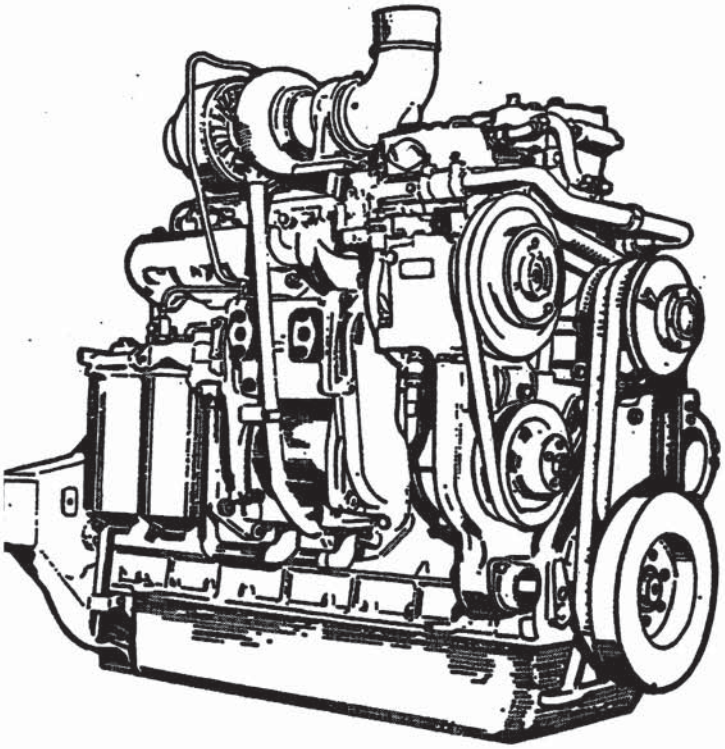
FIATALLIS®

8045

ENGINE

SERVICE MANUAL



Form 604.06.295 English
REPRINT 11/87

AVOID ACCIDENTS

Most accidents, whether they occur in industry, on the farm, at home or on the highway, are caused by the failure of some individual to follow simple and fundamental safety rules or precautions. For this reason MOST ACCIDENTS CAN BE PREVENTED by recognizing the real cause and doing something about it before the accident occurs.

Regardless of the care used in the design and construction of any type of equipment there are conditions that cannot be completely safeguarded against without interfering with reasonable accessibility and efficient operation.

A careful operator is the best insurance against an accident.
The complete observance of one simple rule would prevent many thousand serious injuries each year.
That rule is:

Never attempt to clean, oil or adjust a machine while it is in motion.

WARNING

On machines having hydraulically, mechanically, and/or cable controlled equipment (such as shovels, loaders, dozers, scrapers, etc.) be certain the equipment is lowered to the ground before servicing, adjusting and/or repairing. If it is necessary to have the hydraulically, mechanically, and/or cable controlled equipment partially or fully raised to gain access to certain items, be sure the equipment is suitably supported by means other than the hydraulic lift cylinders, cable and/or mechanical devices used for controlling the equipment.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

8045 Engine

Service manual

Form 604.06.295 - English

⚠ WARNING

STUDY THE OPERATION AND MAINTENANCE INSTRUCTION MANUAL THROUGH BEFORE STARTING, OPERATING, MAINTAINING, FUELING OR SERVICING THIS MACHINE.

⚠ The Operation and Maintenance Instruction Manual provides the instructions and procedures for starting, operating, maintaining, fueling, shutdown and servicing that are necessary for properly conducting the procedures for overhaul of the related components outlined in this Service Manual.

⚠ This symbol is your safety alert sign. It MEANS ATTENTION! BECOME ALERT! YOUR SAFETY IS IN INVOLVED.

⚠ Read and heed all safety instructions carrying the signal words WARNING and DANGER.

⚠ Machine mounted safety signs have been color coded yellow with black border and lettering for WARNING and red with white border and lettering for DANGER points.

IMPORTANT

The information in this manual was current at the time of publication. It is our policy to constantly improve our product and to make available additional optional items. These changes may affect procedures outlined in this manual. If variances are observed, verify the information through your Dealer.

NOTE

Additional publications pertaining to this model and to all other FIAT-ALLIS products are available through FIAT-ALLIS dealers. Publications are generally available in several languages. Refer to Service Publications Index for all such publications; this index is available from FIAT-ALLIS.

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SUPPLEMENT N.1 TO
SERVICE MANUAL
FORM 604.06.295
ENGINE 8045

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604.06.295

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NOTICE
THESE CHANGES ARE
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Add the following pages: 71 - 72 - 73 - 74 - 75 - 76 - 77 - 78 - 79

Write in the following changes:

WRONG		CORRECT	
page 1			
Engine type	Application	Engine Type	Application
8045.04.189	FL5 Crawler loader	8045.04.189	FL5 Crawler loader
8045.04.189	FD5 Crawler dozer	8045.04.189	FD5 Crawler dozer
		8045.05.389	FL5 Crawler loader (S/N 201361 and up)
		8045.05.389	FD5 Crawler dozer (S/N 201360 and up)
		8041.1.002	FR7 Wheel loader (Up to S/N 000440)

FIATALLIS EUPROE S.p.A. - POSTVENDITA - ASSISTENZA - PUBBLICAZIONI
FORM 604.06.295/01 - X 1987

WRONG	CORRECT	
	8041.1.05 All.005 8041.1.002	FR7 Wheel loader (S/N 000441 and up) FG65 A Articulated motor grader
	8041.1.002	FE12 Hydr. excavator (Up to S/N 00124K)
	8041.1.005 All.004 8041.1.002	FE12 Hydr. excavator (S/N 00125K and up) FE12R Wheeled hydr. excavator (up to S/N 00133)
	8041.1.005	FE12R Wheeled hydr. excavator (S/N 00134 and up)
	8045.04.293 8045.05.393	FB7 Backhoe loader FB7B Backhoe loader
page 28-29		
Fig.53 and Fig.55	Exchange pictures	
NOTICE THESE CHANGES ARE INCLUDED IN THIS COPY		
page 33		
5.4.2 FUEL INJECTION PUMP AND GOVERNOR OVERHAUL	5.4.2 ADJUSTING THE CAMSHAFT BEARING	
Adjusting the camshaft bearings		

Supplement 2
8045 Engine Service Manual
Form No. 604.06.295

(9-87)

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ATTENTION: This supplement to be used in conjunction with 8045 Engine Service Manual, Form No. 604.06.295, and its Supplement No. 1.

Revise or Add the following pages:

Page 1	Revised
Page 2	No change
Page 81	Added
Page 82	Added
Page 83	Added
Page 84	Added
Page 85	Added
Page 86	Added
Page 87	Added
	Blank

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SUPPLEMENT No. 3
8045 ENGINE SERVICE MANUAL
604.06.295

(5-88)

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REPLACE the following like pages:

Page 75 No Change
Page 76 (Revised May, 1988)

Page 77 (Revised May, 1988)
Page 78 No Change

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Add or correct the following listings in *"BOLD AND ITALIC*	
ENGINE TYPE	APPLICATION
8045.04.189	FL5 Crawler Loader ***(up to Unit No. 201360)***
8045.04.189	***FD5*** Crawler Dozer ***(up to Unit No. 201360)***
8045.05.389	FL5 Crawler Loader (from Unit No. 201361)
8045.05.389	FD5 Crawler Dozer (from Unit No. ***201361***)
8041.1.002	FR7 Wheel Loader (up to Unit No. 000440)
8041.1.05 All .005	FR7 Wheel Loader (from Unit No. 000441)
8041.1.002	FG65A Motor Grader(articulated)
8041.1.002	FE12 Excavator (up to Unit No. 00124K)
8041.1.005 All .004	FE12 Excavator (from Unit No. 00125K)
8041.1.002	FD12R Excavator(rubber tire) (up to Unit No. 00133)
8041.1.005	FE12R Excavator(rubber tire) (from Unit No. 00134)
8045.04.293	FB7 Backhoe
8045.05.393	FB7B Backhoe
8045.25.390	***FE16B Excavator***
8045.25.395	***FR9B Wheel Loader***

NOTICE
THESE CHANGES ARE INCLUDED IN THIS COPY

GENERAL

Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling, or servicing machine.

Read and heed all machine-mounted safety signs before starting, operating, maintaining, fueling or servicing machine.

Machine-mounted safety signs have been color coded yellow with black borders and lettering for warning and red with white borders and lettering for danger points.

Do not allow unauthorized personnel to service or maintain this machine. Do not perform any work on equipment that is not authorized. Follow the Maintenance and Service procedures. Study the Operation and Maintenance Instruction Manual before starting, operating, maintaining, fueling or servicing this machine.

Always wear safety glasses with side shields.

Do not wear rings, wrist watches, jewelry, or loose or hanging apparel, such as ties, torn clothing, scarves, unbuttoned or unzipped jackets that can catch on moving parts. Wear proper safety equipment as authorized for the job. Examples: hard hats, safety shoes, heavy gloves, ear protectors, safety glasses or goggles, reflector vest, or respirators. Consult your employer for specific safety equipment requirements.

Do not use controls or hoses as handholds when climbing on or off machine. Hoses and controls are movable and do not provide a solid support. Controls may also be inadvertently moved causing accidental machine or equipment movement.

Do not jump on or off machine. Keep two hands and one foot, or two feet and one hand, in contact with steps and grab-rails and handles at all times.

Machine should not be serviced with anyone in the operator's seat unless they are qualified to operate the machine and are assisting in the servicing.

