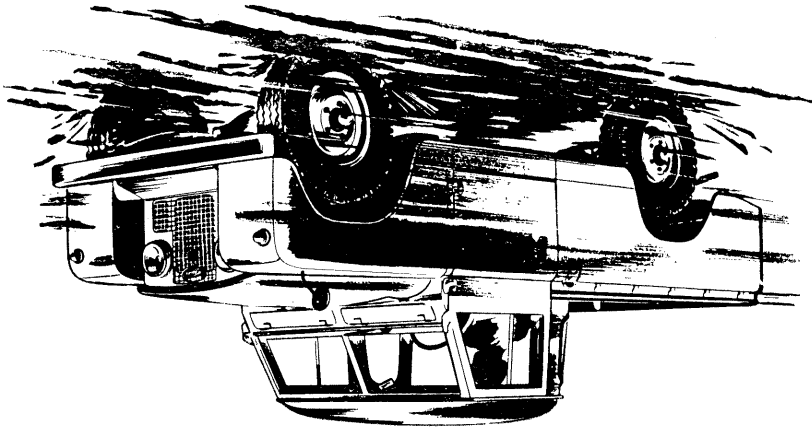


THE ROVER CO. LTD . SOLIHULL . WARWICKSHIRE . ENGLAND

By Appointment to  
Her Majesty  
Queen Elizabeth II  
Manufacturers  
of  
Land-Rovers



109

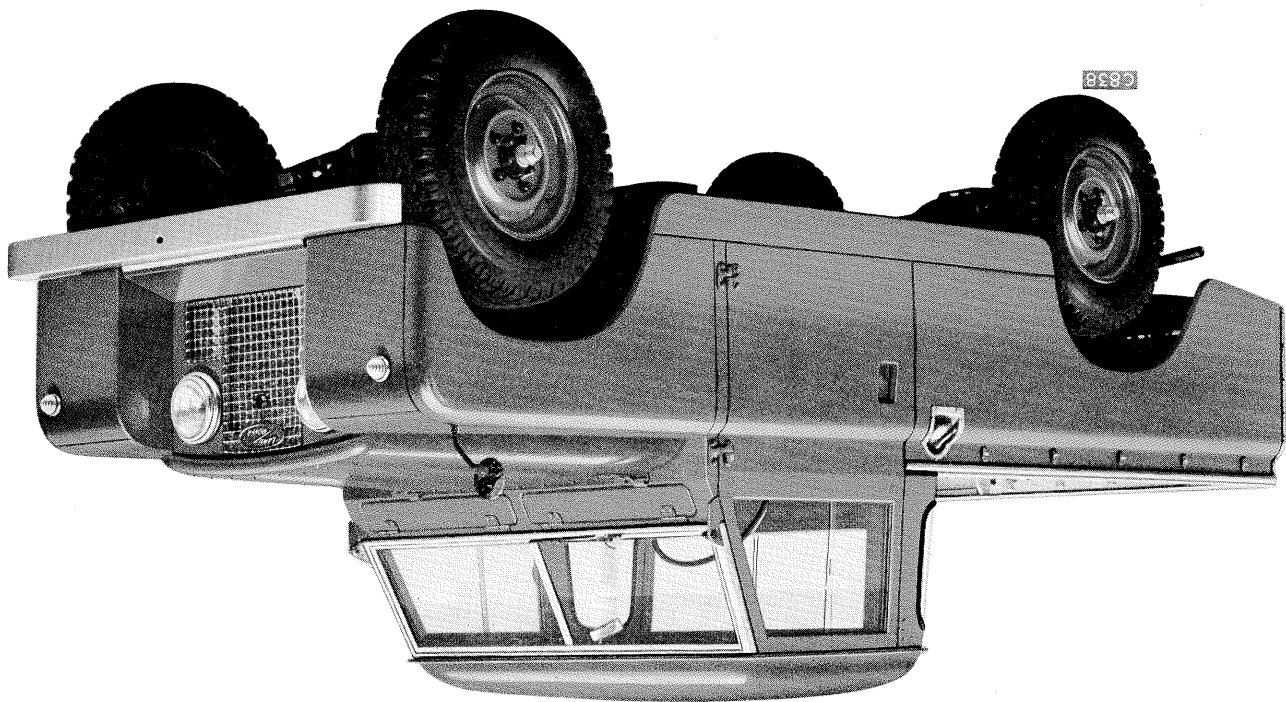
and

88

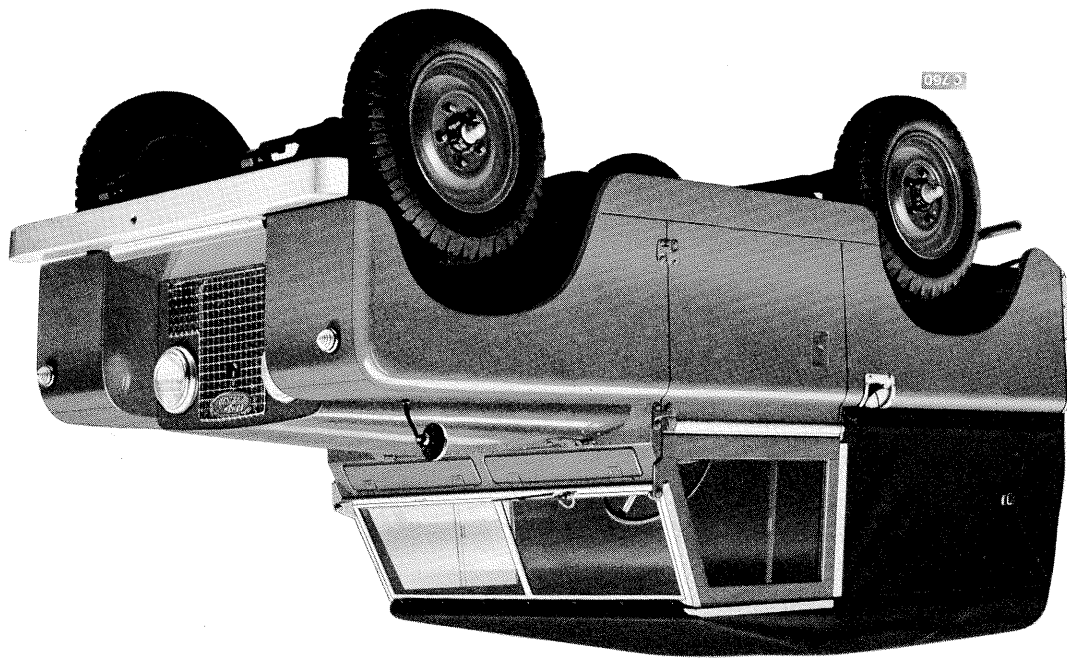
WORKSHOP  
MANUAL  
FOR PETROL  
AND DIESEL  
MODELS



Land-Rover Series II 109 model



Land-Rover Series II 88 model



COMMENCING VEHICLE NUMBERS

PETROL MODELS

109 Station Wagon	161900001 onwards	151800001 onwards	88 All models	141800001 onwards	Basic Vehicle Home
	164900001 onwards	154800001 onwards		144800001 onwards	Basic Vehicle L.H.D. Export
	162900001 onwards	152800001 onwards		142800001 onwards	Basic Vehicle R.H.D. Export
	165900001 onwards	155800001 onwards		145800001 onwards	C.K.D. L.H.D. Export
	163900001 onwards	153800001 onwards		143800001 onwards	C.K.D. R.H.D. Export

DIESEL MODELS

109 Station Wagon	166900001 onwards	156800001 onwards	88 All models	146800001 onwards	Basic Vehicle Home
	169900001 onwards	159800001 onwards		149800001 onwards	Basic Vehicle L.H.D. Export
	167900001 onwards	157800001 onwards		147800001 onwards	Basic Vehicle R.H.D. Export
	170900001 onwards	160800001 onwards		150800001 onwards	C.K.D. L.H.D. Export
	168900001 onwards	158800001 onwards		148800001 onwards	C.K.D. R.H.D. Export

Please note that all prices and specifications are subject to alteration without notice

THE ROVER COMPANY LTD.  
SOLIHULL, WARWICKSHIRE, ENGLAND

SERVICE AND SPARES DEPT.:  
SOLIHULL, WARWICKSHIRE  
ENGLAND

Telegrams: SHELDON 4242  
Roverpair, Solihull, England  
Telex: 33-156

LONDON SERVICE STATION:  
SEAGRAVE ROAD, FULHAM  
LONDON S.W. 6 ENGLAND  
Telegrams: ROVERPAIR, WESPHONE,  
LONDON, ENGLAND  
Telephone: FULHAM 1221

2nd Edition

Part No. 4220

Revised February 1961

DECEMBER, 1958



# Introduction

This Workshop Manual is designed to assist those responsible for the maintenance and overhaul of the Land-Rover.

The subject matter is sectionised as detailed in the index on the next page, and the pages are numbered within those sections. At the beginning of each section will be found a sub-index for that section.

## NOMENCLATURE

As this manual covers both right- and left-hand drive models, reference is made throughout the text to the "left-hand" and "right-hand" sides of the vehicle, rather than to the "near-side" and "off-side". The "left-hand" side is that to the left hand when the vehicle is viewed from the rear; similarly, "left-hand drive" models are those having the driving controls on the left-hand side, again when the vehicle is viewed from the rear.

## CAPACITIES

All capacities are quoted in Imperial and Metric measure; to ascertain the U.S. equivalent, multiply the Imperial figure by 1.2.

## MEASUREMENTS

All measurements are given in Imperial measure; the Metric equivalent is added where possible, but in certain cases, such as cylinder rebore sizes, this is of course not practicable, and the Imperial figure must be used.

## VEHICLE SERIAL NUMBERS

The vehicle serial number will be found on the transfer box instruction plate on the dash panel over the gearbox cover. It is the same as the chassis number, which is stamped on the right-hand front spring shackle bracket.

Gearbox number: Right-hand side of gearbox casing.  
 Rear axle: On top of axle casing on left-hand side.  
 Front axle: On top of axle casing on left-hand side.

The full vehicle serial number must be quoted in all correspondence; the registration number of the vehicle is of no use whatever to us. The engine serial number, which need not be quoted in correspondence unless specifically asked for, is stamped on the left-hand side of the cylinder block at the front. Other units bear serial numbers as detailed below, but they should not be quoted unless specifically requested:—

Front axle: On top of axle casing on left-hand side.  
 Rear axle: On top of axle casing on left-hand side.

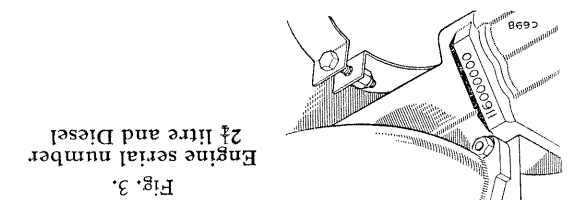


Fig. 1. Vehicle serial number

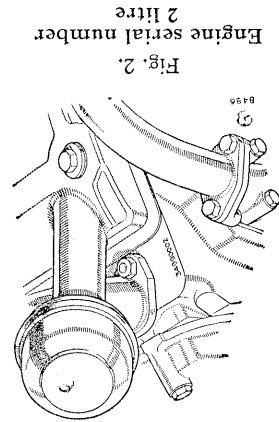


Fig. 2. Engine serial number  
 2 litre

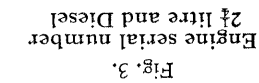


Fig. 3. Engine serial number  
 2½ litre and Diesel

Note that this re-issue incorporates all Workshop Manual information appertaining to Land-Rovers circulated by means of combined Rover Service News Letters numbered up to 117 and Land-Rover Service News Letters numbered up to 8.

# Index to Sections

See section title pages for detailed operation indexes

Section	Title	Pages
A	ENGINE 2 litre petrol 2½ litre petrol 2 litre diesel	A-1 to A-18 A-19 to A-36 A-37 to A-57
A2	VIBRATION DAMPER	A2-1 to A2-2
B	CLUTCH	B-1 to B-14
C	GEARBOX	C-1 to C-27
D	PROPELLER SHAFTS	D-1 to D-4
E	REAR AXLE	E-1 to E-5
F	FRONT AXLE	F-1 to F-17
G	STEERING AND LINKAGE	G-1 to G-9
H	BRAKE SYSTEM	H-1 to H-17
J	SUSPENSION	J-1 to J-4
K	CHASSIS	K-1 to K-3
L	COOLING SYSTEM	L-1 to L-8
M	FUEL SYSTEM	M-1 to M-31
N	EXHAUST SYSTEM	N-1 to N-2
P	ELECTRICAL SYSTEM	P-1 to P-24
Q	INSTRUMENTS AND CONTROLS	Q-1 to Q-10
R	BODY	R-1 to R-14
S	WHEELS AND TYRES	S-1 to S-4
T	EXTRA EQUIPMENT	T-1 to T-52
V	RECLAMATION SCHEMES	V-1 to V-2

# Detailed Index

Section	Component	Section	Component
H	Brake, transmission	M	Air cleaner
H	Brakes, foot	K	Air cleaner support
P	Brush gear dynamo	Q	Accelerator pedal and linkage
P	Brush gear starter motor	Q	Accelerator pedal housing
J	Bump rubber, road spring	M	Accelerator pump carburetter
K	Bumper, front	Q	Accelerator shaft
R	Cable clips	A	Adaptor, distributor, 2½ litre
P	Cable, fuel tank	A	Adaptor, external oil filter
P	Cable harness, dash	T	Adaptor, power-take-off
P	Cable harness, frame	A	Adjuster, timing chain
P	Cable harness, headlamp	Q	Alternator
P	Cable, speedometer	H	Ammeter
P	Cables, high tension	H	Anchor plate, brake, hand
A	Camshaft bearing	H	Anchor plate, brake, foot
A	Camshaft chain	Q	Armature
A	Camshaft chain adjuster	T	Arm, drop
A	Capacity, cooling system	F	Arms, steering
E	Capacity, lubrication system	F	Attachments, towing
E	Captain winch, front	T	Axle casing oil seal
F	Carburetter	F	Axle, front
F	Carrier, battery	F	Axle, rear
M	Carrier, spare wheel (on bonnet)	E	Axle shaft, rear
R	Casing, gearbox	E	Axles, stub
T	Catch, bonnet	M	Back leakage, fuel
R	Centre cover panel	R	Back rest, cab
S	Centre power take-off	R	Back rest, rear seat
P	Chaff guard	S	Balance weight, road wheel
K	Chain, tailboard	P	Batteries
A	Chain, timing	K	Battery and air cleaner support
D	Change speed lever, main	A	Bearings, camshaft
A	Change speed lever, transfer	D	Bearings, centre propeller shaft, 109
C	Chassis frame	A	Bearings, connecting rod
A	Cleaner, air	C	Bearings, gearbox
F	Clutch cylinder, master	A	Bearings, steering column thrust
C	Clutch cylinder, slave	G	Bearings, swivel pin
A	Clutch linkage	F	Bearings, transfer box
L	Clutch pedal unit	C	Bearings, valve rockers
A & L	Clutch unit	A	Belt, fan
C	Clutch operating levers	L	Bell housing
R	Clutch plate	C	Board, tail
R	Clutch withdrawal mechanism	R	Body, rear
R	Coil, ignition	R	Body mounting
R	Connecting rods	R	Body repairs
R	Control box, voltage	R	Body sides
T	Control, mixture	R	Bonnet
R	Control tube, steering	R	Bonnet carrier for spare wheel
R	Control quadrant, engine speed, 2½ litre	R	Bonnet catch
H	Control quadrant, engine speed, Diesel	R	Brake cylinder, master
H	Cooler, oil	R	Brake cylinder, wheel
H	Cooling system	H	Brake drum, foot
H	Cover plate, universal joint	H	Brake drum, hand
H	Cover plate, wing valance	H	Brake hand
H	Crankcase sump	H	Brake lever, hand
H	Crankshaft	H	Brake pedal
H	Cushion, seat	H	Brake pipes

Section	Component	Section	Component	Section	Component
T	Flashing indicators	T	Cushion, seat, rear	.....	.....
R	Floor, front	Q	Cut-off control	.....	.....
A & B	Flywheel	A	Cylinder block	.....	.....
V	Flywheel reclamation	H	Cylinder, brake, master	.....	.....
H	Foot pedal	H	Cylinder, brake, wheel	.....	.....
K	Frame alignment	B	Cylinder, clutch, master	.....	.....
K	Frame harness	B	Cylinder, clutch, slave	.....	.....
P	Front axle	A	Cylinder head	.....	.....
F	Front axle half shaft	A	Cylinder liners	.....	.....
F	Front bumper	A2	Damper, vibration	.....	.....
K	Front capstan winch, mechanical	J	Dampers, hydraulic	.....	.....
T	Front hydraulic winch	R	Dash panel	.....	.....
N	Front hub	E & F	Data, axles	.....	.....
F	Front output shaft	H	Data, brakes	.....	.....
C	Front shock absorber	B	Data, clutch	.....	.....
J	Front wing	L	Data, coolant system	.....	.....
R	Fuel, gauge, instrument panel	P	Data, electrical	.....	.....
Q	Fuel level unit	A	Data, engine	.....	.....
P	Fuel pump, 2 litre petrol	T	Data, extras	.....	.....
M	Fuel pump, 2 1/4 litre petrol and diesel	M	Data, fuel	.....	.....
M	Fuel tank	C	Data, gearbox	.....	.....
P	Fuse box	AO	Data, lubrication	.....	.....
P	Gauge unit, fuel tank	G	Data, steering	.....	.....
P	Gearbox	J	Data, suspension	.....	.....
C	Gearbox bearings	A	Decarbonising	.....	.....
C	Gearbox cover	F	Differential, front	.....	.....
R	Gearbox units, power take-off	F	Differential pinion oil seal	.....	.....
T	Gear change levers	E	Differential, rear	.....	.....
C	Gears, main gearbox	P	Dip switch	.....	.....
C	Gears, rear power take-off	P	Distributor	.....	.....
T	Gears, transfer box	A	Distributor housing	.....	.....
C	Glass, hard top, cab	R	Door	.....	.....
R	Glass, windscreen	R	Door hinges	.....	.....
R	Governor, engine	R	Door locks	.....	.....
T	Grille, radiator	R	Doors and fittings	.....	.....
R	Grommet, bell housing	G	Drag link	.....	.....
C	Gudgeon pins	K	Drawbar, rear	.....	.....
A	Half shaft	B	Driven plate, clutch	.....	.....
F	Hand brake	F	Driving shaft, front axle	.....	.....
H	Hand throttle	G	Drop arm	.....	.....
T	Hard top	H	Drum, foot brake	.....	.....
P	Harness, dash	H	Drum, hand brake	.....	.....
P	Harness, frame	P	Dynamo	.....	.....
P	Harness, main	A	Engine	.....	.....
P	Headlamps	T	Engine governor	.....	.....
P	Heater plugs	A	Engine support, front	.....	.....
P	Heater unit	C	Engine support, rear	.....	.....
R	Hinge, bonnet	A	Exhaust manifold	.....	.....
R	Hinge, door	N	Exhaust pipe, front	.....	.....
R	Hinge, locker lids	A	Exhaust rocker shaft	.....	.....
R	Hinge, ventilator	N	Exhaust silencer	.....	.....
T	Hood, full length	A	Exhaust valves	.....	.....
T	Hood, three-quarter length	T	Extra equipment	.....	.....
P	Horn	L	Fan	.....	.....
P	Horn button	A & L	Fan belt	.....	.....
A	Hood stick	A & L	Fan driving pulley	.....	.....
O	Housing, accelerator pedal	R	Fastener, windscreen	.....	.....
B	Housing, clutch withdrawal	M	Filler cap, petrol	.....	.....
A	Housing, distributor	M	Filter, fuel pump	.....	.....
B	Housing, front output	M	Filter, injection pump	.....	.....
C	Housing, rear mainshaft bearing	M	Filter, oil external	.....	.....
		AO	Filter, oil internal	.....	.....
		AO	Filter, petrol	.....	.....
		M	Fire fighting equipment	.....	.....



(v)

Section	Component
F	Oil seal, pinion housing
F	Oil seal, swivel pin housing
F	Operating levers, clutch
C	Output shaft, front
R	Paint, touch-up process
O	Panel light switch
O	Panel lights
O	Pedal, accelerator
O	Pedal, brake
O	Pedal, clutch
M	Petrol level gauge
M	Petrol pipes
M	Petrol pump
M	Petrol sediment bowl
M	Petrol tank
P	Petrol tank level unit
P	Pins, gudgeon
P	Pins, shackle
P	Pins, swivel
P	Pipes, brake
O	Pistons
M	Plate clutch drive, starter
M	Plate, toe
M	Plate, tow
C	Plug, heater, Diesel
C	Plug, hot, Diesel
G	Plugs, sparking
F	Power take-off, centre
F	Power take-off, gearbox units
F	Power take-off, rear
A	Power take-off, rear pulley
O	Priming fuel system
B	Propeller, shaft, front
H	Propeller shaft joint cover plates
G	Propeller shaft, power take-off
R	Propeller shaft, rear
F	Pulley, power take-off
G	Pump, accelerator
A	Pump, fuel
A	Pump, oil
A	Pump, water
A	Radiator
C	Radiator grille panel
C	Rear axle
C	Rear axle shaft
A	Rear body
H	Rear capstan winch
B	Rear drawbar
O	Rear drive pulley
P	Rear lid, hard top
R	Rear number plate lamp
A	Rear power take-off
M	Rear seats
M	Reboring, petrol models
M	Recommended lubricants
M	Relay unit, steering
M	Relief valve, oil
P	Resistance, heater plugs
T	Reverse stop, gearbox
A	Rings, piston
A	Riveting body panels
T	Road springs, front
A	Road springs, rear
A	Rocker shafts

Section	Component
F	Housing, universal joint
F	Housings, swivel pin
F	Hub, front
J	Hydraulic dampers
O	Ignition switch
A	Ignition timing
A	Indicators, flashing
A	Inlet manifold
A	Inlet rocker shaft
A	Inlet valves
M	Injection nozzle
M	Injection pump
S	Inner tubes
Q	Instruments
P	Lamp, head
P	Lamp, number plate
P	Lamp, rear
P	Lamp, side
P	Lamp, stop
O	Lamp switch
O	Layshaft
O	Level gauge, fuel
O	Level unit, fuel tank
C	Lever, change speed, main
C	Lever, change speed, transfer
G	Lever, hand brake
G	Lever, steering relay
F	Levers, steering
F	Light, warning, instrument panel
A	Liners, cylinder
A	Link, drag
B	Linkage, accelerator
B	Linkage, clutch
H	Linkage, hand brake
G	Linkage, steering
R	Lock, door
F	Lock stop, steering
G	Longitudinal tube, steering
A	Lubricants, recommended
A	Lubricating system
A	Main bearings
C	Main gear change lever
C	Mainshaft bearing housing, rear
C	Mainshaft, gearbox
A	Manifold, exhaust
A	Manifold, inlet
H	Master cylinder, brake
B	Master cylinder, clutch
O	Mixture control
P	Mixture control thermostat switch
R	Mounting, body
A	Mountings, engine
M	Nozzle, cleaning
M	Nozzle, flushing
M	Nozzle, injection
M	Nozzle, testing
P	Number plate lamp
O	Oil cooler
A	Oil filter, external
A	Oil filter, internal
T	Oil pressure gauge
A	Oil pressure release valve
A	Oil pump
F	Oil seal, axle casing

Section	Component	Section	Component
Q	Switch, panel lights	A	Rod, connecting
Q	Switch, starter	H	Rod, track
P	Switch, stop lamp	G	Rod, hard top
P	Switch, stop lamp	R	Rod, tropical
F	Swivel pin housings	R	Rubber grommet, electrical
F	Swivel pins	P	Seat base
C	Synchronising clutch	R	Seat cushions
R	Tailboard	R	Seats, rear
R	Tailboard chain	T	Seats, standard vehicle
P	Tail lamps	R	Sediment bowl, fuel
B & H	Tank, clutch and brake supply	M	Selector, four-wheel drive
A	Tank, fuel	C	Selector, power take-off
M	Tappet adjustment	T	Selector shaft, gear
A	Thermostat	C	Shaft, front axle
L	Throttle control, hand	H	Shaft, front axle
T	Thrust bearings, crankshaft	J	Shaft, propeller, front
A	Timing	C	Shaft, propeller, power take-off
A	Timing chain tensioner	D	Shaft, rear axle
A	Toe plates	D	Shaft, rocker
R	Towing jaws	J	Shock absorber, front
T	Tow plates	J	Shock absorber, rear
G	Track rod	J	Shock absorber, rear
C	Transfer box	A	Shocks, front
C	Transfer shaft housing	E	Shocks, rear
H	Transmission brake	J	Side lamps
R	Tropical roof panel, hard top and cab	J	Side screen
S	Tyre pressures	N	Silencer, exhaust
S	Tyres	B	Sleeve, clutch withdrawal
S	Units, power take-off	P	Solenoid, starter motor
T	Universal joint cover plates	P	Spare wheel carrier (on bonnet)
T	Universal joint, front half shaft	B	Speedometer
F	Universal joint housing	T	Speedometer cable
A	Valve guides	O	Speedometer drive
A	Valve rocker shafts	O	Speedometer nozzle
A	Valve seats, exhaust	M	Spray for, Diesel
A	Valve timing	J	Spring, road, front
A	Valves	J	Spring, road, rear
M	Valves, fuel pump, 2 litre petrol	J	Starter drive
M	Valves, fuel pump, 2½ litre petrol and diesel	J	Starter motor
M	Vehicle heater	P	Starter switch
R	Ventilator, windscreen	P	Steering column thrust bearing
A	Vertical drive shaft gear	P	Steering drag link
A2	Vibration damper	G	Steering longitudinal tube
P	Voltage regulator	G	Steering relay unit
Q	Warning lights, instrument panel	G	Steering rack rod
L	Water pump	G	Steering unit
T	Water temperature gauge	G	Steering wheel
G	Wheel alignment	G	Stop lamp switch
H	Wheel brakes	P	Stop lamps
H	Wheel cylinder, brake	P	Stub axles
G	Wheel, steering	F	Stub shaft
T	Wheel support, spare (on bonnet)	F	Sump, crankcase
S	Wheels, road	A	Sump filter
T	Winch, capstan, front	A	Supply tank, brake and clutch
S	Winch, capstan, hard top	A	Support, air cleaner
R	Windscreen	K	Support, engine front
R	Windscreen fastener	H	Support, engine rear
R	Windscreen wiper	C	Support, spare wheel
P	Windstone horn	T	Switch, dip
P	Wing, front	P	Switch, direction indicator
R	Wing valance cover plate	T	Switch, ignition
R	Wing diagram, flashers and trailers	Q	Switch, lamps
T	Wing diagram, general	Q	
P	Withdrawal mechanism, clutch	Q	

(vi)

# Section A — ENGINE — 2 LITRE — PETROL

## INDEX TO OPERATIONS WITH ENGINE REMOVED

<table border="0"> <tr> <td style="text-align: right;">Page</td> <td>A-17, 18 and 19</td> <td>Data</td> </tr> <tr> <td style="text-align: right;">A-16</td> <td>Defect location</td> <td></td> </tr> <tr> <td style="text-align: right;">A-2 and 13</td> <td>Engine removal and replacement</td> <td></td> </tr> <tr> <td style="text-align: right;">A-2 to 13</td> <td>Engine to overhaul, complete</td> <td></td> </tr> <tr> <td style="text-align: right;">A-13</td> <td>Ignition timing</td> <td></td> </tr> <tr> <td style="text-align: right;">A-6</td> <td>Reboring and fitting cylinder liners</td> <td></td> </tr> <tr> <td style="text-align: right;">A-13</td> <td>Tapet adjustment</td> <td></td> </tr> <tr> <td style="text-align: right;">A-10</td> <td>Timing valves</td> <td></td> </tr> <tr> <td style="text-align: right;">A-13</td> <td>Timing ignition</td> <td></td> </tr> </table>	Page	A-17, 18 and 19	Data	A-16	Defect location		A-2 and 13	Engine removal and replacement		A-2 to 13	Engine to overhaul, complete		A-13	Ignition timing		A-6	Reboring and fitting cylinder liners		A-13	Tapet adjustment		A-10	Timing valves		A-13	Timing ignition		<table border="0"> <tr> <td style="text-align: right;">Page</td> <td>A-4 and 10</td> <td>Camshaft and bearings, to remove and refit</td> </tr> <tr> <td style="text-align: right;">A-4 and 10</td> <td>Camshaft chainwheels, to remove and refit</td> <td></td> </tr> <tr> <td style="text-align: right;">A-3 and 10</td> <td>Connecting rods, bearing and pistons, to remove and refit</td> <td></td> </tr> <tr> <td style="text-align: right;">A-4 and 6</td> <td>Camshaft, bearings and seals, to remove and refit</td> <td></td> </tr> <tr> <td style="text-align: right;">A-4 and 8</td> <td>Cylinder head and rocker shaft, to remove and refit</td> <td></td> </tr> <tr> <td style="text-align: right;">A-3 and 12</td> <td>Cylinder head and rocker shaft, to remove and refit</td> <td></td> </tr> </table>	Page	A-4 and 10	Camshaft and bearings, to remove and refit	A-4 and 10	Camshaft chainwheels, to remove and refit		A-3 and 10	Connecting rods, bearing and pistons, to remove and refit		A-4 and 6	Camshaft, bearings and seals, to remove and refit		A-4 and 8	Cylinder head and rocker shaft, to remove and refit		A-3 and 12	Cylinder head and rocker shaft, to remove and refit	
Page	A-17, 18 and 19	Data																																												
A-16	Defect location																																													
A-2 and 13	Engine removal and replacement																																													
A-2 to 13	Engine to overhaul, complete																																													
A-13	Ignition timing																																													
A-6	Reboring and fitting cylinder liners																																													
A-13	Tapet adjustment																																													
A-10	Timing valves																																													
A-13	Timing ignition																																													
Page	A-4 and 10	Camshaft and bearings, to remove and refit																																												
A-4 and 10	Camshaft chainwheels, to remove and refit																																													
A-3 and 10	Connecting rods, bearing and pistons, to remove and refit																																													
A-4 and 6	Camshaft, bearings and seals, to remove and refit																																													
A-4 and 8	Cylinder head and rocker shaft, to remove and refit																																													
A-3 and 12	Cylinder head and rocker shaft, to remove and refit																																													

THE INDEX TO OPERATIONS WITH ENGINE IN THE CHASSIS IS ON PAGE 14

## LIST OF ILLUSTRATIONS

<table border="0"> <tr> <td style="text-align: right;">Page</td> <td>A-8</td> <td>Checking crankshaft end-float</td> </tr> <tr> <td style="text-align: right;">A-8</td> <td>Guide in position on cylinder block (oil seals)</td> <td></td> </tr> <tr> <td style="text-align: right;">A-9</td> <td>Crankshaft two-piece oil seal</td> <td></td> </tr> <tr> <td style="text-align: right;">A-9</td> <td>Crankshaft three-piece oil seal</td> <td></td> </tr> <tr> <td style="text-align: right;">A-10</td> <td>Checking flywheel run-out</td> <td></td> </tr> <tr> <td style="text-align: right;">A-10</td> <td>Camshaft bearing location bolts</td> <td></td> </tr> <tr> <td style="text-align: right;">A-11</td> <td>Exhaust valve fully open position</td> <td></td> </tr> <tr> <td style="text-align: right;">A-11</td> <td>Timing chain and tensioner</td> <td></td> </tr> <tr> <td style="text-align: right;">A-12</td> <td>Oil pressure relief valve</td> <td></td> </tr> <tr> <td style="text-align: right;">A-12</td> <td>Drilling oil feed holes, inlet rockers</td> <td></td> </tr> <tr> <td style="text-align: right;">A-12</td> <td>Tightening cylinder head bolts</td> <td></td> </tr> <tr> <td style="text-align: right;">A-13</td> <td>Tapet adjustment</td> <td></td> </tr> <tr> <td style="text-align: right;">A-14</td> <td>Removing gudgeon pin</td> <td></td> </tr> <tr> <td style="text-align: right;">A-14</td> <td>Fitting gudgeon pin</td> <td></td> </tr> <tr> <td style="text-align: right;">A-15</td> <td>Flywheel housing drain plug</td> <td></td> </tr> </table>	Page	A-8	Checking crankshaft end-float	A-8	Guide in position on cylinder block (oil seals)		A-9	Crankshaft two-piece oil seal		A-9	Crankshaft three-piece oil seal		A-10	Checking flywheel run-out		A-10	Camshaft bearing location bolts		A-11	Exhaust valve fully open position		A-11	Timing chain and tensioner		A-12	Oil pressure relief valve		A-12	Drilling oil feed holes, inlet rockers		A-12	Tightening cylinder head bolts		A-13	Tapet adjustment		A-14	Removing gudgeon pin		A-14	Fitting gudgeon pin		A-15	Flywheel housing drain plug		<table border="0"> <tr> <td style="text-align: right;">Page</td> <td>A-2</td> <td>Distributor housing location bolt</td> </tr> <tr> <td style="text-align: right;">A-3</td> <td>Oil pressure relief valve</td> <td></td> </tr> <tr> <td style="text-align: right;">A-3</td> <td>Timing chain and tensioner</td> <td></td> </tr> <tr> <td style="text-align: right;">A-4</td> <td>Clip for timing chain tensioner</td> <td></td> </tr> <tr> <td style="text-align: right;">A-4</td> <td>Removing camshaft chainwheel</td> <td></td> </tr> <tr> <td style="text-align: right;">A-4</td> <td>Exhaust rocker shaft location bolts</td> <td></td> </tr> <tr> <td style="text-align: right;">A-4</td> <td>Camshaft bearing location bolts</td> <td></td> </tr> <tr> <td style="text-align: right;">A-5</td> <td>Fitting exhaust valve guide</td> <td></td> </tr> <tr> <td style="text-align: right;">A-5</td> <td>Protection plate</td> <td></td> </tr> <tr> <td style="text-align: right;">A-10</td> <td>Fitting exhaust valve seat</td> <td></td> </tr> <tr> <td style="text-align: right;">A-6</td> <td>Fitting cylinder liner</td> <td></td> </tr> <tr> <td style="text-align: right;">A-6</td> <td>Reboring, jig block</td> <td></td> </tr> <tr> <td style="text-align: right;">A-13</td> <td>Checking piston clearance</td> <td></td> </tr> <tr> <td style="text-align: right;">A-14</td> <td>Checking piston ring gap</td> <td></td> </tr> <tr> <td style="text-align: right;">A-15</td> <td>Checking big-end bearing nip</td> <td></td> </tr> <tr> <td style="text-align: right;">A-16</td> <td>Checking main bearing nip</td> <td></td> </tr> </table>	Page	A-2	Distributor housing location bolt	A-3	Oil pressure relief valve		A-3	Timing chain and tensioner		A-4	Clip for timing chain tensioner		A-4	Removing camshaft chainwheel		A-4	Exhaust rocker shaft location bolts		A-4	Camshaft bearing location bolts		A-5	Fitting exhaust valve guide		A-5	Protection plate		A-10	Fitting exhaust valve seat		A-6	Fitting cylinder liner		A-6	Reboring, jig block		A-13	Checking piston clearance		A-14	Checking piston ring gap		A-15	Checking big-end bearing nip		A-16	Checking main bearing nip	
Page	A-8	Checking crankshaft end-float																																																																																												
A-8	Guide in position on cylinder block (oil seals)																																																																																													
A-9	Crankshaft two-piece oil seal																																																																																													
A-9	Crankshaft three-piece oil seal																																																																																													
A-10	Checking flywheel run-out																																																																																													
A-10	Camshaft bearing location bolts																																																																																													
A-11	Exhaust valve fully open position																																																																																													
A-11	Timing chain and tensioner																																																																																													
A-12	Oil pressure relief valve																																																																																													
A-12	Drilling oil feed holes, inlet rockers																																																																																													
A-12	Tightening cylinder head bolts																																																																																													
A-13	Tapet adjustment																																																																																													
A-14	Removing gudgeon pin																																																																																													
A-14	Fitting gudgeon pin																																																																																													
A-15	Flywheel housing drain plug																																																																																													
Page	A-2	Distributor housing location bolt																																																																																												
A-3	Oil pressure relief valve																																																																																													
A-3	Timing chain and tensioner																																																																																													
A-4	Clip for timing chain tensioner																																																																																													
A-4	Removing camshaft chainwheel																																																																																													
A-4	Exhaust rocker shaft location bolts																																																																																													
A-4	Camshaft bearing location bolts																																																																																													
A-5	Fitting exhaust valve guide																																																																																													
A-5	Protection plate																																																																																													
A-10	Fitting exhaust valve seat																																																																																													
A-6	Fitting cylinder liner																																																																																													
A-6	Reboring, jig block																																																																																													
A-13	Checking piston clearance																																																																																													
A-14	Checking piston ring gap																																																																																													
A-15	Checking big-end bearing nip																																																																																													
A-16	Checking main bearing nip																																																																																													

## ENGINE REMOVAL AND DISMANTLING PROCEDURE

### Removing engine

1. If fitted, remove the spare wheel from bonnet panel.

2. Remove the bonnet panel.

3. Disconnect the battery leads.

4. Disconnect the air intake pipe from the carburetter and remove air cleaner.

5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).

6. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.

7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.

8. Remove the fan blades.

9. Remove the bolts securing the front apron and remove. Remove the bolts securing the grille panel to the front cross member and front wings.

10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.

11. Disconnect the exhaust pipe from exhaust manifold.

12. Disconnect the heater pipes (if fitted) at the engine side of scuttle.

13. Disconnect the petrol pipe at carburetter.

14. Disconnect the throttle return spring, throttle linkage (at a ball joint) and the cold start control cable at carburetter and clamp. If fitted, disconnect the hand speed control cable.

15. Disconnect:

Dynamo wiring; ignition coil leads; starter lead from switch; oil pressure switch wire; mixture control switch wire (at rear of cylinder head).

16. Secure a sling to the engine and with suitable lifting tackle just take the strain.

17. Disconnect the clutch slave cylinder hose at bracket mounted on scuttle.

18. Remove the front floor and gearbox cover.

19. Support the gearbox assembly with a jack or packing blocks.

20. Remove the three nuts and washers securing the clutch slave cylinder bracket to the flywheel housing and pull the complete assembly as far back as possible.

21. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.

22. Remove the bolts from engine front support brackets and allow the engine to move forward and thus clear the gearbox input shaft. Ensure

that the speedometer cable and all wires, etc., are clear, then hoist the engine gently from the vehicle.

23. Drain the oil and remove sump.

24. Bolt the engine to a suitable stand, securing by the sump fixing studs.

## DISMANTLING ENGINE

### Externals

1. Disconnect the accelerator linkage (at a ball joint), distributor vacuum pipe and remove carburetter. Detach sparking plug covers and leads, remove locating screw and withdraw the distributor. Remove sparking plugs.

See Section M for overhaul of carburetter, and Section P for overhaul of distributor.

2. Remove the exhaust manifold.

3. If fitted, disconnect the heater pipe and flow control tap from cylinder head.

4. Remove the inlet and exhaust rocker covers.

5. Remove the dynamo and starter motor.

See Section P for overhaul of dynamo and starter.

6. Disconnect the oil feed pipe—gallery to cylinder head.

7. Remove the dipstick and tube.

8. Remove the external full flow oil filter complete.

See Section AO for details of oil filter.

