Engine

Service Manual - Backhoe Loader

Publication No.
9803/3290-14

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Notes:

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Service Tools

Numerical List

The tools listed in the table are special tools required for removal and replacement of the engine. These tools are available from JCB Service.

Note: *For details of other engine service tools refer to publication 9806/3000.*

Note: *Tools other than those listed will be required. It is expected that such general tools will be available in any well equipped workshop or be available locally from any good tool supplier.*

Part Number	Description	Tool Detail Reference
892/01160	Engine lifting bracket (2-off)	⇨ *Fig 1. (K-2)*
825/10035	Adaptor plate spanner - viscous cooling fan	⇨ *Fig 2. (K-2)*
825/10036	Fan coupling spanner - viscous cooling fan	⇨ *Fig 2. (K-2)*

Tool Detail Reference

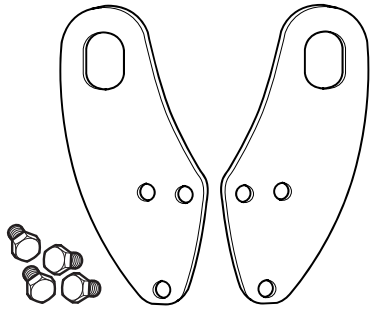

Fig 1. 892/01160 Lifting Bracket (2-off)

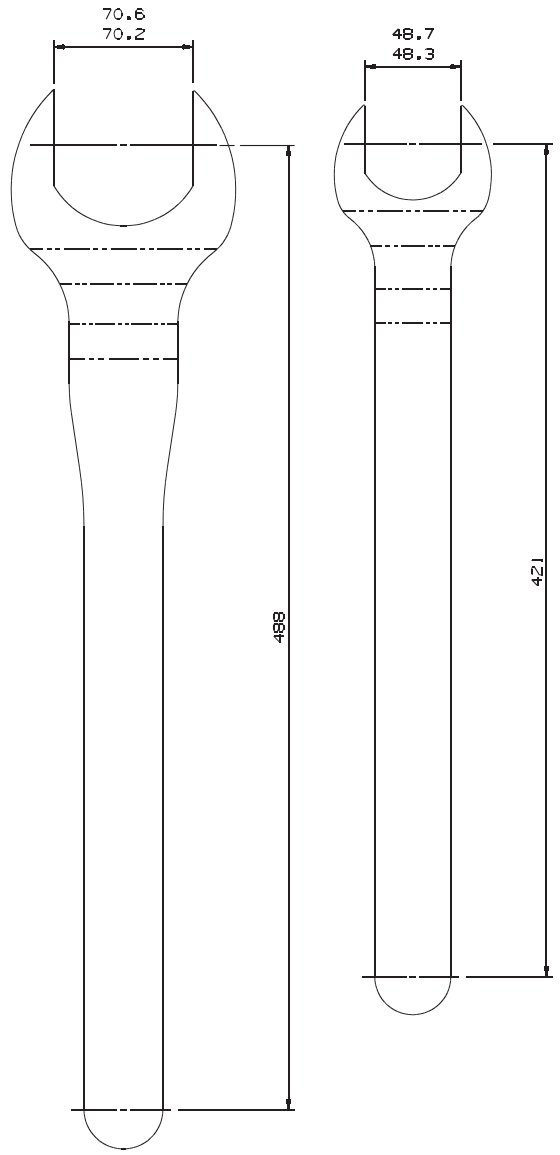

Fig 2. Spanners for Viscous Cooling Fan

825/10035 - Adaptor Plate Spanner
825/10036 - Fan Coupling Spanner

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Technical Data

JCB DieselMax

Engine Specifications

Note: Full technical data for all engine variants is given in publication 9806/3000.

Engine type	SA	Naturally aspirated	63 kW (84 bhp)
	SB	Turbocharged	68 kW (92 bhp)
	SB	Turbocharged	74 kW (100 bhp)
	SD	Turbocharged	63 kW (84 bhp)
	SD	Turbocharged	68 kW (92 bhp)
	SF	Turbocharged and intercooled	74 kW (100 bhp)
Weight (dry)	SA	472 kg (1040 lb)	
	SB, SD, SF	477 kg (1052 lb)	
Number of cylinders	4		
Nominal bore size	103 mm (4.05 in)		
Stroke	132 mm (5.196 in)		
Cylinder arrangement	In line		
Cycle	4 stroke		
Firing Order	1, 3, 4, 2 - Number 1 cylinder at crankshaft pulley end		
Displacement	4.4 litres (268.5 in^3)		
Compression ratio	SA	18.6 : 1	
	SB	18.3 : 1	
	SD, SF	17.2 : 1	
Direction of rotation (viewed from crankshaft pulley end)	Clockwise		
Valves	4 per cylinder		
Valve tip clearances (measured cold)	SA, SB	Inlet: 0.19 mm to 0.27 mm (0.0075 in to 0.0106 in)	
		Exhaust: 0.56 mm to 0.64 mm (0.022 in to 0.252 in)	
	SD, SF	Inlet: 0.35 mm (0.014 in)	
		Exhaust: 0.56 mm to 0.64 mm (0.022 in to 0.252 in)	
Lubricating oil pressure (1)	4.0 to 4.8 bar (58 to 70 lbf/in^2)		
Combustion system	Direct injection		
Fuel injection pump	Rotary mechanical		
Idle speed	910 r.p.m.		
Maximum governed speed	2200 r.p.m.		
High idle speed (throttle stop)	2350 r.p.m.		
Recommended fuel specifications	Refer to ***Section 1, General Information - Fuel***		

(1) Engine at normal operating temperature and maximum revs.

Electrical Connections

Cold Start Heater

This section explains how the cold start electrical system works.

The system aids engine starting by heating the air in the induction manifold via electrical `grid heater' **A**. Operation of the system is fully automatic and is controlled by ECU **MA**. Ambient air temperature sensor **MB** enables the system when air temperature is less than -6°C (21°F). The heating sequence is as follows:

1 Starter key set to the ON position

2 Low ambient temperature warning light **CV** illuminated - grid heater ON - engine not ready to start

3 After a preset `pre-heat' time the warning light **CV** extinguishes - engine ready to start (1)

4 Starter key turned to engage starter motor and start the engine - grid heater on

5 Engine started - starter motor disengaged - grid heater OFF (2)

(1) The `pre-heat' stage can not be repeated unless the starter key is first set to the OFF position.

(2) If the engine stalls and is restarted without turning the starter key to OFF, the grid heater will come on while the starter motor is engaged.