Keep operator's compartment, stepping points, grab-rails and handles clean of foreign objects, oil, grease, mud or snow accumulation to minimize the danger of slipping or stumbling. Clean mud or grease from shoes before attempting to mount or operate the machine.

Never attempt to operate the machine or its tools from any other position than seated in the operator's seat.

Keep operator's compartment clear of loose objects.

If movement of an attachment by means of the machine's hydraulic system is required for service or maintenance, do not raise or lower attachments from any position other than when seated in the operator's seat.

Before starting machine or moving attachment or tool, make sure to set brakes, sound horn and call for an all clear. Raise attachment slowly.

Always block with external support any linkage, parts, or machine according to local or national requirements.

Never allow anyone to walk under or be near unblocked raised equipment. Avoid working or walking under raised blocked equipment unless you are assured of your safety.

Never place head, body, limbs, fingers, feet or hands into an exposed portion between uncontrolled or unguarded scissor points of machine without first providing secure blocking.

Never lubricate, service or adjust a machine with the engine running, except as called for in the Operation and Maintenance Instruction Manuals. Do not wear loose clothing or jewelry near moving parts.

When servicing or maintenance requires access to areas that cannot be reached from the ground, use a ladder or step platform that meets local or national requirements to reach the service point. If such ladders or platform are not available, use the machine handholds and steps as provided. Perform all service or maintenance carefully.

Shop or field service platform and ladders used to maintain or service machinery should be constructed and maintened according to local or national requirements.

Never check or fill fuel tanks, storage batteries or use starter fluid near lighted smoking materials or open flame due to the presence of flammable fluid.

Brakes are inoperative when manually released for servicing. Provision must be made to maintain control of the machine by blocking or other means.

Always place the fuel nozzle against the side of the filler opening before starting and during fuel flow. To reduce the change of a static electricity spark, keep contact until after fuel flow is shut off.

Use only designated towing or pulling attachment points. Use care in making attachment. Be sure pins and locks as provided are secure before pulling. Stay clear of drawbars, cables or chains under load.

To move a disabled machine, use a trailer or low boy truck if available. If towing is necessary, provide warning signals as required by local rules and regulations and follow operation and maintenance instruction manual recommendations. Load and unload on a level area that gives full support to the trailer wheels. Use ramps of adequate strength, low angle and proper height. Keep trailer bed clean of clay, oil and all materials that become slippery. Tie machine down securely to truck or trailer bed and block tracks (or wheels) as required by the carrier.

Never align holes with fingers or hands. Use the proper aligning tool.

Remove sharp edges and burrs from reworked parts.

Use only grounded auxiliary power source for heaters, chargers, pumps and similar equipment to reduce the hazards of electrical shock.

Lift and handle all heavy parts with a lifting device of proper capacity. Be sure parts are supported by proper slings and hooks. Use lifting eyes if provided. Watch out for people in the vicinity.

Never place gasoline or diesel fuel in an open pan. Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flam-

mable, non-toxic solvents.
When using compressed air for cleaning parts use safety glasses with side shields or goggles. Limit the pressure to 2 bar (30 psi) according to local or national requirements.
Do not smoke or permit any open flame or spark near when refueling, or handling highly flammable materials.
Do not use an open flame as a light source to look for leaks or for inspection anywhere on the machine.
Be sure all mechanic's tools are in good condition. DO NOT use tools with mushroomed heads. Always wear safety glasses with side shields.
Move carefully when under, in or near machine or implements. Wear required protective equipment, such as hard hat, safety glasses, safety shoes, ear protectors.
When making equipment checks that require of the engine, have an operator in the operator seat at all times with the mechanic in sight. Place the transmission in neutral and set the brakes and lock. Keep hands and clothing away from moving parts. Shut off engine and disengage the Power Take-Off Lever before attemting adjuustments or service.
Never use the bucket as a man lift.
The articulation point between frames will not clear a person. Stay clear when engine is running. Support, using device provided when servicing. Return support to carry position and secure before moving machine after servicing. See Operation and Maintenance Instruction Manual.
For field service, move machine to level ground if possible and block machine. If work is absolutely necessary on an incline, block machine and its attachments securely. Move the machine to level ground as soon as possible.
Guard against kinking chains or cables. Do not lift or pull through a kinked chain or cable. Always wear heavy gloves when handling chain or cable.
Be sure cables are anchored and the anchor point is strong enough to handle the expected load. Keep exposed personnel clear of anchor point and cable or chain. DO NOT PULL OR TOW UNLESS OPERATOR'S COMPARTMENTS OF MACHINES INVOLVED ARE PROPERLY GUARDED against accidental cable or chain backlash.
Keep maintenance area CLEAN and DRY. Remove water or oil slicks immediately.
DO NOT pile oily, greasy rags – they are a fire hazard. Store in a closed metal container.
Before starting machine or moving attachment check and adjust and lock operator's seat. Be sure all personnel in the area are clear before starting or moving machine and any of its attachments. Sound horn.
Rust inhibitors are volatile and flammable. Prepare parts in well-ventilated place. Keep open flame away – DO NOT SMOKE. Store container in a cool well-ventilated place secured against unauthorized personnel.
Do not carry loose objects in pockets that might fall unnoticed into open compartments.
Keep clutches and brakes on machine and attachments such as Power Control Units, winches and master clutches adjusted according to Operation and Maintenance Instruction Manuals of the manufacturer at all times. DO NOT adjust machine with engine running except ad specified.
Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves when metal or other particles are apt to fly or fall.
Wear welder's protective equipment such as dark safety glasses, helmets, protective clothing, gloves and safety shoes when welding. Wear dark safety glasses near welding. DO NOT LOOK AT ARC WITHOUT PROPER EYE PROTECTION.
Know your jacking equipment and its capacity. Be sure the jacking point used on the machine is appropriate for the load to be applied. Be sure the support for the jack at the machine and under the jack is appropriate and stable. Any equipment up on a jack is dangerous. Transfer load to appropriate blocking as a safety measure before proceeding with service or maintenance .work according to local or national requirements.
Wire rope develops steel slivers. Use authorized protective equipment such as heavy gloves, safety glasses when handling.
Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.
Inspect your seat belt at least twice a year for signs of fraying, wear, or other weakness that could lead to failure.
Where it is necessary to use diesel fuel as a lubricant make sure all smoking material and open flames are extinguished or that no sparks are near. Place all parts in a closed container of clear diesel fuel for use as needed.
To minimize dangers of fire and explosion, it is recommended that before any welding is done on a fuel tank, the tank be completely drained of fuel, fuel lines disconnected and the ends closed to protect them, and the tank be steam cleaned. All traces of fuel must be removed before welding is started. Flood the tank with carbon dioxide (CO_2) before and during welding. Caps must be removed and vents and other openings left open during welding.
Dry ice (solid carbon dioxide) is extremely cold and will freeze flesh on contact. Use care to prevent contact with skin, eyes, or other parts of the body to avoid personal injury.
When work is required under or between components, block with an external support capable of holding the components in place according to local or national requirements.

START UP

Do not run the engine of this machine in closed areas without proper ventilation to remove deadly exhaust gases.
Do not place head, body, limbs, feet, fingers, or hands near a rotating fan or belts. Be especially alert around a pusher fan.
STARTING FLUID IS FLAMMABLE. Follow the recommendations as outlined in the Operation and Maintenance Instruction Manual and as marked on the containers. Store containers in cool, well-ventilated place secure from unauthorized personnel. DO NOT PUNCTURE OR BURN CONTAINERS. Follw the recommendation of the manufacturer for storage and disposal.

ENGINE

Turn radiator cap slowly to relieve pressure before removing. Add coolant only with engine stopped or idling if hot. See Operation and Maintenance Instruction Manual.
Do not run engine when refueling and use care if engine is hot due to the incresed possibility of a fire if fuel is spilled.
Never attempt to check or adjust fan belts when engine is running.
Do not adjust engine fuel pump when the machine is in motion.
Never lubricate a machine with the engine running.
Avoid running engine with open unprotected air inlets. If such running in unavoidable for service reasons, placeprotective screen over all inlet openings before servicing engine.

ELECTRICAL

Be sure to connect the booster cables to the proper terminals (+ to +) and (− to −) at both ends. Avoid shorting clamps. Follow the Operation and Maintenance Instruction Manual procedure.
Always turn the master switch (key switch if so equipped) to the off position when maintaining or servicing machine.
BATTERY GAS IS HIGHLY FLAMMABLE. Leave battery box open to improve ventialtion when charging batteries. Never check charge by placing metal objects across the posts. Keep sparks or open flame away from batteries. Do not smoke near battery to guard against the possibility of an accidental explosion.
Check for fuel or battery electrolyte leaks before starting service or maintenance work. Eliminate leaks before proceeding.
Do not charge batteries in a closed area. Provide proper ventilation to guard against an accidental explosion from an accumulation of explosive gases given off in the charging process.
Disconnect batteries before working on electrical system or repair work of any kind.

HYDRAULIC

Fluid escaping under pressure from a very small hole can almost be invisible and can have sufficient force to penetrate the skin. Use a piece of cardboard or wood to search for suspected pressure leaks. DO NOT USE HANDS. If injured by escaping fluid, see a doctor at once. Serious infection or reaction can develop if proper medical treatment is not administered immediately. Shutt off engine and be sure all pressure in system has been relieved before removing panels, housing, covers, and caps. See Operation and Maintenance Instruction Manual.
When making pressure checks use the correct gage for expected pressure. See Operation and Maintenance Instruction Manual or Service Manual for Guidance.