9. Remove the starter dog, using spanner Part No. 263055 and withdraw the vibration damper complete.

See Section A-2 for overhaul of vibration damper.

10. Remove the clutch, flywheel and housing.

See Section B for overhaul of clutch and flywheel.

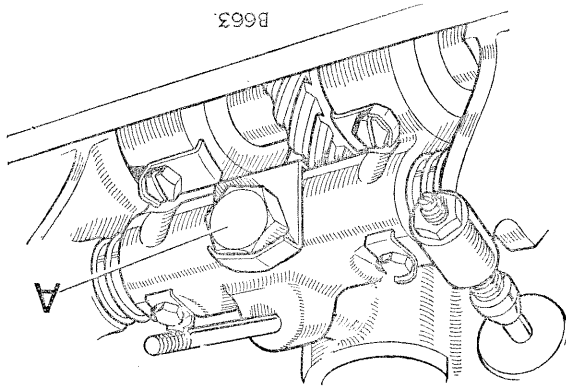


Fig. A-1—Distributor housing location bolt  
A—Distributor housing location bolt

**Oil pump drive shaft, to remove**

**Operation A/6**

1. Remove the hollow bolt locating the distributor housing. Withdraw the distributor housing, and remove oil pump drive shaft, Fig. A-1.

**Oil pump, to remove**

**Operation A/8**

1. Slacken the locknut securing oil pressure adjusting screw, then remove screw, washer, spring, plunger and ball (which may remain in the pump and can be removed when the pump complete is withdrawn).
2. Remove the pump locating screw and withdraw the pump.

Note: See Section A0 for overhaul of oil pump and drive shaft.

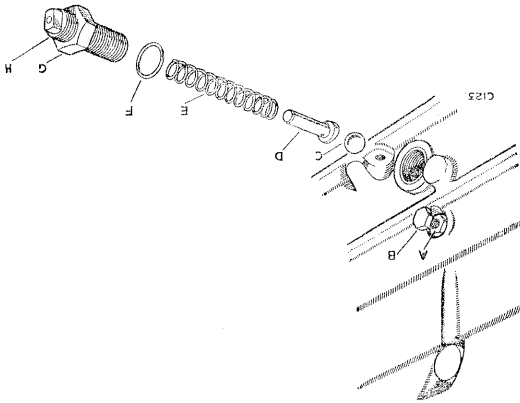


Fig. A-2—Oil pressure relief valve

- A—Locknut
- B—Locating screw—oil pump
- C—Ball
- D—Plunger
- E—Spring
- F—Washer
- G—Locknut
- H—Adjusting screw—oil pressure

**Cylinder head and inlet rocker shaft, to remove**

**Operation A/10**

1. Loosen the nuts securing the rocker shaft.
2. Remove the rocker shaft complete with all components.
3. The  $\frac{3}{8}$  in. (spanner size) nuts have  $\frac{1}{16}$  in. threads. Withdraw the push rods and insert them in a piece of cardboard pre-pierced and numbered 1 to 4.
4. Loosen the securing bolts evenly and lift the cylinder head clear complete with manifold.

**Water pump, to remove**

**Operation A/12**

1. Remove the copper tube and rubber joint ring from either the bottom face of the thermostat housing or the top face of the water pump casing.
  2. Remove the water pump complete with joint washer and inlet pipe; as the pump casing is spigotted in the block, it will be necessary to oscillate it slightly as it is removed.
- See Section L for overhaul of water pump.

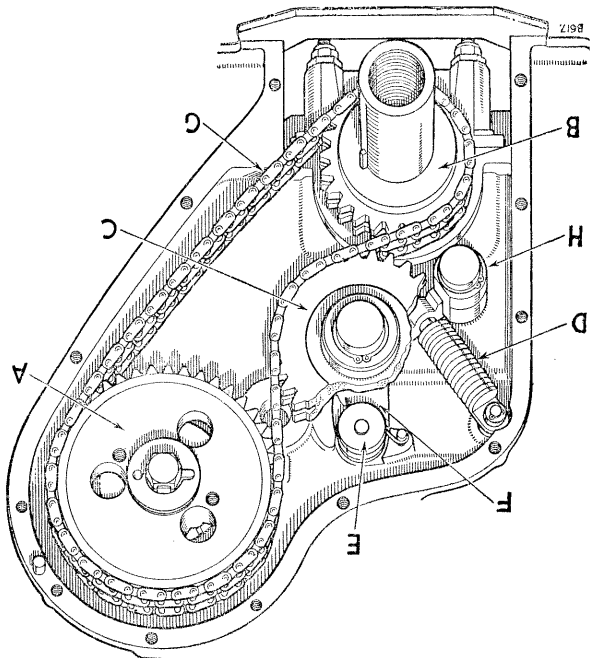


Fig. A-3—Timing chain and tensioner

- A—Pawl
- B—Crankshaft chainwheel
- C—Crankshaft chainwheel
- D—Hydraulic tensioner
- E—Ratchet
- F—Timing chain (driving side)
- G—Jockey pulley
- H—Jockey pulley arm

**Front cover, chain tensioner and chainwheels To remove**

**Operation A/14**

1. Remove the securing bolts and remove the front cover.
2. Remove the crankshaft oil thrower.
3. Release the pawl from the ratchet, compress the tensioner spring by lifting the jockey pulley arm as far as possible, and fit clip, Part No. 262748, over the tensioner.

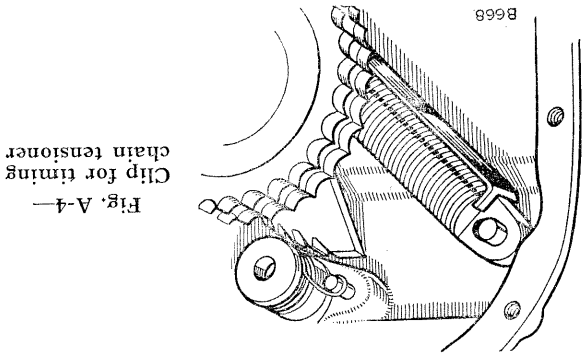


Fig. A-4—Clip for timing chain tensioner

4. Remove the jockey pulley; remove the driving chain.
5. Withdraw the jockey pulley arm and tensioner.
6. Carefully remove the special clip and part the tensioner spring, piston, cylinder and, if necessary, extract the ball and the two retaining springs from the cylinder.

**Camshaft and bearings, to remove**  
Operation A/18

1. Remove the camshaft thrust plate.
  2. Remove the bolt and lock washers locating each of the three front bearings.
  3. Withdraw the camshaft until the third bearing is clear of No. 2 bearing housing; split the bearings and lay aside. Remove the camshaft and front bearing.
- Split the front bearing and remove.

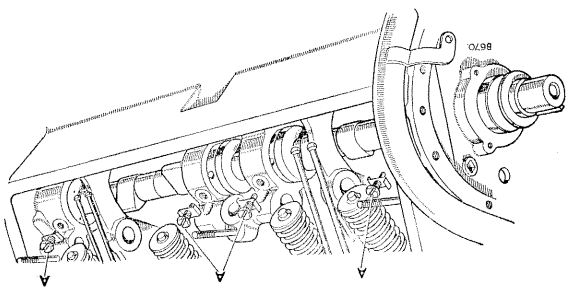


Fig. A-7—Camshaft bearing location bolts  
A—Location bolts

4. If necessary, remove the bolt and lock washer from the rear bearing. Remove the rear camshaft cover.
5. Remove the rear bearing; preserve all bearings in their respective pairs.

**Exhaust valves, to remove**  
Operation A/20

1. Slacken the tappet adjusting screws right back.
2. Set each rocker on the back of its cam, and using a valve spring compressing tool, Part No. 276102, remove the valve assemblies. The valves should be inserted in a piece of cardboard pre-pierced and numbered 1 to 4. Retain the springs in pairs; they are selected to ensure an interference fit.

**Crankshaft, pistons and connecting rods, to remove**  
Operation A/22

1. Remove the connecting rod caps.
2. Remove the main bearing caps and shells. The lower half of the rear main oil seal may be removed complete with rear main bearing cap.
3. Lift out the crankshaft and remaining bearing halves. The bearing halves must be preserved in pairs. Ensure that the thrust washers are retained in original housings if used again.
4. Withdraw the pistons and connecting rods, and replace the caps on their original connecting rods.

**Cylinder block checks**  
Operation A/24

Check that the main bearing caps have not been filed, in the following manner.

7. If necessary, extract the pawl pivot pin ( $\frac{1}{16}$  in. B.S.F. tapped hole); remove the pawl and pawl spring.

8. Remove the camshaft chainwheel, using extractor, Part No. 262750 or 507231.
9. If necessary, remove the crankshaft chainwheel, using a claw extractor.
10. Examine all parts of tensioner mechanism and renew as necessary.

**Exhaust rocker shafts, to remove**  
Operation A/16

1. Remove the plug and fibre washer from the cylinder block.

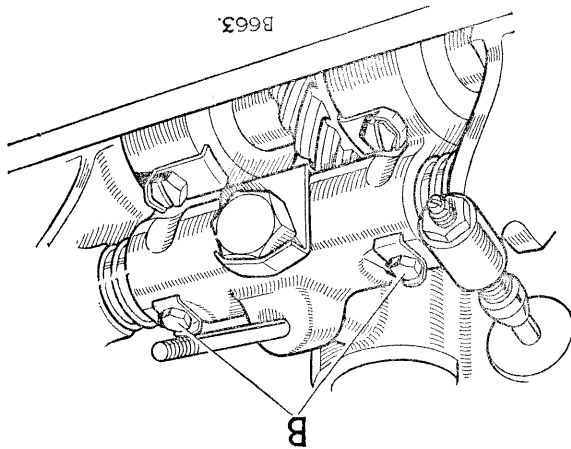


Fig. A-6—Exhaust rocker shaft location bolts  
B—Exhaust rocker shaft location bolts

2. Remove the location bolts; two for the rocker shafts and withdraw the shafts, using extractor, Part No. 262749.

Lay out the components in order:—

Spring; R.H. rocker; washer; R.H. cam follower; washer; L.H. rocker; spring. Same order applies to both rocker shafts.

Assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.

If there is a clearance at the joint face this indicates that the main bearing caps have been filed, and the cylinder block is scrap.

**ENGINE ASSEMBLY**

**Exhaust valve guides, to renew Operation A/26**

1. Remove the guide with a drift, Part No. 263051.
2. Pull in the new guide, using tool Part No. 262753, and ream to .3448 in.—.0005 (8,757 mm—0,012).

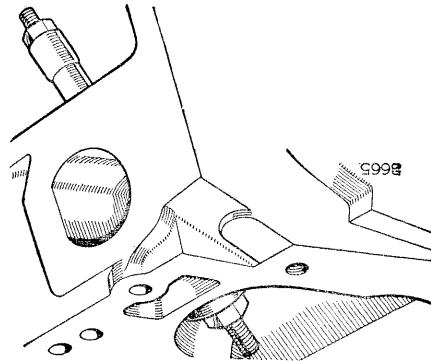


Fig. A-8—Fitting exhaust valve guide

**Valve seats, to renew**

**Operation A/28**

1. Grind the insert away until only a thin sliver remains, then, with the area suitably masked to avoid injury from flying fragments, gently tap the insert with a centre punch and remove the broken parts.
2. Remove the valve guide by means of a piloted drift, Part No. 263051.

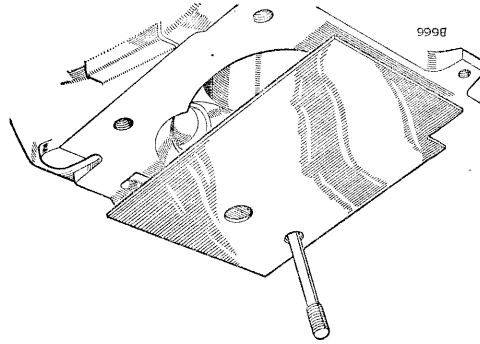


Fig. A-9—Protection plate

3. Clean the seat recess and pull the new insert into position, using tool Part No. 262752. It is not necessary to heat the block or freeze the insert, but light taps on the tool may be required to ensure that the insert enters smoothly.
4. Pull in the new guide, using tool Part No. 262753, and ream to .3448 in.—.0005 in. (8,757 mm—0,012 mm).

**Exhaust valves, to refit Operation A/30**

1. Grind the seats to  $45^\circ \pm \frac{1}{4}$ , using 'Vibro-centric' equipment.
2. Face the valves to  $45^\circ - \frac{1}{4}$  and lap into their respective seats.
3. Wash each valve, seat, port and guide in paraffin.
4. Locate each valve into their respective guides and, using compressor Part No. 276102, fit the spring assemblies, caps and split cones.

**Exhaust valves, to refit**

**Cylinder liner fitting Operation A/32**

If the cylinder block has already been bored out to maximum size, cylinder liners may be fitted. Fitting conforms to standard practice; note the following points:—

Machine the cylinder block bores to 3.245 in. + .001 (82,42 mm + 0,025). This gives an interference fit of .003 to .004 in. (0,07 to 0,10 mm).

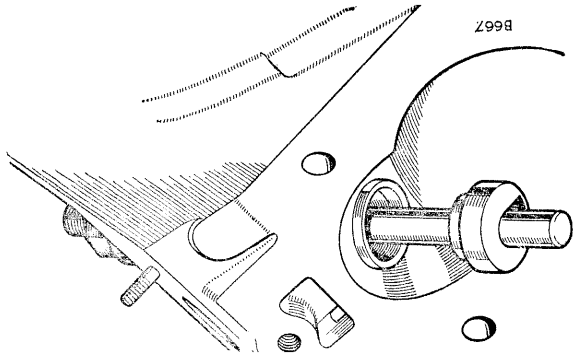
Prior to pressing in the liner, allowance must be made for twist up to  $\frac{1}{16}$  in. (5 mm) clockwise. To facilitate re-alignment should the liner not be positioned correctly at the first attempt, scribe lines down the sides of the liner from the two peaks and make corresponding marks on the cylinder block.

Press in the liner, using press block Part No. 262864, until the top edge is level with the bottom of the exhaust valve pocket. Blend to the shape of the cylinder block.

Bore to suit the selected pistons.

Liners can only be bored out to suit standard or .010 in. (0,25 mm) oversize pistons.

Fig. A-10—Fitting exhaust valve seat



**Four-ring piston**

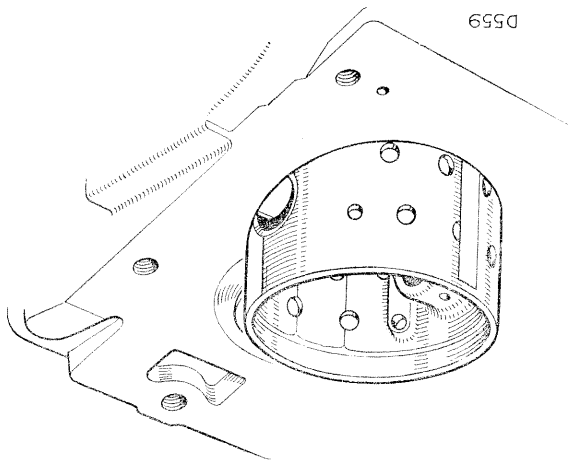
On early models a four-ring piston is used, consisting of two compression rings, one stepped scraper ring and one H-section scraper ring.

**Piston clearance in bore, four-ring type**

In order to obtain the correct piston clearance with a new piston in a new or worn bore, insert a long feeler gauge down the thrust side of the cylinder, that is the left-hand side of the cylinder looking at the engine from the front. Insert the piston upside down in the cylinder bore with the gudgeon pin in line with the centre line of the engine. Push the piston down the cylinder until the piston skirt reaches its tightest point, where the feeler gauge should require a 10 lb. (4,6 kg) pull to withdraw it.

It may be necessary to check the clearance of several pistons in the bore before the correct one is selected.

The above method of checking the piston clearance ensures that the piston has the correct clearance in its working position.



**Three-ring piston**

On late models a three-ring piston is used, consisting of two compression rings, and one H-section scraper ring.

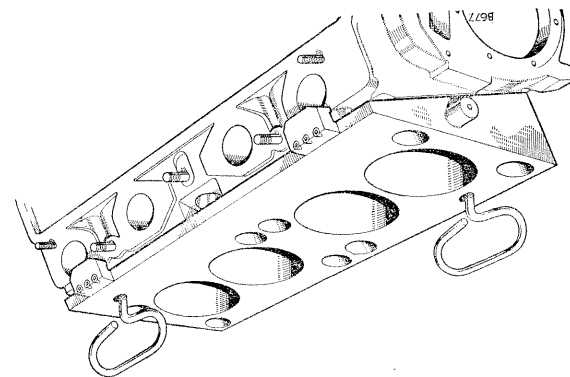
**Piston clearance in bore, three-ring type**

In order to obtain the correct piston clearance with a new piston in a new or worn bore, insert a long feeler gauge looking at the engine from the front. Insert the piston upside down in the cylinder bore with the gudgeon pin in line with the centre line of the engine. Push the piston down the cylinder until the piston skirt reaches its tightest point where the feeler gauge should require a 10 lb. (4,6 kg) pull to withdraw it.

**Reboring**

1. Reboring conforms to normal practice. It is necessary to employ a jig block, Part No. 261287, to enable standard equipment to be used.

The cylinder block may be rebored up to .040 in. (1,00 mm) oversize.



2. If the cylinder block has already been bored out to the maximum size, cylinder liners may be fitted.

The cylinder block must be thoroughly cleaned at this stage.

**Pistons to cylinder**

**Operation A/36**  
When fitting pistons, standard or oversize, the cylinder bore clearance should be in accordance with the dimensions laid down in the data section. When reboring, the block must be honed to suit the selected pistons.

When an engine fitted with standard size pistons is dismantled, it will be noted that the pistons are marked with a grade letter on the crown, and a corresponding letter is stamped on the crankcase sump face, adjacent to the relative bore. If the original pistons are being refitted, they must be returned to their original bores. Where the pistons are being replaced, normal piston clearance must be checked as detailed below.



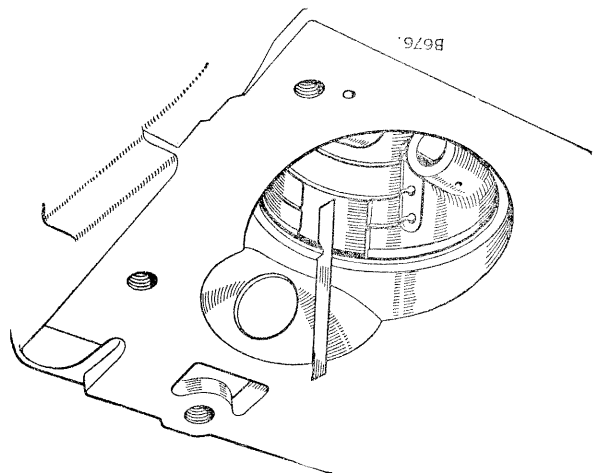
It may be necessary to check the clearance of several pistons in the bore before the correct one is selected.

The above method of checking the piston clearance ensures that the piston has the correct clearance in its working position.

**Piston ring fitting**

1. Check gap and side clearance. To check gap, support the ring in the cylinder bore with an old piston. See Data Section.

2. Stepped scraper rings, where used, must be fitted with the larger diameter at the top.
3. Compression rings are marked "T" or "Top" on one face.



**Connecting rod checks**  
Operation A/38

- Check that the connecting rods and caps have not been filed, in the following manner:
1. Select the correct cap for each connecting rod, joint faces. This number also indicates the crankpin to which it must be fitted.

2. Assemble the connecting rods, less shell bearings, with corresponding numbers together.
3. Tighten the securing nuts, then slacken one of them right off and check that there is no clearance at the joint face.

If there is a clearance at the joint face, this indicates that the connecting rods or caps have been filed, and the assemblies must be scrapped.

**Connecting rod bearing nip**  
Operation A/40

- Check the bearing nip in the following manner.
1. Fit the bearing shells and tighten both securing nuts—slacken one nut as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,05 to 0,10 mm).

2. The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.
3. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct end-float, by inserting a feeler gauge between the end face of the rod and the crankpin shoulder. End-float should be .009 to .013 in. (0,23 to 0,33 mm).
4. Remove the connecting rods from the crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

**Gudgeon pin, bush and piston**  
Operation A/42

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,02 to 0,05 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,007 to 0,012 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.
- This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. When cold and dry, the gudgeon pin should be an *easy sliding* fit in the connecting rod and should have a *slight interference* fit in both piston bores, i.e. so that it can be pressed in by hand but will not fall out under its own weight.
- It is of particular importance that gudgeon pins are not fitted tighter than this in the three-ring type of piston, otherwise piston seizure may result.

3. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.
4. Fit the pistons to their respective connecting rods and insert the pistons into the bores, using a suitable piston ring clamp.

5. Ensure that the oil spray hole in the connecting rod is towards the right-hand side of the engine, opposite side to the camshaft.

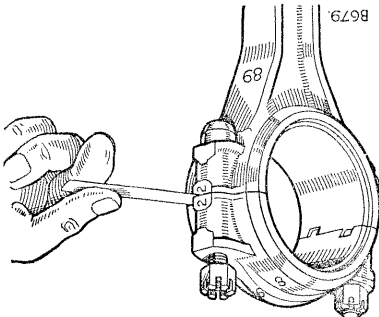


Fig. A-15—Checking big-end bearing nip

4. Check the crankshaft end-float with a feeler gauge (Fig. A-17); adjust at centre bearing by selective assembly of thrust washers to give .002 to .006 in. (0,05 to 0,15 mm) end-float. If the crankshaft end-float reading obtained is not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.

5. Remove the bearing caps, bottom half shells and crankshaft.

6. To the rear main bearing cap fit neoprene seals in recess at each side.

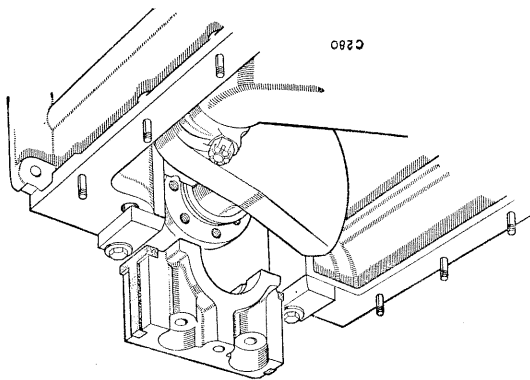


Fig. A-18—Guide in position on cylinder block

**Fitting crankshaft oil seal (two- or three-piece)**

7. **Preparatory work.** This preparatory work is essential when fitting the seal to a crankshaft which has been in service.

To ensure efficient lubrication during the initial running-in period of the oil seal, the crankshaft oil seal journal must be treated with a mixture of molybdenum disulphide and Butyl acetate as detailed below:

(a) **Thoroughly stir** the mixture immediately prior to use.

(b) Degrease the crankshaft oil seal journal.

(c) Paint mixture evenly on to the surface of the oil seal journal with a fine brush; alternatively, if a quantity of crankshafts are being done, it can be sprayed on with a gravity feed spray gun, using 40 lb./sq.in. (2,8 kg/cm<sup>2</sup>) air-line pressure. This solution, which must be dry before the seal is fitted, takes approximately 10 minutes to dry, and the surface must not be scratched after treatment. On crankshafts which have been previously run the solution will take 15 minutes to dry thoroughly. A warm air stream may be used to reduce these times if necessary.

**Crankshaft, main bearing and seals, to refit**

Operation A/44  
Check the main bearing nip in the following manner.

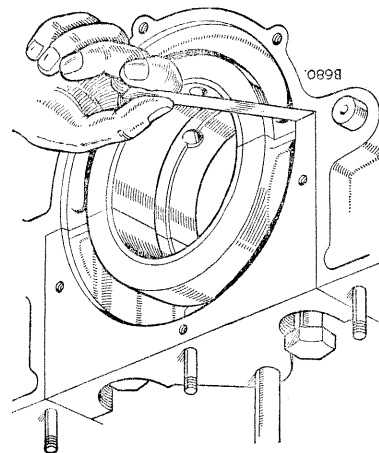


Fig. A-16—Checking main bearing nip

1. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-16, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard-size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.

3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

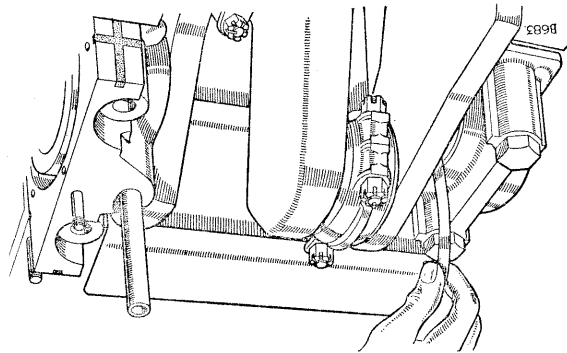


Fig. A-17—Checking crankshaft end-float

**Procedure—three-piece oil seals**

17. Apply Silicone Grease MS4 liberally to both sides of the split oil seal rubbing face.
18. Open the split oil seal sufficiently to allow it to be fitted over the crankshaft oil seal journal. The rubber ribs on the inside of the seal should be facing the crankshaft thrust collar. The split line on the seal should be pointing towards the top of the cylinder block. The oil seal must not be repeatedly fitted and removed from the crankshaft, as this can damage the sealing lip.
19. Slide the split oil seal along the journal until it is nearly touching the crankshaft flange.
20. Fit one half of oil seal housing on to the crankcase dowels. The split oil seal should be compressed to assist assembly.
21. Bolt the housing firmly on to the crankcase, tightening all five bolts fully.
22. Bolt the other half of the oil seal housing firmly on to the main bearing cap, tightening all five bolts fully.
23. Fit the main bearing cap with the seal housing, bearing shell half and packing for main bearing cap to the crankcase. Smear side seals with Silicone Grease MS4 and use special tool Part No. 270304 to assist assembly. Do not fully tighten at this stage.

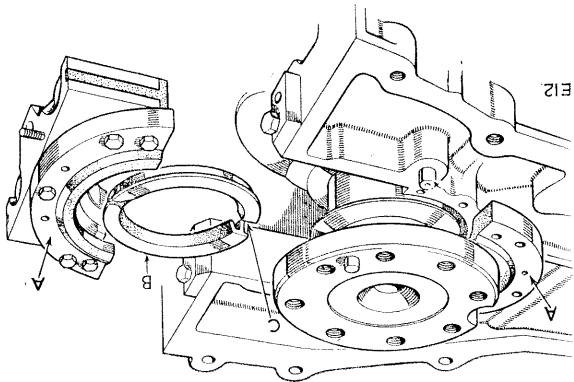


Fig. A-19A—Fitting retainer halves and oil seal (3-piece type)  
 A—Retainer halves B—Split oil seal  
 C—Split line of seal towards top of engine

24. Using two screwdrivers, slide the split oil seal along the shaft until its flange is flush with both the top and bottom oil seal housing halves. It is essential that care is taken to ensure that there is no buckling of the split oil seal or misalignment of the split joint.
  25. Pull the main bearing cap down to the correct torque, that is 65 lb/ft. (9 mkg), ensuring that the split oil seal does not move.
- Note that the split oil seal must be renewed whenever a crankshaft is removed and replaced for any reason.

**Procedure—two-piece seals**

8. Bolt the cylinder block half of the oil seal firmly on to the block by the three bolts. With five-bolt fixing seals leave the two bolts adjacent to the split line loose.
  9. Bolt the other half of the oil seal to the rear main bearing cap in the same manner. Refit the bearing cap in the same manner. Refit the crankshaft, first lubricating the journals, bearing shells and thrust bearings.
  10. The groove in each half of the oil seal is to be half filled with Silicone MS4 Compound, ensuring no grease reaches the split line face.
  11. Apply 'Heldite' jointing compound to both split line joint faces on each half of the seal. This instruction does not apply to the three-piece type oil seal.
- The compound should be spread thinly over the surface, ensuring it reaches across the sealing lips, but must not be allowed to get on to the lips themselves. See Fig. A-19. This compound must be allowed to become tacky before assembly.

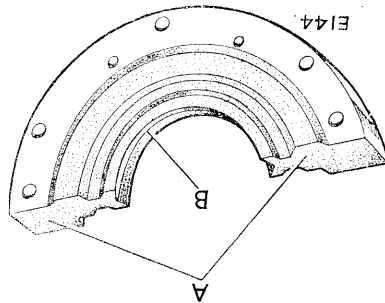


Fig. A-19—Rear crankshaft oil seals—2-piece type  
 A—Apply 'Heldite' jointing compound at this face  
 B—Fill groove with Silicone MS4 Compound

12. Fit rear main bearing cap and tighten to the required torque.
13. Where applicable, tighten the four bolts adjacent to the split line.
14. Rotate the crankshaft through a small arc to prevent the jointing compound from adhering to the crankshaft.
15. Fitment of the rear main bearing cap with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture.
16. It will be found advantageous to cut a very slight lead on to the bottom edges of the side seals, as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Smear seals with Silicone MS4 Compound when fitting.

**Piston and connecting rod, to refit to crankshaft**

**Operation A/46**

1. Turn the crankshaft until the crank journals relative to numbers 1 and 4 cylinders are at B.D.C. Squirt oil on to the journal, refit appropriate bearings to cap and connecting rod, pull the rod down to the journal and fit cap, ensuring that the oil hole in the connecting rod is on the opposite side to the camshaft. Tighten the nuts to 40 lb/ft (5,5 mKg) and then turn on to the next split pin hole. Fit split pin.

**Flywheel housing and flywheel, to refit**

**Operation A/48**

1. Ensure that the rear main bearing oil seal is in good condition, then secure the flywheel housing to cylinder block. See note regarding drain plug at end of section.
2. Fit the flywheel and tighten the securing bolts to 70 lb/ft (9,8 mKg).

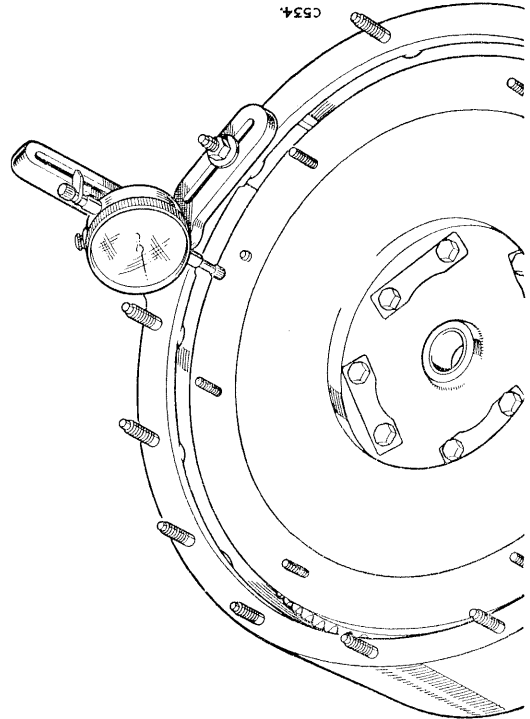


Fig. A-20—Checking run-out on flywheel face

**Camshaft and bearings, to replace**

**Operation A/50**

The bearings must be fitted dry and must be a hand push fit in the cylinder blocks; they must always be renewed in paired halves and the numbers stamped on one of the end faces of each of the bearing halves must be adjacent.

For overhaul of flywheel and clutch see Section B-2.

3. Check the run-out on the flywheel face as illustrated by Fig. A-20. The run-out must not exceed .005 in. (0,12 mm) at outer edge of face.

The rear bearing is provided with four lateral holes.

1. Checking bearing clearance on camshaft; if new bearings are fitted, make sure that they can be dismantled and assembled without difficulty.

2. Insert the camshaft partly into the cylinder block, assemble the bearings in line with the locating holes in the shaft with the housing, and push the shaft into position.

3. Line up the locating holes in the bearings and housings, and before replacing the set bolts, squirt oil down the holes to lubricate the bearings until oil pressure is built up. Replace set bolts. See Fig. A-21.

4. Fit the camshaft thrust plate and chainwheel. The camshaft should have .003 in. (0,07 mm) to .005 in. (0,12 mm) end-float, measured with a dial gauge.

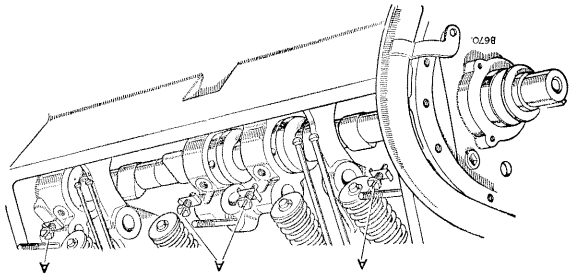


Fig. A-21—Camshaft bearing location bolts

A—Location bolts

**Exhaust rockers, to rebush and refit**

**Operation A/52**

When fitting a replacement rocker or cam-follower, it is essential that the component be fitted with the special protective coating of grease still adhering.

1. Fit new bushes in the rockers and followers as necessary and drill through the  $\frac{1}{16}$  in. (1,58 mm) oil feed hole. The bush must be a light drive fit in the rocker or follower and a sliding fit on the shaft. Ream in position to .593 in. +.001 (15,081 mm +0,025).

2. Ensure that the "F" stamped on one end of each shaft is towards the front of the engine. Replace the rockers in their original order.
3. Ensure that, with both shafts in position, the oil feed holes in the rocker shafts are facing towards the cylinder block. Replace the shaft location bolts and lock in position.
4. Fit the plug and fibre washer to the cylinder block.

**Chainwheels, timing chain, adjuster and valve timing**

**Operation A/54**

1. Fit the crankshaft chainwheel on to shaft and key.

2. Turn the crankshaft in direction of rotation until the E.P. mark on the flywheel is in line with the timing pointer.

3. Replace the camshaft chainwheel and key (do not secure at this stage), rotate the camshaft and set No. 1 exhaust tappet at .010 in. (0,254 mm).  
 4. If removed, refit the pawl pivot pin, pawl and spring.  
 5. Fit dial test indicator and bracket, Part No. 262751, so that the "fully open" position of No. 1 exhaust valve can be ascertained in the following manner:—

6. Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chainwheel and timing case to record the position.

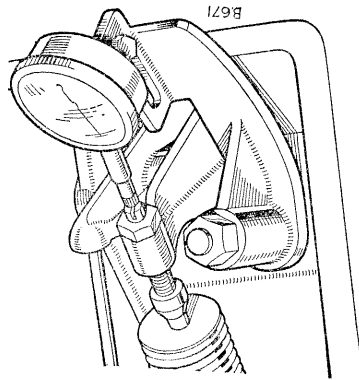


Fig. A-22—Checking exhaust valve fully open position

7. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.

8. Mark the chainwheel at a point opposite to the mark on timing case and make a third mark on the chainwheel, exactly between those made previously.

9. Turn the camshaft against direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.

10. Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chainwheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned. The camshaft chainwheel is provided with three irregularly spaced key-ways to facilitate accurate timing.

11. Fit the jockey pulley arm to its locating spindle.

12. Assemble the hydraulic tensioner, compress and retain the spring with clip, Part No. 262748, and fit complete assembly to its locating spindle. Position the ball-end in its seat on the pulley arm, holding the ratchet pawl clear, and push arm upwards to the extent of its travel. Remove the special clip and fit jockey wheel.

13. Release the pulley arm and allow jockey wheel to take up slack in the timing chain.  
 14. Check the timing by rotating the engine and correct if necessary, by moving the camshaft chainwheel to one of the other key-ways.  
 15. Finally, secure the tensioner with a split pin and plain washer, secure the jockey wheel with a circlip and secure the camshaft chainwheel by locating the lock washer in one of the vacant key-ways and bending over the tag. Fit the oil thrower to the crankshaft noting that, correctly located, it curves away from the chain.

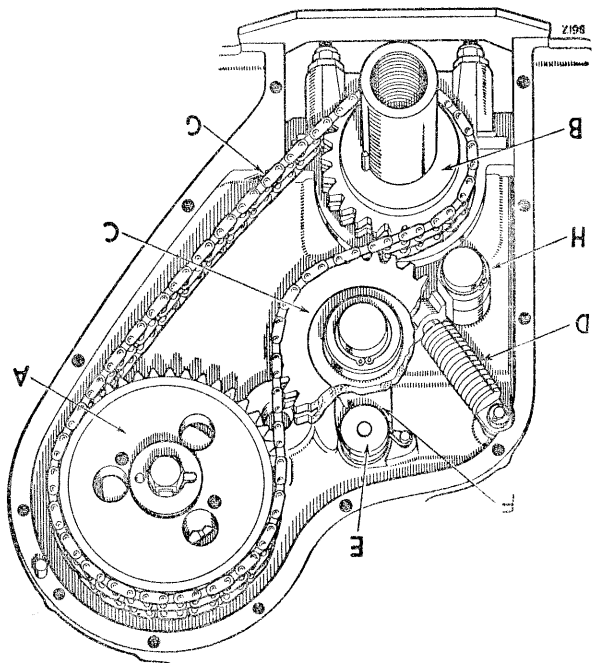


Fig. A-23—Timing chain and tensioner

**Water pump, front cover and vibration damper, to replace**  
**Operation A/56**

1. Fit a new seal into the front cover, using a suitable sealing compound.  
 2. Fit new joint washer, smear with light grease and secure cover to cylinder block.

3. Fit a new joint washer to the water pump and secure to cylinder block complete with copper tube and rubber ring in recess on top of pump.  
 4. Refit the damper to crankshaft, securing with locking washer and starter dog.

5. Tighten the starter dog, using spanner, Part No. 263055.

For details of water pump overhaul, see Section L. For details of vibration damper overhaul, see Section A-2.

**Oil pump, to refit**

**Operation A/58**

1. With the gauze oil strainer secured in position, offer the pump up to the engine.
  2. Fit the pump locating screw and locknut.
  3. Fit the relief valve assembly. Do not tighten the locknut at this stage.
- See Section AO for details of oil pressure adjustment.
- The starter motor, dynamo, external oil filter and oil sump may be refitted at this stage, if convenient.

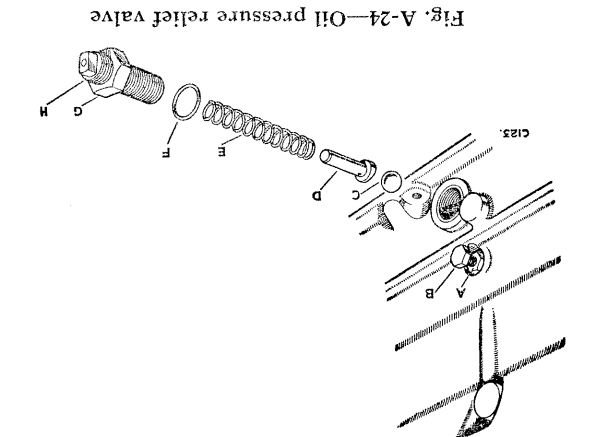


Fig. A-24—Oil pressure relief valve

- A—Locknut
- B—Locating screw—oil pump
- C—Ball
- D—Plunger
- E—Spring
- F—Washer
- G—Locknut
- H—Adjusting screw—oil pressure

**CYLINDER HEAD TO OVERHAUL AND REFIT**

**Operation A/60**

**Rocker shaft, to overhaul**

1. Fit new bushes in the rockers as necessary. The bush must be a *light drive fit* in the rocker and a *sliding fit* on the shaft. Press a new bush in with its shoulder on the same side as the rocker pad; drill through the oil feed holes— $\frac{3}{16}$  in. (2,77 mm) to the push-rod and  $\frac{1}{16}$  in. (1,58 mm) in the top of the rocker. Ream in position to .005 in. +.001 (12,7 mm + 0,025).