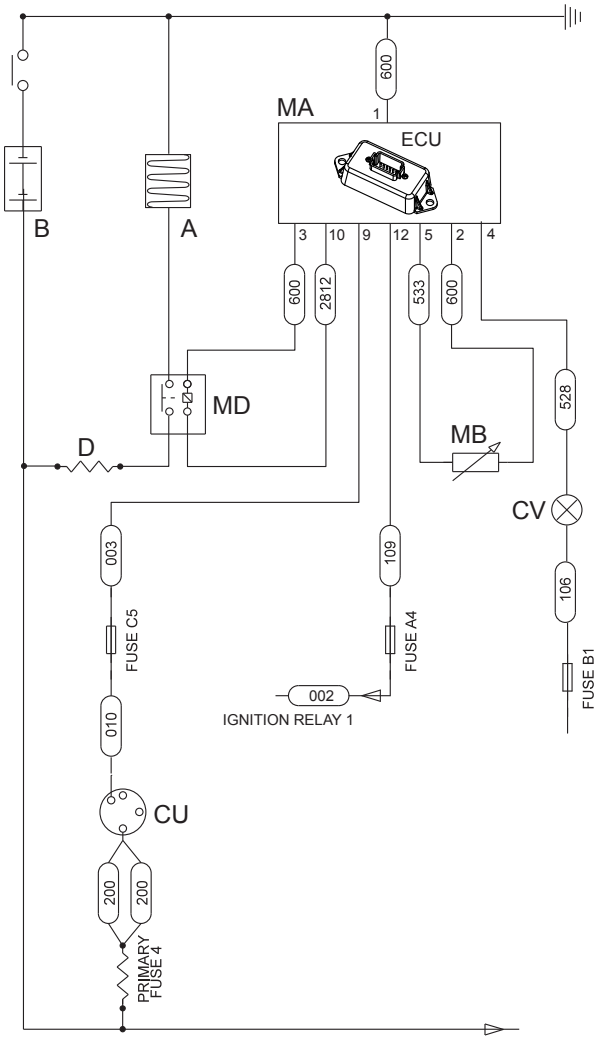

Fig 3. Schematic Diagram

Component Key:

A Grid heater

B Battery

CU Starter switch

CV Warning light - low ambient air temperature - engine not ready to start

D Primary fuse - grid heater

MA Electronic control unit (ECU)

MB Ambient air temperature sensor

MD Relay - grid heater

Diagnostic `Blink' Codes

Machines fitted with a cold start heater incorporate an electronic control unit (ECU). The ECU has the facility to detect faults with the cold start heater electrical system. These faults are indicated using the cold start indicator light **A** in the side console. The blink code sequence consists of the light being switched ON for approximately one second followed by a number of flashes (the code). The sequence is repeated until the fault is cleared.

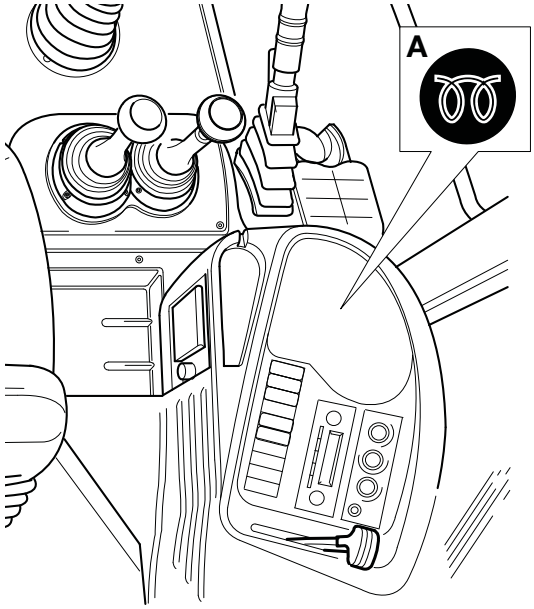

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Fig 4.

Blink Code:	Fault:	Action:
1 Flash	Temperature sensor or circuit fault (open circuit).	Check the temperature sensor (infinite resistance) and related harness wires and connectors.
2 Flashes	Temperature sensor or circuit fault (short circuit).	Check the temperature sensor (no resistance) and related harness wires and connectors.
3 Flashes	Heater relay fault.	Check the relay and related harness wires and connectors.
4 Flashes	Heater relay output fault (open or short circuit).	Check the relay and related harness wires and connectors.

For details of the wires and connectors ⇨ ***Wires and Connectors (K-7)***.

Wires and Connectors

The wire numbers and colours, where appropriate, are shown as an aid to identification whilst fault finding.

Before fault finding make sure that you understand how the the electrical circuits work. Most potential faults can be traced using a multimeter to carry out continuity checks on wires, switches and solenoid coils.

Note: *When fault finding do not use a multimeter on the ECU pins. Only test the associated wiring. Uncouple the connector* ***MA*** *and then use a multimeter at the pins inside the connector as applicable. The ECU is inherently more reliable than its associated wiring and components. Before renewing the ECU be sure to check all the related equipment first.*

Earth Points

Faults may be caused by poor earth connections. For details of these connections see ***Section C, Machine Earth Connections***.

Component Key

The following key identifies the component connectors, see ⇨ *Fig 5. (K-8)* and ⇨ *Fig 6. (K-9)*.

A Grid heater
B +ve battery connection - starter motor
D Primary fuse
h1 Harness - 721/11846 Grid heater
h2 Harness - 721/11727 Mainframe
h3 Harness - 721/11681 Cab/side console

Note: *For harness drawings see* ***Section C****.*

Connectors (h1)

MA Electronic control unit (E.C.U.)
MB Ambient air temperature sensor
MC h1 - h2
MD Relay - grid heater

Connectors (h2)

MU h2 - h1
MB1 Fuses
NH h2 - h3

Connectors (h3)

CA h3 - h2
CCA Fuses A
CCB Fuses B
CCC Fuses C
CD Ignition relay 1
CU Ignition switch
CV Warning light - side console

Splices (h2)

SA
SD

Splices (h3)

