WORKSHOP MANUAL

Series LGW 523-627 and LGW 627 GPL engines
code 1-5302-509

LGW 523
LGW 627

1st Edition

LOMBARDINI
intermotor SLANZI
SERVICE

LOMBARDINI

FOREWORD

We have done all in our power to give up to date and accurate technical information in this manual. Lombardini engines are, however, constantly developing thus the data in this publication may be liable to modification without prior notice.

The information in this manual is given on the assumption that:

1- the persons who service Lombardini engines have been adequately trained and outfitted to safely and professionally carry out the necessary tasks;

2- the persons who service Lombardini engines possess the necessary skills and special Lombardini tools to safely and professionally carry out the necessary tasks;

3- the persons who service Lombardini engines have read the specific information concerning the above mentioned Service operations and that they have clearly understood the operations required.

GENERAL SERVICE NOTES

1 - Only use genuine Lombardini spare parts. Use of spurious spares may lead to incorrect performance and shorten the life of the engines.
2 - The metric system is used to express all data, i.e. the dimensions are given in millimeters (mm), torque is expressed in Newton-meters (Nm), weight in kilograms (Kg), volume in liters or cubic centimeters (cc) and pressure in barometric units (bar).

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WARRANTY CLAUSE

Lombardini S.r.l., guarantees its engines for a period of 12 months from the date of delivery to the first user, and no later than 24 months from the date of delivery to the manufacturer or building site. Of the two alternatives, the one that occurs first shall be considered valid.
Stationary assemblies (with use at constant load and constant speed and/or with load and speed that slightly vary within the regulating limits) are not covered by this clause. For these assemblies, the guarantee is recognized up to a maximum one thousand (1000) hours service if the above mentioned periods have not been exceeded.

In the case of special applications requiring considerable modifications to the cooling, lubricating (example: dry sump systems), supercharging and filtering circuits, either the special warranty clauses explicitly established in writing shall be valid or the above mentioned general clauses if an approval test of the application issued by the Technical Management of Lombardini motori is exhibited.
Within the above mentioned terms, Lombardini undertakes to supply, free of charge, spare parts for those components which are recognized by Lombardini or by one of its authorized representatives as possessing manufacturing or material defects or, at its discretion, to either carry out repairs itself or by means of authorized workshops.
All other total and partial liability and obligation for other direct or indirect expenses, damages or losses deriving from use or the impossibility to use the engines shall, however, remain excluded.
Repairs or supply of substitutions shall in no way extend or renew the length of the warranty period.

Expenses sustained to remove the engine from the machine or hull and to remount it again, plus transport expenses and those for expendable materials (filters, lubricating oils, etc.) shall be at the user's charge.

Lombardini's obligations established in the previous paragraphs shall become void if:

- The engines are not used in compliance with Lombardini's instructions in the operation and maintenance manual;
- The seals affixed by Lombardini are tampered with;
- The engines are repaired, dismantled or modified by workshops that have not been authorized by Lombardini;
- Use has been made of spares that are NOT genuine Lombardini parts;
- The injection systems have been damaged by unsuitable or polluted fuel;
- The electrical systems become faulty owing to components such as remote control relays, for which the manufacturer's warranty is applicable.

Lombardini shall consider itself released from all liability and from the obligations described in the previous paragraphs once the twelve month period from the date on which the engine was delivered to the first users has elapsed and/or the thousand (1000) hours service have terminated.

This warranty, which runs from 1st July 1993, voids and substitutes all other expressed or implicit warranties and may only be modified in writing.

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This manual contains information on how to repair LOMBARDINI **LGW 523, LGW 627** gasoline fuelled engines and LOMBARDINI **LGW 627** LPG fuelled engines and is up to date as of 10.06.1999.

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PROBABLE CAUSES AND THEIR REMEDIES

The table gives the causes of some of the faults that may occur during operation.
Proceed systematically with the simplest inspections before removing or replacing any parts.

	PROBABLE CAUSE	FAULTS										
		Fails to start	Starts then stops	Fails to accelerate	Irregular speed	Black smoke	White smoke	Low oil pressure	High oil pressure	Excessive oil consumption	Oil and fuel drip from exhaust	Coolant fluid overheats
FUEL CIRCUIT	Clogged tubes	▪										
	Fuel filter clogged	▪	▪	▪								
	Air in the fuel circuit	▪	▪	▪								
	Tank plug venting hole clogged	▪	▪	▪								
	Defective fuel pump	▪	▪	▪	▪							
	Fuel dirty or containing water	▪	▪	▪	▪							
	Carburetor incorrectly regulated			▪								
	Dirty carburetor	▪	▪	▪	▪	▪						
LUBRICATION CIRCUIT	Oil level too high				▪		▪			▪		
	Pressure regulating valve jammed or dirty							▪	▪			
	Worn oil pump							▪				
	Air in oil intake pipe							▪				
	Defective pressure gauge or pressure switch							▪				
	Oil intake pipe clogged							▪				
	Oil filter clogged							▪				
ELECTRICAL CIRCUIT	Electronic module defective	▪			▪							
	"Hall" module sensor faulty	▪										
	Battery low	▪										
	Wiring uncertain or incorrect	▪										
	Defective ignition switch	▪										
	Defective starter motor	▪										
	Defective coil	▪	▪	▪								
	Spark plug grounded or defective	▪			▪							
	Spark plug cable disconnected	▪										
	Cut-Off defective or disconnected		▪	▪								
MAINTE-NANCE	Air filter clogged	▪	▪	▪		▪						
	Coolant fluid radiator clogged											▪
	Coolant fluid level low or containing air											▪
	Engine overloaded			▪								▪
DISASSEMBLY / REASSEMBLY ADJUSTMENTS	Speed governor levers incorrectly timed	▪			▪							
	Speed gov. spring broken, released or unsuitable			▪	▪							
	Idling rate too low		▪									
	Piston rings worn or jammed			▪			▪			▪		▪
	Cylinders worn or scored			▪			▪			▪		▪
	Valve guides worn			▪		▪				▪		
	Faulty valve housings	▪										
	Valves jammed	▪	▪	▪								▪
	Worn connecting rod journal bushes							▪				
	Governor levers not free to slide				▪							
	Drive shaft not free to slide	▪				▪						
	Damaged big-end seals											▪
	Timing belt broken	▪										

SAFETY AND WARNING DECALS

DANGER

Failure to comply with the instructions could result in damage to persons and property

CAUTION

Failure to comply with the instructions could lead to technical damage to the machine and/or system

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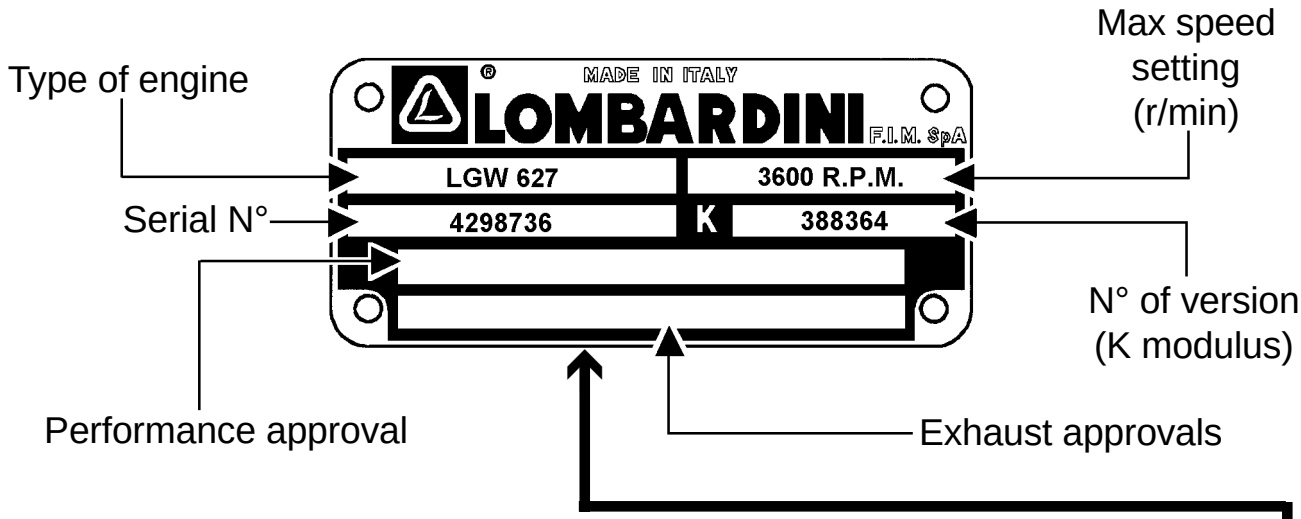
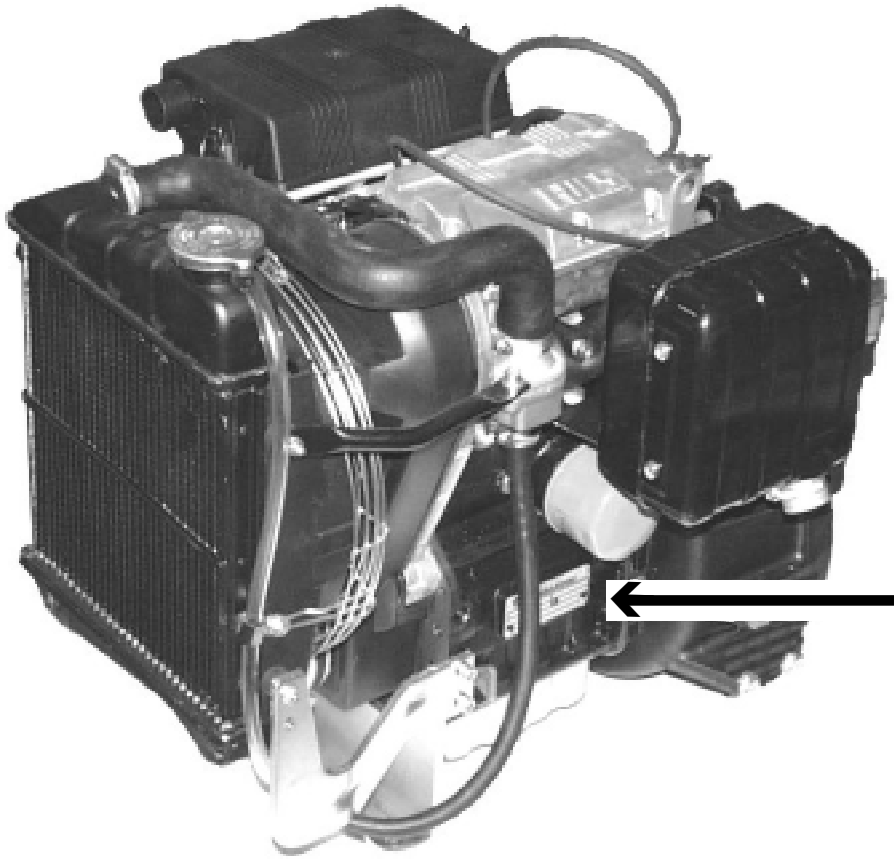
SAFETY INSTRUCTIONS

- Lombardini Engines are built to supply their performances in a safe and long-lasting way. To obtain these results, it is essential for users to comply with the servicing instructions given in the relative manual along with the safety recommendations listed below.
- The engine has been made according to a machine manufacturer's specifications and all actions required to meet the essential safety and health safeguarding requisites have been taken, as prescribed by the current laws in merit. All uses of the engine beyond those specifically established cannot therefore be considered as conforming to the use defined by Lombardini which thus declines all liability for any accidents deriving from such operations.
- The following indications are dedicated to the user of the machine in order to reduce or eliminate risks concerning engine operation in particular, along with the relative routine maintenance work.
- The user must read these instructions carefully and become familiar with the operations described. Failure to do this could lead to serious danger for his personal safety and health and that of any persons who may be in the vicinity of the machine.
- The engine may only be used or assembled on a machine by technicians who are adequately trained about its operation and the deriving dangers. This condition is also essential when it comes to routine and, above all, extraordinary maintenance operations which, in the latter case, must only be carried out by persons specifically trained by Lombardini and who work in compliance with the existing documentation.
- Variations to the functional parameters of the engine, adjustments to the fuel flow rate and rotation speed, removal of seals, demounting and refitting of parts not described in the operation and maintenance manual by unauthorized personnel shall relieve Lombardini from all and every liability for deriving accidents or for failure to comply with the laws in merit.
- On starting, make sure that the engine is as horizontal as possible, unless the machine specifications differ. In the case of manual start-ups, make sure that the relative actions can take place without the risk of hitting walls or dangerous objects, also considering the movements made by the operator. Pull-starting with a free cord (thus excluding self-winding starting only), is not permitted even in an emergency.
- Make sure that the machine is stable to prevent the risk of overturning.
- Become familiar with how to adjust the rotation speed and stop the engine.
- Never start the engine in a closed place or where there is insufficient ventilation. Combustion creates carbon monoxide, an odourless and highly poisonous gas. Lengthy stays in places where the engine freely exhausts this gas can lead to unconsciousness and death.

- The engine must not operate in places containing inflammable materials, in explosive atmospheres, where there is dust that can easily catch fire unles specific, adequate and clearly indicated precautions have been taken and have been certified for the machine.
- To prevent fire hazards, always keep the machine at least one meter from buildings or from other machinery.
- Children and animals must be kept at a due distance from operating machines in order to prevent hazards deriving from their operation.
- Fuel is inflammable. The tank must only be filled when the engine is off. Thoroughly dry any spilt fuel and move the fuel container away along with any rags soaked in fuel or oil. Make sure that no soundproofing panels made of porous material are soaked in fuel or oil. Make sure that the ground or floor on which the machine is standing has not soaked up any fuel or oil.
- Fully tighten the tank plug each time after refuelling. Do not fill the tank right to the top but leave an adequate space for the fuel to expand.
- Fuel vapour is highly toxic. Only refuel outdoors or in a well ventilated place.
- Do not smoke or use naked flames when refuelling.
- The engine must be started in compliance with the specific instructions in the operation manual of the engine and/or machine itself. Do not use auxiliary starting aids that were not installed on the original machine (e.g. Startpilot').
- Before starting, remove any tools that were used to service the engine and/or machine. Make sure that all guards have been refitted.
- During operation, the surface of the engine can become dangerously hot. Avoid touching the exhaust system in particular.
- Before proceeding with any operation on the engine, stop it and allow it to cool. Never carry out any operation whilst the engine is running.
- The coolant fluid circuit is under pressure. Never carry out any inspections until the engine has cooled and even in this case, only open the radiator plug or expansion chamber with the utmost caution, wearing protective garments and goggles. If there is an electric fan, do not approach the engine whilst it is still hot as the fan could also start operating when the engine is at a standstill. Only clean the coolant system when the engine is at a standstill.
- When cleaning the oil-cooled air filter, make sure that the old oil is disposed of in the correct way in order to safeguard the environment. The spongy filtering material in oil-cooled air filters must not be soaked in oil. The reservoir of the separator pre-filter must not be filled with oil.
- The oil must be drained whilst the engine is hot (oil T ~ 80°C). Particular care is required to prevent burns. Do not allow the oil to come into contact with the skin.
- Make sure that the drained oil, the oil filter and the oil it contains are disposed of in the correct way in order to safeguard the environment.
- Pay attention to the temperature of the oil filter when the filter itself is replaced.
- Only check, top up and change the coolant fluid when the engine is off and cold. Take care to prevent fluids containing nitrites from being mixed with others that do not contain these substances since "Nitrosamine", dangerous for the health, can form. The coolant fluid is polluting and must therefore be disposed of in the correct way to safeguard the environment.
- During operations that involve access to moving parts of the engine and/or removal of rotating guards, disconnect and insulate the positive wire of the battery to prevent accidental short-circuits and to stop the starter motor from being energized.
- Only check belt tension when the engine is off.
- Only use the eyebolts installed by Lombardini to move the engine. These lifting points are not suitable for the entire machine; in this case, the eyebolts installed by the manufacturer should be used.



Note: **The Performance Approval and Exhaust Approvals are only stamped for Diesel engines**



LGW 523-627 SPECIFICATIONS

TYPE OF ENGINE			LGW523	LDW 627
Cylinders		N°	2	2
Bore		mm	72	72
Stroke		mm	62	75
Displacement		cc.	505	611
Compression ratio			8.7 : 1	9 : 1
r/min			5000	3600
Power kW/HP	N 80/1269/EEC - 88/195/EEC - ISO 1585		15 / 20.4	14.5 / 19.7
	NB 80/1269/EEC - ISO 1585			
	NA ISO 3946/1 - ICXN			12.3/16.7
Maximum torque		Nm	37 @ 2200	44.5 @ 2400
No-load idling speed r/min			1100	1100
Water pump flow rate		l/min	52 (~) at 5000 rpm	40 (~) at 3600 rpm
Max. tolerated inclination for intermittant service ***			25° (35°)	25° (35°)
Specific fuel consumption		g/kW	300	310
Standard oil sump capacity (filter included)		l.	1.5	1.7
Standard oil sump capacity (filter excluded)		l.	1.4	1.6
Oil consumption (measured at N power rating) *		g/kWh	0.007	
Oil consumption (measured at NA power rating) **		g/kWh		0.007
Recommended battery		V/ah	12/44	12/44
Dry weight		Kg	52	60

* In N power SELF-DRIVING POWER: Discontinuous service at variable rate and load.

** In NA power CONT. OVERLOADABLE POWER: Continuous heavy-duty service at constant rate and load.

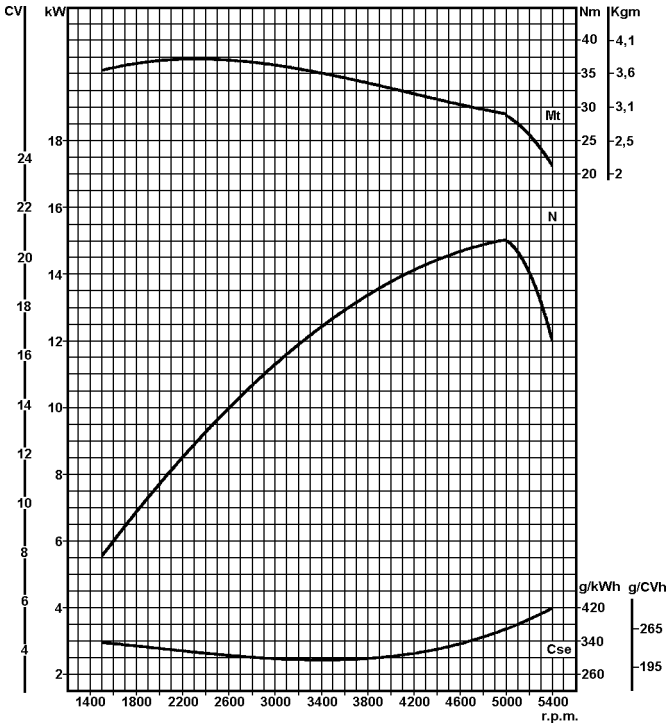
*** Depending on application

LGW 523

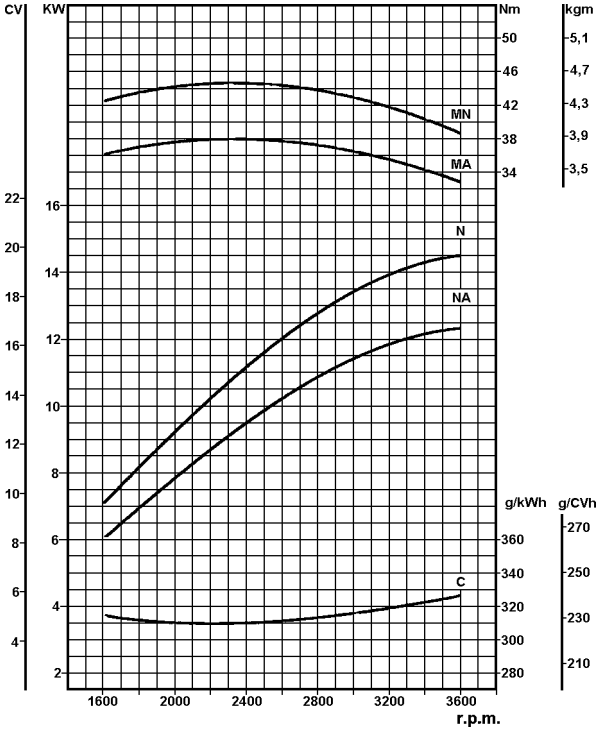
LGW 627

CHARACTERISTIC POWER, DRIVING TORQUE AND SPECIFIC CONSUMPTION CURVES

LGW 523



LGW 627



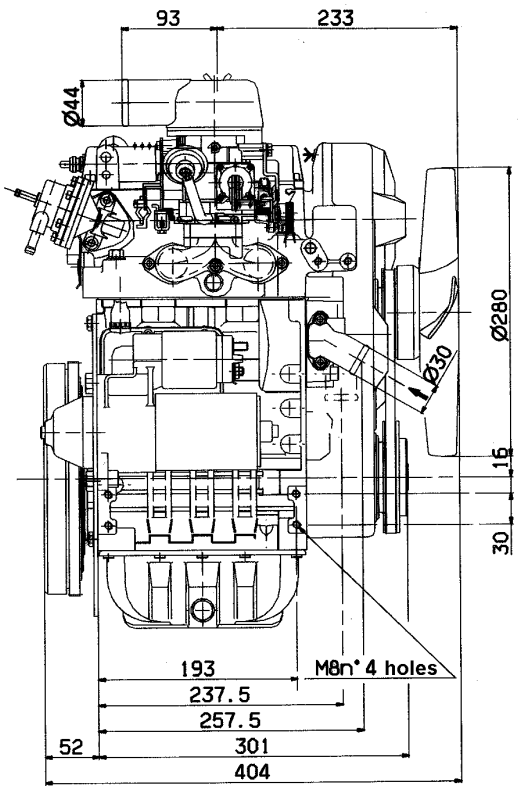
N (80/1269/CEE - ISO 1585) **SELF-DRIVING POWER**: Discontinuous service at variable rates and loads.
NB (ISO 3046 - 1 IFN) **NON-OVERLOADABLE POWER:** Continuous light service at constant rate and with variable loads.
NA (ISO 3046 - 1 ICXN) CONTINUOUS OVERLOADABLE POWER: Continuous heavy-duty service at constant rates and loads.
MN Torque curve (in curve N)
Mt (in curve N)
MA (in curve NA)
C Specific consumption curve measured at power **NB**
Cse Specific consumption curve measured at power **N**

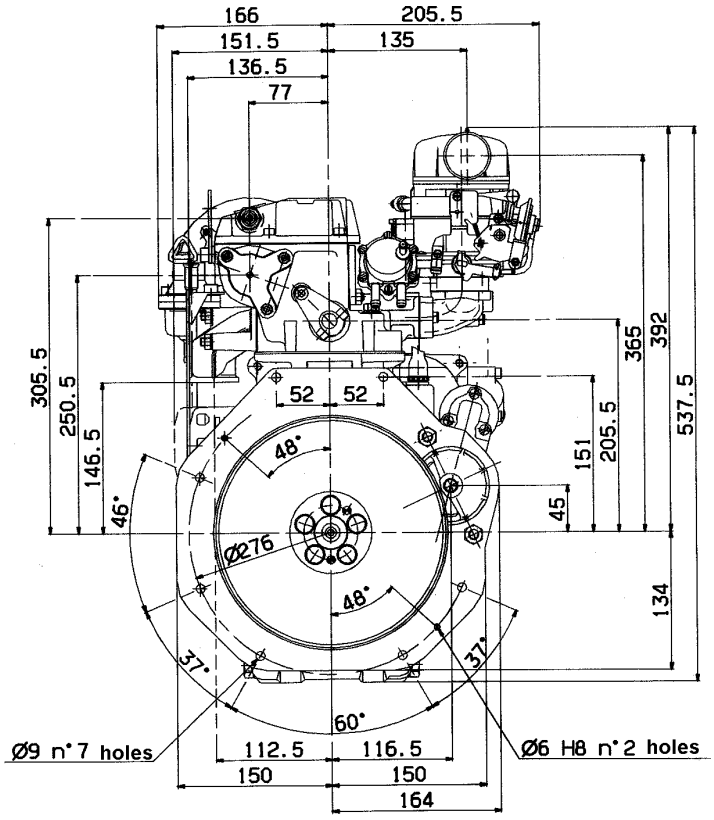
! Remember that all variations to the intake or exhaust systems during the application phase of engines LGW 523 and LGW 627 will involve a variation in the carburation.
Optimizing must be checked beforehand in the Lombardini test departments. Failure of Lombardini to approve this type of modification relieves the same from all liability for any damage the engine may sustain.

The indicated power ratings refer to engines equipped with air filter, standard silencer and fan, with the running-in period terminated and at environmental conditions of 20°C and 1 bar.
Maximum power is guaranteed with a 5% tolerance.
The power ratings drop by about 1% for every 100 m of altitude and by 2% for every 5°C above 25°C.

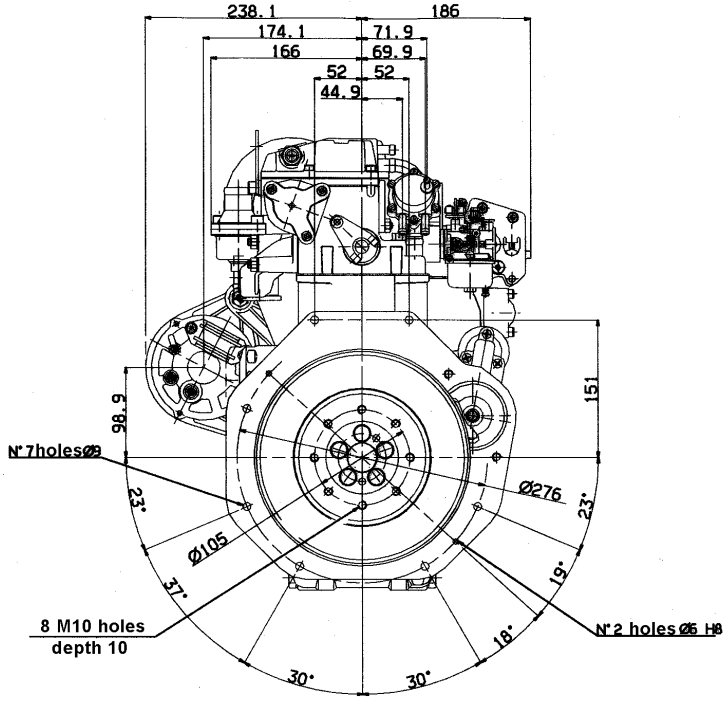
Note: Consult LOMBARDINI for power, torque curves and specific consumptions at rates differing from those given above.

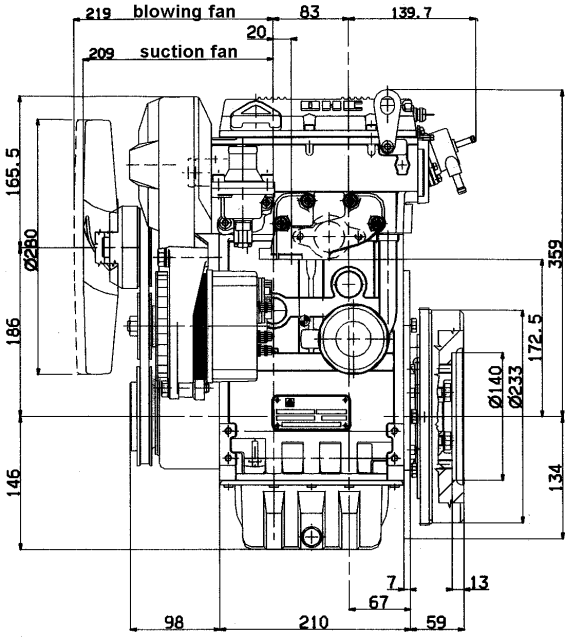
LGW 523





LGW 627





Note : The values are in mm

! Failure to carry out the operations described in the table may lead to technical damage to the machine and/or system

LGW 523 ENGINE MAINTENANCE

OPERATION	PART		FREQUENCY HOURS										
			10	50	80	100	175	250	350	500	1000	2000	5000
INSPECTION	SUMP OIL LEVEL		●										
	RADIATOR FINS			(*)			●		●				
	ALTERNATOR BELT TENSION								●				
	VALVE AND TAPPET PLAY								●				
	AIR FILTER		●										
	CARBURETOR								●				
REPLACEMENT	SUMP OIL LEVEL			□			●						
	ANTI-FREEZE (****)												
	OIL FILTER CARTRIDGE			□					●				
	FUEL FILTER								●				
	AIR FILTER CARTRIDGE						(*)		●				
	TIMING BELT (**)											●	
	FAN (ALTERNATOR) BELT											●	
	SPARK PLUG								●				
OVERHAUL	PARTIAL	(***)										●	
	GENERAL												●
	CARBURETOR											●	

□ First change
(*) In very dusty environments
(**) When the timing belt is removed it must be changed even though it has not terminated its period of use.
(***) Check the cylinders, piston rings, guides, springs and valve seat honing; descale cylinder head and cylinders.
(****) Every two years or after 1000 hours service.

LGW 627 ENGINE MAINTENANCE

OPERATION	PART			FREQUENCY HOURS									
				10	50	80	100	175	250	350	500	1000	2000	5000
CLEANING	OIL-COOLED AIR FILTER			●										
	FUEL TANK										●			
INSPECTION	LEVEL	AIR FILTER OIL		●										
		SUMP OIL		●										
		BATTERY FLUID					●							
	RADIATOR FINS			(*)			●							
	ALTERNATOR BELT TENSION									●				
	VALVE AND TAPPET PLAY									●				
	AIR FILTER			(*)	●									
	CARBURETORS									●				
REPLACEMENT	OIL	AIR FILTER	(*)(**)		●									
		SUMP			□			●						
	ANTI-FREEZE (*****)													
	OIL FILTER CARTRIDGE				□					●				
	FUEL FILTER									●				
	AIR FILTER CARTRIDGE						(*)		●					
	TIMING BELT (***)												●	
	ALTERNATOR BELT												●	
	SPARK PLUG									●				
OVERHAUL	PARTIAL	(****)											●	
	GENERAL													●
	CARBURETORS												●	

□ First change
(*) In very dusty environments
(**) See recommended type of oil
(***) When the timing belt is removed it must be changed even though it has not terminated its period of use.
(****) Check the cylinders, piston rings, guides, springs and valve seat honing; descale cylinder head and cylinders.
(*****) Every two years or after 1000 hours service.

The engine could be damaged if allowed to operate with insufficient oil. It is also dangerous to add too much oil as its combustion could sharply increase the rotation speed.
Use a suitable oil in order to protect the engine.
The lubrication oil influences the performances and life of the engine in an incredible way.
Use of an inferior quality oil or failure to regularly change the oil will increase the risk of piston seizure, may make the compression rings jam and will lead to rapid wear on the cylinder liner, the bearings and all other moving parts. Engine life will also be notably reduced.
Oil viscosity must suit the ambient temperature in which the engine operates.

Old oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time. If contact with the oil is inevitable, you are advised to thoroughly wash your hands with soap and water as soon as possible.
Appropriate protective gloves etc should be wore during this operation.
Old oil is highly polluting and must be disposed of in the correct way. Do not litter.

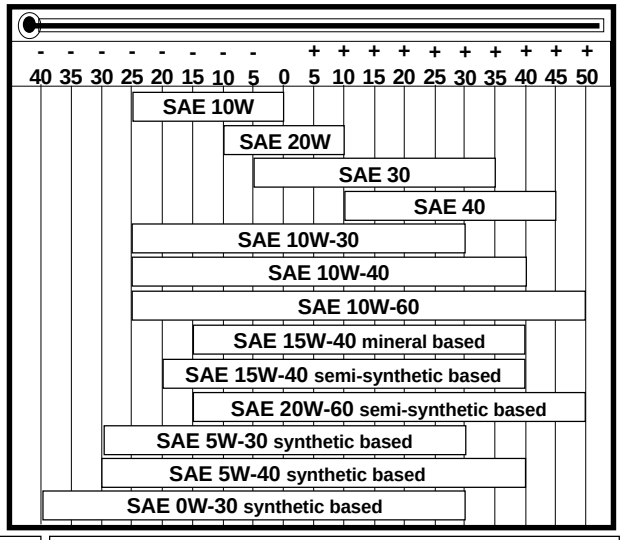
RECOMMENDED OIL

AGIP SINT 2000 5W40 specification API SJ/CF ACEA A3-96 B3-96 MIL-L-46152 D/E.
ESSO ULTRA 10W40 specification API SJ/CF ACEA A3-96 MIL-L-46152 D/E.
In countries where AGIP and ESSO products are not available, use API SJ/CF oil for gasoline-fuelled engines or oil that complies with military specification MIL-L-46152 D/E.

OIL SUPPLY (liters) 523
Standard oil sump
filter included 1.5
filter excluded 1.4

OIL SUPPLY (liters) 627
Standard oil sump
filter included 1.7
filter excluded 1.6

GRADE



ACEA SEQUENCES

A = Gasoline (Petrol)
B = Light Diesel fuels
E = Heavy Diesel fuels

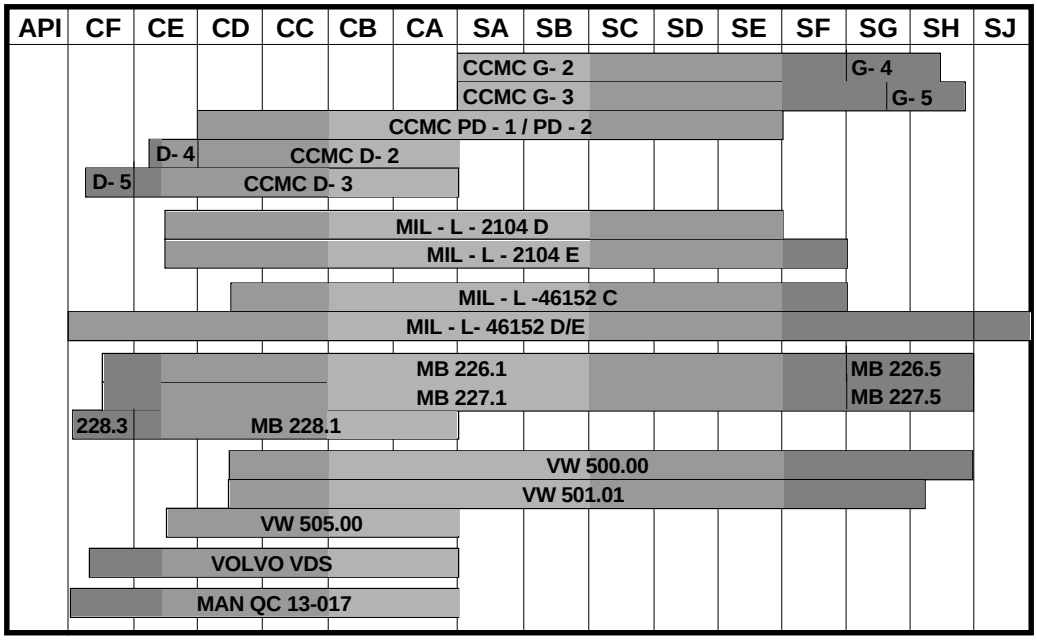
Required levels :

A1-96
A2-96
A3-96

B1-96
B2-96
B3-96

E1-96
E2-96
E3-96

DIESEL	BENZINA - ESSENCE - PETROL BENZIN - GASOLINA -



The fluid coolant circuit is pressurized. Inspections must only be made when the engine has cooled and even in this case, the radiator or expansion chamber plug must be unscrewed with the utmost caution.
If an electric fan is installed, do not approach a hot engine since the fan itself could start up even when the engine is at a standstill.
Coolant fluid is polluting. It must therefore be disposed of in the correct way. Do not litter.

COOLANT FLUID

Remember to use anti-freeze and protective fluids (e.g. (es. AGIP ANTIFREEZE, ESSO PERMANENT ANTIFREEZE, etc.) mixed with decalcified water for preference.
The freezing point of the coolant fluid mixture depends on the concentration of the product in water: at -15° (30%), at -20° C (35 %), at -25° C (40 %), at -30° C (45 %), at -35° C (50 %).
Besides lowering the freezing point, permanent liquid also raises the boiling point. This passes from 100°C (point at which water boils) to temperatures of over 110°C. The boiling point varies according to the characteristics of the fluid and depending on the pressure in the circuit itself.
It is therefore advisable to use a mixture diluted by 50% to ensure a general degree of protection.

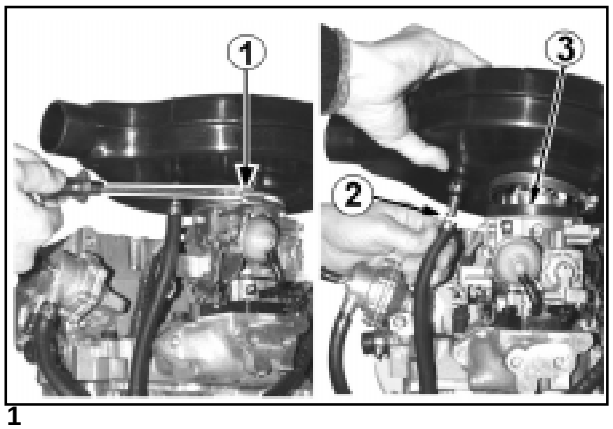
COOLANT FLUID SUPPLY (liters)

With standard radiator	LGW 523 - 627	l. 2.3

! Always wear protective goggles during repair work, when compressed air is used

DISASSEMBLY AND REASSEMBLY

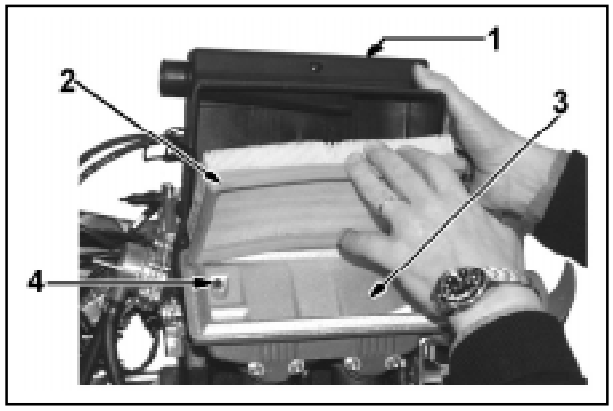
Besides describing how to dismantle and reassemble the various parts, this chapter also includes instructions on how to check and tune the engines, dimensions, repairs and hints on operation.
Always use genuine LOMBARDINI spares to correctly repair the engines.



1

LGW 523 Dry air filter

The dry air filter of engine LGW 523 consists of a single unit (casing and cartridge) which cannot be separated.
Since the internal cartridge cannot be cleaned, the whole filter must be changed.
To remove the old filter, unscrew screw **1** (clamp that fixes it to the carburetor) and screw **2** (clamp that fixes the breather pipe).
To fix seal **3** (see fig. 1), thoroughly clean and and degrease the housing on the carburetor and apply Loctite 401 adhesive.
Consult page 16 for the maintenance (replacement) instructions.



2

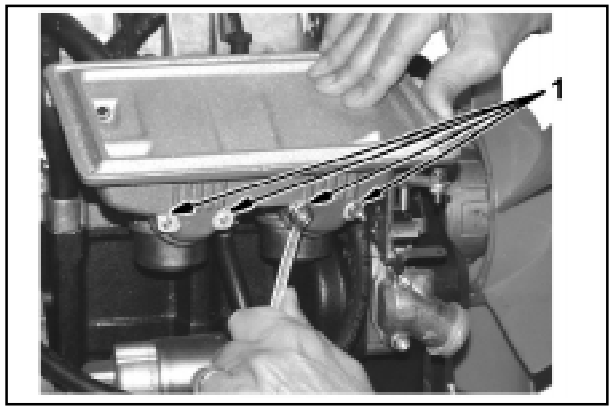
⚠ Never clean the filtering element using solvents with a low flash point. This could cause an explosion !

! It is inadvisable to blow compressed air on to the paper filter element.
If necessary, lightly and repeatedly tap the element on a hard surface to eliminate any excess dirt.

LGW 627 Dry air filter

Parts:
1 Cover
2 Filtering cartridge
3 Support
4 Vent

Cartridge specifications:
Filtering degree = 13 to 14 micron m.
Filtering area = 4470 cm²
See page 16 for the maintenance or replacement instructions.

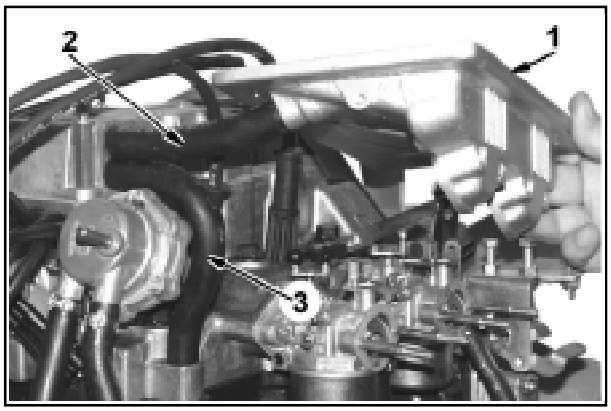


3

LGW 627 Air filter support

The exhaust manifolds are built into the support.
To remove the support, unscrew the 4 nuts **1** and disconnect the bleed pipe between the manifold and the rocker cover.
When remounting the parts, re-connect the bleed pipe, tighten the relative clamps and then torque the 4 nuts **1** to 4 Nm.

! When engines LGW 523 and LGW 627 are being installed, remember that any variation to the intake system (type of air filter, length and diameters of the pipes leading from the intake manifold to the air filter) will involve a modification to the carburation.
The carburation must be tested beforehand in the Lombardini test department. Failure of Lombardini to approve this type of modification shall relieve the same of all liability for deriving operating faults and any damage to which the engine may be subjected.