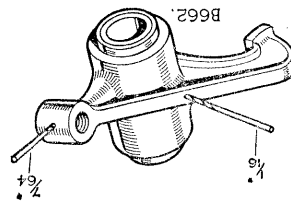


Fig. A-25—Drilling oil feed holes

2. Fit the component parts to the rocker shafts in the following order:

3. Rear bracket (located by set screw); spring; R.H. rocker; bracket; two brackets; R.H. rocker; bracket; L.H. rocker; spring; R.H. rocker; bracket; L.H. rocker; spring; front bracket.

**Inlet valves, to remove**

**Operation A/62**

1. If necessary remove the inlet manifold, thermo-stat housing and cylinder head end plate.
2. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.
3. The valves should be inserted in a piece of cardboard, pre-pierced and numbered 1 to 4.
4. Retain the springs in pairs; they are selected to ensure an interference fit.

**Inlet valve guides, to renew**

**Operation A/64**

1. Remove the guide with a drift, Part No. 263051.
  2. Press in the new guide, and ream to .3448 in.—.0005 (8,757 mm—0,012).
- The valve seat must be ground in the event of a new guide being fitted.

**Inlet valves, to reface and refit**

**Operation A/66**

1. Cut the valve seats (in cylinder head) to  $30^\circ \pm \frac{1}{4}$  only when necessary; normally they require cutting only at every second or third decar-bonising operation.
2. Face the valves to  $30^\circ \pm \frac{1}{4}$  and lap into their respective seats.
3. Wash each valve, seat, port and guide in paraffin.

4. Fit a new 'O' ring seal to each guide.
5. Locate each valve into their respective guides and, using compressor Part No. 276102, fit the spring assemblies, caps and split cones.

**Cylinder head and rocker shaft, to replace**

**Operation A/68**

1. If removed, replace the inlet manifold thermo-stat housing and cylinder head end plate. See Section L for checking of thermostat.
2. Smear the joint face of cylinder block and gasket and cylinder head to cylinder block. Ensure that the copper tube and rubber ring are fitted to the top of the water pump before fitting the cylinder head.

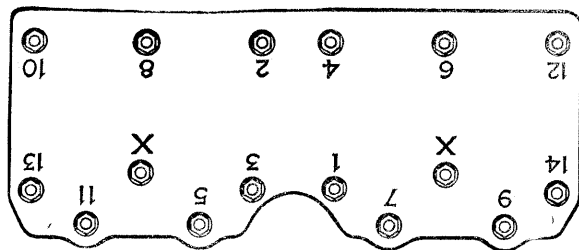


Fig. A-26—

Order of tightening cylinder head bolts. Those marked X also secure the rocker shaft

4. Locate a cork washer in recess in top of distributor housing.
  5. Check the distributor contact breaker clearance and adjust if necessary, .014 to .016 in. (.035 to .040 mm). Set the octane selector so that the fourth line from the L.H. side of the calibrated slide is against the face of distributor body casting.
  6. Rotate the distributor spindle until the rotor is at the firing point for No. 1 cylinder. The broad side of the driving spigot should be towards No. 3 exhaust port and vacuum unit facing forward when the distributor is located.
  7. Mount distributor and secure to distributor housing.
  8. Slacken the pinch bolt at the base of the distributor body; rotate the distributor bodily in the opposite direction to the arrow on the rotor arm, until the contact breaker points are just opening with the fibre cam follower on the leading side of the cam; retighten the pinch bolt.
- Checking with 12 volt timing lamp**
- (a) Connect a lead between the distributor L.T. terminal and the centre pole of the bulb; earth the bulb body.

#### Externals Operation A/74

1. Fit the oil filter complete and joint washer.
2. Fit the exhaust rocker cover and joint washer.
3. Fit the oil feed pipe, gallery to cylinder head.
4. Fit the dynamo and starter motor; adjust the dynamo belt tension to allow the belt to move  $\frac{3}{8}$  to  $\frac{1}{2}$  in. (12 to 19 mm) when pressed by thumb between the crankshaft and water pump pulleys.
5. If removed, refit heater pipes, etc., to cylinder head.
6. Fit the inlet rocker cover and joint washer.
7. Fit the sparking plugs, covers and rubber sealing rings, and connect plug leads to distributor.
8. Fit the carburetter, and connect vacuum pipe between carburetter and distributor, connect fuel feed pipe from pump. Connect the accelerator linkage to the carburetter.
9. Fit the oil sump, noting rubber seal, packing strip and three distance pieces at rear.
10. Fit the dipstick and tube.

#### Engine, to refit Operation A/76

1. Reverse removal procedure—fit new mounting rubbers if necessary. Refill with lubricating oil, 10 imperial pints (5.5 litres), and coolant, 17 imperial pints (9.75 litres).
2. See Section M for details of carburetter adjustments.
3. See Section AO for details of oil pressure adjustment.
4. Check for oil and coolant leaks—rectify as necessary.

3. Locate head and gasket with the securing bolts, fitting all bolts except those which also secure the rocker shaft pedestals, but do not tighten at this stage.
  4. Insert the push-rods into their original position, through cylinder head and locate in the cam-followers.
  5. Fit the rocker shaft to the cylinder head. When in position, the oil feed holes in the rocker shaft must face the push-rods. Tighten all the bolts down in the manner illustrated by Fig. A-26:  $\frac{7}{16}$  in. bolts to 55 lb/ft (7.5 mKg);  $\frac{5}{8}$  in. bolts to 35 lb/ft (4.5 mKg).
- Tappet adjustment Operation A/70**
- The exhaust tappets may be set with the engine cold.
- The inlet tappets should be set with the engine at running temperature.
1. Set the valve receiving attention fully open by engaging the starting handle and turning the engine, then rotate the tappet on the back of the revolution, to bring the tappet on the back of the cam.

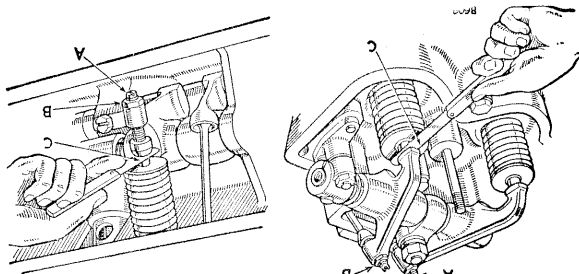


Fig. A-27—Tappet adjustment  
A—Tappet adjusting screw  
B—Locknut  
C—Feeler gauge

2. Slacken the tappet locknut and using a feeler gauge, rotate the adjusting screw to give the correct clearance .010 in. (.025 mm) inlet and .012 in. (.030 mm) exhaust, bearing down on the screw to take up all the clearance at the push-rod ends.
3. Repeat for the remaining tappets.

#### Distributor and ignition timing Operation A/72

1. Rotate the engine in running direction until the F.A. 10° mark on the flywheel is in line with the pointer, with both valves on No. 1 cylinder closed.
2. Fit the oil pump drive shaft so that when fully engaged in oil pump, the broad segment of driving spigot will be nearest to No. 3 exhaust port. The crankshaft may have to be rotated slightly to allow engagement of driving shaft in oil pump, and when this is necessary, item 1 must be repeated.
3. Secure the distributor housing in position with the hollow oil feed bolt, then fit distributor drive shaft.

OVERHAULS TO ENGINE IN CHASSIS

Decarbonise and grind in the valves; carry out the following operations:

Page	Operation	Items
A-2	A/2	1 to 5
A-2	A/4	1, 3 and 4
A-3	A/10	All
A-4	A/20	All
A-5	A/30	All
A-12	A/62 to A/70	All
A-13	A/72 to A/76	As necessary

Timing chain, tensioner, or front cover oil seal to renew; carry out the following operations:

Page	Operation	Items
A-2	A/2	1 to 10
A-3	A/14	All
A-10	A/54	All
A-11	A/56	As necessary

Camshaft bearings, exhaust rockers and shafts, to renew; carry out the following operations:

Page	Operation	Item
A-2	A/2	1 to 10
A-2	A/4	4, 6 and 9
A-3	A/6	All
A-3	A/14	All
A-4	A/16 and A/18	All
A-9	A/50 to A/54	All
A-10	A/56	As necessary
A-13	A/70 and A/72	All
A-13	A/74 and A/76	As necessary

Reboring, renewing pistons, rings, little ends, or big-end bearings; carry out the following operations:

Page	Operation	Items
A-2	A/2	1 to 5 and 23
A-2	A/4	1, 3 and 4
A-3	A/10	All

In order to remove the pistons and connecting rods with the engine in the chassis, it is necessary to carry out the following instructions:

**Pistons and connecting rods, to remove**  
**Operation A/78**

1. Remove the connecting rod caps, bearings and bolts.
2. Push each connecting rod up and turn, in order to engage the slots at the bottom of the cylinder bore. Remove the circlips; withdraw the gudgeon pin, using extractor, Part No. 278668; remove the piston.
3. Lower each connecting rod, turning the crank-shaft as necessary to effect withdrawal.

4. Remove the piston rings.
5. Mark all components in sets.

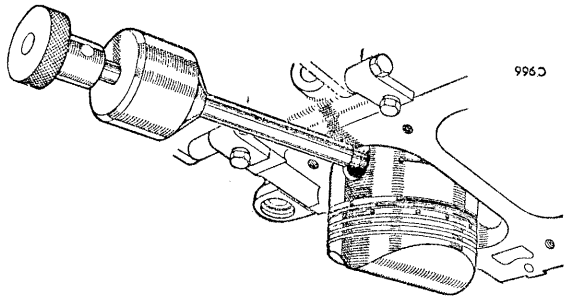


Fig. A-28—Removing gudgeon pin

When the pistons and connecting rods are removed continue with the following operations:

Page	Operation	Items
A-6	A/34 to A/40	As necessary
A-7	A/42	1 to 3

In order to refit the pistons and connecting rods with the engine in the chassis it is necessary to carry out the following instructions:

**Pistons to connecting rods, to refit**  
**Operation A/80**

1. Enter the connecting rod, without bolts, up into the cylinder bore and engage in the cylinder block slots.
2. Enter the skirt of the piston into the top of the bore, with the flat top of the piston in line with the oil hole in the connecting rod.
3. Fit the gudgeon pin, using thimble Part No. 272103, to align piston and connecting rod. Lock the pin in position with circlips.

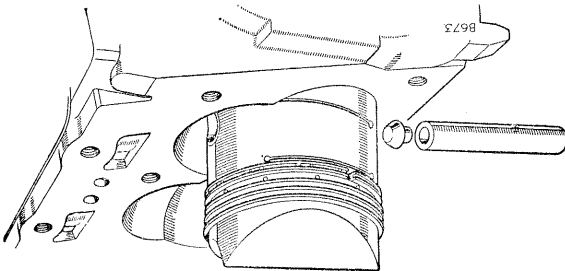


Fig. A-29—Fitting gudgeon pin

**Piston and connecting rod to cylinder block and crankshaft**  
**Operation A/82**

1. The connecting rod bolts are a tight fit in the rod and must be tapped into place with a 'Z'-shaped bar.



Section A-O	Oil pump and filters	....
Section L	Water pump and thermostat	....
Section A-2	Vibration damper	....
Section B	Flywheel and clutch	....
Section P	Starter, dynamo, distributor	....
Section M	Carburetter	....

**Flywheel housing drain plug**

The drain plug should not be fitted to the housing, unless the vehicle is expected to operate under very muddy conditions, or to wade. The plug should be screwed into the stowage bracket fitted to later models, or stored in the tool locker.

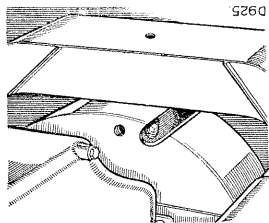


Fig. A-30—Flywheel housing drain plug and stowage bracket

2. Turn the crankshaft until the crank journals relative to numbers 1 and 4 cylinders are at B.D.C. Squirt oil on to the journal, refit appropriate bearings to cap and connecting rod, pull the rod down to the journal and fit cap, ensuring that the oil hole in the connecting rod is on the opposite side to the camshaft. Tighten the nuts to 40 lb/ft. (5.5 mKg) and fit split pin.

When the pistons and connecting rods have been refitted, continue with the following operations for replacement of the cylinder head.

Page	Operation	Items
A-12	A/68 to A/70	All
A-13	A/72 to A/76	As necessary

**Inlet rocker shaft to overhaul: carry out the following operations:**

Page	Operation	Items
A-3	A/10	As necessary
A-12	A/60	All
A-12	A/68	As necessary
A-13	A/70	All

## DEFECT LOCATION

(Symptom, Cause and Remedy)

- A—ENGINE FAILS TO START**
1. Incorrect starting procedure—See *Instruction Manual*.
  2. Starter motor speed too low—Check battery and connections.
  3. Faulty ignition system—Section P.
  4. Water or dirt in fuel system—Section M.
  5. Carburetter flooding—Section M.
  6. Defective fuel pump—Section P.
  7. Defective starter motor—Section P.
  8. Starter pinion jammed in flywheel—Rotate starter shaft with spanner to free pinion.
  9. Starter pinion not engaging—Clean drive sleeve and pinion with paraffin.
- B—ENGINE STALLS**
1. Low idling speed—Section M.
  2. Faulty sparking plugs—Rectify.
  3. Faulty coil or condenser—Renew.
  4. Faulty distributor points—Rectify or renew. Section P.
  5. Incorrect tappet clearance—Adjust.
  6. Incorrect mixture—Adjust carburetter. Section M.
  7. Foreign matter in fuel system—Section M.
- C—LACK OF POWER**
1. Poor compression—If the compression is appreciably less than the correct figure, (Page A-16) the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket.
  2. Badly seating valves—Rectify or renew.
  3. Faulty exhaust silencer—Renew.
  4. Incorrect ignition timing—Rectify. Section M.
  5. Leaks or restrictions in fuel system—Section M.
  6. Faulty sparking plugs—Rectify.
  7. Clutch slip—Section B.
  8. Excessive carbon deposit—Decarbonise.
  9. Brakes binding—Section H.
  10. Faulty coil, condenser or battery—Section P.
- D—ENGINE RUNS ERRATICALLY**
1. Faulty electrical connections—Rectify.
  2. Defective sparking plugs—Rectify. Section P.
  3. Low battery charge—Recharge battery. Section P.
  4. Defective distributor—Rectify.
  5. Foreign matter in fuel system—Section M.
  6. Faulty fuel pump—Section M.
  7. Sticking valves—Rectify or renew.
  8. Incorrect tappet clearance—Adjust.
  9. Defective valve springs—Renew.
  10. Incorrect ignition timing—Rectify.
  11. Worn valve guides or valves—Renew.
  12. Faulty cylinder head gasket—Renew.
  13. Damaged exhaust system—Rectify or renew.
- E—ENGINE STARTS, BUT STOPS IMMEDIATELY**
1. Faulty electrical connections—Rectify low tension circuit.
  2. Foreign matter in fuel system—Section M.
  3. Faulty fuel pump—Section M.
  4. Low fuel level in tank—Replenish.
- F—ENGINE FAILS TO IDLE**
1. Incorrect carburetter settings—Section M.
  2. Faulty fuel pump—Section M.
  3. See defect D, 7-12.
  4. See defect D, 1-4.
- G—ENGINE MISFIRES ON ACCELERATION**
1. Distributor points incorrectly set—Rectify. Section P.
  2. Faulty coil or condenser—Renew.
  3. Faulty sparking plug—Rectify.
  4. Faulty carburetter—Section M.
- H—ENGINE KNOCKS**
1. Ignition timing advanced—Adjust.
  2. Excessive carbon deposit—Decarbonise.
  3. Incorrect carburetter settings—Section M.
  4. Unsuitable fuel—Adjust octane selector.
  5. Worn pistons or bearings—Renew.
  6. Distributor advance mechanism faulty—Rectify. Section P.
  7. Defective sparking plugs—Rectify or renew.
  8. Excessively worn valve stems and guides—Renew.
  9. Loose timing chain—Rectify tensioner.
  10. Excessive carbon deposit—Decarbonise.
- I—ENGINE BACKFIRES**
1. Ignition defect—Section P.
  2. Carburetter defect—Section M.
  3. Incorrect valve timing—Adjust.
  4. Incorrect tappet clearance—Adjust.
  5. Sticking valve—Rectify.
  6. Weak valve springs—Renew.
  7. Badly seating valves—Rectify or renew.
  8. Excessively worn valve stems and guides—Renew.
  9. Loose timing chain—Rectify tensioner.
  10. Excessive carbon deposit—Decarbonise.
- J—ENGINE BACKFIRES**
1. Insufficient tappet clearance—Adjust.
  2. Sticking valves—Rectify.
  3. Weak valve springs—Renew.
  4. Excessive deposit on valve seats—Re-cut.
  5. Distorted valves—Renew.
- K—BURNED VALVES**
1. Excessive tappet clearance—Adjust.
  2. Sticking valves—Rectify.
  3. Weak valve springs—Renew.
  4. Faulty valve mechanism—Renew worn parts.
- L—NOISY VALVE MECHANISM**
1. Low oil pressure—See defect N.
  2. Excessive bearing clearance—Renew bearings; grind crankshaft.
  3. Burnt-out bearings—Renew.
  4. Loose bearing caps—Tighten.
- M—MAIN BEARING RATTLE**
1. Low oil pressure—See defect N.
  2. Excessive bearing clearance—Renew bearings; grind crankshaft.
  3. Burnt-out bearings—Renew.
  4. Loose bearing caps—Tighten.
- N—LOW OIL PRESSURE**
1. Thin or diluted oil—Refill with correct oil.
  2. Low oil level—Replenish.
  3. Choked pump intake filter—Clean.
  4. Faulty release valve—Rectify.
  5. Excessive bearing clearance—Rectify.
  6. Excessive camshaft bearing clearance—Rectify.
  7. Loose or restricted oil line—Rectify.
- P—ENGINE FAILS TO START**
1. Incorrect starting procedure—See *Instruction Manual*.
  2. Starter motor speed too low—Check battery and connections.
  3. Faulty ignition system—Section P.
  4. Water or dirt in fuel system—Section M.
  5. Carburetter flooding—Section M.
  6. Defective fuel pump—Section P.
  7. Defective starter motor—Section P.
  8. Starter pinion jammed in flywheel—Rotate starter shaft with spanner to free pinion.
  9. Starter pinion not engaging—Clean drive sleeve and pinion with paraffin.

GENERAL DATA

Capacity (piston displacement) 1,997 cc (121.9 cu. in.)	Number of cylinders	4
Bore	77.8 mm (3.063 in.)	
Stroke	105 mm (4.134 in.)	
Compression ratio	6.9-1	
B.H.P.	52 at 4,000 R.P.M.	
B.M.E.P.	125 lb/sq.in. (8.8 Kg/cm <sup>2</sup> ) at 1,500 R.P.M.	
Compression pressure (at starter motor cranking speed, i.e., 300 R.P.M. with engine hot)	125 lb/sq. in. (8.8 Kg/cm <sup>2</sup> )	
Piston speed at 4,500 R.P.M.	3,110 ft/min.	
	15.75 m/sec.	
Firing order	1—3—4—2	
Maximum torque	101 lb/ft (14 mKg) at 1,500 R.P.M.	

DETAIL DATA

<b>Camshaft</b>	Journal diameter	.874 in.—,0005 (22,2—0,001 mm)
	Clearance in bearing	.001 to .002 in. (0,02 to 0,05 mm)
	End-float	.003 to .005 in. (0,07 to 0,12 mm)
<b>Camshaft bearings</b>	Type	Split Mazak die castings
	Internal diameter	.876 in.—,001 (22,2—0,001 mm)
<b>Connecting rods</b>	Bearing fit on crankpin	.001 to .0025 in. (0,02 to 0,06 mm)
	Bearing nip	.002 to .004 in. (0,05 to 0,10 mm)
	End-float at big-end	.009 to .013 in. (0,23 to 0,33 mm)
	Gudgeon pin bush fit in small end	.001 to .002 in. (0,02 to 0,05 mm) interference
	Gudgeon pin bush—Internal diameter—	.875 in.—,0005 (22,187 mm—0,012)
	Fit of gudgeon pin in bush	.0003 to .0005 in. (0,007 to 0,012 mm) clearance
<b>Crankshaft</b>	Journal diameter	2.005 in. (50,80 mm)
	Crankpin diameter	1.875 in. (47,52 mm)
	End-float	.002 to .006 (0,05 to 0,15 mm)
	Regrind sizes:	Journal dia. 1.990 in. (50,55 mm)
		Crankpin dia. 1.865 in. (47,37 mm)
		1.880 in. (47,29 mm)
		1.970 in. (50,04 mm)
		1.960 in. (49,79 mm)
		1.835 in. (46,62 mm)

<b>Flywheel</b>	Number of teeth	97
	Thickness at pressure face	1.093 in.—,016 (22,76—0,4 mm)
	Maximum permissible run-out on flywheel face	.005 in. (0,12 mm)
	Maximum refacing depth	.030 in. (0,75 mm)
	Minimum thickness after grinding	1.063 in. (27 mm)
	Markings: T.D.C.	
		When opposite pointer, No. 1 piston is at top dead centre
		When opposite pointer, No. 1 exhaust valve should be fully open. 114° before T.D.C.
		When opposite pointer, with both valves closed, indicates firing point of No. 1 cylinder.
	Primary pinion bush	.001 to .003 in. (0,02 to 0,07 mm) interference
	Internal diameter—	.878 in. (22,3 mm)
	reamed in position	Fit of shaft in bush .003 to .004 in. (0,07 to 0,10 mm) clearance
<b>Gudgeon pin</b>	Fit in piston (selective assembly)	Zero to .0003 in. (zero to 0,007 mm) interference
	Fit in connecting rod bush (selective assembly)	.0003 to .0005 in. (0,007 to 0,012 mm) clearance
<b>Main bearings</b>	Clearance on crankshaft journal	.001 to .002 in. (0,025 to 0,05 mm)
	Bearing nip	.004 to .006 in. (0,10 to 0,15 mm)

Oil pump assembly	See Section AO
Pistons (Four-ring type)	
Type	Light alloy, tin plated
Clearance in bore,	measured at bottom
of skirt at right angles	to gudgeon pin
Clearance in bore,	measured at top of
skirt at right angles	to gudgeon pin
.....	.0022 to .0027 in. (0,055
to gudgeon pin	to 0,068 mm)
Gudgeon pin bore	..... .8747 in. +.0002 (22,21
mm—0,005)	
Piston rings (Four-ring type)	
Compression (2)	..... Taper periphery
Gap in bore	..... .015 to .020 in. (0,38 to
	0,50 mm)
Clearance in groove	..... .0005 to .002 in. (0,012 to
	0,05 mm)
Scrapper ring (upper) Early models only	
Type	..... Stepped
Gap in bore	..... .012 to .017 in. (0,3 to 0,4
	mm)
Clearance in groove	..... .0005 to .002 in. (0,012 to
	0,05 mm)
Pistons (Three-ring type)	
Type	Light alloy, tin plated
Clearance in bore,	measured at bottom
of skirt at right angles	to gudgeon pin
Clearance in bore,	measured at top of
skirt at right angles	to gudgeon pin
.....	.0030 to .0035 in. (0,076
to gudgeon pin	to 0,089 mm)
Gudgeon pin bore	..... .8747 in. +.0002 (22,21
mm+0,005)	
Piston rings (Three-ring type)	
Compression (2)	..... Taper periphery
Gap in bore	..... .015 to .020 in. (0,37 to
	0,50 mm)
Torque loadings	
Connecting rod bolts	40 lb/ft. (5,5 mKg)
Cylinder head bolts:	7/16 in. B.S.F. (7,5 mKg)
.....	55 lb/ft. (4,5 mKg)
.....	35 lb/ft. (4,5 mKg)
Main bearing bolts	80 lb/ft. (11 mKg)
Flywheel securing	bolts
.....	70 lb/ft. (9,7 mKg)
Thrust bearings, crankshaft	
Type	Semi-circular, steel backed,
	tin plated
Thickness	..... .093 in.—.002 (2,36 mm
.....	—0,05)
Oversizes	..... .0025 in., .005 in., .0075 in.
	and .010 in.
Timing chain tensioner	
Driving chain	..... Endless roller, pre-
Type	..... stretched
Diameter of rollers	..... ¼ in. (6,35 mm)
Chain tensioner spring	..... 4.200 in. (106,68 mm)
Free length	..... 1.937 in. (49,2 mm)
Load in position	..... 15½ lb±¼ (7 Kg±¼)
Hydraulic chain tensioner	Inlet valve lifts at
	..... 4 to 12 lb/sq.in. (0,30 to
	0,80 Kg/cm <sup>2</sup> )
Tappet clearance	
Exhaust, engine cold	..... .012 in. (0,30 mm)
Inlet, engine at run-	ning temperature
.....	.010 in. (0,25 mm)
Rocker gear	
Rockers and cam	followers:
Inlet	..... .500 in. +
Exhaust	..... .593 in. +
	.001
	(12,7 mm
	+0,025)
Clearance on shaft	..... .001 to
	.002 in.
	(0,025 to
	0,050 mm)
	(0,075 mm)
Scrapper (1)	
Type	..... Slotted, H section
Gap in bore	..... .012 to .017 in. (0,30 to
	0,43 mm)
Clearance in groove	..... .002 to .004 in. (0,050 to
	0,10 mm)
Clearance in groove	..... .0018 to .0038 in. (0,045
	to 0,096 mm)







## ENGINE REMOVAL AND DISMANTLING

## PROCEDURE

## Removing engine

1. If fitted, remove the spare wheel from bonnet panel.

2. Remove the bonnet panel.
3. Disconnect the battery leads. If fitted, remove the exhaust heat shield.

4. Disconnect the air intake pipe from the carburettor and remove air cleaner.

5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).

6. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.

7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.
8. Remove the fan blades.

9. Remove the bolts securing the front apron and remove. Remove the bolts securing the grille panel to the front cross member and front wings.
10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.

11. Disconnect the exhaust pipe from exhaust manifold.

12. Disconnect the heater pipes (if fitted) at the engine side of scuttle.

13. Disconnect the inlet petrol pipe at pump.

14. Disconnect the throttle return spring, throttle linkage (at a ball joint) and the cold start control cable at carburettor and clamp. If fitted, disconnect the hand speed control rod (at a ball joint).

15. Disconnect: Dynamo wiring; ignition coil leads; starter lead from switch; oil pressure switch wire; thermostat switch wire (at L.H. front of engine).

16. Fit the engine sling to the support brackets at front and rear of cylinder head and with suitable lifting tackle just take the strain.

17. Disconnect the clutch slave cylinder hose at bracket mounted on scuttle.

18. Remove the front floor and gearbox cover.

19. Support the gearbox assembly with a jack or packing blocks.

20. Remove the three nuts and washers securing the clutch slave cylinder bracket to the flywheel housing and pull the complete assembly as far back as possible.

21. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.

22. Remove the bolts from engine front support brackets and allow the engine to move forward and thus clear the gearbox input shaft. Ensure that the speedometer cable and all wires, etc., are clear, then hoist the engine gently from the vehicle.

23. Drain the oil from sump and remove.

24. Bolt the engine to a suitable stand, securing by the sump fixing studs.

## DISMANTLING ENGINE

## Operation A/84

## Externals

1. Disconnect the accelerator linkage (at a ball joint), distributor vacuum pipe and petrol pipe. Remove carburettor.

2. Detach sparking plug covers and leads, remove locating screw and withdraw the distributor. Remove sparking plugs. Disconnect and remove petrol pipe from pump.

- See Section M for overhaul of carburettor and Section P for overhaul of distributor.

3. If fitted, remove the heater pipes and flow control tap.

4. Remove the dynamo, fan belt and starter motor. See Section P for overhaul of dynamo and starter motor.

5. The rearmost tappet chamber cover and fuel pump may be removed as one unit; the foremost tappet chamber cover and oil filler pipe may also be removed together, complete with baffle plate (late models). See Section M for overhaul of fuel pump.

6. Remove the external full-flow oil filter complete with oil pressure warning switch. See Section A O for details of oil filter.

7. Disconnect the oil feed pipe—gallery to cylinder head, and the hose, thermostat to water pump casing.

8. Remove the rocker cover, dipstick, and dipstick tube.

## Clutch and flywheel, to remove

## Operation A/86

1. Mark the cover plate and flywheel, so that on reassembly the plate may be fitted in the same relative position, to retain the original balance of the unit.



1. Remove the clutch, flywheel and housing.
2. Remove the clutch, flywheel and housing. See Section B for overhaul of clutch and flywheel.

**Oil pump, to remove** Operation A/88

1. Remove the securing bolts and withdraw the pump assembly.
  2. Withdraw the driving shaft from the pump upper casing.
- See Section AO for overhaul of oil pump.

**Water pump, to remove** Operation A/90

1. Remove the water pump assembly and pulley. See Section L for overhaul of water pump.

**Fan driving pulley, to remove** Operation A/92

1. Remove the starting dog pulley nut with special tool, Part No. 507234, then withdraw pulley.

**Rocker shaft and cylinder head, to remove** Operation A/94

1. Remove the rocker shaft cover, unscrew the bolts securing the rocker shaft support brackets, and lift the rocker shaft assembly complete from the cylinder head.
2. Ensure the component parts of the rocker shafts remain in their correct relative positions.
3. Withdraw the push rods and insert them in a piece of cardboard pre-pierced and numbered 1 to 8.
4. Loosen the securing bolts evenly and lift the cylinder head clear, complete with manifolds and thermostat.

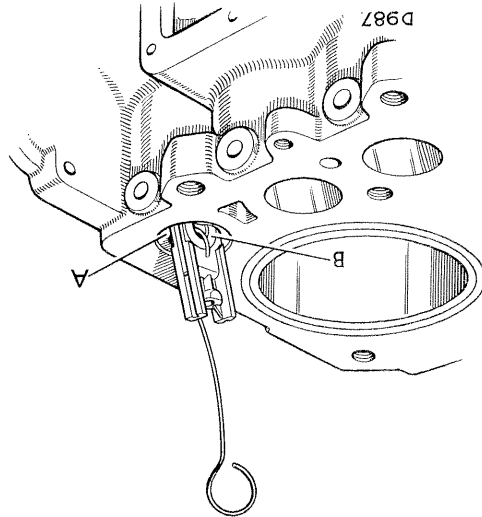


Fig. A-31—Removing tappet and roller  
A—Tappet guide B—Roller

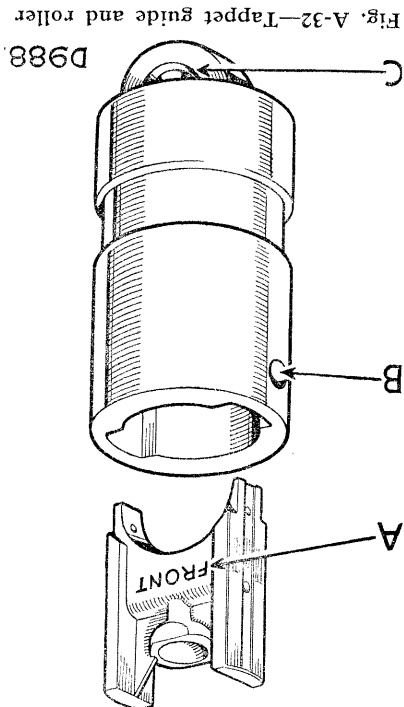


Fig. A-32—Tappet guide and roller  
A—Brass tappet slide marked "Front"  
B—Tappet guide bolt location hole  
C—Roller with chamfer to front.

**Vertical drive shaft gear, to remove** Operation A/98

1. Remove the aluminium adaptor plate, then remove the distributor drive shaft from the vertical drive shaft. Remove the locating grub screw from the external filter adaptor joint face. Lift the drive shaft and external bush assembly clear, with a pair of snipe-nosed pliers. The split bush may be removed by tapping to release the dowels. Do not remove the aluminium plug in the gear unless absolutely necessary. A new plug must be fitted if the old one has been removed.

**Roller**

1. Remove the tappet locating bolts from the R.H. side of the cylinder block.
2. Hook out the roller and brass tappet slide with a piece of wire, ensuring the tappet guide does not move. If the guide moves this may allow the roller to fall down into the camshaft chamber. The tappet assemblies are marked to ensure correct refitment as follows:

**Brass tappet slide**  
The tappet is clearly marked "Front".

**Guide**

The guide can only be fitted one way due to the bolt location hole. See Fig. A-32.

**Cylinder block checks** Operation A/108

Check that the main bearing caps have not been filed, in the following manner:

1. Assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face. If there is a clearance, this indicates that the main bearing caps have been filed, and the cylinder block must be replaced.

**ENGINE ASSEMBLY**

**Reboring** Operation A/110

1. Reboring conforms to normal practice. The cylinder block may be rebored up to .040 in. (1,00 mm) oversize.
2. If the cylinder block is already bored out to maximum oversize, cylinder liners may be fitted. Cylinder liners can only be bored out to take standard size pistons.

**Cylinder liners** Operation A/112

1. Fitting cylinder liners conforms to normal practice.
2. Machine the cylinder block bores to 3.683 in. + .001 (93,54 mm + 0,025). This gives an interference fit of .003 to .004 in. (0,07 to 0,10 mm).
3. Press the liners into the cylinder block, Cylinder liners can only be bored out to standard size, that is 3.562 in. (90,47 mm).

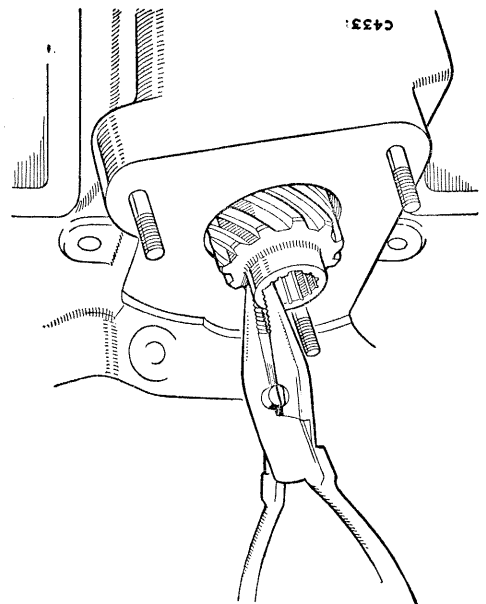
**Checking piston fit in bore** Operation A/114

1. Graded pistons of standard size are available for replacement purposes. This does not apply to oversize pistons. The grade letter which is stamped on the piston crown represents a difference in diameter of .0002 in. (0,0051 mm) as shown below.

'Z'	Nominal to minus .0002 in. (0,005 mm)	above nominal
'A'	Nominal to plus .0002 in. (0,005 mm)	above nominal
'B'	.0002 in. (0,005 mm) to .0004 in. (0,01 mm)	above nominal
'C'	.0004 in. (0,01 mm) to .0006 in. (0,015 mm)	above nominal
'D'	.0006 in. (0,015 mm) to .0008 in. (0,02 mm)	above nominal

When fitting standard pistons in a comparatively new engine, a graded piston, corresponding to the piston removed, should be fitted. However, a check must be made to ensure that the clearance falls within the limits laid down. For example: If the car has done little mileage and there is no appreciable bore wear, a graded piston of the same size as that taken out should be used; however, if a certain amount of bore wear is apparent it may be necessary to fit a piston two or three

Fig. A-33—Removing the vertical drive shaft gear



**Front cover, chain tensioner and chainwheels, to remove** Operation A/100

1. Remove the front cover.
2. Remove the ratchet securing bolt and withdraw the ratchet and spring. Compress the chain tensioner spring, unscrew the lower fixing bolts and remove the chain tensioner assembly.
3. Lift off the timing chain and remove the chainwheels.

**Camshaft, to remove** Operation A/102

1. Remove the camshaft front thrust plate, then withdraw the camshaft.

**Pistons and connecting rods, to remove** Operation A/104

1. Turn the crankshaft until the pistons of numbers 1 and 4 cylinders are at B.D.C. Remove the big end bolt securing nuts of numbers 1 and 4 connecting rods, then withdraw the piston and connecting rod assemblies from the top of cylinder block.
2. Repeat for numbers 2 and 3 assemblies.
3. Remove pistons from connecting rods and ensure that the component parts are retained in their correct relative positions.

**Crankshaft, main bearings and rear bearing seal, to remove** Operation A/106

1. Remove the main bearing caps, lift the crankshaft clear and place in a suitable stand.
2. Retain the shell bearings in pairs adjacent to the journal from which they were removed.
3. The rear bearing seal halves may be removed from the cylinder block and bearing cap.

**Operation A/116**

**Piston ring fitting**

1. Check the piston ring gaps in the cylinder bores, using an old piston as illustrated in Fig. A-35, to keep the rings square in the bore.

2. The two compression rings are of the tapered periphery type, and must be fitted with the side marked "T" uppermost; the oil scraper ring has a square friction edge and may be fitted either way. Fit the piston rings and check the clearance in the oil groove. Clearance should not exceed .0005 to .002 in. (0,012 to 0,05 mm).

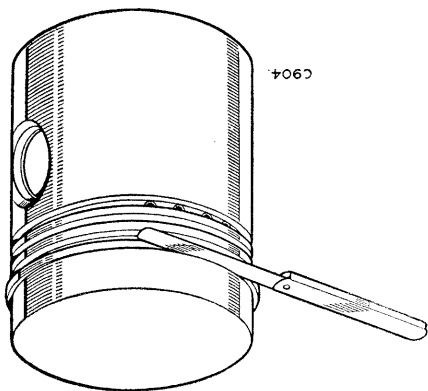


Fig. A-36—Checking ring clearance in groove

**Camshaft bearings, to renew**

**Operation A/118**

When new camshaft bearings are to be fitted, the front and front intermediate bearings must be removed and new ones fitted before re-moving the rear bearings.

1. Unscrew the 3½ in. (88 mm) long stud from the joint face at front of cylinder block.

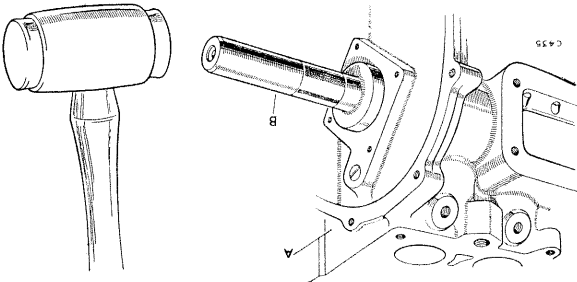


Fig. A-37—Outer camshaft bearing removal  
A—Cylinder block B—Drift

2. Drift the front camshaft bearing into the fore-most tappet chamber, using tool Part No. 274388, then withdraw the bearing from the chamber aperture.

3. The front intermediate bearing is removed by drifting it into the distributor drive chamber, using the same tool, but it must be collapsed before withdrawing from the drive aperture as illustrated in Fig. A-38.