SY

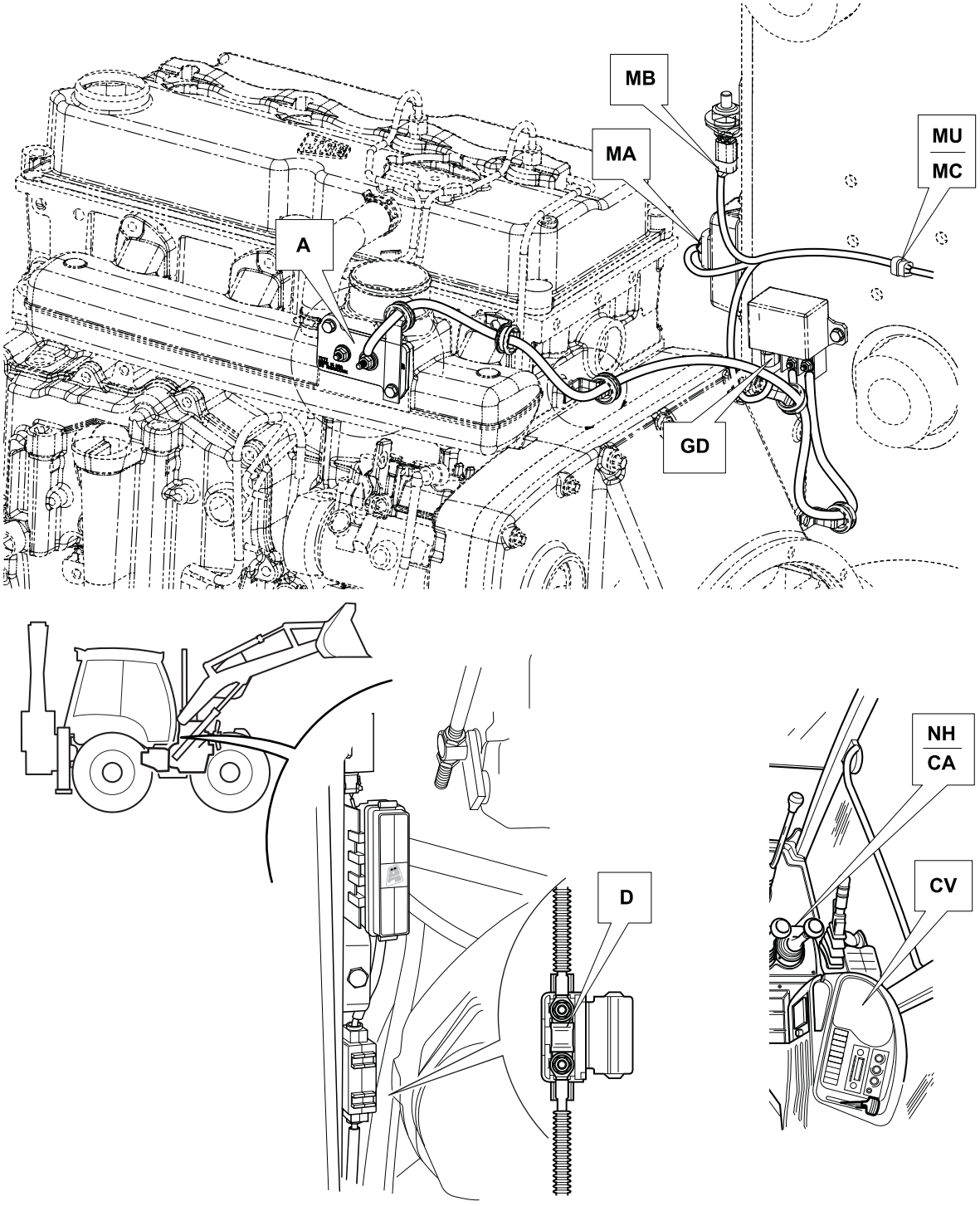

Fig 5. Electrical Connectors and Components

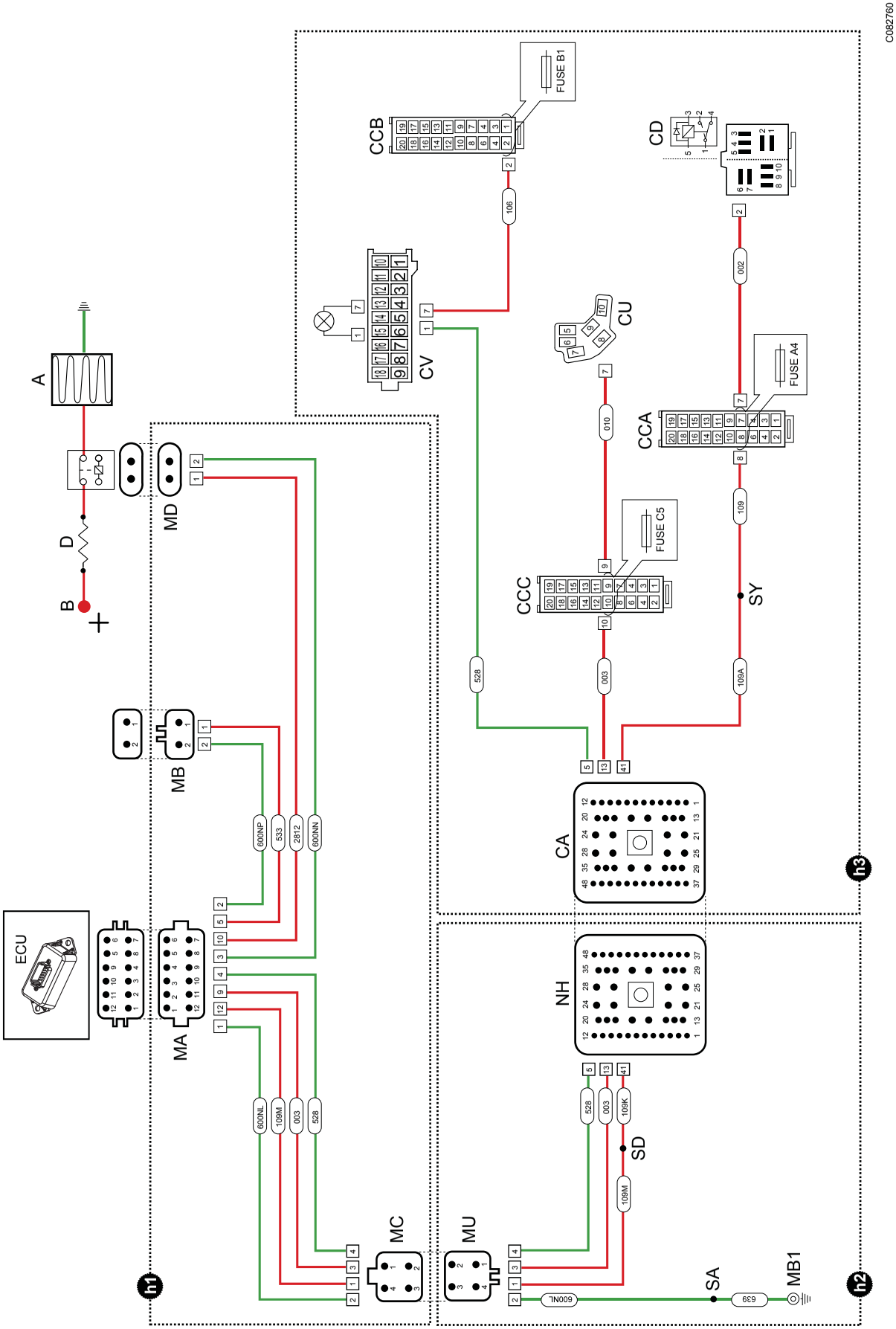

Fig 6. Wires and Connectors

Electrical Sensors and Solenoids

Removal and Replacement

The removal and replacement procedures for the engine electrical sensors and solenoids shown below are given in a separate publication. See the ***Engine Service Manual, Section 10 - Electrical System*** (Publication No. 9806/3000).

Sensor Switches

- Engine Cold Start Switch
- Engine Oil Pressure Switch
- Coolant Temperature Sender Unit

Solenoids

- Cold Start Advance Solenoid
- Engine Shut-Off Solenoid (ESOS)

Engine Bay Support Frame

Removal and Replacement

⇒ *Fig 7. (K-12)*. To gain access to the top of the engine, when removing the rocker cover for example, it will be necessary to first remove the engine bay support frame **A** as follows:

Removal

1 Remove the front grille. Raise the engine cover.

2 Support the engine cover and remove the central gas strut fixing **J**.

3 Disconnect the engine cover release cable **P** at the catch.

4 Disconnect the air intake hoses **K** and **L** on either side of the air filter assembly. Uncouple the electrical connector **M** at the air filter blocked switch.

5 Disconnect the water pipes and electrical connectors at the washer bottle **E**.

6 Undo the brake fluid reservoir **G** fixing screws and tie the reservoir to one side.

7 Disconnect the coolant hoses at the expansion tank **F** and allow the expansion tank to drain. Uncouple the electrical connector at the coolant level switch.

8 Disconnect the fuel lines **H** at the fuel sedimentor assembly. Uncouple the electrical connectors at the water sensor.