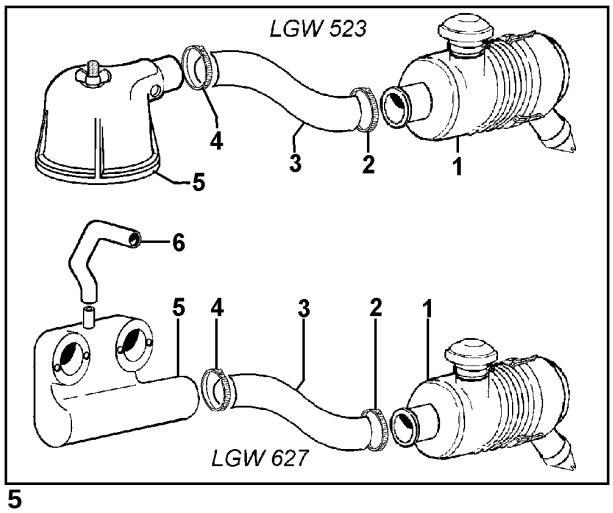


4

LGW 627 Air filter support

1 Air filter support
2 Oil vapour venting tube from the tappet cap to the air filter support
3 Tube that returns the vapour, re-converted into liquid oil, back to the sump

Whenever the intake manifold is demounted, make sure that there are no traces of dust either in the manifold itself or in the intake pipes.
Replace the seals between the carburetors and manifold whenever the support is demounted.



5

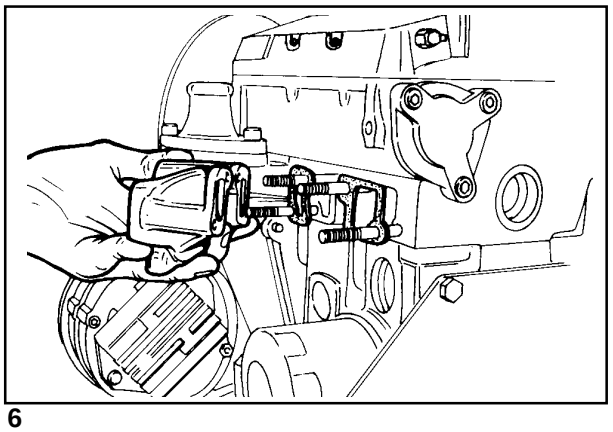
LGW 523 - LGW 627 Remote dry air filter

Configuration example of remote air filters for the two engines in question.
4 or 5 inch filtering elements can be used.

LGW 523: **1** Remote air filter (4 or 5 inches)
2 Clamp
3 Connection pipe from the carburetor cap to the air filter
4 Clamp
5 Carburetor cap

LGW 627: **1** Remote air filter (4 or 5 inches)
2 Clamp
3 Connection pipe from the intake manifold to the air filter
4 Clamp
5 Intake manifold
6 Bleed pipe from the intake manifold to the rocker cap

! When engines LGW 523 and LGW 627 are being mounted, remember that any variations to the exhaust system (type of exhaust silencer, length and diameters of the pipes that lead from the exhaust manifold to the silencer) will involve a variation to the carburation.
The carburation must be tested beforehand in the Lombardini test department. Failure of Lombardini to approve this type of modification shall relieve the same of all liability for deriving operating faults and any damage to which the engine may be subjected.



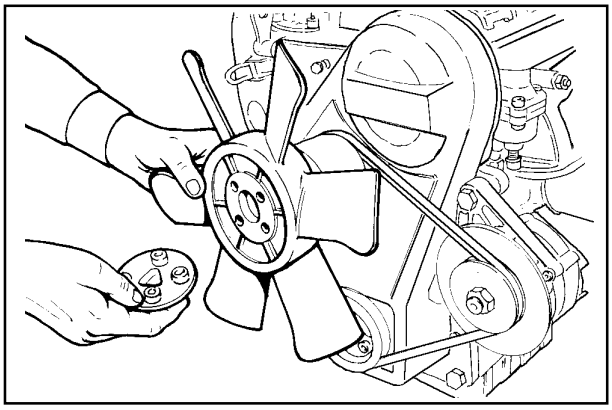
6

! Allow the exhaust manifold to cool before demounting it in order to prevent scorching and burns.

Exhaust manifold

When the exhaust manifold is demounted, make sure that the interior is perfectly clean and free from cracks or fractures.
Replace the seals whenever the manifold is remounted.
Torque the fixing nuts to 25 Nm when the parts are remounted.

COMPILER TECO/ATI	REG. CODE	MODEL N°	DATE OF ISSUE	REVISION 00	DATE	ENDORSED
	1-5302-509	50778	10.06.99		10.06.99	

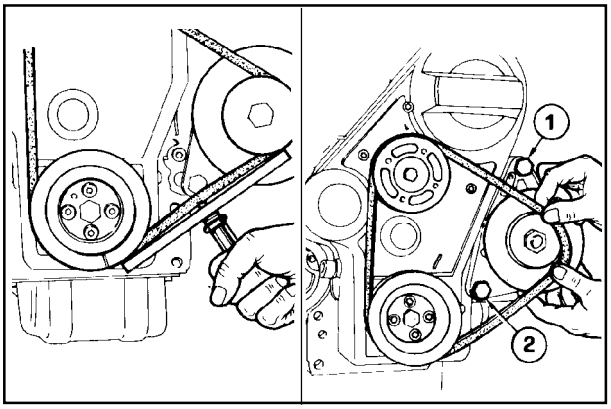


7

Before demounting the cooling fan, disconnect the positive battery cable to prevent accidental short-circuits which could consequently energize the starter motor.

Cooling fan

Thoroughly clean the cooling fan and make sure that all its blades are in a good condition. Replace the fan if even only one of its blades is damaged.

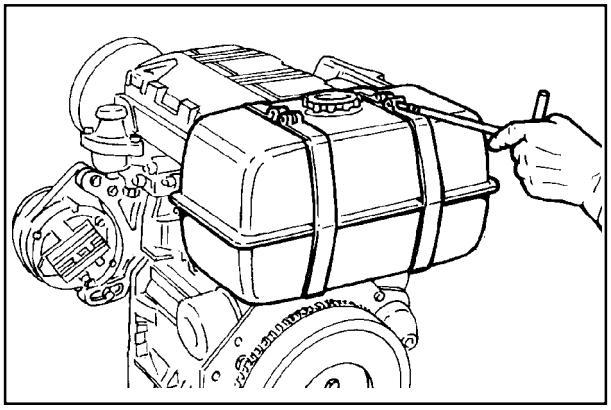


8 9

Only check the belt tension when the engine is at a standstill

Cooling fan and alternator belt

Tension adjustment.
Slacken off screws **1** and **2**.
Tighten the belt so that a 100 Nm load set in the center between the two pulleys will cause the belt to give 10 to 15 mm deflection.
Consult page 16 if the belt needs to be inspected or replaced.

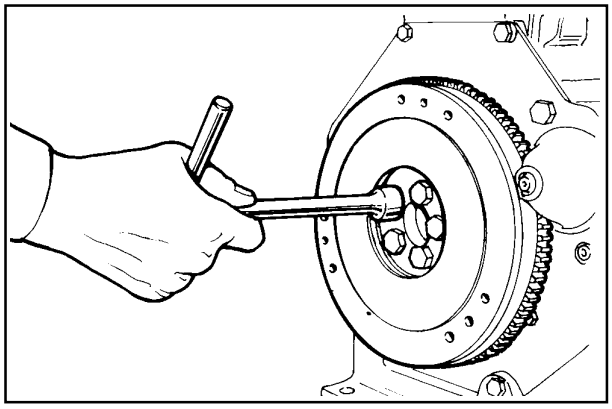


10

Do not smoke or use naked flames during the demounting operations as these could cause explosions or fire outbreaks.
Fuel fumes are highly toxic. Only carry out the operations outdoors or in a well ventilated place.
Keep your face well away from the filler cap or you could inhale harmful fumes. Dispose of fuel in the correct way as it is highly polluting. Do not litter.

Tank (on request)

Demount the fuel filter and then unscrew the screws from the fixing clamps.
Completely empty the tank and check inside to make sure there are no impurities.
Make sure that the filler cap venting hole is not clogged.

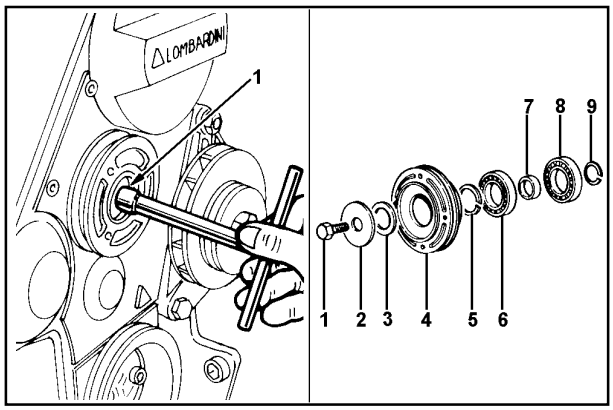


11

During the demounting phases, pay particular attention to prevent the flywheel from dropping as this could seriously injure the operator.
Wear protective goggles when removing the flywheel ring.

Flywheel

Slacken off the bolts that fix it to the crank shaft.
To remove the flywheel ring, it is advisable to cut it into several parts with an iron saw and to then use a chisel. When remounting, slowly heat the ring for 15 to 20 minutes until reaching a max. temperature of 300°C, then fit the ring in the flywheel housing. Make sure that it rests evenly against the rim in the housing itself.
Allow to slowly cool.
Remount and torque the fixing bolts to 80 Nm.



12 13

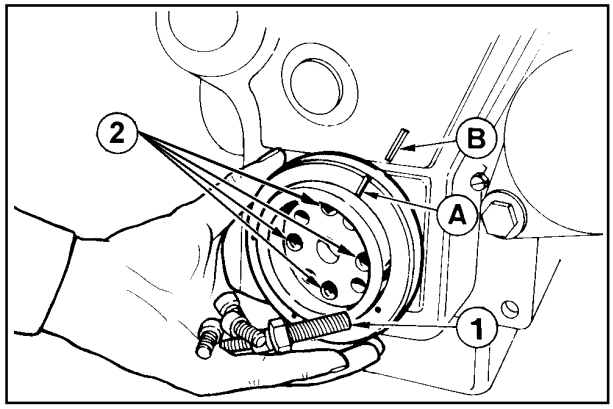
Transmission pulley

Remove the pulley by taking out screw **1** of fig. 12.

Components:

1 Screw
2 Washer
3 Centering bush
4 Pulley
5 Circlip
6 Ball bearing
7 Spacer
8 Ball bearing
9 Circlip

Note: To remount, thoroughly clean the thread of screw **1** and torque to 25 Nm.



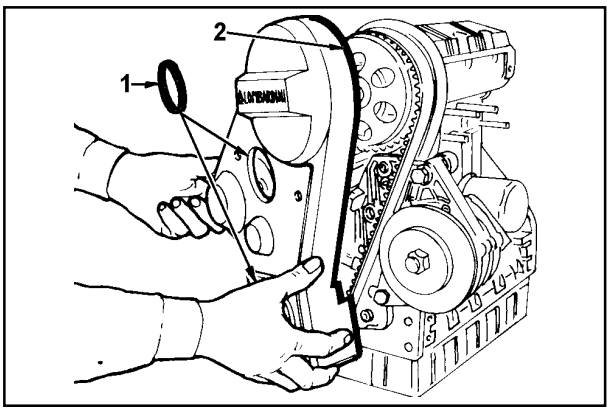
14

! Always lock the crank shaft and not the other engine components to loosen or tighten screw **1** to the required torque value.

Driving pulley

Lock the drive shaft in the following way: demount the starter motor and mount tool 7107-1460-051 in its place (see page 92).
To remove the pulley, slacken off the central screw **1** and proceed with the four side screws **2**.
The central screw **1** is unscrewed in a clockwise direction. When remounting, apply "Moly-slip" anti-seize to the screw thread and torque to 360 Nm.

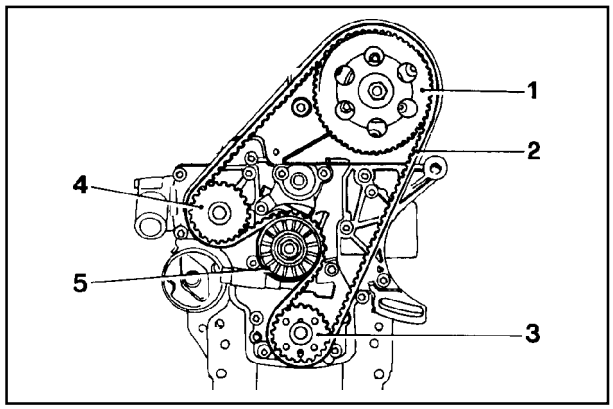
Note: When reference mark **A** coincides with **B**, the piston of the cylinder on the flywheel side (first cylinder) will be at top dead center (**TDC**).



15

Timing belt guard

Unscrew the five screws and remove the guard.
Torque the screws to 10 Nm when remounting.
Check the rubber seal **2** and the two dust seal rings of the two pulleys **1** if mounted.

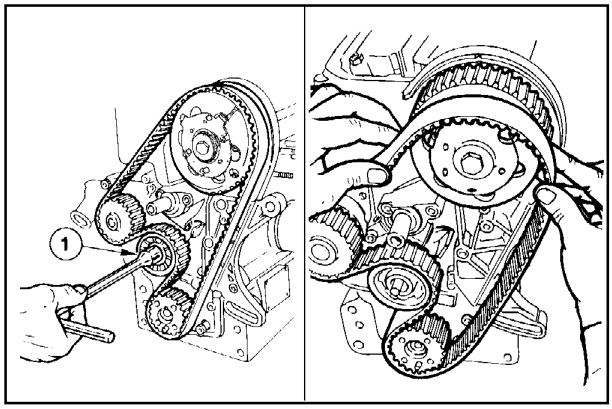


16

Timing belt and gears

Components:

1 Camshaft timing belt
2 Timing belt
3 Crank shaft timing pulley
4 Coolant fluid pump gear
5 Belt tightening guide pulley

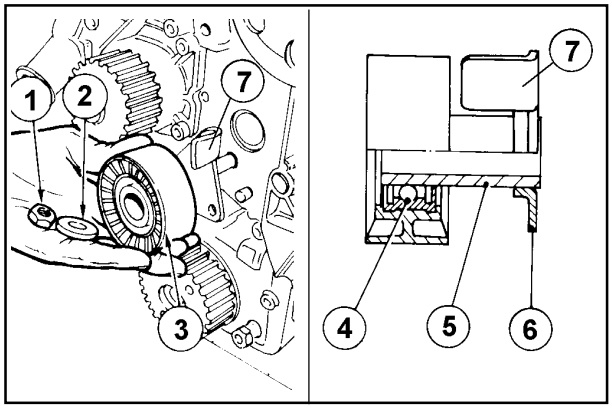


17 18

! If the timing belt is removed, it must be replaced even though it has not terminated its forecast period of use.
Always make sure that the battery + is well disconnected.

Removing the timing belt

Unscrew the screw of the tightening pulley **1** and remove the belt by pulling it from the timing pulley on the camshaft.
Consult page 16 for the frequency with which the belt must be replaced.
Consult page 16 when remounting.



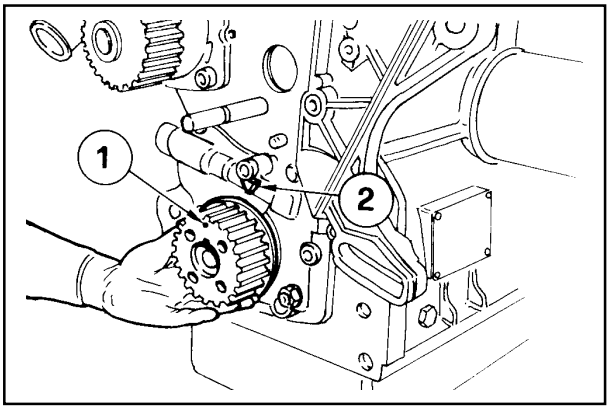
19 20

Belt tightening guide pulley

Components:

1 Nut
2 Washer
3 Belt guide pulley
4 Ball bearing
5 Shaft
6 Bearing plate
7 Timing belt tightening lever.

Torque nut **1** to 40 Nm when remounting.

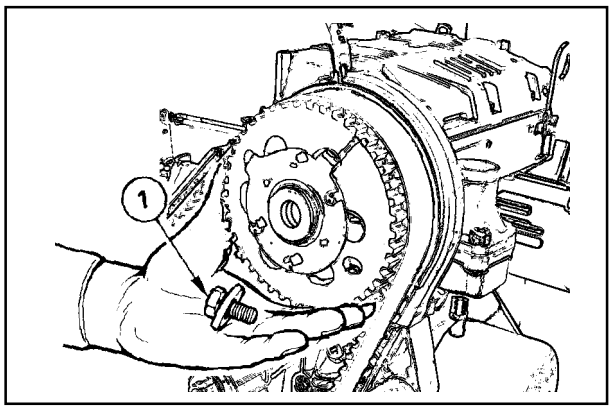


21

Pulley on crank shaft

Make sure that the key remains in its housing when remounting.

Note: reference mark **1** on the timing pulley and reference mark **2** on the oil pump casing are used to tune the timing system. When the two reference marks are aligned, the piston of the cylinder on the flywheel side (first cylinder) will be at top dead center.
A puller is not required for demounting.

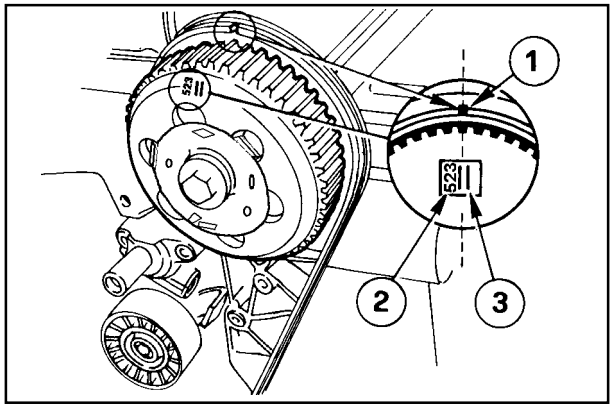


22

Timing pulley - Disassembly/Reassembly

Unscrew screw **1** and remove the timing pulley. A puller is not required.
Torque the screw to 80 Nm when remounting.

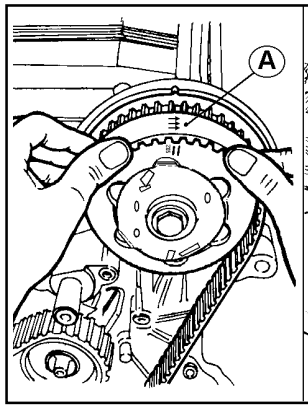
Note: Check for possible wear caused by the lip of the retention ring on the pulley hub.



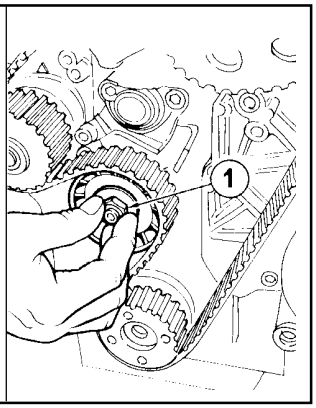
23

Timing pulley - Timing system tuning reference marks

1 Timing system tuning reference mark for LGW 523 and LGW 627
2 Timing system tuning reference mark for LGW 523
3 Timing system tuning reference mark for LGW 627.



24

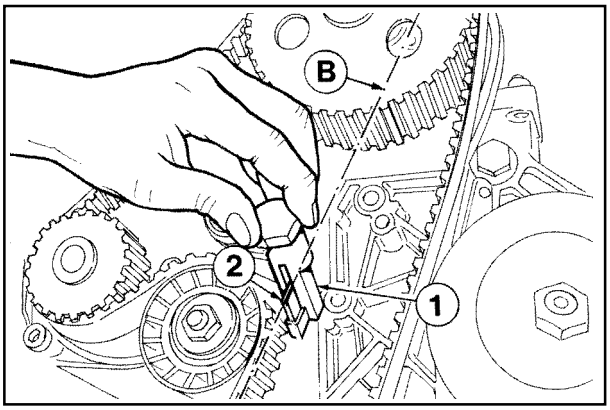


25

! Only remove the timing belt from its protective casing just before assembly.

Tuning the timing system - Refitting the timing belt

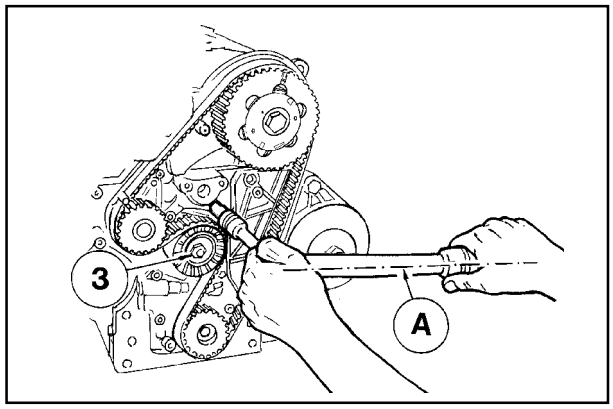
Match the reference marks on both the timing pulley fig. 23 and driving pulley fig. 21.
Insert the timing belt as shown in fig. 24, complying with the direction shown by arrows **A** on it. The arrows must indicate the rotation direction (clockwise) as viewed from the timing system side.
Tighten nut **1** by hand until the belt tightener rests on the surface of the engine block.
Belt remounting must begin with the camshaft pulley and then pass to that of the drive shaft, not the driven shafts.



26

Tuning the timing system - Belt tightening tool

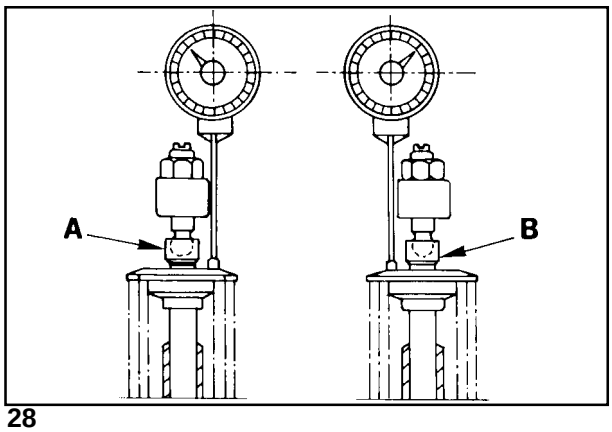
Fit tool **1** Serial N° 7107-1460-049 (see page 92) into lever **2**.



27

Tuning the timing system - Tightening the timing belt and belt tightener torque

Fit the torque wrench into the above mentioned tool so that axis **A** of the wrench fig. 27 is 90° to axis **B** of the tool in fig. 26.
Torque to 20 Nm in a clockwise direction. Maintaining the belt tightened in these conditions, torque nut **3** to 40 Nm with another torque wrench.
After having remounted the single-race pulley, turn the crank shaft a few turns and make sure that the obtained belt tension is as described above.
A further belt tension test can be conducted with a special tension gauge available on the market (type ND DENSE).
Belt tension must be 15 ± 2 Kgm.

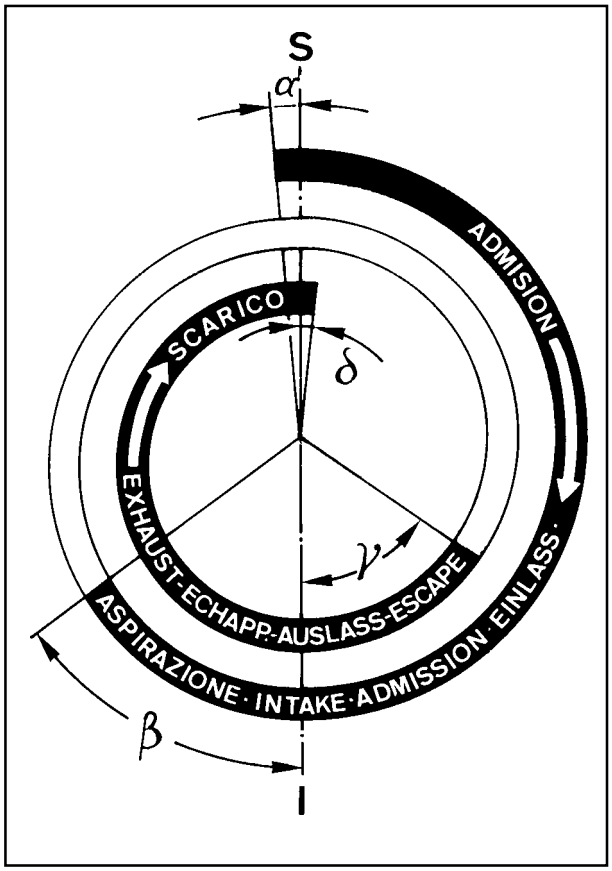


28

Tuning the timing system - Inspection

A = Intake valve
B = Exhaust valve

Move piston N° 1 (the one on the flywheel side) to top dead center. Make sure that intake and exhaust valves **A** and **B** are balanced by setting the touch probes of the two dial gauges on the valve caps.



29

Tuning the timing system - Angles
The values of the angles can be identified by turning the crank shaft in a clockwise direction (viewed from timing system side).

S = Piston at top dead center
I = Piston at bottom dead center
a = Intake valve opening
b = Intake valve closing
g = Exhaust valve opening
d = Exhaust valve closing

Operative timing system tuning angles (valve clearance = 0.26 mm) for LGW 523

a = 38° before S
b = 58° after I
g = 70° before I
d = 26° after S

Tuning angles to check the timing system (valve clearance = 2 mm) for LGW 523

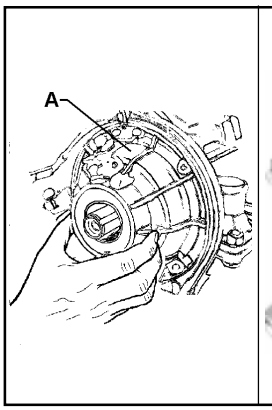
a = opens 2° after **S**
b = closes 18° after **I**
g = opens 30° before **I**
d = closes 14° before **S**

Operative timing system tuning angles (valve clearance = 0.26 mm) for LGW 627

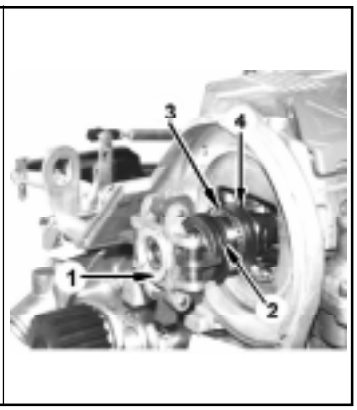
a = 18° before S
b = 62° after I
g = 52° before I
d = 28° after S

Tuning angles to check the timing system (valve clearance = 2 mm) for LGW 627

a = opens 22° after **S**
b = closes 22° after **I**
g = opens 12° before **I**
d = closes 12° before **S**



30



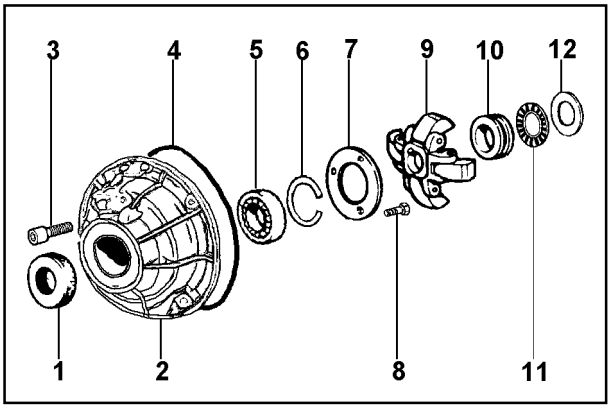
31

LGW 627 speed governor

the speed governor is a mechanical type with centrifugal weights.
It is installed behind aluminium support **A** fig. 30 and is driven directly by the camshaft.

Components:

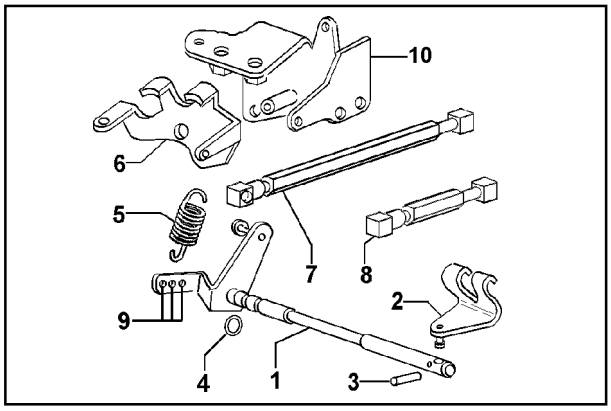
1 Support with 4 weights
2 Sliding sleeve
3 Axial needle bearing
4 Thrust plate



32

LGW 627 speed governor components

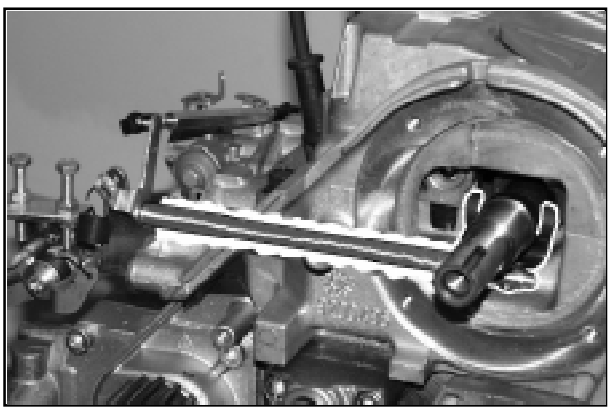
1 Oil retainer ring
2 Support
3 Screw
4 O-Ring
5 Ball bearing
6 Circlip
7 Flat ring
8 Screw
9 Support with 4 weights
10 Sliding sleeve
11 Axial needle bearing
12 Thrust plate



33

LGW 627 speed governor levers

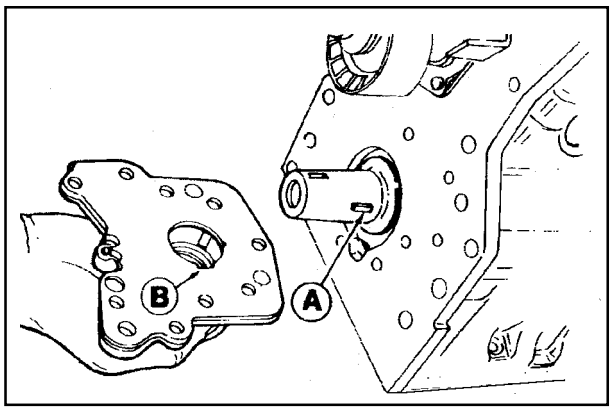
1 Governor control rod
2 Governor fork lever
3 Pin
4 O-Ring
5 Governor spring
6 Accelerator lever
7 Accelerator rod
8 Intermediate rod
9 Governor spring holes (the various holes are used to modify the speed drop with the same spring)
10 Accelerator support bracket



34

! When remounting, make sure that all components are in a good condition and perfectly functional.
A badly operating speed governor can seriously damage the engine and any bystanders in the vicinity.

Remounting the LGW 627 speed governor
Fit all parts in place by reversing the order shown in fig. 32.
When the governor support is inserted into the camshaft, make sure that the four weights enter in an open position so that they can take up the sleeve and close on top of it.
To tune the speed governor with the carburetor, remember that carburetor throttles (gas valves) fully open - governor weights all closed.
Make sure that the O-Ring of the support and the oil retainer ring are in a good condition. Torque the three screws to 10 Nm.
Note: When the speed governor is mounted, camshaft float must be nil.

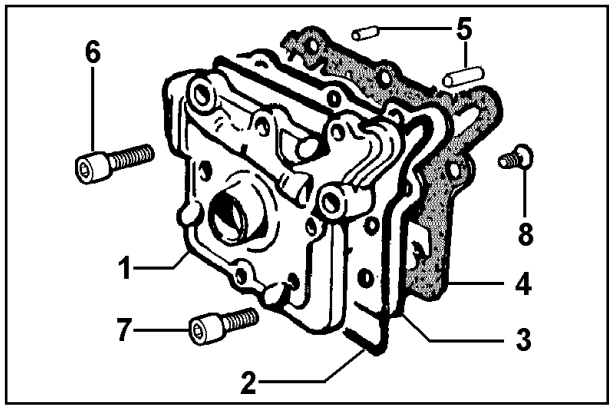


35

Old engine oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time. If contact with the oil is unavoidable, you are advised to wash your hands with soap and water as soon as possible.
Dispose of old oil in the correct way as it is highly polluting. Donot litter.

Demounting the oil pump

The oil pump is tested before and after assembly. Do not open it unless you are sure that it is faulty.
To demount the pump, first remove the fixing bolts from the engine block and set the piston of cylinder N° 1 (flywheel side) to top dead center.
These conditions allow key **A** to pass through cavity **B**.

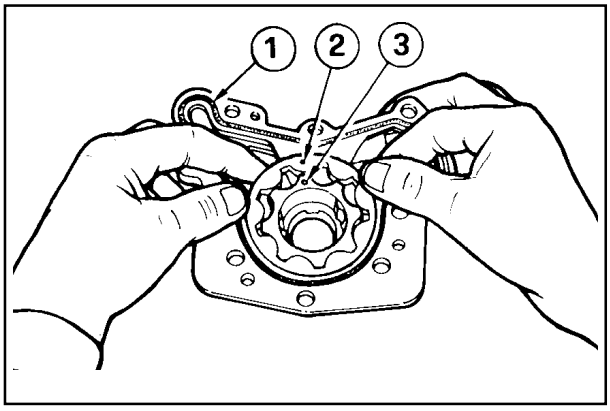


35a

Oil pump

Details and components:

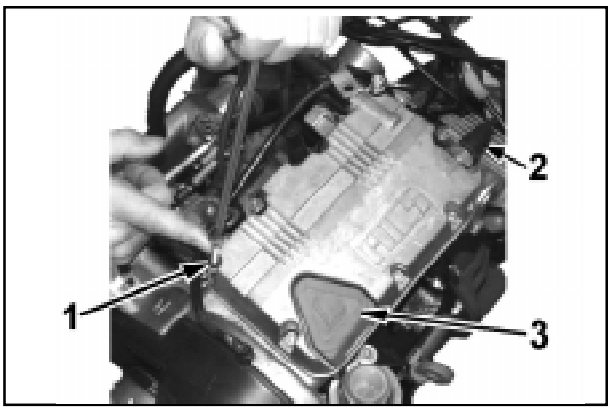
1 Outer casing of oil pump (in aluminium)
2 O-Ring
3 Oil pump cover (in steel)
4 Gasket between oil pump and engine block
5 Centering pins
6 Bolt to fix oil pump to engine block
7 Bolts to fix oil pump to engine block
8 Countersunk screw to fix pump cover to pump casing



36

Remounting the oil pump

The pump lobes should be coupled from the same side. See reference marks **2** and **3**.
Replace ring **1**.
Tighten the fastening bolts to the engine block with a 25 Nm torque.
Fixing bolt **6** (see fig. 35a) is different in length from the others and should be tightened to a 20 Nm torque.
The oil pump specifications are shown in figs. 114-115-116.



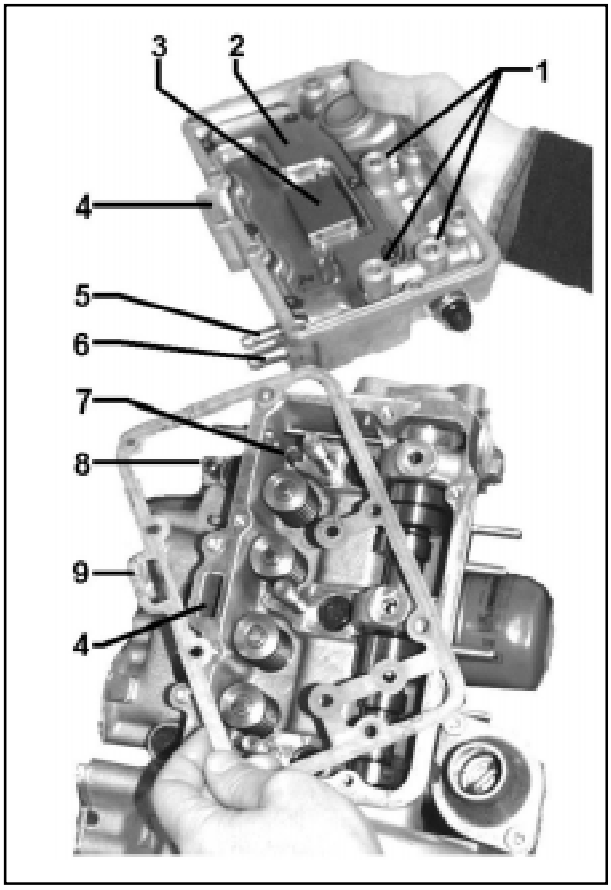
37

LGW 627 rocker cap

Many of the more important engine components are on the cylinder head.
The rocker cover houses part of the camshaft lubrication duct, that of the rockers and part of the engine bleeding system.

External parts of the rocker cover:

1 Screw to fix the rocker cover to the cylinder head
2 Pressure switch (the only point where the engine oil pressure can be gauged)
3 Oil fill plug
Tighten the fixing bolts to a 9 Nm torque when remounting the cover.



38

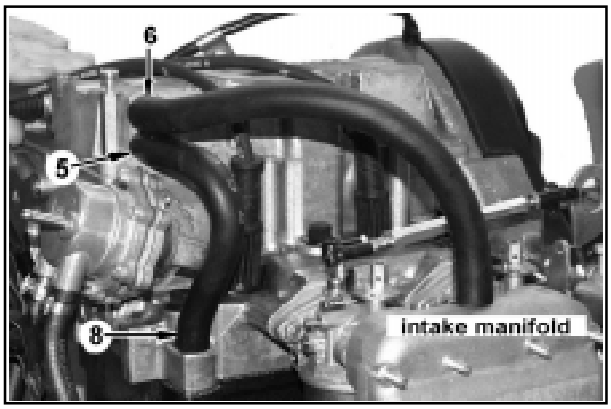
Rocker cover and recirculated oil vapour bleeding system for engine LGW 627

Internal parts of the rocker cover:

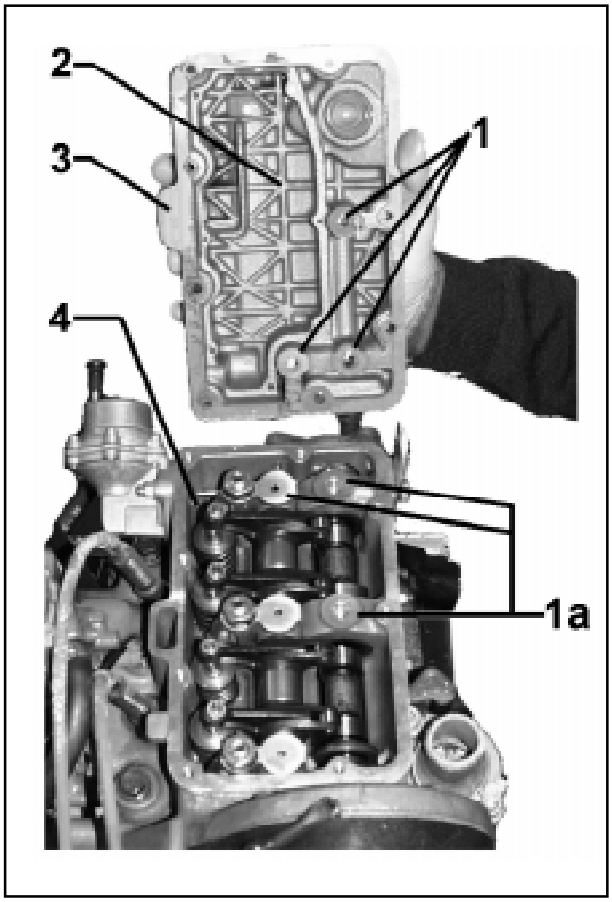
1 Camshaft and rocker rod lubrication ducts
2 Oil vapour cooling labyrinth
3 Vent vacuum valve
4 Space allowing oil vapour to pass from the cylinder head to the rocker cover
5 Outlet for vapour re-converted into oil by cooling in the labyrinth with consequent return to the sump
6 Outlet to vent oil vapours from the duct to the intake manifold
7 Hole to drain oil from the cylinder head
8 Oil return from bleed to sump (see description in point **5**)
9 Seal between rocker cover and cylinder head

The rocker cover seal ensures that the rocker pivot camshaft lubrication circuit is tight. It is therefore advisable to replace it whenever it is demounted and to remount it with particular care.
Damage or breakage of the seal could lead to a pressure drop in the lubrication circuit.
Torque the fixing screws to 9 Nm when remounting the cover.

By physical principle, oil vapours reach the cylinder head from the top part of the engine through hole **4** fig. 38.
The moment in which the vapours approach the cover inlet, they are attracted by the vacuum created in the intake manifold (with the aid of valve **3** of fig. 38) with which the cover is in communication (from **6** to **intake manifold** see fig. 39).
To prevent excessive amounts of oil from reaching the manifold along with the vapour in certain extreme conditions (e.g. lack of filter maintenance, wear on the cylinders, etc.), the venting system has been designed to decant the drops of oil during its passage through labyrinth **2** of fig. 38 and to allow them to return to the sump along the route (**5** --> **8** of fig. 39).
Vapour that is not re-converted into oil enters intake manifold **6** of fig. 39.