ATTACHMENTS

Keep head, body, limbs, feet, hands and fingers away from blade, bucket or ripper when in raised position. Use authorized blocking as a safety measure before proceeding with service or maintenance according to local or national requirements.
If movement of an attachment by means of the machine's hydraulic system is required for service or maintenance do not raise or lower attachments from any position other than when seated in the operator's seat. Before starting machine or moving attachments or tools, make sure to set brakes, sound horn and call for an all clear. Raise attachment slowly.
Do not use machine to carry loose objects by means other than attachments for carrying such objects. Never use any gas other than dry nitrogen to charge accumulators. See Operation and Maintenance Instruction Manual.
Keep clutches and brakes on machine and attachments as power control units, whiched and master clutches adjusted according to Operaltion and Maintenance Instruction Manuals of the manufacturer at all times. DO NOT adjust machine with engine running except as specified.

TIRES (APPLICABLE MACHINES)

Be sure tires are properly inflated to the manufacturer's specified pressure. Inspect for damage periodically. Stand to one side when changing inflation of tires. Check tires only when the machine is empty and tires are cool to avoid overinflation. Do not use reworked wheel parts. Improper welding, heating or brazing weakens them and can cause failure.
Never cur or weld on the rim of an inflated tire. Inflate a spare tire only enough to keep rim parts in place – a fully inflated tire might fly apart when it is non installed on a machine.
Use care if you must transport (haul) a fully inflated tire. When servicing tires block the machine in front and back of all wheels. After jacking up, place blocking under machine to protect from falling according to local or national requirements.
Deflate tires before removing objects from the tread. Never inflate tires with flammable gases. Explosion and personal injury could result.

FOREWORD

This manual contains service instructions for parts common to class 8045 engines listed below.

Engine type	Application
8045.04.189	FL 5 crawler loader
8045.04.189	FD 5 crawler dozer

Service and overhaul procedures described herein are valid for all engine applications shown above. Any differences are indicated by the specific engine type number concerned. See Section 1.1.1 for engine type number interpretation.
Capacities of the crankcase, cooling system, etc., vary depending upon the unit in which the engine is used, and may be found in the Operation and Maintenance Instruction Manual furnished with the unit.
The following topics are not covered herein, as they differ from machine to machine:

- starter;
- alternator;
- engine removal and installation.

For these topics, see the Service Manual forthe unit concerned.

CONTENTS

1. GENERAL

1.1 ENGINE IDENTIFICATION

Each engine is identified by means of two numbers, the engine type number and the serial number, stamped on left side of cylinder block.
The engine type and serial numbers should always be quoted when ordering spare parts.

1.1.1 ENGINE TYPE

All engines installed on a given type of machine carry the same engine type number, which is to be interpreted as follows:
1st digit: 8 = "engine".
2nd and 3rd digits: identify engines of substantially similar design.
4th digit: 5 – indicates that it is installed on earth moving machinery.
5th digit: indicates a design feature of engine through code below.
0 = naturally aspirated engine.
2 = turbo-charged engine.
6th digit: identifies series to which engine belongs within the same project.
7th, 8th, 9th digits: indicate engine variant.

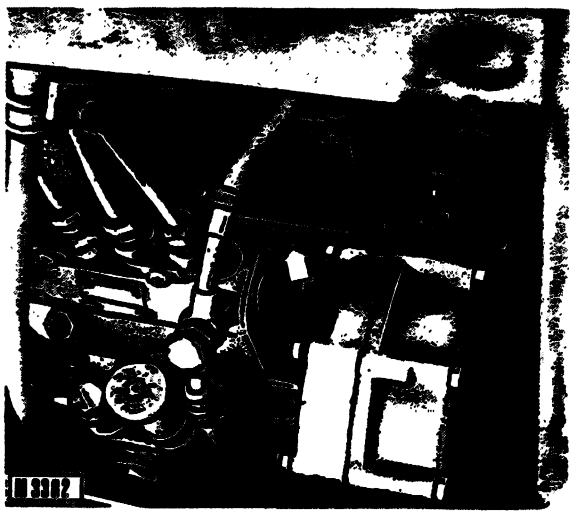

Fig. 1 - Engine type identification.

1.1.2 ENGINE SERIAL NUMBER

Engine serial is a progressive number given to each engine during production.

1.2 DIESEL ENGINE OPERATION

1.2.1 GENERAL

In diesel engines, fuel and air is mixed directly in the combustion chamber. As a result of the high pressure to which the air is subjected, its temperature increases to the point where air/fuel mixture ignites spontaneously.
In fact, when the air is brought rapidly to a pressure of 30 bar or 435 psi its temperature reaches 700°C (1290°F), sufficient to cause spontaneous combustion. During the intake stroke, only air enters the cylinder. Naturally, an effective air cleaner must be placed at the end of the intake manifold to prevent dust and impurities from entering the cylinder, thus causing irrepairable damage to engine components.
Air entering the cylinder may be drawn directly from the outside atmosphere during piston downstroke, as occurs in naturally aspirated engines, or it may be pre-compressed by an exhaust gas activated turbocharger, as in supercharged engines. After being drawn into the cylinder, the air is compressed, and, as a result, heated to a temperature high enough to ignite the fuel spontaneously.
At the start of injection, atomized fuel is a sprayed from the injector nozzle at high pressure (approximately 200 bar, 2900 psi), and penetrates the compressed air in the combustion chamber. Part of the fuel then begins to burn rapidly as result of the high air temperature.
This part of the fuel burns so rapidly that it can be considered to explode.
The resulting great increase of temperature in the combustion chamber, together with the rapid swirling motion imparted to the air, combine to permit complete ignition of the fuel which continues to enter the combustion chamber from the injector.

The operating cycle is completed by the power and exhaust strokes, and is repeated every two revolutions of the crankshaft.
The operating cycle is completed by the power and exaust strokes, and is repeated every two revolutions of the crankshaft.

1.2.2. FUEL INJECTION REQUIREMENTS

Correct fuel injection, and hence optimum engine performance, depend on:

a) Injection timing – For proper functioning, injection should always take place at the same point of the operating cycle.
This point may, if necessary, be modified in accordance with engine speed by means of an automatic advance device.

b) Amount of fuel injected. – In order for the engine to develop the required power, the amount of fuel injected must remain constant and be the same for all cylinders. This amount of fuel must be determined in accordance with the engine requirements and, obviously, must be able to vary with the load applied to the engine.

c) Method of injection. – The fuel spray must:
- Be sufficiently atomized to permit immediate combustion;
- Fully penetrate the compressed air;
- Spread in all directions so that the greatest possible amount of air in the cylinder can be used in combustion.

The fuel injection system, and in particular the pump and injectors, perform all these functions.
When adjusting fuel injection pump timing, care should be taken that injection advance is as prescribed to avoid causing irrepairable damage to engine and fuel injection system. Care should also be taken when adjusting fuel injection pump calibration to ensure that the maximum limit is not exceeded. Never try to increase engine power by increasing pump output, as this would cause permanent damage to the engine.
Also check injector calibration and spray characteristics.

1.3 SPECIFICATION, ENGINE 8045

1.3.1 TYPE

6 - cylinder in-line vertical diesel engine.
Engine internal structure and characteristics are shown in figure 4.

Cycle . . . . . Diesel
Aspiration . . . . . natural
Number of strokes 4
Injection . . . . . direct
Number of cylinders 4
Bore . . . . . 103 mm or 4.05 in
Stroke . . . . . 110 mm or 4.33 in
Total displacement . . . . 3666 cm^3 or 223.7 in^3
Compression ratio . . . . . 17 to 1
Number of main bearings 5
Crankshaft rotation (viewed from fan end) clockwise
Maximum speed, full load . . . . . 2400 rpm
Maximum torque speed . . . . . 1600 rpm
Maximum speed, no-load . . . . . 2590 rpm
Minimum speed, no-load . . . . 800 to 850 rpm
Engine weight (without fluids) approx. 435 kg or 959 lb

Contrarotating weights vibration damper in the engine oil pan.

Valves: type... overhead, 2 per cylinder, pushrod operated. Valves open:

- intake . . . . . 3° BTDC
- exhaust . . . . . 48° 30' BBDC

Valves close:

- intake . . . . . 23° ABDC
- exhaust . . . . . 6° ATDC

Fuel system: Fuel filter with replaceable element.

Fuel injection:

- plunger-type fuel pump with sediment bowl filter
- injection pump with full range governor
- automatic advance

Firing order 1-3-4-2

Air cleaner: dry type with integral automatic dust ejection precleaner and secondary elements.

Lubrication: forced feed type, with double gear pump, feed and scavening.

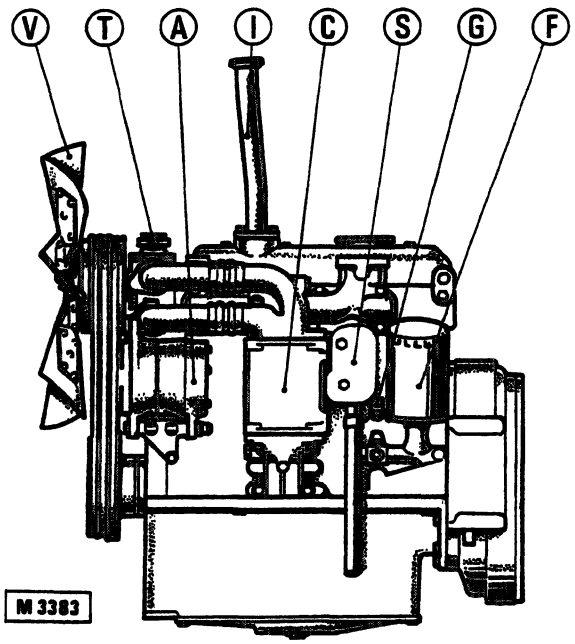

Fig. 2 - L.H. side view of engine.
A. Alternator - C. Converter oil heat exchanger - F. Oil filter - G. Mechanical rev. counter pick up - I. Engine oil filler - S. Breather - T. Thermostat - V. Fan.