9 Unclip the electrical harness from the underside of the support frame **A** and tie up to one side.

10 Release the hose clamps **N** and tie up the hoses to one side.

11 Undo the support frame retaining bolts **B**, **C** and **D**. Carefully lift the support frame clear of the engine compartment complete with the air filter assembly, expansion tank, washer bottle and fuel sedimentor still attached. Note that the engine cover release cable must be fed through the inside of the support frame tube.

Replacement

Replacement is the reverse of the removal sequence. After replacement:

- Top up the washer bottle and engine coolant, refer to ***Section 3 Routine Maintenance***.
- Check the brake fluid level.
- Bleed the fuel system, refer to ***Section 3 Routine Maintenance***. Run the engine and check for fuel leaks.
- Make sure that the engine cover release cable is correctly adjusted before closing the cover.

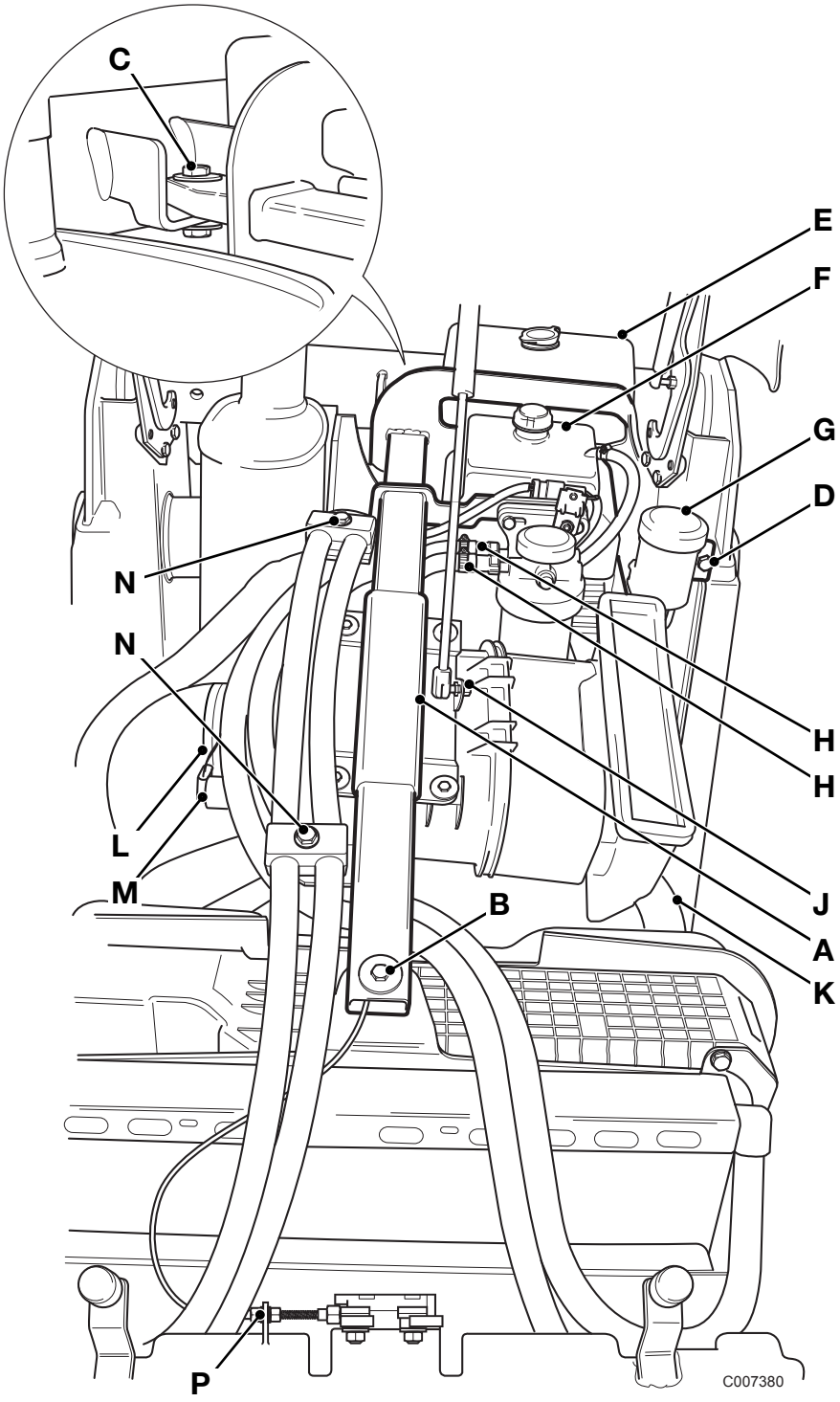

Fig 7. Engine Bay Support Frame

Cooling Fan Viscous Coupling

Principle of Operation

The viscous drive coupling **A** is an integral part of the engine cooling fan **B**. The coupling acts like a variable clutch, which allows the fan to turn at slower speeds than the fan pulley by introducing some slippage in the fan drive.

The coupling has a temperature sensitive bi-metal coil on the front face **C**, which reacts to the air temperature from the engine cooling pack passing over it. When the air temperature across the cooling pack reaches approximately 40 °C, the bi-metal coil begins to operate an internal valve, which has the effect of changing the fluid viscosity inside the coupling, and thereby changes the fan drive characteristic (i.e. begins to reduce the amount of coupling slippage).

When the air temperature is less than 40 °C the coupling will be `unlocked' (i.e. maximum slippage). If the engine is running at idle speed, the fan will turn at about the same speed as the fan pulley, and appear as though the coupling is `locked' (i.e. minimum slippage). However, as the engine speed is gradually increased, the fan will begin to turn progressively more slowly than the fan pulley. By the time the engine reaches maximum speed, the fan will be turning at about 45% of the pulley speed (i.e. maximum slippage).

When the air temperature reaches approximately 65 °C, the fan will turn at about 95% of the fan pulley speed, the coupling will be `locked' (i.e. minimum slippage).

Note: *The viscous coupling is a non-serviceable part. If the coupling is suspected as being faulty the cooling fan must be renewed as a complete assembly.*

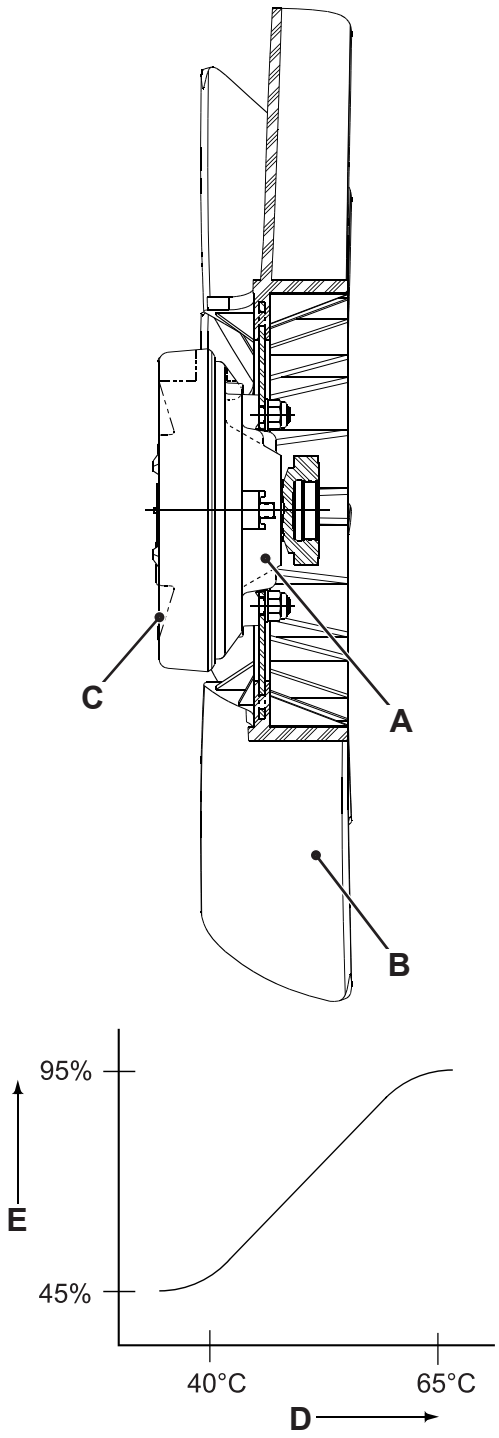

Fig 8. Example at Maximum Engine RPM

D Cooling pack air temperature

E Fan speed (relative to fan pulley speed)

