling solenoid.

4. TROUBLESHOOTING AND REPAIRING OF PETROL ENGINE OF CUET'S HEAT ENGINELAB

4.1 CONDITIONS OF PETROL ENGINE IN CUET'S HEAT ENGINE LAB:

Fig1 describes the condition of petrol engine of heat engine lab before repairing. The engine was not in working condition before repairing. It had various defective parts which are being seen in Fig1.

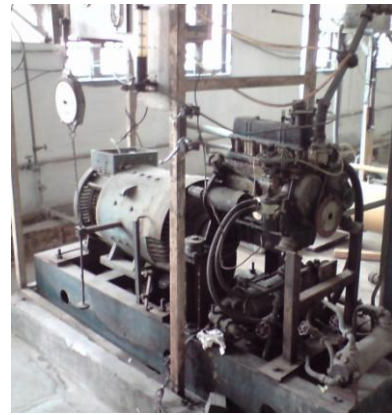


Fig1: Conditions of Petrol Engine in CUET'S Heat Engine Lab

4.2 DEFECTIVE PARTS

I checked the engine and found the following defective parts that need to be replaced or repaired:

Ignition System:

- 1) Ignition coil
- 2) Spark plug
- 3) Battery
- 4) Distributor
- 5) Dynamo
- 6) C.B. point

Starting System:

- 1) Self starter
- 2) Self starter wire

Fuel Supply System:

- 1) Carburetor
- 2) Carburetor kits
- 3) Running jet
- 4) Slow jet
- 5) Float
- 6) Fuel pump

Cooling System:

- 1) Water jacket
- 2) Water pipeline leakage
- 3) Water pump

Engine:

- 1) Piston
- 2) Cylinder
- 3) Piston ring
- 4) Valve etc.
- 5) Engine Switch

4.3 POSSIBLE CAUSES OF DEFECT AND REMEDIES:

IGNITION COIL

CAUSES	REMEDIES
Internal short circuiting occurred	Replace
Resistance of primary and secondary winding is improper	Replace

SPARK PLUG

CAUSES	REMEDIES
Erosion of electrodes resulting a large gap	Adjust the gap
Following of plug results misfiring	Replace

BATTERY

CAUSES	REMEDIES
Fully discharged battery	
Sulfate ion short circuiting occurred	Replacement of the defected battery
Internal short circuiting occurred	
Plates deteriorated	

SELF STARTER

CAUSES	REMEDIES
It is weak to crank the engine	Repair
Damage of self starter wire	Replace

CARBURETTOR KITS

CAUSES	REMEDIES
Clogged and worm running jet	Repair
Clogged and worm slow jet	Repair
Atmospheric erosion on float	Repair

ELECTRICAL SYSTEM

CAUSES	REMEDIES
Damaged engine switch	Replace
Isolated electrical circuit	Wiring accurately to complete the electrical circuit
Damaged distributor cap	Replace
Isolated high tension lead	Replace

ROCKER ARM

CAUSES	REMEDIES
Rocker arms lost or stolen	Replacement by new one

C.B. POINT

CAUSES	REMEDIES
Burnt and worm C.B. point	Replacement
Spring of C.V. point lost stiffness	Replacement

COOLING SYSTEM

CAUSES	REMEDIES
Disturbance of water pump	Repairing
Pipeline leakage	Repairing or replacement

5. DISCUSSION

The engine is now in condition of running but still it has a problem in ignition timing, resulting a slight bend on the push rods, after some times of running the engine. It has an improper cooling system due to malfunctioning of water pump. Further modification is necessary.

6. CONCLUSIONS

The outcome of this project can grow the interest on further study of the petrol engine using direct fuel injection system. Being very old engine the carburetor is malfunctioning. It will be needed to repair and servicing the carburetor frequently for proper functioning which will lead to increase the maintenance cost of the engine. Also the carburetor cannot be replaced by new one because it is not sold in the local market. To get the optimum solution, carburetor system can be replaced by direct fuel injection system. So it is suggested for further study on direct fuel injection system.

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