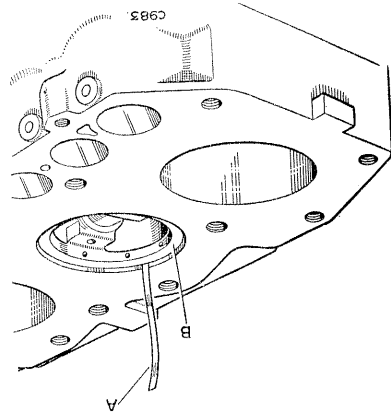
Fit new front and front intermediate bearings, before removing the rear bearings with drift.

grades larger than the one removed. In the case of a top-limit piston fitted as original equipment it may be necessary to rebore to the first oversize to obtain the correct piston fit.

The grade size of any particular bore is also stamped on the cylinder block at the sump joint face, using the same letters as stamped on the piston crown.

2. In order to obtain the correct piston clearance with a new piston in a new or worn bore, insert a long .0025 in. (0,063 mm) feeler gauge down the thrust side of the cylinder, that is the left-hand side of the cylinder looking at the engine from the front. Insert the piston upside down in the cylinder bore with the gudgeon pin in line with the centre line of the engine. Push the piston down the cylinder until the piston skirt reaches its tightest point in the bore, where the feeler gauge should require a 10 lb. pull to withdraw it.

Fig. A-34—Checking piston clearance  
A—Feeler gauge B—Piston



It may be necessary to check the clearance of several pistons in the bore before the correct one is selected.

This method of checking the piston clearance ensures that the piston has the correct clearance in its working position.

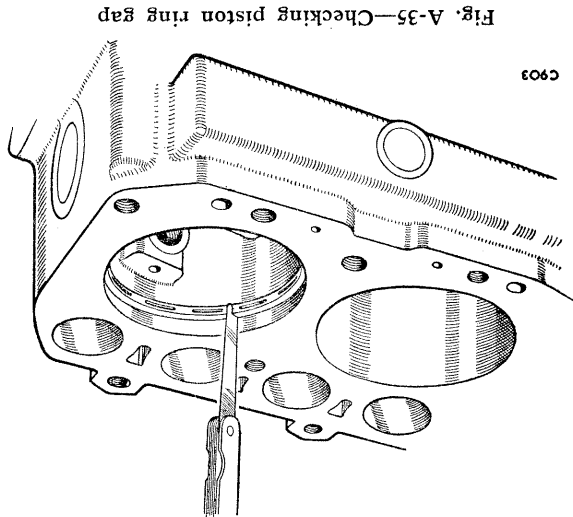


Fig. A-35—Checking piston ring gap

6. When the fitting bar has been pressed in as far as possible by hand, ensure that all locating points are properly engaged, then drive the bearings into position with a hide-faced hammer. Remove the bearing fitting tools and check the oil holes for alignment. Remove the two rear-most bearings as illustrated in Figs. A-37 and A-38.

7. Fit new camshaft rear bearings in the same manner as for front bearing fitment, but remove the spacer from fitting bar and use guide tool, Part No. 274386, instead of the guide tube used when fitting front bearings.

8. Locate a guide plug, Part No. 274394, in the

front new camshaft bearing and locate, using the end plate screws. Do not tighten these screws until the reamer, Part No. 274389, is put into position and the guide collar immediately in front of the cutter is entered into the rear-most bearing, which is first to be cut. This precaution is to ensure correct alignment of the reamer. Before commencing the reaming operation it is necessary to turn the engine block to a vertical position, i.e. front end facing downwards, in order that the weight of the reamer will assist in the cutting operation. As each bearing is cut the reamer should be held steady by the operator whilst an assistant, using a high-pressure air line, blows away the white metal cuttings, before allowing the reamer to enter the next bearing.

9. After the rear-most and the two intermediate bearings have been cut, remove the guide plug Part No. 274394, before cutting the foremost bearing. Remove the reamer handle and care-fully remove the reamer, turning it in the same direction as for cutting. Care must be taken to prevent the reamer damaging the foremost bearing as the reamer is removed. No lubricant is necessary for the reaming operation, best results are obtained when the bearings are cut dry.

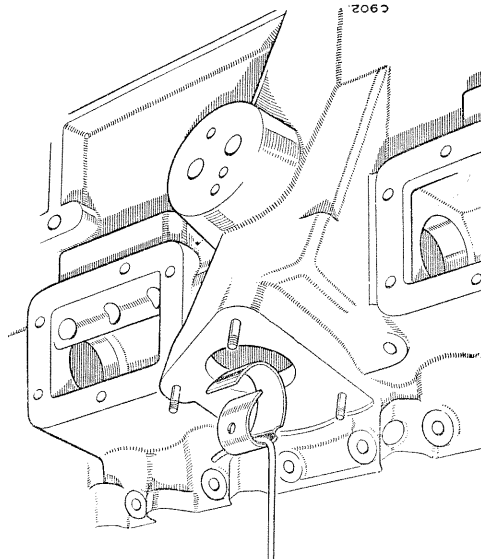


Fig. A-38—Inner camshaft bearing removal

4. Fit a guide tool, Part No. 274385, into the two old rear-most bearings with the part of flange marked "TOP" uppermost, then insert three end cover set bolts loosely for location purposes. Position a new bearing on to the handle end of bearing fitting bar, Part No. 274382, and locate by means of the peg and semi-circular cut-out, then slide a spacer, Part No. 274383, on to the fitting bar and engage the locating shoulder.

5. Place a new bearing on spigot, Part No. 274384, and position it inside the foremost tappet chamber with the bearing nearest the front intermediate housing. Insert the bearing fitting bar into the front bearing housing and feed the spigot on to the bar; withdraw the spigot handle. Turn the spigot to engage the locating shoulder in the spacer, then press the fitting bar inward, turning as necessary to engage the bar slot with the peg in guide tube.

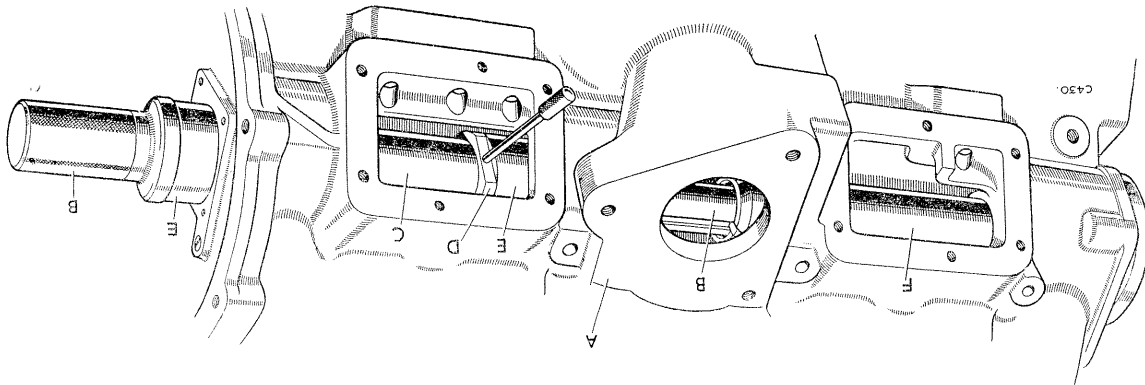


Fig. A-39—Fitting camshaft front bearings

- A—Cylinder block
- B—Bearing fitting bar
- C—Spacer
- D—Spigot
- E—New bearings
- F—Guide tube

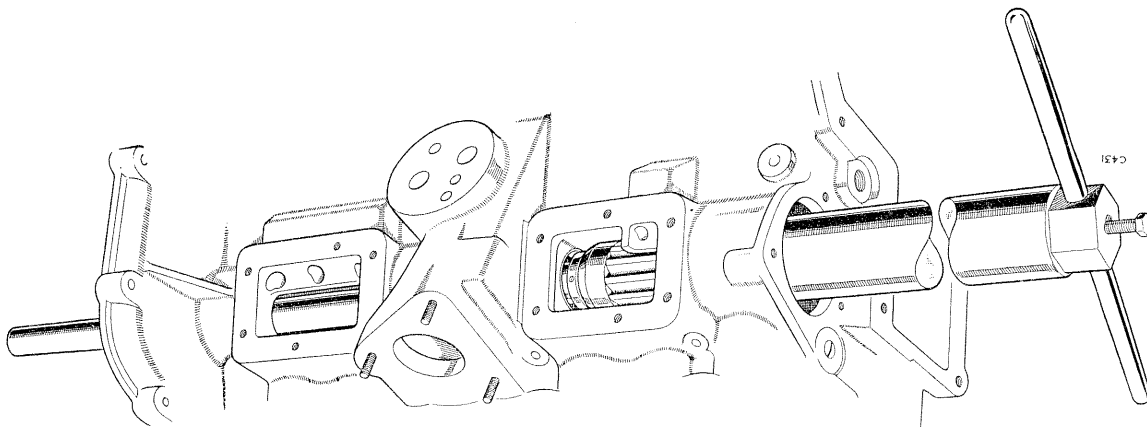


Fig. A-40—Reaming camshaft bearings  
(Engine must be in vertical position)

10. The cylinder block must be thoroughly cleaned at this stage.
- Remove the plugs from the ends of oil gallery passages to camshaft and crankshaft bearings, using compressed air. Refit the plugs and lock in position.

**Crankshaft main bearings and seals**

**Operation A/120**

Check the main bearing nip in the following manner.

1. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-41, ensuring that the clearance does not exceed .004 to .006 in. (0,10 to 0,15 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

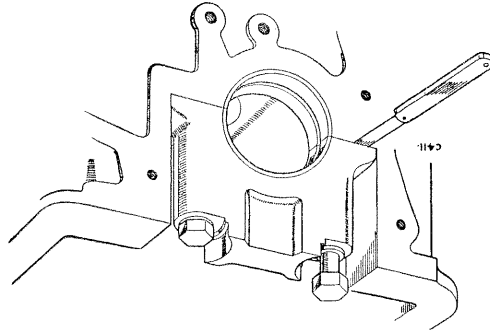


Fig. A-41—Checking main bearing nip

2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.

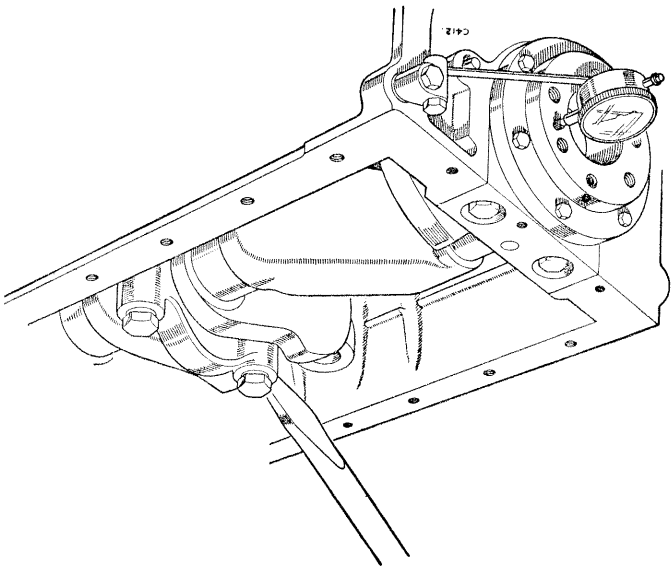


Fig. A-42—Checking crankshaft end-float

3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (0,06 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.
4. Mount a dial test indicator, then check and note the crankshaft end-float reading which should be .002 to .006 in. (0,050 to 0,15 mm). If the crankshaft end-float reading obtained is not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (0,07 mm) to ensure that the crankshaft remains centralised.
5. Remove the bearing caps, bottom half shells and crankshaft.

11. Apply 'Heldite' jointing compound to both split line joint faces on each half of the seal. This instruction does not apply to the three-piece type oil seal.

The compound should be spread thinly over the surface, ensuring it reaches across the sealing lips, but must not be allowed to get on to the lips themselves. See Fig. A-43. This compound must be allowed to become tacky before assembly.

12. Fit rear main bearing cap and tighten to the required torque.

13. Where applicable, tighten the four bolts adjacent to the split line.

14. Rotate crankshaft through a small arc to prevent the jointing compound from adhering to the crankshaft.

15. Firmment of the rear main bearing cap, with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture. See Fig. A-44.

16. It will be found advantageous to cut a very slight lead on to the bottom edges of side seals as this will prevent them from folding under the cap during fitting, thus causing an oil leak due to the cap not seating properly. Lubricate seals with Silicone MS4 Compound.

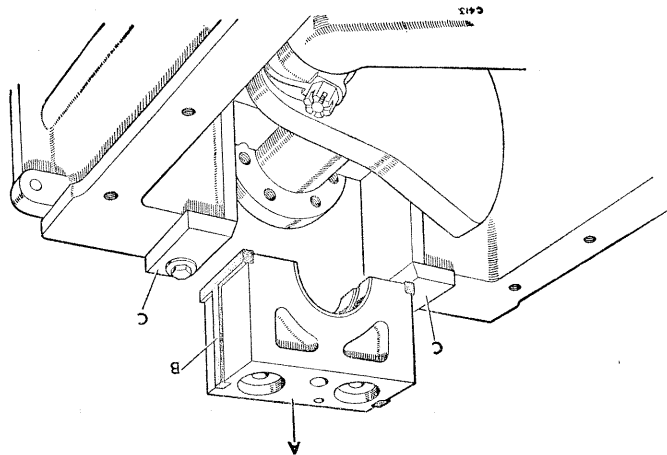


Fig. A-44—Fitting rear bearing cap and seal assembly  
A—Bearing cap B—Seal C—Lead tool

Connecting rod checks  
Operation A/122

1. Check that the connecting rods and caps have not been filed as follows:

2. Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.

3. Assemble the connecting rods, less shell bearings, with corresponding numbers together.

6. To the rear main bearing cap fit neoprene seals in recess at each side.

7. Preparatory work. This preparatory work is essential when fitting the seal to a new crankshaft and desirable when fitting to a crankshaft which has been in service. To ensure efficient lubrication during the initial running-in period of the oil seal, the crankshaft oil seal journal must be treated with a mixture of molybdenum disulphide and Butyl acetate as detailed below:

- (a) Thoroughly stir the mixture immediately prior to use.
- (b) Degrease the crankshaft oil seal journal.
- (c) Paint mixture evenly on to the surface of the oil seal journal with a fine brush; alternatively, if a quantity of crankshafts are being done, it can be sprayed on with a gravity feed spray gun, using 40 lb./sq.in. (2,8 kg/cm<sup>2</sup>) air-line pressure. This solution, which must be dry before the seal is fitted, takes approximately 10 minutes to dry, and the surface must not be scratched after treatment. On crankshafts which have been previously run the solution will take 15 minutes to dry thoroughly. A warm air stream may be used to reduce these times if necessary.

8. Bolt the cylinder block half of the oil seal firmly on to the block by the three bolts. With five-bolt fixing seals leave the two bolts adjacent to the split line loose.

Bolt the other half of the oil seal to the rear main bearing cap in the same manner.

9. Refit the crankshaft, first lubricating the journals, bearing shells and thrust bearings.

10. The groove in each half of the oil seal is to be half filled with Silicone MS4 Compound, ensuring no grease reaches the split line face.

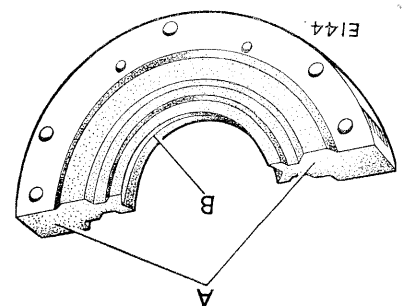


Fig. A-43—Rear crankshaft oil seals  
A—Apply 'Heldite' jointing compound at this face.  
B—Fill groove with Silicone MS4 Compound

Procedure

(0,025 to 0,050 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,007 to 0,012 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.

3. The gudgeon pin, when cold and dry, should be an easy sliding fit in the connecting rod.

The gudgeon pin should be fitted to the piston with the piston warmed to 120°-140°F, and should be an easy hand fit.

If the piston is not warmed to within this range, the pin may "pick up" on the piston bores, and will rattle when the engine is at normal running temperature.

4. Fit the connecting rods to the pistons with the oil spray hole of the rod facing the same side of the cylinder block as the camshaft.

5. Turn the crankshaft until the crankpins relative to numbers 1 and 4 cylinders are at B.D.C. Insert the connecting rods and pistons for these cylinders from the top of cylinder block, with the oil spray hole in connecting rod towards the cam-right-hand side of engine—towards the camshaft. Secure the big-ends to crankpins, using new bolts and nuts; tightening nuts to 35 lb/ft (4 mkg), for machined threads and 25 lb/ft (3,5 mkg) for bolts with rolled threads (identified by a drill point at the nut end).

6. Repeat Item 5 for numbers 2 and 3 cylinders.

### Camshaft, to refit

When replacing camshafts it should be noted that 2½ litre petrol engine camshafts are marked "petrol" between No. 1 and No. 2 cam lobes. This is to differentiate between diesel and petrol camshafts, which look similar in all respects except for the positioning of the cam lobes.

1. Insert the camshaft—keyed end to extend at front of engine.

2. Fit the front thrust plate and secure the camshaft chainwheel but do not bend up the locking tab for securing bolt at this stage.

Check the camshaft end-float with a dial test indicator as illustrated by Fig. A-46 and ensure that the reading is within .0025 to .0055 in. (0,063 to 0,139 mm).

Adjust by selective assembly of the front thrust plate.

3. Refit the camshaft rear end cover.

4. Tighten the securing bolts, then slacken one of them right off and check that there is no clearance at the joint face.

If there is a clearance, this indicates that the connecting rods or caps have been filed, and the assemblies must be replaced.

### Connecting rod bearing nip Operation A/124

1. Check the bearing nip as follows:—

2. Fit the bearing shells and tighten both securing bolts—slacken one bolt as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,05 to 0,10 mm).

3. The nip can be corrected by selective assembly of the bearing shells; these are available in slightly varying thickness. Do not file the rod or cap.

4. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct clearance.

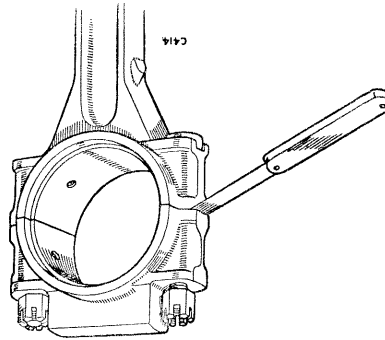


Fig. A-45—Checking big-end bearing nip

5. The connecting rod should resist rotation when a .0025 in. (0,063 mm) shim paper is fitted between the crankpin and one-half of big-end bearing shell, then move freely by hand when the shim paper is removed. Adjust by selective assembly of bearing shells.

6. Bearing clearance should be .001 to .0025 in. (0,025 to 0,063 mm).

7. Check the connecting rod end-float on crankpin by inserting a feeler gauge between the end face of rod and the crankpin shoulder. End-float should be .007 to .011 in. (0,17 to 0,27 mm).

8. Remove the connecting rods from crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

### Connecting rods and pistons, to refit

Operation A/126

1. The oil hole in gudgeon pin bush is pre-drilled and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in.

4. Fit tappet into the guide and locate on to the roller. The tappet is marked "Front" and must be facing the front of the guide.
5. Fit the tappet locating screws and washers; the locating screws must be screwed up with the fingers and then tightened; if they are not free, remove and investigate reason.
6. Lock the locating screws in pairs, using 20 s.w.g. iron wire.

**Flywheel housing, flywheel and clutch, to replace**

1. Ensure that the rear main bearing oil seal is in good condition, then secure the flywheel housing to cylinder block. See note regarding drain plug at end of section.

2. Fit the flywheel and tighten the securing bolts to 50 lb/ft (7 mkg) torque.

3. Check the run-out on flywheel face as illustrated in Fig. A-48. The run-out on flywheel face must not exceed .002 in. (0,050 mm).

4. Ensure that the clutch disc splines are clean, and will slide on every one of the primary shaft splines.

5. Fit the clutch assembly to the flywheel, using an old primary shaft to ensure that the clutch disc is central with the flywheel bush.

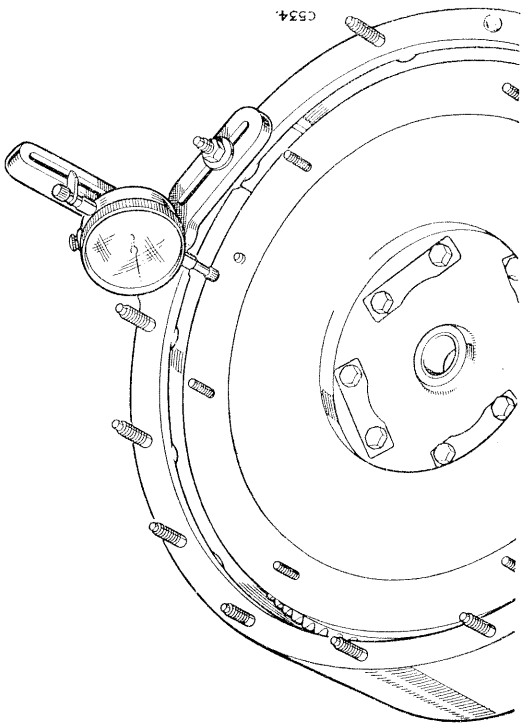


Fig. A-48—Checking run-out on flywheel face

**Cylinder head, valves and rocker shaft, to overhaul**  
 Operation A/134  
 1. If necessary remove the inlet and exhaust manifold assembly and thermostat.

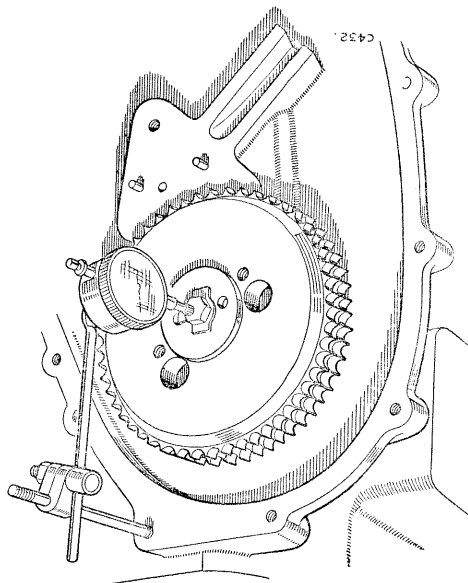


Fig. A-16—Checking camshaft end-float

- Tappet assembly, to replace** Operation A/130
1. Before fitting the tappet assembly into the block, thoroughly clean all parts and check that the tappet will move freely in the tappet guide when held in the hand and shaken up and down.
  2. Fit tappet guides into the cylinder block, ensuring that the locating hole lines up with the hole in the cylinder block. The tappet guides must not be too tight in the block or they may be damaged by insertion of the locating screw in cases when they are not properly aligned.
  3. Gently insert the roller into the guide. Do not drop the roller, as it is easily damaged.

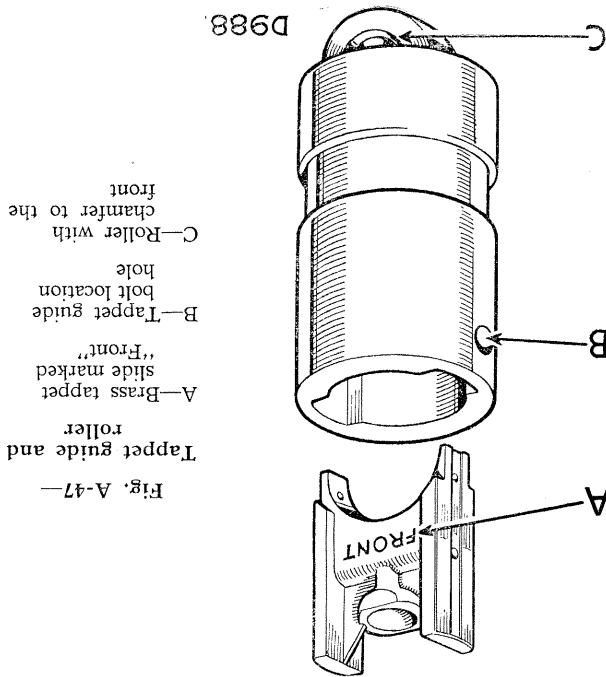


Fig. A-47—



When cutting the valve seats do not use excessive weight on the tool as this will cause the cutter to judder and thus ruin the seating.

Seat angle, inlet	....	30°
Seat angle, exhaust	....	45°

3. Using a little grinding paste, lap the new or reground valves into the seatings.

4. When lapping is completed, thoroughly wash the cylinder head and valves in paraffin, to remove all traces of grinding paste. Retain the valves in their original order.

5. Fit a new rubber seal into each valve guide, noting that the larger diameter seals must be fitted to the exhaust valve guides.

6. Lubricate the valve stem and fit the valves, springs, cups and split cotters, ensuring that the components are retained in their original sets and positions.

**A new valve seal must be fitted whenever a valve is removed.**

The valve springs have an interference fit of .005 in. If the inner spring will slide through the outer spring both must be renewed.

7. Refit the manifolds to the cylinder head, using a new gasket. Tighten all securing nuts evenly, to ensure alignment of the gasket faces.

8. Test the thermostat before refitting to cylinder head, by immersing in hot water. Expansion should commence between 164°F and 173°F and be complete at 193°F.

Insert the thermostat with rubber "O" ring in the housing in cylinder head and fit the joint washer and cover.

### Rocker shaft, to overhaul Operation A/136

1. If necessary, press new bushes into the rockers. The oil holes in the rocker bushes are pre-drilled and care must be taken to ensure that the oil holes of bush and rocker will align when pressed into position.

2. Reamer the bush to .530 in. +.001 (13,4 mm + 0,02) to obtain the correct clearance. The reamer and rocker assembly must be held in such a manner as to ensure the correct alignment of the reamed hole.

3. Align the rocker shafts, with the bored ends together, and slide a support bracket on to each shaft. The locating hole in each bracket must be positioned immediately above the chamfered

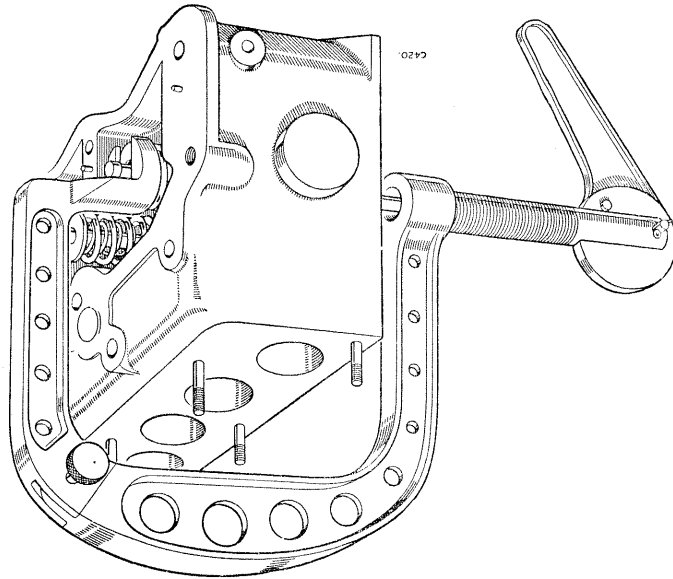


Fig. A-49—Compressing valve springs

2. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.

3. If necessary drift the valve guides from the cylinder head, using tool Part No. 274401 (exhaust) and 274400 (inlet).

4. Pull the new inlet and exhaust valve guides into position, using tool Part No. 274406.

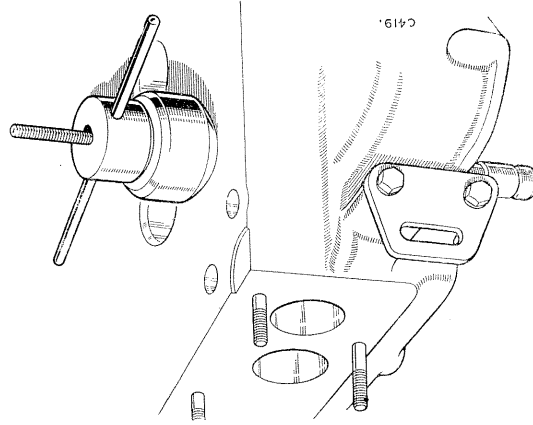


Fig. A-50—Fitting valve guides

1. It is necessary to remove the very hard crust of carbon from the valve seats with a piece of emery cloth before attempting to reface them as personal injury can be caused by flying fragments of hard carbon.

2. Reface the valve seats, using Standard Workshop Vibro-Centric equipment. Always ensure that the cutting angle is correct and dress the stone before use.

### Valve seats, to renovate Operation A/135

1. Turn the crankshaft in direction of rotation until the E.P. mark on flywheel is in line with the timing pointer.
2. Rotate the camshaft until the dwell of the cam serving the exhaust valve for No. 1 cylinder is nearest the tappet and set the tappet clearance to .010 in. (0,25 mm).

3. Assemble the remaining components with the plugged end of the shafts in the end brackets and the bored end of both shafts located in the centre bracket.
4. The screwed plug and ball may be removed from the piston if necessary and the piston pressed from its housing if unduly worn.
5. The tensioner cylinder and bush must be renewed complete if the bush is unduly worn.
6. The bushes in idler wheel and ratchet arm should also be removed if worn beyond reasonable limits.
7. If removed, fit the crankshaft chainwheel on to shaft and key.

**Cylinder head and rocker shaft, to replace**  
Operation A/138

1. Smear the joint face of cylinder block and gasket and cylinder head assembly to cylinder block.
2. Locate head and gasket with the securing bolts, fitting all bolts except those which also secure the rocker shaft pedestals, but do not tighten at this stage.
3. Insert the push-rods into their original positions, through cylinder head and locate in the tappets.
4. Slacken off all tappet adjusting screws and offer the rocker assembly to cylinder head. Fit the bracket securing bolts, but do not tighten.
5. Tighten down the cylinder head bolts in the order indicated by Fig. A-51. The ½ in. U.N.F. bolts, including those that also secure the rocker brackets, must be pulled down to 65 lb/ft (9,9 mkg) whilst the ⅜ in. U.N.F. bolts securing the rocker brackets only are pulled down to 12 lb/ft (1,66 mkg).

6. Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chain-wheel and timing casing to record the position.
7. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.

8. Fit a dial test indicator so that the "fully open" position of the valve can be ascertained in the following manner:—
9. Turn the camshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chain-wheel and timing casing to record the position.
10. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.

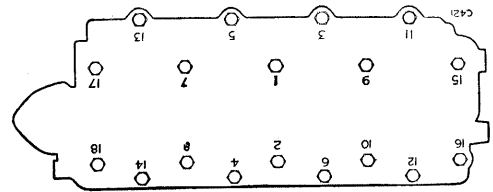


Fig. A-51—Order of tightening cylinder head bolts

**Chainwheels, timing chain, adjuster and valve timing**  
Operation A/140

1. The screwed plug and ball may be removed from the piston if necessary and the piston pressed from its housing if unduly worn.
2. The tensioner cylinder and bush must be renewed complete if the bush is unduly worn.
3. The bushes in idler wheel and ratchet arm should also be removed if worn beyond reasonable limits.
4. If removed, fit the crankshaft chainwheel on to shaft and key.

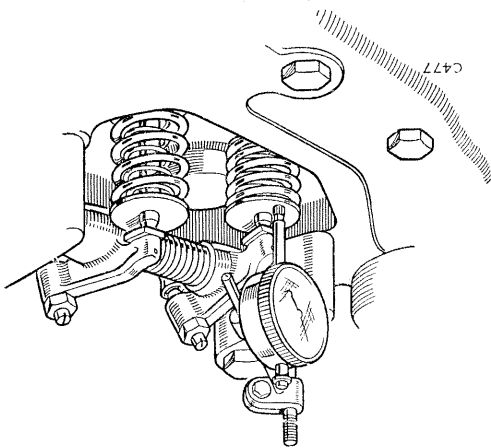
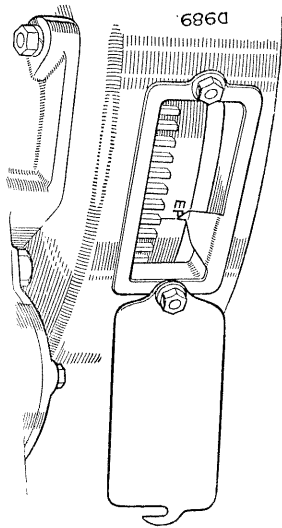
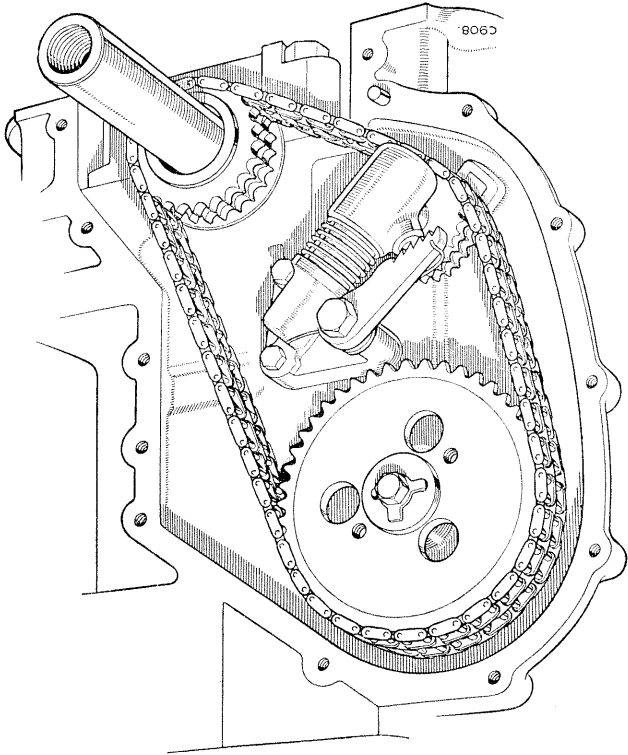


Fig. A-53—Checking exhaust valve "fully open" position

Fig. A-52—Timing pointer



16. Lock the set bolt securing camshaft chain-wheel when timing has been set satisfactorily.



Operation A/142 Front cover, to replace

1. Examine the crankshaft oil seal and replace if necessary, using a little sealing compound on the outside of the seal.

2. Position new joint washers and fit the front cover.

Operation A/144 Fan driving pulley, to replace

1. Examine the hub of the pulley for excessive wear, and if necessary fit a replacement.

2. Locate the pulley on the crankshaft and key, then secure with the locking washer and starting dog.

Vertical drive shaft gear, to assemble

Operation A/146

1. Fit the circlip to groove dividing the upper and lower internal splining and enter the tapered splined plug in the end furthest from gear teeth, small end first.

2. Drift the plug into the gear until it abuts on the circlip.

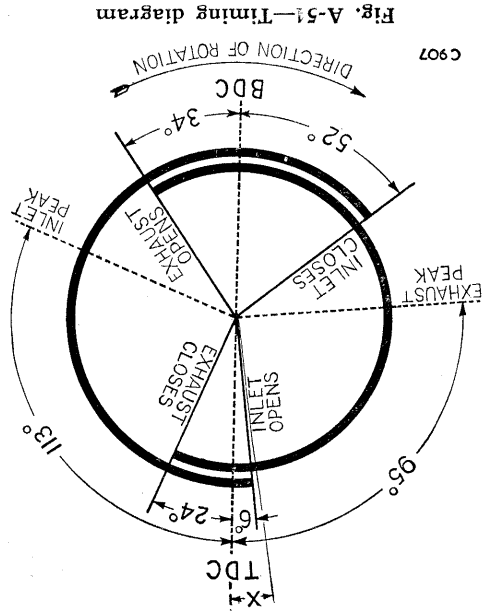
3. Lubricate the split bush and fit it to the gear with the reduced diameter nearest the teeth.

10. Mark the chainwheel at a point opposite to the mark on timing casing and make a third mark on the chainwheel, exactly between those made previously.

11. Turn the camshaft against direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.

12. Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chainwheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned.

13. Fit new bushes to the chain tensioner components as necessary; ensure that the fit and clearances are in accordance with those laid down in the Data Section. Position the ball in chain tensioner piston and secure with the retaining clip. Fit the compression spring over piston, locate the cylinder assembly, compress the spring and retain in compressed position. Place the idler wheel on bearing arm and offer the assembly to the cylinder block, locating by means of the dowels. Screw the stepped bolt with ratchet and spring in position into cylinder block, then finally secure with two set bolts. Remove the spring compressing clip and allow the idler wheel to take up the chain slack.



14. Turn the flywheel against direction of rotation approx. 90°, then slowly in direction of rotation, checking that the exhaust valve reaches the "fully open" position, as indicated by the dial test indicator, exactly when the "E.P." mark on flywheel is in line with the pointer on flywheel housing.

15. Adjust if necessary by means of the six irregularly spaced keyways in the timing chain-wheel. This arrangement allows a variation of 2° between each position.

**Ignition timing and vertical drive gear, to replace**

1. Rotate the crankshaft in direction of rotation until the 3° mark on the flywheel, using regular fuels, or 6° mark, using premium fuels, is in line with the pointer on the flywheel housing and both valves of number 1 cylinder are closed.

2. Locate the vertical drive shaft so that with the short distributor drive shaft entered into the splines, the narrow segment of the distributor drive shaft is toward the R.H. side of the vehicle and the slot pointing toward number 1 cylinder. Lock the driving gear assembly in position with a grub screw.

3. Locate and secure the aluminium adaptor plate. 4. Locate a cork washer in the recess in top of adaptor plate.

5. Check the distributor contact breaker gap and adjust to .012 to .014 in. (0,35 to 0,40 mm). Set the octane selector so that the fourth line from L.H. side of the calibrated slide is against the face of the distributor body casting.

6. Rotate the distributor spindle in direction of arrow on rotor arm until the rotor is at the firing point for number 1 cylinder. With the vacuum unit facing rearward, the narrow segment of the distributor shaft should be toward the R.H. side of the vehicle and the slot pointing toward number 1 cylinder.

7. Mount the distributor and secure to distributor adaptor plate.

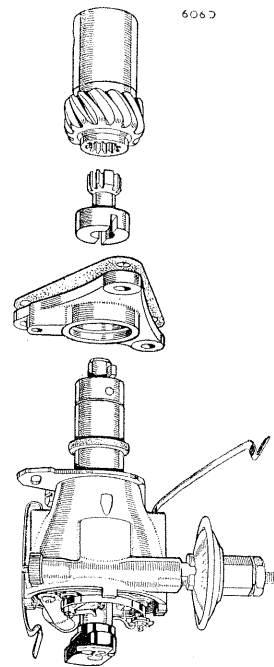


Fig. A-56—Distributor, adaptor and driving gear

8. Slacken the pinch bolt in base of distributor body and rotate the distributor in opposite direction to arrow on rotor arm until the contactor breaker points are just opening with the cam follower on the leading side of the cam. Re-tighten the pinch bolt.

9. Connect one lead of a 12 volt test lamp to the distributor L.T. terminal and the other one to a good earth on engine. Switch ignition 'on' and turn the crankshaft two revolutions in direction of rotation. The bulb should light as the pointer on flywheel housing comes into line with the predetermined mark on flywheel. See item 1.

10. Adjust as required by slackening the pinch bolt and turning the distributor bodily, or for fine adjustment, by means of the vernier screw.

**Oil pump**

See Section AO for overhaul of oil pump.

1. Insert the longer splined end of driving shaft into the pump and locate in the driving gear.

2. With the inlet port rearward, and the splined upper end of driving shaft aligned to the vertical drive gear, offer the pump to engine and secure in position.

No provision is made for oil pressure adjustment.