Removal and Replacement

Note: *The following procedure describes the use of special spanners, which make it possible to remove the cooling fan without having to remove the oil cooler and radiator to get access to the front of the engine.*

Removal

1 Park the machine on firm level ground, engage the park brake and set the transmission to neutral. Raise the loader arms and fit the loader arm safety strut. Lower the backhoe to the ground, switch OFF the engine and remove the starter key.

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

2 Remove the front grille and raise the engine cover.

3 Disconnect the battery.

4 ⇨ *Fig 9. (K-14)*. Working at the left hand side of the engine compartment, fit special spanners **A** and **B** (see ***Service Tools***) onto the fan coupling and drive hub adaptor plate as shown.

5 Hold spanner **A** to prevent the drive hub from turning, and pull down on spanner **B** to unscrew the fan (the fan coupling has a LEFT HAND THREAD).

Note: *The fan cowl may need to be released from the rear of the radiator to allow the cooling fan to be lifted clear of the engine.*

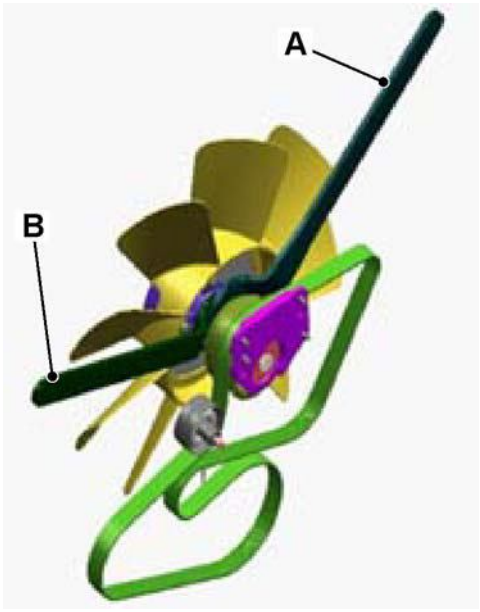

Fig 9.

Replacement

Replacement is a reversal of the removal sequence, but note the following:

Apply JCB High Strength Threadlocker to the fan coupling threads before fitting.

Important: *It is not possible to dismantle the viscous coupling. If the coupling is suspected as being faulty it must be renewed as a complete assembly.*

Cooling Radiator

Removal and Replacement

⇒ *Fig 10. (K-16)*. The engine cooling radiator **A** is part of the machine `cooling pack'. Before the radiator can be removed the hydraulic and transmission oil cooler matrix **B** must be removed.

Removal

1 Park the machine on firm level ground, engage the park brake and set the transmission to neutral. Raise the loader arms and fit the loader arm safety strut. Stop the engine and remove the starter key.

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

2 Vent any residual hydraulic pressure that may be in the system by operating the controls back and forth several times.

3 Remove the oil cooler matrix **B**. See ***Section F, Transmission***.

Important: *If the machine is fitted with air conditioning, it will be necessary to remove the condenser from the front of the cooling pack. DO NOT disconnect the air conditioning hoses at the condenser. Refer to* ***Section B, Air Conditioning.***

4 Disconnect the bottom radiator hose **C** and drain the engine coolant.

5 Disconnect the top radiator hose **D**.

6 Undo the fan cowl **E** retaining bolts (3 each side).

7 Undo the support frame bolt **F**. Retrieve the bracket. **G**.

Turbocharged Engines: Some machines may have a charge air cooler (CAC) **X**. Disconnect the hose **Y** to the turbocharger. Disconnect the hose **Z** to the engine inlet manifold. If the radiator is to be replaced, remove the charge air cooler and install it onto the new radiator.

8 Undo the radiator mounting bolts **H** (2 each side).

9 Carefully tilt the radiator forward to clear the support frame and then lift it from the machine.

Replacement

Replacement is the reverse of the removal sequence, but note the following:

Ensure that the anti-recirculation seal around the fan cowl is not damaged, and correctly located. If the seal is not correctly fitted, the radiator and oil cooler will be less efficient.

Fill the engine cooling system with the correct coolant. See ***Section 3, Routine Maintenance***.

On completion, run the engine and check for leaks.

Check the transmission oil level and fill with the correct fluid as necessary. See ***Section 3***, ***Routine Maintenance, Synchro Shuttle or Powershift Gearbox*** as applicable.

Check the hydraulic oil level and fill with the correct fluid as necessary. See ***Section 3***, ***Routine Maintenance***.

If necessary, adjust the engine cover release cable, see ***Section D***, ***Controls, Control Cables***.