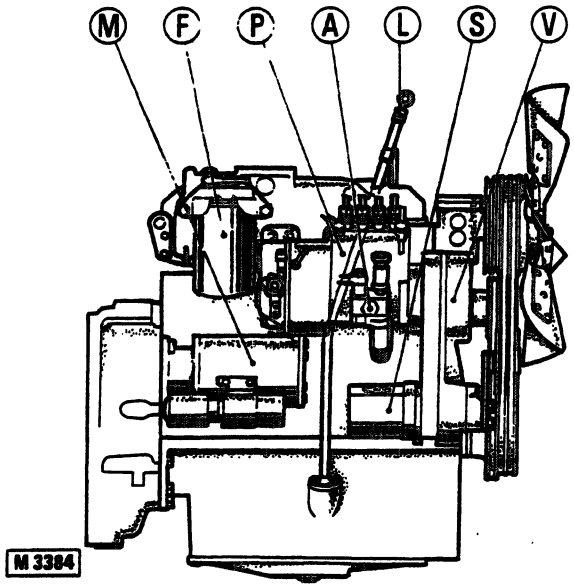

Fig. 3 - R.H. side view of engine.
A. Fuel supply pump - F. Fuel filter - L. Oil dipstick - M. Starter motor - P. Injection pump - S. Steering clutches hydraulic pump - V. Advance mechanism.

Oil filter: with replaceable paper element, located on crankcase.
Porosity . . . . . 15-16 μ
Oil is cooled by an oil-to-water heat exchanger connected to the engine cooling system.

Cooling system:
Type . . . . . water
Pump . . . . . centrifugal
Thermostat . . . . . wax type

2. CYLINDER BLOCK AND SLEEVES

2.1 CYLINDER BLOCK AND SLEEVES

The cylinder block is a single-piece special cast-iron casting. The main oil gallery is on the left side; other galleries duct the oil to the main bearings, camshaft bearings and cylinder heads.
The block also carries cylinder sleeve housings, main bearing seats, camshaft bushing seats and valve lifter seats.
The sleeves are pressed into the block and then reamed and ground to reach the specified bore.

2.1.1 CYLINDER SLEEVE INSPECTION AND DRESSING

Check the engine block top for distortion using a surface plate smeared with a thin coat of carbon

⚠ WARNING

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves, when metal or other particles are apt to fly or fall.

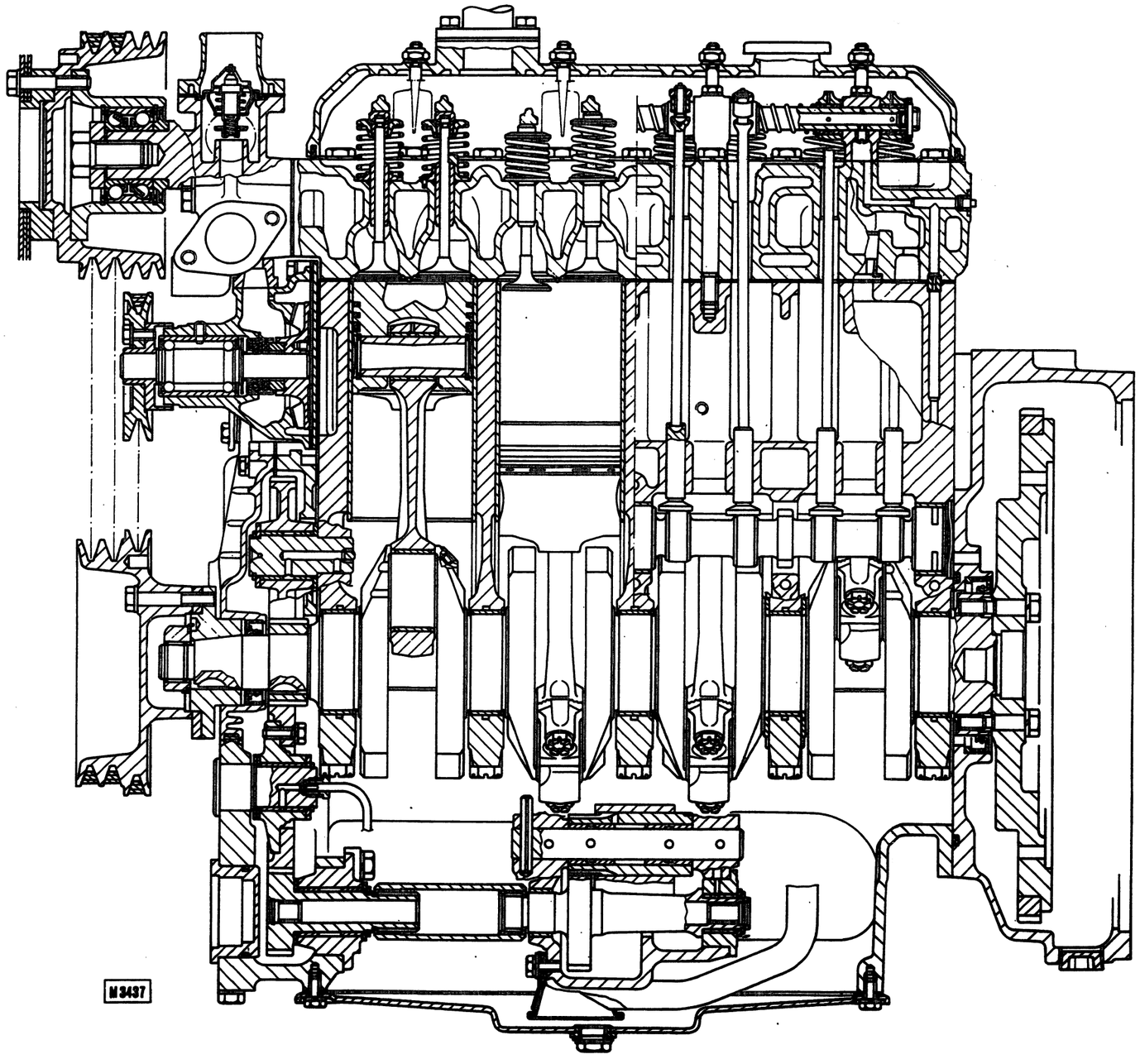

Fig. 4 - Engine 8045 longitudinal section.

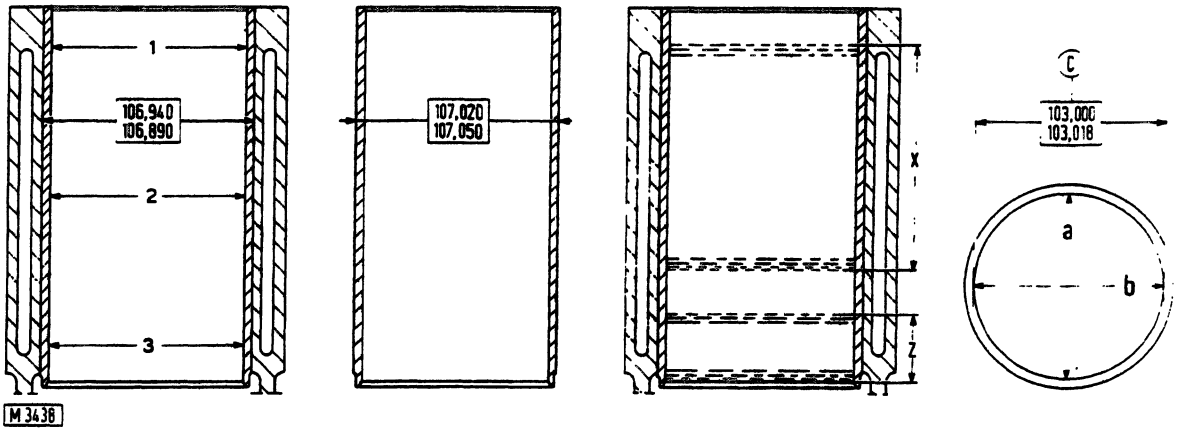

Fig. 5 - Standard dimensions (mm) of cylinder sleeves and seats in the block, and checking sleeve wear.
a-b. Perpendicular gauge positions for sleeve I.D. measurement - C. Figure to be obtained after sleeve installation - Z. Measurement area of worn sleeve I.D. to determine clearance with pistons (measure along axis b perpendicular to crankshaft) - X. Measurement area of worn sleeve I.D. (area swept by piston rings) to determine out-of-round and taper (measured along axis a and b, parallel and perpendicular to crankshaft) - 1-2-3. I.D. measurement level for new or refaced sleeve, along two perpendicular axes a and b.

black; if distortion is found to exist, dress using a grinder. If a surface plate is not available, use a straightedge (1, Fig. 6) and feeler gauge to detect areas of deformation.
Check the cylinder sleeve bores for sign of pick-up, scoring, out-of-round, taper or abnormal wear. To check the bore diameter in order to assess the amount of out-of-round, taper and wear, use gauge (Fig. 7) with attached dial gauge.