39



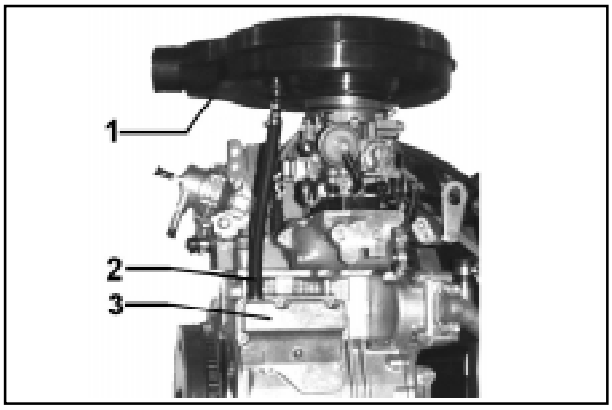
40

LGW 523 rocker cover

Components :

1 Camshaft and rocker rod lubrication ducts
1a Camshaft and rocker rod lubrication routes
2 Rocker cover without labyrinth for oil vapour
3 Seal for rocker cover without hole for oil vapour access
4 Hole to drain oil from the cylinder head

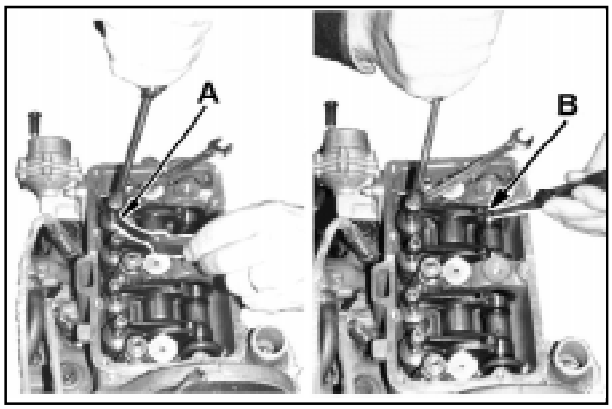
The rocker cover seal ensures that the rocker pivot camshaft lubrication circuit is tight. It is therefore advisable to replace it whenever it is demounted and to remount it with particular care.
Damage or breakage of the seal could lead to a pressure drop in the lubrication circuit.
Torque the fixing screws to 9 Nm when remounting the cover.



41

LGW 523 bleed

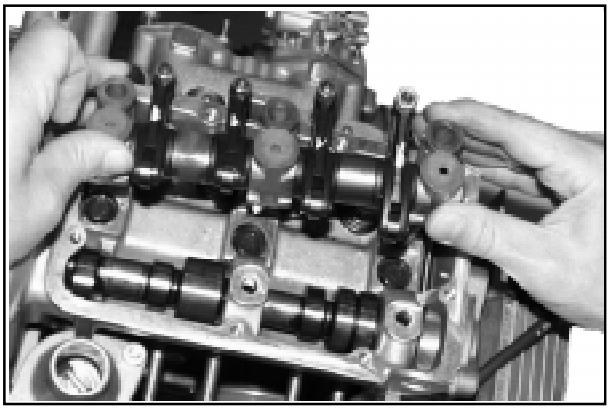
The operating principle of the bleeding system for engine LGW 523 is similar to that of engine LGW 627.
Vapour and oil are no longer recovered in the rocker cover but in the engine block (cover **3**).
The oil vapour reaches air filter casing **1** through pipe **2**



42

LGW 523 - LGW 627 valve/rocker clearance

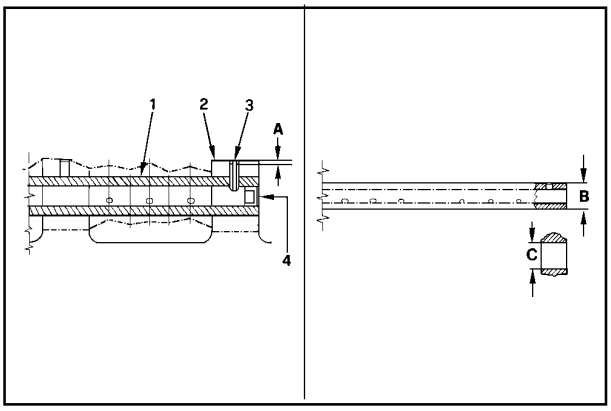
Adjust when the engine is cold: set the pistons of each cylinder to compression top dead center and adjust the clearance in position **A** to 0.20 mm for both the intake and exhaust valves.
For greater convenience, clearance adjustment is also accepted in position **B**; in this case, the value is 0.15 mm.



43

Rocker shaft

Unscrew the nuts from the supports that fix the rocker shaft to the cylinder head. Tighten them to a 40 Nm torque when they are remounted.
The shaft is hollow inside to allow for lubrication and is closed at both ends by two plugs.



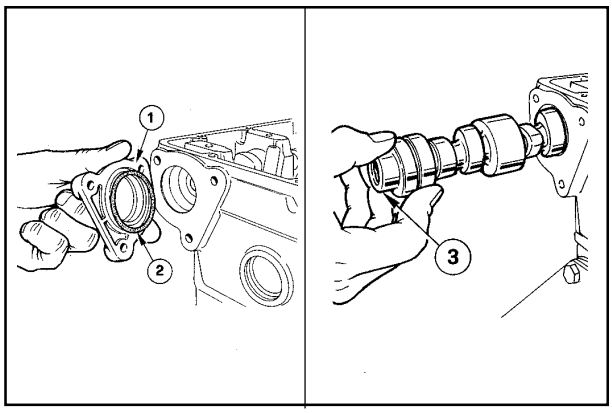
44 45

Rocker shaft, demounting and refitting

To take the shaft **1** from the support **2**, remove pin **3** by drilling it with a 4 mm bit.
On remounting, insert a new pin and recess it in relation to the surface of support **A** (0 to 1 mm).
Check the shaft (diam. **B**) and rocker holes (diam. **C**) for wear.
Remove the closing plugs **4** from the ends and thoroughly clean inside.

Dimensions (mm):

A = 0 to 1.00
B = 17.989 to 18.000
C = 18.015 to 18.030
(**C-B**) = 0.015 to 0.041 (**C-B**) wear limit = 0.090

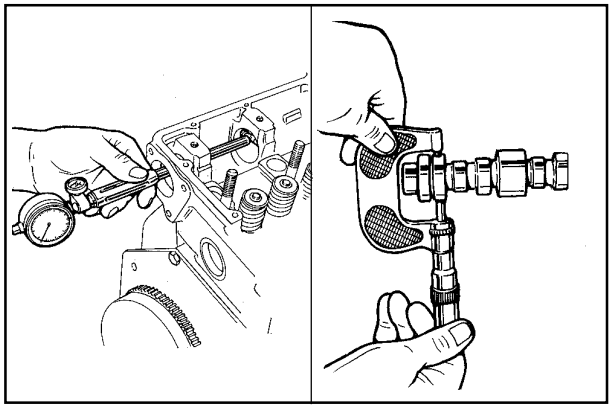


46 47

Camshaft, demounting

Before removing the camshaft, demount the rocker shaft as indicated in fig. 43
Slacken off the screws and remove the cover **1**.
Make sure that the retention ring **2** is in a perfect condition.
Remove the rod from the fuel pump.
Remove the camshaft by pulling and turning, paying particular attention since the cam turns directly on the cylinder block without the aid of bushes.

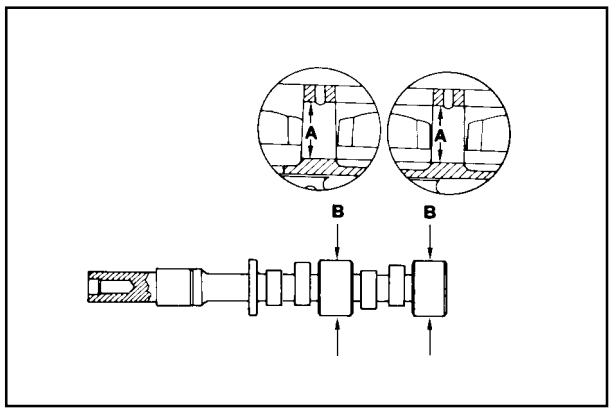
Note: The eccentric that controls the fuel pump **3** is not an intengral part of the camshaft, but is faced on to it and fixed with a bolt. Tighten the screw on the eccentric to an 80 Nm torque in case of replacement.



48 49

Camshaft, inspection of pin diameters and housings

Measure the diameters of the housings with a internal comparator and the camshaft journals with an externalmicrometer.

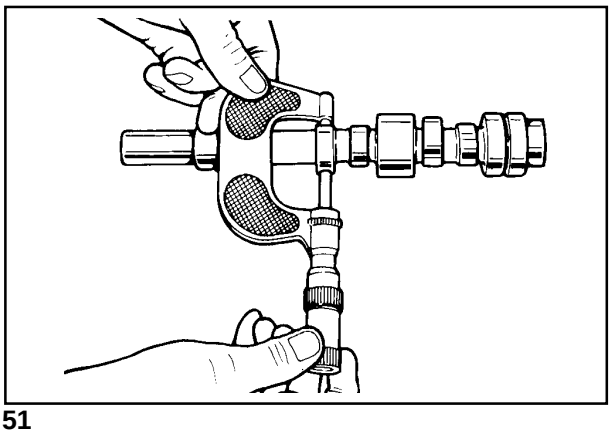


50

Camshaft and housings, pin dimensions (mm)

A = 37.035 to 37.060
B = 36.975 to 37.000
(**A-B**) = 0.035 to 0.085 (**A-B**) wear limit = 0.170

Note: The diameters of the camshaft journals and the relative housings are not the same for all engines in the LGA 523-627 series.



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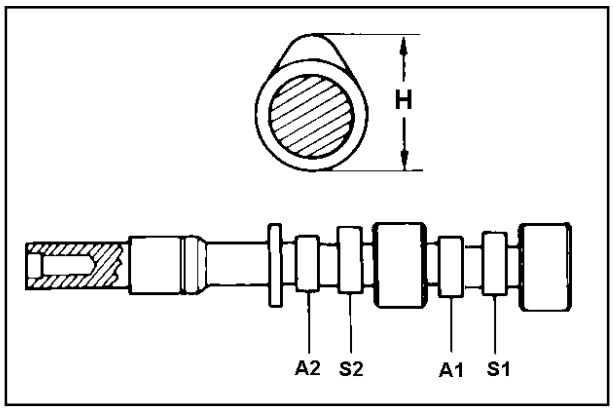
Cam height inspection

Use a micrometer for exteriors.



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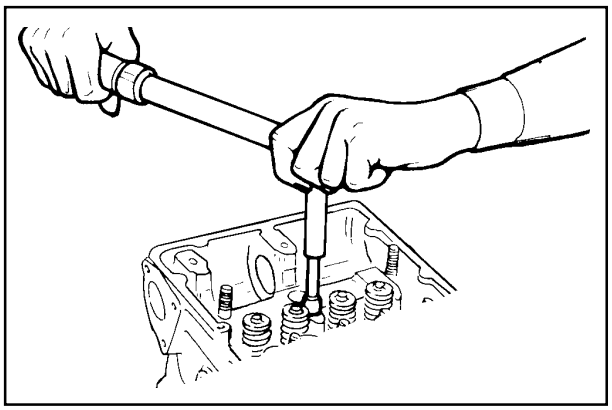
Intake, exhaust cam height

LGW 523
A1 = 1st cylinder intake
S1 = 1st cylinder exhaust
A2 = 2nd cylinder intake
S2 = 2nd cylinder exhaust
H = 30.78 to 30.718 mm (intake and exhaust cam height)

LGW 627
A1 = 1st cylinder intake
S1 = 1st cylinder exhaust
A2 = 2nd cylinder intake
S2 = 2nd cylinder exhaust
H = 30.64 to 30.578 mm (intake and exhaust cam height)

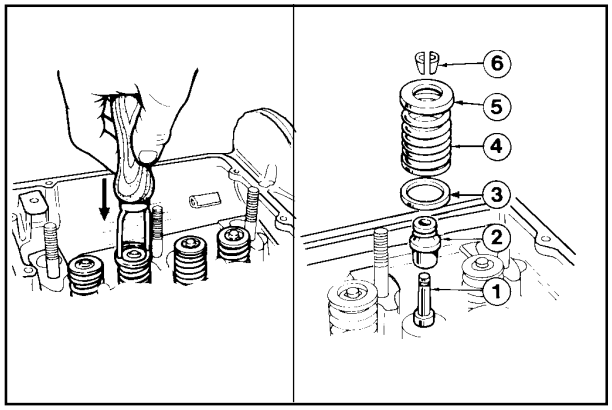


53

! Do not demount or remount while hot as this could lead to deformations.

CYLINDER HEAD, removal

If deformation exceeding 0.10 mm is gauged on the cylinder head surface, level off by grinding, removing 0.20 mm at most. Consult fig. 82 when tightening the head.



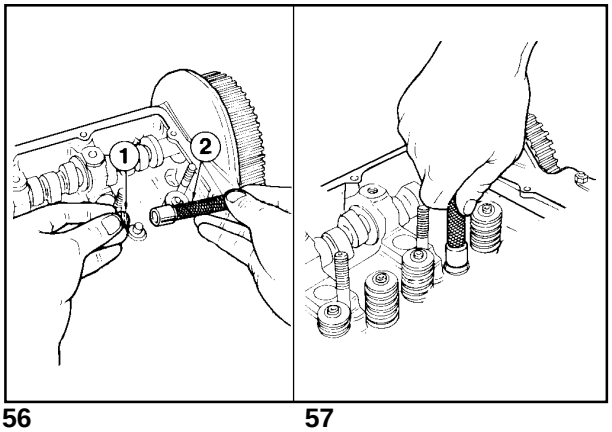
54

55

Valves

To remove the valves, first take out the cotters. Place a shim under the valve mushroom, strongly press on the upper spring plate as shown in the figure.

Components:
1 Valve stem
2 Oil retainer seal
3 Lower spring ring
4 Spring
5 Upper spring ring
6 Cotters



56

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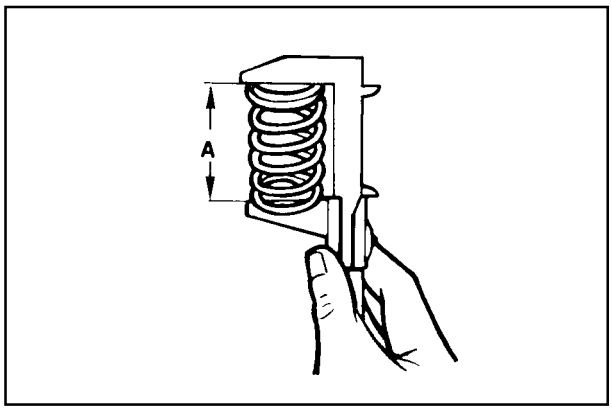
Oil retainer seal in valve guide, removal

To prevent seal **1** from being deformed when the valve guide is mounted, fit it into tool **2** (serial N° 7107-1460-047 on page 92) and proceed as shown in the figure, making sure that the seal **1** is fully inserted.



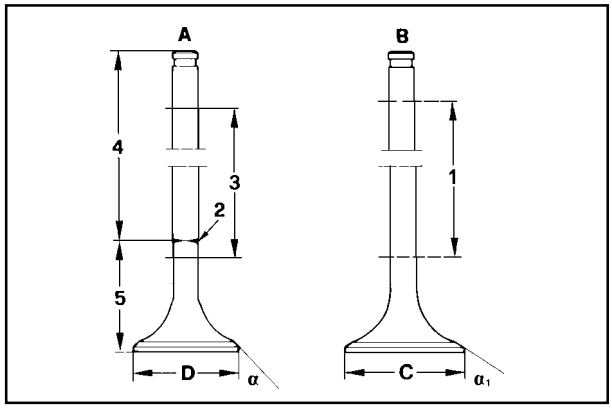
58

Valve springs

Measure the free length with a gauge.

For LGW 523 - Free length **A** = 39.8 mm.
Replace the spring if the length value is less than 37.3 mm.

For LGW 627 - Free length **A** = 45.6 mm
Replace the spring if the length value is less than 43.1 mm.



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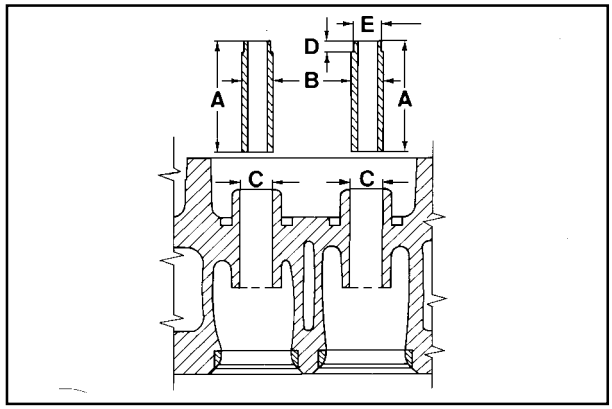
Valves, specifications

Exhaust valve **A** - Stem and mushroom are made of two different materials.
2 Welded section
3 Chromium plated section
4 Section of material: X 45 Cr Si 8 UNI 3992
a = 45°30' to 45°45'
D = 29.00 mm

Intake valve B - Material: X 45 Cr Si 8 UNI 3992
1 = Chromium plated section
a1 = 60°30' to 60°45'
C = 33.00 mm

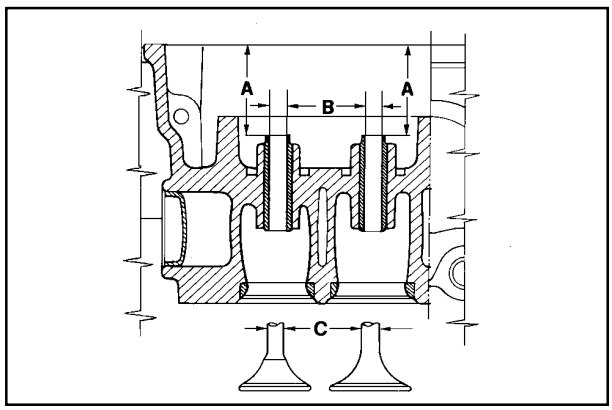


60

Valve guides and housings

The intake and exhaust guides are both made of grey iron of phosphorous pearlitic matrix and are dimensionally the same:
Dimensions (mm):
A = 36.4 to 36.6
B = 11.045 to 11.054
C = 11.000 to 11.018
D = 5.80 to 6.20
E = 9.75 to 9.85

Note: Since they are pre-finished, the guides must no longer be machined after they have been inserted.
There are also valve guides with outer diameters **B** increased by 0.5 mm.



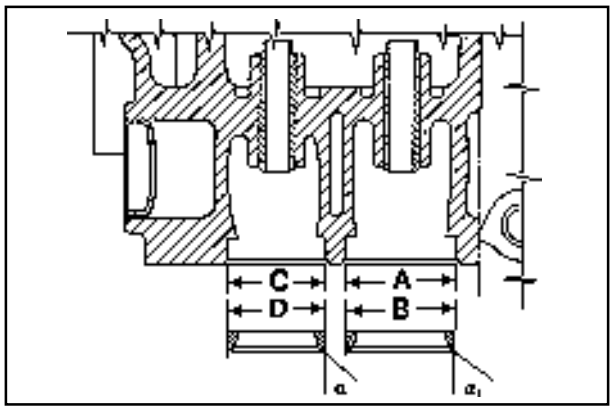
61

Valve guides, assembly

Insert the guides with a punch, taking value **A** into account, in relation to the head surface.

Dimensions (mm):
A = 39.5 to 40.0
B = 7.005 to 7.020
C = 6.960 to 6.990

Play (mm):
(**B-C**) = 0.015 to 0.050 (**B- C**) wear limit = 0.10

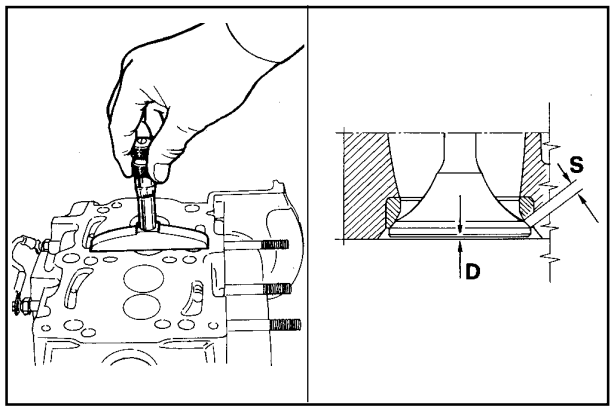


62

Valve seats and housings

Dimensions (mm)
A = 34.020 to 34.045
B = 34.106 to 34.115
C = 30.020 to 30.041
D = 30.108 to 30.116
a = 44°53' to 45°
a1 = 59°53' to 60°
Insert the seats in their housings

Note: Since they are pre-finished, the seats must no longer be machined after insertion.



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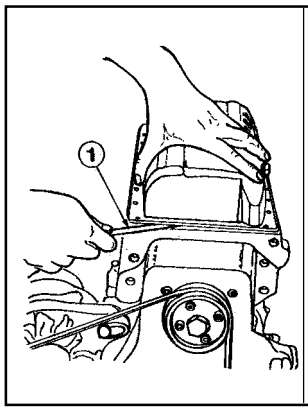
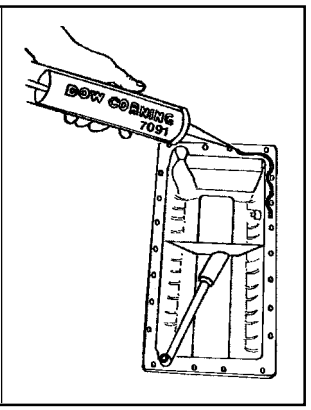
Valve recessing and width of housing seal.

Dimensions (mm)
D = 0.5 to 0.8 **D** (wear limit) = 1.1
S = 1.6 to 1.7 **S** (wear limit) = 2.0

Grind the valves in their seats with fine emery paste.
After grinding, check the recess of valves **D** in relation to the head surface and the retention width of seat **S**.



65



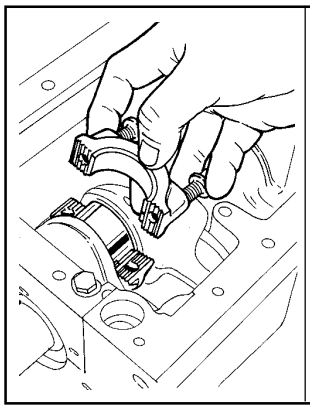
66

Old engine oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time. If contact with the oil is unavoidable, you are advised to wash your hands with soap and water as soon as possible.
Dispose of old oil in the correct way as it is highly polluting. Do not litter.

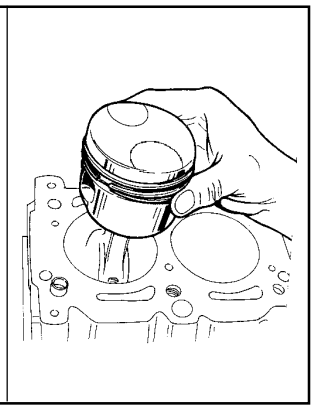
Oil sump, removal

Remove the fixing screws.
Insert blade **1** into the front and rear main bearing zone to detach the sump from the engine block.
Remove the silicone from the main bearing seals.
Apply silicone of the **" Dow Corning 7091"** type when remounting, as shown in the figure.
Tighten the fixing bolts to a 10 Nm torque.

Before starting the engine, make sure that:
1) the oil drain plug on the sump has been tightened in the correct way
2) that the right quantity of oil has been added (see pages 13 and 17).



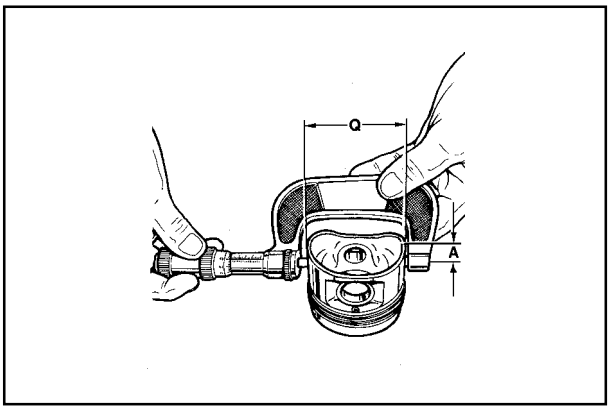
67



68

Piston

Remove the big-end cap.
Remove the piston connecting-rod assembly.

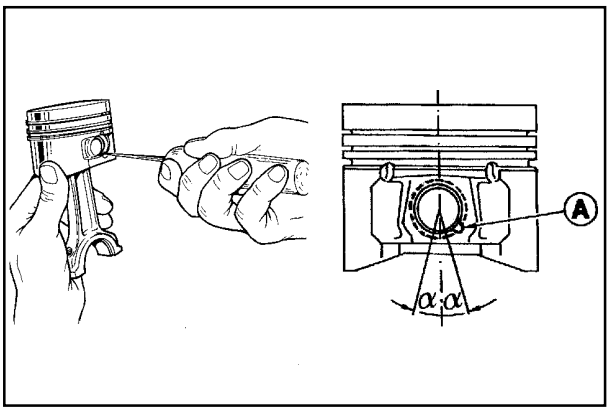


69

Piston, demounting and inspection

Remove the circlips and take out the pin, see fig. 77.
Take out the piston rings and clean the slots.
Measure diameter **Q** at dimension **A** from the base of the skirt (**A** = 9 mm).
Replace the piston and piston rings if wear on the diameter exceeds the minimum given value by more than 0.05 mm.

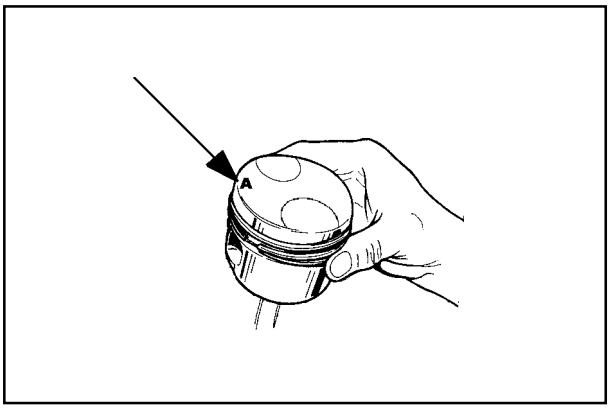
Note: The forecast allowances are 0.50 and 1.00 mm.



70

Demounting and remounting the pin stop rings

Remove the circlip by inserting a pointed tool into slot **A**.
When remounting, insert the circlips with their tips pointing downwards within the angles (**a = 15°**).

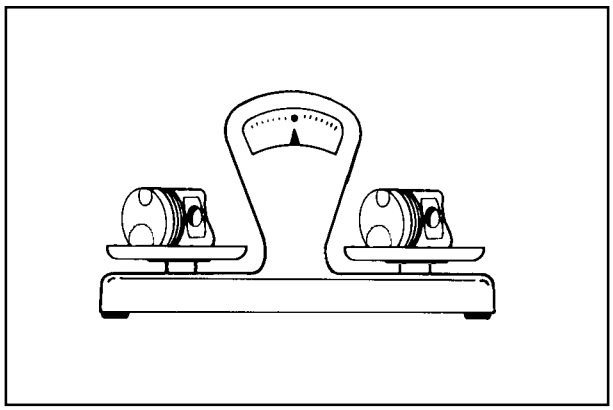


71

Piston, class and logotype
Depending on their diametral values, the pistons are divided into classes: **A**, **B**, **C**. This reference is marked on the crown of the piston, see fig. 71.
The logotype is marked inside the piston.
Dimensions (mm)

Classes	cylinder Ø	piston Ø	play
A	71.990 to 72.000	71.930 to 71.940	0.05 to 0.07
B	72.000 to 72.010	71.940 to 71.950	
C	72.010 to 72.020	71.950 to 71.960	

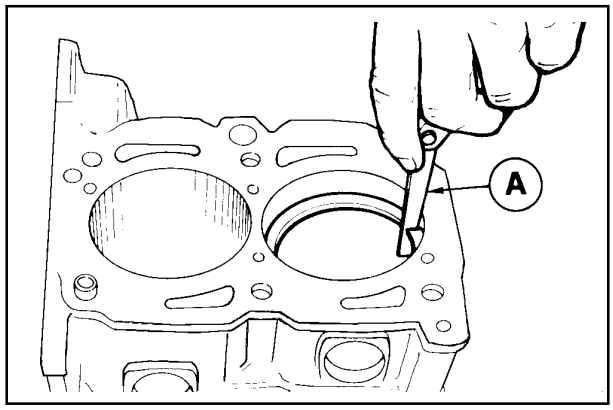
Piston supply:
Pistons with nominal value diameters are only supplied in class **A**. Pistons oversized by 0.50 and 1.00 mm are supplied with a size reference Ø = 72.5 and Ø = 73 on the crown.



72

Pistons, weight

To prevent imbalance, the pistons must be weighed before they are replaced.
The difference in weight must not exceed 4 g.

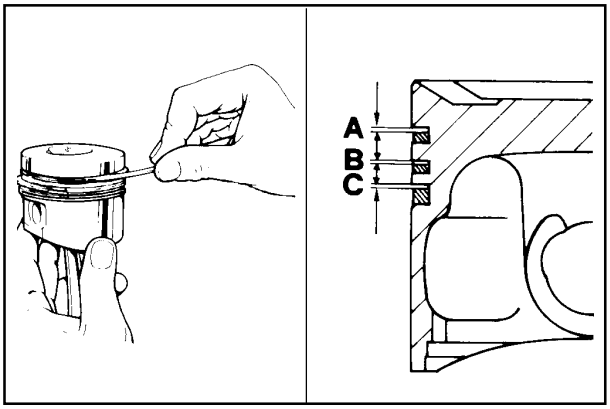


73

Piston rings - Distance between the tips

Fit each piston ring into the cylinder and measure the distance between tips **A** in the operating zone.

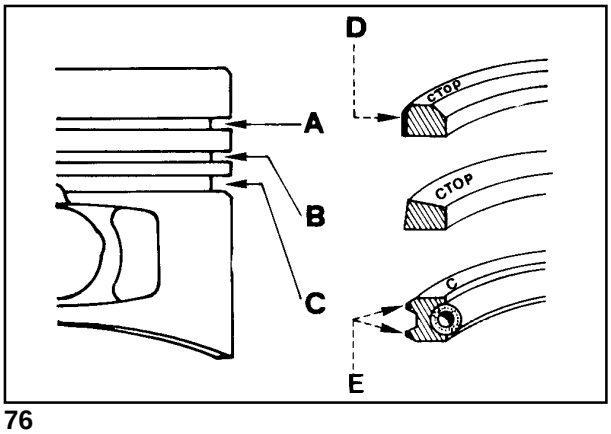
1st piston ring **A** = 0.20 to 0.40 wear limit = 1.0
2nd piston ring **A** = 0.20 to 0.40 wear limit = 1.0
3rd piston ring **A** = 0.20 to 0.45 wear limit = 1.0



74 75

Piston rings, play between slots (mm)

A = 0.030 to 0.050
B = 0.020 to 0.040
C = 0.010 to 0.030



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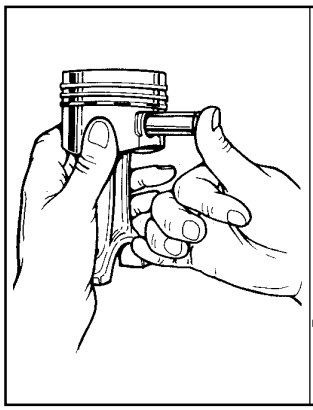
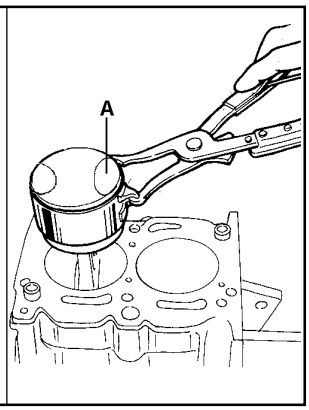
Piston rings, assembly order

A = 1st piston ring (tapering and torsional interior)
B = 2nd piston ring (tapering interior)
C = 3rd oil scraper piston ring
D = Chromium plated zone
E = Chromium plated zone

Note: If there is a caption on the surface of a piston ring, that surface should be mounted pointing upwards.



77

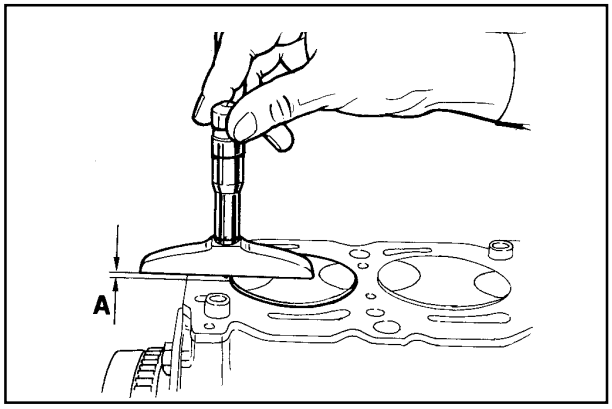


78

! Lubricate the following parts with oil before mounting: the piston pin, the piston, the cylinder and the big-end bearing

Piston, refitting

Couple the piston to the connecting-rod by inserting the pin (after it has been lubricated) and simply pressing with the thumb.
Fit in the two circlips that hold the pin in place and make sure that they are well housed in their seats; also see fig. 70.
Using a piston ring clamp, fit the piston into the cylinder so that the intake valve impression (larger than the exhaust one) on the crown is pointing towards timing system side **A**.
Couple the piston/connecting-rod unit to the crank shaft: consult fig. 83 for the head/connecting-rod torque value.



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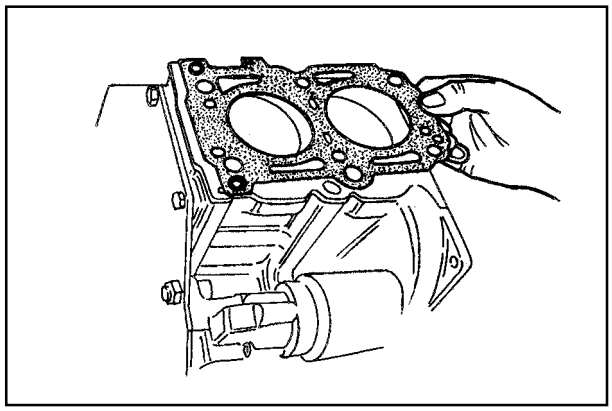
Piston protrusion test

Establish value A of each piston by checking in four different diagonally opposite points of the piston crown, then make sure that the protrusion does not exceed the following values: 0.95 to 1.27.
Series LGW 523-627 has a head gasket with a single thickness measurement (1.65 mm). This means that the clearance can be 0.38 min. to 0.70 max..



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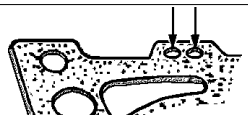
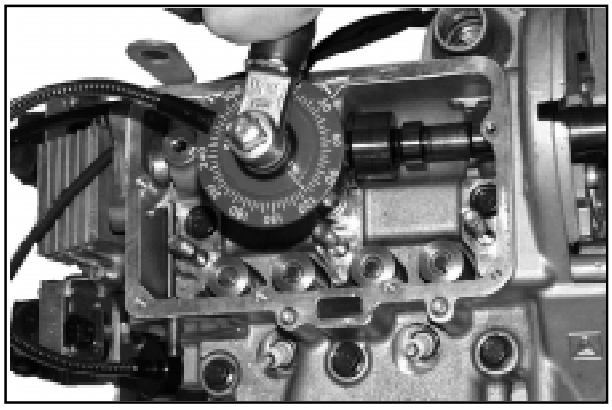
! Only remove the head gasket from its protective wrapping just before assembly

Head gasket

Measured piston protrusion	Gasket thickness	Clearance
0.95 to 1.27	1.65	0.38 min 0.38 max



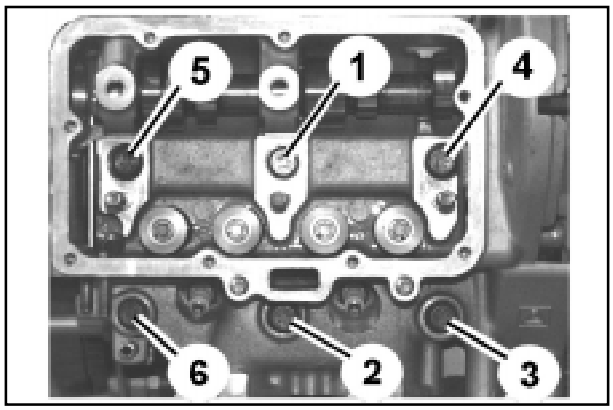


81

! The head must not be re-torqued after the running test.

Head torquing

Use a torque wrench with an angular torquing tool, see fig. 81.
Measure the length of each bolt (initial free length = 89.5 to 90.5 mm). Replace it if it exceeds 92 mm.
Lubricate with low viscosity engine oil.



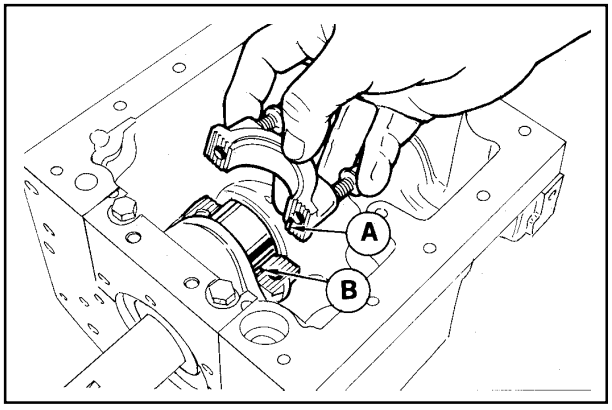
82

! Once the head has been correctly torqued, it will not need re-torquing unless it is disassembled again.
Before mounting, it is advisable to lubricate the bolt shanks and under their heads with SPARTAN SAE 460 oil.

LGW 523-627 head torquing phases

The bolts must be torqued in three phases, in compliance with the numeric order shown in fig. 82:

1st phase = 50 Nm
2nd phase = Turn the torque wrench through 90° in a clockwise direction.
3rd phase = Continue by turning the torque wrench through 90° in a clockwise direction.



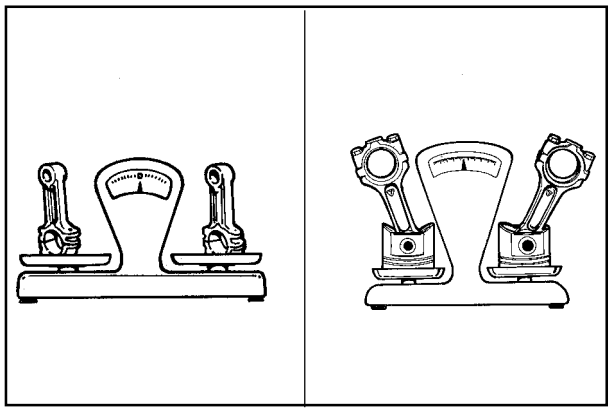
83

! When remounting the big-end bearings, remember to thoroughly clean the parts and generously lubricate them to prevent seizure when the engine is started up for the first time

Connecting rod (Big-end bearing)

After having uncoupled the connecting-rod from the crank shaft in order to make the necessary inspections, make sure when remounting that the two centering marks **A** and **B** are on the same side (see fig. 83).
Tighten the big-end cap bolts to a 40 Nm torque.

Note: The big-end bearing is supplied in both the nominal value and undersized by 0.25 and 0.50 mm.



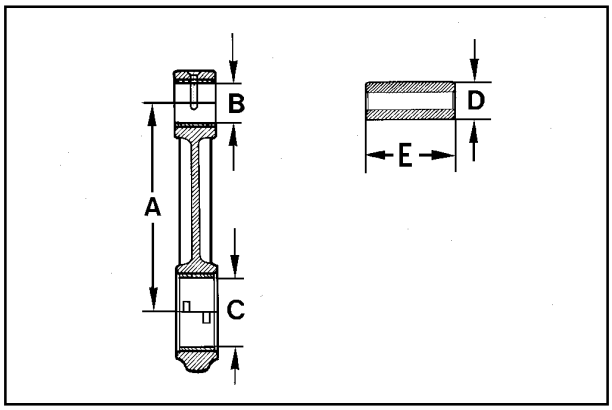
84

85

Connecting rod, weight

To prevent imbalance, the connecting rods must be weighed before they are replaced.
The difference in weight must not exceed 8 grams.
The connecting-rods of engines LGW 523 and LGW 627 are made of cast iron and differ from each other as to length.

Note: For the LGW 523 AUTOMOTIVE version, weigh the pre-assembled connecting rod, piston and pin. The margin of error must be within 8 grams.



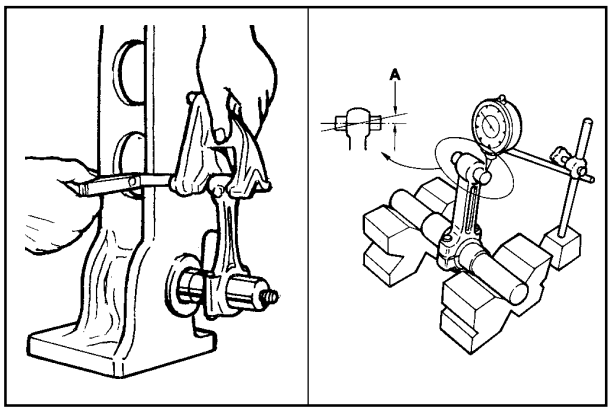
86

Connecting rod complete with bearings and pin

Dimensions (mm)

A = 106.98 to 107.02 (for LGW 523)
A = 126.48 to 126.52 (for LGW 627)
B = 18.015 to 18.025
C = 40.021 to 40.050 (with bearing torqued to 40 Nm)
D = 17.996 to 18.000
E = 50.900 to 51.100
(B-D) = 0.015 to 0.039 **(B-D)** wear limit = 0.060

Note: When the small-end bearing is inserted, make sure that the two lubrication holes coincide.
Lubricate before remounting



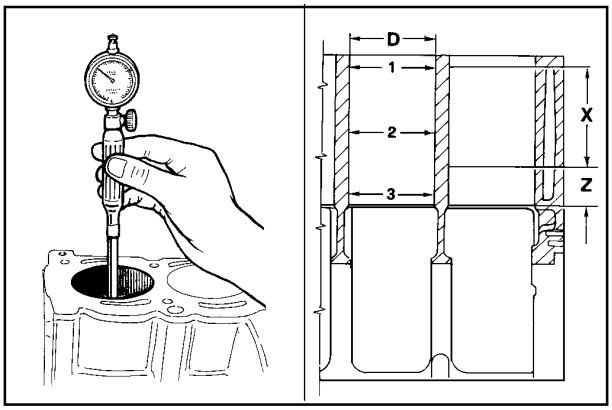
87

88

Connecting-rod alignment

Use a gauge with surface plate or a comparator as shown in the figure.
Check the alignment of the axes using the piston pin;
deviation **A** = 0.015 mm
limit 0.030 mm.