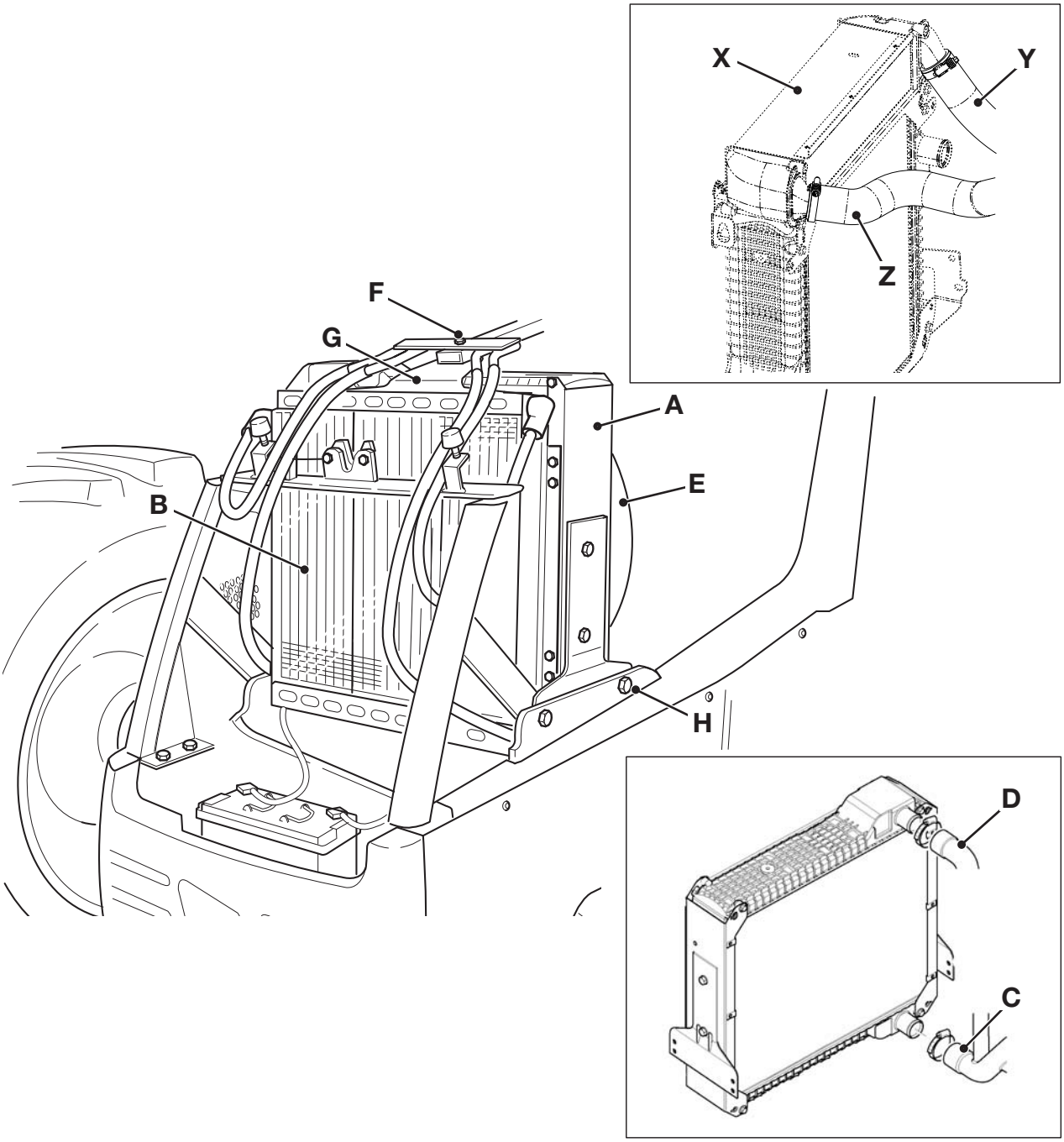

Fig 10. Cooling Pack

Coolant Expansion Tank

Removal and Replacement

⚠ WARNING

The cooling system is pressurised when the coolant is hot. When you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

9-3-3-1_2

Removal

1 Park the machine on firm level ground, engage the park brake and set the transmission to neutral. Raise the loader arms and fit the loader arm safety strut. Lower the backhoe to the ground, switch OFF the engine and remove the starter key.

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

2 Remove the front grille and raise the engine cover.

3 Drain the engine coolant, see ***Section 3, Routine Maintenance - Changing the Coolant***.

4 ***⇨ Fig 11. (K-18)***. Loosen the clips and pull off the two hoses **A**. Tie the hoses out of the way.

5 Uncouple the electrical connector **B** at the low coolant level sensor (if fitted).

6 Remove the two mounting bolts **C** and carefully lift the tank away from the machine.

Replacement

Replacement is a reversal of the removal sequence, but note the following:

On completion, fill the engine cooling system with the correct coolant, see ***Section 3, Routine Maintenance - Changing the Coolant***.

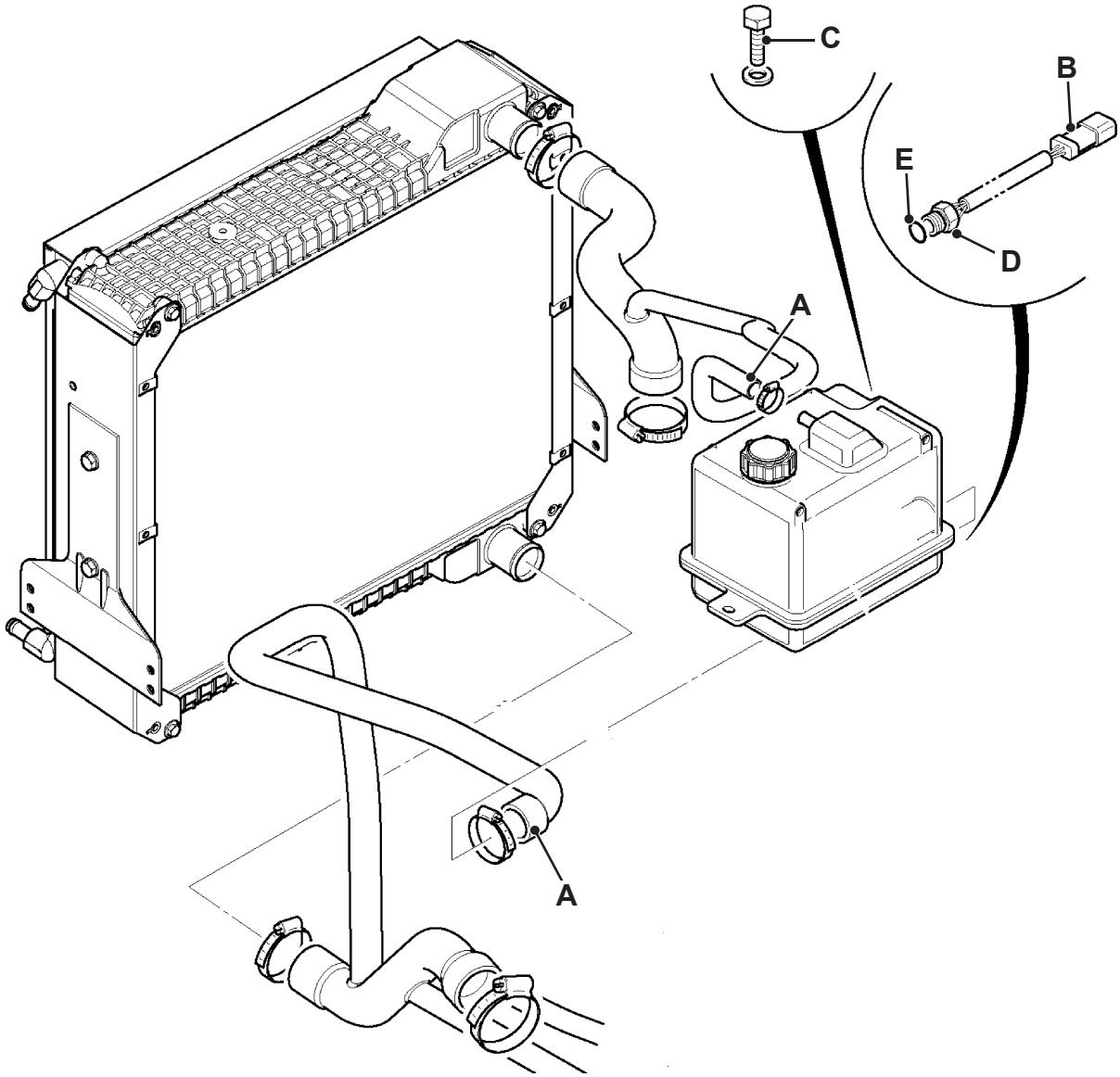

Fig 11.

Low Coolant Level Sensor - if fitted

Note: *The low coolant level sensor switch is not fitted on machines from serial no. 976832.*

To get access to the low coolant level sensor, it is recommended that the expansion tank is removed from the machine first.