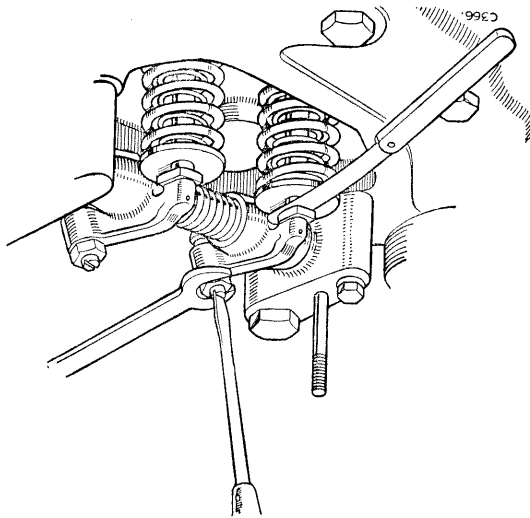


Fig. A-57—Adjusting tappets

**Tappet adjustment**

Operation A/152

1. Turn the crankshaft in direction of rotation until number 8 valve (counting from front end of engine) is fully open. In this position the tappet for number 1 valve is on the dwell of its cam and the tappet clearance may be set with a .010 in. (0,25 mm) feeler inserted between the rocker and valve stem. Recheck the clearance after tightening the locknut.

**Thermostatically controlled hot spot**  
 The hot spot, located in the centre of the exhaust manifold, see Fig. A-58, is accurately adjusted before the vehicle leaves the factory and should not require any further attention, but if after a very long period of service, it becomes necessary to alter the setting, the operation should be carried out as detailed below:—

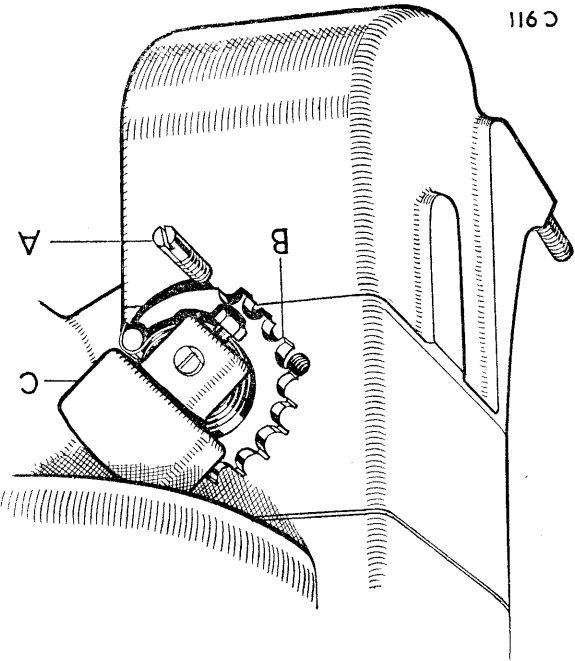


Fig. A-58—Hot spot adjustment

A—Set screw B—Adjustment plate C—Balance weight

**Operation A/158**

**To adjust**

1. Remove the retaining set screw 'A' and turn the serrated adjustment plate 'B', in an anti-clockwise direction until the balance weight 'C' is just supported.
2. Replace the retaining set screw, selecting the appropriate serration, and tighten.

**Operation A/160**

**Engine—to refit**

1. Reverse the removal procedure—fit new mounting rubbers if necessary.
2. Refill with lubricating oil, 11 Imperial pints, 13 U.S. pints (6,0 litres) and coolant, 17½ Imperial pints, 20½ U.S. pints (9,75 litres).
3. See Section M for details of carburetter setting.
4. Check for oil and coolant leaks—rectify as necessary.

The tappets should be set in the following order:  
 Set No. 1 tappet with No. 8 valve fully open.  
 Set No. 3 tappet with No. 6 valve fully open.  
 Set No. 5 tappet with No. 4 valve fully open.  
 Set No. 2 tappet with No. 7 valve fully open.  
 Set No. 8 tappet with No. 1 valve fully open.  
 Set No. 6 tappet with No. 3 valve fully open.  
 Set No. 4 tappet with No. 5 valve fully open.  
 Set No. 7 tappet with No. 2 valve fully open.

**Water pump fitment to front cover**

1. Renew the joint washer, then locate and secure the pump to front cover.

**Operation A/154**

**Externals**

1. Fit the oil filter assembly and joint washer.

2. Secure the breather pipe and oil filler assembly, complete with baffle plate, where fitted, and joint washers over the forward tappet chamber aperture and steady bracket, to top of cylinder block.
3. Mount and secure the petrol pump and cover plate assembly over the rear tappet chamber aperture.
4. Fit the starter motor and dynamo.

5. Fit the dynamo driving belt and adjust the tension to allow the belt to move  $\frac{1}{16}$ — $\frac{1}{8}$  in. (4—6 mm) when pressed by thumb between the crankshaft and water pump pulleys.

6. Connect the oil feed pipe and pressure gauge assembly between cylinder head and cylinder block rear end.
7. Secure the coolant pipe to thermostat and water pump casings.
8. Position the joint washer and fit the rocker and valve gear cover.
9. Fit the oil sump.
10. Fit the exhaust and inlet manifold assemblies.
11. Fit the sparking plugs and connect leads between plugs and distributor.
12. Fit the carburetter and connect the vacuum pipe between carburetter and distributor.

Fit petrol pipe between pump and carburetter.

OVERHAULS TO ENGINE IN CHASSIS

Rocker shaft, to overhaul, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 5
A-22	A/84	As necessary
A-23	A/94	All
A-30 and 32	A/134 and A/138	All
A-34	A/148	As necessary
A-34	A/152	All
A-35	A/156 and A/158	As necessary

Timing chain, tensioner or front cover oil seal, to renew, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 10
A-23	A/90 and A/92	All
A-24	A/100	All
A-32	A/140 to A/144	All
A-34	A/148	As necessary
A-34	A/152 to A/160	As necessary

Camshaft or roller tappets, to renew, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 10
A-22	A/84	As necessary
A-23	A/90 to A/102	All

CAMSHAFT BEARINGS CANNOT BE RENEWED WHILEST THE ENGINE IS IN THE CHASSIS

Page	Operation	Items
A-29	A/128 and A/130	All
A-32	A/138 to A/148	All
A-34	A/152 and A/154	All
A-35	A/154 to A/160	As necessary

Reboring, renewing pistons, rings, little ends or big-end bearings, carry out the following operations:

Page	Operation	Items
A-22	A/82	1 to 5
A-22	A/84	As necessary
A-23	A/88	All
A-24	A/94	All
A-24	A/104	All
A-24	A/112 to A/116	All
A-28	A/122 to A/126	All
A-32	A/138	All
A-34	A/150	All
A-34	A/152	All
A-35	A/156 to A/160	As necessary

Flywheel housing drain plug

The drain plug should not be fitted to the housing, unless the vehicle is expected to operate under very muddy conditions, or to wade. The plug should be screwed into the stowage bracket fitted to later models, or stored in the tool locker.

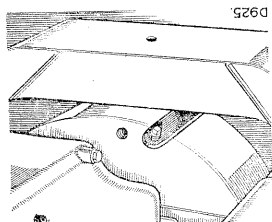


Fig. A-59—Flywheel housing drain plug and stowage bracket

Section	Operation	Items
Section AO	Oil pump and filters	As necessary
Section L	Water pump and thermostat	1
Section B	Flywheel and clutch	All
Section P	Starter, dynamo and distributor	All
Section M	Carburettor and petrol pump	As necessary

DEFECT LOCATION

(Symptom, Cause and Remedy)

- A—ENGINE FAILS TO START**  
 1. Incorrect starting procedure—See *Instruction Manual*.  
 2. Starter motor speed too low—Check battery and connections.  
 3. Faulty ignition system—Section P.  
 4. Faulty coil or condenser—Renew.  
 5. Carburetter flooding—Section M.  
 6. Defective fuel pump—Section M.  
 7. Defective starter motor—Section P.  
 8. Starter pinion jammed in flywheel—Rotate starter shaft with spanner to free pinion.  
 9. Starter pinion not engaging—Clean drive sleeve and pinion with paraffin.
- B—ENGINE STALLS**  
 1. Low idling speed—Section M.  
 2. Faulty sparking plugs—Rectify.  
 3. Faulty coil or condenser—Renew.  
 4. Faulty distributor points—Rectify or renew. Section P.  
 5. Incorrect tappet clearance—Adjust.  
 6. Incorrect mixture—Adjust carburetter. Section M.  
 7. Foreign matter in fuel system—Rectify. Section M.
- C—LACK OF POWER**  
 1. Poor compression—If the compression is appreciably less than the correct figure, (Page A-34) the piston rings or valves are faulty. Decarbonate and grind in valves.  
 2. Badly seating valves—Rectify or renew.  
 3. Faulty exhaust silencer—Renew. Section N.  
 4. Incorrect ignition timing—Rectify. Section P.  
 5. Leaks or restrictions in fuel system—Section M.  
 6. Faulty sparking plugs—Rectify.  
 7. Clutch slip—Section B.  
 8. Excessive carbon deposit—Decarbonate.  
 9. Brakes binding—Section H.  
 10. Faulty coil, condenser or battery—Section P.
- D—ENGINE RUNS ERRATICALLY**  
 1. Faulty electrical connections—Rectify.  
 2. Defective sparking plugs—Rectify.  
 3. Low battery charge—Recharge battery. Section P.  
 4. Defective distributor—Rectify. Section P.  
 5. Foreign matter in fuel system—Section M.  
 6. Faulty fuel pump—Section M.  
 7. Sticking valves—Rectify or renew.  
 8. Incorrect tappet clearance—Adjust.  
 9. Defective valve springs—Renew.  
 10. Incorrect ignition timing—Rectify.  
 11. Worn valve guides or valves—Renew.  
 12. Faulty cylinder head gasket—Renew.  
 13. Damaged exhaust system—Rectify or renew.
- E—ENGINE STARTS, BUT STOPS IMMEDIATELY**  
 1. Faulty electrical connections—Rectify low tension circuit.  
 2. Foreign matter in fuel system—Section M.  
 3. Faulty fuel pump—Section M.  
 4. Low fuel level in tank—Replenish.
- F—ENGINE FAILS TO IDLE**  
 1. Incorrect carburetter setting—Section M.  
 2. Faulty fuel pump—Section M.  
 3. See defect D, 7-12.  
 4. See defect D, 1-4.
- G—ENGINE MISFIRES ON ACCELERATION**  
 1. Distributor points incorrectly set—Rectify. Section P.  
 2. Faulty coil or condenser—Renew.  
 3. Faulty sparking plugs—Rectify.  
 4. Faulty carburetter—Section M.
- H—ENGINE KNOCKS**  
 1. Ignition timing advanced—Adjust.  
 2. Excessive carbon deposit—Decarbonate.  
 3. Incorrect carburetter setting—Section M.  
 4. Unsuitable fuel—Adjust octane selector.  
 5. Worn pistons or bearings—Renew.  
 6. Distributor advance mechanism faulty—Rectify. Section P.  
 7. Defective sparking plugs—Rectify or renew.  
 8. Incorrect tappet clearance—Adjust.  
 9. Incorrect valve timing—Adjust.
- J—ENGINE BACKFIRES**  
 1. Ignition defect—Section P.  
 2. Carburetter defect—Section M.  
 3. Incorrect valve timing—Adjust.  
 4. Incorrect tappet clearance—Adjust.  
 5. Sticking valve—Rectify.  
 6. Weak valve springs—Renew.  
 7. Badly seating valves—Rectify or renew.  
 8. Excessively worn valve stems and guides—Renew.  
 9. Loose timing chain—Rectify tensioner.  
 10. Excessive carbon deposit—Decarbonate.
- K—BURNED VALVES**  
 1. Insufficient tappet clearance—Adjust.  
 2. Sticking valves—Rectify.  
 3. Weak valve springs—Renew.  
 4. Excessive deposit on valve seats—Re-cut.  
 5. Distorted valves—Renew.
- L—NOISY VALVE MECHANISM**  
 1. Excessive tappet clearance—Adjust.  
 2. Sticking valves—Rectify.  
 3. Weak valve springs—Renew.  
 4. Faulty valve mechanism—Renew worn parts.
- M—MAIN BEARING RATTLE**  
 1. Low oil pressure—See N.  
 2. Excessive bearing clearance—Renew bearings; grind crankshaft.  
 3. Burnt-out bearings—Renew.  
 4. Loose bearing caps—Tighten.
- N—LOW OIL PRESSURE**  
 1. Thin or diluted oil—Refill with correct oil.  
 2. Low oil level—Replenish.  
 3. Choked pump intake filter—Clean.  
 4. Faulty release valve—Rectify.  
 5. Excessive bearing clearance—Rectify.  
 6. Excessive camshaft bearing clearance—Rectify.  
 7. Loose or restricted oil line—Rectify.
- Capacity (piston displacement)** ..... 2,286 cc. (140 cu.in.)  
**Number of cylinders** ..... 4  
**Bore** ..... 3.562 in. (90.47 mm)  
**Stroke** ..... 3.5 in. (88.8 mm)  
**Compression ratio** ..... 7 : 1  
**B.H.P. at 4,250 R.P.M.** ..... 77  
**B.M.E.P. at 2,500 R.P.M.** ..... 134 lb/sq. in. (9,421 Kg/cm<sup>2</sup>)  
**Maximum torque** ..... 124 lb/ft. (17 mKg) at 2,500 R.P.M.  
**Firing order** ..... 1 3 4 2  
**Piston speed at 4,280 R.P.M.** ..... 2,500 ft./min. (12.6 m/sec.)  
**Compression pressure at starter motor cranking speed, with engine hot** 145 lb./sq.in. (10.2 Kg/cm<sup>2</sup>)

GENERAL DATA

DETAIL DATA

Camshaft		Camshaft bearings		Connecting rods		Crankshaft	
Journal diameter	1.842 in.—.001	Journal diameter	2.5 in.—.001	Journal diameter	2.5 in.—.001	Journal diameter	2.5 in.—.001
Clearance in bearing	.001 to .002 in.	Clearance in bearing	.001 to .002 in.	Clearance in bearing	.001 to .002 in.	Clearance in bearing	.001 to .002 in.
End-float	.0025 to .005 in.	End-float	.0025 to .005 in.	End-float	.0025 to .005 in.	End-float	.0025 to .005 in.
Cam lift—inlet	.257 in. (6,53 mm)	Cam lift—inlet	.257 in. (6,53 mm)	Cam lift—inlet	.257 in. (6,53 mm)	Cam lift—inlet	.257 in. (6,53 mm)
Cam lift—exhaust	.257 in. (6,53 mm)	Cam lift—exhaust	.257 in. (6,53 mm)	Cam lift—exhaust	.257 in. (6,53 mm)	Cam lift—exhaust	.257 in. (6,53 mm)
Type	Split, steel backed, white metal lined	Type	Split, steel backed, white metal lined	Type	Split, steel backed, white metal lined	Type	Split, steel backed, white metal lined
Internal diameter (line-reamed in position)	1.843 in. +.0005	Internal diameter (line-reamed in position)	1.843 in. +.0005	Internal diameter (line-reamed in position)	1.843 in. +.0005	Internal diameter (line-reamed in position)	1.843 in. +.0005
Bearing fit on crankpin	.001 to .0025 in.	Bearing fit on crankpin	.001 to .0025 in.	Bearing fit on crankpin	.001 to .0025 in.	Bearing fit on crankpin	.001 to .0025 in.
Bearing nip	.002 to .004 in.	Bearing nip	.002 to .004 in.	Bearing nip	.002 to .004 in.	Bearing nip	.002 to .004 in.
End-float at big-end	.007 to .011 in.	End-float at big-end	.007 to .011 in.	End-float at big-end	.007 to .011 in.	End-float at big-end	.007 to .011 in.
Gudgeon pin bush, fit in small-end	.001 to .002 in.	Gudgeon pin bush, fit in small-end	.001 to .002 in.	Gudgeon pin bush, fit in small-end	.001 to .002 in.	Gudgeon pin bush, fit in small-end	.001 to .002 in.
Gudgeon pin bush internal diameter—reamed in position	1.000 in. +.0005	Gudgeon pin bush internal diameter—reamed in position	1.000 in. +.0005	Gudgeon pin bush internal diameter—reamed in position	1.000 in. +.0005	Gudgeon pin bush internal diameter—reamed in position	1.000 in. +.0005
Fit of gudgeon pin in bush	.0003 to .0005 in.	Fit of gudgeon pin in bush	.0003 to .0005 in.	Fit of gudgeon pin in bush	.0003 to .0005 in.	Fit of gudgeon pin in bush	.0003 to .0005 in.
Clearance	.001 to .002 in.	Clearance	.001 to .002 in.	Clearance	.001 to .002 in.	Clearance	.001 to .002 in.
Journal diameter	2.490 in.	Journal diameter	2.490 in.	Journal diameter	2.490 in.	Journal diameter	2.490 in.
Under-size	(0,254 mm)	Under-size	(0,254 mm)	Under-size	(0,254 mm)	Under-size	(0,254 mm)
Regrind sizes	2.115 in.	Regrind sizes	2.115 in.	Regrind sizes	2.115 in.	Regrind sizes	2.115 in.
Crankpin dia.	(53,721 mm)	Crankpin dia.	(53,721 mm)	Crankpin dia.	(53,721 mm)	Crankpin dia.	(53,721 mm)
Journal dia.	2.480 in.	Journal dia.	2.480 in.	Journal dia.	2.480 in.	Journal dia.	2.480 in.
End-float (controlled by thrust washers at centre bearing)	.002 to .006 in.	End-float (controlled by thrust washers at centre bearing)	.002 to .006 in.	End-float (controlled by thrust washers at centre bearing)	.002 to .006 in.	End-float (controlled by thrust washers at centre bearing)	.002 to .006 in.
Clearances on crank-shaft journal	.001 to .0025 in.	Clearances on crank-shaft journal	.001 to .0025 in.	Clearances on crank-shaft journal	.001 to .0025 in.	Clearances on crank-shaft journal	.001 to .0025 in.
Bearing nip	.004 to .006 in.	Bearing nip	.004 to .006 in.	Bearing nip	.004 to .006 in.	Bearing nip	.004 to .006 in.
Oil pump assembly	See Section AO.	Oil pump assembly	See Section AO.	Oil pump assembly	See Section AO.	Oil pump assembly	See Section AO.

Flywheel	
Number of teeth	97
Thickness at pressure face	1.515—.015 in.
Maximum permissible run-out on flywheel face	.002 in. (0,05 mm)
Primary pinion bush fit in flywheel	.001 to .003 in.
Internal diameter—reamed in position	.875 in. +.002
Fit of shaft in bush	.001 to .003 in.
Maximum refacing depth	.030 in. (0,76 mm)
Minimum thickness after grinding	1.485 in. (37,7 mm)

Markings	
T.D.C.	When opposite pointer, No. 1 piston is at top dead centre
E.P.	When opposite pointer, No. 1 exhaust valve should be fully open.
3° (Regular fuels)	When opposite pointer, indicates firing point of No. 1 cylinder when both valves are closed.
6° (Premium fuels)	When opposite pointer, indicates firing point of No. 1 cylinder when both valves are closed.

Gudgeon pin	
Fit in piston	Zero to .0002 in. (0,005 mm) interference
Fit in connecting rod bush	.0003 to .0005 in. (0,0076 to 0,013 mm) clearance

Main bearings	
Clearances on crank-shaft journal	.001 to .0025 in. (0,02 to 0,06 mm)
Bearing nip	.004 to .006 in. (0,10 to 0,15 mm)



<b>Pistons</b>	Type	Light alloy, tin plated, flat top
	Clearance in bore, measured at bottom of skirt at right angles to gudgeon pin	.0023 to .0028 in. (0,058 to 0,071 mm)
	Clearance in bore, measured at top of skirt at right angles to gudgeon pin	.0035 to .004 in. (0,89 to 0,10 mm)
	Fit of gudgeon pin in piston	Zero to .0002 in. (0,005 mm) interference
	Gudgeon pin bore	.9998 in + .002 (25,37 mm + 0,05)
<b>Piston rings</b>	Compression (2)	Type
	Gap in bore	.015 to .020 in. (0,38 to 0,50 mm)
	Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)
<b>Scrapper</b>	Type	Slotted, square friction edge
	Gap in bore	.015 to .020 in. (0,38 to 0,50 mm)
	Clearance in groove	.0005 to .002 in. (0,012 to 0,05 mm)
<b>Rocker gear</b>	Bush internal diameter, reamed in position	.53 in. + .001 (13,4 mm + 0,02)
	Shaft clearance in rocker bush	.001 to .002 in. (0,02 to 0,05 mm)
	Tappet clearance	.010 in. (0,25 mm) hot or cold
<b>Timing chain tensioner</b>	Fit of bush in cylinder	.003 to .005 in. (0,07 to 0,12 mm) interference
	Fit of bush in idler wheel	.001 to .003 in. (0,02 to 0,07 mm) interference
	Fit of idler wheel on steel shaft	.001 to .003 in. (0,02 to 0,07 mm) clearance
	Fit of piston in cylinder bush	.0005 to .001 in. (0,001 to 0,02 mm) clearance
<b>Thrust bearings, crankshaft</b>	Type	Semi-circular, steel back, tin plated on friction surface
	Standard size, total thickness	.093 in. — .002 (2,362 mm — 0,05)
	Oversizes	.0025 in. (0,06 mm) .005 in. (0,12 mm) .0075 in. (0,18 mm) .010 in. (0,25 mm)
<b>Torque loadings</b>	Connecting rod bolts ( $\frac{8}{16}$ in. U.N.F.)	35 lb/ft (4,84 Kg/m) for bolts with machined threads and 25 lb/ft (3,5 Kg/m) for bolts with rolled threads (identical by a drill point at the nut end)
	Cylinder head bolts, special	65 lb/ft (8,98 Kg/m)
	Main bearing bolts ( $\frac{16}{16}$ in. U.N.F.)	85 lb/ft (11,75 Kg/m)
	Rocker shaft support bracket bolts ( $\frac{16}{16}$ in. U.N.F.)	12 to 13 lb/ft (1,66 to 1,80 Kg/m)
	Flywheel securing bolts	50 lb/ft (6,91 Kg/m)
<b>Valves</b>	Inlet valve	Diameter (stem) .312 in. — .001 (7,93 mm — 0,02) or .311 in. — .0005 (7,91 mm — 0,01) later type
	Face angle	30° — $\frac{1}{4}$
	Exhaust valve	Diameter (stem) .343 in. — .001 (8,73 mm — 0,02) or .342 in. — .0005 (8,70 mm — 0,01) later type
	Face angle	45° — $\frac{1}{4}$
	Fit of inlet and exhaust valves in guide	.001 to .003 in. (0,02 to 0,07 mm)
<b>Valve seat</b>	Seat angle—inlet	30°
	Seat angle—exhaust	45°
<b>Valve guides</b>	Inlet guide bore size, after fitting	.3125 in. + .0015 (7,93 mm + 0,04)
	Exhaust guide bore size, after fitting	.3435 in. + .0015 (8,73 mm + 0,04)

Valve timing		Valve springs—inlet		Valve springs—exhaust	
6° B.T.D.C.	Inlet opens	1.61 in. (40,89 mm)	Length—free	1.61 in. (40,89 mm)	Length—free
52° A.B.D.C.	Inlet closes	1.38 in. (35,1 mm)	Length under 17.5 lb (7,9 kg) load	1.37 in. (34,8 mm)	Length under 18.5 lb (8,3 kg) load
34° B.B.D.C.	Exhaust opens	1.76 in. (44,9 mm)	Length—free	1.76 in. (44,9 mm)	Length—free
24° A.T.D.C.	Exhaust closes	1.50 in. (38,3 mm)	Length under 46 lb (21 kg) load	1.49 in. (38 mm)	Length under 48 lb (21,76 kg) load
95°	Exhaust peak				
Vertical drive shaft gear		Inner		Outer	
.006 to .010 in. (0,15 to 0,25 mm)	Backlash	1.61 in. (40,89 mm)	Length—free	1.37 in. (34,8 mm)	Length—free
.001 to .003 in. (0,02 to 0,07 mm) clearance	Fit of gear in bush	1.61 in. (40,89 mm)	Length under 48 lb (21,76 kg) load	1.37 in. (34,8 mm)	Length under 48 lb (21,76 kg) load
1.00 in. +.001 (25,4 mm +0,02)	Internal diameter of bush	1.61 in. (40,89 mm)	Length—free	1.37 in. (34,8 mm)	Length—free

# Section A—ENGINE—2 LITRE—DIESEL

## INDEX TO OPERATIONS WITH ENGINE REMOVED

<table border="0"> <tr> <td>Page</td> <td>A-60—62</td> <td>.....</td> <td>Data</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-59</td> <td>.....</td> <td>Defect location</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-42—57</td> <td>.....</td> <td>Engine removal and replacement</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-42—57</td> <td>.....</td> <td>Engine, to overhaul, complete</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-52</td> <td>.....</td> <td>Hot plugs, to renew</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-55</td> <td>.....</td> <td>Injection pump timing</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-52</td> <td>.....</td> <td>Injector shrouds, to remove and refit</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-44—48</td> <td>.....</td> <td>Liners, to remove and refit</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-56</td> <td>.....</td> <td>Tappet adjustment</td> <td>.....</td> <td></td> </tr> <tr> <td></td> <td>A-53</td> <td>.....</td> <td>Valve timing</td> <td>.....</td> <td></td> </tr> </table>	Page	A-60—62	.....	Data	.....			A-59	.....	Defect location	.....			A-42—57	.....	Engine removal and replacement	.....			A-42—57	.....	Engine, to overhaul, complete	.....			A-52	.....	Hot plugs, to renew	.....			A-55	.....	Injection pump timing	.....			A-52	.....	Injector shrouds, to remove and refit	.....			A-44—48	.....	Liners, to remove and refit	.....			A-56	.....	Tappet adjustment	.....			A-53	.....	Valve timing	.....		<table border="0"> <tr> <td>Page</td> <td>A-44, 45—49</td> <td>.....</td> <td>Camshaft and bearings, to remove and refit</td> <td>.....</td> </tr> <tr> <td></td> <td>A-44—53</td> <td>.....</td> <td>Camshaft chainwheels, to remove and refit</td> <td>.....</td> </tr> <tr> <td></td> <td>A-44—48</td> <td>.....</td> <td>Connecting rods, bearings and pistons, to remove and refit</td> <td>.....</td> </tr> <tr> <td></td> <td>A-44—46</td> <td>.....</td> <td>Crankshaft, bearings and seals, to remove and refit</td> <td>.....</td> </tr> <tr> <td></td> <td>A-43—53</td> <td>.....</td> <td>Cylinder head and rocker shaft, to remove and refit</td> <td>.....</td> </tr> </table>	Page	A-44, 45—49	.....	Camshaft and bearings, to remove and refit	.....		A-44—53	.....	Camshaft chainwheels, to remove and refit	.....		A-44—48	.....	Connecting rods, bearings and pistons, to remove and refit	.....		A-44—46	.....	Crankshaft, bearings and seals, to remove and refit	.....		A-43—53	.....	Cylinder head and rocker shaft, to remove and refit	.....
Page	A-60—62	.....	Data	.....																																																																																		
	A-59	.....	Defect location	.....																																																																																		
	A-42—57	.....	Engine removal and replacement	.....																																																																																		
	A-42—57	.....	Engine, to overhaul, complete	.....																																																																																		
	A-52	.....	Hot plugs, to renew	.....																																																																																		
	A-55	.....	Injection pump timing	.....																																																																																		
	A-52	.....	Injector shrouds, to remove and refit	.....																																																																																		
	A-44—48	.....	Liners, to remove and refit	.....																																																																																		
	A-56	.....	Tappet adjustment	.....																																																																																		
	A-53	.....	Valve timing	.....																																																																																		
Page	A-44, 45—49	.....	Camshaft and bearings, to remove and refit	.....																																																																																		
	A-44—53	.....	Camshaft chainwheels, to remove and refit	.....																																																																																		
	A-44—48	.....	Connecting rods, bearings and pistons, to remove and refit	.....																																																																																		
	A-44—46	.....	Crankshaft, bearings and seals, to remove and refit	.....																																																																																		
	A-43—53	.....	Cylinder head and rocker shaft, to remove and refit	.....																																																																																		

THE INDEX TO OPERATIONS WITH ENGINE IN THE CHASSIS IS ON PAGE A-53

## LIST OF ILLUSTRATIONS

<table border="0"> <tr> <td>Page</td> <td>A-51</td> <td>.....</td> <td>Compressing valve springs</td> <td>.....</td> </tr> <tr> <td></td> <td>A-51</td> <td>.....</td> <td>Fitting valve guides</td> <td>.....</td> </tr> <tr> <td></td> <td>A-51</td> <td>.....</td> <td>Valve seat cutting tool</td> <td>.....</td> </tr> <tr> <td></td> <td>A-52</td> <td>.....</td> <td>Push-rod tube removal</td> <td>.....</td> </tr> <tr> <td></td> <td>A-52</td> <td>.....</td> <td>Correct position of push-rod tubes in relation to hot plugs</td> <td>.....</td> </tr> <tr> <td></td> <td>A-52</td> <td>.....</td> <td>Fitting push-rod tubes</td> <td>.....</td> </tr> <tr> <td></td> <td>A-53</td> <td>.....</td> <td>Order of tightening cylinder head bolts</td> <td>.....</td> </tr> <tr> <td></td> <td>A-53</td> <td>.....</td> <td>Timing pointer</td> <td>.....</td> </tr> <tr> <td></td> <td>A-54</td> <td>.....</td> <td>Checking exhaust valve "fully-open" position</td> <td>.....</td> </tr> <tr> <td></td> <td>A-54</td> <td>.....</td> <td>Timing gear arrangement</td> <td>.....</td> </tr> <tr> <td></td> <td>A-54</td> <td>.....</td> <td>Timing diagram</td> <td>.....</td> </tr> <tr> <td></td> <td>A-55</td> <td>.....</td> <td>Driving gear in correct timing position</td> <td>.....</td> </tr> <tr> <td></td> <td>A-55</td> <td>.....</td> <td>Injection pump timing marks correctly aligned</td> <td>.....</td> </tr> <tr> <td></td> <td>A-56</td> <td>.....</td> <td>Adjusting tappets</td> <td>.....</td> </tr> <tr> <td></td> <td>A-56</td> <td>.....</td> <td>Position of injection nozzle washers</td> <td>.....</td> </tr> <tr> <td></td> <td>A-58</td> <td>.....</td> <td>Flywheel housing drain plug</td> <td>.....</td> </tr> </table>	Page	A-51	.....	Compressing valve springs	.....		A-51	.....	Fitting valve guides	.....		A-51	.....	Valve seat cutting tool	.....		A-52	.....	Push-rod tube removal	.....		A-52	.....	Correct position of push-rod tubes in relation to hot plugs	.....		A-52	.....	Fitting push-rod tubes	.....		A-53	.....	Order of tightening cylinder head bolts	.....		A-53	.....	Timing pointer	.....		A-54	.....	Checking exhaust valve "fully-open" position	.....		A-54	.....	Timing gear arrangement	.....		A-54	.....	Timing diagram	.....		A-55	.....	Driving gear in correct timing position	.....		A-55	.....	Injection pump timing marks correctly aligned	.....		A-56	.....	Adjusting tappets	.....		A-56	.....	Position of injection nozzle washers	.....		A-58	.....	Flywheel housing drain plug	.....	<table border="0"> <tr> <td>Page</td> <td>A-43</td> <td>.....</td> <td>Removing tappet and roller</td> <td>.....</td> </tr> <tr> <td></td> <td>A-43</td> <td>.....</td> <td>Tappet guide and roller</td> <td>.....</td> </tr> <tr> <td></td> <td>A-44</td> <td>.....</td> <td>Removing vertical drive shaft gear</td> <td>.....</td> </tr> <tr> <td></td> <td>A-44</td> <td>.....</td> <td>Outer camshaft bearing removal</td> <td>.....</td> </tr> <tr> <td></td> <td>A-45</td> <td>.....</td> <td>Inner camshaft bearing removal</td> <td>.....</td> </tr> <tr> <td></td> <td>A-45</td> <td>.....</td> <td>Fitting camshaft bearings</td> <td>.....</td> </tr> <tr> <td></td> <td>A-46</td> <td>.....</td> <td>Reamering camshaft bearings</td> <td>.....</td> </tr> <tr> <td></td> <td>A-46</td> <td>.....</td> <td>Checking main bearing nip</td> <td>.....</td> </tr> <tr> <td></td> <td>A-47</td> <td>.....</td> <td>Checking crankshaft end-float</td> <td>.....</td> </tr> <tr> <td></td> <td>A-47</td> <td>.....</td> <td>Rear crankshaft oil seal</td> <td>.....</td> </tr> <tr> <td></td> <td>A-47</td> <td>.....</td> <td>Fitting rear bearing cap and seal assembly</td> <td>.....</td> </tr> <tr> <td></td> <td>A-48</td> <td>.....</td> <td>Checking cylinder liner extension</td> <td>.....</td> </tr> <tr> <td></td> <td>A-48</td> <td>.....</td> <td>Checking piston clearance</td> <td>.....</td> </tr> <tr> <td></td> <td>A-48</td> <td>.....</td> <td>Checking piston ring gap</td> <td>.....</td> </tr> <tr> <td></td> <td>A-49</td> <td>.....</td> <td>Checking ring clearance in groove</td> <td>.....</td> </tr> <tr> <td></td> <td>A-49</td> <td>.....</td> <td>Checking big-end bearing nip</td> <td>.....</td> </tr> <tr> <td></td> <td>A-50</td> <td>.....</td> <td>Checking camshaft end-float</td> <td>.....</td> </tr> <tr> <td></td> <td>A-50</td> <td>.....</td> <td>Tappet guide and roller</td> <td>.....</td> </tr> <tr> <td></td> <td>A-50</td> <td>.....</td> <td>Checking run-out on flywheel face</td> <td>.....</td> </tr> </table>	Page	A-43	.....	Removing tappet and roller	.....		A-43	.....	Tappet guide and roller	.....		A-44	.....	Removing vertical drive shaft gear	.....		A-44	.....	Outer camshaft bearing removal	.....		A-45	.....	Inner camshaft bearing removal	.....		A-45	.....	Fitting camshaft bearings	.....		A-46	.....	Reamering camshaft bearings	.....		A-46	.....	Checking main bearing nip	.....		A-47	.....	Checking crankshaft end-float	.....		A-47	.....	Rear crankshaft oil seal	.....		A-47	.....	Fitting rear bearing cap and seal assembly	.....		A-48	.....	Checking cylinder liner extension	.....		A-48	.....	Checking piston clearance	.....		A-48	.....	Checking piston ring gap	.....		A-49	.....	Checking ring clearance in groove	.....		A-49	.....	Checking big-end bearing nip	.....		A-50	.....	Checking camshaft end-float	.....		A-50	.....	Tappet guide and roller	.....		A-50	.....	Checking run-out on flywheel face	.....
Page	A-51	.....	Compressing valve springs	.....																																																																																																																																																																												
	A-51	.....	Fitting valve guides	.....																																																																																																																																																																												
	A-51	.....	Valve seat cutting tool	.....																																																																																																																																																																												
	A-52	.....	Push-rod tube removal	.....																																																																																																																																																																												
	A-52	.....	Correct position of push-rod tubes in relation to hot plugs	.....																																																																																																																																																																												
	A-52	.....	Fitting push-rod tubes	.....																																																																																																																																																																												
	A-53	.....	Order of tightening cylinder head bolts	.....																																																																																																																																																																												
	A-53	.....	Timing pointer	.....																																																																																																																																																																												
	A-54	.....	Checking exhaust valve "fully-open" position	.....																																																																																																																																																																												
	A-54	.....	Timing gear arrangement	.....																																																																																																																																																																												
	A-54	.....	Timing diagram	.....																																																																																																																																																																												
	A-55	.....	Driving gear in correct timing position	.....																																																																																																																																																																												
	A-55	.....	Injection pump timing marks correctly aligned	.....																																																																																																																																																																												
	A-56	.....	Adjusting tappets	.....																																																																																																																																																																												
	A-56	.....	Position of injection nozzle washers	.....																																																																																																																																																																												
	A-58	.....	Flywheel housing drain plug	.....																																																																																																																																																																												
Page	A-43	.....	Removing tappet and roller	.....																																																																																																																																																																												
	A-43	.....	Tappet guide and roller	.....																																																																																																																																																																												
	A-44	.....	Removing vertical drive shaft gear	.....																																																																																																																																																																												
	A-44	.....	Outer camshaft bearing removal	.....																																																																																																																																																																												
	A-45	.....	Inner camshaft bearing removal	.....																																																																																																																																																																												
	A-45	.....	Fitting camshaft bearings	.....																																																																																																																																																																												
	A-46	.....	Reamering camshaft bearings	.....																																																																																																																																																																												
	A-46	.....	Checking main bearing nip	.....																																																																																																																																																																												
	A-47	.....	Checking crankshaft end-float	.....																																																																																																																																																																												
	A-47	.....	Rear crankshaft oil seal	.....																																																																																																																																																																												
	A-47	.....	Fitting rear bearing cap and seal assembly	.....																																																																																																																																																																												
	A-48	.....	Checking cylinder liner extension	.....																																																																																																																																																																												
	A-48	.....	Checking piston clearance	.....																																																																																																																																																																												
	A-48	.....	Checking piston ring gap	.....																																																																																																																																																																												
	A-49	.....	Checking ring clearance in groove	.....																																																																																																																																																																												
	A-49	.....	Checking big-end bearing nip	.....																																																																																																																																																																												
	A-50	.....	Checking camshaft end-float	.....																																																																																																																																																																												
	A-50	.....	Tappet guide and roller	.....																																																																																																																																																																												
	A-50	.....	Checking run-out on flywheel face	.....																																																																																																																																																																												

## ENGINE REMOVAL AND DISMANTLING PROCEDURE

The information in this Section, covering the dismantling and assembly of the engine, is also applicable to the Series I Diesel models.

### Removing engine Operation A/162

1. If fitted remove the spare wheel from bonnet.

2. Disconnect the bonnet support stay and remove the bonnet.

3. Disconnect the hose from inlet manifold, unscrew the securing wing nut and lift the air cleaner and hose clear.

4. Disconnect the battery leads and remove the L.H. battery.

5. Drain the coolant from system (one tap at bottom L.H. side of radiator and one tap at L.H. side of cylinder block).

6. Disconnect the side lamp leads at each side of the grille panel assembly and the front lamp harness from the junction box at R.H. side of scuttle, then pull the wiring clear to front of engine.

7. Detach the top hose at radiator header tank and the bottom hose from water pump inlet.

8. Remove the fan blades.

9. Remove bolts securing the front apron. Remove the bolts securing the grille panel to front cross-member and front wings.

10. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle. Remove the L.H. battery support.

11. Loosen the bolts securing the intermediate to front exhaust pipe and disconnect the exhaust pipe from exhaust manifold.

12. Disconnect the heater pipes (if fitted) at the engine side of bulkhead.

13. Disconnect the wiring from starter motor, dynamo, oil pressure warning switch and glow-plug lead at resistance on bulkhead.

14. Disconnect the fuel inlet and outlet pipes from fuel lift pump and injection pump, then disconnect the three pipes joined at scuttle, lower R.H. side.