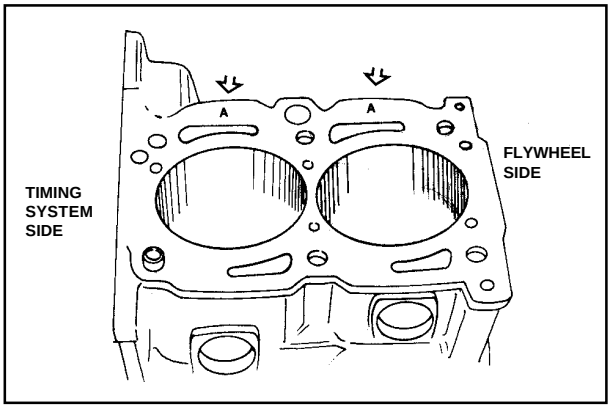
Small deformations can be corrected under a press, proceeding by gradual movements.



89 90

Cylinders

Reset the comparator with a calibrated ring.
Check diameter **D** in points **1, 2** and **3**; repeat the same operation by turning the comparator through 90° at the same levels.
Check for possible wear in zone **X** where the piston rings operate and grind the cylinder to the next allowance if it exceeds the max. given limit (e.g. 72 mm) by 0.05 mm.
Dimensions (mm) LGW 523, LGW 627 = 71.990 to 72.000
The diametrical values given belong to class **A** cylinders to which pistons of the same class must be coupled, see fig. 71.
To check the coupling play with the pistons, measure the diameter of zone **Z** of each cylinder according to the axis perpendicular to the crank shaft.

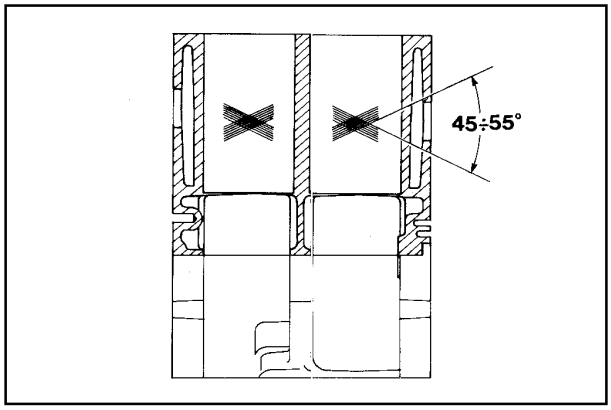


91

Cylinders, class

The class references of the pistons (**A, B, C,**) are on the piston crowns while those of the cylinders are on the cylinder block, in the places indicated by the arrows (see fig. 91).

Note: For engine LGW 523 with aluminium cylinder block, the cast iron cylinders can be normally ground to 0.5 and 1.0 mm allowances.
The cylinders must not be replaced.

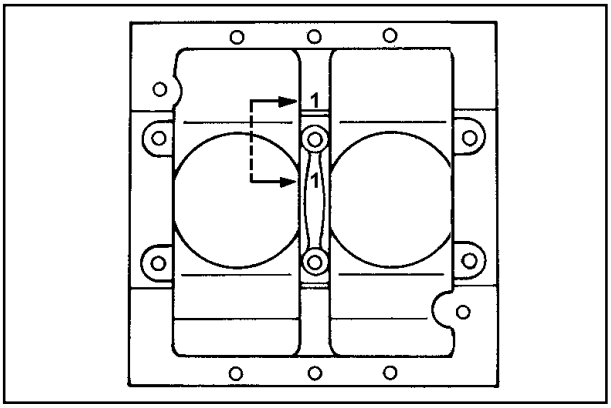


92

! It is forbidden to touch up the inner surfaces of the cylinders with emery paper.

Cylinders, roughness

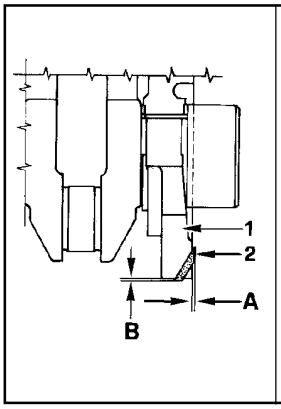
The slant of the crossed honing marks must be between 45° and 55°.
These marks must be clear and uniform in both directions.
The average roughness must be between 0.5 and 1 µ (micron).
The entire surface of the cylinder that comes into contact with the piston rings must be machined by the faceplate method.



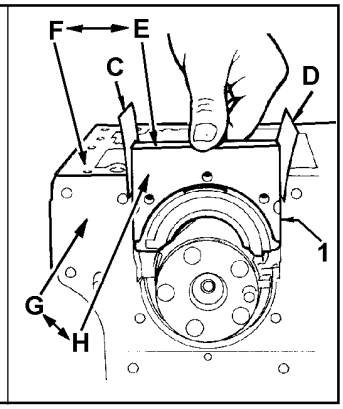
93

Central main bearing caps

The central main bearing caps have reference marks that can either be numbers as shown in the figure, or punch marks.
The same reference marks are also applied to the cylinder block.
Match the caps with the same reference marks and on the same side. In any case, always refer to the two centering marks on the bush. They must be on the same side.
Tighten the screws to a 60 Nm torque.



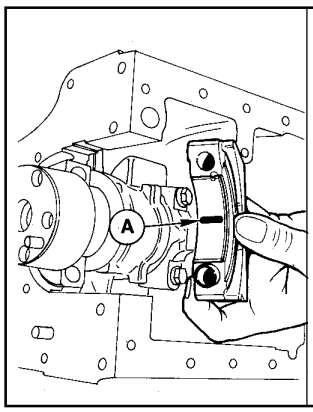
94



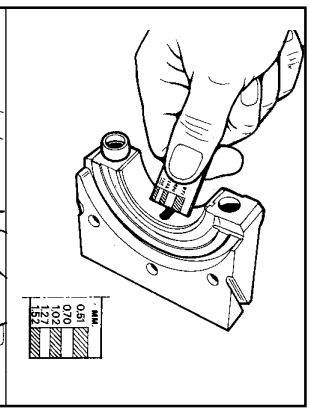
95

! Before finally torquing and after having torqued, check with a ground bar to make sure that planes **E-F** and **G-H** are coplanar

Rear and front main bearing caps
When remounting rear main bearing cap **1**, replace the rubber side seals **2** remembering that projection **A** and **B** from the support must be 0.5 to 1.0 mm. Cut off any excess but never ever recess in relation to the retention surface, only project. Proceed in the same way for the front main bearing cap.
To fit the supports into the cylinder block, insert the two 0.1 mm thick laminations **C** and **D** between their surfaces (tool serial N° 7107-1460-053). Tighten the screws to a 60 Nm torque.
Note: It is advisable to apply a few drops of silicone sealer on the shearing plane of gasket **2.**



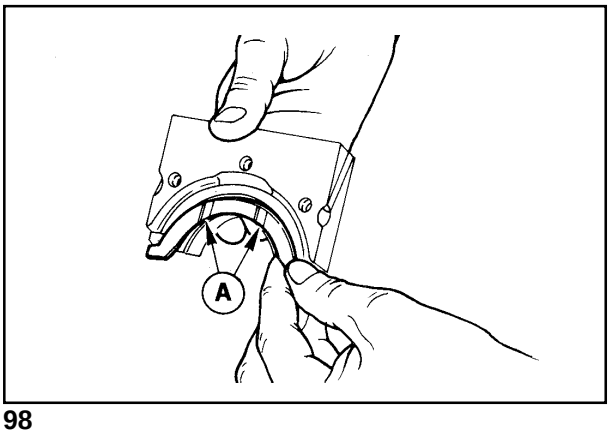
96



97

Checking for play between bearings and main journals

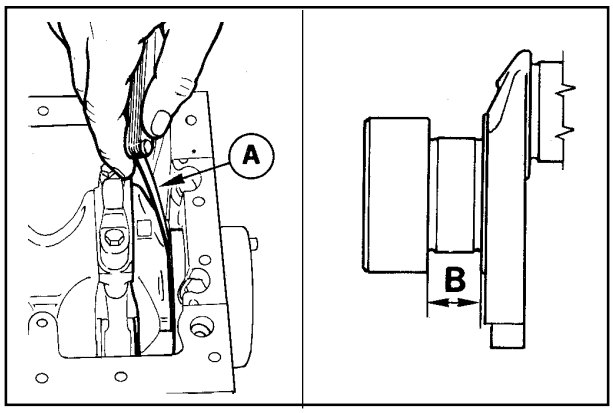
Use calibrated wire **A** type "Perfect Circle Plastigage" and apply a little grease in the center of the bearing. Tighten the screws to a 60 Nm torque.
Measure the play, checking the extent to which the wire is crushed by means of the relative graduated scale supplied with it in the same pack and available on the market.
Consult fig. 107 for the values of the play between main journals, connecting rod pivots and corresponding bearings.



98

Supporting half-rings

Apply a little grease to make sure that they remain in their housings during assembly.
The half-rings must be mounted with grooves **A** as shown in the figure.
Thickness of the half-rings = 2.31 to 2.36 mm; 0.1 and 0.2 mm thickness oversizes are supplied as spares. See further on.



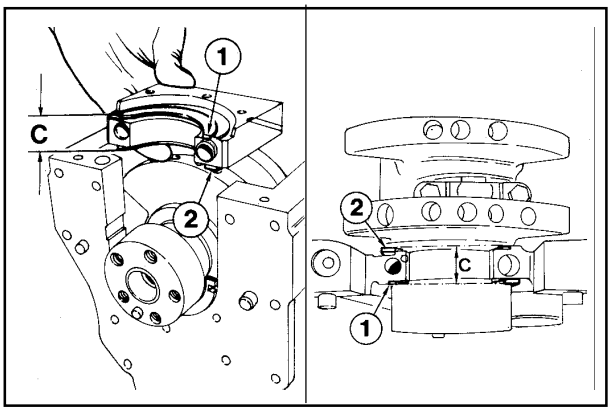
99 100

Crank shaft float

After having tightened the main bearings, measure float **A** between the crank shaft support on the flywheel side and the main bearing half-rings.

A = 0.130 to 0.313 mm limit 0.5 mm
B = 23.05 to 23.10 mm limit 23.50 mm

If the play is not within the given value, check value **B**. Mount oversized half-rings if necessary. See further on.



101 102

Bearing half-rings, oversizes

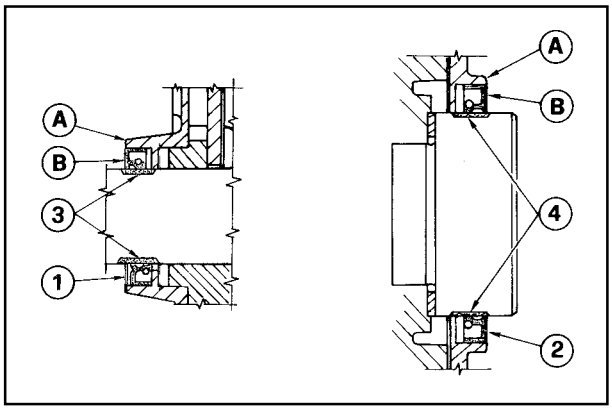
Dimensions

	C	B**	A*
Standard	22.787-22.920	23.050-23.100	0.130-0.313
1st Oversize	22.987-23.120	23.250-23.300	
2nd Oversize	23.087-23.220	23.350-23.400	
3rd Oversize	23.187-23.320	23.450-23.500	

* **A** of fig. 99
** **B** of fig. 100

The following half-rings can be mounted by grinding **B** as shown in the table:

1st Oversize. Half-rings **1** and **2** + 0.10 mm on both sides of the support.
2nd Oversize. Half-rings **1** and **2** + 0.10 mm on one side of the support and + 0,20 mm on the other.
3rd Oversize. Half-rings **1** and **2** + 0.20 mm on both sides of the support.



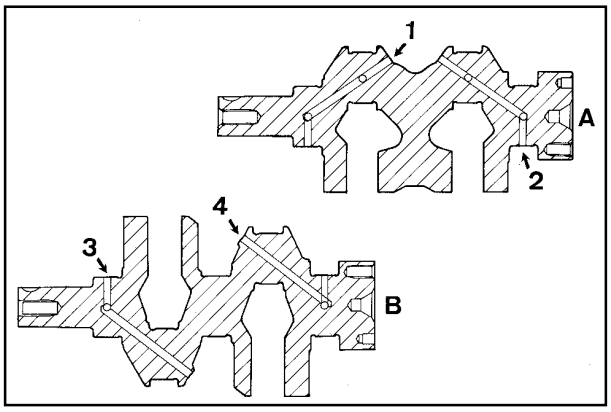
103

! The rings could be damaged with ambient temperatures of less than -35°C.

Crank shaft front and rear oil retention seals

Front oil retention seals **1** in the oil pump cover and rear oil retention seals **2** in the flange on the flywheel side.
Replace the seals if they are deformed, hardened or damaged.
To replace:
- Thoroughly clean the housing
- Keep the seals immersed in engine oil for about half an hour.
- Insert it in its housing with a plug, exercising an even pressure all over its front surface. The two surfaces **A** and **B** must be on the same plane.
- Fill the inner cavity with grease and lubricate the retention lip with thick oil.

Note: Before overhauling the engine and if an oil leak is noted in the retention zone of seals **3** and **4**, this fault can be rememdied by replacing the seals and pushing the new ones inwards by about 2 mm in relation to the previously mounted ones.
If the seals are black in colour, this means that zones **3** and **4** of the drive shaft are hardened. In this case, remount a seals of the same colour. If the seals are brown, zones **3** and **4** are not hardened and brown coloured seals must be mounted.



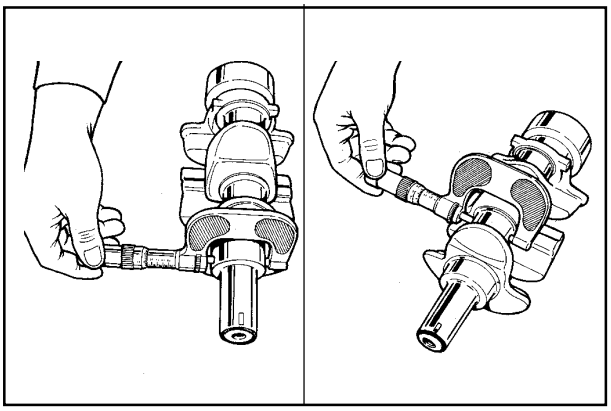
104

! It is important to wear protective goggles when compressed air is used during repairs

Crank shaft, lubrication ducts

A = Crank shaft LGW 523
B = Crank shaft LGW 627
Place the shaft in a bath of degreasing and detergent fluid.
Remove the plugs and clean ducts **1** and **2** or **3** and **4** with a pointed tool. Blow with compressed air.
Fit the plugs back into their housings and check for tightness.

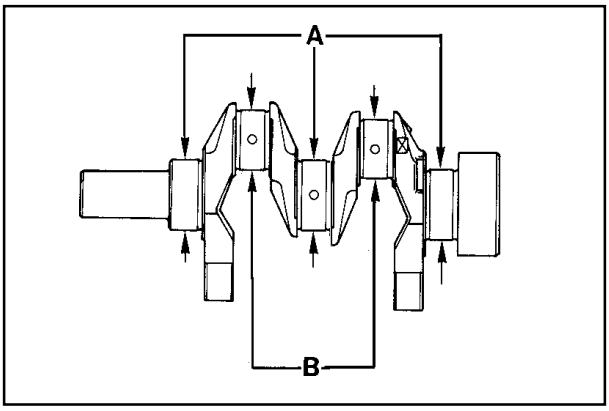
Note: The crank shaft of engine LGW 523 with aluminium cylinder block cannot be interchanged with that of the cast iron cylinder block since the counterweights are different.



105 106

Crank shaft, main journal and crank inspection

Use a micrometer for exteriors.

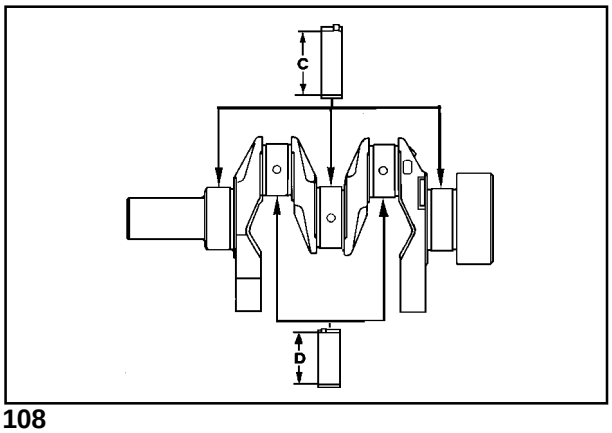


107

Diameters of main journal and big-end journals

Dimensions:
A = 47.984 to 48.000 wear limit = 47.900
B = 39.984 to 40.000 wear limit = 39.900

The diametrical values of the main journal and big-end journals are the same for all the engines in the series (LGW 523, LGW 627).



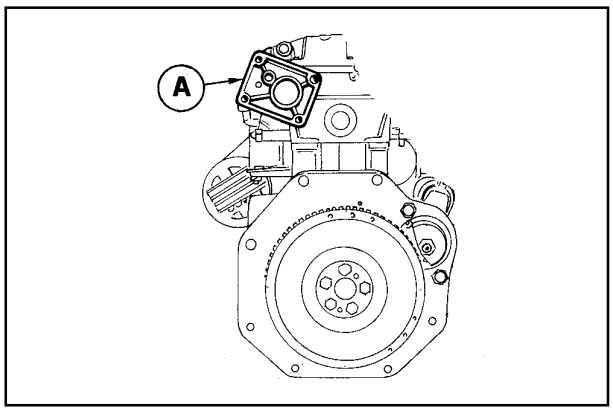
108

Inner diameters of main and big-end bearings

Dimensions (mm):
C = 48.041 to 48.091 wear limit = 48.130
D = 40.021 to 40.050 wear limit = 40.100

The given dimensions refer to tightened bearings. Consult fig. 83 for the big-end tightening torque and fig. 93 for the main bearing cap tightening torque. Play between bearings and corresponding pivots (mm) see figs. 107, 108.
(**C-A**) = 0.041 to 0.107 wear limit = 0.230
(**D-B**) = 0.021 to 0.066 wear limit = 0.130

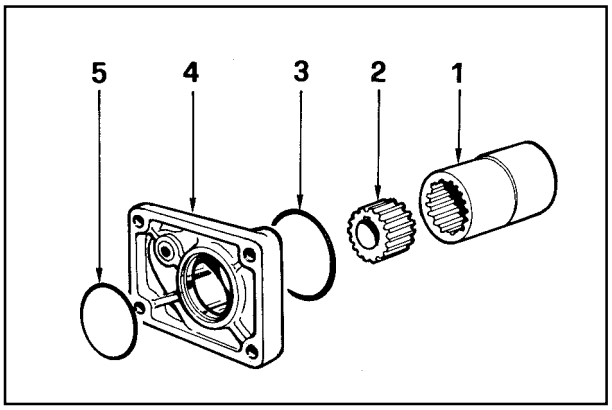
Note: There are 0.25 and 0.50 mm inner diameter undersizes for both main and big-end bearings.



109

Hydraulic pump drive (for LGW 627)

A = Third drive
A hydraulic pump (2 PD, Bosch flanging or a 1 PD) type can be mounted on the third drive.
The power that can be supplied by the third drive is 7 kW, corresponding to a 37 Nm torque at 3600 rpm.
Engine r/min/pump r/min transmission ratio = 1:0.5.



110

Third drive, components (for LGW 627)

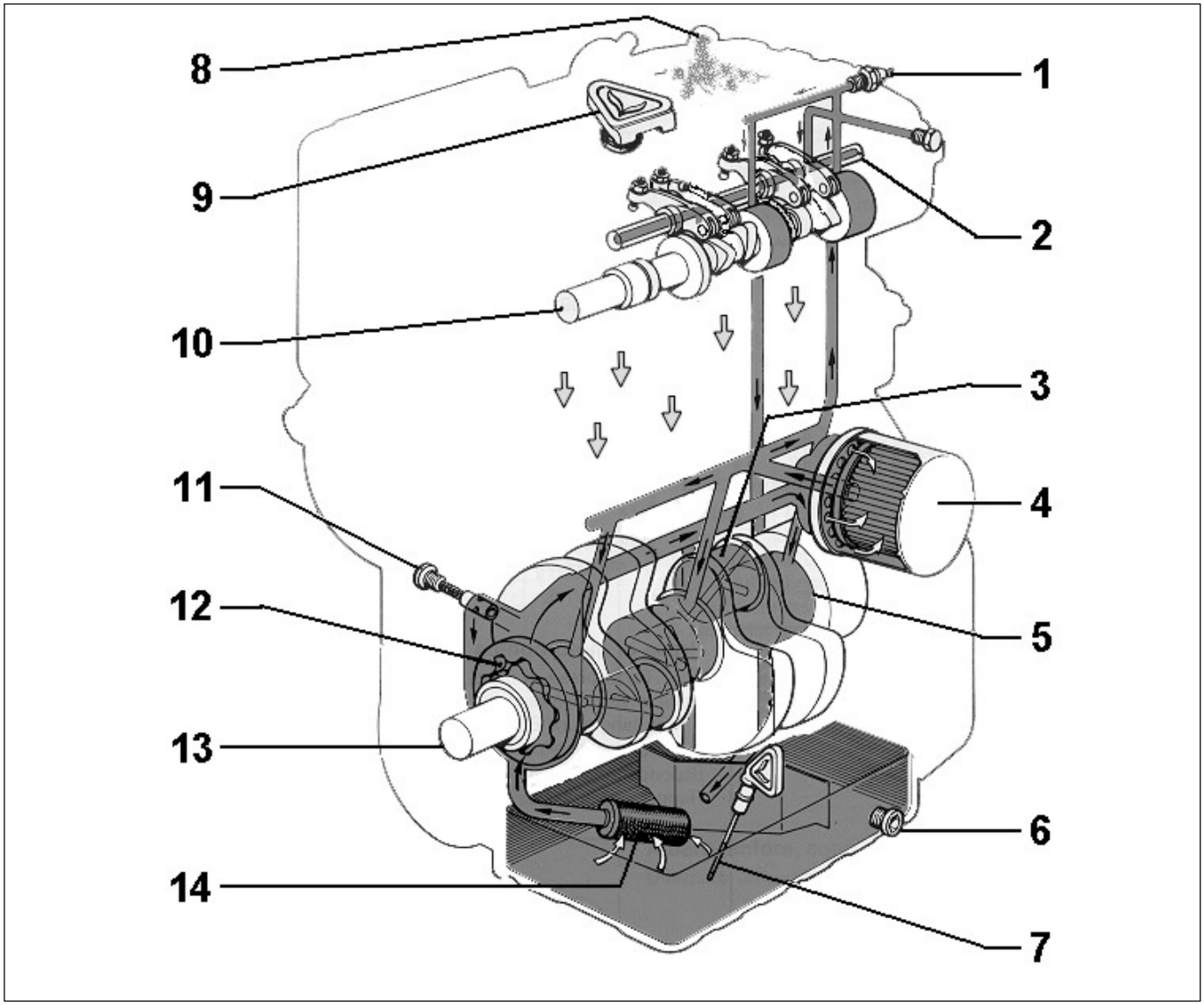
1 Splined sleeve
2 Timing pinion
3 Retention ring
4 Flange for hydraulic pump 1 PD
5 Retention ring

Note: Sleeve **1** also includes the fuel pump control eccentric and should be fixed with the same bolt as the standard eccentric but with an 80 Nm driving torque. Tighten pinion **2** to the hydraulic pump with a 45 Nm torque.

The engine can be damaged if allowed to operate with insufficient oil. It is also dangerous to add too much oil because its combustion may lead to a sharp increase in the rotation speed.
Use suitable oil in order to protect the engine.
Nothing more than lubrication oil can influence the performances and life of an engine.
Use of an inferior quality oil or failure to regularly change the oil will increase the risk of piston seizure, will cause the piston rings to jam and will lead to rapid wear on the cylinder liner, the bearings and all other moving parts. Engine life will also be notably reduced.
The oil viscosity must suit the ambient temperature in which the engine operates.

Old engine oil can cause skin cancer if repeatedly left in contact with the skin and for long periods of time. If contact with the oil is unavoidable, you are advised to wash your hands with soap and water as soon as possible.
Dispose of old oil in the correct way as it is highly polluting.

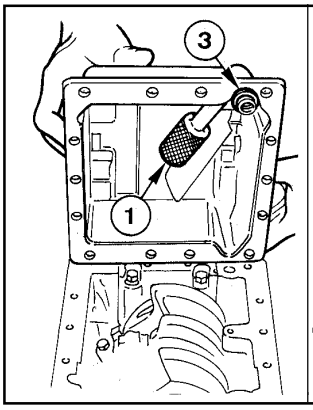
LUBRICATION CIRCUIT



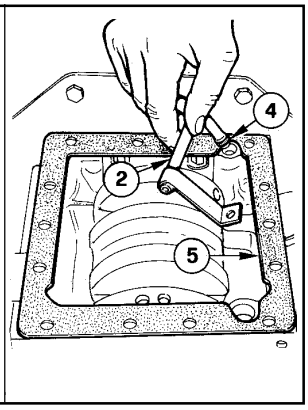
111

Components:

1) Pressure switch
2) Rocker shaft
3) Big-end journal
4) Oil filter cartridge
5) Main journal
6) Oil drain plug
7) Oil dipstick
8) Breather
9) Oil fill plug
10) Camshaft
11) Oil pressure regulating screw
12) Oil pump
13) Crank shaft
14) Oil suction strainer



112

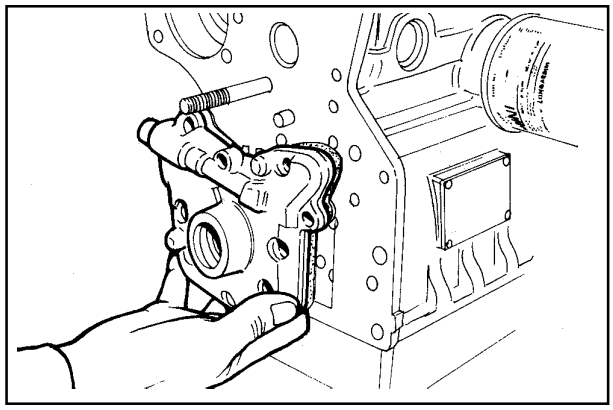


113

! It is important to wear protective goggles when compressed air is used during repairs.
Wash the parts with degreasing and detergent liquid.

Internal suction strainer and engine oil return tube

Wash the internal suction strainer **1** and the engine oil return tube **2**; blow them with compressed air.
Replace retention rings **3** and **4 .**
Tighten the bolts to a 10 Nm torque when the sump is remounted.
Tighten the oil drain plug to a 40 Nm torque.



114

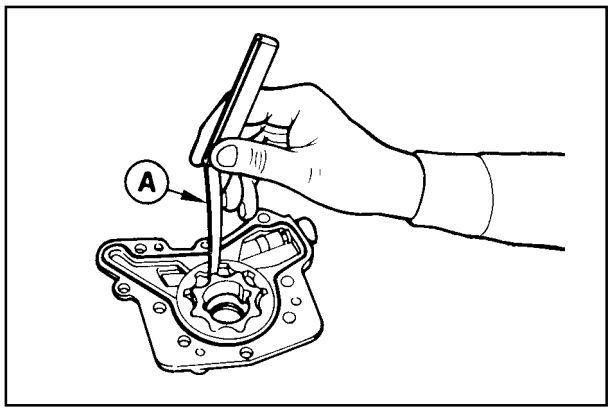
Oil pump

Oil pump flow rate test at 1000 r/min with oil at 80°C.

Engine	Flow rate (l/min)	Pressure(bar)
LGW 523 - LGW 627	4 to 4.3	3 to 3.5

Flow rate test at 3600 r/min with oil at 80°C

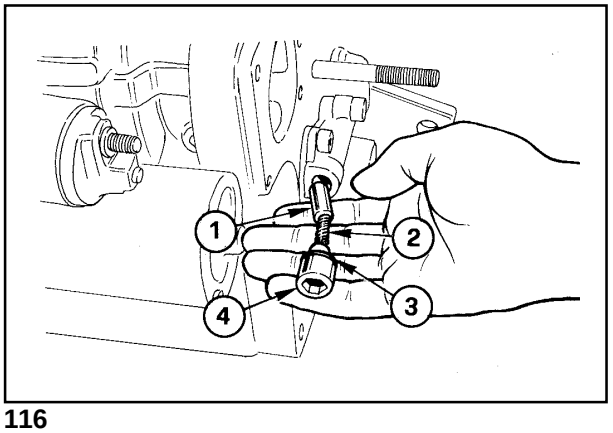
Engine	Flow rate (l/min)	Pressure(bar)
LGW 523 - LGW 627	19.3	4 to 4.5



115

Oil pump, play between rotors

Measure play **A** between the teeth as shown in the figure. The max value is 0.171 mm; wear limit play 0.250 mm.
Consult figs. 35, 35a and 36 when disassembling and remounting.



116

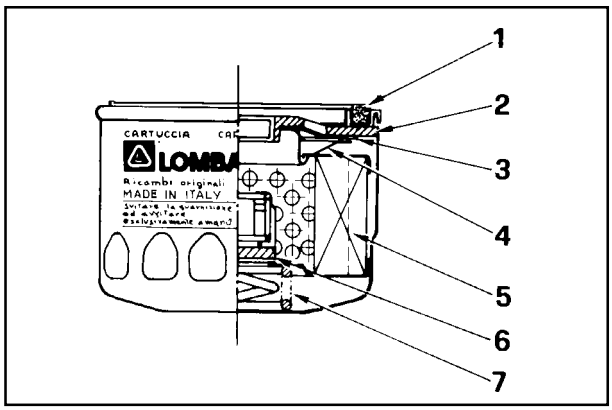
Oil pressure regulating valve

Components:
1 Valve
2 Spring
3 Seal
4 Plug

Spring length = 27.50 to 27.75 mm
Blow the valve housing with compressed air and thoroughly clean all parts before remounting them.

Note: The valve begins to open at a pressure of 4.5 to 5.5 bar at 1000 r/min.

COMPILER TECNIATI	REG. CODE	MODEL N°	DATE OF ISSUE	REVISION 00	DATE	ENDORSED
	1-5302-509	50778	10.06.99		10.06.99	



117

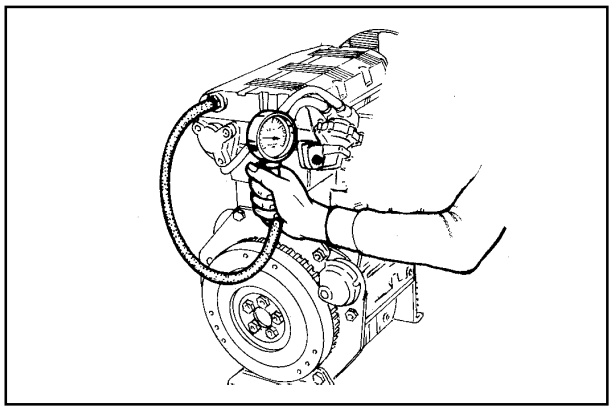
! When the oil filter is replaced, keep it separate from other waste. Dispose of the old oil correctly since it is highly polluting. Do not litter.

Oil filter cartridge

Components:

1 Seal
2 Plate
3 Rubber pad
4 Spring
5 Filtering element
6 By-pass valve
7 Spring

Specifications:
Maximum working pressure: 7 bar
Maximum bursting pressure: 20 bar
Filtering degree: 15 m
By-pass valve setting: 1.5 to 1.7 bar
Total filtering area: 730 cm²



118

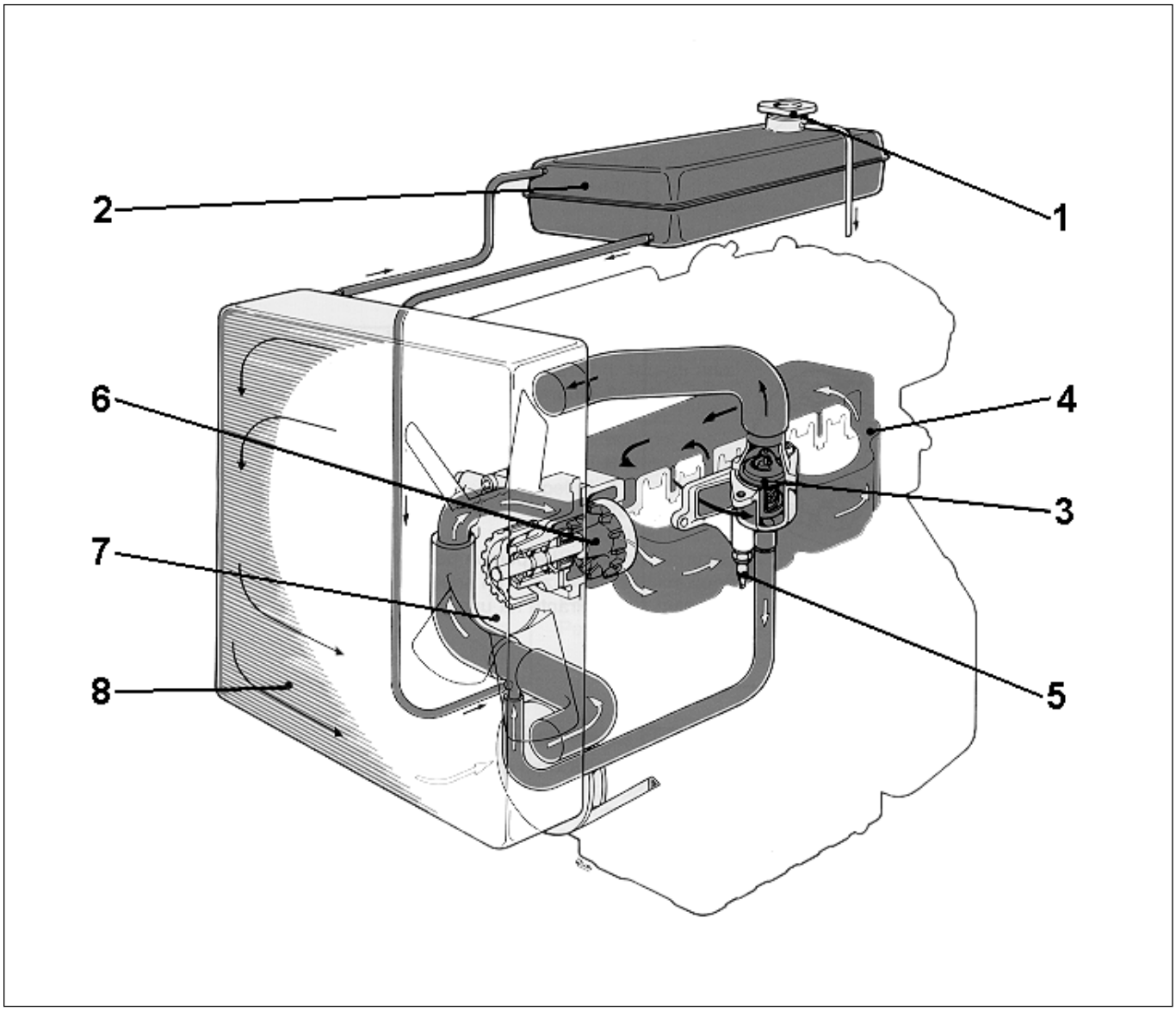
Oil pressure check

After remounting, fill up with engine oil, fuel and coolant fluid.
Remove the pressure switch, fit on a union and connect a 10 bar pressure gauge.
Start the engine and watch the pressure variation in relation to the oil temperature.

Note : The pressure of the oil must never be less than 1 bar with a max operating temperature of 80°C at 900 r/min.

The cooling circuit contains fluid under pressure. Do not carry out any inspections until the engine has cooled and even then, open the plug of the radiator or expansion chamber with caution.
Keep well away from a hot engine if an electric fan is installed since this could start up even when the engine is at a standstill.
Coolant fluid is polluting. It must therefore be disposed of correctly. Do not litter.

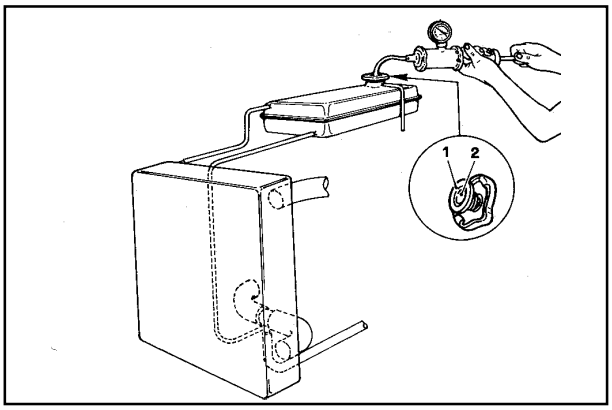
COOLING CIRCUIT



119

Components :

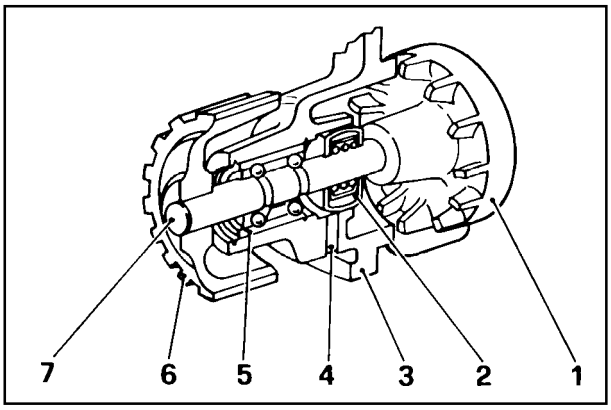
1) Coolant fill plug
2) Compensation chamber
3) Thermostatic valve
4) Cylinder block
5) Fluid temperature thermoswitch
6) Circulation pump
7) Fan
8) Radiator



120

Radiator and compensation chamber plug, Inspections and tightness

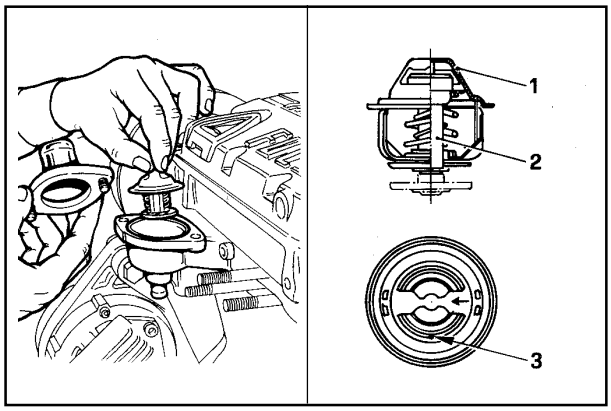
Remove the plug from the compensation chamber and make sure that the coolant is at the correct level.
Replace the plug with one with a connection for a manual air pump.
Compress the air to a pressure of **1** bar for about two minutes.
Make sure that there are no leaks from the radiator.
The tank plug has a vacuum valve **1** and an overpressure valve **2.**
Overpressure valve opening pressure 0.7 bar.



121

Cooling fluid pump, components

1 Impeller
2 Front seal
3 Pump casing
4 Drain hole
5 Bearing
6 Pulley
7 Shaft



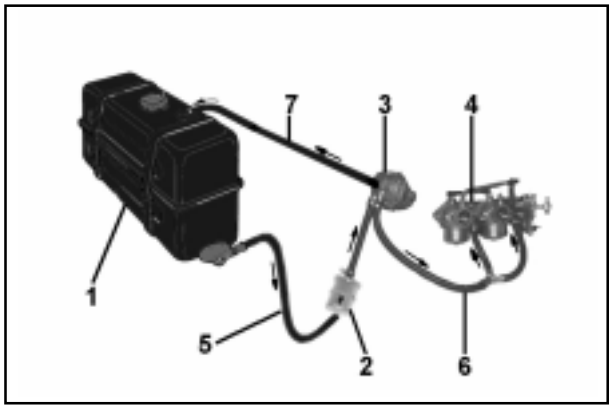
122

123

Thermostatic valve

1 - Stainless steel or brass casing
2 - Wax bulb
3 - Air bleed hole

Specifications:
Opening temperature: 83° to 87°C
Max stroke at 94°C = 7 mm
Fluid flow rate = 30 to 80 l/h.



124

Do not smoke or use naked flames during the disassembly and reassembly operations as this could lead to explosions or fire outbreaks.
Fuel vapours are highly toxic. Only carry out these operations outdoors or in a well ventilated place.
Keep your face well away from the cap to avoid inhaling harmful vapours.