Check sleeve wear as follows (Fig. 5):
- measure I.D. in area X (swept area);
- measure this area at the top and at the botton along axis (a) parallel to the crankshaft, and along axis (b) perpendicular to the crankshaft;
- compare measurements to determine out-of-round and taper.

To check clearance with pistons measure I.D. of each sleeve in area (Z) only along axis (b).
In case out-of-round or tape exceed 0.12 mm (0.004 in) or clearance with pistons is over 0.3 mm (0.012 in) rebore sleeves (or replace them) to the nearest oversize (see table Specification). Check dimensions along axes (a and b) at three different levels (1, 2, 3).
Then match sleeves with pistons of the correct size (see "Pistons and rings").

2.1.2. REPLACING CYLINDER SLEEVES

By reaming the sleeve, thickness of its wall decreases. Max. thickness of the material that may be removed is 0.8 mm (0.03 in) after which sleeves have to be renewed. To remove sleeves use universal

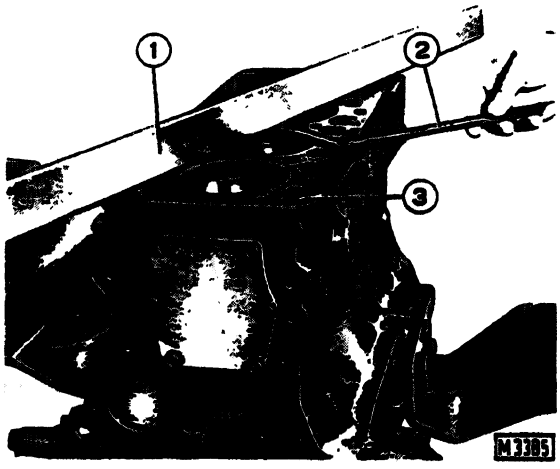

Fig. 6 - Checking engine block top.
1. Straightedge - 2. Feeler gauge - 3. Engine block top.

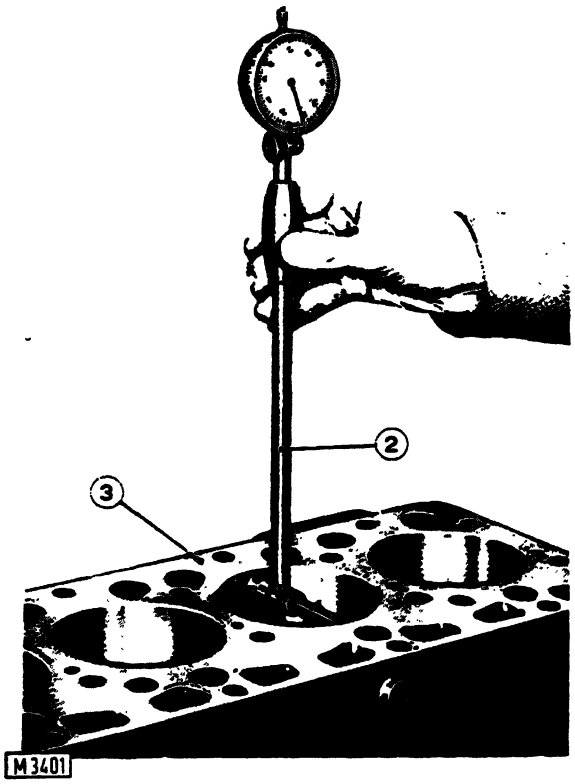

Fig. 7 - Checking cylinder sleeve diameter with dial gauge.
2. Dial gauge - 3. Cylinder block.

puller **75295731**, to install them use hydraulic press with plate **75291501**.
When installing the sleeves adhere to the following:
- check sleeve O.D. to be 107.020 ÷ 107.050 mm (4.2133 ÷ 4.2145 in) and diameter of housing in the block to be 106.890 ÷ 106.940 mm (4.2082 ÷ 4.2102 in);
- smear mating surfaces with engine oil;
- start pressing the sleeve into the housing;

⚠ WARNING

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

- after driving in the sleeve 70 ÷ 90 mm (2.75 ÷ ÷ 3.54 in) check load to be ≥ 1400 daN (3146 lb.) (fig. 8);
- continue pressing and 10 mm (0.39 in) before the end of installation check that load is 3500 ÷ ÷ 6300 daN (7,865 ÷ 14,157 lb.)

⚠ WARNING

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves, when metal or other particles are apt to fly or fall.

If load is not within these limits, withdraw sleeve and renew. After installation the sleeves should be bored and ground. In fact, they are supplied as spare with I.D. slightly below the nominal value in order to allow correction of any distortion caused by installation.
Sleeves are also supplied with O.D. oversized by 0.2 mm (0.0078 in).

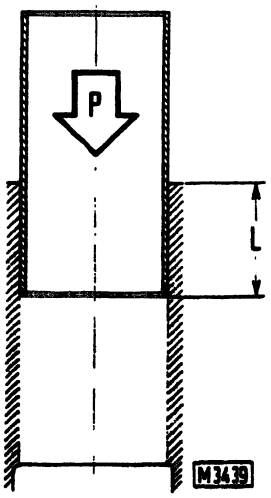

Fig. 8 - Installing cylinder sleeves in the block.
L = 70 ÷ 90 mm (2.75 ÷ 3.54 in) lead-in depth after which preload (P) must be checked - P = 3500 ÷ 6300 daN (7865 ÷ 14157 lb) Load required to complete installation.

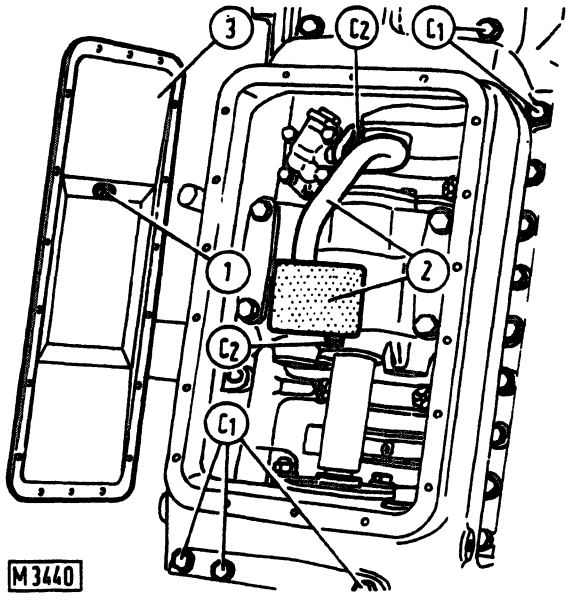

Fig. 9 - Oil pan with cover (3) removed.
C_1. Oil pan capscrews - C_2. Screws securing strainer to controrotating weight box and to oil pump - 1. Oil drain plug - 2. Oil strainer.

2.3.1 REMOVING CYLINDER HEAD

Do not remove the cylinder head with engine hot as this could cause distortions.

- drain coolant;
- depending on the type of machine, remove and disconnect all components and/or units preventing access to the cylinder head, as engine hood, air cleaner, exhaust system, etc.;
- remove exhaust manifold;
- disconnect the temperature gauge wire;
- remove inlet manifold capscrews and withdraw manifold;
- disconnect and remove radiator top hose. Remove screws and washers securing water outlet manifold to cylinder head and remove manifold with thermostat and fan hub;
- remove rocker arm cover nuts and remove cover;
- disconnect and remove fuel return lines from nozzle holders;
- plug all fuel lines to prevent ingress of dirt. Remove nozzle holders from cylinder heads to prevent damaging the nozzle after the head has been removed;
- remove nuts and washers securing rocker arm shaft supports to the heads and remove supports, shafts and rocker arms from each cylinder head;
- withdraw push-rods from heads and cylinder block;
- remove cylinder head self-locking screws.

2.2 OIL PAN

The cast-iron oil pan covers the contrarotating weight damper (Fig. 9).
When overhauling, wash the pan with hot water and soda, then rinse with water.

2.3 CYLINDER HEAD

The engine block is provided with a cast-iron cylinder head and the valve seats are integral with the cylinder head.
The gasket, placed between head and engine block, is fitted with an adhesive strip coated on both faces on intake manifold side to improve water sealing. Therefore renew the gasket in conjunction with any removal of the head.

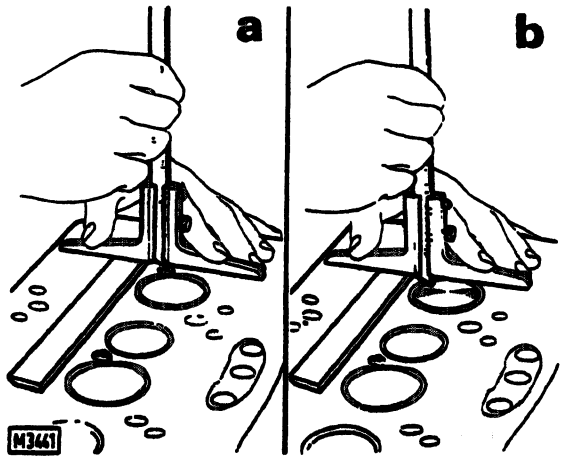

Fig. 10 - Checking injector protrusion and valve inset with respect to cylinder head deck.
a. Injector protrusion: 1 ÷ 1.5 mm (0.039 ÷ 0.059 in) - b. Valve inset: 0.7 ÷ 1.1 mm (0.027 ÷ 0.043 in).