Removal

1 Drain the engine coolant and remove the coolant expansion tank, see ***Coolant Expansion Tank - Removal and Replacement***.

2 ⇒ *Fig 11. (K-18)*. Carefully unscrew the low coolant level sensor **D** from the tank.

Replacement

Replacement is a reversal of the removal sequence, but note the following:

The low coolant level sensor is a non-serviceable part. If the sensor is suspected as being faulty, it must be renewed as a complete assembly.

Use a new O-ring **E**.

Torque tighten the low coolant level sensor **D**.

Table 1. Torque Settings

Item	Nm	lbf ft	kgf m
D (1)	1.4 - 2.7	1 - 2	0.14 - 0.27

(1) DO NOT tighten more than 1/6 of a turn beyond that required to seat the sensor against the surface of the tank. If the sensor is too tight, water can leak into the sensor and failure of the sensor can occur.

Fuel Injection Pump

Removal and Replacement

It is possible to remove the fuel injection pump without removing the engine.

Where applicable refer to the ***Engine Service Manual, Section 7 - Fuel System*** (Publication No. 9806/3000) for the correct procedures.

IMORTANT NOTE: DO NOT attempt to remove the fuel injection pump until both the engine and pump are mechanically locked in the correct position. Failure to carry out the correct procedure will make re-timing the engine and pump impossible, see ***Engine Service Manual***.

Prepare the machine:

1 Raise the loader arms and fit the loader arm safety strut. Stop the engine and remove the starter key. Note that if it is not possible to run the engine, select `arms raise' on the loader control lever while lifting the arms with a suitable hoist.

⚠ WARNING

Raised Equipment

Never walk or work under raised equipment unless it is supported by a mechanical device. Equipment which is supported only by a hydraulic device can drop and injure you if the hydraulic system fails or if the control is operated (even with the engine stopped).

13-2-3-7_2

2 Remove the front grille and raise the engine cover.

3 Disconnect the battery.

4 To improve access to the fuel injection pump, remove the windscreen washer bottle, hose clamp and mounting bracket.

Removal

Working in the engine compartment remove the fuel injection pump, see the ***Engine Service Manual*** for the correct procedures:

Replacement

See the ***Engine Service Manual*** for the correct procedures and torque values.

Removal and Replacement

JCB DieselMax

Component Identification

Note: *The following component identification is for a typical engine installation.There will be some component differences depending on the machine variant. Before attempting to remove the engine ensure that all the necessary components have either been removed, or safely disconnected from the engine.*

⇨ *Main Component Identification (* K-22)

Component Key:

A	Lifting bracket - front
B	Lifting bracket fixing bolts
C	Lifting bracket - rear
D	Electrical connection - cold start heater (if fitted)
E	Electrical connector - Electric shut off solenoid
F	Fuel line connector - return to tank line
G	Vacuum hose connector - brake vacuum pump
H	Electrical connector - cold start advance solenoid
J	Electrical connector - oil pressure switch
K	Electrical connector - cold start advance switch
L	Electrical connections - alternator
M	Electrical connections - starter motor
N	Electrical connection - harness earth
P	Fixing bolts - gearbox to engine (12 off)
Q	Fixing bolts - torque converter drive plate - engine flywheel
R	Rear axle drive shaft fixing - gearbox end
S	Front axle drive shaft fixing - gearbox end (4WD only)
T	Exhaust stack
U	Exhaust silencer
V	Electrical connection - coolant temperature sender unit
W	Hose connection - cab heater
X	Engine mounting bolts
Y	Gearbox mounting bolts
Z	Engine speed sensor (if fitted)

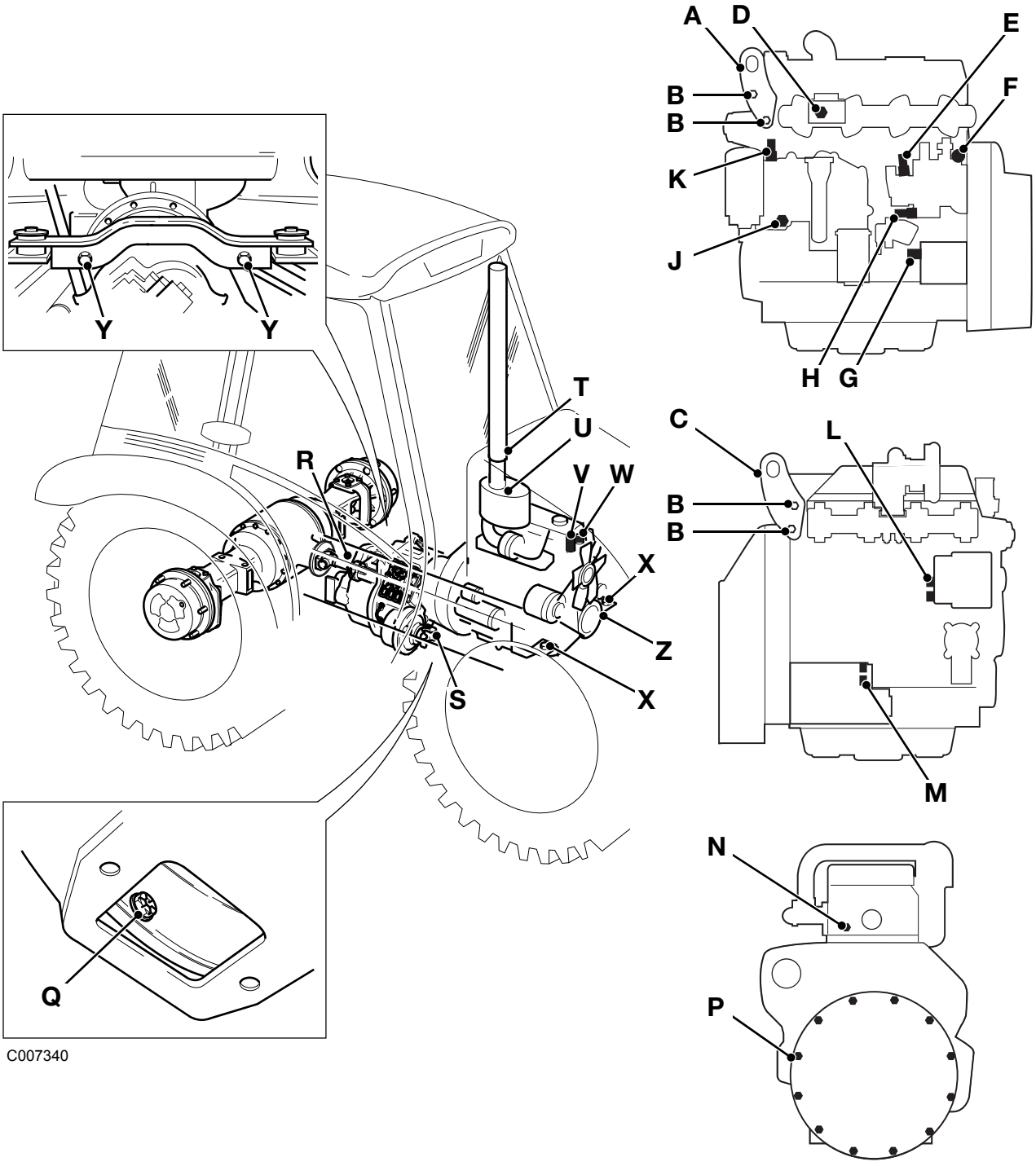

Fig 12. Main Component Identification

Table 2. Torque Settings

Item	Nm	kgf m	lbf ft
B	50	5.1	37
P	98	10	72
Q	44	4.5	32
R	70	7	52
S	70	7	52
X	205	21	151
Y	237	24	175

Removal

Note: *The following procedure is for a typical engine installation. There will be some procedural differences dependent on machine variant. Before attempting to remove the engine ensure that all the necessary components have either been removed, or safely disconnected from the engine.*

Machines with air conditioning: Where possible the engine should be removed without opening the air conditioning circuit. If it is necessary to disconnect any of the hoses the system must first be discharged, see ***Section B, Body and Framework***.