Fuelling circuit
Components:
1 Tank
2 Fuel filter
3 Fuel pump
4 Carburetors
5 Tube from tank to fuel filter
6 Pipes from fuel pump to carburetor
7 Drain tube from fuel pump to tank

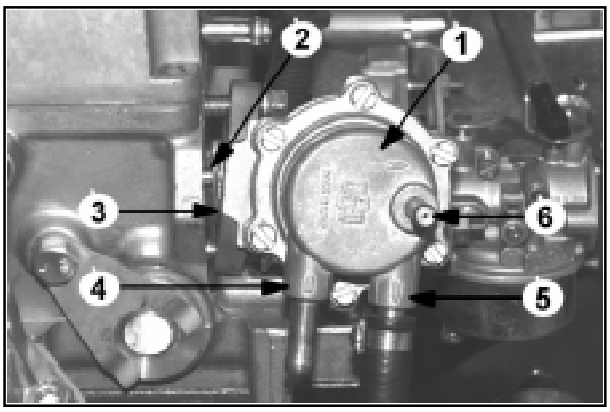
Note: The tank complete with filter is supplied on request.

Never ever fit the fuel filter near heat sources or naked flames (e.g. silencers, exhaust connection pipes, etc.).
Periodically check the condition of the fuel pipes.

125

Fuel filter detached from tank

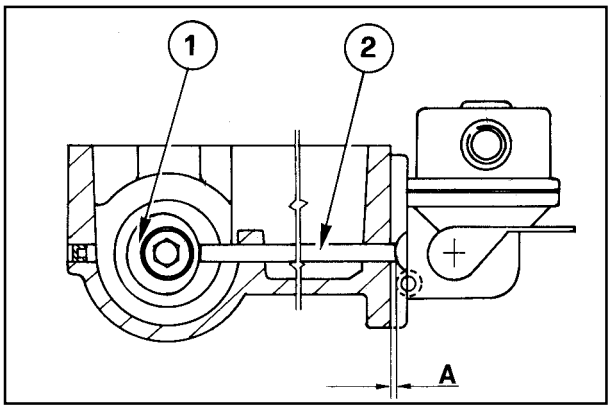
The fuel filter for the engines in question is the Lombardini type serial N° 3730.106.
You are advised to use genuine spare parts since their 350 cm^3 filtering area volume and their filtering degree have been specially researched.
It is advisable to replace the fuel filter after every 350 hours service in normal operating conditions.
When replacing, check the arrow that indicates the correct mounting direction, see fig. 125.



126

Fuel pump

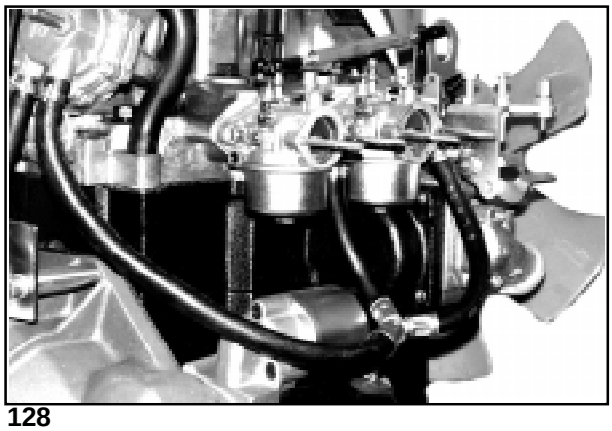
Components:
1 Fuel pump casing
2 Rod
3 Retention ring
4 Fuel inlet from tank
5 Fuel outlet from fuel pump to carburetor
6 Fuel pump return to tank
The fuel pump is the diaphragm type and is operated by an eccentric of the camshaft by means of a rod.
The eccentric should be tightened to a 80 Nm torque.
Specifications:
At 2000 r/min of the eccentric, the flow rate is 40 l/h and the self-regulating pressure 0.3 ±0-05 bar.



127

Fuel pump rod projection

Projection **A** of rod **2** from the head surface is 0.85 to 1.35 mm.
Inspections must be made with eccentric **1** in the non-operative position as shown in figure 127.
Lock the two fuel pump fixing nuts to a 24 Nm torque.
Check the length of the rod and change it if it is not the right size.
Rod length = 85.45 ±0.5 mm.

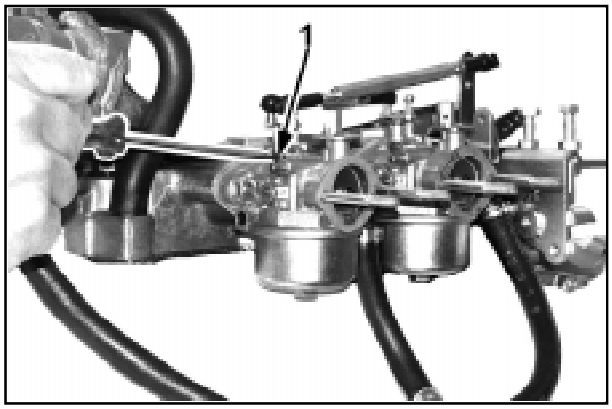


128

Carburetor

Engine LGW 627 is fuelled by two "DELLORTO" carburetors type FHCD22-18.
Comply with the following instructions when adjusting:
- The air filter must have a clean cartridge.
- Air must not be drawn through vacuum pipes, seals, etc.
- Parts that use electric power must not be operating (electric fans, alternator, etc).

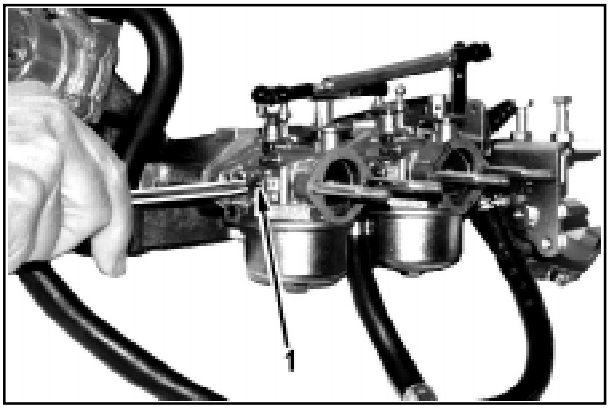
If the carburetors are remounted, tighten the fixing nuts to an 8 Nm torque and the stud bolts to a 5 Nm torque.



129

Speed adjuster screw regulation (idling rate)

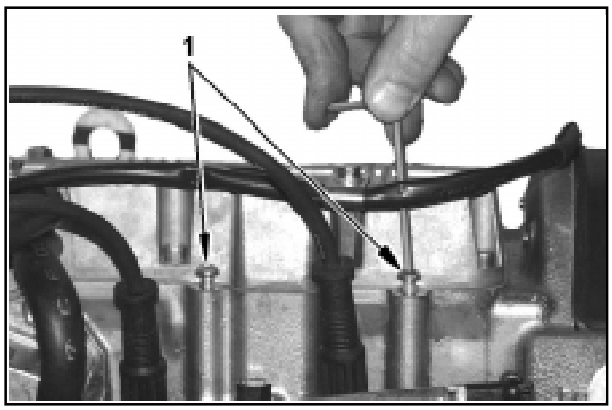
Use a precision revolution counter.
Insert the exhaust gas analyzer probe into the exhaust pipe. Bring the engine to operating temperature by allowing it to run at about 2000 r/min until the thermostat opens (do not allow the engine to heat at idling rate alone as measurement of the "CO" content would not be valid in these conditions).
Operate with the cold starting device deactivated.
Work on the speed adjuster screw **1** (see fig. 129) unable obtaining a stable rate of 900 r/min.



129a

Mixture adjuster screw regulation (idling rate)

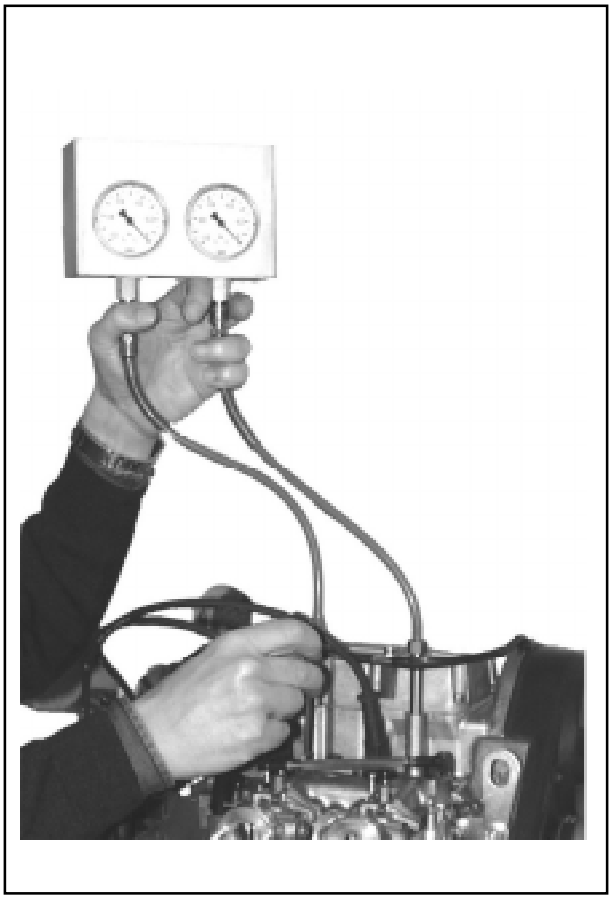
Work on the idling mixture adjuster screw **1** (see fig. 129a) on both carburetors in succession, first on one and then on the other, until the "CO" content on the exhaust is 5 to 8 %.
If no exhaust gas analyzer is available, work on the above mentioned screw until obtaining the highest r/min rate that this adjustment allows.
Use the speed adjuster screw **1** (see fig. 129) again until obtaining a rate of 1100 r/min.



130

Carburetor vacuum adjustment

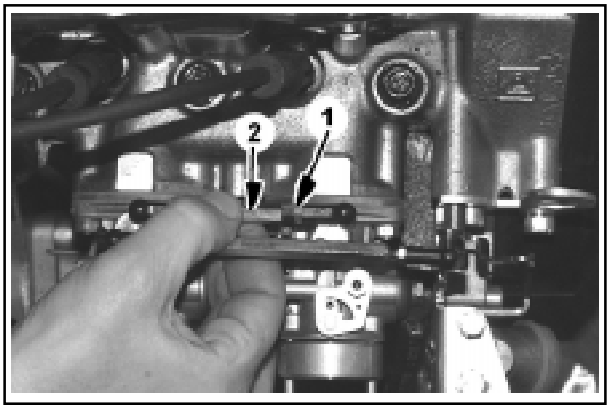
Slacken off screws **1** (see fig. 130).
Mount the two stud bolts with calibrated holes and the relative vacuum gauges in their place (see fig. 130a).



130a

Carburetor vacuum balancing test

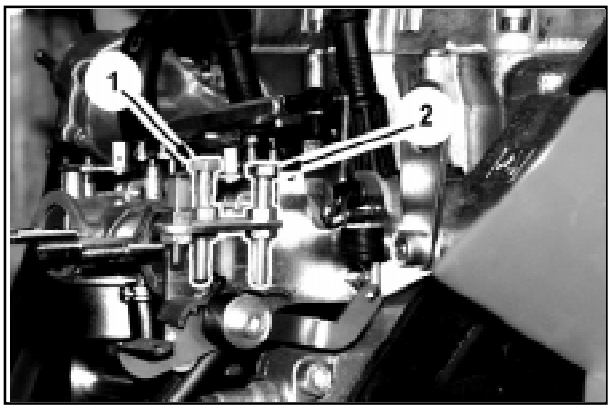
Connect the differential vacum gauges to the two carburetors with the engine idling and make sure that the vacuum in the two intake ducts differs by no more than 0.05 bar (5 kPa).



130b

Carburetor vacuum adjustment

If the vacuum reading on the vacuum gauges exceeds the previously mentioned 0.05 bar (5 kPa) limit, slacken off check nuts **1** and work on rod **2** until the setting is correct.
Lock check nuts **1** after having calibrated.
Disconnect the vacuum gauge and plug the two holes to check the vacuum on the head with the relative screws (as indicated in fig. 130).
Apply a weak thread-locking product to make certain that these screws are perfectly tight.

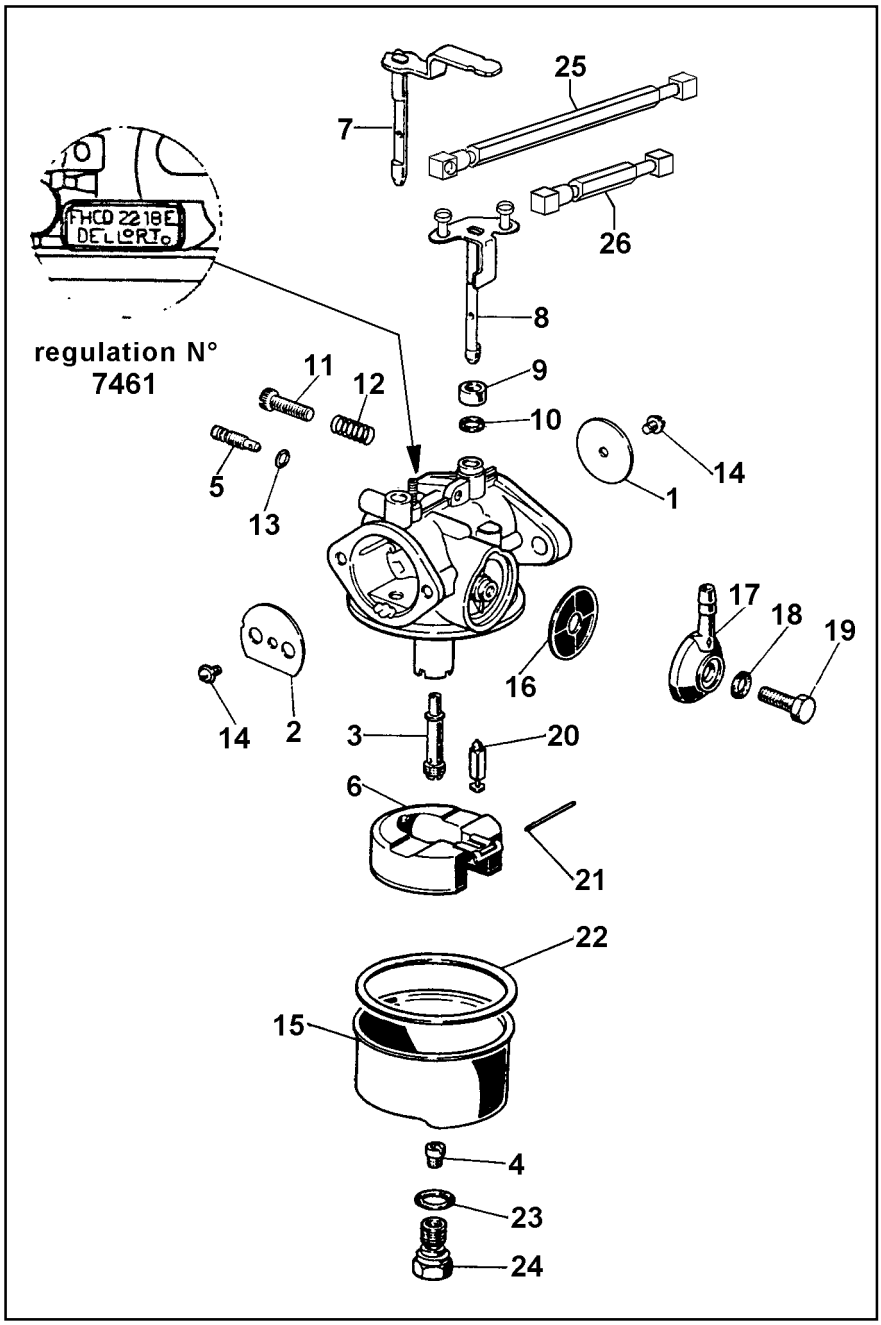


131

High and idling speed adjustment

Using a precision revolution counter, check the high speed with no load and adjust it to the required value by means of screw **1** (Fig. 131).
Check the idling speed again and modify it if necessary by means of screw **2** (fig. 131).
Indicatively, if the carburation is correct, this can be ascertained by conducting the engine pickup test; the engine must immediately accelerate from idling to high speed, i.e. carburation must be smooth and not faster or hesitate.

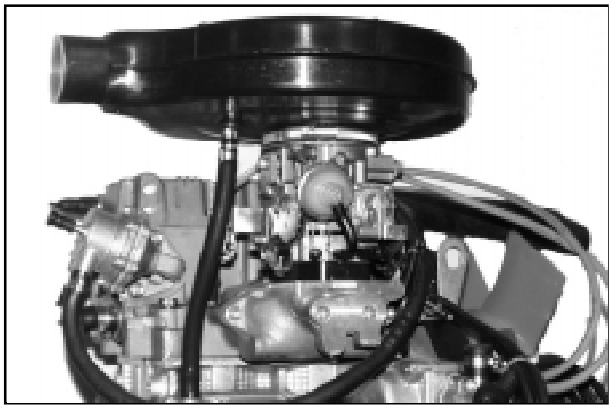
ADJUSTMENTS AND CALIBRATION		
DESCRIPTION		1st CONDITION
Choke		18
Float		4.5 g.
Level from float chamber surface		7 mm
Fast running jet		94
High speed air		300
Slow running jet		40
Idling air		90
Progressive outlets	1st	70
	2nd	70
	3rd	100
Idling screw opening turns		2 ¼



CARBURETOR FHCD22.18E

1- Gas valve
2- Air valve
3- Diffuser
4- Fast running jet
5- Slow running jet
6- Float
7- Air valve pin
8- Gas valve pin
9- Seal cap
10- Seal
11- Gas rod adjuster screw
12- Gas rod adjuster screw spring
13- Idling mixture adj. screw seal
14- Valve fixing screw
15- Float chamber
16- Fuel filter
17- Fuel pipe union pipette
18- Pipette fixing screw seal
19- Pipette fixing screw
20- Fuel shut-off pin
21- Float pin
22- Float chamber seal
23- Float chamber fixing plug seal
24- Float chamber fixing plug
25- Rod (1)
26- Rod (2)

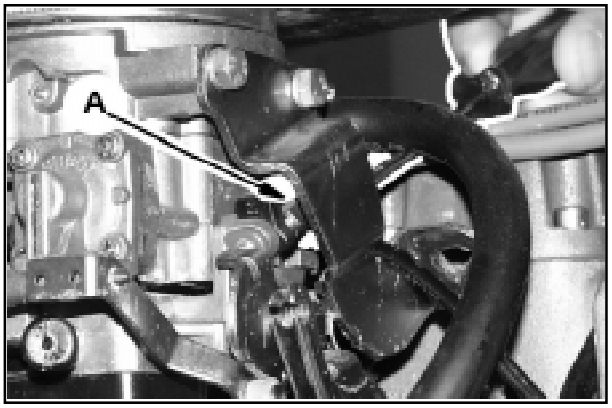
132



133

Carburetor LGW 523

Engine LGW 523 is fuelled by carburetor WEBER 32TLF39.

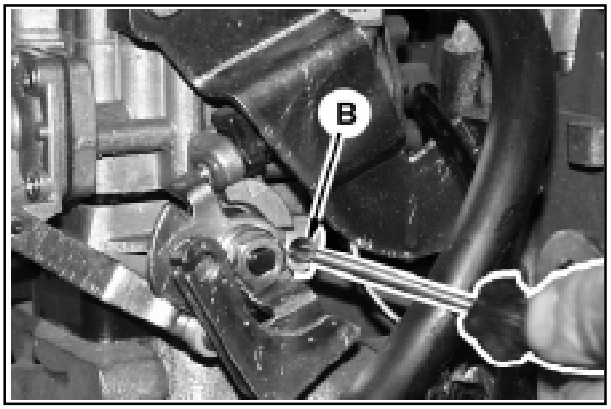


134

IDLING ADJUSTMENT

Preliminary conditions

Work with the cold starting device deactivated.
Bring the engine to operating temperature by allowing it to run at approx. 2000 r/min until the thermostat opens.
Do not allow the engine to idle alone as measurement of the "CO" content is no longer valid when an engine is allowed to idle for several minutes.
The idling speed must correspond to the declared values.
The air filter must be mounted with a clean cartridge.
The ignition system must be in a good condition and perfectly regulated.
No air must be drawn through vacuum tubes, seals, etc.
The exhaust system must not leak to any extent.
Equipment powered by electricity must not be operating (electric fans, alternator, etc.).



135

Enrichment adjustments

This adjustment must only be carried out with the right equipment.
It can, however, be done without this material (see next section).

Without analyzer

Proceed in the following way after having brought the engine to a 1100 to 1200 r/min idling rate:

- Remove the sealing plug from enrichment screw **B** (fig. 135) and, using it, find the top rate.
- Increase the idling speed by 50 r/min using screw **A** (fig. 134) and lower by the same value by tightening enrichment screw **B** (fig. 135).
- Replace the sealing plug after the adjustments have been made.

With analyzer

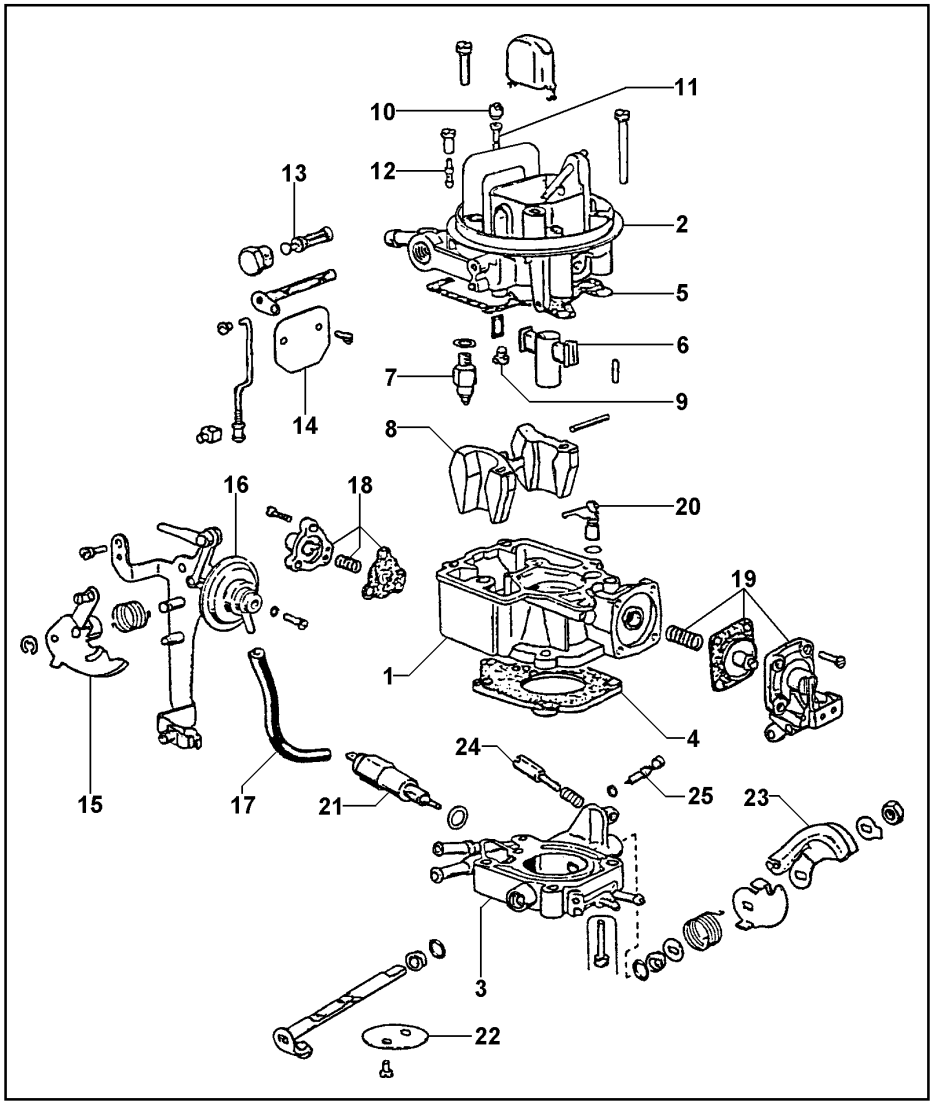
Proceed in the following way after having brought the engine to a 1100 to 1200 r/min idling speed:
- Remove the sealing plug from enrichment screw **B** (fig. 135) and work on this until obtaining the prescribed 2.5 to 3% "CO" content.
- If necessary, modify the idling rate adjustment by means of screw **A** (fig. 134).
- Repeat these two operations until the prescribed values (rate and "CO" percentage) are obtained.
- Replace the sealing plug after the adjustments have been made.

Idling adjustment

Adjust the idling speed by means of the throttle screw **A** (fig. 134) in order to obtain the 1100 r/min value.

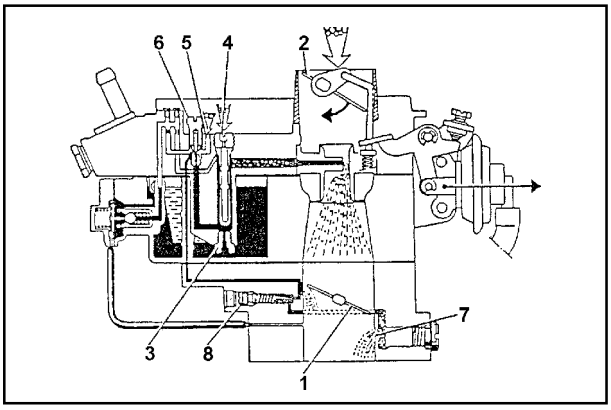
CALIBRATED PARTS	
DESCRIPTION	1st CONDITION
Choke	22
Centering device	2.8
Main jet	120
Brake air jet	190
Diffuser tube	F 74
Slow running jet	50
Slow running air jet	160
Pump jet (at 20°)	40
Pump discharge	40
Pump cam	14850.218
Ignition cam	45200.211
Relief capsule bush	40
Pin valve	150
Fuel return hole	100
Non-return hole	120
Idling mixture adjuster hole	170
Idling mixture bush	150
Lead hole under throttle	200
Slot compression holes	4.9x0.8

ADJUSTMENTS	
DESCRIPTION	VALUE
MECHANICAL LEVEL WITH SEAL	27 ± 0.25
FLOAT TRAVEL	34.2 ± 0.5
ACCELERATION PUMP Total flow rate (10.....pump strokes) cc.	10 ± 2
TOTAL THROTTLE OPENING	15 ± 0.5
IGNITION	
Full starter air elimination	3.75 ± 4.25
Fast Idling	32 ± 0.75
1st Hole mechanical air elimination	5 ± 0.5
Fast idling (value to regulate) Kg/h	13 ± 1
AIR FLOW RATE WHEN IDLING 1st duct	5



CARBURETOR 32TLF39/250

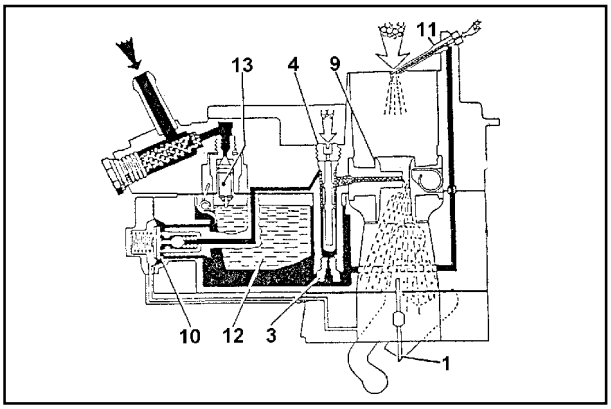
1- Casing
2- Cover
3- Base
4- Spacer
5- Float chamber seal
6- Mixture centering device
7- Pin valve
8- Float
9- Main jet
10- Brake air jet
11- Diffuser tube
12- Slow running jet
13- Filter
14- Ignition throttle
15- Starter command
16- Air eliminating capsule
17- Vacuum pick-up tube
18- Full loaf enriching valve
19- Pickup pump
20- Pump jet
21- Idling damper
22- Accelerator throttle
23- Accelerator cable winder
24- Idling adjuster screw
25- Idling mixture adjuster screw



137

Cold starting

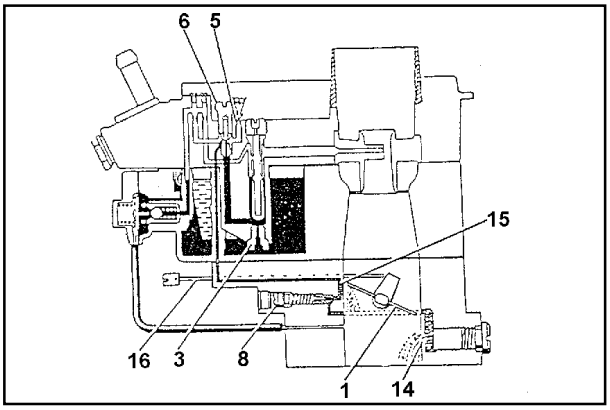
Enrichment is obtained by shutting off eccentric throttle **2**, controlled by a cam.
An intermediate cam meanwhile partially opens accelerator throttle **1**.
Fast idling speed allows the engine to quickly warm up and be immediately used.



138

Normal speed

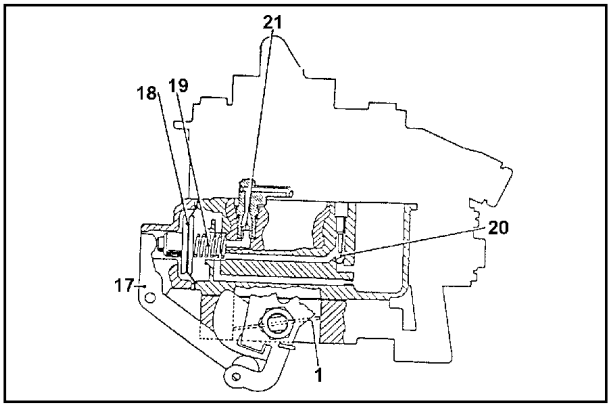
The fuel passes through the reedle valve into the float chamber where float **12**, articulated in the center pivot, regulates reedle **13** opening to keep the fuel itself at a constant level.
The fuel passes from the float chamber through main jet **3** until it reaches the diffuser tube. Mixed with the air from the calibrated bush **4**, the fuel reaches the carburation zone formed by the centering device and choke **9**. A full load enrichment jet increases mixture enrichment through the opening of a fuel inlet by-pass **10** in the fuelling circuit controlled by the air system. When the low speed throttle opens, vacuum reaches under the throttle, the spring acts on the diaphragm and the valve opens a complementary circuit to the main jet.
At a high rate, a power enricher **11** adds a a supplementary quantity of fuel to the engine by the action of vacuum at jet level.



139

Idling speed

Fuel from the float chamber passes through jet **3** and reaches the sump of the diffuser tube. A hole transfers the fuel to slow running jet **6** where it is mixed with the air. The fuel flows past the throttle through the enrichment jet adjuster screw **8**. When the throttle opens, operation progressively passes from the idling circuit to that of normal speed through the holes on a level with throttle **15**, forming an offtake of the idling circuit (progressive outlet holes).

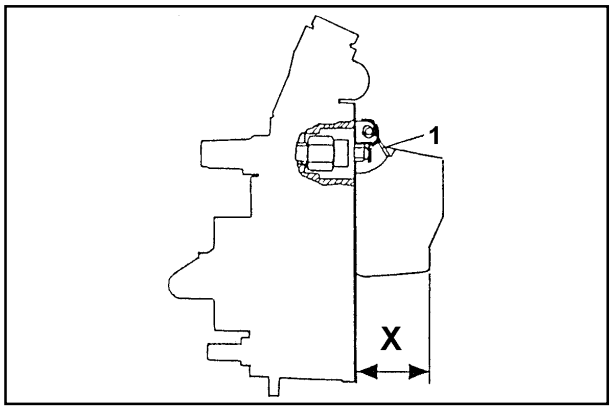


140

Pick-up

When the throttle opens, the cam actuated with the throttle rod acts on lever **17** which pushes diaphragm **18**. The fuel passes through a non-return valve **21** and flows towards jet **19** to be atomized in the choke. A spring on the diaphragm rod absorbs the quick throttle openings, prolonging the fuel supply. When the diaphragm returns to its position, the valve on the jet shuts and the valve on the float chamber **20** side opens, taking in the fuel which fills the pump chamber.

COMPILER TECCIATI	REG. CODE	MODEL N°	DATE OF ISSUE	REVISION 00	DATE	ENDORSED
	1-5302-509	50778	10.06.99		10.06.99	



141

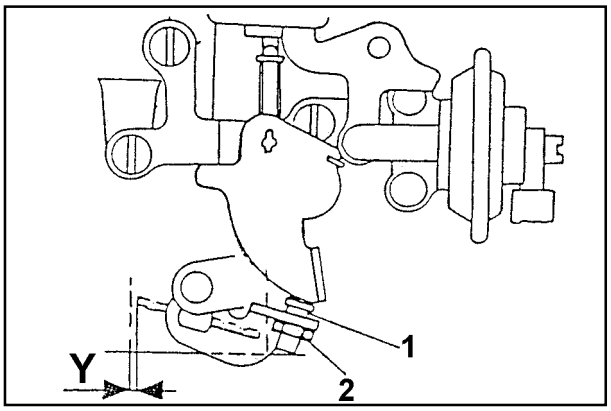
Inspections and adjustments

Float chamber level

The level in the float chamber must be checked with the cover of the carburetor in a vertical position and with the tongue of the float slightly touching the ball of the reedle valve.
In these conditions, the distance between the float and the surface of the cover (with seal) must be 27 ± 0.25 mm (dimension **X**). Work on the connection of float **1** if the value is different.

Pick-up pump delivery

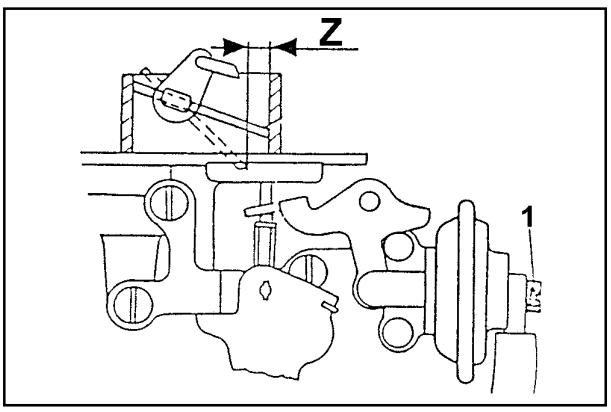
Pick-up pump delivery cannot be regulated.
The only thing that can be done is to check the amount of fuel delivered.
Fill the float chamber of the carburetor with fuel and operate the throttle control lever (from idling speed to high speed) until the circuit has been completely supplied and the pump jet delivers in a regular way.
Comply with the following instructions when testing:
Work the pump about ten successive times, stopping with the throttle completely open after each cycle. Before beginning the return to idling stroke, make sure that the pump jet has stopped delivering.
Wait a few seconds in the idling position to allow the pump to make a complete delivery. After the pump has been operated about ten times, delivery, i.e. the quantity of fuel collected in the test tube, must be between 8 and 12 cc.



142

Positive opening

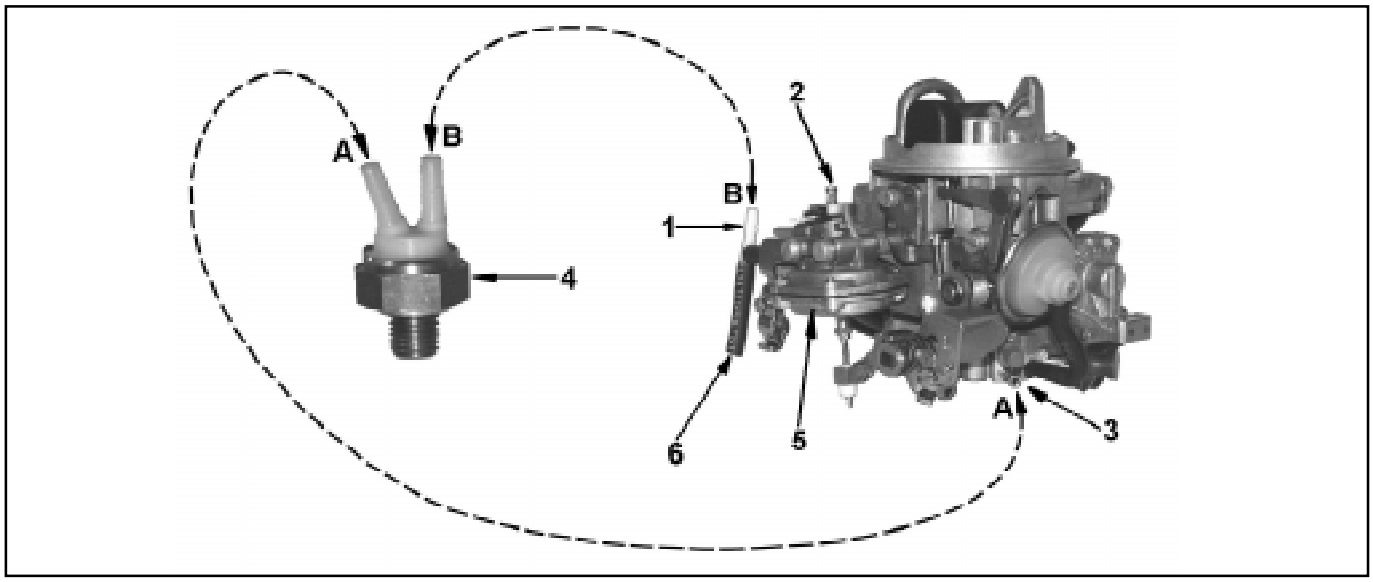
Fully pull out the starter lever and keep it in this position by means of an elastic band between the lever and the sheath support. The throttle opening must be 0.65 to 0.75 mm (dimension **Y**) in these conditions.
Dimension **Y** must be measured from the side of the progressive outlet holes.
If the primary throttle opening fails to correspond to the prescribed value, modify the position of the adjuster screw (**1**) and then lock it in place with the check nut (**2**).



143

Partial air powered opening of the ignition throttle

After having fully pulled out the starter, the choke throttle opens leaving a 4 ± 0.25 mm space (dimension **Z**) while the vacuum acts after the primary throttle (simulate the condition by lowering the air control lever). Measure dimension **Z** as indicated in the figure.
If choke throttle opening fails to correspond to the prescribed value, it can be modified by means of adjuster screw (**1**).



144

Carburetor with variant to keep the engine idling when cold

Components:

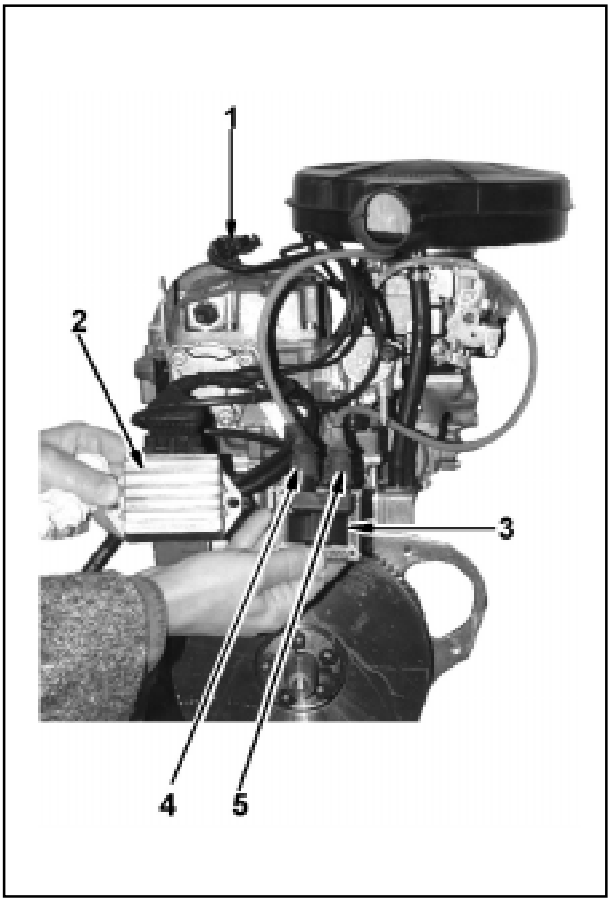
1 T union
2 Accelerated idling adjuster screw
3 Pressure hole
4 Thermovalve
5 Pneumatic actuator on the carburetor
6 Calibrated hole
7 Not in the drawing - Plant 2193-113 (see fig. 164 on page 73)

Operating principle

Thermovalve **4**, which guarantees regulation of the on-off type in the air circuit, is installed on the water pump support to adjust to the temperature of the aluminium.
The thermovalve is then connected by tubes in the following way:
a) union **parallel** to its axis, with union **1** free on the actuator plenum (obligatory route **B-B**)
b) union **slanting**, with union after the throttle of carburetor **3** (obligatory route **A-A**).
There is a T union **1** with calibrated hole **6** to allow the idling actuator to be released in the connection between the plenum and thermovalve.
Make sure that the hole is free to prevent the engine from remaining accelerated when hot, and check that the reduction is installed to prevent the engine from accelerating when idling and cold.
To ensure the device operates in the correct way, the system also has an electronic module to handle the ignition phase: compared to the original one, which gave an increasing timing to to 3000 r/min, the modified module has a constant 11° timing up to 2000 r/min in closed throttle conditions.
This allows an optimum adjustment of the air device when hot.
The actuator consists of a diaphragm which, controlled by the vacuum, allows the throttle valve to open and the idling speed to be consequently corrected.
This means that once the engine has started and the starter has been disengaged, the idling speed (initially around 1050 - there is a certain delay in the system) then stabilizes at around 1200 to 1300 r/min.
From the moment in which the system reaches its running speed, with gradual heating of the engine, the idling rate rises to about 1600 to 1700 r/min before the solenoid valve cuts out the device.