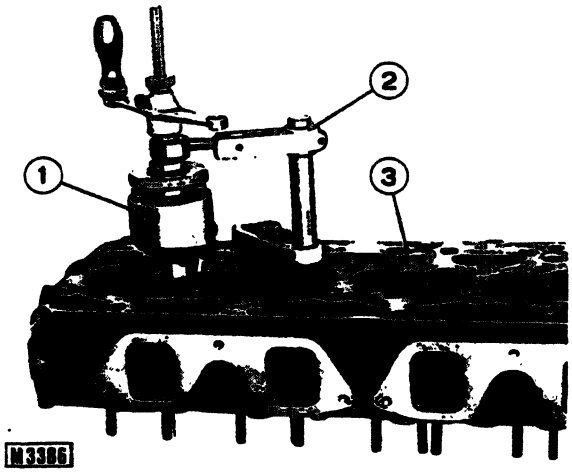

Fig. 11 - Grinding valve seats.
1. "Hunger" tool 75291113 - 2. Mounting - 3. Cylinder head.

2.3.2. CHECKING CYLINDER HEAD

For an accurate check of the cylinder head remove valves and springs, clean resting surfaces, valve seats and ducts.
To check cylinder head deck move the head on a reference plane covered with a thin film of carbon black or Prussian blue to find areas to be rectified with a scraper or to be ground in case of significant distortions.
Grinding of the cylinder head should be done after grinding the valve seats. The max. thickness that may be removed is 0.5 mm (0.019 in).

2.3.3 GRINDING VALVE SEATS AND REPLACING INJECTOR HOLDERS

⚠ WARNING

Wear proper protective equipment such as safety goggles or safety glasses with side shields, hard hat, safety shoes, heavy gloves, when metal or other particles are apt to fly or fall.

Valve seat and valve face grinding (Fig 11) is necessary when tightness of the valves is not satisfactory.

Use tool **75291113** to rest cylinder head and support **75291112** to position valves. To regrind valve seats use universal hand-lathe **75291113** as follows:
- remove scale from the galleries and thoroughly clean valve guide inside before installing tool pilot;
- work with tool secured by means of special revolving support;
- zero set tool on the seat centerline;
- make 0.1 ÷ 0.2 mm deep cuts (0.003 ÷ 0.007 in) until seat is completely refaced;
- make a 0.05 mm (0.0019 in) deep finishing cut.

Note what follows:
- to check seat contact on valve face smear face with Prussian blue and bounce the valve on the seat;
- do not turn the valve to check tightness. A thin continuous line should be noticed on the valve face; otherwise repeat grinding;
- the surface finish with hand lathe allows installing new valves without further grinding.

If, after repeated grindings, valve inset below the head deck is beyond the prescribed limit (Fig. 10) the head may be salvaged by grinding the resting surface on the block.
To renew and install new injector holders proceed as follows:

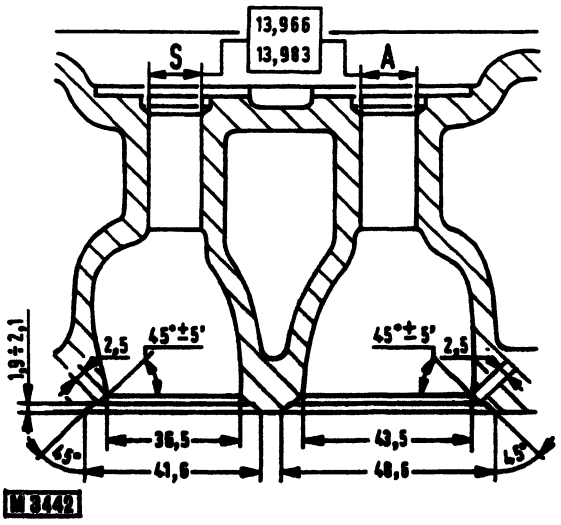

Fig. 12 - Valve seat and valve guide seat dimensions (mm)
A. Intake - S. Exhaust.

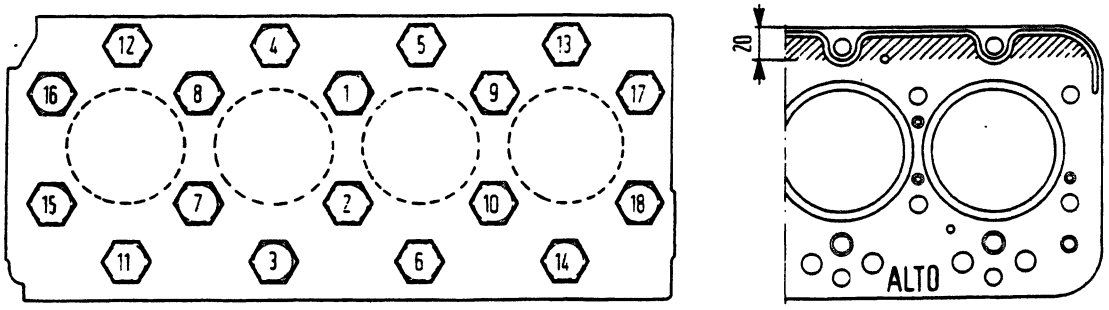

Fig. 13 - Cylinder head screws and nuts tightening sequence and detail of gasket.

- small leaks of the injector holders may be cured with punch **75295880**;
- to ensure injectors tightness on the botton of the holders grind tapered contact surface with end teeth cutter.

In case of injector holder removal use screw tap set **75290687** to thread them and puller **75295845** to remove them from the head.
Drive in new injector holders with hand press and swage their bottom with punch **75295880**.
After installing injectors and valves make sure that injectors protrusion and valve inset are as specified in Fig. 10. In case of insufficient injector protrusion, regrind tapered seat on the holder with end teeth cutter. If protrusion exceeds max. value, renew holder.

2.3.4 REINSTALLING CYLINDER HEAD

Before installing cylinder head, thoroughly clean and degrease contact surfaces and position gasket as follows:

- place gasket (adhesive type) on the block with the word "ALTO" (a, Fig. 13) contacting the cylinder head. Install head and tighten capscrews following the sequence indicated in the figure. Reach the specified torque in at least three stages, as indicated in the table below.

NOTE - Hatched area on the gasket (Fig. 13) within the dimensions in mm, indicates adhesive surface applied in production

Recommended tightening stages for cylinder head bolts:

Stage	1°	2°	3°
daN·m (*)	5	10	15
lb·ft (*)	37	74	110

(*) Lubricate bolts with engine oil.

3. TIMING SYSTEM

3.1 TIMING COVER AND GEARS

The timing gears are contained in a special housing (Fig. 16). Lubrication is by means of a gallery in the housing which, in case of overhaul, should be checked and cleaned with a wire, as shown in Fig. 15.

⚠ WARNING

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.

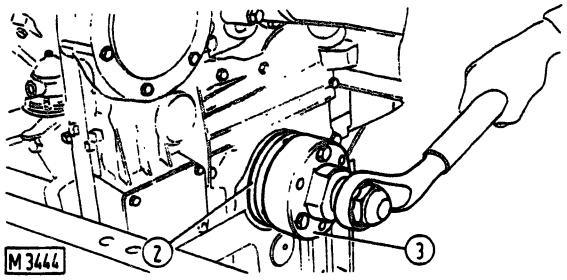

Fig. 14 - Removing the crankshaft sprocket hub. 2. Hub - 3. Tool 75291504.

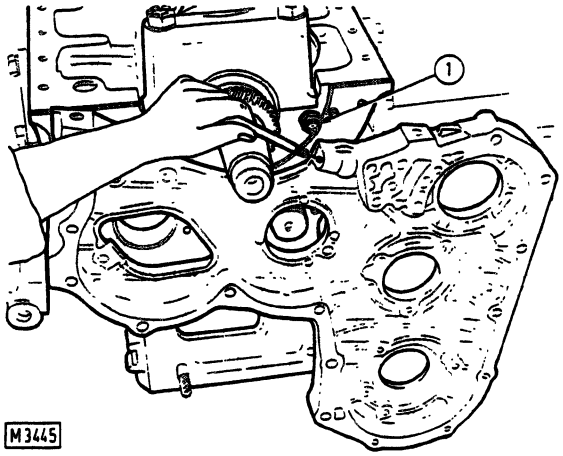

Fig. 15 - Cleaning the timing housing lubrication orifice. 1. Rubber seal.

3.1.1 REMOVING AND INSTALLING TIMING GEARS

To remove gears proceed as follows:

- for camshaft drive gear (6, Fig. 16) follow instructions in section 3.1.2.
- For idler gear (4, Fig. 16) first remove circlip and relevant washer.
- for injection pump idler gear (2, Fig. 16) remove complete unit by removing cover (6, Fig. 22) and circlip (7), then remove screws (C_1).

Check backlash to be 0.050 ÷ 0.100 mm (0.0019 ÷ ÷ 0.0039 in). Max. backlash due to wear should be 0.15 mm (0.0059 in).

- for camshaft drive gear (Fig. 18) use universal puller yoke. To install, heat gear (180°C - 356°F) and press it into camshaft after installing the key.