15. Remove the accelerator control rod, then the cut-off control cable from the steady bracket on engine and from the lever on injection pump.

16. Fit the engine sling to the support brackets at front and rear of cylinder head and with suitable lifting tackle just take the strain.

17. Disconnect the clutch slave cylinder hose at bracket mounted on dash.

18. Remove the front floor and gearbox cover.

19. Support the gearbox assembly with a jack or packing blocks.

20. Remove the clutch slave cylinder bracket from the flywheel housing and pull back the complete assembly as far as possible.

21. Remove the remaining nuts and washers securing the gearbox to the flywheel housing.

22. Remove the bolts from engine front support brackets, allow the engine to move forward and thus clear the gearbox input shaft. Ensure that the speedometer cable, etc., and all wires are clear, then hoist the engine gently from the vehicle.

23. Drain engine oil and remove the sump.

24. Bolt the engine to a suitable stand, securing by the sump fixing studs.

## DISMANTLING ENGINE

### Externals Operation A/164

1. Disconnect the fuel spill gallery pipe from injectors and remove the fuel feed pipes— injection pump to injectors.

2. Remove the securing straps, then withdraw the injectors and seating washers. Make sure the small steel washer is also removed from out of the orifice in the cylinder head.

3. Release the accelerator pull-off spring and remove the injection pump; disconnect the wiring, then remove heater plugs carefully to avoid damage to element.

4. All items of injection equipment should be stored in dustproof containers or submerged in clean Diesel fuel.

See Section M for details of all fuel injection equipment.

5. If necessary remove the inlet and exhaust manifolds, then the starter, fan belt and dynamo. See Section P for overhaul of starter and dynamo.

6. Disconnect the heater pipes and water tap from cylinder head if fitted. Remove the fuel filter from mounting bracket at R.H. front of engine.

7. The rearmost tappet chamber cover and fuel lift pump may be removed as one unit; the foremost tappet chamber cover and oil filler pipe may also be removed together.

See Section M for details and overhaul of fuel filters and lift pump.

8. Remove the external full-flow oil filter complete with oil pressure warning switch.

See Section AO for details of oil filter.

9. Disconnect the oil feed pipe—gallery to cylinder head.

Remove the rocker cover, dipstick and dipstick tube.

**Clutch and flywheel, to remove**  
**Operation A/166**

1. Mark the cover plate and flywheel, so that on reassembly the plate may be fitted in the same relative position, to retain the original balance of the unit.
2. Remove the clutch, flywheel and housing.

**Oil pump, to remove**  
**Operation A/168**

1. Remove the securing bolts and withdraw the pump assembly.
2. Withdraw the driving shaft from the pump upper casing.

See Section AO for overhaul of oil pump.

**Water pump, to remove**  
**Operation A/170**

1. Remove the water pump assembly and pulley.

See Section L for overhaul of water pump.

**Vibration damper, to remove**  
**Operation A/172**

1. Remove the starting dog nut with special tool, No. 507234, and tab washer, then withdraw the vibration damper assembly from crankshaft.

See Section A2 for overhaul of vibration damper.

**Rocker shaft and cylinder head, to remove**  
**Operation A/174**

1. Remove the rocker shaft cover, unscrew the bolts securing the rocker shaft support brackets, and lift the rocker shaft assembly complete from the cylinder head.
2. Ensure the component parts of the rocker shafts remain in their correct relative positions.
3. Withdraw the push-rods and insert them in a piece of cardboard pre-pierced and numbered 1 to 8.
4. Loosen the securing bolts evenly and lift the cylinder head clear, complete with manifolds and thermostat.

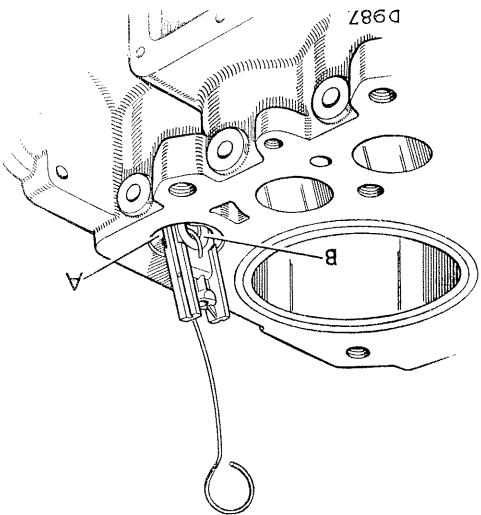
**Tapet assembly, to remove**  
**Operation A/176**

1. Remove the tapet locating bolts from the right-hand side of the cylinder block.
2. Hook out the roller and brass tapet slide with a piece of wire, ensuring the tapet guide does not move. If the guide moves this may allow the roller to fall down into the camshaft chamber.

The tapet assemblies are marked to ensure correct refitment.

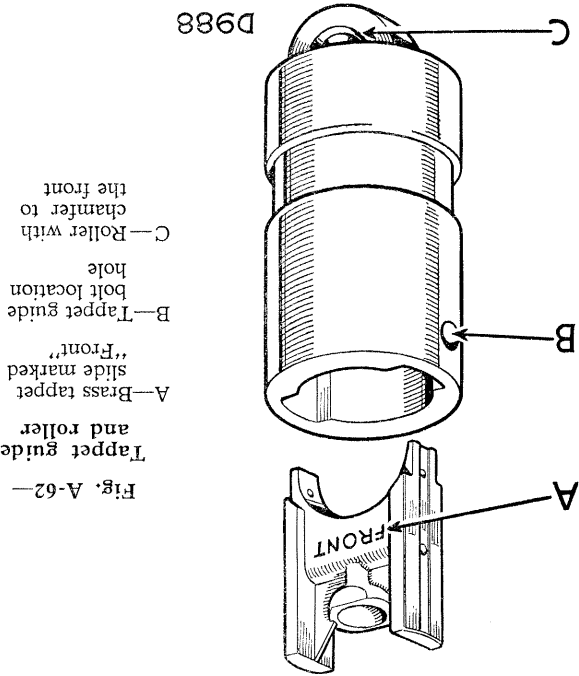
**Roller**  
 The front of the roller is indicated by a chamfer on its inside diameter.

**Fig. A-61—Removing tapet and roller**



**Brass tapet**  
 The tapet is clearly marked "FRONT".

**Guide**  
 The guide can only be fitted one way due to the bolt locating hole. See Fig. A-62.



**Vertical drive shaft gear, to remove**  
**Operation A/178**

1. Remove the locating screw from the external filter adaptor joint face.

Ensure that the component parts are retained in their correct relative positions.

### Crankshaft, main bearings and seals, to remove Operation A/188

Crankshafts removed from Diesel engines and considered unserviceable because of wear on the journals, must not under any circumstances be reconditioned.

It is most important, therefore, that when a Diesel crankshaft becomes unserviceable it should be scrapped out, and damaged to ensure that it cannot be subsequently reconditioned. A new crankshaft of the latest type must be fitted.

1. Remove the main bearing caps, lift the crankshaft clear and place in a suitable stand.
- Retain the shell bearings in pairs adjacent to the journal from which they were removed.
2. The rear bearing seal halves may be removed from the cylinder block and bearing cap.

### Cylinder block checks Operation A/190

1. Check that the main bearing caps have not been filed, in the following manner.

2. Assemble the caps without bearing shells to the crankcase, ensuring that they are correctly located by means of the dowels. Tighten both securing bolts for each cap, then slacken one bolt of each pair right off. There should be no clearance at the joint face.
- If the main bearing caps have been filed, the cylinder block is scrap.

## ENGINE ASSEMBLY

### Camshaft bearing, to renew Operation A/192

When new camshaft bearings are to be fitted, the front and front intermediate bearings must be removed and new ones fitted before removing the rear bearings.

1. Unscrew the  $3\frac{1}{8}$  in. (88,9 mm) long stud from the joint face at front of cylinder block.

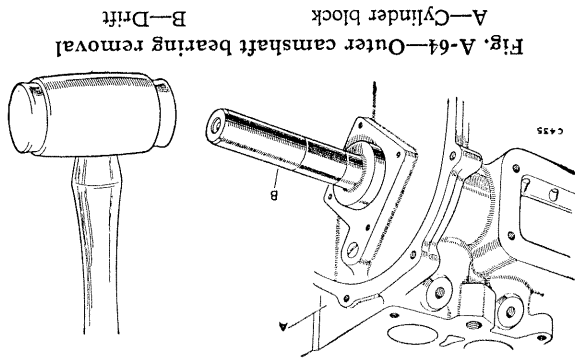


Fig. A-64—Outer camshaft bearing removal  
A—Cylinder block  
B—Drift

2. Lift the drive shaft gear and external bush assembly clear with a pair of snipe-nosed pliers.
3. The split bush may be removed by tapping to release the dowels. Do not remove the aluminium plug in the gear unless absolutely necessary. A new plug must be fitted if the old one has been removed.

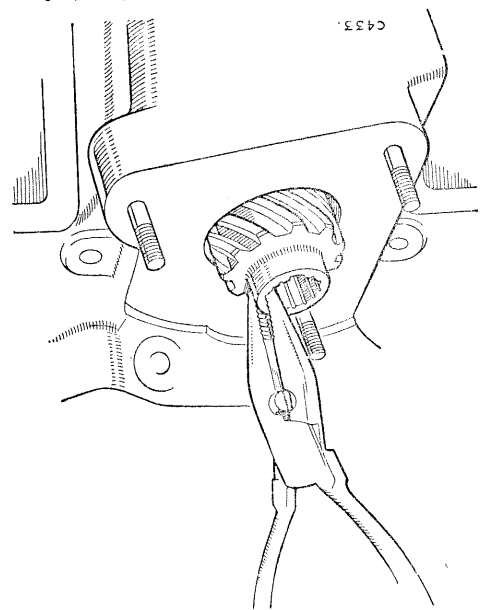


Fig. A-63—Removing the vertical drive shaft gear

### Front cover, chain tensioner and chainwheels, to remove Operation A/180

1. Remove the front cover.
2. Remove the ratchet securing bolt and withdraw the ratchet and spring. Compress the chain tensioner spring and unscrew the lower fixing bolts and remove the chain tensioner assembly.
3. Lift off the timing chain and remove the chainwheels.

### Camshaft removal Operation A/182

1. Remove the camshaft front thrust plate, then withdraw the camshaft.

### Pistons and connecting rods, to remove Operation A/184

1. Turn the crankshaft until the pistons of numbers 1 and 4 cylinders are at B.D.C. Remove the big-end bolt securing nuts of numbers 1 and 4 connecting rods, then withdraw the piston and connecting rod assemblies from the top of cylinder block.

Repeat for numbers 2 and 3 assemblies.

### Cylinder liners, to remove Operation A/186

1. Mark the top of the liners and the cylinder block removed from the crankcase end of cylinder block bores.

5. Place a new bearing on spigot, Part No. 274384, and position it inside the foremost tappet chamber with the bearing nearest the front intermediate housing.

6. Insert the bearing fitting bar into the front bearing housing and feed the spigot on to the bar; withdraw the spigot handle. Turn the spigot to engage the locating shoulder in the spacer, then press the fitting bar inward, turning as necessary to engage the bar slot with the peg in guide tube.

7. When the fitting bar has been pressed in as far as possible by hand, ensure that all locating points are properly engaged, then drive the bearings into position with a hide-faced hammer. Remove the bearing fitting tools and check the oil holes for alignment. Remove the two rearmost bearings.

8. Fit new camshaft rear bearings in the same manner as for front bearing fitting, but remove the spacer from fitting bar and use guide tool, Part No. 274386, instead of the guide tube used when fitting front bearings.

9. Locate a guide plug, Part No. 274394, in the front new camshaft bearing and locate, using the end-plate screws. Do not tighten these screws until the reamer, Part No. 274389, is put into position and the guide collar immediately in front of the cutter is entered into the rearmost bearing, which is first to be cut. This precaution is to ensure correct alignment of the reamer. Before commencing the reaming operation it is necessary to turn the engine block to a vertical position, front end facing downwards, in order that the weight of the reamer will assist in the cutting operation. As each bearing is cut the reamer should be held steady by the operator whilst an assistant, using a high pressure air line, blows away the white metal cuttings, before allowing the reamer to enter the next bearing.

10. After the rearmost and the two intermediate bearings have been cut, remove the guide plug, Part No. 274394, before cutting the foremost

2. Drift the front camshaft bearing into the foremost tappet chamber, then withdraw the bearing from the chamber aperture. Fig. A-64.

3. The front intermediate bearing is removed by drifting it into the fuel injection pump drive chamber, using the same tool, but it must be collapsed before withdrawing from the drive aperture as illustrated in Fig. A-65.

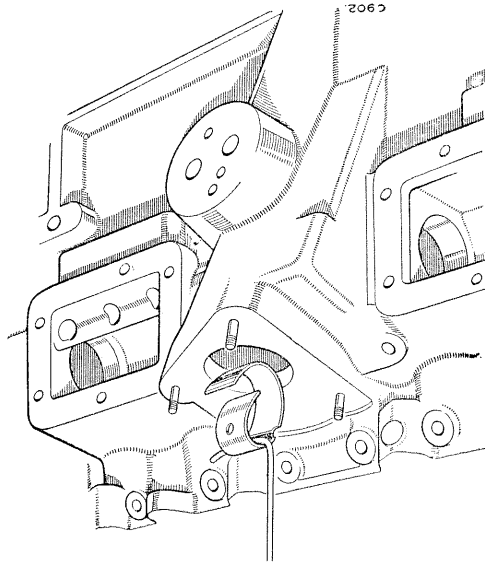


Fig. A-65—Inner camshaft bearing removal

4. Fit a guide tool, Part No. 274385, into the two old rearmost bearings with the part of flange marked "TOP" uppermost, then insert three end cover set bolts loosely for location purposes. Position a new bearing on to the handle end of bearing fitting bar, Part No. 274382, and locate by means of the peg and semi-circular cut-out, then slide a spacer, Part No. 274383, on to the fitting bar and engage the locating shoulder.

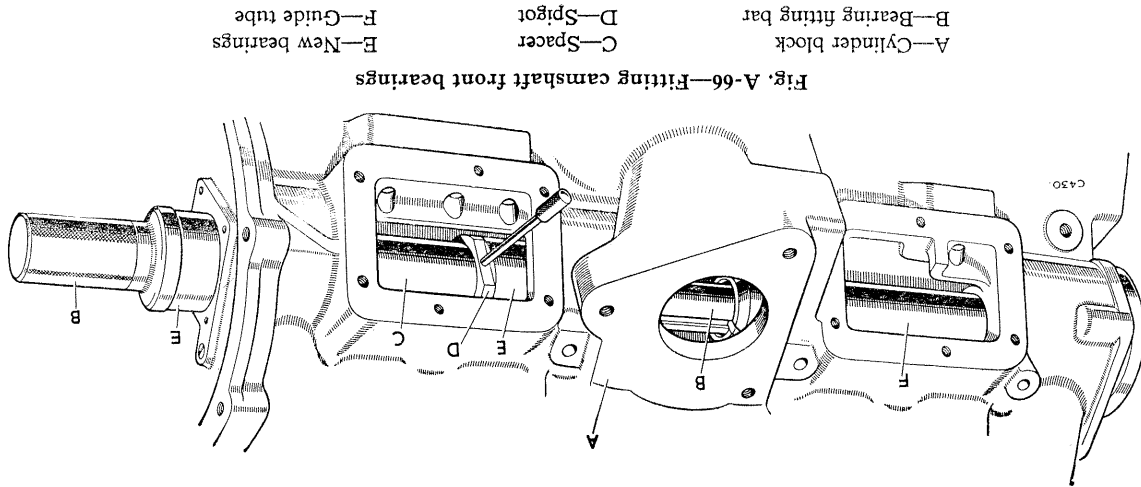


Fig. A-66—Fitting camshaft front bearings

A—Cylinder block  
B—Bearing fitting bar  
C—Spacer  
D—Spigot  
E—New bearings  
F—Guide tube

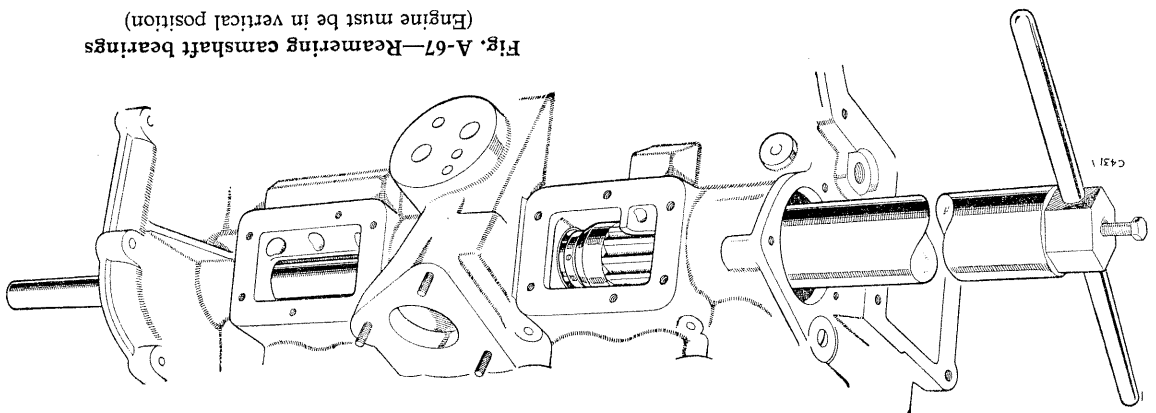


Fig. A-67—Reamering camshaft bearings  
(Engine must be in vertical position)

3. Refit the bearing shell bottom halves and bearing caps. Tighten the securing bolts evenly and check each bearing in turn for correct clearance. The crankshaft should resist rotation when a feeler paper, .0025 in. (.006 mm) thick, is placed between any one bearing shell and crankshaft journal, and turn freely by hand when the feeler paper is removed. Adjust by selective assembly of bearing shells.

Remove the reamer handle and carefully remove the reamer, turning it in the same direction as for cutting. Care must be taken to prevent the reamer damaging the foremost bearing as the reamer is removed. No lubricant is necessary for the reaming operation, best results are obtained when the bearings are cut dry.

11. Remove the plugs from the ends of oil gallery passage and clean the gallery and oil feed passages to camshaft and crankshaft bearings, using compressed air. Refit the plugs and lock in position.

The cylinder block must be thoroughly cleaned at this stage with special attention to the inner seal grooves.

### Crankshaft main bearings and seals

#### Operation A/194

Crankshafts removed from Diesel engines and considered unserviceable because of wear on the journals, must not under any circumstances be reconditioned.

It is most important, therefore, that when a Diesel crankshaft becomes unserviceable it should be scrapped out, and damaged to ensure that it cannot be subsequently reconditioned. A new crankshaft of the latest type must be fitted.

1. Remove the bearing caps and fit the bearing shells, locating by means of the tags. Tighten the caps down and slacken off one bolt of each pair. Check the bearing nip, as illustrated in Fig. A-68, ensuring that the clearance does not exceed .004 to .006 in. (.010 to .015 mm). The nip can be corrected by selective assembly of bearing shells; these are available in slightly varying thicknesses.

2. When the bearing nip has been checked, remove the caps and bearing shell bottom halves. Position a standard size thrust bearing at each side of centre bearing shell—top half, and fit the crankshaft.

4. Mount a dial test indicator, then check and note the crankshaft end-float reading which should be .002 to .006 in. (.050 to .15 mm).
5. If the crankshaft end-float reading obtained is not within the limits, fit suitable oversize thrust bearings. The variation of thrust bearing thickness at each side must not exceed .003 in. (.007 mm) to ensure that the crankshaft remains centralised.
6. Remove the bearing caps, bottom half shells and crankshaft.
7. To the rear main bearing cap fit neoprene seals in recess at each side.

### Fitting two-piece oil seal

8. Preparatory work. This preparatory work is essential when fitting the seal to a new crankshaft and desirable when fitting to a crankshaft which has been in service.

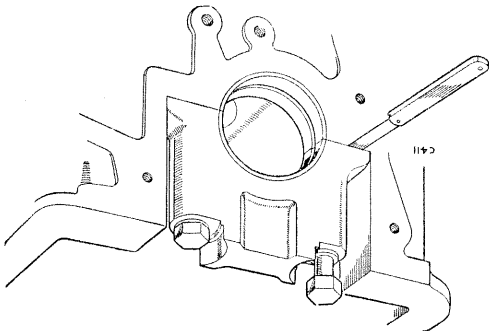


Fig. A-68—Checking main bearing nip



instruction does not apply to the three-piece type oil seal.  
 The compound should be spread thinly over the surface, ensuring it reaches across the sealing lips, but must not be allowed to get on to the lips themselves. See Fig. A-70. This compound must be allowed to become tacky before assembly.

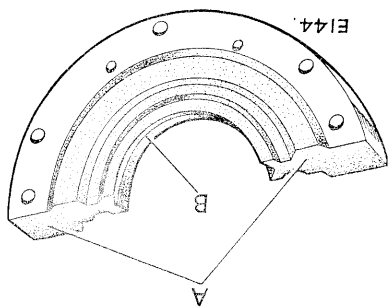


Fig. A-70—Rear crankshaft oil seals  
 A—Apply 'Heldite' jointing compound at this face  
 B—Fill groove with Silicone MS4 Compound

13. Fit rear main bearing cap and tighten to the required torque.

14. Where applicable, tighten the four bolts adjacent to the split line.

15. Rotate crankshaft through a small arc to prevent the jointing compound from adhering to the crankshaft.

16. Fitment of the rear main bearing cap, with side seals in position, will be facilitated by using a lead tool (Part No. 270304) fitted to the sump studs adjacent to rear bearing cap aperture. See Fig. A-71.

17. It will be found advantageous to cut a very slight lead on to the bottom edges of side seals as this will prevent them from folding under the cap during fitment, thus causing an oil leak due to the cap not seating properly. Lubricate seals with Silicone MS4 Compound.

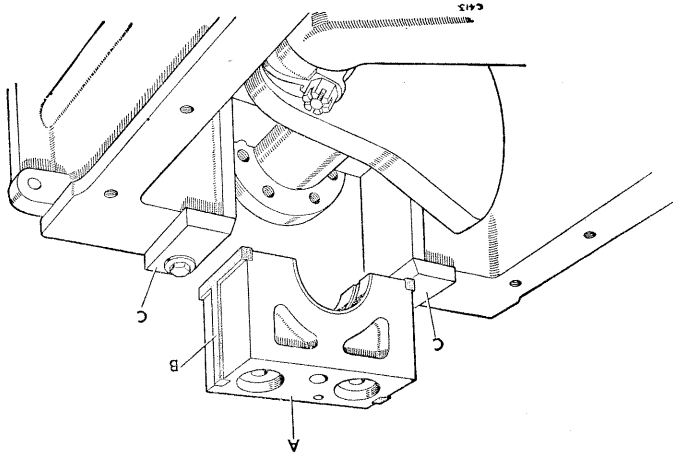


Fig. A-71—Fitting rear bearing cap and seal assembly  
 A—Bearing cap  
 B—Seal  
 C—Lead tool

To ensure efficient lubrication during the initial running-in period of the oil seal, the crankshaft oil seal journal must be treated with a mixture of molybdenum disulphide and Butyl acetate as detailed below:

(a) **Thoroughly** stir the mixture immediately prior to use.

(b) Degrease the crankshaft oil seal journal.

(c) Paint mixture evenly on to the surface of the oil seal journal with a fine brush; alternatively, if a quantity of crankshafts are being done, it can be sprayed on with a gravity feed spray gun using 40 lb/sq.in. (2,8 kg/cm<sup>2</sup>) air-line pressure. This solution, which must be dry before the seal is fitted, takes approximately 10 minutes to dry, and the surface must not be scratched after treatment. On crankshafts which have been previously run the solution will take 15 minutes to dry thoroughly. A warm air stream may be used to reduce these times if necessary.

**Procedure**

9. Bolt the cylinder block half of the oil seal firmly on to the block by the three bolts. With five-bolt fixing seals leave the two bolts adjacent to the split line loose.

Bolt the other half of the oil seal to the rear main bearing cap in the same manner.  
 10. Refit the crankshaft, first lubricating the journals, bearing shells and thrust bearings.

11. The groove in each half of the oil seal is to be half filled with Silicone MS4 Compound, ensuring no grease reaches the split line face.

12. Apply 'Heldite' jointing compound to both split line joint faces on each half of the seal. **This**

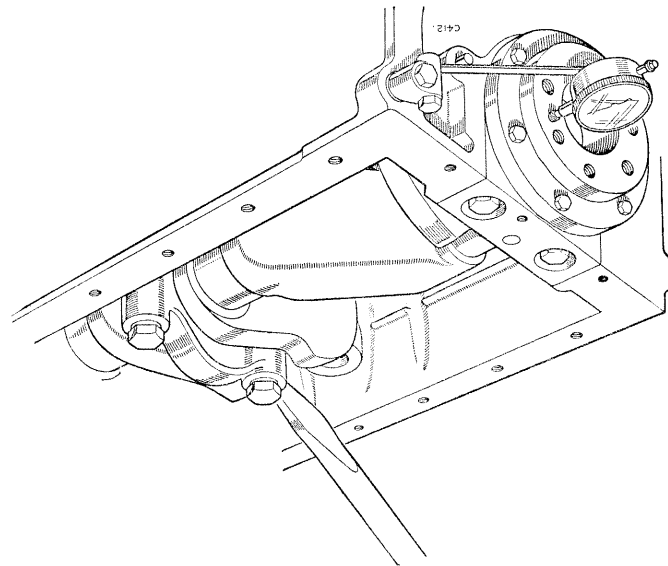


Fig. A-69—Checking crankshaft end-float

**Cylinder liners and seals, to refit**

**Operation A/196**

1. Smear the sealing ring grooves at the crankcase end of cylinder block bores, and the liner sealing rings, with Silicone MS4 Compound, then fit a ring to the upper and lower grooves of each bore.

A small hole is drilled through the cylinder block into the middle groove to provide evidence of coolant leakage past the top sealing ring.

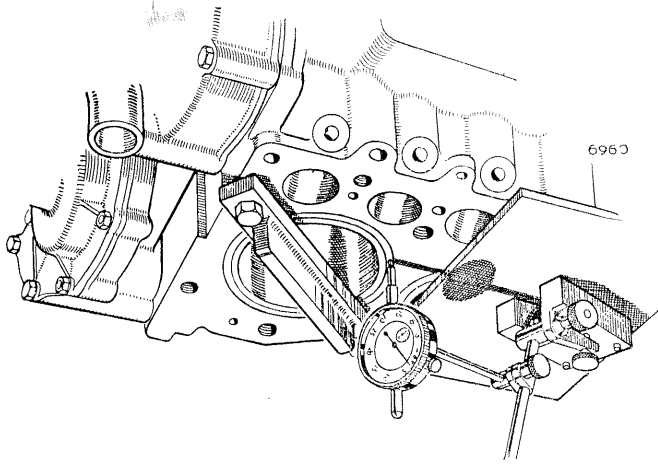


Fig. A-72—Checking cylinder liner extension

2. Press the liners into their respective bores by hand and align the marks made whilst dismantling.

3. Clamp each liner in turn in the manner illustrated and tighten the securing bolts to 65 lb/ft (8,9 mKg) torque. Mount a dial test indicator and check that the outer edge of the cylinder liner is from .002 to .004 in. (0,050 to 0,10 mm) above the cylinder head joint face. See Fig. A-72. Adjust if necessary by removing liner and adding a suitable shim washer under the flange. Clamp and re-check liner as described above. Shim washers are available .002 in. (0,50 mm) and .004 in. (0,10 mm) thick.

**Pistons and rings, to refit**

**Operation A/198**

1. When fitting pistons, the clearance in liner bore should be in accordance with the dimensions laid down in the Data Section. In the absence of suitably accurate measuring instruments, a long feeler, .004 in. (0,1016 mm) thick, may be inserted in the thrust side of the liner bore, as illustrated in Fig. A-73, and the piston located with the centre line of cylinder block. The piston should become a tight fit when the bottom of skirt enters the bore.

2. Check the piston ring gaps in the liner bores, using an old piston as illustrated in Fig. A-74, to keep the rings square in the bore.

**Connecting rod checks**

**Operation A/200**

1. Check that the connecting rods and caps have not been filed, in the following manner.

2. Select the correct cap for each connecting rod, as denoted by the number stamped near the joint faces. This number also indicates the crankpin to which it must be fitted.

Assemble the connecting rods, less shell bearings, with corresponding numbers together.

It will be seen that provision is made for the fitment of two oil scraper rings. The second groove is for service purposes only.

Fig. A-74—Checking piston ring gap  
A—Scrap piston B—Piston ring C—Feeler gauge

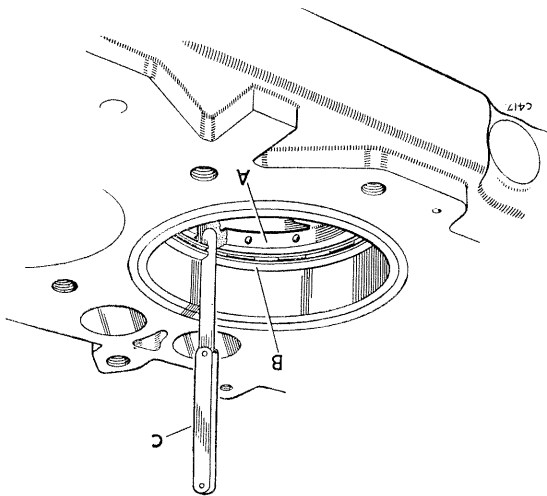
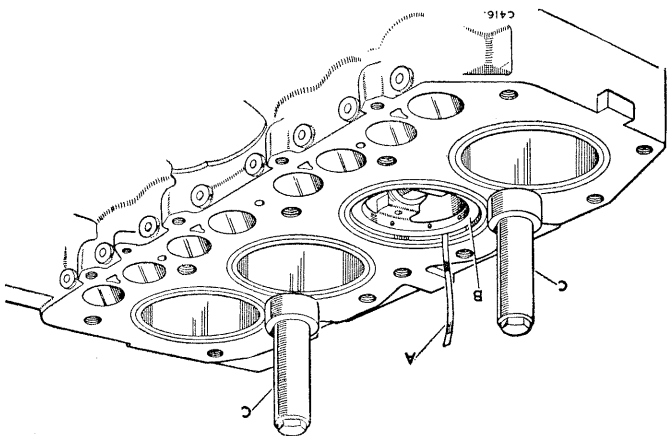


Fig. A-73—Checking piston clearance  
A—Feeler gauge B—Piston C—Liner retainer



3. The second and third compression rings are bevel edged and must be fitted with the side marked "T" uppermost; the top chromium plated compression and the oil scraper ring has a square friction edge and may be fitted either way. Fit the piston rings and check the clearance in ring groove. See Data Section.

Bearing clearance should be .001 to .0025 in.

(0,025 to 0,063 mm).

6. Check the connecting rod end-float on crankpin face of rod and the crankpin shoulder. End-float should be .007 to .011 in. (0,177 to 0,2792 mm).

7. Remove the connecting rods from crankshaft, ensuring that the bearing shells are kept with the rods to which they were fitted.

**Gudgeon pin, bush and piston fitting**

**Operation A/204**

1. The oil hole in gudgeon pin bush is pre-drilled

and care must be taken to ensure that the oil holes of bush and connecting rod will align when the bush is pressed into position. The gudgeon pin bushes should be a .001 to .002 in. (0,025 to 0,050 mm) interference fit in connecting rods. Ream the bush when fitted to connecting rod to allow a .0003 to .0005 in. (0,0076 to 0,0127 mm) gudgeon pin clearance. Ensure that correct alignment is maintained while reamering.

This fit is selected to give the smallest possible clearance consistent with a smooth revolving action.

2. Fit each connecting rod to a suitable test rig and check for twist and mal-alignment.

3. The gudgeon pin, when cold and dry, should be a slight **interference** fit in both bores of the piston—see Data. It must be fitted by hand pressure but must **not** be able to fall out of either bore under its own weight.

Lubricate the gudgeon pin when the correct size has been selected for a particular piston, but do not fit and remove the pin from piston unnecessarily thereafter, or the slight interference fit may be lost.

4. Fit the connecting rod to the piston with the oil spray hole of rod on the same side as the swirl-inducing recess in piston crown. Lock the gudgeon pin in position with circlips.

5. Turn the crankshaft until the crankpins relative to numbers 1 and 4 cylinders are at B.D.C. Insert the connecting rods and pistons for these cylinders from the top of cylinder block, with the oil spray hole in connecting rod and turbulence recess in piston towards the R.H. side of engine—toward the camshaft. Secure the big-ends to crankpins, tightening the securing nuts to 35 lb/ft (4,338 Kg/m).
6. Repeat Item 1 for numbers 2 and 3 cylinders. Lock the securing nuts with split pins.

**Camshaft, to replace**

**Operation A/206**

When replacing camshafts it should be noted that 2 litre Diesel engine camshafts are marked "DIESEL" between No. 1 and No. 2 cam lobes.

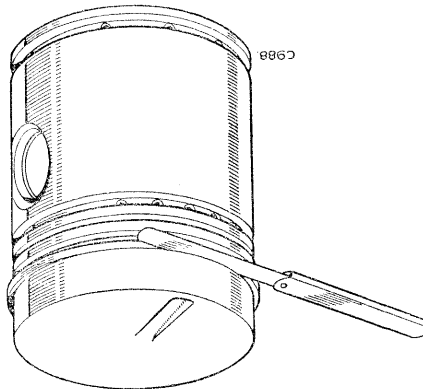
3. Tighten the securing bolts, then slacken one of them right off and check that there is no clearance at the joint face.
- If the connecting rods or caps have been filed the assemblies must be scrapped.

**Connecting rod bearing nip**

**Operation A/202**

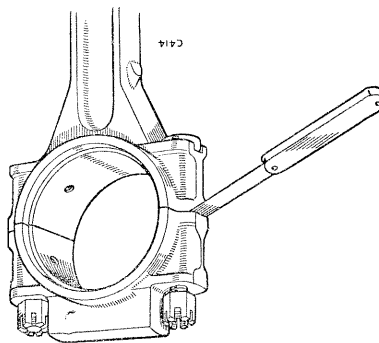
1. Check the bearing nip in the following manner.
2. Fit the bearing shells and tighten both securing bolts—slacken one bolt as before and check the nip with a feeler gauge; this should be .002 to .004 in. (0,050 to 0,10 mm).

Fig. A-75—Checking ring clearance in groove



3. The nip can be corrected by selective assembly of the bearing shells; these are available in slightly varying thickness. **Do not file the rod or cap.**
4. Fit liner retainers (Part No. 274411) to joint face of cylinder block, then rotate assembly in the stand to bring crankshaft uppermost.

Fig. A-76—Checking the big-end bearing nip



5. Assemble the big-end of each connecting rod to its respective crankpin, then check for correct clearance.

The connecting rod should resist rotation when the shim paper is removed. Adjust by selective bearing shell, then move freely by hand when the shim paper is fitted between the crankpin and one-half of big-end .0025 in. (0,0635 mm) shim paper is fitted.

assembly of bearing shells.

This is to differentiate between Diesel and petrol camshafts, which look similar in all respects except for the positioning of the cam lobes.

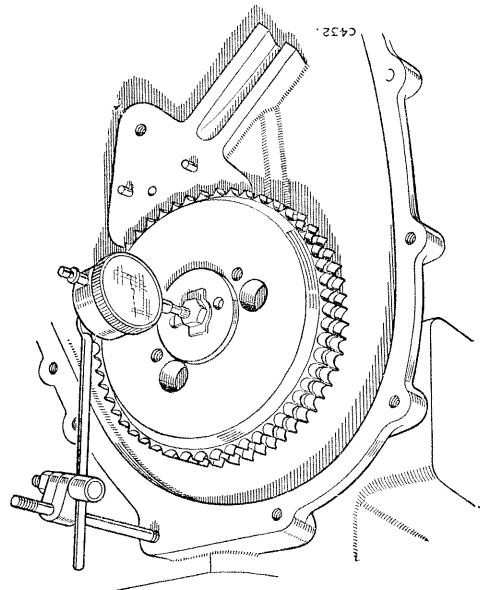


Fig. A-77—Checking camshaft end-float

1. Insert the camshaft—keyed end to extend at front of engine.
2. Fit the front thrust plate and secure the cam-shaft chainwheel but do not bend up the locking tab for securing bolt at this stage.

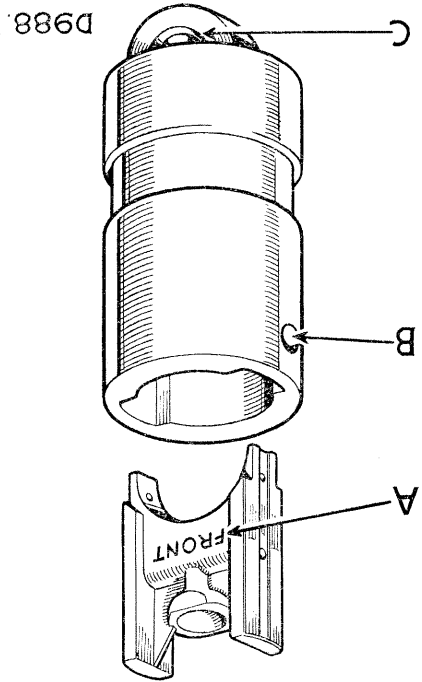


Fig. A-78—Tappet guide and roller  
A—Brass tappet slide marked "front"  
B—Tappet guide bolt location hole  
C—Roller with chamfer to the front

Check the camshaft end-float with a dial test indicator as illustrated by Fig. A-77 and ensure that the reading is within .0025 to .0055 in. (0.063 to 0.139 mm).  
Adjust by selective assembly of the front thrust plate.

**Tappet assembly and fitment**  
**Operation A/208**

1. Before fitting the tappet assembly into the block, thoroughly clean all parts and check that the tappet will move freely in the tappet guide when held in the hand and shaken up and down.
2. Fit tappet guides into the cylinder block, ensuring that the locating hole lines up with the hole in the cylinder block.  
The tappet guides must not be too tight in the block or they may be damaged by insertion of the locating screw in cases when they are not properly aligned.
3. Gently insert the roller into the guide. Do not drop the roller, as it is easily damaged.
4. Fit tappet into the guide and locate on to the roller. The tappet is marked "Front" and must be facing the front of the guide.
5. Fit the tappet locating screws and washers; the locating screws must be screwed up with the fingers and then tightened; if they are not free, remove and investigate reason.
6. Lock the locating screws in pairs, using 20 s.w.g. iron wire.

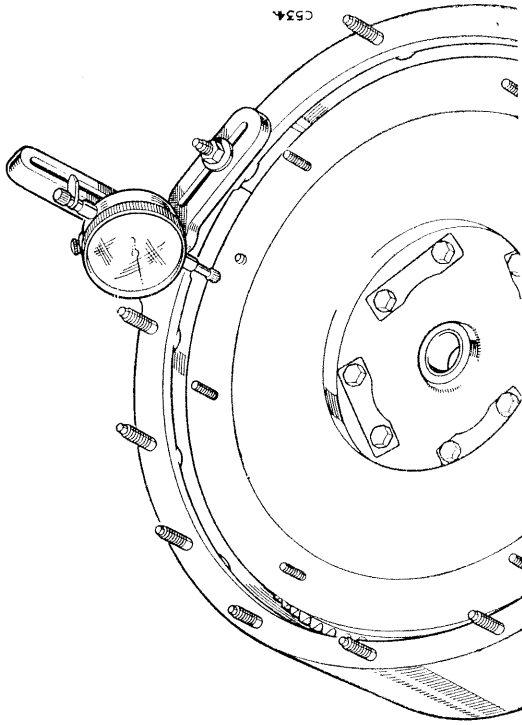


Fig. A-79—Checking run-out on flywheel face

**Flywheel housing, flywheel and clutch**

**Operation A/210**

1. Ensure that the oil seal is in good condition, then secure the flywheel housing to cylinder block. See note regarding drain plug at end of section.