Adjusting the device

To adjust the idling speed, connect the actuator straight on to the carburetor (on the union after the throttle, see fig. 144), bypassing the thermovalve.
After having warmed up the engine, adjust regulation screw **2** on the upper part of the actuator, see fig. 144, to obtain a speed of about 1700 r/min (tighten the screw to decrease the supplementary opening of the throttle and lower the rotation speed of the engine, and vice versa).
Now re-connect the tubes on the thermovalve and on the carburetor, then adjust the idling speed of the engine to around 1100 speed by means of the idling speed screw.



145

! This warning is valid for engines LGW 523 and 627
Take care to fix the harness wires in the correct way to prevent twists from forming.
Electromagnetic fields could create abnormal voltage values leading to faulty operation in the ignition system.

LGW 523 ignition system

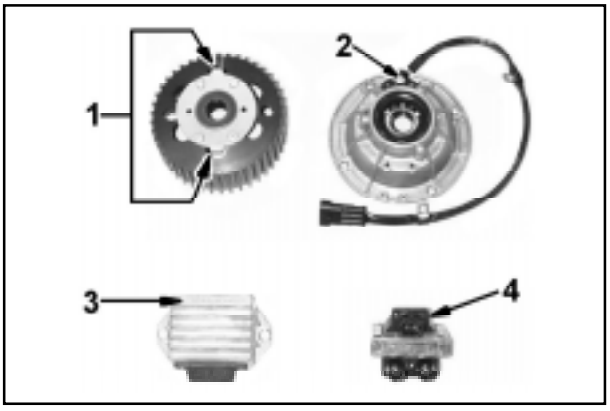
Components
1 Sensor with the Hall effect
2 Electronic module serial N° 122.2193.108 (see fig. 162)
2 Electronic module serial N° 122.2193.113 (see fig. 164)
3 Coil
4 Spark plug wire for cylinder N° 2
5 Spark plug wire for cylinder N° 1

Introduction

The ignition system on LGW engines consists of an electronic module **2** (fig. 145) which, by means of the sensor with the Hall effect, detects the passage of a plate **1** (fig. 146) on the timing pulley of the camshaft. This produces the number of revolutions and the phase angle.
These parameters are used to handle the high voltage outputs that pilot the coil **3** (fig. 145), connected by means of two high voltage cables to the respective spark plugs.

Operating principle

The ignition system installed on these engines allows the firing control point to be monitored using the number of engine revolutions and the reference given on a level with top dead center as parameters.
The data concerning the required spark lead curve are in (mapped) the memory of the microprocessor.
The system is called static since there are no rotating magnets or other mechanical devices in movement. Neither is a distributor installed.
The module determines the lead angle according to the number of engine revolutions, taking the information from the sensor with the Hall effect, along with with the corresponding phase angle.
The information is given by a single sensor that also allows the timing angle to be gauged.

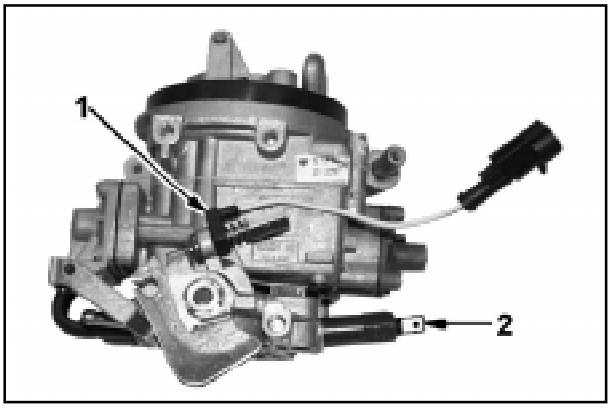


146

Main components of the LGW 523 ignition system (fig. 146)

1 Timing pulley of the camshaft with plate (configuration **1** for engine LGW 523 at 180°) to transmit to the sensor with the Hall effect
2 Cover on the camshaft on the timing system side with the Hall effect sensor mounted
3 Electronic module
4 Coil

Apply a 6 Nm torque when remounting the (switching plate).



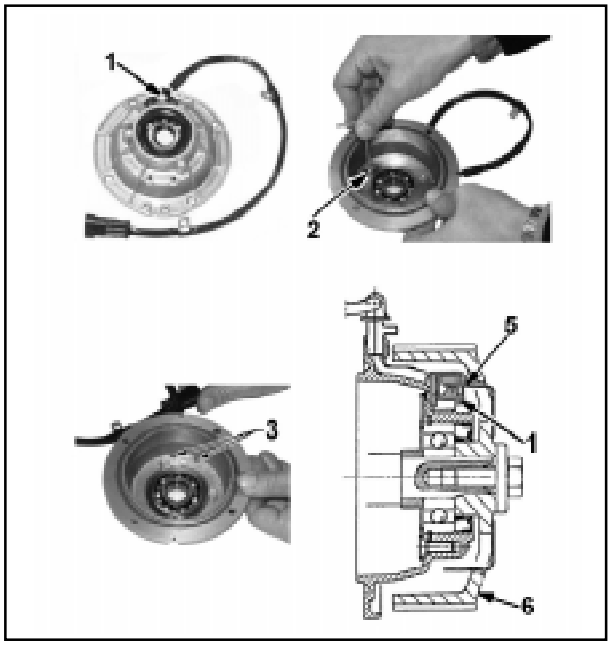
147

LGW 523 cut-off

In engine LGW 523, the module pilots an inductive load (coil of the cut-off solenoid valve on the carburetor **2** fig. 147) by means of a contact signal (on the idling speed adjuster screw) **1** fig. 147.
When the fuel throttle is released, the speed adjuster screw (which is mounted on an insulating support) is grounded. A wire leads from this screw to the module.
The module recognizes whether the throttle is being released when the contact is grounded.
In this condition and if the engine rate is more than 2000 r/min, the solenoid valve of the cut-off is closed to prevent fuel from flowing into the idling duct.
This prevents fuel from being consumed when the engine is in the release phase at high speeds.
The solenoid valve of the cut-off is powered by the module and this occurs when the engine operates (the module detects the passage of the switching plate).

523 Ignition process

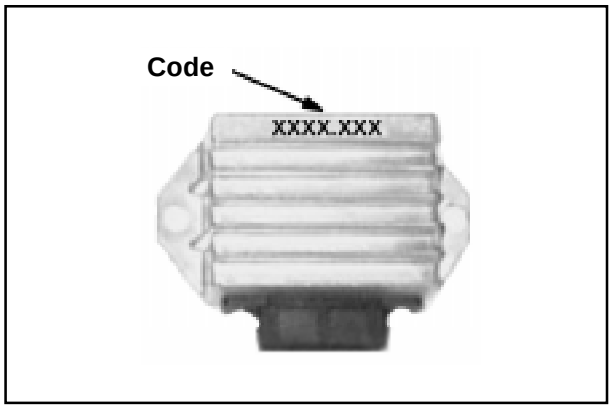
There is a support 1with two laminations set at 180° (fig. 146) on the timing pulley of the camshaft timing system.
The spark is supplied on each revolution on both cylinders (lost spark). The current runs from a high voltage contact of the coil to the connected spark plug and from thence via the ground to the other spark plug subsequently returning to the coil via the cable. The sparking instant is therefore necessarily the same for both spark plugs.
If one of the spark plugs fails to spark, the spark will also not strike on the other. If the spark plug discharges towards ground, the other will not have a normal spark.
The two spark plugs operate with opposite polarities. The central electrode of one will be positive and the other negative (this latter is more liable to wear).



148

Phase sensor

The phase sensor used to identify the correct phase angle, is a sensor with Hall effect **1**. It is activated by a magnet inside the sensor itself.
The influence of the magnet is eliminated when lamination **5** is held by sensor **1**, thus determining an output signal.
The engine rotating speed is gauged by measuring the time that elapses between two consecutive lamination passages.
The input instant of lamination **5** forms the reference for the calculations made by the module to determine the firing point.
Three wires reach sensor **1**: the black one is grounded, the red one is connected to 15-54 of the ignition block (and, thus, to the battery +) while the green one is connected to the module.
The green wire will not be powered if the sensor is free. A 5 Volt value can be read if the sensor is held by the lamination.
Sensor **1** is positioned so that the voltage transmitted to the green wire changes from 5 Volts to 0 with the crank shaft at 11° prior to T.D.C.
Sensor **1** is glued to the cover of the camshaft. Its functionality can be tested by connecting the relative test instrument which, when the contact is made, checks whether the sensor is functional.
In the event of faults, the sensor cannot be repaired and must therefore be replaced.
If the Hall effect sensor must be replaced, unscrew the three screws **2** fig. 148 to remove the lamination and take out the two pins **3** fig. 148.
Immerse the pins in Loctite type 648BV when remounting.
After the timing pulley of the camshaft has been mounted complete with lamination **6**, make sure that this sets into its housing on the center-line of the sensor.
If the setting is less than perfect owing to accidental deformations in the lamination, its position must be restored as indicated in **1**-**5**



149

The technical specifications of the modules are similar for engines LGW 523 and LGW 627. Despite this fact, different types can be mounted since the programming maps can vary. Make sure that the right one is installed in case of replacement.
The spark lead curve is the same for both engines LGW 523 and LGW 627

Technical specifications of the ignition module

- Spark produced regardless of a low idling rate
- Power source voltage rating : from 5.6 Volts to 18 Volts; can withstand 18 Volts for 1 hour of 24 Volts for 1 minute
- Operating temperature : from -40° to +85° C.
- Maximum power draw: 2.1 A at a low idling rate (<500 r/min) with 14.5 Volt power supply
- Power draw before start-up: 50 mA (current activation in the coil occurs after engine movement has been detected)
- Protection against overtemperatures
- Protection against short circuits
- Ability to pilot coils with a 0.5 **W** primary (primary resistance) and 7 mH inductance
- Current limitation in the coil: 6 A
- Coil disconnected from the power supply if the engine accidentally stops (with the ignition key inserted)
- Protection against disconnection (accidental and intentional) of the high voltage wires from the coil and spark plugs
- Solenoid cut-off monitoring output protected against short circuits
- Fade-free current to primary of high voltage coil

The functionality test of the ignition module should be carried out by means of the relative instrument. The module should be replaced if faults are discovered.

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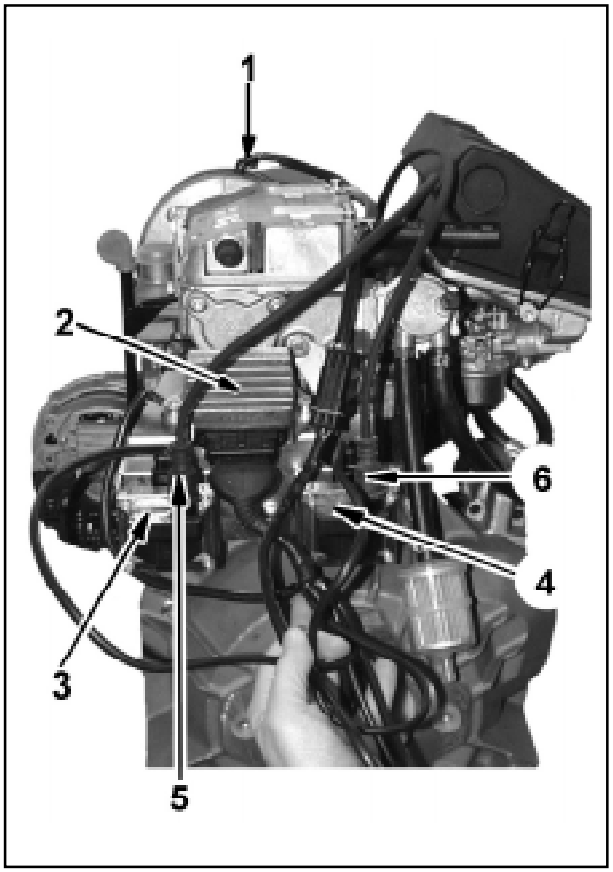
LGW 523 coil

The coil is powered by two wires.
The red one is constantly powered by the battery through 15-54.
The brown (or pale blue) wire is controlled by the module.
To charge the coil, the module is grounded by the second wire via an internal contact: this allows current to circulate (regulated by the module and no longer at 6 A) and the magnetic circuit of the coil to charge.
The moment in which the spark must strike, the ground connection is opened. This causes the voltage to rapidly rise on the secondary and thus produce the spark.
At engine speed of less than 900 r/min, the coil is powered when the lamination enters the sensor, to guarantee maximum energy during the ignition phase.

At higher speeds, the module measures the time that elapses between two successive entries of the lamination, thus evaluating the rotating speed of the engine.
The sparking point is chosen according to the rotating speed in a table measured by the module.
More precisely, the table gives the time that must be waited after the lamination has entered the sensor before the coil is activated. The coil remains activated for 1.5 ms (0.0015 sec.) after which the spark is struck.
Since the coil activation point is determined by the module according to the rotation speed value measured during the previous revolution, module calculations may involve an excessive delay in the coil activation instant in the case of repeated accelerations and this may make the engine misfire.
To prevent this from happening, the spark is never given beyond the point the enabling lamination leaves the sensor even if the delay time calculated by the module has not yet elapsed.
The coil can be checked by means of the instrument used to test the module.
Faulty coils must be replaced.

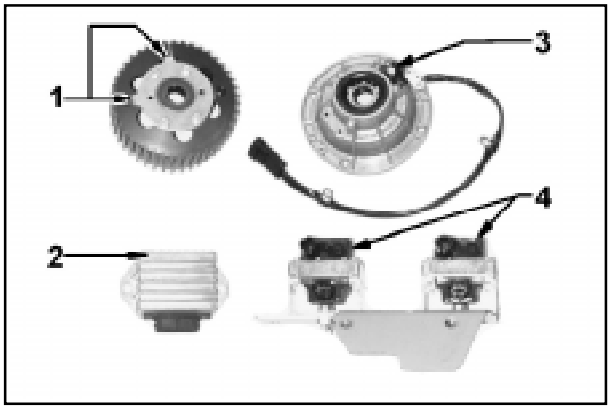


151

This warning applies to engines LGW 523 and 627
Take care to fix the harness wires in the correct way to prevent coils from forming.
Electromagnetic fields could create abnormal voltage values leading to faulty operation in the ignition system.

LGW 627 ignition system

Components
1 Sensor with Hall effect
2 Electronic module serial N° 122.2193.109 (see fig. 156)
2 Electronic module serial N° 122.2193.114 (see fig. 158)
3 Coil
4 Coil
5 Wire for cylinder N° 1 spark plug
6 Wire for cylinder N° 2 spark plug



152

Main components of the LGW 627 ignition system (fig. 152)

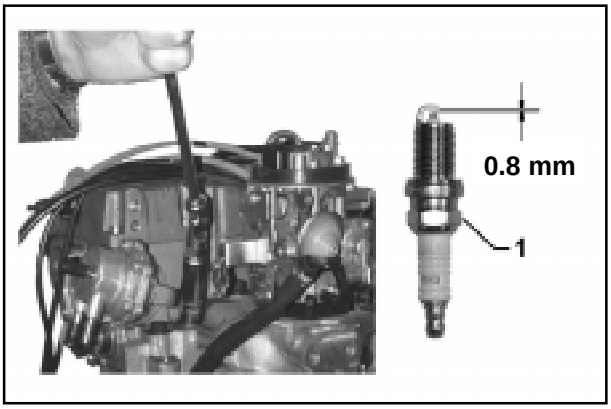
Foreword : A phase sensor and two high voltage coils with one output are activated.

1 Timing pulley of the camshaft with lamination (in configuration **1** for engine LGW 627 at 90°) to transmit to the sensor with Hall effect
2 Electronic module
3 Cover situated on the camshaft on the timing system side with the Hall effect sensor installed
4 Coils

Apply a 6 Nm driving torque to remount the enabling (switching plate).

Operating principle

In engine LGW 627, the two laminations **1** are at 90° to each other.
Module **2** waits for the engine to accomplish a complete starting cycle (two crank shaft turns) to set the signal from laminations **1** in phase with the cylinders.
The starter motor must therefore remain engaged for about 1 second before the first spark is produced.
Following this, module **2** will alternate its control of coils **4** on each lamination passage.



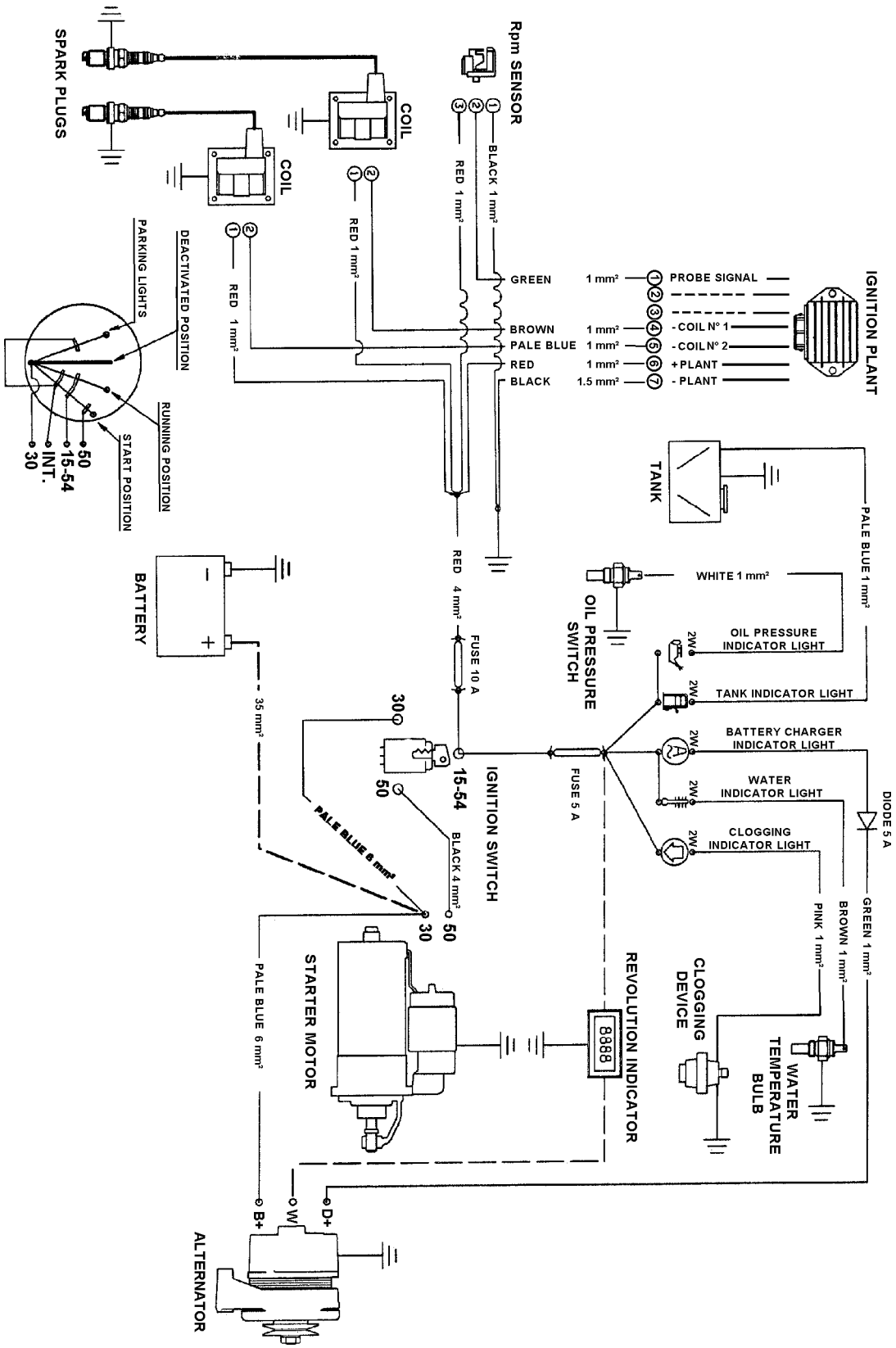
153

! The spark plug must always be demounted and remounted when the engine is cold to prevent the thread on the aluminium cylinder head from being damaged.

Spark plug (type Champion RC12YC)

Fit the spark plugs in place by fully screwing them on to the head by hand.
Final torquing must be carried out with the relative 90° angle wrench or to a 30 Nm driving torque.
Hex nut **1** to demount and remount the spark plug measures 16 mm.
If necessary, clean the electrodes with a bronze bristle brush and blow with compressed air.
If the ceramic insulation is chipped or the electrodes worn, replace the spark plug for another with the same thermal rating.

Wiring diagram of gasoline (petrol) fuelled engine LGW 627 with external alternator and module serial N° 122.2193.109



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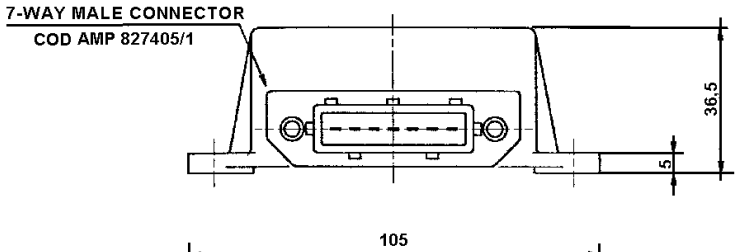
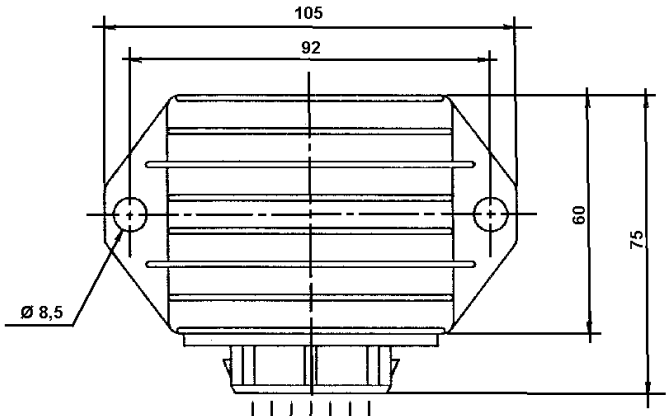
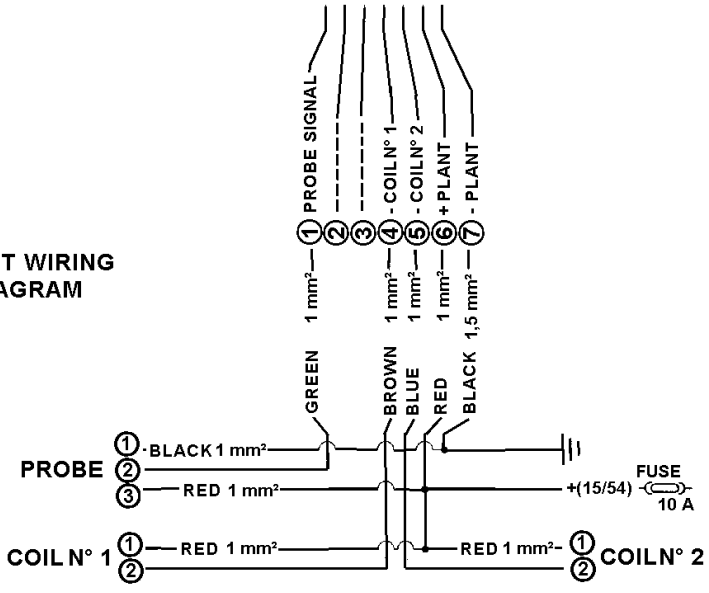
		1-5302-509	50778	10.06.99		10.06.99	

Ignition module of gasoline (petrol) fuelled engine LGW 627 with spark lead variation device serial N° 122.2193.109

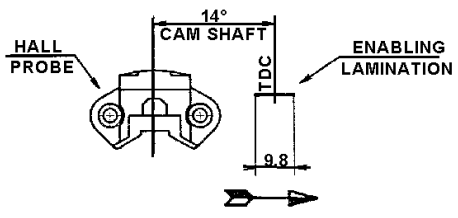




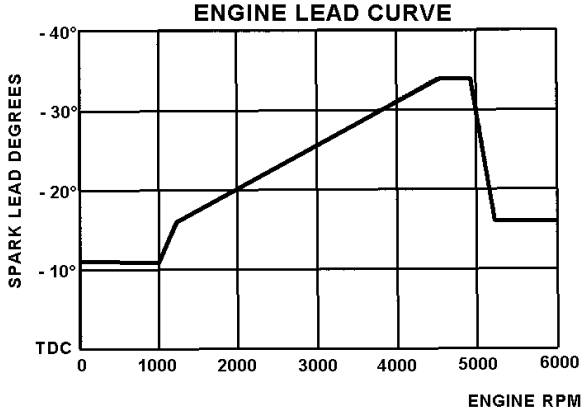
PLANT WIRING DIAGRAM



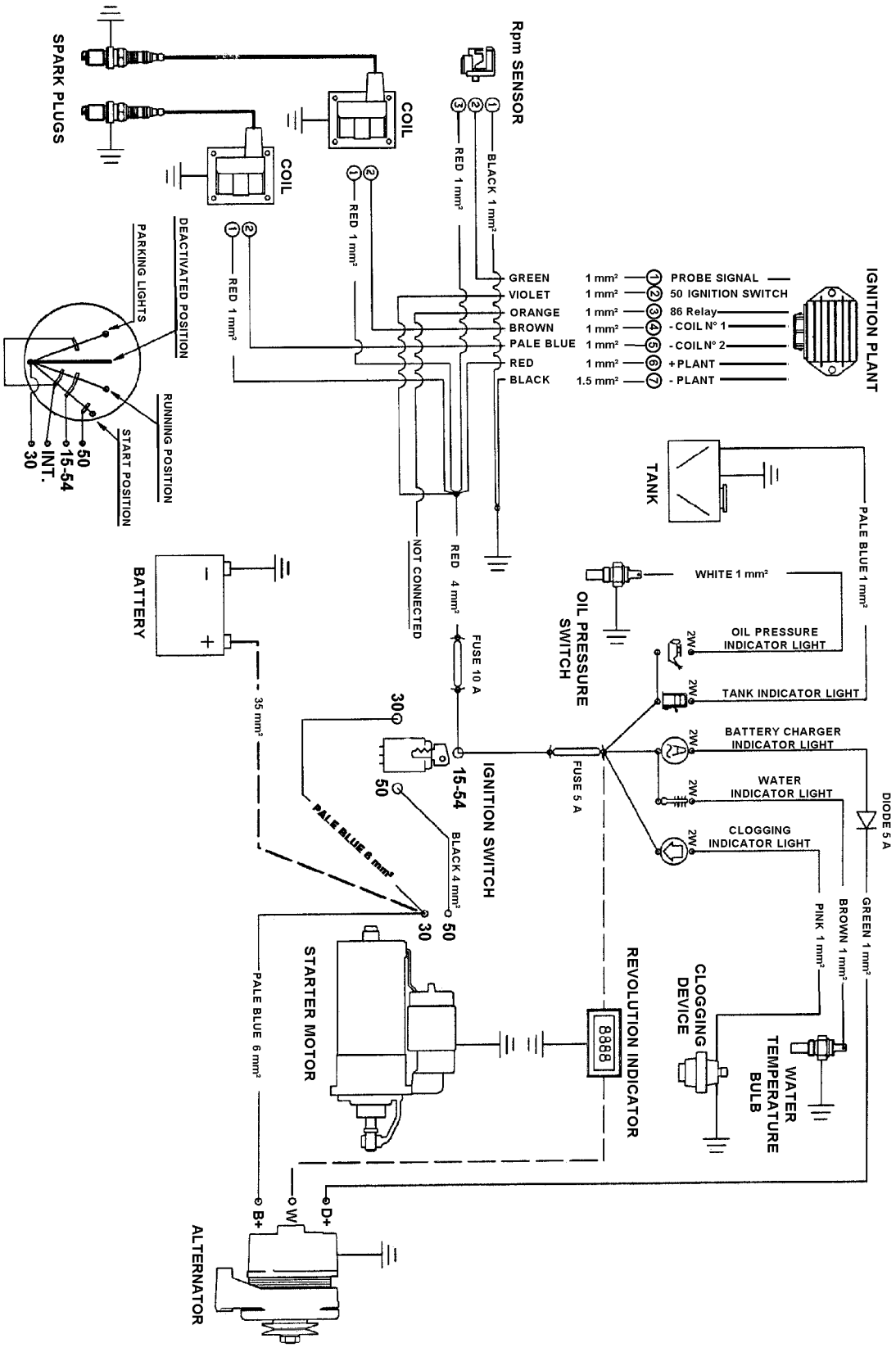
IGNITION PLANT CONFIGURATION



ENGINE LEAD CURVE



Wiring diagram of gasoline (petrol) fuelled engine LGW 627 with external alternator and module serial N° 122.2193.114



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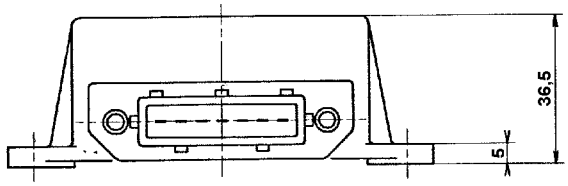
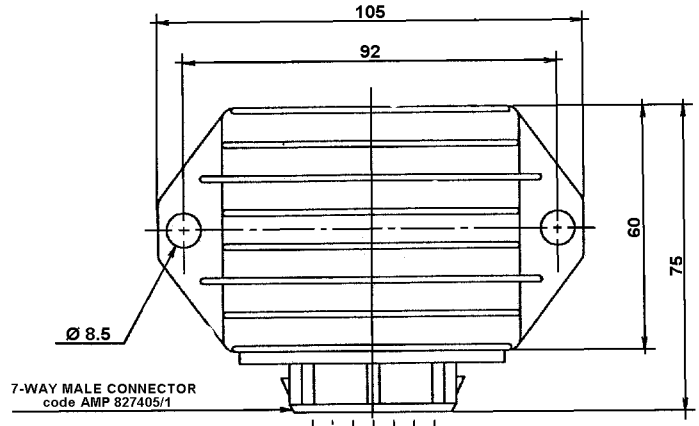
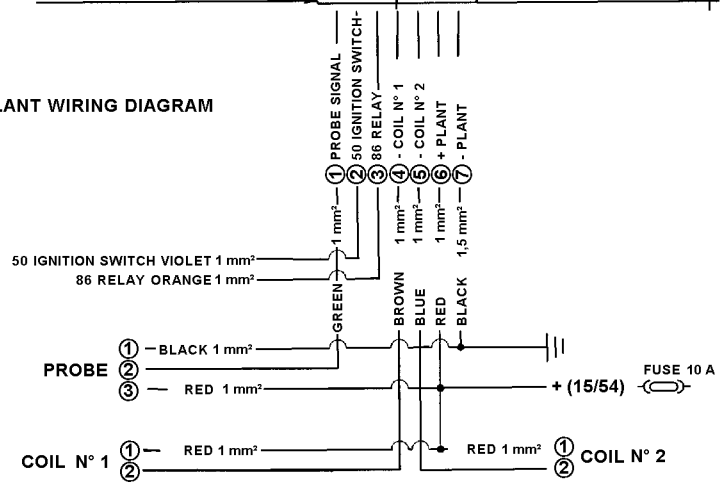
Ignition module of gasoline (petrol) fuelled engine LGW 627 with spark lead variation device serial N° 122.2193.114

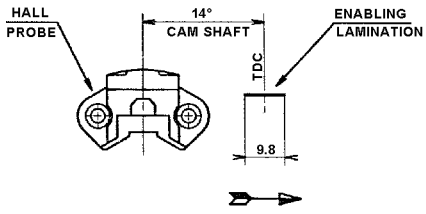




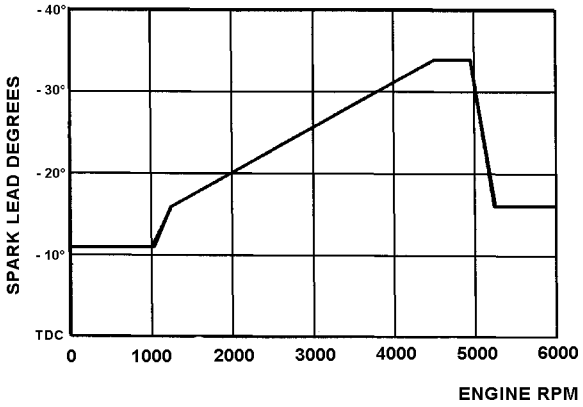
PLANT WIRING DIAGRAM



IGNITION PLANT CONFIGURATION

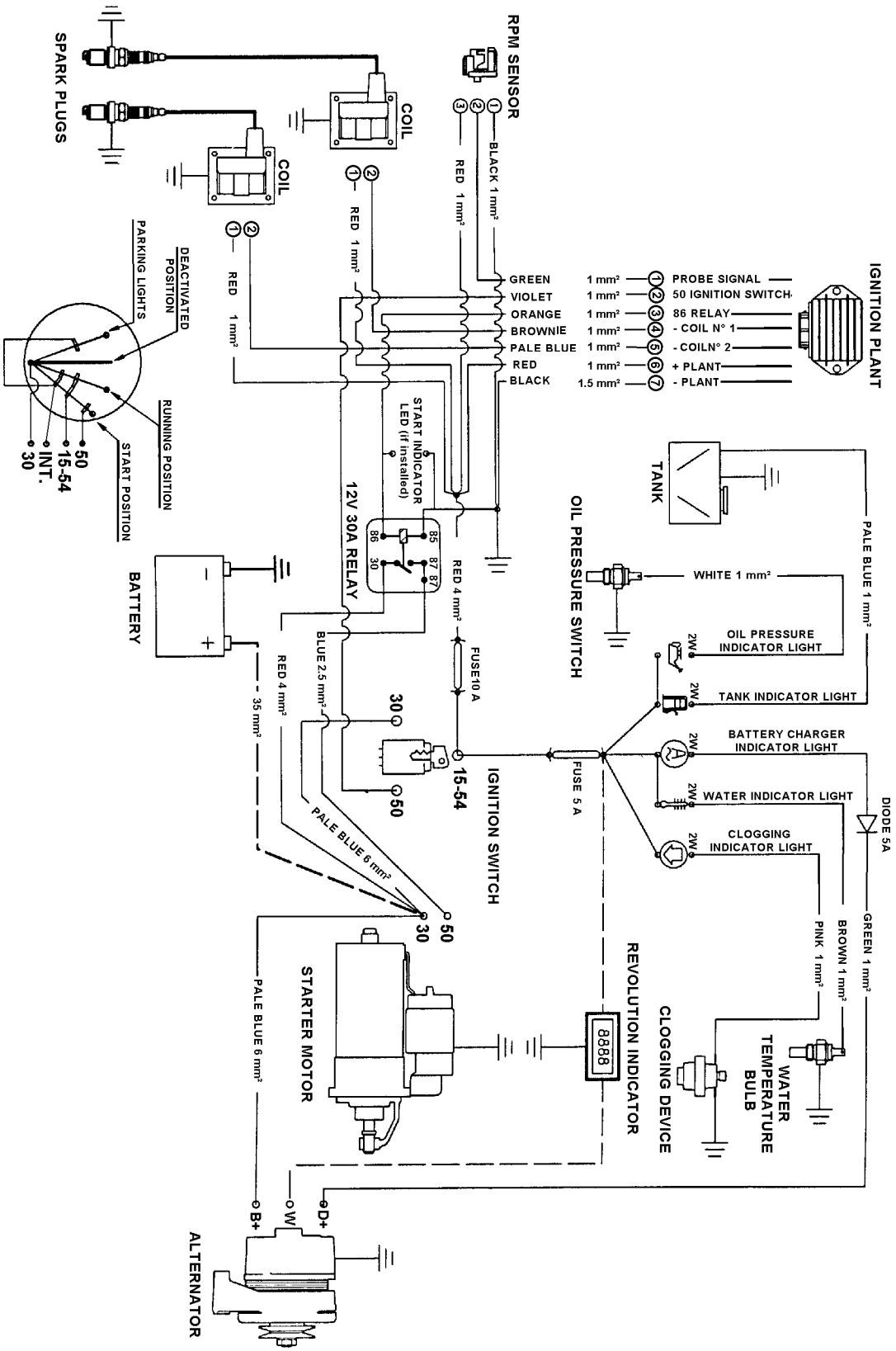


ENGINE LEAD CURVE



COMPILER TECO/ATL	REG. CODE	MODEL N°	DATE OF ISSUE	REVISION 00	DATE	ENDORSED	67
	1-5302-509	50778	10.06.99		10.06.99		

Wiring diagram of LPG fuelled engine LGW 627 with external alternator and module serial N° 122.2193.114



68	COMPILER TECNIATI	REG. CODE	MODEL N°	DATE OF ISSUE	REVISION 00	DATE	ENDORSED
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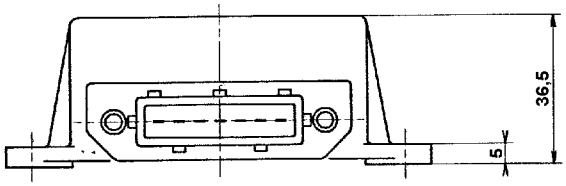
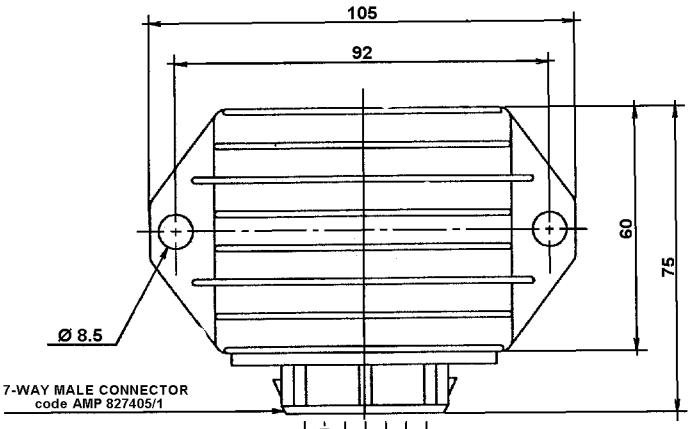
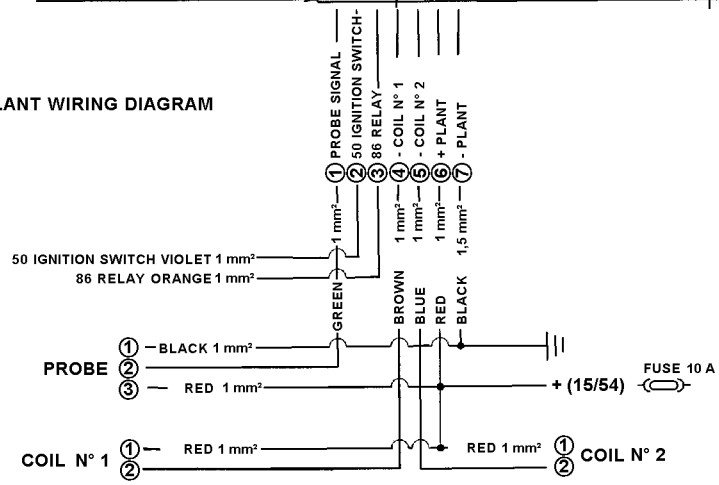
Ignition module of gasoline (petrol) and LPG fuelled engine LGW 627 with spark lead variation device serial N° 122.2193.114