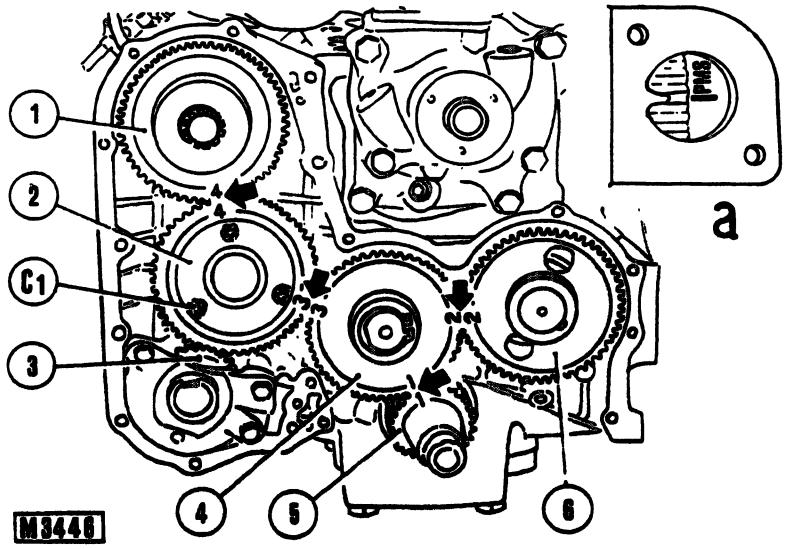

Fig. 16 - Timing gear alignment.
Note - Arrows indicate marks that must be lined-up when cylinder No. 1 at T.D.C. in the compression stroke as shown by detail (a).
a. Detail of timing mark on flywheel - C_1. Idler gear capscrews - 1. Injection pump drive gear - 2-4. Idler gears - 3. Steering clutches pump drive gear - 5. Timing system drive gear - 6. Camshaft drive gear.

3.1.2 CAMSHAFT

The camshaft is located in the engine block, supported by three babbitt metal-lined steel bushings pressed into their seats in the block.
The camshaft (1, Fig. 17) is held in place at the front by a thrust collar (3, Fig. 18) where a gear (1), hot pressed and keyed, drives it.

Removing the camshaft

To remove the camshaft remove rocker arms and push-rods to relieve all pressure on the cams.

- turn engine on rotating stand by 180°, remove oil pan and oil pump, as the oil pump gear takes its motion from the camshaft helical gear.
- remove timing gear cover, remove screws (C_1, Fig. 18) securing the thrust plate to the timing housing and withdraw camshaft with gear.

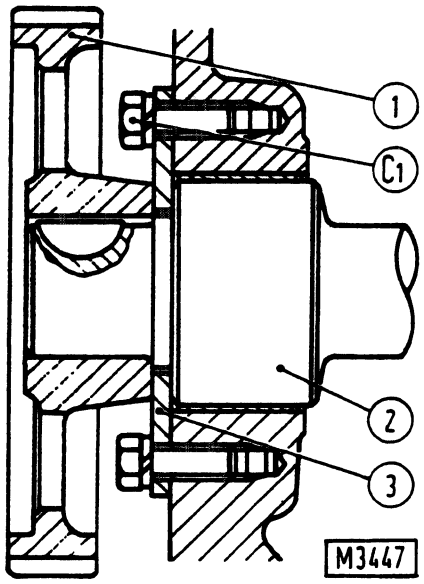

Fig. 18 - Section of camshaft drive.
C_1. Camshaft gear thrust collar capscrews - 1. Drive gear - 2. Camshaft - 3. Thrust collar.

3.1.3 CHECKING CAMSHAFT

Check camshaft journal wear referring to Fig. 20 and to data given in Section 9.
Very slight cam scoring may be rectified with a fine grade abrasive stone, but renew camshaft if the result is not satisfactory.
Check camshaft for distortions (Fig. 19). The dial gauge placed on the center journal should not indicate variations greater than 0.02 mm (0.00078 in). Straighten camshaft with a press.

⚠ WARNING

Handle all parts with extreme care. Keep hands and fingers from between parts. Wear authorized protective equipment such as safety glasses, heavy gloves, safety shoes.

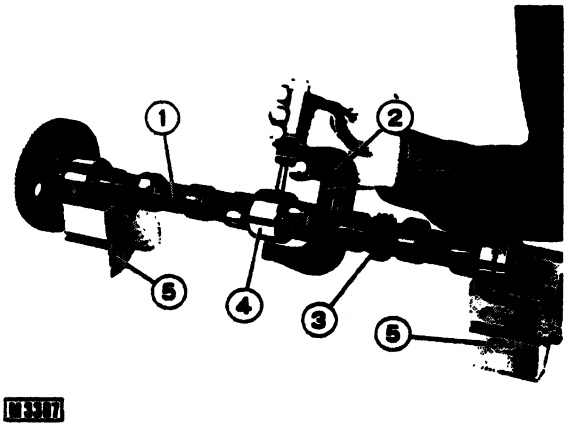

Fig. 17 - Checking camshaft journal diameter.
1. Camshaft - 2. Micrometer - 3. Oil pump drive gear - 4. Center journal - 5. Vee blocks.

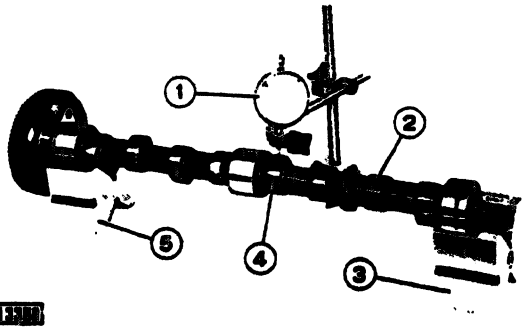

Fig. 19 - Checking cam lift.
1. Dial gauge with magnetic mount - 2. Camshaft - 3-5. Vee blocks - 4. Cam.

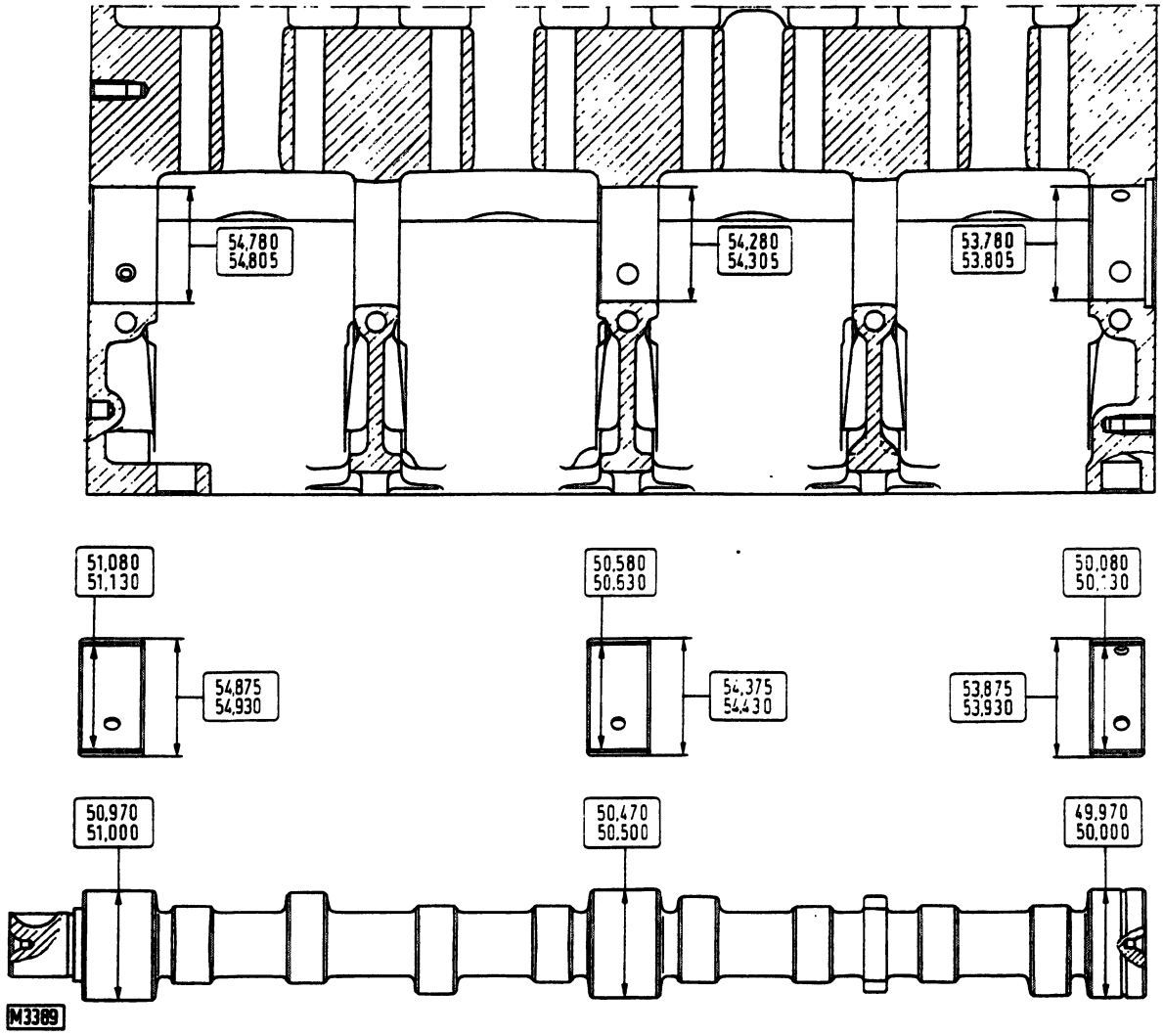

Fig. 20 - Main data of camshaft, bushings and seats in the block.