2. Fit the flywheel and tighten the securing bolts to 50 lb/ft (6,912 Kg/m) torque.
3. Check the run-out on flywheel face as illustrated by Fig. A-79. The run-out on flywheel face must not exceed .002 in. (0,050 mm).

4. Ensure that the clutch disc splines are clean, and will slide on every one of the primary shaft splines.
5. Fit the clutch assembly to the flywheel, using an old primary shaft to ensure that the clutch disc is central with the flywheel bush.

**Cylinder head overhaul**

If necessary remove the inlet manifold, exhaust manifold and thermostat.

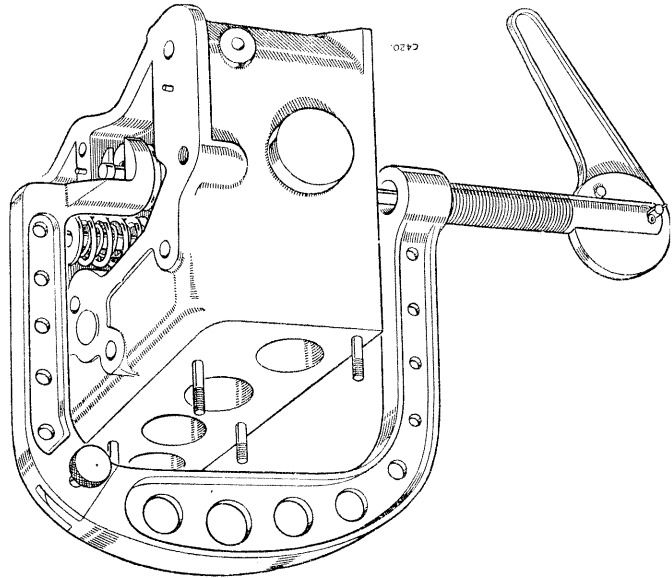


Fig. A-80—Compressing valve springs

**Valves, to overhaul**

**Operation A/212**

1. Using a valve spring compressing tool, Part No. 276102, remove the valve assemblies.
2. Drift the valve guides from the cylinder head, using tools Part No. 274401 (exhaust) and 274400 (inlet). Remove and scrap the seals.
3. Pull the inlet and exhaust valve guides into position, using tool Part No. 274406.

**Valve seats**

4. It is necessary to remove the very hard crust of carbon from the valve seats with a piece of emery cloth before attempting to re-face them with the special tools recommended.

5. Reface the inlet valve seats using special tool No. 274413 and special tool No. 274414 for the exhaust valve seats. See Fig. A-82.

When cutting the valve seats, do not use excessive weight on the tool, as this will cause the cutter to judder and thus ruin the seating.

Seat angle, inlet: 45°  
Seat angle, exhaust: 45°

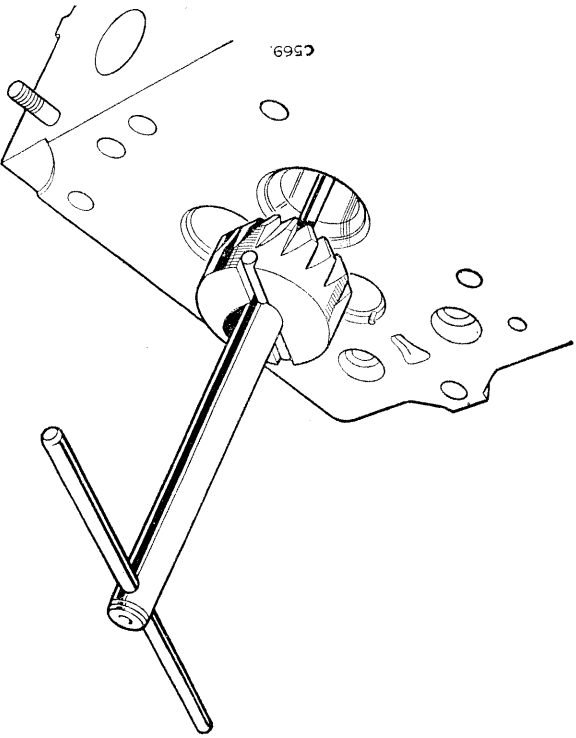


Fig. A-81—Fitting valve guides

6. Using a little grinding paste, lap the new or re-ground valves into the seatings.

7. When lapping is completed, remove each valve in turn and fit a new rubber seal into the valve guide. Clean off all traces of grinding paste, lubricate the valve stem.

Fig. A-82—Valve seat cutting tool

C569

Fit the valves, springs, cups and split cotter, ensuring that the components are retained in their original sets and positions.

A new valve seal *must* be fitted whenever a valve is removed.

The valve springs have an interference fit of .005 in. (0,01 mm). If the inner spring will slide through the outer spring, both are scrap.

**Push-rod tubes**  
Operation A/214

1. The push-rod tubes may also be removed if necessary by drifting them out, using tool Part No. 274399.

When the tubes are removed they are scrap, and new ones must be fitted.

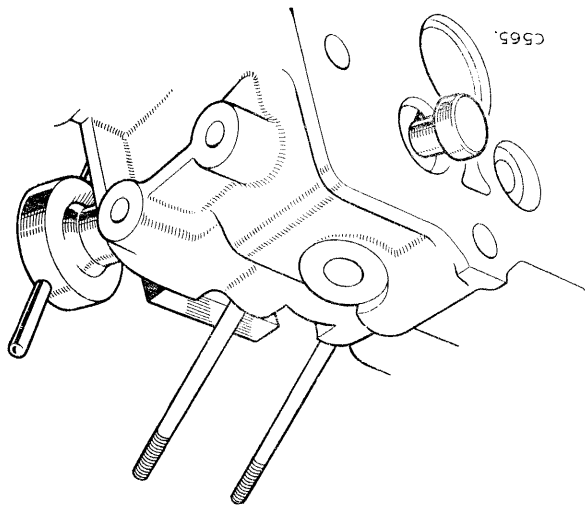


Fig. A-85—Fitting push-rod tubes

**Hot plugs and injector shroud, to renew**  
Operation A/216

In order to renew the injector shrouds it is necessary to remove the hot plugs.

1. If necessary, remove the hot plugs by inserting a copper drift through the injector shroud aperture, then tap evenly and gently around the inside of hot plug. Avoid using a heavy hammer if possible and thus minimise the possibility of damage.

2. If necessary, remove the injector shrouds, using suitably shaped drift.

3. Thoroughly clean out the combustion chamber. The hole in the side of the injector shroud is for manufacturing purposes only, but at the same time can be used as a guide when refitting the shroud.

4. Smear a little oil on the shroud and insert into the cylinder head with the hole pointing towards the centre of the cylinder head, and drift into position, using tool No. 274399.

5. The hot plugs must now be replaced by tapping gently into position with a hide-faced hammer. When fitted they must be checked with a clock gauge to ensure that they do not protrude above the level of the cylinder head face more than .002 in. (0,050 mm) and are not recessed below the level of the cylinder head face more than .001 in. (0,025 mm).

If the hot plugs are loose in the cylinder head they may be retained with a little grease.

6. The fitment of wooden plugs in the injector nozzle apertures will be found advantageous at this stage, to prevent entry of dirt into the combustion chamber.

7. Refit the inlet and exhaust manifolds to the cylinder head, using a new gasket.

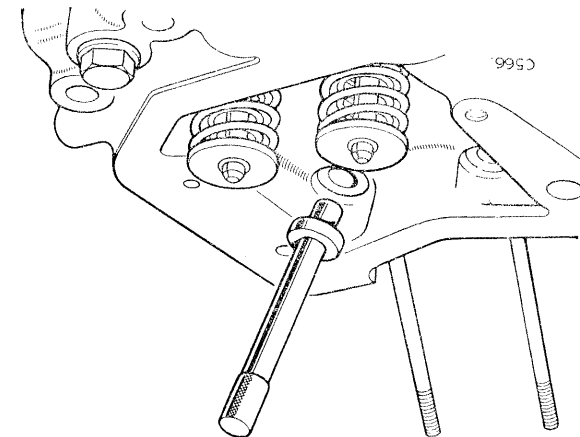


Fig. A-83—Removing push-rod tubes

2. If the push-rod tubes were removed, new tubes complete with new sealing rings, smeared with Silicone M.S.4 Compound, should be pulled into position, using tool Part No. 274402. Ensure that the chamfers on tube and in cylinder head are in full contact and that the "flat" of tube is at right angles to a line drawn between the centre of push-rod tube and centre of hot plug, as illustrated by Fig. A-84.

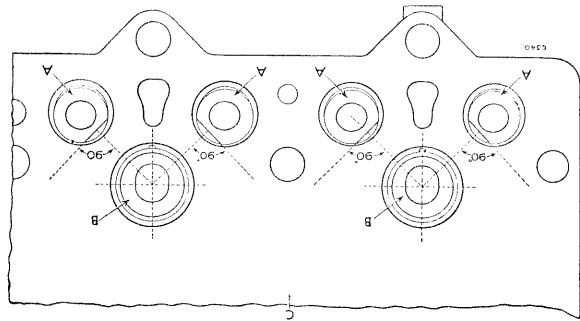


Fig. A-84—Correct position of push-rod tubes in relation to hot plugs  
A—Push-rod tubes  
B—Hot plug  
C—Cylinder head inverted

8. Test the thermostat before fitment to cylinder head, by immersing in hot water. Expansion should commence between 164°F and 173°F and be complete at 193°F.
- Insert the thermostat with rubber "O" ring in the housing in cylinder head and fit the joint washer and cover.

**Rocker shaft, to overhaul** Operation A/218

1. Remove locating set bolts from the intermediate support brackets. Remove the component parts from the rocker shafts but retain the items in their correct relative positions.

2. If necessary, press new bushes into the rockers. The oil holes in the rocker bushes are pre-drilled and care must be taken to ensure that the oil holes of bush and rocker will align when pressed into position.

3. Reamer the bush to .530 in +.001 (13,4 mm + 0,02) to obtain the correct clearance. The reamer and rocker assembly must be held in such a manner as to ensure the correct alignment of the reamed hole.

4. Align the rocker shafts, with the bored ends together, and slide a support bracket on to each shaft. The locating hole in each bracket must be positioned immediately above the chamfered hole in shaft, 4,75 in. (120,65 mm) from the plugged end, and then secured with a locating screw and spring washer.

5. Assemble the remaining components with the plugged ends of the shafts in the end brackets and the bored ends of both shafts located in the centre bracket.

**Cylinder head and rocker shaft, to refit** Operation A/220

1. Smear the joint face of cylinder block and cylinder head gasket with engine oil, then fit the gasket and cylinder head assembly to cylinder block, using the two studs to facilitate alignment.
2. Locate head and gasket with the securing bolts, fitting all bolts except those which also secure the rocker shaft pedestals, but do not tighten at this stage.
3. Insert the push-rods into their original positions, through cylinder head and locate in the tappets.

4. Slacken off all tappet adjusting screws and offer the rocker assembly to cylinder head. Fit the bracket securing bolts, but do not tighten.

5. Tighten down the cylinder head bolts in the order indicated by Fig. A-86. The  $\frac{3}{16}$  in. U.N.F. bolts, including those that also secure the rocker brackets, must be pulled down to 75 lb/ft (10,3 Kg/m) whilst the  $\frac{1}{8}$  in. U.N.F. bolts securing the rocker brackets only are pulled down to 12 lb/ft (1,66 Kg/m).

**Chainwheels, timing chain, adjuster and Valve timing** Operation A/222

1. The screwed plug and ball may be removed from the piston if necessary and the piston pressed from its housing if unduly worn.
2. The tensioner cylinder and bush must be renewed complete if the bush is unduly worn.
3. The bushes in idler wheel and ratchet arm should also be removed if worn beyond reasonable limits.
4. Fit the crankshaft chainwheel on to shaft and key.

5. Turn the crankshaft in direction of rotation until the E.P. mark on flywheel is in line with the timing pointer.

6. Fit a dial test indicator so that the "fully open" position of the valve can be ascertained in the following manner:—

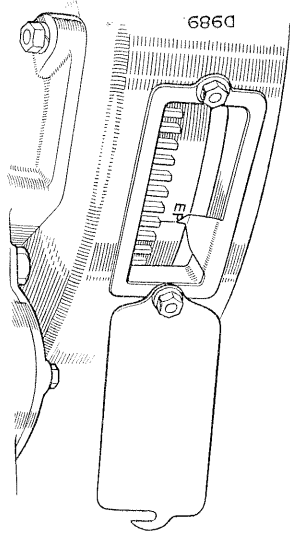
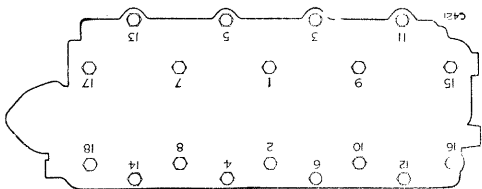


Fig. A-87—Timing pointer

7. Turn the crankshaft in direction of rotation until the lobe of cam has nearly opened the valve fully, then stop rotation and mark the chainwheel and timing casing to record the position.
8. Note the reading on dial test indicator, then continue to turn the chainwheel slowly in direction of rotation until the needle has again reached the same position.

Fig. A-86—Order of tightening cylinder head bolts



12. Fit new bushes to the chain tensioner components as necessary; ensure that the fits and clearances are in accordance with those laid down in the Data Section. Position the ball in the chain tensioner piston and secure with the retaining clip. Fit the compression spring over the piston, locate the cylinder assembly, compress the spring and retain in compressed position. Place the idler wheel on bearing arm and offer the assembly to the cylinder block, locating by means of the dowels. Screw the stepped bolt with ratchet and spring in position into cylinder block, then finally secure with two set bolts. Remove the spring compressing clip and allow the idler wheel to take up the chain slack.

13. Turn the flywheel against direction of rotation approx. 90° then slowly in direction of rotation, checking that the exhaust valve reaches the "fully open" position, as indicated by the dial test indicator, exactly when the "E.P." mark on flywheel is in line with the pointer on flywheel housing.

14. Adjust if necessary by means of the six irregularly spaced keyways in the timing chainwheel. This arrangement allows a variation of 2° between each position.

15. Lock the set bolt securing camshaft chainwheel when timing has been set satisfactorily.

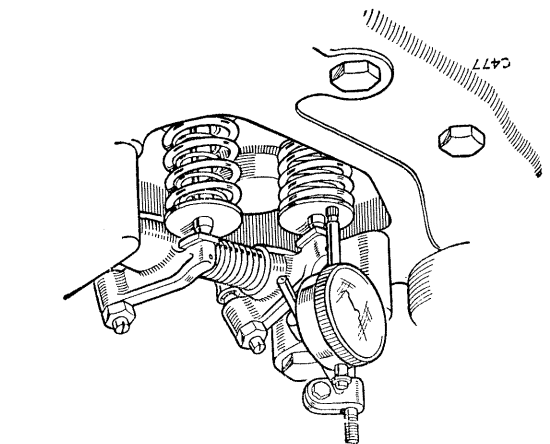


Fig. A-88—Checking exhaust valve "fully open" position

9. Mark the chainwheel at a point opposite to the mark on timing casing and make a third mark on the chainwheel, exactly between those made previously.

10. Turn the camshaft against direction of rotation until the third mark is in line with that on timing casing, whereon the valve should be fully open.

11. Fit the timing chain with "no slack" on the driving side. It may be necessary to remove and re-position the camshaft chainwheel to obtain this "no slack" condition on the driving side when the flywheel and camshaft are correctly positioned.

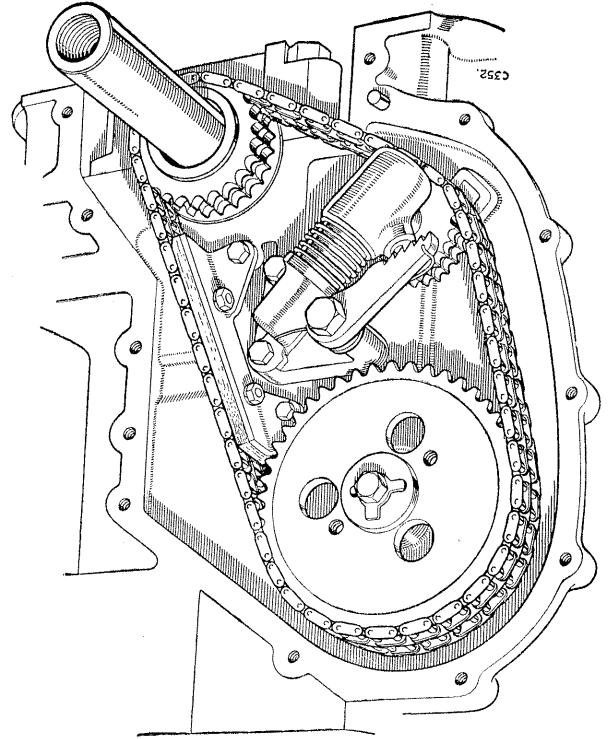


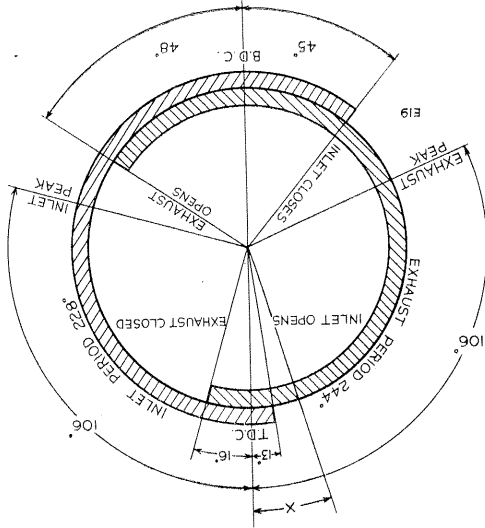
Fig. A-89—Timing gear arrangement

1. Examine the crankshaft oil seal and replace if necessary, using a little sealing on the outside of the seal.

2. Position new joint washers and fit the front cover to cylinder block

Operation A/224

Fig. A-90—Timing diagram



X—Injection point is 17°



- Vibration damper, to refit** Operation A/226
1. Locate the vibration damper on crankshaft and key, then secure with the starting dog and tab washer.

*Note:* For overhaul of vibration damper see Section A2.

**Vertical drive shaft gear assembly**

- Operation A/228
1. Fit the circlip to groove dividing the upper and lower internal splining and enter the tapered splined plug in the end furthest from gear teeth, small end first.
  2. Drift the plug into the gear until it abuts on the circlip.
  3. Lubricate the split bush and fit it to the gear with the reduced diameter nearest the teeth.

**Injection pump timing** Operation A/230

The line against which the timing figure is stamped on the flywheel, as detailed below, when set opposite the pointer, indicates the position at which injection starts.

88 Diesel, up to engine number 146900522

109 Diesel, up to engine number 156900285

Set the pointer exactly between the 16° and 18° markings, that is the 17° position.

88 Diesel, from engine number 146900523 onwards

109 Diesel from engine number 156900286 onwards

Set the pointer in line with the 16° mark.

It is possible, however, that engines numbered in the range up to 146900522 and 156900285 have been modified. These are easily identified by a splash of red paint on the cylinder head. The injection pump timing for these engines is 16°.

The injection pump timing must be carried out with the utmost precision, therefore the following procedure must be executed methodically.

1. Turn the crankshaft in the direction of rotation until both valves of number 1 cylinder are closed and the piston is ascending the bore on the compression stroke, continue to turn the crankshaft slowly until the appropriate timing mark is visible through the timing aperture in the fly-wheel housing. Carefully align the timing mark with the pointer. If the flywheel is inadvertently turned too far and the timing mark goes past the pointer the operation must be repeated from item 1.

Ensure that a correct line of vision is taken when lining up the timing marks. An incorrect line of vision can result in the timing being 1° to 2° out.

2. Insert the driving gear assembly for injection and oil pumps complete with split bushes, then mesh with camshaft gear so that when fully engaged, the master spline is approx. 20° from the centre line of engine (measured from front end) and the locating holes are correctly aligned. Lock the driving gear assembly in position with a grub screw.
3. Remove the inspection cover from the injection pump and rotate the spindle in direction of rotation until the line marked "A" on driving plate aligns with the mark on the timing ring.
4. Offer the pump to the engine and engage in the splined drive shaft. With a small mirror observe the markings through inspection aperture in injection pump and make any final necessary adjustment by turning the pump body to align the timing ring with the "A" mark.

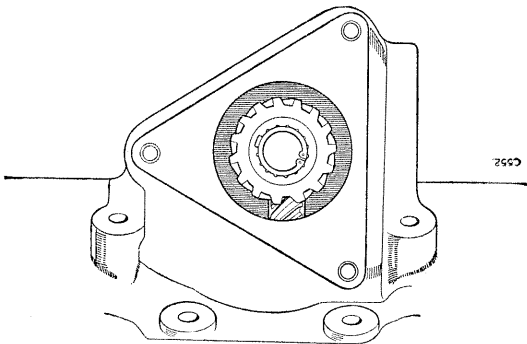


Fig. A-91—Driving gear in correct timing position

5. Re-check the timing by turning the crankshaft in the direction of rotation until both valves of number 1 cylinder are closed and the piston is ascending the bore on the compression stroke, continue to turn the crankshaft slowly. As the final adjustment is made to the timing by turning the pump body, this action in itself is sufficient to cause a slight error in the timing, due to the backlash in the pump drive skew gear. It is therefore essential that the pump drive plate and thus the skew drive gear is held back against the driving side of the teeth whilst final adjustment is made and the pump secured.

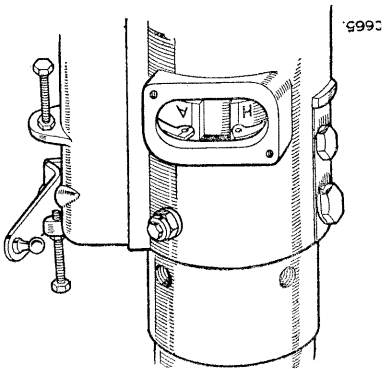


Fig. A-92—Injection pump timing marks correctly aligned

2. With the inlet port rearward, and the splined upper end of driving shaft aligned to the vertical drive gear, offer the pump to engine and secure in position. No provision is made for oil pressure adjustment.

**Water pump, to replace** Operation A/236

1. See Section L for overhaul of water pump.
2. Renew the joint washer, then locate and secure the pump to front cover.

**Externals** Operation A/238

1. Fit the lubricating oil filter assembly and joint washer.

2. Secure the breather pipe and oil filler assembly over the forward tappet chamber aperture, and steady bracket to top of cylinder block.

3. Mount and secure the fuel lift pump and cover plate assembly over the rear tappet chamber aperture.

4. Mount and secure the fuel oil filter assembly.

5. Fit the starter motor.

6. Fit the dynamo driving belt and adjust the tension to allow the belt to move  $\frac{1}{16}$  to  $\frac{1}{8}$  in. (4 to 6 mm) when pressed by thumb between the camshaft and water pump pulleys.

7. Connect the oil feed pipe and pressure gauge assembly between cylinder head and cylinder block rear end.

8. Secure the coolant pipe to thermostat and water pump casings.

9. Position the joint washer and fit the rocker and valve gear cover.

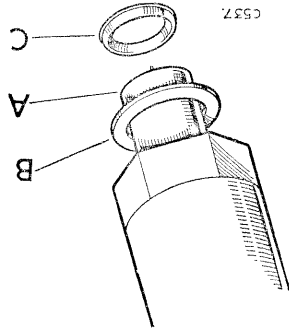


Fig. A-94—Position of injection nozzle washers  
A—Nozzle B—Copper washer C—Steel washer

10. Fit the oil sump.

11. Smear new injector copper joint washers with grease and fit one to each injector. Insert a new corrugated sealing washer into each injector nozzle recess in cylinder head, with the raised portion upward, then locate the injector nozzles; do not tighten the clamping straps fully at this stage.

6. With a small mirror observe that the timing mark "A" on the pump drive plate aligns with the timing ring. When the "A" mark is exactly in line with the mark on the timing ring, the appropriate flywheel timing mark should be exactly in line with the flywheel housing pointer. In this way any slight timing error is magnified by the 2 : 1 ratio of the camshaft. An error of 12 given width on the pump marking will be 12 times that width if transferred to the flywheel. If the flywheel is inadvertently turned too far and the timing mark on the pump drive plate goes past the mark on the timing ring, the operation must be repeated from item 6.

**Tappet adjustment** Operation A/232

1. Turn the crankshaft in direction of rotation until number 8 valve (counting from front end of engine) is fully open. In this position the tappet for number 1 valve is on the dwell of its cam and the tappet clearance may be set with a .010 in. (0,25 mm) feeler inserted between the rocker and valve stem. Re-check the clearance after tightening the locknut.

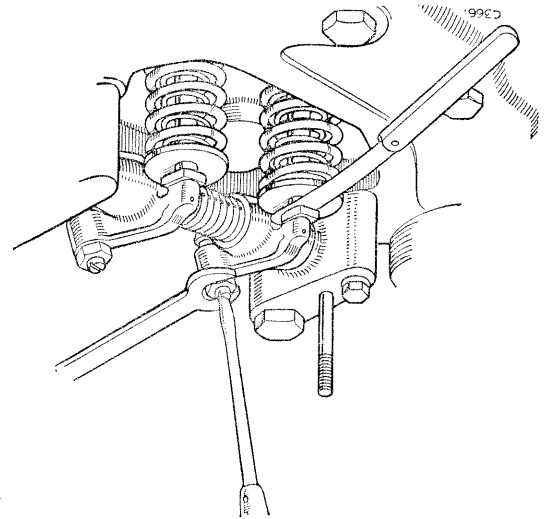


Fig. A-93—Adjusting tappets

- The tappets should be set in the following order:
- Set No. 1 tappet with No. 8 valve fully open.
  - Set No. 3 tappet with No. 6 valve fully open.
  - Set No. 5 tappet with No. 4 valve fully open.
  - Set No. 2 tappet with No. 7 valve fully open.
  - Set No. 8 tappet with No. 1 valve fully open.
  - Set No. 6 tappet with No. 3 valve fully open.
  - Set No. 4 tappet with No. 5 valve fully open.
  - Set No. 7 tappet with No. 2 valve fully open.

**Oil pump** Operation A/234

1. Insert the longer splined end of driving shaft into the pump and locate in the driving gear. See Section AO for overhaul of oil pump.

2. See Section M, Fuel Section, for method of priming injection pump, then Section Q for resetting controls and slow-running adjustment procedure.

3. Check for oil and water leaks—rectify as necessary.

At all times when the Diesel engine is running, it is necessary to ensure that the oil bath air cleaner is fastened securely in the vertical position.

If adjustments are made with the engine running and the oil bath cleaner balanced on top of the engine, it is possible, should the cleaner tip to one side, for oil to be drawn into the intake manifold and hence into the engine, where it will act as a fuel and cause the engine to overspeed out of control and serious damage may result.

Should it be necessary to run the engine with the air cleaner out of the normal position, the rubber hose should be disconnected from the inlet manifold and the whole oil bath removed from the vehicle.

*Note:* Ensure that the bottom steel washer (corrugated) is replaced correctly, when refitting injectors. See Fig. A-94.

*Note:* For injector assembly and check, see Section M.

12. Connect the injector pipes to the injector pump. Turn the injectors to align with the pipes and connect.

Do not overtighten the clamping strap.

13. Fit the heater plugs to cylinder head and tighten to 25 lb/ft (3,4 Kg/m).

### Engine, to refit

### Operation A/240

1. Reverse removal procedure—fit new mounting rubbers if necessary. Refill with lubricating oil. If 11 Imperial pints, 13 U.S. pints (6 litres). If necessary add extra oil for filter, capacity 3½ Imperial pints, 3½ U.S. pints (1,75 litres) and coolant, 17 Imperial pints, 20½ U.S. pints (9,75 litres).

OVERHAULS TO ENGINE IN CHASSIS

Rocker shaft to overhaul, carry out the following operations:

Page	Operation	Items
A-43	A/174	1 to 3
A-53	A/218	All
A-53	A/220	As necessary
A-56	A/232	All

Decarbonise and grind in valves, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 5
A-42	A/164	1, 2, 4 and 9
A-43	A/174	All
A-51	A/212	All
A-53	A/220	All
A-56	A/232	All
A-56	A/238 and A/240	As necessary

Hot plugs, injector shrouds and push-rod tubes to renew, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 5
A-42	A/164	1, 2, 4 and 9
A-43	A/174	All
A-52	A/214	All
A-52	A/216	All
A-53	A/220	All
A-56	A/232	All
A-56	A/238 and A/240	As necessary

Camshaft or roller tappets, to renew, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 12
A-42	A/164	1, 2, 3 and 9
A-43	A/170 to A/184	All
A-49	A/206 and A/208	All
A-55	A/228 to A/232	All
A-56	A/236	All
A-56	A/238 and A/240	As necessary

Renewing pistons, liners, little-end or big-end bearings, carry out the following operations:

Page	Operation	Items
A-42	A/162	1 to 5
A-42	A/164	1, 2, 4 and 9
A-43	A/174	All
A-44	A/184 and A/186	All
A-48	A/196 to A/204	All
A-53	A/220	All
A-56	A/232	All
A-56	A/238 and A/240	As necessary

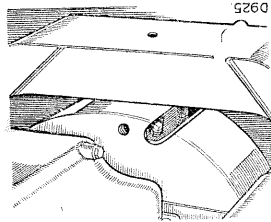


Fig. A-95—Flywheel housing drain plug and storage bracket

The drain plug should not be fitted to the housing, unless the vehicle is expected to operate under very muddy conditions, or to wade. The plug should be screwed into the storage bracket fitted to later models, or stored in the tool locker.

Flywheel housing drain plug

Section AO	Oil pump and filters	.....
Section L	Water pump and thermostat	.....
Section B	Flywheel and clutch	.....
Section P	Starter, dynamo	.....
Section M	Injection pump and filters	.....
Section A-2	Vibration damper	.....

## DEFECT LOCATION

(Symptom, Cause and Remedy)

- A—ENGINE FAILS TO START**
1. Incorrect starting procedure—See *Instruction Manual*.
  2. Starter motor unserviceable—Section P.
  3. Batteries in low state of charge—Remove and charge.
  4. Heater plug circuit broken—Section P.
  5. Foreign matter in fuel system—Section M.
  6. Supply of fuel to injection nozzles restricted—Section M.
  7. Insufficient compression—Check tappet clearance, cylinder head for tightness, cylinder head gasket, valve seats, valve springs, pistons, piston rings and liners for wear.
  8. Injection nozzles setting incorrect—Reset. Section M.
  9. Injection nozzle auxiliary spray hole blocked—Clean. Section M.
- B—ENGINE STALLS**
1. Slow-running incorrectly adjusted—See Section Q.
  2. Incorrect tappet clearance—Adjust.
  3. Injection nozzle setting incorrect—Reset. Section M.
  4. Injection nozzle auxiliary spray hole blocked—Clean. Section M.
  5. Insufficient compression—See item 7 of "A" above.
- C—REDUCED POWER AND ROUGH RUNNING**
1. Broken valve spring—Renew.
  2. Incorrect tappet clearance—Reset.
  3. Burnt valve—Renew, reset tappet clearance and tighten injection nozzles.
  4. Broken piston rings—Renew damaged parts as necessary.
  5. Compression uneven—See Item 7 of "A" above.
  6. Injection nozzles burnt—nozzle valve seating badly—Service. Section M.
  7. Incorrectly timed injection pump—Check and adjust.
- D—ENGINE OVERHEATING**
1. Defective coolant system—See "Defect Location". Section L.
  2. Defective lubrication system—See "Defect Location". Section AO.
  3. Defective injection nozzles—See "Defect Location". Section M.
  4. Incorrect injection pump timing—Check and adjust.
  5. Restricted fuel supply—Section M.
- E—LOW OIL PRESSURE**
1. Defective lubrication system—See "Defect Location". Section AO.
- F—BLACK SMOKE ISSUES FROM EXHAUST**
1. Defective fuel injection nozzle—Section M.
  2. Injection pump incorrectly timed—Check and adjust.
- G—WHITE VAPOUR ISSUES FROM EXHAUST**
1. Coolant leaking into combustion chamber—Ascertain cause.
- Note:—Do not confuse with the issue of vapour immediately after starting and caused by condensation in the exhaust pipe.*

GENERAL DATA

B.M.E.P. ....	105 lb/sq.in. (7,382 Kg/cm <sup>2</sup> ) at 2,000 R.P.M.
Capacity (piston displacement) ....	2,052 cc (125 cu.in.)
Number of cylinders ....	4
Bore ....	3.375 in. (85,725 mm)
Stroke ....	3.5 in. (88,9 mm)
Compression ratio ....	22.5 to 1
B.H.P. ....	52 at 3,500 R.P.M.
Piston speed at 3,500 R.P.M. ....	2,040 ft./min.
Firing order ....	1 - 3 - 4 - 2
Maximum torque ....	87 lb/ft (12,00 Kg/m) at 2,000 R.P.M.

DETAIL DATA

<b>Flywheel</b>	Number of teeth .... 100
	Thickness at pressure face .... 1.375 in.—.015 (85,725 mm—0,39)
	Maximum permissible run-out on flywheel face .... .002 in. (0,05 mm)
	Maximum refacing depth .... .030 in. (0,76 mm)
	Minimum thickness after grinding .... 1.345 in. (33,15 mm)
<b>Camshaft</b>	Journal diameter .... 1.842 in.—.001 (26,70 mm—0,02)
	Clearance in bearing .... .001 to .002 in. (0,02 to 0,05 mm)
	End-float .... .0025 to .0055 in. (0,06 to 0,14 mm)
	Cam lift—inlet .... .262 in. (6,65 mm)
	Cam lift—exhaust .... .279 in. (7,10 mm)
<b>Camshaft bearings</b>	Type .... Split—steel backed, white metal lined
	Internal diameter (line reamed in position) 1.843 in.—.0005 (46,812 mm+0,012)
<b>Connecting rods</b>	Bearing fit on crankpin .001 to .0025 in. (0,02 to 0,06 mm) clearance
	Bearing nip .... .002 to .004 in. (0,05 to 0,10 mm)
	End-float at big-end .... .007 to .011 in. (0,177 to 0,280 mm)
	Gudgeon pin bush fit in small end .... .001 to .002 in. (0,02 to 0,05 mm) interference
	Gudgeon pin bush internal diameter—reamed in position .... 1.1875 in.—.0005 (31,87 mm+0,012)
	Fit of gudgeon pin in bush .... .0003 to .0005 in. (0,007 mm to 0,012) clearance
<b>Crankshaft (do not regrind)</b>	Journal diameter .... 2.5 in.—.001 (63,5 mm—0,021)
	Crankpin diameter .... 2.126 in.—.001 (54 mm—0,02)
	End-float (controlled by thrust washers at centre bearing) .... .002 to .006 in. (0,05 to 0,15 mm)

**Markings**

T.D.C. .... When opposite pointer, No. 1 piston is at top dead centre

E.P. .... When opposite pointer, No. 1 exhaust valve should be fully open

88 Diesel, up to engine No. 146900522

109 Diesel, up to engine No. 156900285

Set the pointer exactly between the 16° and 18° markings, that is, the 17° mark.

88 Diesel, from engine No. 146900523 onwards

109 Diesel, from engine No. 156900286 onwards

Set the pointer in line with the 16° mark.