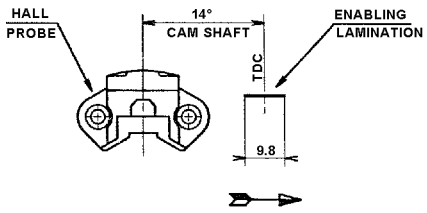




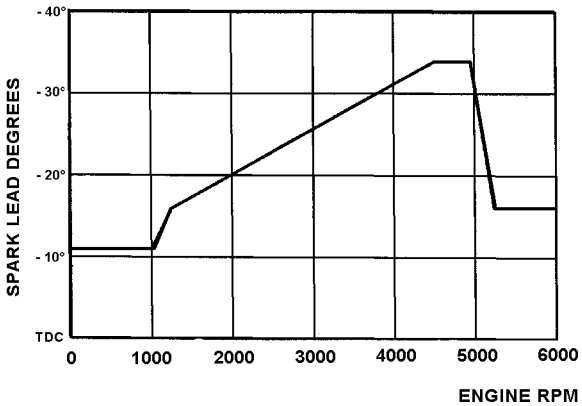
PLANT WIRING DIAGRAM



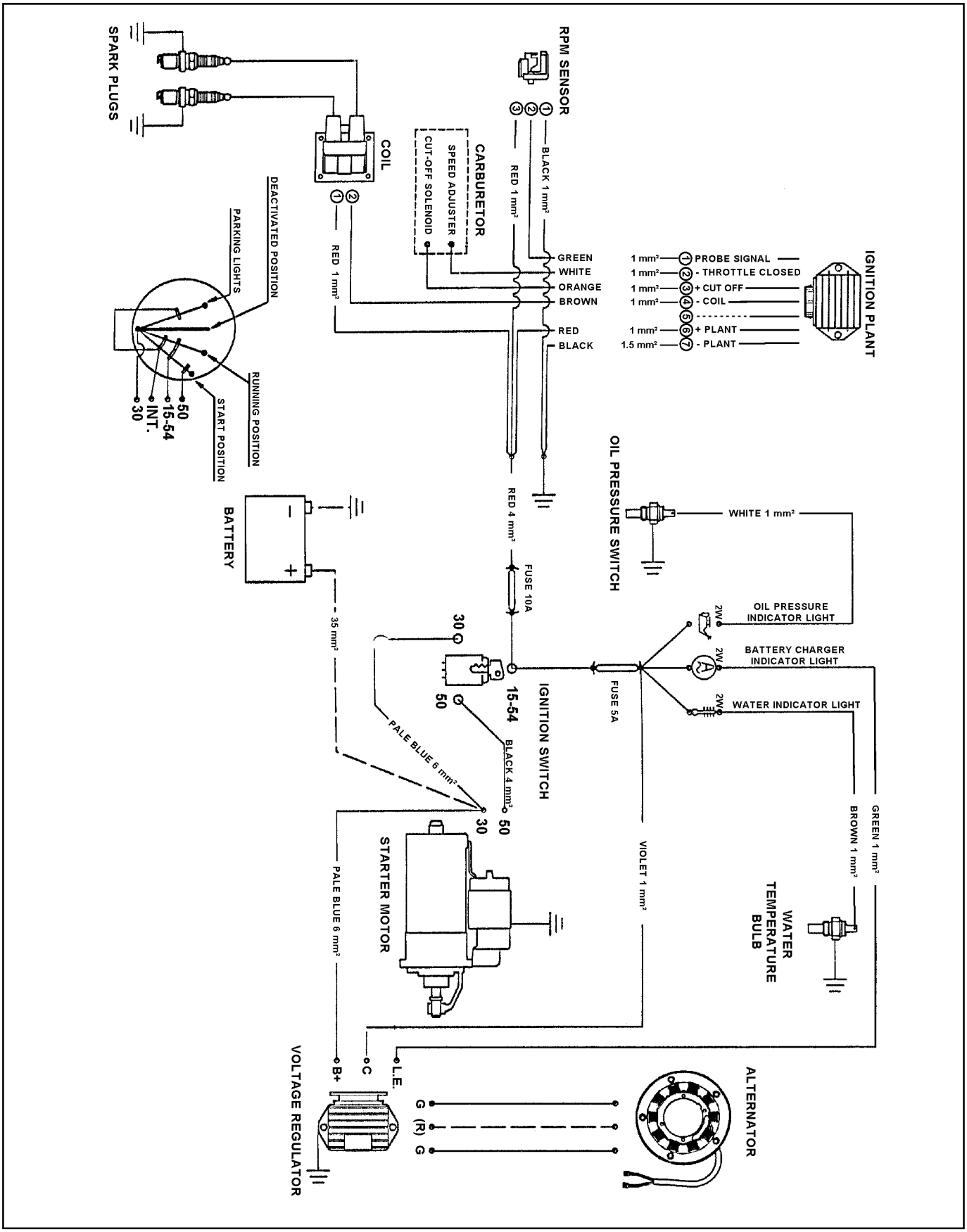
IGNITION PLANT CONFIGURATION



ENGINE LEAD CURVE



Wiring diagram of gasoline (petrol) fuelled engine LGW 523 without idling back-up device, with internal alternator and module serial N° 122.2193.108



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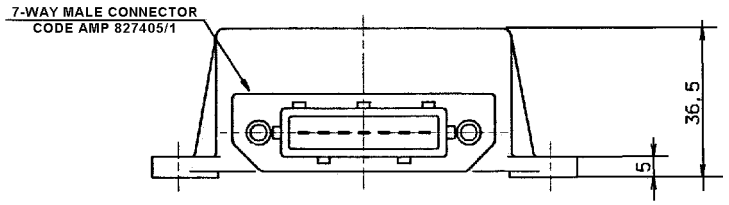
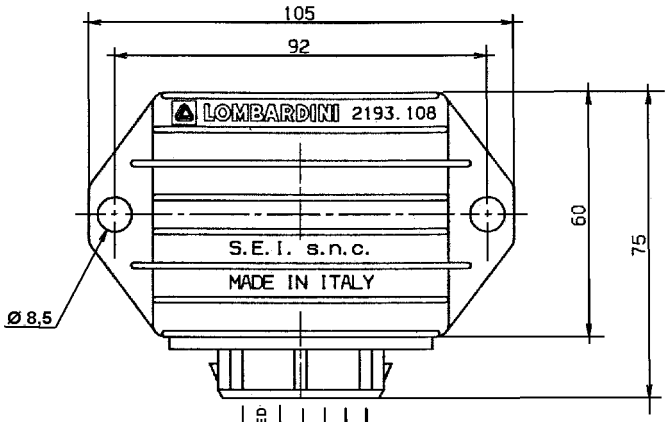
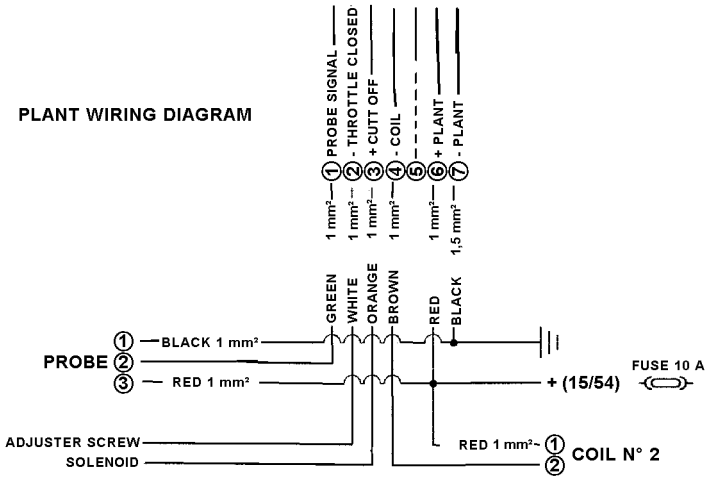
Ignition module of gasoline (petrol) fuelled engine LGW 523 without idling back-up device serial N° 122.2193.108

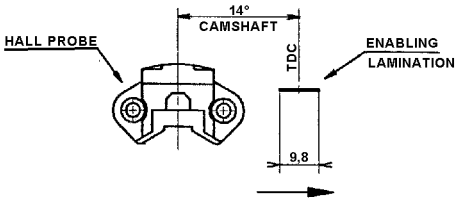




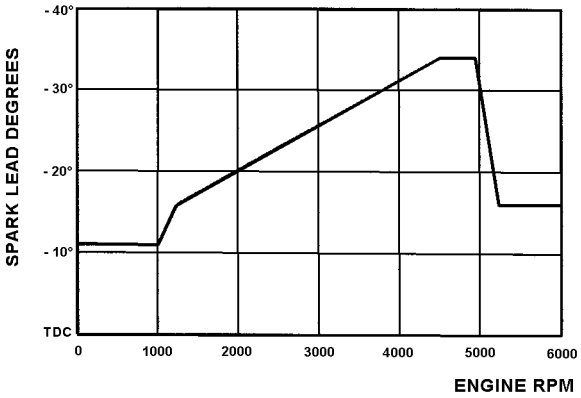
PLANT WIRING DIAGRAM



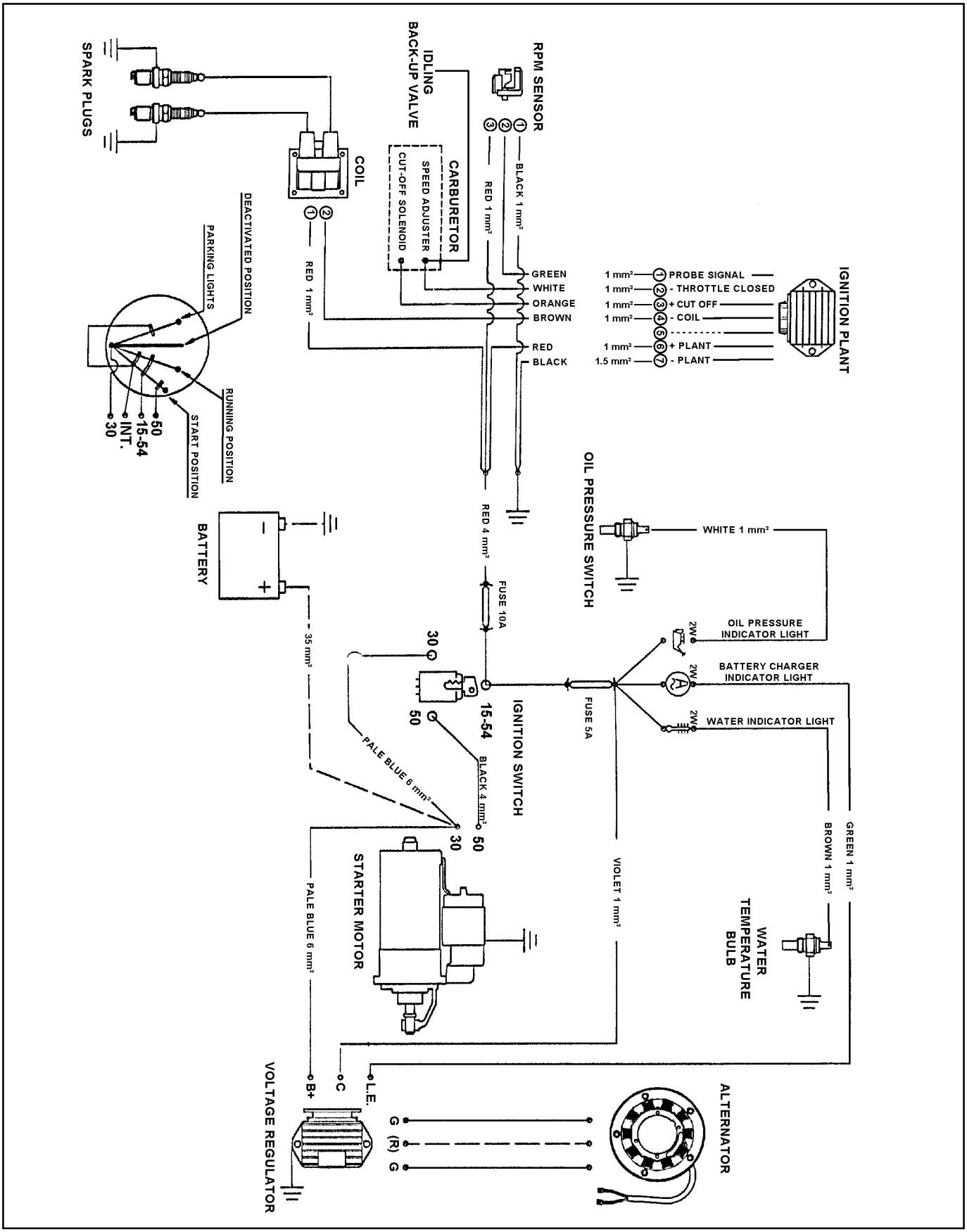
IGNITION PLANT
CONFIGURATION ON CAMSHAFT



ENGINE LEAD CURVE



Wiring diagram of gasoline (petrol) fuelled engine LGW 523 with idling back-up device, internal alternator and module serial N° 122.2193.113



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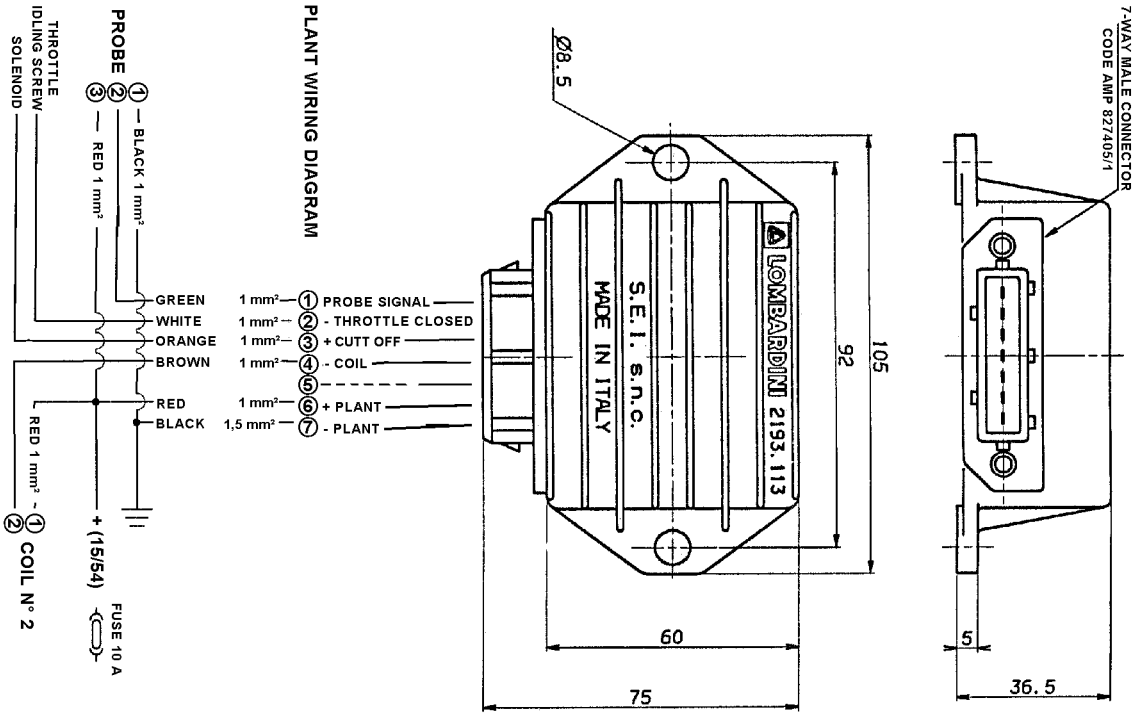
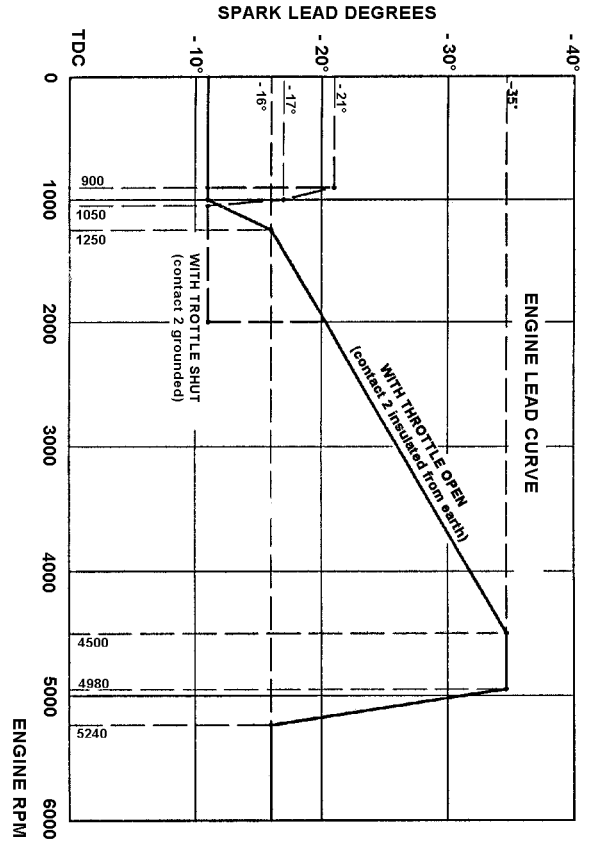
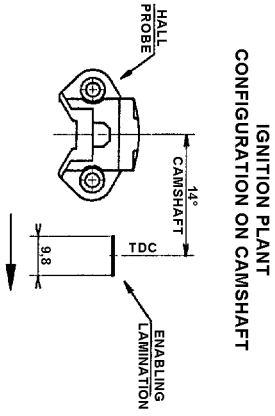
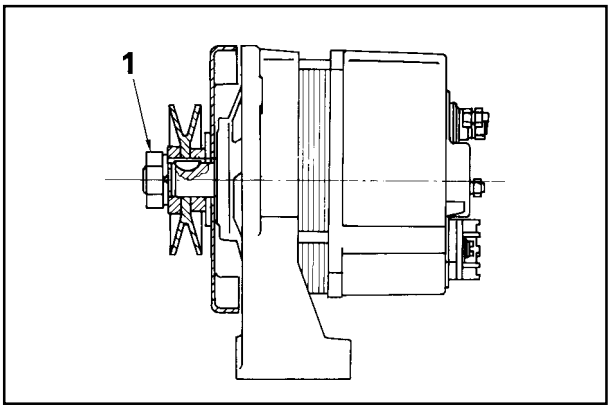
		1-5302-509	50778	10.06.99		10.06.99	

Ignition module of gasoline (petrol) fuelled engine LGW 523 with idling back-up device serial N° 122.2193.113







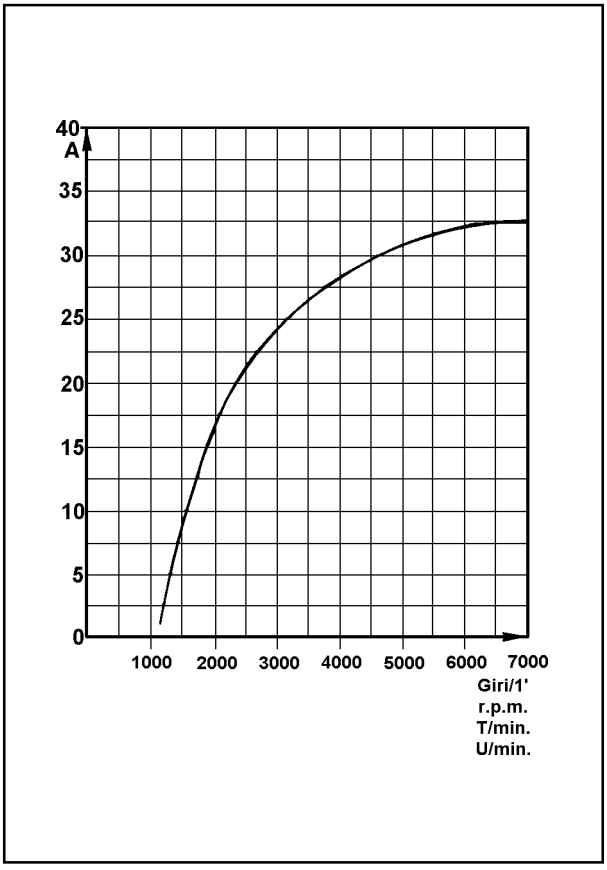


165

Alternator Iskra 14V 33A

Voltage rating = 14V
Rated current = 33A
Max speed = 12000 r/min
Max peak speed = 13000 r/min
AER 1503 voltage governor
Clockwise rotation

Note: Tighten nut **1** to a 35 to 45 Nm torque.



166

Characteristic curve of the Iskra 14V 33A alternator

The curve was measured at a constant voltage rating of 14V and at an ambient temperature of 25°C.

Note: The r/min speed in the table are those of the alternator.
Engine r/min / alternator r/min ratio with diameter 88 mm driving pulley = 1:1.23

Incorrect corrections with the battery can create electrical discharge of considerable intensity and may even explode the battery itself.
Never work on the battery near naked flames, lighted cigarettes or sparks: risk of explosion or fire outbreaks. The fluid in the battery is poisonous and corrosive. Avoid contact with the skin and eyes.
The battery must be recharged in a well ventilated place, well away from naked flames and possible sources of sparks.
Batteries contain substances that are very harmful to the environment. If the battery is replaced, have the old one disposed of by authorized companies to protect the environment, in compliance with the laws in force.

Battery

The battery is not supplied by LOMBARDINI.
Recommended batteries for the engines in question (consult the table on the right)

Type of engine	Starter motor class (Epicyclic type) kW	Normal starting conditions		Heavy duty starting conditions(max tolerated)	
		Capacity (K 20) Ah	Quick disch. intensity (DIN standards at -18° C) A	Capacity (K 20) Ah	Quick disch. intensity (DIN standards at -18° C) A
LDW 523	1.1	44	210	66	300
LDW 627	1.1	44	210	66	300

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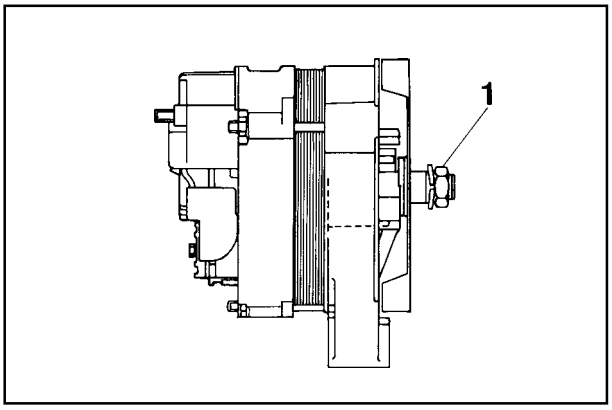
	1-5302-509	50778	10.06.99		10.06.99	



167

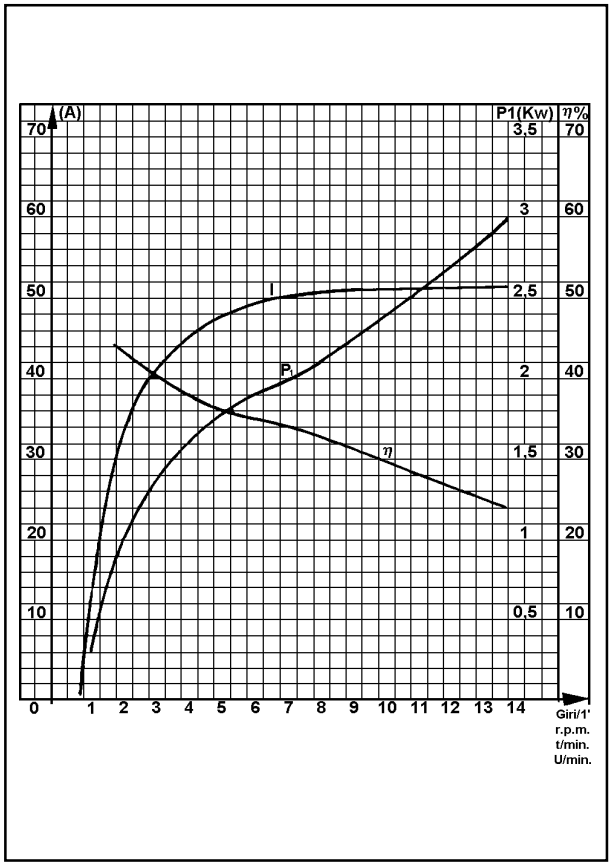
Marelli alternator, type AA 125 R 14V 45A

Specifications:

Voltage rating	= 14V
Rated current	= 45A
Maximum speed	= 14000 r/min
Maximum peak speed (for 15 sec.)	= 15000 r/min
Bearing on control side	= 6203-2Z
Bearing on collector side	= 6201-2Z/C3
Voltage governor	= RTT 119 A

Clockwise rotation

Note: Lubricate the bearings with grease suitable for high temperatures.
Tighten nut **1** to a 60 Nm torque.

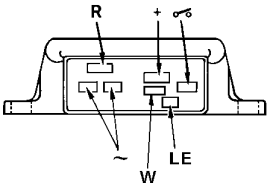


168

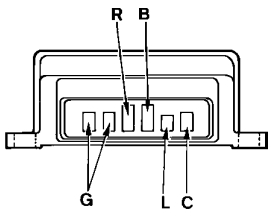
Characteristic curve of alternator Marelli AA 125 R 14V 45A

The curves were measured with an electronic voltage governor after a 25°C heat stabilizing process; test voltage 13,5 V.
P1 = Power in KW
I = Current in Amperes
h = Alternator efficiency

Note: The r/min rates in the table multipled by 1000 are those of the alternator.
Engine r/min / alternator r/min ratio with 88 mm diameter driving pulley = 1:1.3; with 108 diam. driving pulley = 1:1.6.



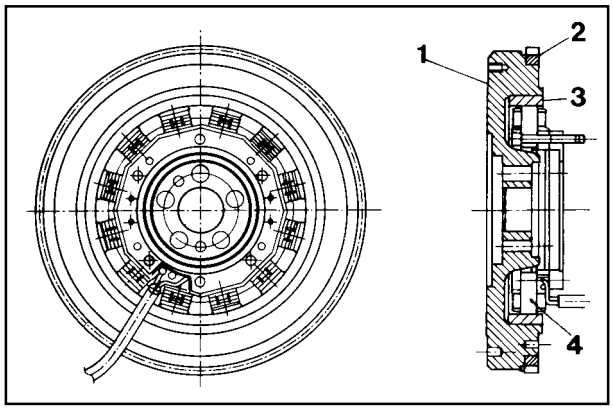
169



170

Voltage regulator connection

AETSA SAPRISA NICSA	Wire colours	DUCATI	Tab dimensions	
			Width	Thickness
~	Yellow	G	6.35	0.8
R	Red	R	9.50	1.2
+	Red	B	9.50	1.2
LE	Green	L	4.75	0.5
○ ○	Brown	C	6.25	0.8
W	Orange	W	6.35	0.8

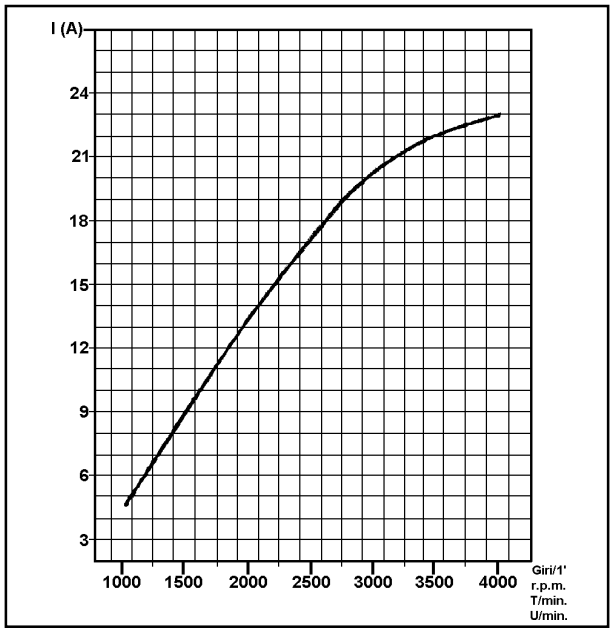


171

Alternator housed in the flywheel

12V 20A with three output wires
12V 30A with two output wires

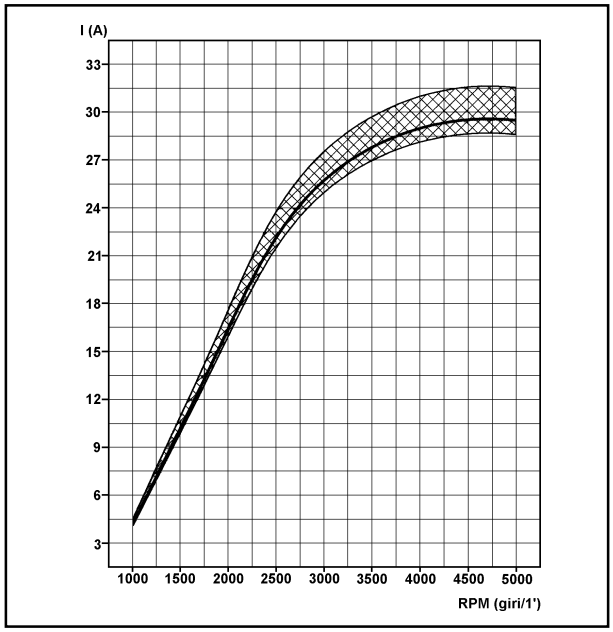
1 Flywheel
2 Ring gear
3 Rotor
4 Stator



172

Battery recharging curve for 12V 20A alternator
(three output wires)

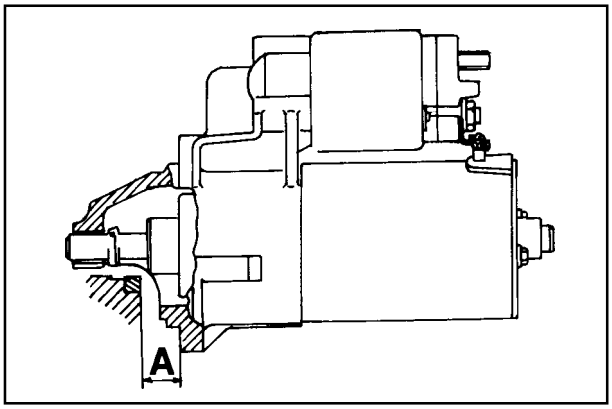
The test was conducted after a 20°C heat stabilizing process.
The current delivery with reference to the curve may be subjected to variations between +10 % and -5 %.



173

Battery recharging curve for 12V 30A alternator
(with two output wires)

The test was conducted after a 20°C heat stabilizing process.
The current delivery with reference to the curve may be subjected to variations between +10 % and -5 %.

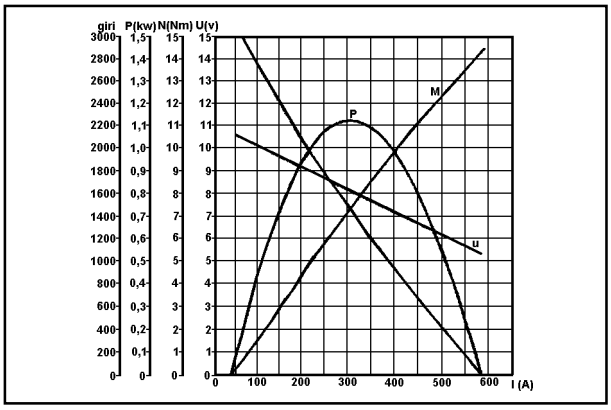


174

STARTER MOTOR
Bosch type DW 12V 1.1 KW
Clockwise rotation

A = 17.5 to 19.5 mm (distance from flywheel ring gear plane to starter motor flange plane)

Note: Contact the Bosch after-sales service network if repairs are needed.

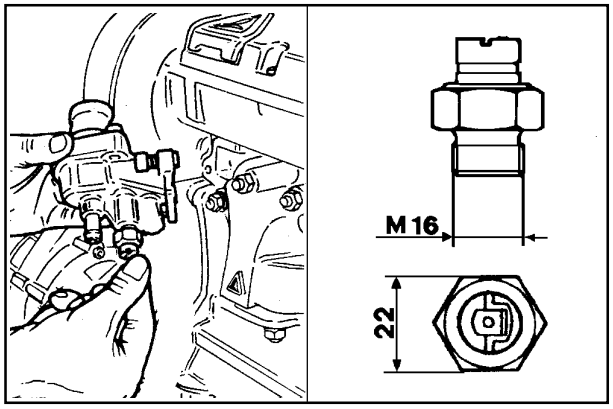


175

Characteristic curve of starter motor
Bosch type DW 12V 1.1 KW

The curves were measured at a temperature of -20°C with a 66 Ah battery

U = Voltage to starter motor terminals in Volts
n = Starter motor speed in r/min
I = Power draw in Amperes
P = Power in KW
M = Torque in Nm.

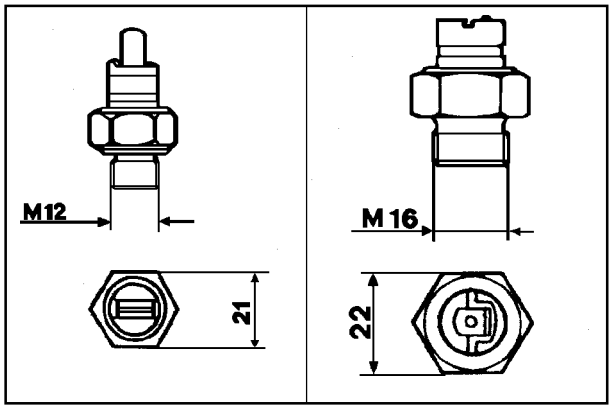


176

177

Sensor for coolant fluid temperature indicator

Specifications :
Circuit : unipolar
Power source voltage rating: 6 to 24 V
Power draw : 3W
Circuit closing temperature: 107 to 113°C
Driving torque: 25 Nm.

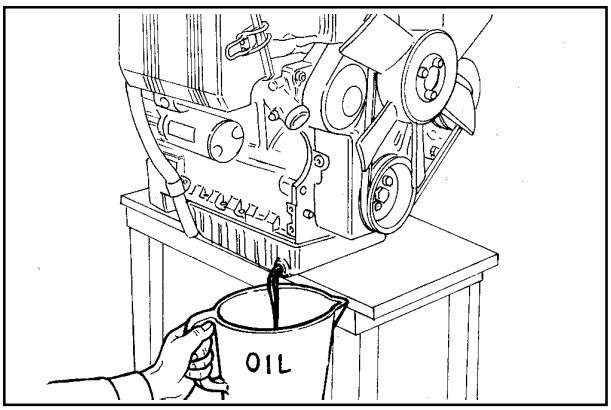


178

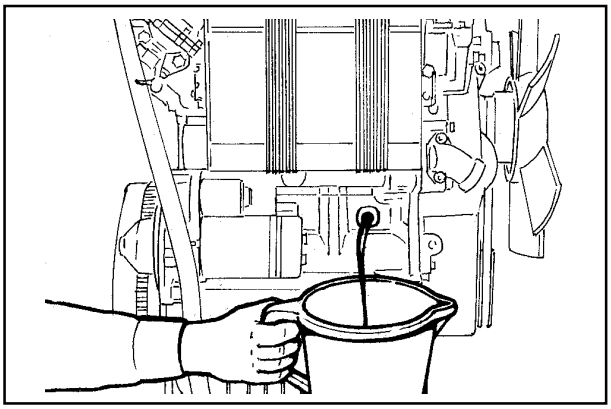
179

Pressure switch for oil pressure indicator (fig.177) and (fig.37 on page 28)

Specifications:
Activating pressure 0.15/0.45 bar (Excluding fixed speed generating set application)
Driving torque 25 Nm.



180



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STORAGE

Engines that must be stored for more than 30 days must be prepared in the following way:

Temporary protection (1/6 months).

- Allow the engine to idle in a no-load condition for 15 minutes.
- Fill the sump with protective oil MIL-1-644-P9 and allow the engine to run for 5 to 10 minutes at three-quarters of the top speed.
- When the engine is hot, empty out bottom plug (fig. 166) and fill with normal new oil (see recommended oil on page 17).
- Remove the fuel pipe and empty the tank.
- Take out the fuel filter and replace it with a new one.
- Remove the spark plugs and pour in a spoonful of engine oil per cylinder. Allow the engine to turn over a few times to distribute the oil over the cylinders, then fit the spark plugs back in place.
- Empty the carburetor (if unused for a long time, a transparent lacquer will form on the surface of unleaded petrol and this can clog all the holes, e.g. the fast running and slow running jets).
- Thoroughly clean the radiator fins and fan.
- Seal all openings with adhesive tape (intake and exhaust).
- Spray SAE 10W oil into the exhaust and intake manifolds, tappets, valves, etc., and protect unpainted parts with grease.
- Slacken off the fan belt.
- Wrap the engine in a sheet of plastic.
- Store the engine in a dry place, raised from the ground and well away from high voltage electric lines.

Permanent protection (longer than 6 months)

Besides the previous operations, it is advisable to:

- Treat the lubrication system and moving parts with rust-inhibitor oil corresponding to MIL-L-21260 P10 - grade 2 specifications, SAE 30 (E.g. ESSO RUST-BAN 623-AGIP, RUSTIA C SAE 30). Allow the engine to turn when full of rust-inhibitor, then drain off the excess.
- Cover the external unpainted surfaces with rust-inhibitor oil corresponding to MIL - C 16173D - grade 3 specifications (E.g. ESSO RUST BAN 398 - AGIP, RUSTIA 100/F).
- Replace the coolant fluid in the radiator once every two years (see page 18 of the Operation and Maintenance manual for the recommended type of coolant)

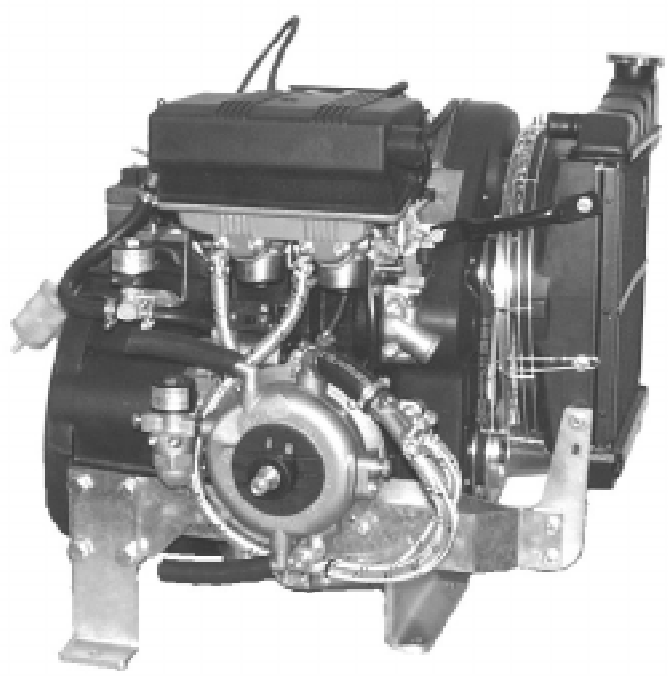
Preparing for operation

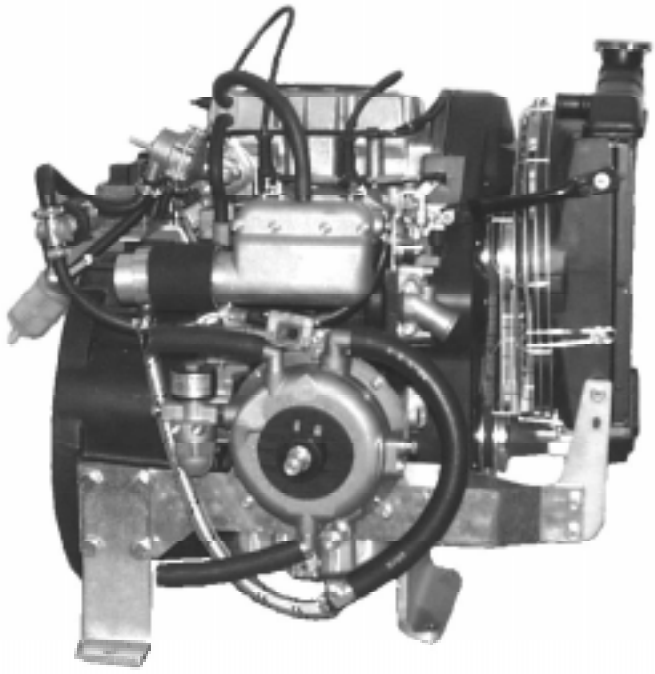
- Clean the outside parts.
- Remove the protections and wrapping.
- Remove the rust-inhibitor from the external parts using an appropriate solvent or degreasing product.
- Remove the air filter support and spray engine oil into the valves. Turn the crank shaft a few times, then demount the oil sump and drain off the oil containing the dissolved protective substance.
- Clean the fast running and slow running jets with trichloroethylene.
- Check the valve clearance, alternator belt tension, oil and air filters.
- Remove the spark plugs and pour in a spoonful of engine oil per cylinder. Allow the engine a turn over a few times to distribute the oil over the cylinders, then fit the spark plugs back in place.

If the engine has been stored for a very long period (longer than 6 months), examine a bushing to make sure there are no signs of rust.
After having carried out the previous start-up recommendations, comply with the instructions given in the Operation and Maintenance manual supplied with each engine.

Engine LGW 627

LPG fuelled





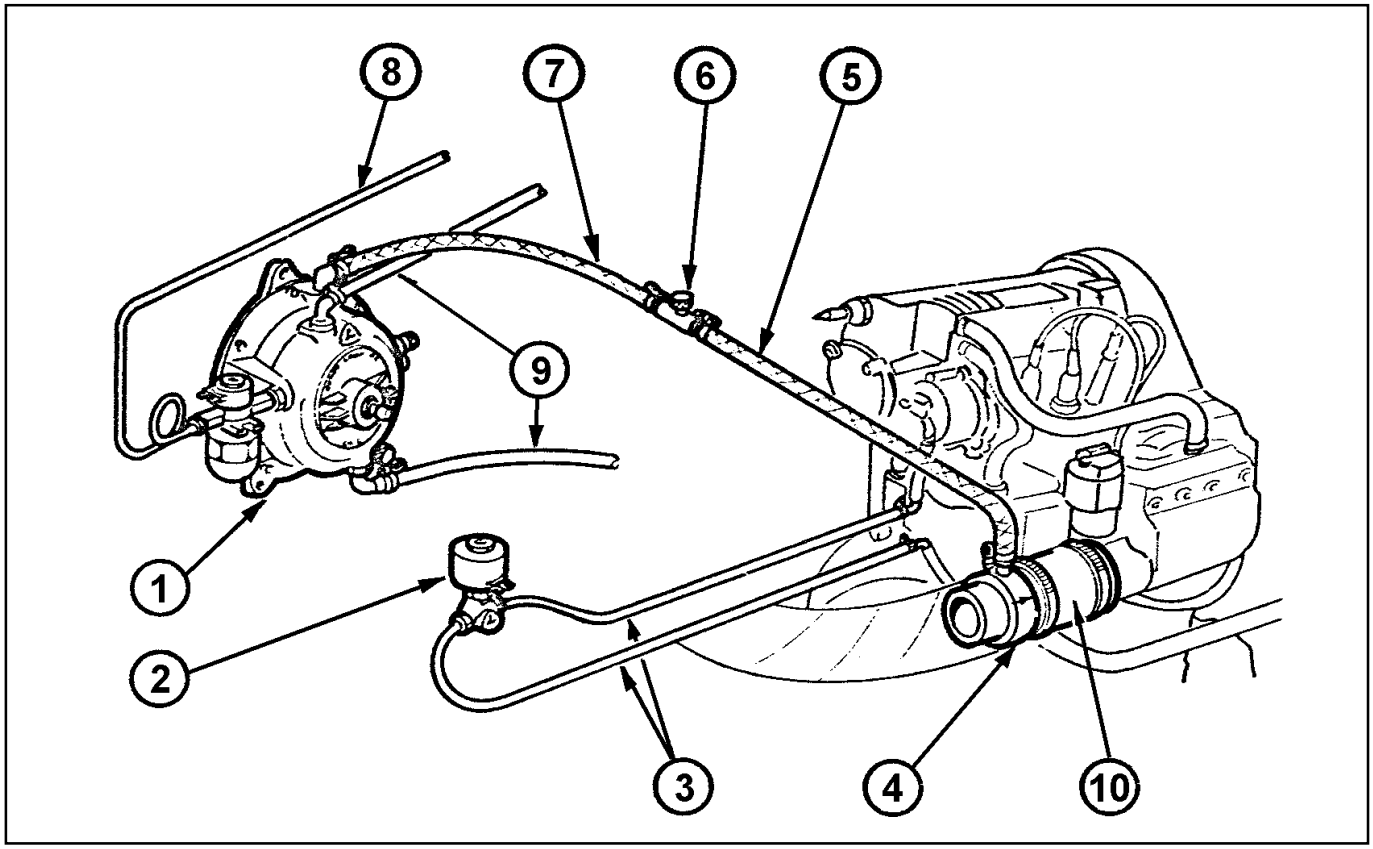
XV LPG fuelled ENGINE LGW 627

When the relative conversion unit is installed, engine LGW 627 can operate with LPG fuel (liquid petroleum gas).
LPG is a mixture of hydrocarbons, amongst which propane and butane are present in major proportions.
This fuel is considered a valid alternative to gasoline (petrol) particularly owing to its lower cost and less polluting emissions.