⚠ WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitably trained person. You can be severely frostbitten or injured by escaping refrigerant.

4-3-4-1_2

1 Remove the front grille and raise the engine cover.

2 Disconnect and remove the battery.

3 Remove the engine bay support frame, see ***Engine Bay Support Frame***.

4 Remove the engine cover, see ***Section B, Body and Framework***.

5 Remove the front grille housing, see ***Section B, Body and Framework***.

6 Disconnect and remove the cooling pack, see ***Cooling Radiator - Removal and Replacement***.

7 ⇨ *Fig 12. (K-22)*. Uncouple the exhaust stack retaining springs **T** and lift off the stack.

8 Undo the silencer coupling bolts at the exhaust manifold or turbocharger as applicable. Undo the silencer retaining bolts and lift off the silencer **U**.

9 Undo the heater hose clip and pull off the hose **W**.

10 **Machines with Servo Brakes:** Undo the brake vacuum hose clip **G** and pull off the hose.

11 Disconnect the throttle cable at the fuel injection pump.

12 Uncouple the fuel line **F** (return to tank) at the fuel injection pump.

13 Label the electrical connectors and then uncouple the following electrical ancillary devices:

- **a** Coolant temperature sender units **V**.
- **b** Cold start switch **K**.
- **c** Oil pressure switch **J**.
- **d** Alternator **L**.
- **e** Starter motor **M**.
- **f** Engine speed sensor **Z** (if fitted).
- **g** Electrical shut off solenoid **E**.
- **h** Cold start advance solenoid **H**.
- **i** Cold start grid heater **D** (if fitted).
- **j** Harness earth point **N**.

14 Ensure that all relevant harnesses and hoses are unclipped from the engine and tied out of the way.

15 Loosen and remove the rear propshaft to gearbox retaining bolts **R**.

16 On 4WD machines, loosen and remove the front propshaft to gearbox retaining bolts **S**.

17 Remove the access plate located at the base of the flywheel housing. Through the access hole, loosen and remove the torque converter to engine flywheel retaining bolts **Q** (turn the flywheel to align bolts with access hole).

18 If a manual gearbox is fitted, disconnect the gearshift lever from the top of the gearbox.

19 Use a suitable trolley jack and support the weight of the gearbox.

20 Loosen and remove the gearbox mounting bolts **Y**.

Note: *Attach a `cradle' to the trolley jack that will evenly support the weight of the gearbox. Refer to* ***Section F, Service Tools****.*

21 Using the trolley jack **13A**, lower the gearbox and engine to gain access to the top torque converter housing to engine retaining bolts **P**. Use a suitable stand **13B** and support the weight of the engine.

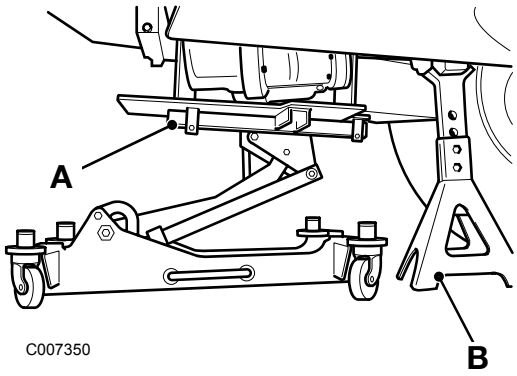

Fig 13.

22 Remove the gearbox to engine retaining bolts **P**, pull the transmission and converter clear of the engine, make sure that the converter stays mounted on the gearbox shaft.

23 If they are not already fitted, fit the engine lifting brackets **A** and **C** to the cylinder head. See ***Service Tools***.

24 Ensure that the lifting bracket fixing bolts **B** are torque tightened to 50 Nm (37 lbf ft). Attach suitable lifting equipment to the engine lifting brackets, then take the weight of the engine on a hoist.

25 With the engine suitably supported on a hoist, loosen and remove the engine mounting bolts **X** (both sides).

26 Lift the engine clear of the machine.

27 Put the engine on a suitable stand, the correct dismantling and assembly procedures are detailed in the Engine Service Manual, see ***Technical Data***.

Replacement

Replacement is the reverse of the removal sequence, but note the following:

When mating the gearbox/torque converter to engine, ensure that the drive dogs are correctly located in the gearbox pump. See ***Section F, Gearbox Replacement*** for a detailed procedure.

Important: *It is vitally important that the torque converter is fitted at the gearbox and engine flywheel correctly. Failure to locate the converter correctly will result in damage to the gearbox oil pump on engine start up.*

When you are satisfied that the torque converter is located correctly, use the access hole in the bottom of the flywheel housing to fit and tighten the flexi-plate to engine flywheel retaining bolts **Q**. Rotate the flywheel to align the next bolt hole, fit and tighten all retaining bolts.

When fitting the radiator sub-assembly, (including the fan shroud), take care not to damage the engine fan. Make sure that the engine fan does not foul the fan shroud.

Machines with Servo Brakes: Ensure that the brake vacuum hose is reconnected at the brake vacuum pump.

When connecting engine coolant hoses, do not push the hose past the location stop **14A**.

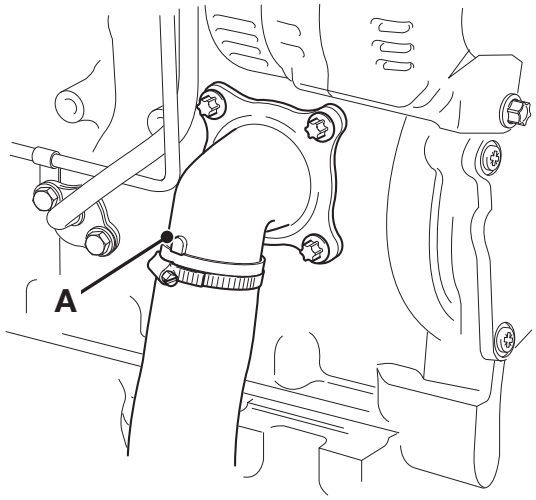

Fig 14.

- Fill the cooling system with the correct mix of coolant fluid.
- Check the transmission fluid and hydraulic fluid levels.
- Check the engine oil level.

For the correct procedures, see ***Section 3, Routine Maintenance***.

When connecting the battery, connect the earth (black) lead last.

Make sure that the engine speed sensor is correctly adjusted (if fitted). See ***Section F, Service Procedures, Powershift Gearbox (Shiftmaster)***.

Make sure that the engine idle speed is correct, adjust as required, refer to ***Technical Data***.

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