When opposite pointer, with both valves closed, indicates start of injection

Primary pinion bush Fit in flywheel .... .001 to .003 in. (0,02 to 0,083 mm) interference

Internal diameter—reamed in position .875 in.—.002 (22,23 mm+0,051)

Fit of shaft in bush .001 to .0035 in. (0,02 to 0,08 mm) clearance

Fit of gudgeon pin in piston	Zero to .0002 in. (0,005 mm) interference	Fit in piston	Zero to .0002 in. (0,005 mm) interference
Fit of gudgeon pin bore	1,187 in. +.002 (47,57 mm + 0,05)	Fit in connecting rod bush	.0003 to .0005 in. (0,075 to 0,127 mm) clearance
<b>Piston rings</b>			
Compression No. 1	Square friction edge—chromium plated	Injection pump	Type Distributor, self-governing
Gap in liner bore	.010 to .015 in. (0,25 to 0,38 mm)	Injection takes place	16°, 17° or 18° B.T.D.C. See Flywheel markings.
Clearance in groove	.0025 to .0035 in. (0,063 to 0,089 mm)	Injector	Type C.A.V. Pintaux
Compression—Nos. 2 and 3	Bevelled friction edge. Marked 'T' on upper side.	Internal diameter	3,375 in. +.001 (85,725 mm + 0,02)
Gap in liner bore	.010 to .015 in. (0,25 to 0,38 mm)	Fit in cylinder block	Top—upper .005 to .015 in. (0,13 to 0,38 mm) clearance
Clearance in groove	.0025 to .0035 in. (0,063 to 0,089 mm)	Top—lower	.001 to .003 in. (0,02 to 0,08 mm) clearance
Scaper No. 4	Slotted, square friction edge, double landed	Bottom	.001 to .003 in. (0,02 to 0,08 mm) clearance
Gap in liner bore	.010 to .015 in. (0,25 to 0,38 mm)	Main bearings	Clearance on crankshaft journal .001 to .0025 in. (0,02 to 0,06 mm)
Clearance in groove	.0025 to .0035 in. (0,063 to 0,089 mm)	Push-rod tubes	Fit in cylinder head .0005 to .002 in. (0,01 to 0,051 mm) interference on large diameter. Full contact fit at chamfered edges of tube and cylinder head
Gap in liner bore	.010 to .015 in. (0,25 to 0,38 mm)	Oil pump assembly	See Section AO.
Clearance in groove	.0025 to .0035 in. (0,063 to 0,089 mm)	Pistons	Type Light alloy, with swirl-inducing recess in crown
Scaper No. 4	Slotted, square friction edge, double landed	Clearance in liner bore, measured at bottom of skirt at right angles to gudgeon pin	.004 to .005 in. (0,10 to 0,12 mm)
Gap in liner bore	.010 to .015 in. (0,25 to 0,38 mm)	Timing chain tensioner	Fit of bush in cylinder .003 to .005 in. (0,07 to 0,12 mm) interference
Clearance in groove	.0025 to .0035 in. (0,063 to 0,089 mm)	Fit of bush in idler wheel	.001 to .003 in. (0,02 to 0,07 mm) interference
Compression—Nos. 2 and 3	Bevelled friction edge. Marked 'T' on upper side.	Fit of idler wheel on stub shaft	.001 to .003 in. (0,02 to 0,07 mm) clearance
Gap in liner bore	.010 to .015 in. (0,25 to 0,38 mm)	Fit of piston in cylinder	.0005 to .001 in. (0,01 to 0,02 mm) clearance
Clearance in groove	.0025 to .0035 in. (0,063 to 0,089 mm)		

Thrust bearings, crankshaft	Type	Semi-circular, steel back, tin plated on friction surface
Standard size, total thickness	.....	.093 in.—.002 (2,362 mm—0,05)
Overizes	.....	.0025 in. (0,06 mm)
	.....	.005 in. (0,12 mm)
	.....	.0075 in. (0,18 mm)
	.....	.010 in. (0,25 mm)
Torque loadings	Connecting rod bolts	35 lb/ft (4,84 Kg/m)
	Cylinder head ( $\frac{3}{8}$ in. U.N.F.)	75 lb/ft (10,3 Kg/m)
	Main bearing bolts ( $\frac{1}{8}$ in. U.N.F.)	85 lb/ft (11,75 Kg/m)
	Rocker shaft support bracket bolts ( $\frac{1}{8}$ in. U.N.F.)	12 to 13 lb/ft (1,66 to 1,80 Kg/m)
	Flywheel securing bolts	50 lb/ft (6,91 Kg/m)
Valves	Inlet valve	Diameter (stem) ..... .312 in.—.001 (7,93 mm—0,02) or .311 in.—.0005 (7,91 mm—0,01) later type
	Face angle	..... 45°— $\frac{1}{4}$
	Exhaust valve	Diameter (stem) ..... .343 in.—.001 (8,73 mm—0,02) or .342 in.—.0005 (8,70 mm—0,01) later type
	Face angle	..... 45°— $\frac{1}{4}$
	Fit of inlet and exhaust valves in guides	..... .0005 to .003 in. (0,01 to 0,07 mm) clearance
	Valve seat	Seat angle (inlet and exhaust)
		..... 45°+ $\frac{1}{4}$
Valve springs—inlet	Inner	Length—free ..... 1.61 in. (40,89 mm)
		Length under 17,5 lb. (7,9 Kgs) load ..... 1.383 in. (35,12 mm)
	Outer	Length—free ..... 1.768 in. (44,90 mm)
		Length under 46 lb. (21 Kgs) load ..... 1.508 in. (38,30 mm)
		Maximum permissible run-out of flywheel ..... .005 in. (0,12 mm)
Valve springs—exhaust	Inner	Length—free ..... 1.61 in. (40,9 mm)
		Length under 18,5 lb. (8,37 Kgs) load ..... 1.372 in. (34,8 mm)
	Outer	Length—free ..... 1.768 in. (44,9 mm)
		Length under 48 lb. (21,76 Kgs) load ..... 1.497 in. (38,0 mm)
Valve timing	Inlet opens	..... 13° B.T.D.C.
	Inlet closes	..... 45° A.B.D.C.
	Inlet peak	..... 106° A.T.D.C.
	Exhaust opens	..... 48° B.B.D.C.
	Exhaust closes	..... 16° A.T.D.C.
	Exhaust peak	..... 106° B.T.D.C.
Vertical drive shaft gear	Backlash	..... .006 to .010 in. (0,1524 to 0,254 mm)
	Internal diameter of bush	..... 1.00 in.—.001 (25,4 mm—0,02)
	Fit of gear in bush	..... .001 to .003 in. (0,02 to 0,07 mm) clearance
Vibration damper	Fit of bushes in fly-wheel and back plate	..... .002 to .004 in. (0,05 to 0,10 mm)
	Internal diameter of bushes (reamed in position)	..... 1.917 in.—.001 (47,70 mm+0,02)
	Fit of bushes on driving flange	..... .001 to .003 in. (0,02 to 0,07 mm) clearance
	Maximum permissible run-out of flywheel	..... .005 in. (0,12 mm)



# SECTION AO — ENGINE LUBRICATION

## INDEX

Page	Recommended lubricants:	Page	Data, all models
AO-3	2 litre Petrol	AO-8	Defect location, all models
AO-3	2½ litre Petrol	AO-7	Filter, external, 2 litre Petrol
AO-3	2 litre Diesel	AO-7	Filter, external, 2½ litre Diesel
AO-5	Relief valve adjustment, 2 litre Petrol	AO-1	Oil pump, 2 litre Petrol
		AO-5	Oil pump, 2½ litre Petrol, 2 litre Diesel

Page	Fig.	LIST OF ILLUSTRATIONS	Page	Fig.
AO-1	AO-1	Oil pressure relief valve, 2 litre Petrol	AO-1	AO-1
AO-2	AO-2	Distributor housing location bolt	AO-2	AO-2
AO-3	AO-3	Exploded view of oil pump and driving gear, 2 litre Petrol	AO-3	AO-3
AO-4	AO-4	Checking clearance of oil pump gears, 2 litre Petrol	AO-4	AO-4
AO-5	AO-4	Oil pump ball valve lapping tool	AO-5	AO-5
AO-6	AO-6	2½ litre Diesel	AO-6	AO-6
AO-7	AO-7	Engine oil filters, 2½ litre Diesel	AO-7	AO-7
AO-7	AO-7	Engine oil filters, 2½ litre Petrol, 2 litre Diesel	AO-7	AO-7
AO-8	AO-8	Exploded view of oil pump and driving gear, 2½ litre Petrol, 2 litre Diesel	AO-8	AO-8
AO-7	AO-7	Oil pump ball valve lapping tool	AO-7	AO-7
AO-5	AO-5	Oil pump, 2 litre Petrol	AO-5	AO-5
AO-10	AO-10	Engine oil filters, 2 litre Petrol	AO-10	AO-10
AO-7	AO-7	Checking clearance of oil pump gears, 2½ litre Diesel, 2 litre Petrol	AO-7	AO-7

**Pump drive shaft and distributor housing**  
**Operation AO/4**

1. Detach sparking plug covers and leads, remove distributor locating screw and withdraw the distributor.

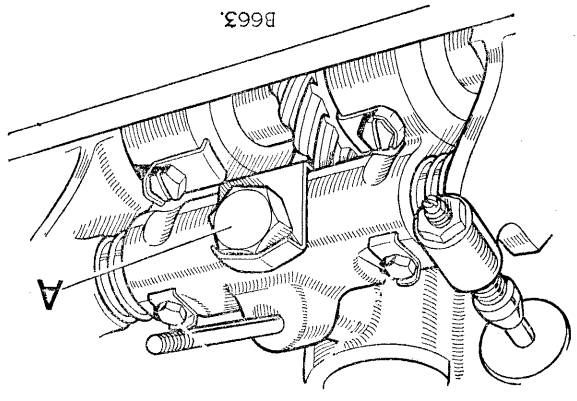


Fig. AO-2—Distributor housing location bolt  
 A—Location bolt  
 B663.

2. Remove the hollow bolt for the distributor housing. Withdraw the distributor housing, and remove oil pump drive shaft.
3. Remove the oil pump cover and lift out the gears. Remove the idler gear spindle. If necessary, press out the idler gear bush and drive out the bush in the pump body.
5. Clean parts, examine for wear and renew as necessary.
6. If removed, press a new bush into the body and ream in position to .5625 in. +.001 (14.28 mm + 0.025), ensuring correct alignment with the bush should be a *light drive fit* in the pump body.

**Oil pump, 2 litre Petrol**  
**Operation AO/2**

To remove

1. Drain the oil and remove sump.
2. Slacken the locknut securing oil pressure adjusting screw, then remove screw, washer, spring, plunger and ball (which may remain in the pump and can be removed when the pump complete is withdrawn).
3. Remove the pump locating screw.
4. Withdraw the pump, leaving the drive shaft in position.
5. If necessary, withdraw the oil pump drive shaft.

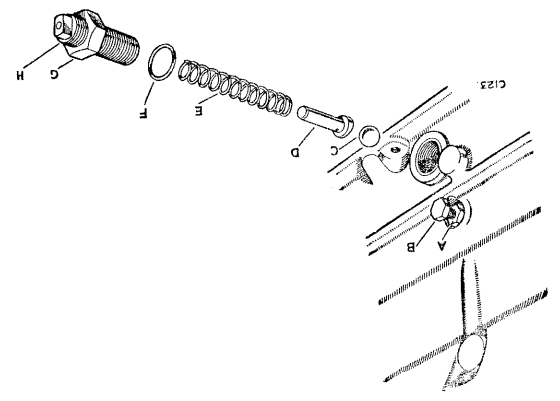
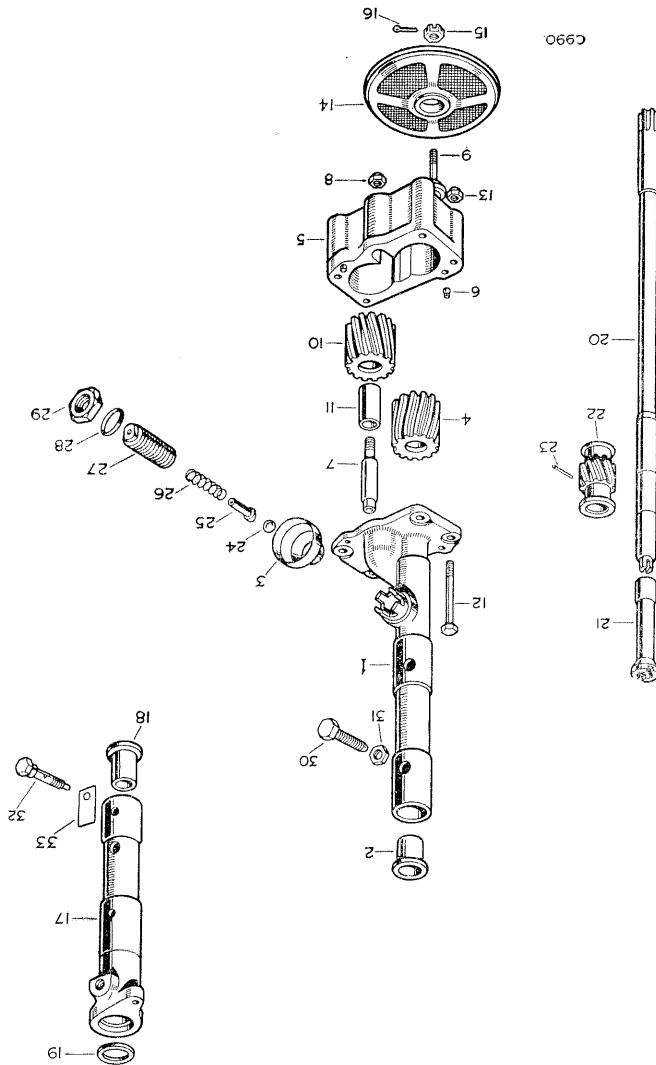


Fig. AO-1—Oil pressure relief valve  
 A—Locknut  
 B—Locating screw—oil pump  
 C—Ball  
 D—Plunger  
 E—Spring  
 F—Washer  
 G—Locknut  
 H—Adjusting screw—oil pressure

Fig. AO-3—Exploded view of oil pump and driving gear, 2 litre Petrol



- 1 Oil pump body assembly
- 2 Bush for drive shaft
- 3 Oil pump shield
- 4 Oil pump gear, driver
- 5 Oil pump cover assembly
- 6 Dowel locating body
- 7 Spindle for idler wheel
- 8 Self-locking nut ( $\frac{3}{8}$ ") fixing spindle
- 9 Stud for oil strainer
- 10 Oil pump gear idler assembly
- 11 Bush for idler gear
- 12-13 Fixings—cover to body
- 14 Oil strainer for pump
- 15-16 Fixings—oil strainer to pump
- 17 Distributor housing assembly

- 18 Bush for drive shaft
  - 19 Cork washer for housing
  - 20 Oil pump drive shaft
  - 21 Drive shaft for distributor
  - 22 Oil pump driving gear
  - 23 Taper pin, fixing gear to shaft
  - 24 Steel ball
  - 25 Plunger
  - 26 Spring
  - 27 Adjusting screw
  - 28 Washer
  - 29 Locknut
  - 30-31 Fixings—oil pump to cylinder block
  - 32 Oil feed bolt, locating distributor housing
  - 33 Locker for bolt
- } For oil pressure release valve

RECOMMENDED LUBRICANTS

These recommendations apply to temperate climates where operational temperatures may vary between approximately 10°F (-12°C) and 90°F (32°C). Information on recommended lubricants for use under extreme Winter or Tropical conditions can be obtained from The Rover Co. Ltd. Technical Service Department.

2 LITRE AND 2 1/4 LITRE PETROL ENGINES							
COMPONENTS	S.A.E.	B.P.	DUCKHAM'S	ESSO	MOBIL	REGENT	SHELL
PETROL ENGINE, AIR CLEANER AND GOVERNOR	20W	Energol SAE 20W	Duckham's NOL 20	Esso Extra Motor Oil 20W/30	Mobiloil Arctic	Advanced Havoline 20/20W	Shell X-100 SAE 20/20W
2 LITRE DIESEL ENGINE							
DIESEL ENGINE, AIR CLEANER AND GOVERNOR	20W	Energol Diesel D20W	NOL Diesel Engine Oil 20	Esso Lubric H.D. 20	Mobiloil Arctic	R.P.M. Delo Special 20	Rotella 20/20W
ALL MODELS							
GEARBOX, DIFFERENTIALS AND STEERING BOX, SWIRL PIN HOUSINGS, STEERING RELAY (SEALD), REAR POWER TAKE-OFF, PULLEY UNIT, CAPSTAN WINCH AND HYDRAULIC WINCH GEARBOX	90HP	Energol E.P. SAE 90	Duckham's Hypoid 90	Esso Gear Oil GP 90	Mobilube GX 90	Universal Thuban 20	Spirax 90 EP Castrol Hypoy
HYDRAULIC WINCH SUPPLY TANK	—	—	—	Teresso 43	D.T.E. Light	—	Hyspin 70
LUBRICATION NIPPLES	—	Energrease I2	LB 10 Grease	Esso Multi- purpose Grease H	Mobilgrease MP	Marlak Multi- purpose 2	Retimax A Castrol LM

14. If necessary press a new bush into the distributor housing and ream to .572 in.
15. If necessary the pump may be tested before refitting, as follows.
16. Install the pump drive shaft in a hand drilling brace.
17. Submerge the pump gear housing in a container of oil, insert the driving shaft into the pump and rotate the shaft for a few minutes.
18. Refit pump, pressure valve, and oil sump. Fill the engine with 10 Imperial pints (5,5 litres) of the correct grade oil.

### Distributor and ignition timing

#### Operation AO/6

1. Rotate the engine in running direction until the F.A. 10° mark on the flywheel is in line with the pointer, with both valves on No. 1 cylinder closed.
2. Fit the oil pump drive shaft so that when fully engaged in oil pump, the broad segment of driving spigot will be nearest to No. 3 exhaust port. The crankshaft may have to be rotated slightly to allow engagement of driving shaft in oil pump, and when this is necessary, item 1 must be repeated.

3. Secure the distributor housing in position with the hollow oil feed bolt, then fit distributor drive shaft and side cover.
4. Locate a cork washer in recess in top of distributor housing.
5. Check the distributor contact breaker clearance and adjust if necessary, .014 to .016 in. (.035 to .040 mm). Set the octane selector so that the fourth line from the left-hand side of the calibrated slide is against the face of distributor body casting.

6. Rotate the distributor spindle until the rotor is at the firing point for No. 1 cylinder. The broad side of the driving spigot should be towards No. 3 exhaust port and vacuum unit facing forward when the distributor is located.
7. Mount distributor and secure to distributor housing.
8. Slacken the pinch bolt at the base of the distributor body; rotate the distributor bodily in the opposite direction to the arrow on the rotor arm, until the contact breaker points are just opening with the fibre cam follower on the leading side of the cam; retighten the pinch bolt.

### Checking with 12 volt timing lamp

- (a) Connect a lead between the distributor L.T. terminal and the centre pole of the bulb; earth the bulb body.
- (b) Rotate the distributor; the bulb will glow exactly when the points begin to open.

7. If removed, press a new bush in the idler gear. Drill the  $\frac{3}{8}$  in. (3,17 mm) oilway and ream in position to .500 in. +.001 (12,7 mm + 0,025).

8. Check the radial clearance (.001 to .004 in., .02 to .010 mm), backlash (.008 to .012 in., .20 to .030 mm) and end-float (.003 to .005 in., .075 to .013 mm steel gear, and .004 to .006 in., .10 to .015 mm aluminium gear) of the gears; renew parts as necessary. If incorrect, oil flow would be insufficient.

9. To renovate the pressure relief valve seating it is necessary to make a lapping tool.

10. Solder a new ball bearing (Part No. 01035) on to the end of a suitable length of tubing, as shown in Fig. AO-5.

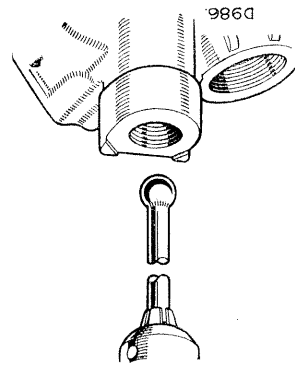
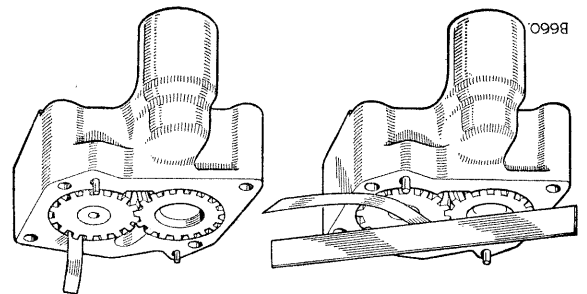


Fig. AO-5—Oil pump ball valve lapping tool

11. The lapping tool may be installed in a drilling machine or hand brace and the ball seating refaced, using coarse grinding paste. The tool may then be removed and used to "hand lap" the ball seating with fine grinding paste to a good finish.
12. Complete the assembly ensuring that the gears do not bind.

13. Examine the pump drive shaft and gear for excessive wear and renew as necessary. Ensure that the new gear is fitted in the same position on the shaft as the old one.

Fig. AO-4—Checking clearance of oil pump gears



**Clearances, early type pump**

End-float of gears	..... .002 to .005 in. (.025 to .012 mm)
Radial clearance of gears	.0005 to .002 in. (.012 to 0,050 mm)
Backlash of gears	..... .004 to .008 in. (.010 to 0,20 mm)

**Clearances, late type pump**

End-float, steel gear	..... .002 in (.05 mm)
End-float, aluminum gear	.003 in. (.07 mm)
Radial clearance of gears	.001 to .003 in. (.02 to 0,07 mm)
Backlash of gears	..... .006 to .012 in. (.015 to 0,28 mm)

If necessary the idler gear bush may be renewed on late type pumps only. Press the new bush into the gear, drill the lubrication hole .125 in. (.3,175 mm) and ream the bush to .5 in. (.12,7 mm).

7. To renovate the pressure relief valve seating it is necessary to make a lapping tool.
8. Solder a new ball bearing (Part No. 3748) on to the end of a suitable length of tubing, as shown in Fig. AO-7.

9. The lapping tool may be installed in a drilling machine or hand brace and the ball seating refaced, using coarse grinding paste. The tool may then be removed and used to "hand lap" the ball seating with fine grinding paste to a good finish.

10. Smear the joint faces of pump body and cover highly with suitable jointing compound, then bolt together.
11. Insert the relief valve ball, plunger and spring. Secure with plug and washer.
12. Fit a tab locking washer and seal to the filter pump inlet ports and position the filter square with sump bottom; lock in position.
13. If necessary the pump may be tested before refitting, as follows.

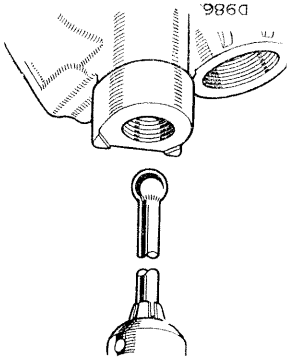


Fig. AO-7—Oil pump ball valve lapping tool

9. Adjust as required by slackening the pinch bolt and turning the distributor bodily, or for fine adjustments, by means of the vernier screw.

**Oil pressure relief valve, 2 litre Petrol models Operation AO/8**

1. Fit a slave oil pressure gauge in place of the warning light switch, run the engine and ensure that there is at least 20 lb./sq.in. (1,4 kg/cm<sup>2</sup>) oil pressure.
2. Warm the engine to running temperature and adjust the pressure by means of the valve to 55-65 lb./sq.in. (3,8-4,5 Kg/cm<sup>2</sup>) at 30 m.p.h. (50 k.p.h.) in top gear. Tighten the screw to increase pressure and vice versa. If necessary, renew the release valve spring.
3. Refit the warning light switch and lead.

**Oil pump, 2½ litre Petrol—2 litre Diesel To remove Operation AO/10**

1. Drain the oil and remove sump.
2. Remove the securing bolts and withdraw pump assembly.
3. Withdraw the driving shaft from pump upper casing.

**To overhaul and refit Operation AO/12**

There are two types of oil pump fitted to both 2½ litre Petrol and 2 litre Diesel models. The early type pumps are fitted with spur type gears. The driving gear being made of steel, the idler cast iron. The late type pumps are fitted with skew gears, the driving gear being made of steel, the idler aluminium, with a pressed-in brass bush.

1. Unscrew the securing nut and remove filter gauze assembly.
2. Remove the bolts securing the upper casing to lower body, tap them gently apart and withdraw the gears. The idler gear spindle may be removed if necessary.
3. Unscrew the relief valve plug and remove the spring, plunger and ball.
4. Clean parts, examine for wear and renew as necessary.
5. Check the radial clearance and end-float of the gears as shown in Fig AO-6.

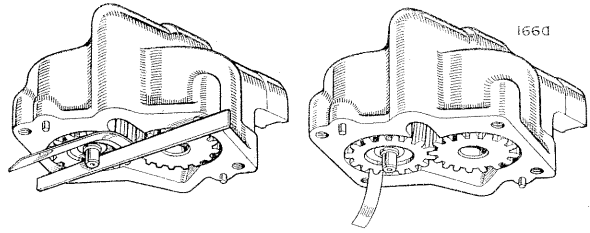


Fig. AO-6—Checking clearance of oil pump gears

14. Install the pump drive shaft in a hand drilling brace.
  15. Submerge the pump gear housing in a container of oil, insert the driving shaft into the pump and rotate the shaft for a few minutes.
  16. Insert the longer splined end of driving shaft into the pump and locate in the driving gear.
  17. With the inlet port rearward, and the splined upper end of driving shaft aligned to the drive
- The above figures do not include filter capacity, which is 3½ Imperial pints, 3 U.S. pints (1,75 litres).
18. Refit the crankcase sump and refill with oil—11 Imperial pints, 13 U.S. pints (6 litres)—to the "high" mark on dipstick, run the engine and check for oil leaks at the sump joint face, then add more oil as necessary. Figure for capacity includes 2 pints (1 litre) for filter.

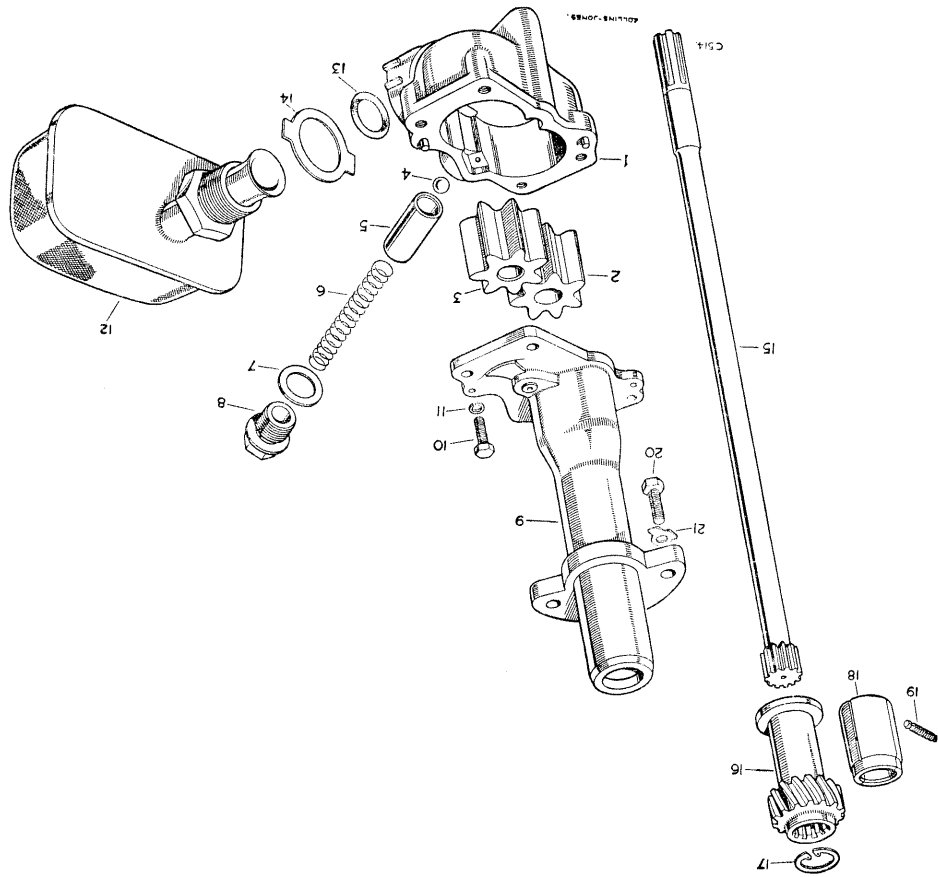


Fig. AO-8—Exploded view of oil pump and driving gear, 2½ litre Diesel

- |    |                      |    |                        |
|----|----------------------|----|------------------------|
| 10 | Set bolt for casings | 11 | Spring washer for bolt |
| 9  | Upper casing         | 12 | Filter gauze assembly  |
| 8  | Plug                 | 13 | Oil seal               |
| 7  | Washer               | 14 | Tab washer             |
| 6  | Relief valve spring  | 15 | Driving shaft          |
| 5  | Relief valve plunger | 16 | Driving shaft gear     |
| 4  | Relief valve ball    | 17 | Circlip                |
| 3  | Driven gear          | 18 | Bush—drive shaft gear  |
| 2  | Driving gear         | 19 | Locating screw         |
| 1  | Lower casing         | 20 | Securing bolt          |
|    |                      | 21 | Locking washer         |

External oil filter, Petrol and Diesel models  
 Element, to renew

Operation AO/14

1. Position a suitable drip-tray beneath the filter, then unscrew the bolt at base of the filter, withdraw the container complete with the element, which must be discarded. If necessary, the filter may be removed complete from the cylinder block.

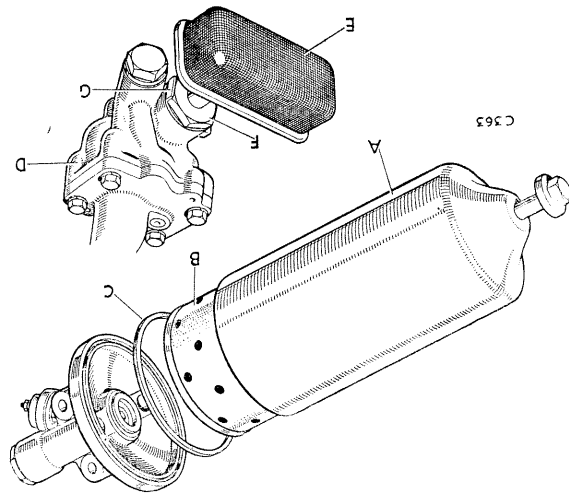
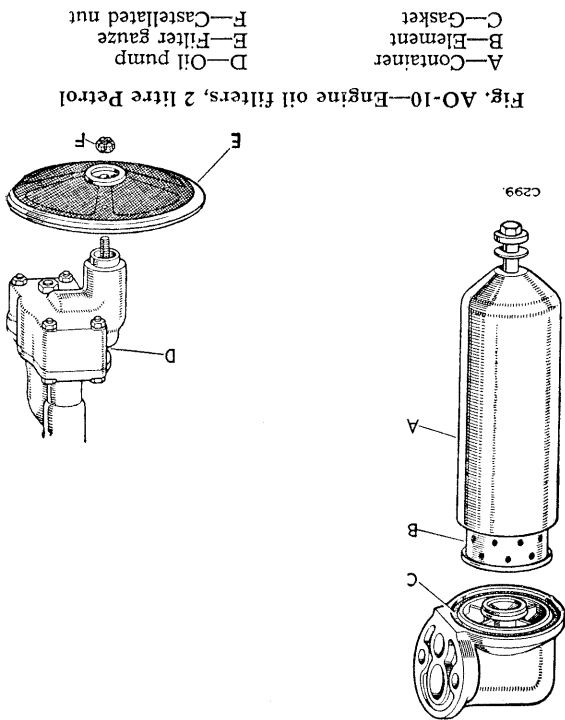


Fig. AO-9—Engine oil filters, 2½ litre Petrol, 2 litre Diesel  
 A—Container  
 B—Element  
 C—Gasket  
 D—Oil pump  
 E—Filter gauze  
 F—Nut for filter gauze  
 G—Locker for nut

2. Wash the container thoroughly in petrol, fit a new element, sealing rings, then replace the container.

3. Fill sump with clean oil to the "high" mark on dipstick, run the engine and check for oil leaks and then add more oil as necessary.

Fig. AO-10—Engine oil filters, 2 litre Petrol



A—Container  
 B—Element  
 C—Gasket  
 D—Oil pump  
 E—Filter gauze  
 F—Castellated nut

DEFECT LOCATION

(Symptom, Cause and Remedy)

- A—WARNING LIGHT REMAINS "ON"—ENGINE RUNNING**
1. Low oil pressure—*See item B.*
  2. Oil pressure switch unserviceable—*Renew.*
  3. Electrical fault—*Check circuit.*
- B—LOW OIL PRESSURE**
- Ascertained by gauge fitted in place of switch and with sump oil level correct.
1. Dirty gauze filter on pump—*Remove sump, remove filter gauze and clean in petrol with a stiff brush. Refill with clean oil.*
  2. Pump body joints loose—*Tighten.*
  3. Foreign matter on pump ball valve seat—*Remove and clean.*
- C—WARNING LIGHT FAILS TO GLOW**
- When engine is stopped and ignition (petrol engines) or auxiliary services (Diesel) switch is "on".
1. Bulb filament broken—*Renew bulb. Section Q.*
  2. Oil pressure switch unserviceable—*Renew.*
  3. Electrical fault—*Check circuit.*
4. Relief valve plunger sticking—*Remove and ascertain cause.*
  5. Weak relief valve spring—*Renew.*
  6. Incorrectly adjusted relief valve (2 litre Petrol only)—*Adjust to 55 to 65 lb/sq. in. (3,8 to 4,5 Kg/cm<sup>2</sup>)*
  7. Gears excessively worn—*Renew.*
  8. Excessively worn bearings—main, connecting rod big-end, camshaft, etc.—*Ascertain which bearings and rectify.*

DATA

<p><b>Oil pump—2 litre Petrol</b></p> <p>Type .....                  Drive .....                  End-float of gears: .....                  Steel gear .....                  Aluminium gear .....                  Radial clearance of gears .....                  .001 to .004 in. (0,02 to 0,10 mm)                  .008 to .012 in. (0,20 to 0,30 mm)</p> <p><b>Oil pressure relief valve</b></p> <p>Type .....                  Relief valve spring: .....                  Free length .....                  Compressed length .....                  at 13 lb. (5,89 Kg) load .....                  1,990 in. (50,54 mm)</p>	<p><b>Oil pump, early type—2½ litre Petrol, 2 litre Diesel</b></p> <p>Type .....                  Drive .....                  Splayed shaft from cam-shaft skew gear .....                  Spur gear .....                  End-float of gears .....                  shaft skew gear .....                  .002 to .005 in. (0,05 to 0,12 mm)</p> <p><b>Oil pressure relief valve</b></p> <p>Type .....                  Relief valve spring: .....                  Free length .....                  Compressed length .....                  at 10 lb. load .....                  2,840 in. (52,93 mm)</p>
<p><b>Oil pump, late type—2½ litre Petrol, 2 litre Diesel</b></p> <p>Type .....                  Drive .....                  Splayed shaft from cam-shaft skew gear .....                  End-float of gears: .....                  Steel gear .....                  Aluminium gear .....                  Radial clearance of gears .....                  .001 to .003 in. (0,02 to 0,07 mm)                  .006 to .012 in. (0,14 to 0,28 mm)</p> <p><b>Oil pressure relief valve</b></p> <p>Type .....                  Relief valve spring: .....                  Free length .....                  Compressed length .....                  at 10 lb. load .....                  2,840 in. (52,93 mm)</p>	<p><b>Oil pump—2 litre Petrol</b></p> <p>Type .....                  Drive .....                  End-float of gears: .....                  Skew gear .....                  Splayed shaft from cam-shaft skew gear .....                  .001 to .004 in. (0,02 to 0,10 mm)                  .008 to .012 in. (0,20 to 0,30 mm)</p> <p><b>Oil pressure relief valve</b></p> <p>Type .....                  Relief valve spring: .....                  Free length .....                  Compressed length .....                  at 13 lb. (5,89 Kg) load .....                  1,990 in. (50,54 mm)</p>
<p><b>Oil pump, engine warm</b></p> <p>At 2,000 R.P.M. ....                  55 to 65 lb./sq.in. (3,8 to 4,6 Kg/cm<sup>2</sup>)</p>	<p><b>Oil pump, engine warm</b></p> <p>At 2,000 R.P.M. ....                  55 to 65 lb./sq.in. (3,8 to 4,6 Kg/cm<sup>2</sup>)</p>



# Section A2—VIBRATION DAMPER 2 LITRE PETROL and 2 LITRE DIESEL

## INDEX

Page	A2-1	.....	Radiator, to remove
Page	A2-1	.....	Vibration damper, to overhaul
Page	A2-2	.....	Radiator, to refit
Page	A2-2	.....	Data

## LIST OF ILLUSTRATIONS

Page	A2-1	.....	Checking vibration damper run-out
Page	A2-2	.....	Sectioned view of vibration damper
Page	A2-3	.....	Balancing vibration damper

In order that the vibration damper may be removed it is necessary to remove the radiator.

### Radiator, to remove

#### Operation A2/2

1. Drain off the coolant. Diesel models only: Disconnect the lead coupling the two batteries.
2. Disconnect the top and bottom hoses from the radiator.
3. Disconnect the side lamp leads at snap connectors at each side of the grille panel assembly and the front lamp harness from the junction box at right-hand side of scuttle, then pull the wiring clear to front of engine.
4. Remove the radiator grille and chaff guard (if fitted) from the grille panel complete with the name plate.
5. Remove the fan blades.
6. Remove the bolts securing the front apron and remove panel. Remove the bolts securing the grille panel to the front cross-member and front wings.
7. Lift the radiator, grille panel and headlamps assembly upward, then forward to clear the vehicle.
8. Remove the rubber buffers from beneath the grille panel.
9. Slacken the dynamo and remove the fan belt.

- ### Vibration damper, to overhaul
- #### Operation A2/4
1. Remove the starting nut and tab washer, then withdraw the vibration damper assembly from crankshaft.
  2. Unscrew the set bolts securing the backplate to flywheel, withdraw the backplate, rubber discs and shims.
  3. If necessary renew the bushes in flywheel and backplate with an interference fit of .002 in. (.05 mm) to .004 in. (.10 mm).
  4. Bolt the flywheel and backplate together, and reamer the bushes (ensuring that the bore is axially concentric) to allow a clearance fit on driving flange of .001 to .003 in. (0.02 to 0.07 mm).
  5. Remove the securing bolts and withdraw the backplate from flywheel.

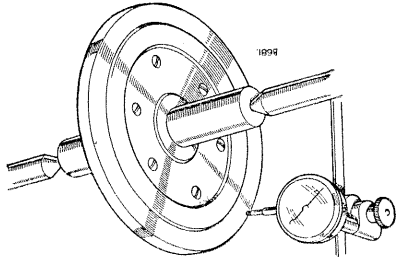


Fig. A2-1—Checking vibration damper run-out

6. Fit a rubber disc to each side of the driving flange, mount the flywheel, shims and backplate, with the arrows on backplate and flange aligned, then fit the set bolts and locking

7. Mount the unit on a suitable mandrel and rotate dial test indicator and adjust to within .005 in. (0,127 mm) by means of the securing bolts. Add or remove shims to ensure this condition.

Finally bend up the locking tabs to secure the set bolts, on the 2½ litre petrol, and Diesel models. On 2 litre petrol models the screws should be staked with a centre punch.

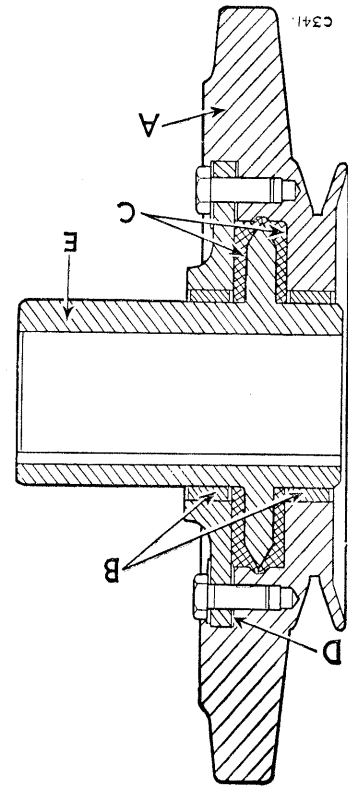


Fig. A2-2—Sectioned view of vibration damper  
A—Flywheel and pulley  
B—Bushes  
C—Rubber discs  
D—Shims  
E—Driving flange

8. Balance statically, using putty or similar material. Weigh the putty and drill balancing hole in the flywheel. A hole  $\frac{3}{8}$  in. (9,5 mm) dia. x  $\frac{1}{4}$  in. (6 mm) deep represents 1½ grams.

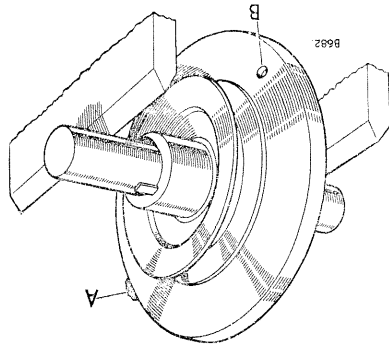


Fig. A2-3—Balancing vibration damper  
A—Putty  
B—Balancing hole

9. Locate the vibration damper on crankshaft and key, then secure with the starting dog and tab washer.

10. Fit the dynamo driving belt and adjust the tension to allow the belt to move  $\frac{1}{16}$  to  $\frac{1}{8}$  in. (8 to 11 mm) when pressed by thumb between the camshaft and water pump pulleys.

**Radiator, to refit**

1. Reverse the removal procedure, replacing the rubber buffers, if necessary, and connecting the wiring in accordance with the appropriate wiring diagram—Section P.

The total capacity of the cooling system is: 2½ litre petrol models, 17½ Imperial pints (10 litres); 2 litre petrol and Diesel models, 17 Imperial pints (9,5 litres).

Note: Use soft water wherever possible; if the local water supply is hard, clean rain or distilled water should be used.

2. Run the engine until working temperature is reached and top the water level as necessary.

**DATA—ALL MODELS**

**Vibration damper**

Fit of bush in flywheel .002 to .004 in. (0,05 to 0,10 mm) interference  
Clearance of bush or driving flange .005 to .007 in. (0,12 to 0,17 mm)  
Run-out on front face .005 in. (0,12 mm) maximum

Permissible out-of-balance 3 grams