! When LPG fuelled engine LGW 627 is installed, remember that any variations to the intake and exhaust system (pipe diameters and lengths, type of filter and silencer, etc.) will involve a variation to the carburation.
Optimizing of the process must be ascertained beforehand in the Lombardini test rooms. Failure of Lombardini to approve this type of modification shall relieve the same from all liability for operating faults and for any damage the engine might sustain.

Operation of the LPG conversion unit.

LPG flows from the tank and reaches the regulator/atomizer through the high pressure pipe.
The gas flow is regulated by a solenoid valve that remains closed when the engine is at a standstill or when it is fuelled with gasoline (petrol).
The gas changes from the liquid to gaseous state in the regulator/atomizer, while the hot water of the cooling system supplies the heat required for atomizing.
LPG in the gaseous state and at low pressure reaches the mixer, which doses the gas flow in proportion to engine requirements, controlled by the vacuum created in the mixing devices.



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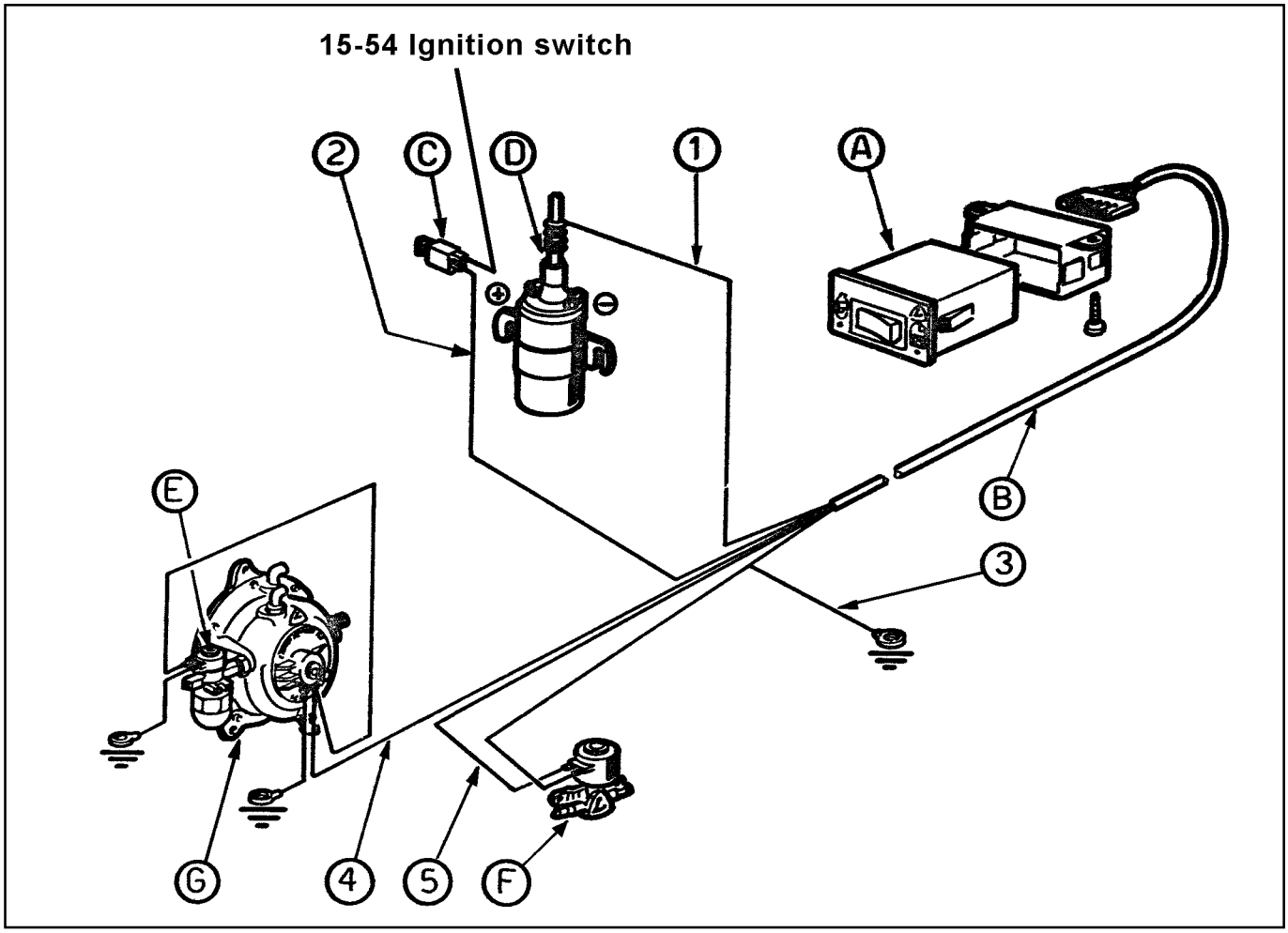
Components :

1 Regulator vaporizer mod. 81 SIC preset for primer assembly (with gas solenoid valve mounted)
2 Gasoline (petrol) solenoid valve
3 Gasoline (petrol) pipe
4 Lombardini mixer
5 Braided gas pipe
6 Adjuster
7 Gas pipe
8 PVC covered copper tube in reel
9 Water pipe
10 Rubber connecting sleeve



183

Components :

A Switch mod. 093
B Connection harness between switch and users
C Fuse holder with 7.5 Amp fuse
D Ignition coil
E Gas solenoid valve
F Gasoline (petrol) solenoid valve
G Regulator

Connections :

1 Brown wire (antenna: the high voltage wire of the ignition coil can be wound around this, or it can be connected to the revolution counter wire)
2 Red wire (connect to an ignition key controlled positive, making sure that 12V are supplied)
3 Black wire (earth connection)
4 Blue wire (connect to gas users)
5 Green wire (connect to gasoline users)

Operation of the ignition system for gasoline (petrol) or LPG fuelled engines

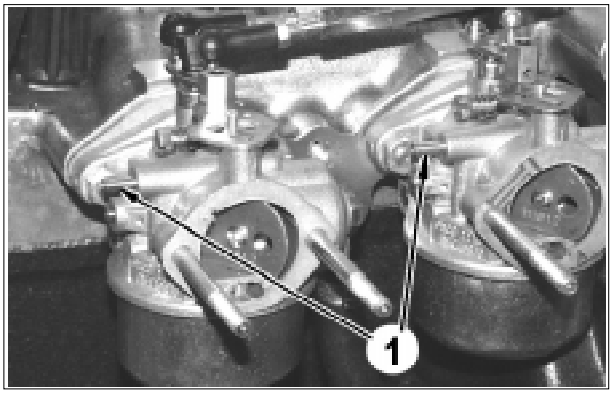
Note that to operate with LPG, the engine must be equipped with module 122.2193.114 and the relative wiring serial N° 2185.942, since this ignition system has been designed to operate when the engine is fuelled with either gasoline (petrol) or LPG.

The location of the module connections determines the difference in the system (Gasoline or LPG), as in the following cases:

- Engine fuelled with gasoline (petrol) alone: the wire of contact N° 2 on the module should be connected to the ignition key switch in the 15-54 position while the wire of contact N° 3 must not be connected (consult the relative wiring diagram, see 157 on page 66).

- Engine fuelled with LPG: the wire of contact N° 2 on the module should be connected to position 50 of the ignition switch (it is normally connected to 50 of the starter motor), while contact N° 3 controls the relay, supplied along with the LPG conversion kit, which allows the module to pilot the starter motor.
  This relay is essential owing to the current value required by the starter motor (10 A with 30 A peaks); values not tolerated by the module driver.
  It is important for the module to handle the starter motor to prevent undesired explosions in the intake manifold. The starter motor is activated when the ignition key is turned to the start position. If the engine starts, starter motor powering will be automatically cut-off by the module when the engine speed exceeds 900 r/min. The voltage supplied to contact N° 3 is zero even if contact N° 2 remains powered (the key is maintained in the start position).
  If the key is released and the engine runs at a speed of less than 900 r/min (owing to difficult starting or because the ignition key has been released too early), the module will no longer power the coils but will continue to power the starter motor, allowing the engine to make a complete cycle without sparks on the plugs, this is to eliminate any abnormal combustion that could cause explosions in the intake manifold.
  The coil power supply will be cut-off if the speed drops below 600 r/min during engine operation (consult the relative wiring diagram, see fig. 159 on page 68).

Components of the LPG conversion unit.

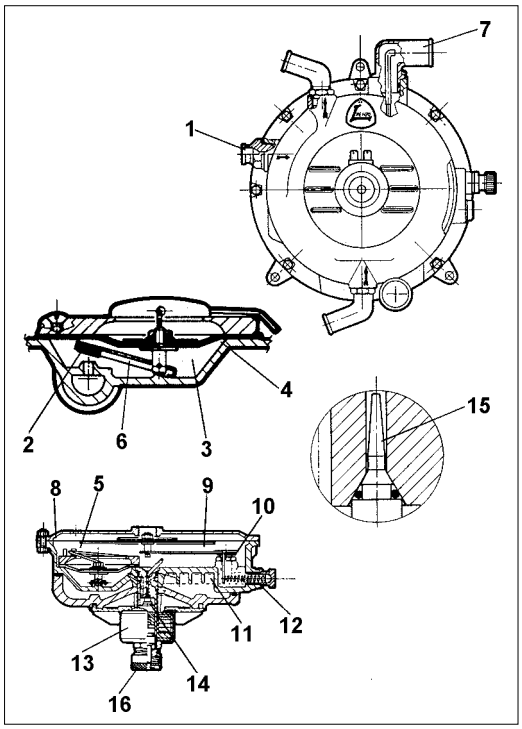


183a

To fuel the engine with LPG alone, shut off the bleed tubes **1** (fig. 183a) of the carburetors.
The bleed tubes must be left open if the engine is also or only to operate with gasoline (petrol).

Regulator/atomizer

The reducer allows LPG to change from the liquid state to the gaseous state. It is a container divided into compartments by membranes.
Gasification of the LPG notably lowers the pressure and temperature. The heat required is supplied by the hot water from the engine cooling system that circulates around the regulator/atomizer.
The LPG passes through gas inlet union **1**, valve **2** and enters the first stage chamber **3**. The flow is dosed by the pressure exercised by the gas on membrane **4**. This causes an expansion which overcomes the resistance opposed by spring **5** and operates lever **6**, which regulates the opening and closing movements of the first stage valve **2**.



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Engine intake through gas outlet **7** creates a vacuum in the second stage chamber and produces an axial movement of membrane **8**. The membrane is connected to lever **9** and controls the opening movement of valve **10**, allowing gas to reach the second stage chamber through duct **11** and from thence to the engine through gas outlet **7**. Appropriately calibrated spring **12** retains valve **10** and lever **9**.
The idling ignition device consists of a solenoid valve **13** controlled by an electronic device. Core **14** moves and frees hole **15** from which gas from first stage **3** is outlet, allowing the engine to idle. If the engine stops, the core de-energizes and core **14** shuts outlet hole **15**. The idling speed is regulated with adjuster **16**.
When the engine starts, the electronic device energizes coil **13**, core **14** frees hole **15** and allows the amount of gas required for ignition to pass through.

Technical specifications

- Body - GDALSI 13 UNI 5079
- First stage regulating pressure - 0.8 bar
- Power source - 12 V d.c.
- Coil power rating - 18W
- Suitable for engines - Carburetor, injection.

Electronic ignition device with idling at positive pressure.
Italian Ministry of Transport Approval N° 5853/2° ext LPG.
EEC Approval - Regulation N° 67

Regulator installation

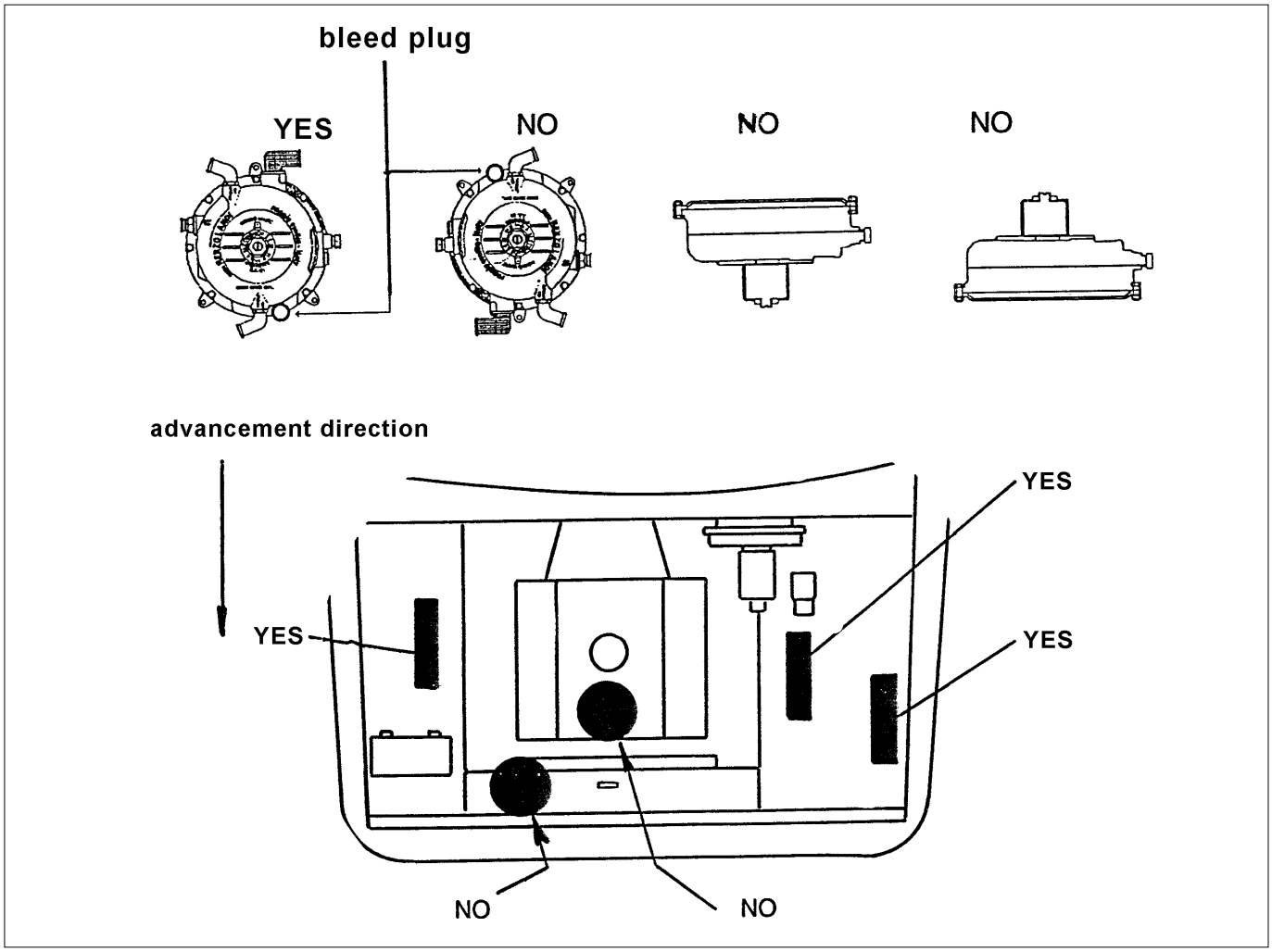
Comply with the following recommendations when installing:

· the Regulator must be installed in the engine compartment;
· it must be firmly fixed to the bodywork with M10 screws;
· it must be positioned parallel to the advancement direction, see fig. 185;
· position the unit so that it can be easily accessed for adjustments and maintenance operations;
· set it in a lower position than the level of the water in the radiator;
· the bleed plug of the regulator must not be above the ignition coil;
· position the unit as near as possible to the place where the mixer will be installed;
· clean the LPG ducts before they are connected to the regulator to prevent impurities from penetrating the regulator body;
· check to make sure that when the engine is running, there are no leaks from the water pipes (the water pipes are generally connected to the heating circuit of the passenger compartment);
· make sure that the thermostat operates correctly, checking that the regulator/atomizer heats quickly.

! Whenever the engine cooling circuit is emptied, the level of the coolant fluid must be topped up. Take care to completely eliminate any air bubbles that could prevent the regulator from heating.

The gas outlet must point upwards. It should be connected to the mixer by means of a tube, taking care to prevent curves and pockets from forming as far as possible .
The water outlet is normally in the upper part of the regulator/atomizer.
Fixing brackets are supplied with the regulator so that it can be installed in the engine compartment.
These must be adapted to the type of engine compartment in question.

POSITIONING THE REGULATOR



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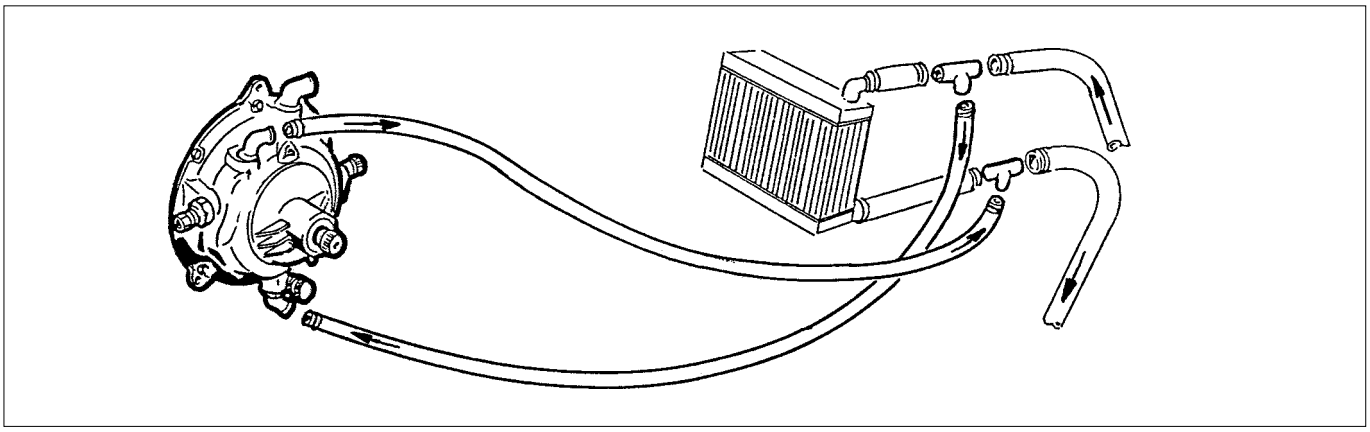
	1-5302-509	50778	10.06.99		10.06.99	

Regulator heating circuit connection

The regulator should be connected to the cooling circuit of the engine or the heating circuit of the passenger compartment, using the relative pipes (fluid cooling).
Fit the T unions in the position indicated in fig. 186, and use the relative pipe clamps for fixing purposes.
Comply with the directions indicated by the water inlet and outlet arrows stamped on the regulator/atomizer.

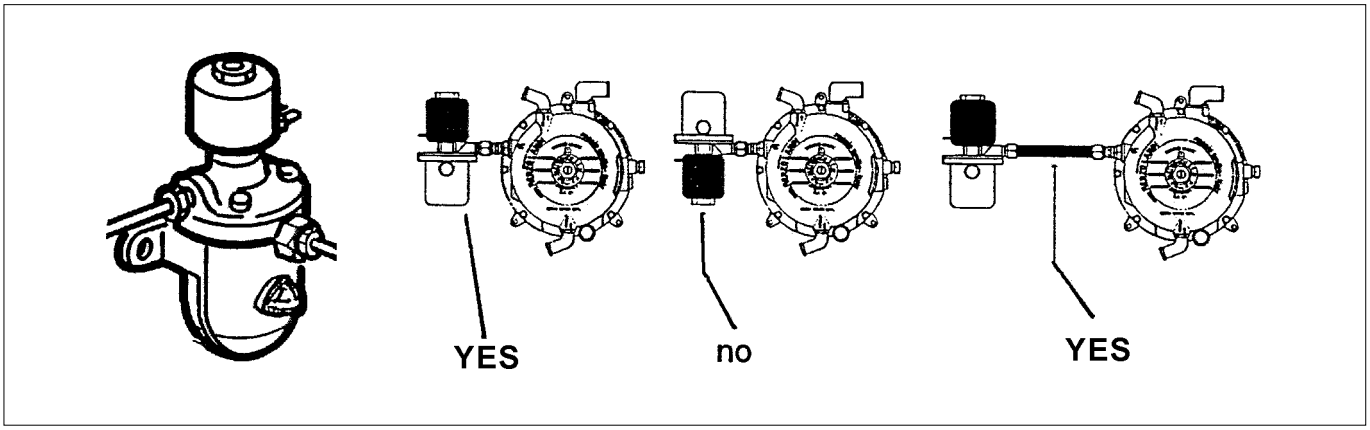


186

Liquid phase LPG shut-off solenoid valve

The LPG solenoid valve is a device that allows the LPG flowing to the regulator to be automatically shut off by means of an electric contact.
It also has a filter that retains the coarser impurities the fuel may contain.
The electric power source voltage rating is necessarily identical to that of the vehicle circuit. The body of the solenoid valve is tested at the internal pressure of 45 bar.
The unit consists of a reservoir containing the filter, and two input and outlet unions. The magnetic coil is installed on top of the reservoir.
The gas solenoid valve is normally closed while, after being enabled by the electrical circuit, the coil attracts the magnetic core, enbloc with the shutter, allowing LPG to flow from the tank to the regulator/atomizer.

Solenoid valve assembly : The solenoid valve must be installed in the engine compartment, between the tank and regulator, as near as possible to the regulator. It can be fixed to the bodywork by means of the relative bracket, this latter being locked in place by two M6 screws.
It is currently supplied fixed to the regulator/atomizer.



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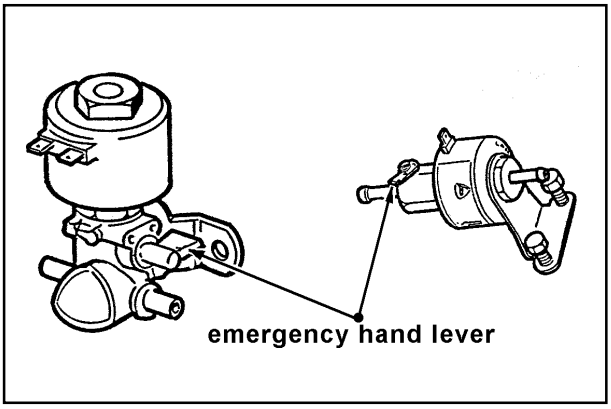
Gasoline (petrol) solenoid valve

This solenoid valve is a device that allows the flow of gasoline to be shut off when the vehicle is fuelled with gas, and the passage of gasoline (petrol) when the vehicles uses this fuel to operate.
It is equipped with a manual device to use if the electrical device breaks down, allowing the valve to be by-passed.
Similarly to the LPG solenoid valve, this one consists of a coil and a body with fuel inlet and outlet unions.
When the coil is energized, the magnetic core lifts and allows the fluid to pass through. Remember that this solenoid valve is only installed in engines with carburetors and diaphragm fuel pumps.



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Solenoid valve assembly :

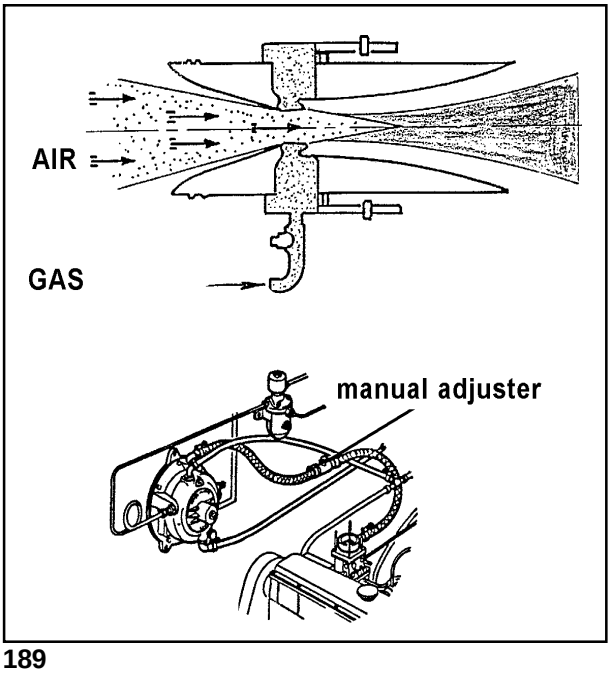
the solenoid valve must be installed in the engine compartment of the vehicle between the gasoline (petrol) pump and the carburetor, with the arrow pointing in the gasoline (petrol) flow direction.
It should be fixed to the vehicle with two M6 screws, well away from exhaust pipes and electrical components.
It must be positioned so as to allow free access to the emergency lever for manual opening if required.

The mixer

An air-gas mixer must be installed to allow the engine to operate with gas. This device has been designed to mix air and gas in an optimum ratio and at any speed. It normally consists of a supplementary venturi that makes all the regulations, leaving the regulator with the sole task of supplying gas at a constant pressure as the engine requires.

It consists of the following parts:
- a casing more or less the original shape of the carburetor or intake manifold so that it can be easily fixed in place;
- an appropriately sized fixed Venturi shaped choke with a series of gas outlet holes in its narrow part.

Owing to the effect of the intake phases, an air flow is established as the engine runs. By passing through the narrow section of the choke, this air creates a vacuum, attracting gas from the regulator.
The mixer is a very important part and as such, various studies are conducted in order to produce it. Accurate tests are required to make it suitable for operation with both gas and gasoline (petrol).
The mixers and reducers must always be of the same make in order to operate correctly as a whole.



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Connecting the mixer to the regulator

In engines with carburetors, the mixer should be connected to the gas regulating adjuster pipe while this latter should be connected to the gas outlet of the regulator. Dimensionally, it is a rubber tube with an inner diameter of 19 mm. It should be as short as possible. If, in fact, the volume of the tube is considered (section x length), a smaller volume, for low pressures, means that the delay required to fill the tube is reduced each time the engine is accelerated and this improves engine response.
It also means less fuel wastage when the throttle valve is shut, thus reducing fuel consumption. Also note that, in engines with carburetors, there is a manual adjuster used to regulate the gas supplied to the engine, between the regulator and mixer.

Electrical system

This is an essential component on which the correct operation of the entire system depends.
Comply with the following rules:

- all conductors must be equipped with insulation and protection and be installed in a perfectly workmanlike way;
- the electrical circuit must be equipped with a current limiting device;
- the voltage and current ratings must not exceed the values established by the specifications of each connector;
- the electric leads must be routed as far away as possible from the high voltage cables of the ignition system;
- the best way to connect between cables is by using terminals or connectors duly insulated from the cables themselves.

Change-over switch Mod. 093

Change-over switch Mod. 093 is used in LPG conversion systems in vehicles with carburetors.
Designed for easy installation on any type of dashboard, it includes the following components:

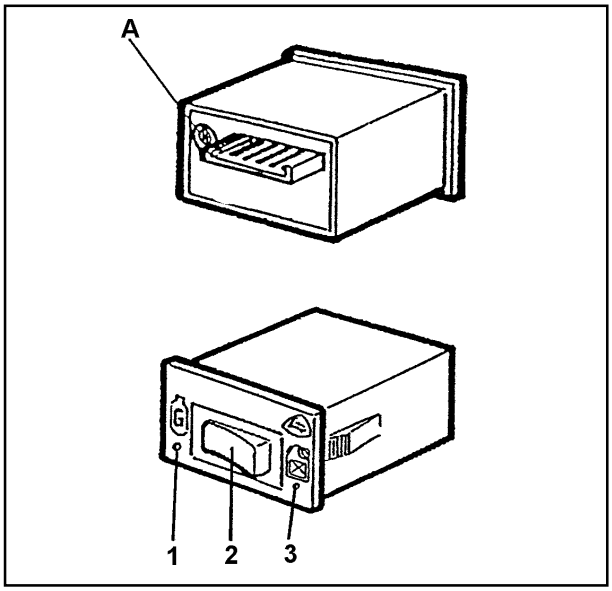
- gas-gasoline (petrol) switch;
- safety device that shuts off the supply to the solenoid valves if the engine accidentally stops;
- adjustable priming time.

Mod. 093 change-over switch installation

Change-over switch Mod. 093 can be installed in two different ways:

1) in the conventional way, using the relative bracket with screws;
2) by fitting into the dashboard after having made a rectangular hole in it of the required size (approx. 25x28 mm) using the relative cutter

! Install the change-over switch where it is protected from water



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Priming time setting

The trimmer (A) used to set the priming time is behind the change-over switch housing.
The priming time must be set according to the type of regulator in question (normal or SIC), the length of the tube between the reducer and mixer and the swept volume of the vehicle.
The priming time can be set from a minimum of 0 seconds to a maximum of 4 seconds, by turning the trimmer in a clockwise direction.

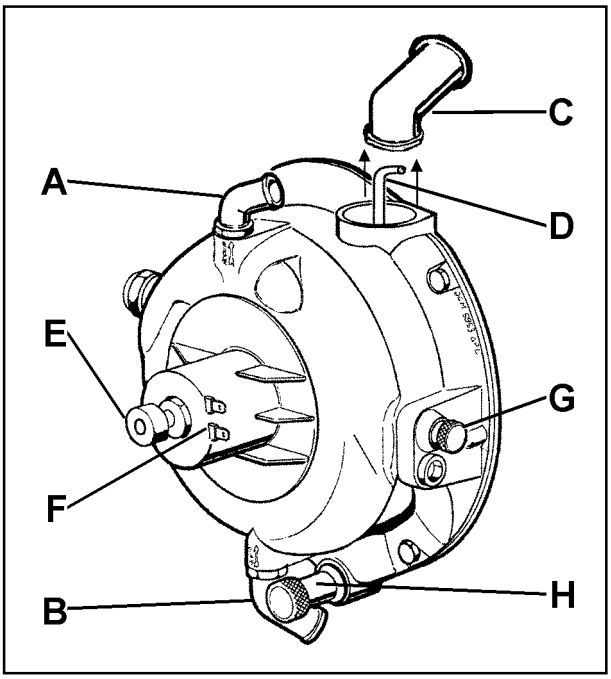
! To check and regulate the priming time, shut off the gas supply from the tank and measure the time according to the noise issued by the solenoid valve.

1 Green led indicating that the engine is fuelled with LPG
2 Switch to change from gasoline (petrol) to gas fuelling and vice versa, with the reservoir emptying position in the center. All the leds will be off when the switch is in the central position
3 Yellow led indicating that the engine is fuelled with gasoline (petrol)

Consult the relative wiring diagram on page 81, fig. 183, for the electrical connections

Incorrect adjustments may saturate the air with LPG.
Make all the adjustments outdoors or in a well ventilated place, well away from naked flames that could create sparks.

REGULATING PROCEDURE WITH REDUCER SE 81 SIC



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The first operation is to regulate the peak rate:
bring the engine to about $^{2}/_{3}$ rds of its r/min speed and turn the peak speed adjuster on the reducer/mixer tube to set the CO, HC, CO_2 values as shown in the table.

The second operation is to regulate the idling speed:
with the engine running, turn the idling screw **E** (clockwise to decrease, anticlockwise to increase) until the CO, HC, CO_2 values are as shown in the table.

Components:

A Water outlet union to connect to a return duct of the engine cooling circuit;
B Water inlet union to connect to a delivery duct of the engine cooling circuit;
C Gas outlet tube;
D Idle rate delivery tube (should always be positioned in the same direction as the gas outlet tube);
E Idling adjuster;
F Positive and negative contact of the idling solenoid valve;
G Sensitivity adjuster;
H Reducer bleed plug

If there is no exhaust gas analyzer, it is advisable to:

1 max speed adjustment
Regulate the adjuster on the reducer/mixer pipe. Keep the engine accelerated (approx $^{2}/_{3}$ rds of its r/min speed) and turn the adjuster screw clockwise until the engine speed varies as the mixture becomes leaner. Now turn the same screw very slowly in an anticlockwise direction until the engine r/min speed increases. If you continue to turn the screw in an anticlockwise direction, the only result will be a high consumption and no increase in efficiency.

2 idling adjustment
regulate the idling speed by means of the relative adjuster on the reducer.

Proceed with a test once the idling and peak speeds have been obtained.

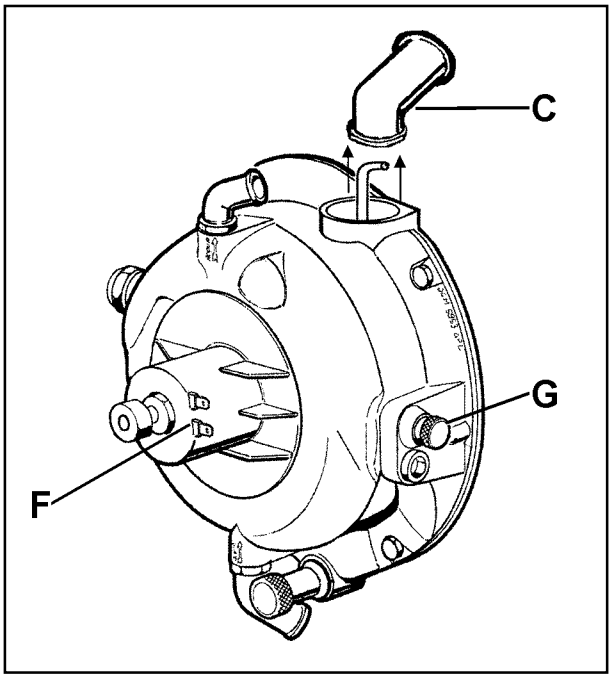
Carburation test with exhaust gas analyzer

The following conditions are required to correctly measure the exhaust gas:
- the engine must be at running temperature;
- the ignition must be tuned (dwell angle, firing point and idling speed must correspond to the values prescribed by the manufacturer);
- multiple carburetor devices must be balanced (see carburetor balancing section);
- the exhaust system must be tight;
- the pick-up probe of the analyzer must be inserted at least 30 cm into the end of the exhaust

GAS	RATE	REDUCER SE 81 SIC
CO	idling	1 to 1.5
	$^{2}/_{3}$ rds r/min rate	0.20 to 0.50
CO_2	idling	11.5 to 12.5
	$^{2}/_{3}$ rds r/min rate	12.50 to 13.50
HC	idling	200 to 400
	$^{2}/_{3}$ rds r/min rate	50 to 80

HOW TO REGULATE THE SENSITIVITY OF REDUCER SE 81 SIC

The reducers will have already been regulated by the manufacturer, but if faults such as an instable idling speed or unsteady acceleration occur, it is advisable to check the sensitivity of the reducer itself.
Adjuster screw **G** is not used to regulate the idling speed but just to adjust the sensitivity of the reducer. Slacken it off to lighten the load that the spring exercises on the second stage lever or tighten it to increase the load that the spring exercises on the second stage lever towards the shut-off position.
Since the idling flow is separate from that of max speed, the change over from idling speed to higher speeds must occur without "carburation vacuums". These are particularly noticeable when the engine is accelerated very slowly (adjuster too tight). Meanwhile, the reducer must remain tight and must not leak gas each time the engine is switched off (adjuster too slack).



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Proceed in the following way to adjust the sensitivity:

1) Remove the tube that conveys the gas from gas outlet tube **C** to the mixer;
2) Fully tighten sensitivity adjuster **G**;
3) Disconnect the wire on the positive contact of idling solenoid valve **F** and connect it to a +30 (battery positive) in order to charge the gas reducer;
4) Form a bubble with soapy water on gas outlet tube **C** and tighten adjuster **G** until gas begins to leave the reducer and to swell the bubble;
5) The moment in which gas begins to leave the reducer, tighten adjuster **G** until the gas leak stops then, from the point in which the leak terminates, give an additional half-turn to the adjuster for safety purposes.
6) Fit the protective cap on to sensitivity adjuster **G** in order to prevent it from being tampered with.

MAIN DRIVING TORQUES

POSITION	Reference (figure N° and page)	Diam. X Pitch (mm)	Torque (Nm)
Spark plug	N° 153 - page 63	14 x 1.25	30 *
Intake manifold fixing nut (LGW 627)	N° 3 - page 19	5 x 0.8	4
Carburetor fixing nut	N° 128 - page 51	6 x 1	8
Rocker arm journal bearing fixing nut	N° 43 - page 30	10 x 1.5	40
Tightening pulley nut	N° 19/20 - page 23	10 x 1.5	40
Flange for rear tang retention ring		6 x 1	12
Rocker cap fixing	N° 37/40 - page 24	6 x 1	9
Cast iron connecting rod cap	N° 83 - page 38	8 x 1	40
Main journal cap	N° 94/95 - page 41	10 x 1.5	60
Flywheel fixing (self-locking nut)	N° 11 - page 21	10 x 1.25	80
Timing system pulley fixing	N° 22 - page 23	10 x 1.25	80
Fuel pump eccentric	N° 126 - page 50	10 x 1.25	80
Air pump coupling		10 x 1.25	50
Driving pulley fixing	N° 14 - page 22	16 x 1.5 LH	360***
Carburetor stud bolt	N° 128 - page 51	6 x 1	5
Intake manifold stud bolt (LGW 627)	N° 3 - page 19	5 x 0.8	4
3rd P.T.O. control pulley		10 x 1.25	80
Oil pressure switch		12 x 1.5	25
External oil filter union		20 x 1.5	25
Oil sump plug	N° 112/113 - page 46	12 x 1.5	40
Enabling lamination screw	N° 152 - page 62	5 x 0.8	6
Timing system shaft bearing locking screw		6 x 1	10
Intake manifold fixing screw (LGW 523)		6 x 1	8
Oil sump fixing screws	N° 65/66 - page 34	6 x 1	10

* Tightening without torque wrench: tighten the spark plug fully on to the head by hand. Tighten to a 90° angle using the relative wrench. Tighten when the engine is cold.

*** Lubricate under the screw head and pulley centering with "Molyslip".

Note: Comply with the following general regulations when tightening screws and nuts not indicated in the table:

M 6 ➔ 10 Nm - M 8 ➔ 25 Nm - M 10 ➔ 45 Nm material A 8.8

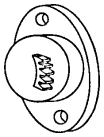
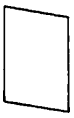
USE OF SEALING AGENT

POSITION	DENOMINATION (Diam. in mm)	SEALER (Loctite type)
Cylinder head water thermostat unit	H_2O thermostat unit	518
Oil pump stud bolts		270
Carburetor fixing on intake manifold	M 5 x 0.8	242
Main bearing gaskets		DAW CORNING 7091
External water pump gasket		495
Timing shaft bearing lamination	3 screws 6 x 16	270
Engine block	Plug Ø 30	648 BV
Engine block	Plug M 12x1.5	242 / E
Fuel pump stud bolt	M 5 x 0.8	270
Carburetor stud bolt	M 6 x 1	242
Cylinder block stud bolt on exhaust side		242
Belt tightening pulley stud bolt		DRAYLONG + 270
Oil filter cartridge union	M 20 x 1.5	270
External oil filter union	M 20 x 1.5	270
Plate centering pin (internal alternator)		638
Cylinder head	Plug Ø 30	648 BV
Cylinder head	M 6 x 1	242
Enabling lamination screw	M 5 x 0.8	242
Flange fixing screw on flywheel side (2 ext.alternator through holes)		270
Oil pump fixing screw		270
External alternator cable fixing screw		242

DRIVING TORQUES FOR STANDARD SCREWS

DENOMINATION						
Diameter x pitch (mm)	R ³ 800 N/mm²		R ³ 1000 N/mm²		R ³ 1200 N/mm²	
4x0.70	3.6	0.37	5.1	0.52	6	0.62
5x0.80	7	0.72	9.9	1.01	11.9	1.22
6x1.00	12	1.23	17	1.73	20.4	2.08
7x1.00	19.8	2.02	27.8	2.84	33	3.40
8x1.25	29.6	3.02	41.6	4.25	50	5.10
9x1.25	38	3.88	53.4	5.45	64.2	6.55
10x1.50	52.5	5.36	73.8	7.54	88.7	9.05
13x1.75	89	9.09	125	12.80	150	15.30
14x2.00	135	13.80	190	19.40	228	23.30
16x2.00	205	21.00	289	29.50	347	35.40
18x2.50	257	26.30	362	37.00	435	44.40
20x2.50	358	36.60	504	51.50	605	61.80
22x2.50	435	44.40	611	62.40	734	74.90
24x3.00	557	56.90	784	80.00	940	96.00

SPECIFIC TOOLS

	DENOMINATION	SERIAL N°
	Tool to mount the intake and exhaust valve guide seal	7170-1460-047
	Tool to adjust the timing belt tension	7170-1460-049
	Crank shaft locking tool	7107-1460-051
	Shim to insert main bearings into the engine block	7107-1460-053

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