Camshaft-to-bushing clearance	0.080 ÷ 0.160 mm (0.0031 ÷ 0.0062 in)
Max. play	0.20 mm (0.0078 in)
Bushing-to-seat interference	0.07 ÷ 0.15 mm (0.0027 ÷ 0.0059 in)

3.1.4 CHECKING AND REMOVING CAMSHAFT BUSHINGS

Bushings must be forced into their seats; if play exists renew bushings.
Examine bushing inner surface; if signs of seizing or scoring are noticed renew bushings.
Check dimensions (Fig. 20) with inside gauge. To remove bushings proceed as follows:

- use a universal puller of the type shown in Fig. 21 to remove front bushing, and the same puller with extension for the center bushing;
- remove engine block rear support;
- with a punch of suitable length, act through the block to remove the expansion plug near the rear bushing;
- withdraw rear bushing using the front and intermediate bushing.

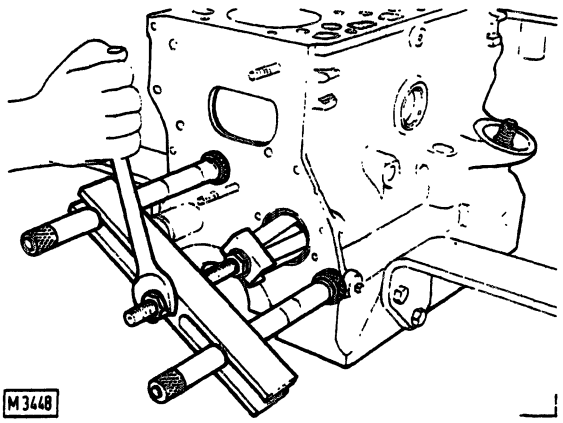

Fig. 21 - Front camshaft bushing removal with universal puller.

3.1.5 INSTALLING CAMSHAFT BUSHINGS

⚠ WARNING

Use proper tools to bring holes into alignment. DO NOT USE FINGERS OR HANDS.

When reinstalling the bushings, consider the following:

- locate bushings so that lubrication holes line up with those on the block;
- install bushings with punch **75295863** starting from the intermediate one;
- reface bushing bore with fixed blade reamer to bring diameter to dimension indicated in Fig. 20.

3.1.6 INSTALLING CAMSHAFT

Reverse removal operations.
After any operation on camshaft or engine overhaul lubricate camshaft by pouring 1 kg (2.2 lbs) of oil through the cylinder head, before starting the engine.

3.1.7 TIMING GEAR ALIGNMENT (Fig. 16)

To align timing gears proceed as follows:

- turn crankshaft so that piston No. 1 reaches T.D.C. at the end of the compression stroke;
- install drive gears with reference marks lined up.

If you want to check angular values for valve opening and closing listed in table, provisionally set clearance between valves and rocker arms at 0.45 mm (0.017 in).

Intake	Start: before TDC End: after BDC	3° 23°
Exhaust	Start: before BDC End: after TDC	48°30' 6°

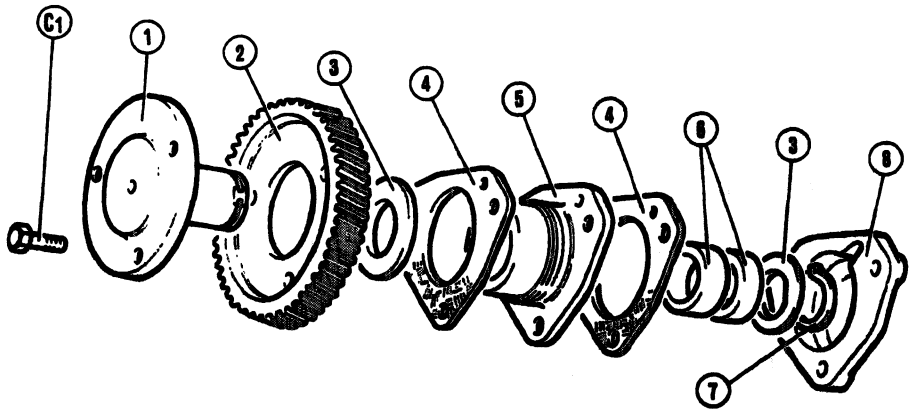

Fig. 22 - Exploded view of injection pump idler gear.
C_1. Capscrews securing gear (2) to shaft (1) - 1. Shaft - 2. Idler gear - 3. Thrust washer - 4. Seals - 5. Shaft support - 6. Bushings - 7. Circlip - 8. Cover.

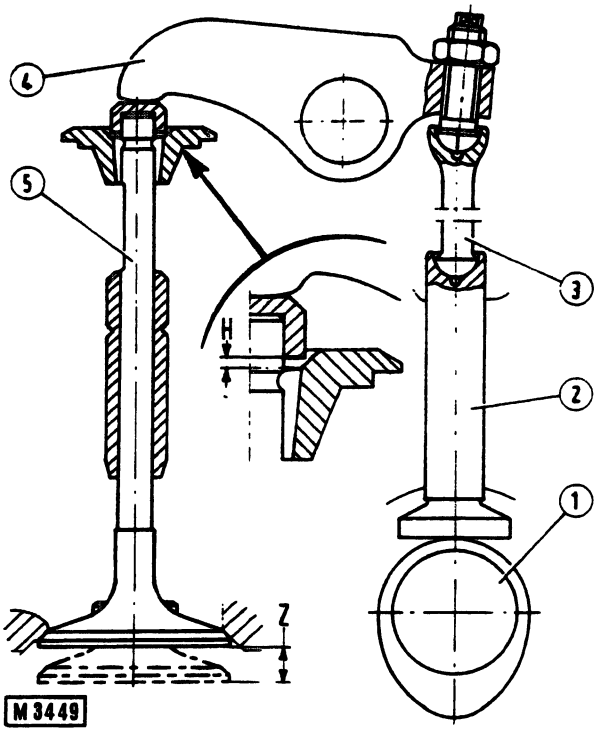

Fig. 23 - Valve operating mechanism.
H. Clearance between cap and split cone retainer - Z = 10 mm (0.39 in) Max. valve lift - 1. Camshaft - 2. Valve lifter - 3. Push-rod - 4. Rocker arm - 5. Valve.

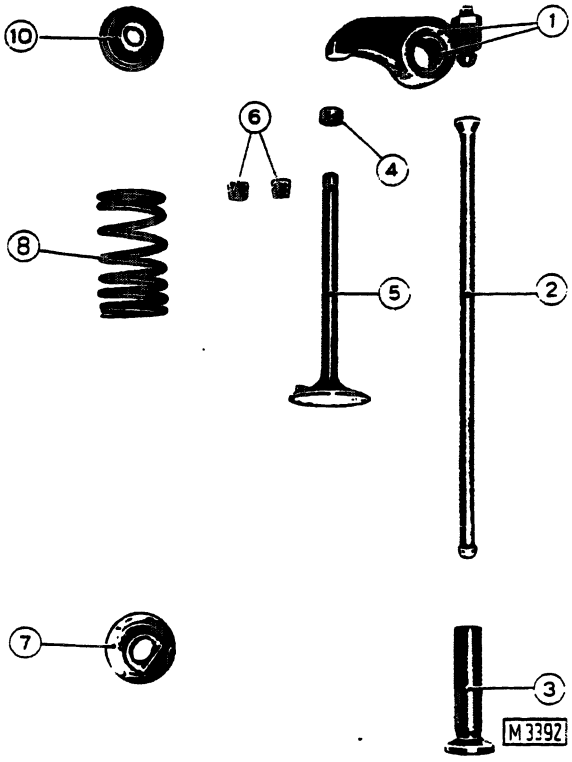

Fig. 25 - Valve mechanism components.
1. Rocker arm with bushing - 2. Push-rod - 3. Valve lifter - 4. Cap - 5. Intake valve - 6. Split cone retainers - 7. Lower retaining cup - 8. Spring - 10. Upper retaining cup.

3.2 VALVES AND VALVE GUIDES

Many malfunctions of the engine are caused by abnormal operating conditions of the valves. Consequently, tightness in their seats and clearance in the guides are crucial points.

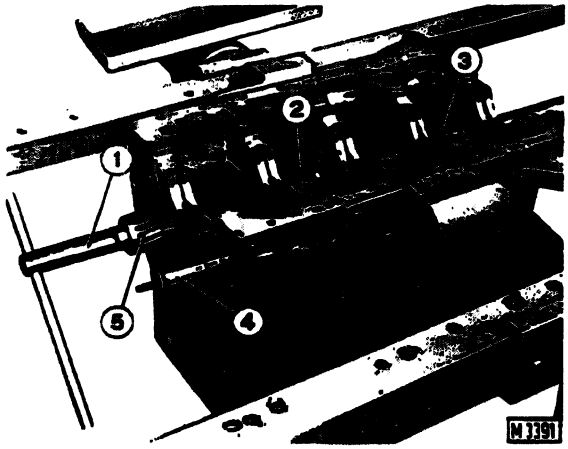

Fig. 24 - Reboring camshaft bushings.
1. Mandrel - 2-3. Centering bushings - 4. Idler gear spindle - 5. Cutter.

3.2.1 DISMANTLING AND CHECKING VALVES

- remove cylinder head from block;
- remove cap (4, Fig. 25) from valve stem;
- compress springs with tool **75291050** (Fig. 26) and remove upper retaining cup split cone keepers (6, Fig. 25);
- thoroughly clean valves. In case of poor tightness grind valves and seats, and if necessary wash the parts to remove any abrasive left;
- check dimensions (Fig. 28).

WARNING

Never use gasoline or solvent or other flammable fluid to clean parts. Use authorized commercial, non-flammable, non-toxic solvents.